ACKNOWLEDGEMENT

This binding is a result of compilation from the authentic material from the webs. It is a result of short browsing. The aim is to provide a suitable module for our ESP classroom sessions in the first semester of the 2011/2012 academic year in our study program. This module consists of some lessons for the concept of ESP, some lessons for ESP lesson plans used abroad and in Indonesia, ESP for some school levels, and ESP for Academic Purposes and for Occupational Purposes. The main teaching objective in our classroom is to provide the students with the competence on designing a good lesson plan to teach ESP for academic purposes and occupational purposes at any level according to its context.
We fully intend that this binding is only to facilitate some compiled authentic materials from the webs for our ESP Classroom instructions. By this opportunity, we would like to extend our sincere thanks all the authors of the materials and the websites which publish them. May God the Almighty bless them all!

Medan-Pematangsiantar, September 2015
The Authors,

Bertaria Sohnata Hutauruk
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Lesson 1
Introduction

What is ESP?
The aim of the ESP is to determine the needs of a specific group of learners. ESP is often divided into English for Academic Purposes (EAP) and English for Occupational Purposes (EOP). Further sub-divisions of EOP are sometimes made into business English, professional English (e.g. English for doctors, lawyers) and vocational English (e.g. English for tourism, nursing, aviation, bricklaying).

ESP Characteristic
According to Dudley-Evans (2001) the absolute characteristics of ESP are:
1. ESP is designed to meet the specific needs of the learners.
2. ESP makes use of the underlying methodology and activities of the specialism it serves.
3. It is centred not only on the language (grammar, lexis, register), but also the skills, discourses and genres appropriate to those activities.

ESP practitioners are also becoming increasingly involved in intercultural communication and the development of intercultural competence.

For Dudley-Evans (2001) the defining characteristic of ESP is that teaching and materials are based on the results of a needs analysis. The key questions are:
1. What do students need to do with English?
2. Which of the skills do they need to master and how well?
3. Which genres do they need to master either for comprehension or production purposes?

Traditionally ESP courses were typically designed for intermediate or advanced adult learners. Nowadays many students can start to learn academic or vocational English at an earlier age and at a lower level of proficiency.

Why is ESP important?

ESP has become increasingly important as:
1. There has been an increase in vocational training and learning throughout the world.
2. With the spread of globalisation has come the increasing use of English as the language of international communication. More and more people are using English in a growing number of occupational contexts.
3. Students are starting to learn and therefore master general English at a younger age, and so move on to ESP at an earlier age.

An increasing number of learners are taught in English medium schools using approaches such as CLIL (Content and Language Integrated Learning).

In some English speaking countries governments are launching initiatives to help economic migrants obtain the practical English skills necessary to function in the workplace. For example, the new ESOL for Work Qualifications in the UK are designed to help employers and employees access courses which offer them the functional language skills demanded across a variety of employment sectors. Content includes topics such as customer care and health and safety.

Some teachers are afraid of making the transition from teaching general English to teaching ESP. There is also the danger that the novice ESP teacher will only use materials that they feel comfortable with and will not stretch their learners.

ESP Teacher’s Competence
Bell (2002) argues that the depth of knowledge of a subject matter that a teacher requires depends on a number of variables which include:

1. How much do the learners know about their specialism?
2. Are the students pre-experience or post-experience learners?
3. How specific and detailed are the language, skills and genres that the learners need to learn?

Although you perhaps don't need to be an expert in a specialist area, you do need to have some awareness and feel for a particular vocational area. Bell (2002) advocates the three Cs for helping teachers to improve their knowledge and skills in a particular area of ESP.

1. Curiosity
   The teacher should be interested in the subject area and want to learn more.
2. Collaboration
   Teachers should seek out subject specialists, show them their work and ask for their feedback.
3. Confidence
   Confidence will grow as teachers explore the new subject matter, engage with subject specialists and learn from their learners.

ESP Teaching Material

Harding (2007) stresses that the general skills that a general English teacher uses e.g. being communicative, using authentic materials and analysing English in a practical way are also applicable to ESP. He also suggests that teachers should:

1. Think about what is needed and don’t just follow an off-the-shelf course or course book.
2. Understand the nature of their students' subject area.
3. Work out their language needs in relation to their specialism.
4. Use contexts, texts, situations from their subject area.
5. Use authentic materials.
6. Make the tasks as authentic as possible.
7. Motivate the students with variety, relevance and fun.
8. Take the classroom into the real world and bring the real world into the classroom.

Like it or not, the days of the EFL generalist teacher may be numbered, so it might just be time to explore the possibility of working in ESP!

Acronyms in ESP:

- CLIL (Content and Language Integrated Learning)
- EAP (English for Academic Purposes)
- EBP (English for Business Purposes)
- ESAP (English for Specific Academic Purposes)
- EGAP (English for General Academic Purposes)
- EMP (English for Medical Purposes)
- EOP (English for Occupational Purposes)
- EPP (English for Professional Purposes)
- EST (English for Science and Technology)
- EVP (English for Vocational Purposes)
- EWP (English for/in the Workplace)
References
Bell, D (2002) ‘Help! I’ve been asked to teach a class on ESP!’ in IATEFL Voices, Issue 169, Oct/Nov
Lesson 2
ESP AND ESL

How is English for Specific Purposes (ESP) different from English as a Second Language (ESL), also known as general English?
The most important difference lies in the learners and their purposes for learning English. ESP students are usually adults who already have some acquaintance with English and are learning the language in order to communicate a set of professional skills and to perform particular job-related functions. An ESP program is therefore built on an assessment of purposes and needs and the functions for which English is required.

ESP concentrates more on language in context than on teaching grammar and language structures. It covers subjects varying from accounting or computer science to tourism and business management. The ESP focal point is that English is not taught as a subject separated from the students' real world (or wishes); instead, it is integrated into a subject matter area important to the learners.

However, ESL and ESP diverge not only in the nature of the learner, but also in the aim of instruction. In fact, as a general rule, while in ESL all four language skills; listening, reading, speaking, and writing, are stressed equally, in ESP it is a needs analysis that determines which language skills are most needed by the students, and the syllabus is designed accordingly. An ESP program, might, for example, emphasize the development of reading skills in students who are preparing for graduate work in business administration; or it might promote the development of spoken skills in students who are studying English in order to become tourist guides.

As a matter of fact, ESP combines subject matter and English language teaching. Such a combination is highly motivating because students are able to apply what they learn in their English classes to their main field of study, whether it be accounting, business management, economics, computer science or tourism. Being able to use the vocabulary and structures that they learn in a meaningful context reinforces what is taught and increases their motivation.

The students' abilities in their subject-matter fields, in turn, improve their ability to acquire English. Subject-matter knowledge gives them the context they need to understand the English of the classroom. In the ESP class, students are shown how the subject-matter content is expressed in English. The teacher can make the most of the students' knowledge of the subject matter, thus helping them learn English faster.

The term "specific" in ESP refers to the specific purpose for learning English. Students approach the study of English through a field that is already known and relevant to them. This means that they are able to use what they learn in the ESP classroom right away in their work and studies. The ESP approach enhances the relevance of what the students are learning and enables them to use the English they know to learn even more English, since their interest in their field will motivate them to interact with speakers and texts.

ESP assesses needs and integrates motivation, subject matter and content for the teaching of relevant skills.

The responsibility of the teacher
A teacher that already has experience in teaching English as a Second Language (ESL), can exploit her background in language teaching. She should recognize the ways in which her
teaching skills can be adapted for the teaching of English for Specific Purposes. Moreover, she will need to look for content specialists for help in designing appropriate lessons in the subject matter field she is teaching.

As an ESP teacher, you must play many roles. You may be asked to organize courses, to set learning objectives, to establish a positive learning environment in the classroom, and to evaluate student progress.

Organizing Courses
You have to set learning goals and then transform them into an instructional program with the timing of activities. One of your main tasks will be selecting, designing and organizing course materials, supporting the students in their efforts, and providing them with feedback on their progress.

Setting Goals and Objectives
You arrange the conditions for learning in the classroom and set long-term goals and short-term objectives for students achievement. Your knowledge of students' potential is central in designing a syllabus with realistic goals that takes into account the students' concern in the learning situation.

Creating a Learning Environment
Your skills for communication and mediation create the classroom atmosphere. Students acquire language when they have opportunities to use the language in interaction with other speakers. Being their teacher, you may be the only English speaking person available to students, and although your time with any of them is limited, you can structure effective communication skills in the classroom. In order to do so, in your interactions with students try to listen carefully to what they are saying and give your understanding or misunderstanding back at them through your replies. Good language learners are also great risk-takers, since they must make many errors in order to succeed; however, in ESP classes, they are handicapped because they are unable to use their native language competence to present themselves as well-informed adults. That's why the teacher should create an atmosphere in the language classroom which supports the students. Learners must be self-confident in order to communicate, and you have the responsibility to help build the learner's confidence.

Evaluating Students
The teacher is a resource that helps students identify their language learning problems and find solutions to them, find out the skills they need to focus on, and take responsibility for making choices which determine what and how to learn. You will serve as a source of information to the students about how they are progressing in their language learning.

The responsibility of the student
What is the role of the learner and what is the task he/she faces? The learners come to the ESP class with a specific interest for learning, subject matter knowledge, and well-built adult learning strategies. They are in charge of developing English language skills to reflect their native-language knowledge and skills.
Interest for Learning
People learn languages when they have opportunities to understand and work with language in a context that they comprehend and find interesting. In this view, ESP is a powerful means for such opportunities. Students will acquire English as they work with materials which they find interesting and relevant and which they can use in their professional work or further studies. The more learners pay attention to the meaning of the language they hear or read, the more they are successful; the more they have to focus on the linguistic input or isolated language structures, the less they are motivated to attend their classes.
The ESP student is particularly well disposed to focus on meaning in the subject-matter field. In ESP, English should be presented not as a subject to be learned in isolation from real use, nor as a mechanical skill or habit to be developed. On the contrary, English should be presented in authentic contexts to make the learners acquainted with the particular ways in which the language is used in functions that they will need to perform in their fields of specialty or jobs.

Subject-Content Knowledge
Learners in the ESP classes are generally aware of the purposes for which they will need to use English. Having already oriented their education toward a specific field, they see their English training as complementing this orientation. Knowledge of the subject area enables the students to identify a real context for the vocabulary and structures of the ESP classroom. In such way, the learners can take advantage of what they already know about the subject matter to learn English.

Learning Strategies
Adults must work harder than children in order to learn a new language, but the learning skills they bring to the task permit them to learn faster and more efficiently. The skills they have already developed in using their native languages will make learning English easier. Although you will be working with students whose English will probably be quite limited, the language learning abilities of the adult in the ESP classroom are potentially immense. Educated adults are continually learning new language behaviour in their native languages, since language learning continues naturally throughout our lives. They are constantly expanding vocabulary, becoming more fluent in their fields, and adjusting their linguistic behaviour to new situations or new roles. ESP students can exploit these innate competencies in learning English.

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Downloaded from:
http://www.usingenglish.com/teachers/articles/teaching-english-for-specific-purposes-esp.html
Leson 3
ESP Course
at Technical Secondary Vocational School
for Construction and Building Trade students

Abstract
The is about ESP course in technical secondary school to construct the trade students. The first discusses the meaning of ESP and then tells about its characteristics. It discusses the role of English as a trade and finance language globally and then further narrates the various steps that are being taken by various countries' governments to promote English for Specific Purposes programs for its workforce. The reflects that these governments understand the importance of introducing ESP courses at secondary level so that their people can comfortable choose the vocational field of their own choice. This offers a research of made efforts especially by Asian countries.

ESP Course at Technical Secondary Vocational School for Construction and Building Trade students

Introduction
There are three reasons for the emergence of ESP (Kristen Gatehouse 2001
The revolution in linguistics ii) The demands of a Brave New World and iii) Focus on the learner

ESP has some following characteristics (Kristen Gatehouse, 2001
ESP is to fulfill some particular requirements of the learner
ESP includes grammar, lexis, skills and varieties of activities
ESP can have some particular disciplines
ESP is mainly planned for intermediate or advanced students
ESP is planned for adult learners who can be at secondary level also that is in a professional work situation

According to Dudley Evans and St. John (1998, there are five major roles for an ESP practitioner: i) course designer ii) teacher iii) researcher iv) collaborator and v) evaluator (Kristen Gatehouse, 2001

David Carter has categorized ESP in three parts (Kristen Gatehouse 2001
English with some particular s
English for Occupational and Academic Purposes both
English as a Restricted Language

English with some particular s transfer from purpose to s and it is generally used by the scientists

Hutchinson and Waters have made three divisions of English for Occupational and Academic Purposes: a) English for Business and Economics that is EBE b) English for Science and Technology that is EST c) English for Social Studies that is ESS

English as a Restricted Language is used by traffic controllers and by waiters (Kristen Gatehouse, 2001

According to Carter (1983) ESP courses have three common features (Kristen Gatehouse, 2001}
Authentic Material
Purpose Related Orientation
Self-Direction

Dudley Evans (1997) has argued that ESP should be recommended at secondary or intermediate level. His argument was that at this stage authentic leaning material is very practical that can be modified and unmodified in form which makes it ESP’s main characteristic. It emphasizes on self directed study and research tasks. Most of the students were evaluated on the basis of independent study assignments for doing language preparation for Employment in Health Sciences where the learners needed to make researches and they had to show their area of interest. The students were motivated to make researches by using various kinds of resources including internet (Kristen Gatehouse, 2001).

In the 21st century the function of English has become as the language of trade, technology and finance. This language is bonding the...
Lesson 4
ESP Vocabulary Teaching
at the Vocational Secondary School of Furniture Industry

Ing. Oskar Kraváček

Introduction

English has become the language of the multicultural world and plays a key role in human lives. At present it is considered to be an inevitable part of general and specific education for people all over the world. People need English for different purposes: to deal with the foreign business partners in their jobs, to know it for their studies, to travel abroad to meet other cultures or on holiday. English has become not only an international language but also a global language, an Esperanto of nowadays, a language which is communicated in every part of the world. Moreover, one of the most important impacts of globalization is the broader opportunity to live and work abroad. To live contently and work successfully in another culture, in our case in an English-speaking country, means to manage not only the basics of the language but also the terminology of the relevant field of occupation.

The aim of this thesis is to display how to teach English Vocabulary for Specific Purposes (ESP) at the technical secondary school of furniture industry. This topic was not chosen by chance. Some students will be specialized in wood/furniture processing industry as joiners, carpenters, folk-art joiners and wood/furniture processing supervisors and managers. At the end of each term they are taught vocabulary from their branch. But there are only the words/special terms in isolation. The intention of this work is to demonstrate teaching vocabulary in a dynamic form, in practical use, in the form of practical exercises to remember the new words actively.

The thesis reflects a revival of interest in vocabulary teaching in recent years. This is partly due to the development of new approaches to language teaching which are much more word-centred, partly due to a long-term practical teaching experience and students’ results in managing language skills. Moreover, vocational classrooms are viewed as potentially good environment for language learning because of the work carried out in small groups, using authentic materials and equipment, and requiring close interpersonal communication. Another important aim of this work is to suggest how vocational teachers can enhance learning opportunities for students/apprentices with limited English proficiency in order to improve their English language skills as they master vocational content. The focus of this thesis is to find out the best way how to motivate mostly teenage students for learning special wood/furniture industry vocabulary and how to teach them with the best effect.

The theoretical part of this thesis is devoted to the short summary of basic principles of vocabulary teaching, and it also underlines the specific factors in teaching special terminology that the teachers at vocational secondary school should take into consideration. In the practical part, the examples of the lessons/topics aimed at practising ESP vocabulary are presented. Consequently, the students of furniture industry should have basic knowledge of vocabulary
regarding their field. This knowledge might help them to adapt quite easily to the new working environment and fulfil the requirements of a foreign employer.

Theoretical part

Characteristics of the target group

The target group discussed in this thesis includes adolescent vocational students between 15 and 20. It is not easy to learn English in this problematic age. Some students have negative attitudes to studying theoretical subjects at all. They may suppose a foreign language not to be necessary for their future career. They often argue that they will not need to use English language as cabinet makers or carpenters. Moreover, there is a lack of English textbooks for vocational schools. The materials should be adequate to their needs and ability to acquire the language.

This thesis is focused on vocational students with the lack of motivation and some learning difficulties with acquiring English. There is an increasing amount of students with different disabilities nowadays, e.g. dyslexia, dysgraphia, mental problems or psychological barriers, which can negatively influence the process of learning. To avoid these factors it is necessary to choose the efficient teaching strategy for learners, taking into consideration various aspects resulting from their specific needs. One of the ways is incorporation of the special terminology, English for Specific Purposes (ESP), into the normal English lessons. It is an excellent way for reinforcing vocabulary in connection with practice of students at the school workshops, supporting the naturalness of learning English by enriching the conditions in which the students live, learn and work. This type of purposeful learning closely connected with the practical work can encourage their interest in English. “ESP must be seen as an approach not as a product. ESP, then, is an approach to language teaching in which all decisions as to content and method are based on the learner’s reason for learning” (Hutchinson and Waters 19). On the other hand, it is necessary to realize that it is hard work to use additional teaching/learning materials in the normal lessons, and what is more at the technical secondary schools, where the learners struggle with the basics of English language. Because of population reduction, contemporary technical secondary schools concentrate the worst educated pupils from primary schools.

Motivation of vocational students

The aim is to make learning English terminology in the field of wood/furniture industry more stimulating and motivating. It is necessary to realize that students learning a foreign language may only learn well if you find a way to activate and encourage their desire to invest effort in the learning activity. The main point is to find the best way how to motivate vocational students for learning English. The age of the students is between 15 and 20 so it can be difficult to connect fun and studying drill. The teaching should be based on friendly but demanding atmosphere with the appropriate space for games and talking.

Sources of motivation

Students are influenced by many attitudes of different participants in the learning process (Dörnyei 34, 39):

- Teacher – is the key factor in student’s motivation. He or she must have a positive attitude and enthusiasm for teaching English. If the teacher makes lessons interesting, the students like learning English and they appreciate it.
Parents – if parents have positive attitudes to learning, it is easier for the student to study. If family members do not accept the importance of learning a foreign language and emphasize it by unreasonable comments, frequent disturbing or not paying attention, then such atmosphere could be very demotivating.

Environment – it depends on what social background children come from. If they are brought up in a positive society it is good for their school results. A positive classroom atmosphere should be created to enhance a good school environment.

Intrinsic and extrinsic motivation

As it has been said one of the factors that have a strong impact on success or failure in learning English is motivation. If students miss motivation for studying English, it will be very hard to make them cooperate. It can simply be said that without motivation students would not do any activities and consequently there would not be any effort to acquire a language (Uhr 274). In other words, students must be motivated by some basic kinds of motivation, which include intrinsic and extrinsic motivation (Harmer 3-4).

According to Harmer (3-4) intrinsic motivation is commonly defined as an internal drive. This is something that students want to do themselves because they are personally interested in it (e.g. acquiring the knowledge of language). A typical example of intrinsic motivation is an interest or a hobby, i.e. an activity carried out for its own sake. On the contrary, extrinsic motivation is influenced from outside. Students carry out activities because they are expected or forced to do them. It may be the compulsory subjects in school curriculum, a need to satisfy parents’ expectations, longing to be praised or an idea of a better career. The ordinary motives are tangible rewards.

As Jeremy Harmer (4) states, intrinsic motivation is concerned with the factors taking place inside the classroom while extrinsic motivation is concerned with factors outside the classroom. Harmer points out that intrinsic motivation is very important in students’ success or failure. What happens in the classroom is very important in establishing students’ attitude to a language. In his opinion (4) extrinsic motivation includes situations in which students believe that managing of the target language will be a means for getting a better job, position or status (instrumental motivation) or it will help them to integrate into a particular culture environment (integrative motivation). This stresses the fact that students’ attitude to learning can be predominantly affected by members of a community. But other factors participating in the learning process can also essentiaaly affect it. They are physical conditions, teaching methods, success/failure and especially a teacher. All of them have an important impact on learning a foreign language.

Instrumental and integrative motivation

As it has been mentioned above, there are also other two types of motivation identified by Gardner and Lambert (Eylidrim, Ashton 3): instrumental and integrative motivation. People who acquire language for reasons such as to obtain a good and well-paid job, to be able to read and understand instructions for equipment needed in their profession, or study in the foreign country, have instrumental motivation. “Instrumental values are consequences and benefits of having learnt the target language” (Dörnyei 51). The knowledge is exploited as an instrument to achieve something in life.

Integrative motivation is applied by people who want to get in touch with “the culture of the second language group and become involved in social interchange in that group” (Brown qtd.
Integrative motivation may apply to students who want to read magazines/journals, understand foreign music, if they come to a foreign country they want to speak in shops and ask for directions, simply they have to communicate. They want to integrate into the society. The main point, regarding teaching special terminology, is to find the best way how to motivate students for studying English vocabulary in the strict but at the same time friendly atmosphere.

Teaching methods
Vocabulary has not always been considered as an important part of second language teaching because much more attention has been paid to teaching grammatical and phonological structures. There is a short review of some linguistics approaches that appeared during the 20th century.

Grammar-translation method
Grammar-translation method (GTM) was frequently used in the past for teaching the classical languages. It is logically based on translation from one language into another. Students translate independently, student-student interaction is nearly missing. Students are given grammar rules/patterns and they memorize them. Teachers often teach in the mother tongue with little use of the target language. Correcting mistakes is considered to be highly important. The primary aim is to be able to read different texts written in the target language. Vocabulary is presented in the form of isolated words. Grammatical accuracy is more important than the ability to communicate. However, this method can work quite well for ESP and EST students who need to be able to read technical texts, journals or manuals in a foreign language without intention to communicate or write.

Direct method
The aim of Direct method (DM) is to think in the target language and, as a result of this, to develop a good communication ability. Spoken word is emphasized and is considered to be the primary form of language. Vocabulary and grammar are learnt through examples and associations. Teacher presents the subject by acting or demonstrations. Vocabulary is studied in a natural conversational context whereas textbook explanations are presented later. Vocabulary is preferred to grammar, but only everyday vocabulary is taught. Students learn to talk by listening and interacting with their classmates. Emphasis is put on speaking in the form of sentences rather than on using words in isolation.

Audio-lingual method
Learning through Audio-lingual method (ALM) means forming habits. The method is based on teaching drills of sentence patterns and their pronunciation. ALM was thought out during the World War II for military objectives. The main aim was to create communicative ability of learners in a short time and make responses habitual and mostly automatic. The only language used during lessons is the target language, special importance is given to pronunciation, and memorizing of phrases plays the key role. Teacher has the central and leading role, his/her work is very demanding because of accuracy, activity and control. Except for automatic responses, there is a great effort to produce mistake-free utterances. Language is displayed through conversations divided into lines that are drilled repetitely. Vocabulary is strictly limited and learned only in context.
Task-based learning
Tasks are often the central part of the practical learning activity. The main idea of Task-based learning (TBL) is that students study more effectively when their brain is occupied with a specific task or topic offering, besides concentration on language, its grammar or vocabulary, also another practical experience, e.g. solving problems or making decisions. In this way, students are forced to communicate in the target language and therefore they use a wider range of language items, not only a particular pattern or vocabulary group. Tasks may include projects for producing pictures, presentations, dramatic performances, films etc. Teacher helps to choose topics, encourages, regulates and monitors. These activities improved above all students’ communication ability, and solving real problems is highly motivating and offer students actual reasons for learning a language.

Total physical response method
The Total physical response method (TPR) is based on the fact that a foreign language should be learnt in a similar way as children learn their mother tongue: firstly they only listen to it and do what they are asked for. Therefore, the main skill in TPR is listening with concentration on listening comprehension. Mother tongue is rarely used in lessons. All explanations are done through voice, body language, gestures and actions. Students can listen to a recording while looking at additional materials that help to understand the meaning from context. The main aim is to decrease stress in speaking, make lessons more enjoyable and encourage students to feel more confident and successful. This method is convenient for beginners of all ages but generally it is rather supportive and requires cooperation with other methods.

Suggestopedia
This method belongs to Accelerated Language Learning developed on the theories of Georgi Lozanov, based on the power of suggestion in learning. It is supported by the use of mostly Baroque music and comfortable environment (decorations and classroom arrangement) that create relaxed but focused state (it is called the alpha state). Various colours and tones of presented materials help to avoid monotony of learning process, emotionalize meaning of language materials and evoke positive mood. Relaxed students can acquire new language naturally and easily, their mind is clear, receptive to information, and rapidly makes connections. The main aim of Suggestopedia is to overcome psychological barriers and to increase confidence. Stress is put on memorization of vocabulary pair – a target item and its translation into a mother tongue. It is good for acquiring language but predominantly for building vocabulary in respect of displaying the right context for usage of certain words. This method is specific and rather supportive, suitable for a certain group of students.

Teaching approaches
Teaching methods discussed above are closely linked with teaching approaches. Whereas teaching methods are collections of individual teaching techniques, systematic sets of teaching practices based on the appropriate theory of language learning, teaching approaches are the ways through which the teaching methods are achieved. The examples of some approaches are above all the Lexical approach (Lewis, 3), Communicative approach (Harmer, 41-42) and Eclectic approach (Halvorson, 11).
Lexical approach
Lexical approach is based on the idea that a significant part of language acquisition is the ability to make lexical phrases in chunks (pairs or groups of words which are usually found together or in a close proximity). In this way language consists of chunks and they, in the form of combinations, make up a coherent text. Language is viewed predominantly as lexis rather than a combination of grammar structures and vocabulary. Stress is put on vocabulary as the main carrier of meaning, but this concept is moved from words to lexis. The goal is to achieve fluency and accuracy through acquisition of a large storage of fixed or semi-fixed prefabricated items. Lexical approach puts a big stress on spoken language rather than on writing. Activities are based on target language / mother tongue comparison and translation with looking for equivalents from mother tongue. Meaning of vocabulary might be guessed from context. Language patterns/collocations are noticed and noted into systematically organized notebooks. Students are supported to work with monolingual dictionaries, which provide good base for active manage of a language. Listening skill is stressed and developed at lower levels while at higher levels it is predominantly reading: mostly short texts read in class and extensive reading (articles chosen because of personal interest or for pleasure). Various texts are used for different purposes. The motto of this approach according to Thornbury (13) may be: “Without grammar little can be conveyed, without vocabulary nothing can be conveyed.”

Communicative approach
The teaching methods as TPR and Suggestopedia have brought new thoughts that originated in the nowadays most widely used Communicative approach which emphasizes usage of the target language. Harmer (41) states the following characteristics: “Because of the focus of communicative activities and the concentration on language as a means of communication such an approach has been called the communicative approach.” As Thornbury points out, the introduction of Communicative approach in the 1970s helped to emphasize the role of vocabulary. The communicative value of a core vocabulary has been recognized, especially by tourists. Communicative sources provided by phrase books are more valuable than those in grammar-organized textbooks. Acknowledgment of the meaning-making potential of words means that vocabulary has become again the main learning objective (14). Vocabulary acquisition is the most important and at the same time the largest task facing the language learner. The recent trend has proven that coursebooks include more activities than specifically targeted vocabulary. More attention is given to a collection of vocabulary items, the grammar of words, to collocations, semantic relations between lexical items and to word frequency.

Eclectic approach
According to a definition found in Oxford Advanced Learner’s Dictionary (367), eclectic means: “not following only one style, etc. set of ideas but choosing from or using a wide range.” It means that Eclectic Approach includes valuable techniques and procedures of other different approaches and benefits from them. The biggest advantage is flexibility. Teachers can make experiments with techniques and activities of different approaches and methods to find out the one that might be the most suitable for their target group. It should allow teachers to choose the most appropriate teaching methods and incorporate them into their lessons. It also gives great opportunities to concentrate on individuals’ needs.
The important fact follows from the above-mentioned: teachers have to make compromises in using teaching approaches and methods because the completely effective teaching method does not exist. There are some effective methods for a certain usage, but they do not function in other circumstances. But one tendency is transparent: Vocabulary, not grammar, is put to the centre of the classroom in order to help learners develop their ability to use English for real communication. In my opinion, the best way is when neither grammar nor lexis is underestimated and the attention is paid to both approximately in the same extent. But then teachers have to deal with the problem how also an effective way of teaching vocabulary can be incorporated into lessons, besides the stress put on teaching grammar.

Vocabulary teaching

All languages contain words. Most learners acknowledge the importance of vocabulary acquisition. According to Thornbury “the acquisition of new words is the process which never stops” (1). To build a good storage of vocabulary is the first and one of the most important steps when starting to learn a new language. People learn new words permanently and identify their meaning. Vocabulary learning does not officially belong to the language skills (listening, speaking, reading and writing) but there is no way of making advance in language without building vocabulary that can be applied into grammar structures and make meaningful utterances. It is difficult for students to communicate without creation and developing their own lexicon.

ESP vocabulary teaching

English for Specific Purposes (ESP) represents a specific reason for learning a foreign language. There are distinguished two types of ESP: English for Occupational Purposes (EOP - learning English for a job) and English for Academic Purposes (EAP - learning English for a study specialization). At present these streams include a lot of other fields, e.g. English for Technicians.

The students at the vocational secondary school of furniture industry should study ESP vocabulary, especially English for Technicians. According to Hatch and Brown (312), “special lexical items are present in nearly all professions, and each branch has special vocabulary to cover abstract concepts.” Kennedy and Bolitho (56-58) distinguish these word categories for teaching technical vocabulary:

- Technical Abbreviations, Symbols and Formulae – they partly cause the problems. Teachers’ role is to explain patiently their form and meaning, and students should practise them in spoken and written exercises.

- Sub-technical vocabulary – words which are not directly a part of specific technical branch, but they occur generally in scientific and technical texts – e.g. derivation, conversion, dense and isolation.

- Highly technical vocabulary – words that have a close thematic relationship and belong to the specific technical field.

The fundamental problem which has to be solved by authors designing technical teaching materials is: contemporary students at the vocational secondary school have little knowledge not only English, but also their profession. This fact reflects in these two factors: teaching material should be managed by students in both the language and specialization. Hatch and Brown (370) stress that “the specificity of any individual’s knowledge about a word depends on the person
and his or her motivation, desires, and needs for the word.” There is also an important role of teachers to facilitate learning of technical vocabulary with the favourable secondary impact on the good general knowledge of English.

Selecting vocabulary
The initial step in teaching ESP vocabulary is to determine which words and special terms in fact to teach. Gairns and Redman (59) emphasize especially cultural reasons and the principles of need and level. Authors of teaching materials and teachers should take into account also the criteria of learnability and teachability. According to Harmer (154), one of the most common principles of vocabulary selection is to teach at first concrete words and gradually abstract words. Words like chair, table, sofa and wardrobe are easily presented and explained, because students can see or imagine the real things which the words represent. On the contrary, abstract words like density, qualifications, safety are more difficult to explain. There are a number of words that are connected with the idea of furniture (chair, table, sofa and wardrobe). Words that have this kind of thematic relationship are said to belong to the same lexical field. The texts of practical part also contain the lexical field of tool-related words that partly overlap with furniture words (hammer, screwdriver and saw) as well as terminology connected with trees (hardwood and softwood).

After selection words for teaching purpose it is also indispensable to decide what to teach about each naming unit. According to Harmer (158) and Thornbury (15), knowledge of a word involves knowing its:
Meaning - meanings in context, sense of relation (synonyms/antonyms),
Form – spelling and pronunciation, affixes, parts of speech,
Grammar – plurals, countability, past simple/participle forms,
Usage – collocations and appropriate register.

Presenting vocabulary
The main aim of presenting vocabulary is to insert the meaning, the correct form and appropriate usage of the new word into the student’s memory. There are quite lots of methods and techniques how to present the form and meaning of new lexical items. It depends on teachers, which form of presentation is the most suitable for the particular topic. According to Gairns and Redman (73), there are some traditional methods and techniques used to present new vocabulary:

Visual techniques:
- Visuals – photographs, flashcards, blackboard drawings, pictures, videos, wallcharts, pictograms and real objects; they are useful for teaching concrete words.
- Demonstrating: mime/facial expression and gesture – useful for teaching action verbs.

Verbal techniques:
- Illustrative situations (oral or written) – this technique is helpful when the words are more abstract.
- Synonyms and antonyms – using the words students have already known to teach them similar words.
- Definitions and explanations – appropriate for intermediate learners. To make definition of words can be difficult, especially at elementary levels.
• Scales – if students know 'big' and 'small', for example, other steps could be to teach 'short' and 'long' etc.
• Examples of the type – give examples of words you want to introduce.
• Translation – it has been the most widespread activity used for presenting the meaning of a word in classes.
• Guessing from the context, matching/labelling – learners match words to words or sentences or pictures. It belongs to so called discovery techniques: they activate the learner’s previous knowledge of a language and initiate the work with the new vocabulary. Discovery techniques demand the autonomous students with higher knowledge of English.

Taking into consideration the specific factors of ESP vocabulary teaching “many of the techniques traditionally used in ELT work can be exploited in ESP vocabulary teaching especially at the early stages when both subject and linguistic content are at an elementary level” (Kennedy and Bolitho 59). Consequently, presenting ESP vocabulary can be fully realised by methods and techniques mentioned above. Often even translation may be useful, necessary and appropriate because of the level of students at the vocational secondary schools and to avoid the fatal misunderstanding. During presentation wood/furniture vocabulary, teachers have a great opportunity to explain the purposeful meaning of a word in the context of the real life and work at the school workshops. However, this kind of presentation should be simple, interesting and amusing to motivate and encourage students’ interest.

Vocabulary consolidation

As Thornbury (23) states, “in fact, learning is remembering. Unlike the learning of grammar, which is essentially a rule-based system, vocabulary knowledge is largely a question of accumulating individual items.” He distinguishes three basic types of memory (23):
• Short-term store – some information is held in memory for a very short time (a few seconds). Students are able to repeat a word that they have just heard from their teacher.
• Working memory – it is a space, where a student first places information for later usage to recall a word repeatedly. It lasts about 20 seconds.
• Long-term memory – to compare working memory, where the capacity is limited with long-term memory, where the capacity is wide and its contents are lasted over time.

The great challenge for learners is to transform vocabulary from the quickly forgotten (short-term store) to the never forgotten (long-term store), and to turn passive knowledge of vocabulary into an active form. Research into memory suggests that, in order to ensure that information moves into permanent long-term memory, a number of principles must be followed. One of them is use. “Putting words to use, preferably in some interesting way, is the best way of ensuring they are added to long-term memory. It is the principle well-known as Use it or lose it (Thornbury 24). For this reason, words must be presented in their usual contexts, so that learners can get a sense for their meaning, their register and collocations. In separated vocabulary activities, words are often presented in the form of lexical sets. It is highly recognised that it is easier to learn the words that are thematically arranged but have looser relation than lexical sets. The system of practical exercises should be thoroughly organized so that the amount of new words does not discourage the student.
Vocabulary practice

Presenting a word in the class does not secure that it will be remembered for a long time. There are many practice activities that include repeating of the new vocabulary to fix the new words in the learners’ memory. The practice activities are divided into two main groups: receptive and productive.

Receptive practice (the learner does not really produce the target words) includes these types (Thornbury 94-99):

1) Identifying – means finding words in a text or listening, e.g. underline specific words or expressions in the text, or tick, put in the correct column or list items that you hear.
2) Selecting – means recognizing words and making choices among them, e.g. circle the odd word in the line.
3) Matching – includes recognizing words and than pairing them with their synonym, antonym, definition, pictures to words etc. It can be intended to matching parts of lexical items to create collocations (there is a very popular memory game based on matching called Pelmanism).
4) Sorting – putting the lexical items into different categories, e.g. put these adjectives in two groups – positive and negative.
5) Ranking and sequencing – putting the lexical items in some kind of order, e.g. ordering items chronologically, ranking items according to personal preference etc.

Productive practice (the productive skills – writing or speaking – are incorporated in the vocabulary teaching,) includes these types (Thornbury 100): completion and creation.

- Completion tasks (context is given), often called gap-fills, are widely used not only in practice but also in revision stages. They include open gap-fills or closed gap-fills (multiple choice activities), crosswords,
- Creation tasks: the learner use the word in a sentence or a story, in writing, speaking or both forms, use affixes to build new naming units from given words.

Generally speaking, vocabulary practice is divided into controlled and free. Controlled practice has to come first, because controlled activities require the student to produce a certain structure, they practice accuracy and fix the pattern. The second phase, which demands productive use of vocabulary, is free practice. The specialists point out the usage of free practice in the class, because according to Lewis (151-152) “to know a word means how to use it in the real life to be able to communicate.” This is a typical example of the lexical approach where is a primary role of words which determine grammar. Free practice is aimed at fluency and is productive. However, Gairns and Redman warn against “a certain degree of stress involved in productive practice” (137). According to them, practice should be challenging, but not frustrating or stressful for the learner. They give several arguments in favour of productive practice of vocabulary in the classroom (137), above all, it promotes fluency and improves pronunciation, it helps the memory to store words, and retrieve them later, conversation in English is very motivating and it builds learner’s confidence, learners expect to get the opportunity to practise new language.

Another division includes spoken and written practice. Many vocabulary activities used in the class are based on discussions, dialogues, descriptions, role-play activities, or different written tasks. It has become a part of communicative classes, e.g. in the form of an activity well-known as ‘Find someone who…’, memory games and funny games (hot seat) etc.
The students should be encouraged to think about the importance of the word, therefore the examples in context are highly useful. Moreover, this approach must be focused predominantly on learners, each unit has to have clear aims, motivating topics and challenging practical activities. The appropriate issues must be presented in the context of the real life, in this case, of the present vocational school, where “young people are given numerous opportunities to follow purposeful learning” (Buchanan 6). As Maehr points out, in this way, teachers can support the naturalness of learning vocabulary, and in such an enriched atmosphere, learners find ideal authentic reasons for learning a foreign language (1).

According to Morgan and Rinvolucrì (7) the new words are not learned mechanically, but associatively. Therefore the most progressive methods in ESP vocabulary teaching should be sorting words by process or activity, by categories (materials: hard and soft wood), by word families (to join, joiner, joinery), by theme/topic (types of furniture) and synonyms/antonyms. Contemporary supplementary vocabulary books are typically organised thematically like in this thesis. Moreover, it allows learners to work independently on vocabulary areas that they are interested in.

ESP vocabulary can be practised and consolidated by similar methods and techniques used for practising and consolidation of general vocabulary (See sub-section 1.5.4.). Writing tasks can include reports and different instructions for wood/furniture processing, making summaries from technical journals, describing processes and techniques, labelling diagrams and pictures, describing graphs and comments on charts etc. Nowadays a lot of students take part in various competitions where they display their projects and so they may create a short English summary of their presentations. There are different exchange practices with other vocational/technical secondary schools within the European Union, school trips, e-learning activities and participations in Comenius and Socrates programmes, where students can improve their ESP vocabulary in practical circumstances.

Practical part

In this part of the thesis there is a comment on the hand-out (see Appendix) which reflects the theoretical part about the ESP vocabulary teaching. The hand-out called Furniture Industry Vocabulary in Use is intended for the pre-intermediate (B1) students of the vocational secondary school of furniture industry. The overall aims, hand-out design and its using are based on introduction in Basic Technical English, Teacher’s Book (1-9).

Target students

Furniture Industry Vocabulary in Use is aimed at students requiring English for practical use in technical fields who have pre-intermediate knowledge of general English. It regards the group of about 15 students aged 17-18 attending the third and forth grade of the vocational secondary school of furniture industry, the branch of supervisor of wood/furniture processing industry. They are timetabled for 2x45 minutes of ESP English a month. It aims to develop students’ competence in processing the kind of technical information found in manuals and handbooks so that they will approach the reading and understanding of technical material with some confidence in the course of their vocational or occupational training. Furniture Industry Vocabulary in Use constitutes a teaching programme of some 20 lessons. It is logical that it might be used as a complement to a compulsory language teaching programme involving spoken technical English. It can be also ideal for the new school curriculum – RVP and ŠVP at the
vocational secondary school. On the other hand, it is necessary to realize that students at technical schools are a mixed ability group, most of them have only a basic knowledge of grammar and vocabulary. They have problems with reading and it is difficult to make them speak.

Linguistic objectives

Furniture Industry Vocabulary in Use is a combination thematic/topic-based and semantic syllabus. The aim is to present technical material in the topics which are chosen as the most important for students specialized in the branch of wood/furniture industry. System of the practical exercises support the learning new vocabulary – it provides the better understanding the basic meaning of unfamiliar new words and using them in appropriate contexts and collocations. This additional teaching/learning material displays systematic vocabulary syllabus, collocations, and easy-to-understand definitions. New vocabulary is presented in context to stress the fact that the language is used to express relationship between information. Visual devices (tables, pictures and drawings) which are common in technical books are used with the aim to familiarize the learners with them and use these devices as a means of vocabulary presentation.

Target skills and materials

The hand-out is based on technical texts and pictures adopted from http://www.taunton.com/finewoodworking. Original texts were shortened and simplified to be appropriate for teaching/learning purpose and language abilities of young learners. The key information was left in the texts, the redundant one was removed. The basic range of topic areas creates the logical order following the wood/furniture processing. The ability to extract information from written text includes a variety of skills connected, above all, with the content of a reading course. Among the most important is the capability to understand the main idea of a passage (skimming). Further skills involve the ability to find quickly specific information (scanning) and intensive reading to get details.

Language functions

There are three functional areas in the hand-out:

Static description includes the use of language to describe properties, characteristics or attributes of materials, devices, technologies and systems: “Drill presses are precision tools, capable of boring holes in exact locations at carefully controlled depths.”

Dynamic description involves the description of relationships between a series of events or processes: “It does not matter how many screws you use, or how much glue you put into a joint. If a piece of furniture is constructed without taking wood movement into consideration, it finally might break.”

Instructions entails mostly language to describe the correct order of furniture processing: “Lift the part off the bit after it touches the far stop.”

Within the above described categories, the occurrence of certain language functions in written technical materials deserves special linguistic attention. The following survey provides examples of some functions (types of exercises) covered in the topics/lessons:

Classifying: “There are two basic types of drying wood: kiln-dried and air-dried.”

Comparing: “Files produce a finer finish than rasps.”

Defining: “Vessels are wood cells that extend parallel to the grain.”

Recommending: “Rough lumber should be purchased oversized in thickness and length.”
Exemplifying: “For example, 4/4 lumber is approximately 1 inch thick, and 8/4 lumber is about 2 inches thick.”

Warning: “Protect your eyes, ears, and lungs.”

Expressing priority/degree: “Ensuring the integrity of a piece of furniture is the number one priority in furniture construction.”

Expressing function: “Band saw provides cutting curves and resawing thick planks into thinner ones.”

Expressing purpose: “Whereas solid wood shrinks and expands with changes in humidity affecting its dimensions, the panel is able to expand and contract freely inside an unchanged frame.”

Describing measurements: “Most rough lumber is delivered up to 12/4.”

Expressing possibility: “Workshops offer plenty of ways to get hurt, from airborne dust and chemicals that may lead to chronic health problems to flying chunks of wood or metal that may damage your body.”

Different types of exercises were chosen intentionally for practising vocabulary to demonstrate the ability to prepare broad variety of exercises which might be highly interesting for learners. The types of exercise students will usually do are matching expressions, definitions or words/meanings (1.2., 2.2.), gap-filling with supplied words/expressions (2.1.), finishing sentences with multi-choice words (2.5., 3.2.), correct/incorrect exercise for checking vocabulary used in given sentences (5.1.), translations the given sentences (8.2.), labelling of pictures (1.1., 4.3.), the crossword puzzle (3.1.), word formation exercises (4.2.), identification of a word according to its meaning or grammar (4.1., 9.4.), rearranging word exercises (6.1.) and rearranging of actions/procedures (8.1).

Unit organization and layout

The hand-out consists of 9 units. With taking into account a class of about 15 students at pre-intermediate level, it will be worked on the basis of approximately two teaching hours per unit. Units are organized around the topics arranged in the logical order following the wood/furniture processing. Each unit/topic is divided into two parts: Presentation (text, vocabulary, drawings, pictures and tables) and Practice/Revision (exercises).

The units begin with a presentation of vocabulary from a given topic in the form of a technical text. The important words are selected and identified by bold type. Under the text or a part of the text (according to the text length) there is a vocabulary list with English-Czech meaning. In the list there is not pronunciation of English words, because it is supposed that students with pre-intermediate level English will take notes about pronunciation according to the teacher’s instructions. Wood/furniture vocabulary logically contains a lot of the other technical vocabulary. Students should be encouraged to make notes of vocabulary relevant to their technical area. In this way a student is actively involved at this presentation phase.

Practical exercises revise, consolidate, exploit and reinforce the main features from the presentation. The types of exercises vary from gap completion exercises to labelling pictures (see section 2.4.). Where completion exercises occur, it is important to realize that mostly a word or a compound is missing. The intention was to give simpler types of tasks to complicated to be managed by students at the vocational secondary school. At the end of the hand-out there is a key that provides the solution to the problems presented by the particular exercise.
The teacher’s role

The teacher’s role should be seen, in an ideal way, as a guide through the teaching/learning material and as an initiator of activities, deciding when to facilitate through answers and explanations. However, because of the target group, there are mostly expected the situations when teacher-centered learning will occur. Firstly, in situations when the new vocabulary is expected to be extremely difficult for students, or when the meaning of key words cannot be deduced from the context. Selected items should be presented and explained through the pre-teaching activities before students start to read the given technical text. Secondly, it is important task of the teacher to do the summary/revision of a unit, drawing attention to the main vocabulary or other main points from a unit (e.g. technical meaning or definition), checking understanding and discussing problems according to the feedback. In addition, teachers can think out further examples or exercises to explain some problems or practise vocabulary.

Particularly, in the early stages and in some complicated occasions, the mother tongue can be used to avoid the fatal misunderstanding. As regards translation, while translation of individual words may be beneficial in the terms of accuracy and time saving, translation the whole sentences of the text might be detrimental to the lessons/course objectives. For this reason there is only one translation exercise in practical part.

The student’s role

Not all students would receive the idea of the teacher’s role as the guides or moderators of the lessons. However, the teacher should do everything possible to lead students on the way of self-studying learning. Since students will not be familiar with all of the topics, an effort has to be focused on understanding of both: new vocabulary and new technical information. The secondary aim is to stimulate curiosity and interest about information from the branch of wood/furniture processing industry. The tasks are designed to involve the students actively in the process of gaining the new information. This corresponds with the idea of reading as an active skill in learning technical terminology. The intention is also to learn students to work with the technical texts to achieve a satisfactory level of understanding and to manage different tasks in their future careers.
Lesson 5
ESP International Sample lesson plan

Sample lesson plan is made for Measuring Tools.

Lesson plan

Topic: Measuring Tools

Date: 12. 12. 2007                                Length: 2x45´
Class: 3.C (3rd year students)                   Target level: Pre-intermediate (B1)
Number of students: 12 technically minded students aged 17 - 18
School/course: Vocational Secondary School of Furniture Industry
Material used: Syllabus Topic 4, whiteboard + markers, folding rule, caliper, square, tape rule, bilingual and monolingual dictionaries (e.g. Oxford Advanced Learner’s Dictionary of Current English)
Skills: reading, writing, speaking
Aims: to present and study new technical vocabulary, to introduce vocabulary in connection with pictures and realia (tapes), to practise the pronunciation of the new words and abbreviations, to practise the new vocabulary in reading, writing and speaking activities. to develop both: ESP vocabulary and knowledge of measuring tools.

Reasons:
Students of the vocational secondary school of furniture industry are supposed to work with measuring tools and they should be able to speak about them as well as to understand the written or spoken texts.
Assumptions:
Ss know each other, Ss are ready to share and co-operate, Ss have some experience with measuring tools, Ss have some experience with doing practical activities in syllabus (matching, filling in the gaps and labelling the pictures), Ss are technically minded, Ss should be encouraged by the topic which is known to them, Ss’ knowledge of measuring devices and measures will be boosted through English vocabulary

Stages and procedures:

The first lesson: 45´

Stage 1: Introduction                                Time: 2 minutes                                Interaction: T-Ss

Aim: to show that lesson has started, to let Ss know what to expect and what is on the programme.

Procedure:
Stage 2: Warming up                      Time: 5 minutes                      Interaction: T-Ss

Aim: to get students thinking about the topic, to revise general English vocabulary, to develop pronunciation and speaking skill, to present new vocabulary, to provoke asking questions – getting information

Materials: folding and tape rule, square, caliper, markers

Procedure:
T shows the basic measuring tools brought in the class. Ss try to recognize and name the basic measuring tools which they have known from the previous studies. If Ss do not know a tool, they are encouraged by T to ask questions: What is it in English? How can we say it in English?, etc.

Stage 3: Vocabulary introduction 1     Time: 10 minutes               Interaction: T- Ss in pairs

Aim: to introduce the new vocabulary from the first part of the topic, to practise the pronunciation, to give simple explanations

Materials: syllabus, whiteboard + markers

Procedure:
Ss go through the new vocabulary 1 in pairs. Ss have dictionaries to check pronunciation. Ss read the new words and practise pronunciation with T. The problematic words are pronounced chorally. T corrects pronunciation, gives a short explanation and marks the stress on the board.

Stage 4: Reading the text 1                  Time: 15 minutes                 Interaction: T- Ss

Aim:
to introduce the first set of new vocabulary in context, to practice reading and correct pronunciation of the unknown words and English and Metric measures (length).

Materials: syllabus, whiteboard + markers

Procedure: Ss read the introduction of the text including the most important characteristics and Tape measures. T draws Ss’ attention to the correct pronunciation and reading the abbreviations of English measures: foot and inch. T accidentally checks the meaning other words in the text. T focuses Ss attention on practice the correct reading the English and Metric measures under the vocabulary set.

Stage 5: Vocabulary introduction 2     Time: 10 minutes               Interaction: T- Ss in pairs

Aim: to introduce the new vocabulary from the second part of the topic, to practise the pronunciation, to give simple explanations

Materials: syllabus, whiteboard + markers

Procedure:
Ss go through the new vocabulary 2 in pairs. Ss have dictionaries at their disposal to check pronunciation. Ss read the new words and practise pronunciation with T. The problematic words are pronounced chorally. T corrects pronunciation, gives a short explanation and marks the stress on the board.

After a 5 minute break, the second lesson: 45´

**Stage 6: Reading the text 2**  
**Time: 10 minutes**  
**Interaction: T- Ss**

Aim: to introduce the second set of new vocabulary in context, to practice reading and correct pronunciation of the unknown words.

Materials: syllabus, whiteboard, markers

Procedure: Ss read the text about Rules and Other measuring devices. T draws Ss’ attention to the correct pronunciation. T accidentally checks the meaning other words in the text.

**Stage 7: Practice – writing exercises**  
**Time: 10 minutes**  
**Interaction: T – Ss in pairs**

Aim: to consolidate Ss’ awareness of the meaning and the form of the new words, practising of the knowledge of new vocabulary, practising the knowledge of the basic word classes: nouns and adjectives.

Materials: syllabus, exercises 4.1.and 4.2.

Procedure: Ss choose and mark the word that is different from the others and say to her/his partner why it is different (ex. 4.1.). Ss think about the meaning the word and the grammar. T shares Ss’ solutions with the whole class. In ex. 4.2., Ss fill in the gaps in the table with the nouns, adjectives and their opposites from the choice given above the table. T again shares Ss’ solutions with the whole class.

**Stage 8: Vocabulary introduction 3**  
**Time: 5 minutes**  
**Interaction: T- Ss individually**

Aim: to introduce the new ESP vocabulary from the third part of the topic in combination with pictures, to practise the pronunciation, to give simple explanations, to revise vocabulary that is known from the first two parts of the topic

Materials: syllabus: table with the pictures of the basic measuring tools, whiteboard, markers

Procedure: Ss go through the new vocabulary individually. Ss read the new words and practise pronunciation with T. The problematic words are pronounced chorally. T corrects pronunciation, gives a short explanation and marks the stress on the board.

**Stage 9: Practice – labelling exercise, speaking**  
**Time: 8 minutes**  
**Interaction: T – Ss in pairs**

Aim: to consolidate the new words, practising using the new vocabulary, practising the both knowledge of English and technical mind.

Materials: syllabus, exercise 4.3.

Procedure: Ss in pairs match and label the pictures with the relevant words. T shares Ss’ solutions with the whole class. Ss try to describe the purpose of a relevant measuring device to her/his partner. T monitors their mini-dialogues and shares notices with the whole class.

**Stage 10: Calming down: Hot seat - a competition**  
**Time: 10 minutes**  
**Interaction: T- Ss individually**
Aim: to revise ESP vocabulary in a funny way, to relax in a pleasant atmosphere, to release the tension, to develop ability to speak (meaning description)
Materials: whiteboard, markers, a chair
Procedure:
- Split the class into two teams.
- Take an empty chair and put it at the front of the class, facing the team members. The chair is a 'hot seat'.
- Get one member from each team to sit in that chair, so they are facing their team-mates and have their back to the board.
- T has a list of vocabulary items that s/he wants to use in this game.
- T takes the first word from that list and writes it clearly on the board.
- The aim of the game is for Ss in the teams to describe that word, using synonyms, antonyms, definitions etc. to their team mate who is in the hot seat - that person can't see the word!
- The student in the hot seat listens to their team mates and tries to guess the word.
- The first hot seat student to say the word wins a point for their team.
- Then T changes the students over, with a new member of each team taking their place in their team's hot seat.
- Then T writes the next word. There is a time limit. T evaluates the game.

Stage 11: Assessment, short summary of the lesson, Homework Time: 2 minutes Interaction: T
Aim: to sum up the lesson to keep in Ss mind and to give Ss the opportunity to consolidate the new ESP vocabulary
Procedure: HW: describe 5 measuring tools you use the most at the school workshop

Conclusion

It was the rapid development of new technologies at the beginning of 1990s that contributed to the formation of learners who started learning English not only for pleasure but also for specific purposes. They indispensably needed to understand manuals, to purchase or distribute products, or to read specialized textbooks and journals. English has become a global language of various industrial and business branches. There are more opportunities for Czech people to exploit not only their general English knowledge, but they can also study different subjects in English or provide qualified work.

The main aim of the thesis is to find out the best way how to motivate mostly teenage students for learning wood/furniture vocabulary and how to teach them with the best effect. The appendix is in the form of a hand-out intended as a practical teaching/learning material used as an additional textbook through the terms. The topics are chosen as the most important for students specialized in the branch of wood/furniture industry. The system of practical exercises support the learning of new vocabulary - it provides better understanding of the basic meaning of unfamiliar words and using them in appropriate contexts. My teaching experience has proved that acquiring the vocabulary connected with the wood/furniture terminology is not so effort-demanding, the new words can be fairly easily acquired by providing practical exercises.

I suppose this thesis might become useful for both teachers and students/apprentices, and above all, it will not be only the academic work written for bachelor studies at university. Moreover, the practical part might be used not only at the vocational/technical secondary schools, but also by the students at technical universities, e.g. Mendel University of Agriculture and Forestry in Brno, Faculty of Forestry and Wood Technology.

Résumé
The bachelor thesis “ESP Vocabulary Teaching at the Vocational Secondary School of Furniture Industry” deals with teaching of special terminology at the technical secondary school. The theoretical part is devoted to the brief summary of general principles of vocabulary teaching and emphasizes the specific factors in teaching ESP vocabulary. The stress is put predominantly on the practical part and appendix, which is actually a small textbook containing a set of topics chosen intentionally as the most important in the wood/furniture industry. The main goal is to demonstrate vocabulary teaching in the broad variety of practical exercises with the vivid visual presentation to remember the new words more actively. Teaching material has become a part of the school educational programme at the vocational secondary school.

Resumé
Bakalářská práce “Výuka odborné slovní zásoby na střední odborné škole nábytkářské” se zabývá výukou odborné terminologie na technické střední škole. Teoretická část se věnuje stručnému přehledu základních principů při výuce slovní zásoby a zdůrazňuje specifické faktory výuky odborné slovní zásoby. Důraz je položen zejména na praktickou část a přílohu, která je vlastně malou učebnicí, obsahující témata z nejdůležitějších oblastí dřevařského a nábytkářského průmyslu. Hlavním cílem je demonstrovat výuku slovní zásoby formou široké škály praktických cvičení s názornou vizuální prezentací k aktivnějšímu zapamatování nových slov. Výukový materiál se již stal součástí školního vzdělávacího programu na střední odborné škole.

Bibliography


Lesson 6
ESP Lesson Plan in Indonesia

LESSON PLAN

Subject : Mathematics
Grade/Semester : X/1
Time : 2 x 45
Standard Competence : To solve the problem in exponent, root and logarithm forms
Basic Competence : To use the root, exponent, and logarithm rule in solving problem
Aspects : Conceptual understanding, strategies and reasoning, Problem solving and communication
Indicators : 1. To change negative integer exponent into positive integer exponent.
2. To do algebra operation of exponent and root forms

I OBJECTIVES
1. Students are able to change negative integer exponent into positive integer exponent.
2. Students are able to do algebra operation of exponent and root forms

II LEARNING CONTENTS
Exponent and Root Forms

III METHODS
1. Contextual Teaching Learning
2. Discussion
3. Cooperative learning
4. Assignment 10

IV LEARNING ACTIVITIES
A. Opening Activities
- Students and teacher discussing the contextual mathematics related to integer exponent and root
B. Main Activities
- The teacher lets the students to formulate contextual mathematics into mathematical form of exponent and root
- Students discuss how to change the exponent from the positive to negative under teacher guidance.
- Students operate exponential numbers.
- Students do the exercise with the teacher guides them.
C. Closing Activities
   - The students make the summary.
   - The teacher gives the assignments.

V LEARNING RESOURCES
Resource : Student book

VI ASSESSMENT
A. Technique :
   - written
   - giving quiz
   - group assignments
   - individual assignments
B. When : After all operation learned
Lesson Plans

Step 1.
Songs & Games to learn the English

Step 2.
Put the English to use in real projects!

Needless to say it takes quite a bit of time to get to step 2. But keep it in the back of your mind as we start with ....

A few words about step 1 ...

- The aim of Genki English is to get the kids able to say * anything they want to say * in English, in as short a period of time as possible. We do that using the themes below.
- The themes were chosen by researching hundreds and hundreds of kids and finding out what *they* want to say. (But the curriculum is also now used to teach many adults as they find the course much more fun than traditional textbooks.)
- If you are teaching in a normal elementary or private English school then I would recommend using these lessons as the main base of your course.
- If you have a set textbook that you can't change, then use the lessons below as a "spice" to liven up your classes.
- The lessons are presented in a thought out way that allows for plenty of review and a balance between topics that are very easy and those that may present a bit of a challenge. However the curriculum is mostly non-linear in format, so please feel free to mix and match, and change the order as much as you like. All classes are different and it is very important to mold the curriculum to the children's interests and abilities, not the other way round.
- The songs are the reason this programme has become so successful. They allow you to teach a theme very quickly (as you have a solid goal) and the students can then use the song to review everyday, even if you are not present. e.g. at home, on the lunchtime broadcasts, morning assembly or cleaning time.
- Reviewing of the material is very important. Review the previous lessons at the beginning of each new lesson by using the previous song. Plus I always leave room for lessons that are purely for review.
- Each lessons consists of one English question and several answers to the question. Questions, rather than statements, are what children most usually want to communicate. The quantity of material allows a full theme to be taught, with a bit of practice, in one 45 minute lesson.
- Each lesson should be broken down into the following sections:
  - 1. Warm up/Review (3-5 minutes)
  - 2. Introduction of new English (15-20 minutes), including teaching of the song. Use this 3 step approach to keep kids interest and energy levels high.
- a) introduce new vocab
- b) teach song a cappella with the "Mini Lesson"
- c) sing together with the music,
  - 3. Practice of new material (15-20 minutes)
  - (See the "planning a fun 45 minute lesson" page for more details)
  - And of course all the lessons are designed to be lots of fun!

So to start off, pick a couple of the lessons below, give them a read and try them in your class!

**Easy, easy lessons**

<table>
<thead>
<tr>
<th>Title</th>
<th>Target English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genki Disco Warm Up</td>
<td>stand up, sit down, clap, cheer etc.</td>
</tr>
<tr>
<td>Rock, Paper, Scissors</td>
<td>The game of &quot;Janken&quot; in English, getting the kids used to English and having fun. In Japan a very effective first lesson. For other countries, go straight to &quot;What's your name?&quot;</td>
</tr>
<tr>
<td>What's your name?</td>
<td>What's your name? My name is ...... Nice to meet up. + eye contact!</td>
</tr>
<tr>
<td>How are you?</td>
<td>How are you? I'm .. hungry, tired, cold, sad, happy, great, good, OK.</td>
</tr>
<tr>
<td>I'm a superhero! I can....</td>
<td>I can jump, run, hide, cook, stretch, climb, swim, fly</td>
</tr>
<tr>
<td>Left and right</td>
<td>Left, right, forward, back, stop, stand up, sit down, spin, jump</td>
</tr>
<tr>
<td>Numbers 1 to 12</td>
<td>1,2,3,4,5,6,7,8,9,10,11,12</td>
</tr>
<tr>
<td>How old are you?</td>
<td>I'm ... (years old). 1,2,3,4,5,6,7,8,9,10,11,12 (including 1 to 12 makes the step to teaching the time easier)</td>
</tr>
<tr>
<td>Weather</td>
<td>What's the weather like? / How's the weather? It's..... rainy, cloudy, windy, snowy, sunny, fine, hot, a beautiful day.</td>
</tr>
</tbody>
</table>
Once you have the hang of those, you can try the ....

Linking together lessons

<table>
<thead>
<tr>
<th>Title</th>
<th>Target English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you like food?</td>
<td>Do you like.....? I like..... + kids favourite foods</td>
</tr>
<tr>
<td>Do you like animals?</td>
<td>Same English as above with animals.</td>
</tr>
<tr>
<td>I like animals</td>
<td>I like snails, kangaroos, bears, ducks, camels, spiders, giraffes, rhinos,</td>
</tr>
<tr>
<td></td>
<td>hippos, penguins, dinosaurs, bees.</td>
</tr>
<tr>
<td>I like vegetables</td>
<td>I like onions, peas, carrots, beans, mushrooms, potatoes, pumpkin, tomatoes.</td>
</tr>
</tbody>
</table>
| Do you have any pets?| "Do you have ....?", "I have a ...."
|                     | hamster, rabbit, turtle, goldfish, lion, lizard, horse, gorilla                 |
| Animal Voices       | I have a ... dog, cat, bird, mouse, chicken, sheep, cow, pig, elephant,       |
|                     | monkey, snake, tiger + the sounds they make.                                   |
| Baby Monkey Family  | Who's this?                                                                    |
|                     | This is my ... brother, sister, dad, mum (mom), grandma                       |
Do you have any brothers or sisters?
I have 1,2,3,4 brothers.
I have 1,2,3,4 sisters.
No

"What can you see?", "I can see a ...
whale, squid, seahorse, jellyfish, crab, dolphin, shark, starfish

head, shoulders, knees, toes, eyes, ears, mouth nose

Parts of the face: "Put on the ..."); "Draw a ....
nose, ears, mouth, eyes, eyebrows, cheeks, hair, tongue.

Doctor, doctor, my .... head, arm, leg, stomach, hand, foot, back, tooth .... hurts

A touch higher level

<table>
<thead>
<tr>
<th>Title</th>
<th>Target English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baby Monkey's Winter Clothes</td>
<td>Put on, take off your hat, scarf, coat, boots</td>
</tr>
<tr>
<td>Baby Monkey's Summer Clothes</td>
<td>Don't forget your ... plus hat, t-shirt, shoes, shorts, bucket, spade, fishing rod, shades, sunscreen</td>
</tr>
<tr>
<td>Treasure Adventure</td>
<td>Phonics &quot;ure&quot; sound + there's a pirate, hat, parrot, map, ship, island, shark + presentations</td>
</tr>
<tr>
<td><strong>How many ... do you have?</strong></td>
<td>How many .... do you have?</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>$</strong></td>
<td>How much?</td>
</tr>
<tr>
<td><strong>20</strong></td>
<td>How much is that...? I'll take it! Thank you, goodbye</td>
</tr>
<tr>
<td><strong>Numbers 13 to 20</strong></td>
<td>13, 14, 15, 16, 17, 18, 19, 20,</td>
</tr>
<tr>
<td><strong>Shapes!</strong></td>
<td>Triangle, circle, diamond, oval, rectangle, heart, square, star</td>
</tr>
<tr>
<td><strong>Fruit Market</strong></td>
<td>What's this? What's that? Apple, orange, pineapple, banana, lemon, cherry, strawberry, watermelon, peach, grape, pear, kiwi fruit,</td>
</tr>
<tr>
<td><strong>Can you speak....?</strong></td>
<td>Can you speak English, French, Chinese etc.</td>
</tr>
<tr>
<td><strong>Come on, Come on!</strong></td>
<td>kick, pass, shoot, save, catch, throw, head, score.</td>
</tr>
<tr>
<td><strong>Can you kick?</strong></td>
<td>Can I play? Can you ... kick, pass, shoot, save, catch, throw, head, score?</td>
</tr>
<tr>
<td><strong>I can do it!</strong></td>
<td>Confidence building! Can you do it? I can do it! I can play the .... + musical instruments</td>
</tr>
<tr>
<td><strong>Where are you from?</strong></td>
<td>Where are you from? I'm from..... America, Australia, Britain ( and constituent countries), China, Canada, Korea, New Zealand, Japan + any other countries that are relevant to the children's lives.</td>
</tr>
<tr>
<td><strong>Where do you live?</strong></td>
<td>&quot;Where do you live?&quot;, &quot;I live near the....&quot; forest, river, bridge, farm, hospital, station, castle, supermarket.</td>
</tr>
<tr>
<td><strong>How do you say ?</strong></td>
<td>How do you say ... in English? Review theme</td>
</tr>
<tr>
<td>Title</td>
<td>Target English</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>What time is it, Mr Wolf?</td>
<td>What time is it? it's 1...12 o'clock.</td>
</tr>
<tr>
<td>What time is it? 2</td>
<td>It's 1:05, 2:10, 3:15 etc,</td>
</tr>
<tr>
<td>How did you get here?</td>
<td>I came here by... aeroplane, car, train, rocket, helicopter, boat, bus, mountain bike</td>
</tr>
<tr>
<td>What's your favourite colour?</td>
<td>red, blue, green, yellow, black, white, pink, orange, purple, gold, silver, bronze</td>
</tr>
<tr>
<td>What's your favourite flavour?</td>
<td>I like ... ice cream flavours.</td>
</tr>
</tbody>
</table>

More things kids like to ask

<table>
<thead>
<tr>
<th>Title</th>
<th>Target English</th>
</tr>
</thead>
<tbody>
<tr>
<td>What sports do you play?</td>
<td>I play.... tennis, soccer, basketball, volleyball, table tennis, badminton, rugby, baseball</td>
</tr>
<tr>
<td>When is your birthday?</td>
<td>January, February, march etc. When is your birthday?</td>
</tr>
<tr>
<td>How did you get here?</td>
<td>I came here by... aeroplane, car, train, rocket, helicopter, boat, bus, mountain bike</td>
</tr>
<tr>
<td>What's your favourite colour?</td>
<td>red, blue, green, yellow, black, white, pink, orange, purple, gold, silver, bronze</td>
</tr>
<tr>
<td>What's your favourite flavour?</td>
<td>I like ... ice cream flavours.</td>
</tr>
<tr>
<td>What's your favourite subject?</td>
<td>I like math, art, science, P.E., music, English, social studies</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>What's your favourite ... ?</td>
<td>What's your favourite ... ? movie, sport, cartoon, video game, pet, food, comic book, TV show.</td>
</tr>
</tbody>
</table>

### Describing and ordering

<table>
<thead>
<tr>
<th>Title</th>
<th>Target English</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Mountain" /> Where are you going?</td>
<td>Where are you going? I'm going to .... + mountain, pool, sea, beach, school, shops, park, home + other words that are relevant to the children</td>
</tr>
<tr>
<td><img src="image" alt="Dance" /> Eat! Drink! Dance!</td>
<td>Basic commands used in the following songs.</td>
</tr>
<tr>
<td><img src="image" alt="Book" /> What are you doing?</td>
<td>What are you doing? + I'm... eating, drinking, reading, sleeping, singing, dancing, cooking, fishing</td>
</tr>
<tr>
<td><img src="image" alt="Card" /> What do you want to do?</td>
<td>I want to .... + verbs above</td>
</tr>
<tr>
<td><img src="image" alt="Superhero" /> What do you want to be?</td>
<td>I want to be a ....</td>
</tr>
<tr>
<td><img src="image" alt="Chef" /> What do you do?</td>
<td>What do you do? I'm a ... pilot, chef, farmer, teacher, doctor, student, fire fighter, police officer, carpenter, singer, dentist</td>
</tr>
<tr>
<td>Image</td>
<td>Text</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>I, you, he, she, we are happy</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Making questions from the words in the how are you song?</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Is it... big, small, a fruit, an animal, heavy, light, red, green</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>I have a question!</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>More questions</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>Is it good, bad, slow, fast, expensive, cheap, scary, cute?</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td>It's not bad, it's good!</td>
</tr>
<tr>
<td><img src="image8.png" alt="Image" /></td>
<td>I'm thirsty!</td>
</tr>
<tr>
<td><img src="image9.png" alt="Image" /></td>
<td>I'm thirsty. Would you like a drink? Yes, please! I'd like an orange juice, a glass of milk, a cola, a lemonade, a cup of tea, a hot chocolate, a milkshake.</td>
</tr>
<tr>
<td><img src="image10.png" alt="Image" /></td>
<td>What would you like for breakfast?</td>
</tr>
<tr>
<td><img src="image11.png" alt="Image" /></td>
<td>I'd like some bacon, ham, eggs, bread, cereal, pancakes, fish, salad.</td>
</tr>
<tr>
<td><img src="image12.png" alt="Image" /></td>
<td>Bigger</td>
</tr>
<tr>
<td><img src="image13.png" alt="Image" /></td>
<td>bigger, smaller, slower, faster, cheaper, &quot;Is this OK?&quot;</td>
</tr>
<tr>
<td><img src="image14.png" alt="Image" /></td>
<td>Where's the...?</td>
</tr>
<tr>
<td><img src="image15.png" alt="Image" /></td>
<td>Where's the... toilet, phone, TV, teachers' room, computer, piano, CD player? Over there!</td>
</tr>
</tbody>
</table>
### Days of the week
- Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, today

### When?
- This year, last year, next year, next month etc., Next week etc., today, yesterday, tomorrow.

### More lessons + special events

<table>
<thead>
<tr>
<th>Title</th>
<th>Target English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creepy Crawlies</td>
<td>What's that? What's this? It's a cockroach, beetle, caterpillar, butterfly, ant, worm, dragonfly, mosquito</td>
</tr>
<tr>
<td>Where is Mr Monkey?</td>
<td>Where is ...? He's near, next to, in front of, behind, under, on, in</td>
</tr>
<tr>
<td>Where is Baby Monkey?</td>
<td>Is he in the kitchen, living room, bathroom, bedroom, dining room, garage, attic, garden.</td>
</tr>
<tr>
<td>Look at me!</td>
<td>Look at me, him, her etc.</td>
</tr>
<tr>
<td>What do you think of ... ?</td>
<td>What do you think of ...? I think it's/he's/she's good, great, cool, excellent.</td>
</tr>
<tr>
<td>Ordering Food</td>
<td>I'd like some apples, bananas, cheese, doughnuts, eggs, fish, grapes, hot dogs, ice cream, jelly, ketchup, lettuce, mayonnaise. Try the &quot;Do you like food?&quot; theme before this one!</td>
</tr>
<tr>
<td>Easter Egg Hunt</td>
<td>&quot;Look, in the ....&quot; trees, grass, pond, flowers, bath, bed, fridge</td>
</tr>
<tr>
<td>Happy Halloween</td>
<td>Happy Halloween! &quot;I'm scared&quot;, &quot;Look, there's a ...&quot;, wizard, witch, ghost, mummy, bat, broom, wand, vampire</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Apple Bobbing</td>
<td>Apple Bobbing rules for Halloween.</td>
</tr>
<tr>
<td>Trick or Treat</td>
<td>Trick or Treat + Scarecrow Soup, Skeleton Steak, Monster Mash, Pirate Pancakes, Black Cat Cookies, Pumpkin Pie, Spider Spaghetti, Ice Cream Eyes!</td>
</tr>
<tr>
<td>Let's build a house</td>
<td>windows, door, walls, roof, garden etc.</td>
</tr>
<tr>
<td>Let's build a gingerbread house</td>
<td>windows, door, walls, roof, garden etc.</td>
</tr>
<tr>
<td>Let's build a snowman</td>
<td>Body parts body, head, nose, neck, eyes, arms, buttons, mouth</td>
</tr>
<tr>
<td>Genki Christmas</td>
<td>snowman, Santa Claus, reindeer, Christmas tree, Christmas stocking, candy cane, presents, Christmas card.</td>
</tr>
<tr>
<td>What colour is Christmas?</td>
<td>red, white, green, gold, blue, purple, orange, silver</td>
</tr>
<tr>
<td>&quot;What would you like for Christmas?&quot; &quot;I'd like a ...&quot;</td>
<td>robot, doll, bag, video game, bear, phone, rainbow, bone</td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>What would you like for Xmas?</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image of Christmas presents" /></td>
<td></td>
</tr>
<tr>
<td>Where are the Christmas presents?</td>
<td>Next to, under, on etc.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image of Happy New Year" /></td>
<td></td>
</tr>
<tr>
<td>Happy New Year!</td>
<td>Happy New year!</td>
</tr>
</tbody>
</table>
Lesson 8
ESP for Middle School Students
Narrative Writing Lesson

Narrative Writing Lesson Plan

Sixth Grade

Objectives:
1. Students will learn the stages of process writing.
2. Students will learn to work cooperatively.
3. Students will learn to critique.
4. Students will incorporate software tools to enhance writing and problem solving skills

Materials: Paper, Pencil, Computers (Inspiration, MS Word, MS Power Point) and Clipboards
Suggested Teaching Time: No longer than thirty minutes at a time. Ongoing until all students are finished.

Prewriting Activities:
I. Beanbag Toss Ice Breaker/Warm Up Exercise (Brain Storming)
A. Students throw one beanbag to someone else in the class saying only their name before they toss the bag to.
B. Second time around they need to say what is their favorite food.
C. Third time through the students say their favorite activity before throwing the bag.
Drafting: (Create rough draft webs or outlines on Inspiration software)

II. Inny-outy Circles (two groups of 14 students)
A. Students on the outside of the circle face the students on the inside of the circle.
B. When you say "begin", the students have thirty seconds to establish eye contact with their partner, shake their hand, greet each other, introduce themselves (names only). Rotate after 30 seconds.
C. Repeat "B" until everyone has introduced themselves to people in the circle.
D. Send students to seats. Have the students in paragraph form write the introduction they just gave. Use webs to create rough draft paragraphs from their webs or outlines.

III. Inny-OUTY Circle Part II
A. Repeat directions in part II doing the same things but adding the students favorites, dislikes, great memories, family, what they are afraid of, etc.
B. Add these interests to their story webs or outlines.
C. Export outlines in Inspiration to MS Word.
D. Return to seats to draft. Add more paragraphs to the writing they already have.
IV. Critiquing (practice on a teacher creation first)
   A. Start with a compliment.
   B. Use "I" statements (I think, I like, I wonder, I believe)
   C. Direct criticism to the piece of work, not the person creating the piece.
   D. Be positive, no put-downs.
   E. Be Specific (No "I like it." statements) (Correction: I like _____ because___)

V. Pair Share
   A. Students read rough drafts to each person in their group. Listeners practice the rules of
      critiquing. (Must make at least one suggestion for improvement)
   B. Rotate until all students have heard each other’s stories. Make notes on rough draft when
      others give suggestions for improvement.

Revising: (MS Word)

VI. Students work independently to make necessary changes. (homework activity)

VII. Edit and Revise until students are satisfied.

VIII. Cooperative Group Share/Critique  
Publishing: (Export from Word to Power Point)

IX. Independent type/write (family technology center activity)

X. Present Power Point Presentations

Strategies
1. Beanbag Toss
2. Inny-Outy Circle
3. Pair Share/Small Group Share

Developmental Needs:
Cognitive Characteristics
My plan will cater to nearly all of the cognitive characteristics of an adolescent. Students enjoy
learning interesting facts about others. My plan encourages a lot of student interaction. This may
be problematic for the shy child, but the skills they practice in the inny-outy circles and small
groups will be less threatening than other larger group activities.

Emotional Characteristics:
Students will learn about themselves by being helped by others. They will be supported and
encouraged in their writing and speaking. It should be a positive experience where they learn a
lot about themselves and others.

Physical Characteristics:
The students will be allowed to move around the room quite a bit. They will only spend small
amounts of time in their desks.

Social Characteristics:
This lesson will hopefully be motivating to the students as well as informative. Students who despise writing will feel less threatened by not having the teacher leading their paper in the direction he or she wants. The students will have a sense of ownership and pride in their product when they compare their first draft to their last draft.

Character Development:
The focus on the lesson will be on helping each other and complimenting each other in a cooperative setting.

Developmentally Responsive Rationale:
My plan is developmentally responsive because it meets a variety of adolescent needs. If the lesson goes as planned, all students will go away feeling non-threatened, proud, happy and accepted. The movement from one activity to the next will help with the physical characteristics of adolescents. Academically, I will be covering a lot in this lesson and the concepts covered will not only help them in my class, they will take several skills learned with them as they advance in school.
Lesson 9
ESP for Middle School Students
Native American Legends, Folk Stories and Tales

Reading/Writing, level: Middle

7th Grade Reading Class Projects

Some possible subjects for your tale:
How would indigenous native people describe
A thunderstorm?
A hurricane?
A tornado?
Why a turtle has a shell?
Why a porcupine has quills?
Why an animal or insect is a particular color?
Night and day?
An eclipse?
Fire?
Ice?
Snow?
Mountains?
Earthquakes?
Why a bear hibernates during the winter?
The creation of men and women?
Earth's creation?
The sun?
The moon?
A dream?
A nightmare?
Birth?
Death?
Disease?
A human characteristic?
A plant characteristic?

Format of the Indian Tale:
1. The tale must be a "story within a story". For example: A grandfather is telling the story to his grandson to explain some of the topics above. You must include dialogue in your story. For example: The grandson asked the grandfather, "Grandfather, where did the porcupine get his quills?" The grandfather answered, "Grandson, it happened a long time ago."
2. The tale must be at least 100 words or more long.
3. You must use black ink or type your tale.
4. You must have a rough draft, edited draft and a polished draft to hand in when required.

Sample Indian Folktales
Native American Tales!
Native American Stories are passed down from generations and many have to do with why things are or how they were created. There are many stories about how everything came to be and I am going to share with you a few stories that were told. I hope you enjoy them as much as I do.

The Bluebird and Coyote

*Pima tribe

The bluebird was once a very ugly color. But there was a lake where no river flowed in or out, and the bird bathed in it four times every morning for four mornings. Every morning it sang: There's a blue water, it lies there. I went in. I am all blue.

On the fourth morning it shed all its feather and it came out of the lake in its bare skin, but on the fifth morning it came out with blue feathers. All this while Coyote had been watching the bird. He wanted to jump in and get it, but he was afraid of the water. Oh the fifth morning he said, "How is it that all your ugly color has come out and you are now blue and gay and beautiful? You're more beautiful than anything that flies in the air. I want to be blue too." Coyote was at this time a bright green. "I went in four times," said the bluebird, and taught Coyote the song. So Coyote went in four times, and the fifth time he came out as blue as the little bird.

That made him feel very proud. As he walked along, he looked on every side to see if anyone was noticing how fine and blue he was. He looked to see if his shadow was blue too, and so he was not watching the road. Presently he ran into a stump so hard that it threw him down in the dirt, and he became dust colored all over. And to this day all coyotes are the color of dirt.

Why Mole Lives Underground

*Cherokee

A man was in love with a woman who disliked him and wanted nothing to do with him. He tried every way to win her favor, but with no success. As last he grew discouraged and made himself sick thinking about it.

Mole came along, and finding the man so low in his mind, ask what the trouble was. The man told him the whole story, and when he had finished, the Mole said: "I can help. Not only will she like you, but she'll come to you of her own free will."

That night burrowing underground to the place where the girl was in bed asleep, Mole took out her heart. He came back by the same way and gave the heart to the discouraged lover, who couldn't see it even when it was in his hand. "There," said Mole. "Swallow it, and she will be so drawn to you that she has to come."

The man swallowed the heart, and when the girl woke up she somehow thought of him at once. She felt a strange desire to be with him, to go to him that minute. She couldn't understand it,
because she had always disliked him, now the feelings grew so strong she was compelled to find the man and tell him that she loved him and wanted to be his wife. And so they were married. All the those who knew them both were surprised and wondered how it had come about. When they found out it was the work of Mole, whom they had always thought too insignificant to notice, they were jealous and threatened to kill him. That's why Mole hid under the ground and still doesn't dare to come up.
Lesson 10
Cabinet Making

Cabinet making is the practice of using various woodworking skills to create cabinets, shelving and furniture. Cabinet making involves techniques such as creating appropriate joints, dados, bevels, chamfers and shelving systems, the use of finishing tools such as routers to create decorative edgings, and so on.[1]

Old German cabinet.

Before the advent of industrial design, cabinet makers were responsible for the conception and the production of any piece of furniture. In the last half of the 18th century, cabinet makers such
as Thomas Sheraton, Thomas Chippendale and George Hepplewhite also published books of furniture forms. These books were compendiums of their designs and those of other cabinet makers. With the industrial revolution and the application of steam power to cabinet making tools, mass production techniques were gradually applied to nearly all aspects of cabinet making, and the traditional cabinet shop ceased to be the main source of furniture, domestic or commercial. In parallel to this evolution there came a growing demand by the rising middle class in most industrialised countries for finely made furniture. This eventually resulted in a growth in the total number of traditional cabinet makers.

Before 1650, fine furniture was a rarity in Western Europe and North America. Generally, people did not need it and for the most part could not afford it. They made do with simple but serviceable pieces.

The arts and craft movement which started in the United Kingdom in the middle of the 19th century spurred a market for traditional cabinet making, and other craft goods. It rapidly spread to the United States and to all the countries in the British Empire. This movement exemplified the reaction to the eclectic historicism of the Victorian era and to the 'soulless' machine-made production which was starting to become widespread.

After World War II woodworking became a popular hobby among the middle classes. The more serious and skilled amateurs in this field now turn out pieces of furniture which rival the work of professional cabinet makers. Together, their work now represents but a small percentage of furniture production in any industrial country, but their numbers are vastly greater than those of their counterparts in the 18th century and before.

Schools of design

Scandinavian
This style of design is typified by clean horizontal and vertical lines. Compared to other designs there is a distinct absence of ornamentation. While Scandinavian design is easy to identify, it is much more about the materials than the design.

French Provincial
This style of design is very ornate. French Provincial objects are often stained or painted leaving the wood concealed. Corners and bevels are often painted with a gold leaf or given some other kind of gilding. Flat surfaces often have artwork such as landscapes painted directly on them. The wood used in provincial varied, but was often originally Beech. [2]

Early American Colonial
This design emphasises both form and materials. Early American chairs and tables are often constructed with turned spindles and chair backs often constructed with steaming to bend the wood. Wood choices tend to be deciduous hardwoods with a particular emphasis on the wood of edible or fruit bearing trees such as Cherry or Walnut. [3]

Rustic
The rustic style of design sometimes called "log furniture" or "log cabin" is the least finished. Design is very utilitarian yet seeks to feature not only the materials used but in as much as possible, how they existed in their natural state. For example a table top may have what is considered a "live edge" that allows you to see the original contours of the tree that it came from. It also often uses whole logs or branches including the bark of the tree. Rustic furniture is often made from Pine, Cedar, Fir and Spruce. Also see Adirondack Architecture.

Mission Style
Mission Design is characterized by straight, thick horizontal and vertical lines and flat panels. The most common material used in Mission furniture is oak. For early mission cabinetmakers, the material of choice was white oak, which they often darkened through a process known as "fuming".\[4\] Hardware is often visible on the outside of the pieces and made of black iron. It is a style that became popular in the early 20th century; popularized by designers in the Arts and Crafts and Art Nouveau movements.

Oriental
Also known as Asian Design, this style of furniture is characterized by its use of materials such as bamboo and rattan. Red is a frequent color choice along with landscape art and Chinese or other Asian language characters on the pieces.

Shaker
Shaker furniture design is focused on function and symmetry. Because it is so influenced by an egalitarian religious community and tradition it is rooted in the needs of the community versus the creative expression of the designer. Like Early American and Colonial design, Shaker craftsmen often chose fruit woods for their designs. Pieces reflect a very efficient use of materials.

Types of cabinetry

A frameless cabinet

A cabinet with a face frame

The fundamental focus of the cabinet maker is the production of cabinetry. Although the cabinet maker may also be required to produce items that would not be recognized as cabinets, the same skills and techniques apply.
A cabinet may be built-in or free-standing. A built-in cabinet is usually custom made for a particular situation and it is fixed into position, on a floor, against a wall, or framed in an opening. For example modern kitchens are examples of built-in cabinetry. Free-standing cabinets are more commonly available as off-the-shelf items and can be moved from place to place if required. Cabinets may be wall hung or suspended from the ceiling.
Cabinets may have a face frame or may be of frameless construction (also known as European or euro-style). Face frame cabinets have a supporting frame attached to the front of the cabinet box.
This face frame is usually 1½ inches in width. Mounted on the cabinet frame is the cabinet door. In contrast, frameless cabinets have no such supporting front face frame, the cabinet doors attach directly to the sides of the cabinet box. The box’s side, bottom and top panels are usually 5/8 to 3/4 inches thick, with the door overlaying all but 1/16 inch of the box edge.[5] Modern cabinetry is often frameless and is typically constructed from man-made sheet materials, such as plywood, chipboard or MDF. The visible surfaces of these materials are usually clad in a timber veneer, plastic laminate, or other material. They may also be painted.

Cabinet components

Bases

Enclosed cabinet base with a kick space

Scrolled base

Bracket feet

Cabinets which rest on the floor are supported by some sort of a base. This base could be a fully enclosed base (i.e. a plinth), a scrolled based, bracket feet or it could be a set of legs.

Adjustable feet

A relatively new type of adjustable leg has been adopted from the European cabinet system which offers several advantages. First off, in making base cabinets for kitchens, the cabinet sides would be cut to 34½ inches, yielding four cabinet side blanks per 4 foot by 8 foot sheet. Using the adjustable feet, the side blanks are cut to 30 inches, thus yielding six cabinet side per sheet. These feet can be secured to the bottom of the cabinet by having the leg base screwed onto the cabinet bottom. They can also be attached by means of a hole drilled through the cabinet bottom at specific locations. The legs are then attached to the cabinet bottom by a slotted, hollow machine screw. The height of the cabinet can be adjusted from inside the cabinet, simply by inserting a screwdriver into the slot and turning to raise or lower the cabinet. The holes in the cabinet are capped by plastic inserts, making the appearance more acceptable for residential cabinets. Using these feet, the cabinets need not be shimmmed or scribed to the floor for leveling. The toe kick board is attached to the cabinet by means of a clip, which is either screwed onto the
back side of the kick board, or a barbed plastic clip is inserted into a saw kerf, also made on the back side of the kick board. This toe kick board can be made to fit each base cabinet, or made to fit a run of cabinets. [6]  
Kitchen cabinets, or any cabinet generally at which a person may stand, usually have a fully enclosed base in which the front edge has been set back 75 mm or so to provide room for toes, known as the kick space. A scrolled base is similar to the fully enclosed base but it has areas of the base material removed, often with a decorative pattern, leaving feet on which the cabinet stands. Bracket feet are separate feet, usually attached in each corner and occasionally for larger pieces in the middle of the cabinet.
Compartments
A cabinet usually has at least one compartment. Compartments may be open, as in open shelving: they may be enclosed by one or more doors; or they may contain one or more drawers. Some cabinets contain secret compartments, access to which is generally not obvious. Modern cabinets employ many more complicated means (relative to a simple shelf) of making browsing lower cabinets more efficient and comfortable. Such means include (names may be heavily colloquialised):
- The lazy susan, a shelf which rotates around a central axis, allowing items stored at the back of the cabinet to be brought to the front by rotating the shelf. These are usually used in corner cabinets, which are larger and deeper and have a greater "dead space" at the back than other cabinets.
Cabinet insert hardware
Another recent development in cabinet inserts or hardware, often taking the place of the lazy susan, particularly in base cabinets is the blind corner cabinet pull out unit. These units pull out and turn, making the attached shelving unit slide into the open area of the cabinet door, thus making the shelves accessible to the user. These units vary greatly in design and cost, but are very practical in making what was once dead space usable. Other insert hardware is continuously being designed and includes such items as mixer shelves that pull out of a base cabinet and spring into a locked position at counter height. This hardware makes lifting these somewhat heavy mixers and mechanically helping with the process of positioning the unit for use. More and more components are being designed to enable specialized hardware to be used in standard cabinet carcasses.
Tops
Most cabinets incorporate a top of some sort. In many cases, the top is merely to enclose the compartments within and serves no other purpose - as in a wall hung cupboard for example. In other cabinets, the top also serves as a work surface - a kitchen countertop for example.
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Lesson 11
The Hydrologic Cycle
Water's journey through time

Anne E. Egger, Ph.D.

Key Concepts

- The hydrologic cycle is the set of processes by which water moves through different reservoirs on earth.
- Studies indicating that the amount of water on earth is constant helped lead to the concepts of the hydrologic cycle.
- The hydrologic cycle influences climate and weather patterns and thus changes as global climate changes.
- The hydrologic cycle is driven primarily by energy from the sun.

As recently as 12,000 years ago, you could walk from Alaska to Siberia without having to do a wetsuit. At that time, glaciers and ice sheets covered North America down to the Great Lakes and Cape Cod, though coastal areas generally remained ice-free. These extensive ice sheets occurred at a time when sea level was very low, exposing land where water now fills the Bering Strait. In fact, throughout earth’s history, times of extensive glaciers correlate with low sea level and times when only minor ice sheets exist (like today) correlate with high sea levels. These correlations are due to the fact that the amount of water on the earth is constant, and is divided up between reservoirs in the oceans, in the air, and on the land. In addition, earth’s water is constantly cycling through these reservoirs in a process called the hydrologic cycle. Both of these facts together lead us to the conclusion that more water stored in ice sheets means less water in the oceans.

Earth is the only planet in our solar system with extensive liquid water—other planets are too hot or too cold, too big or too small. Though Mars appears to have had water on its surface in the past and may still harbor liquid water deep below its surface, our oceans, rivers, and rain are unique as far as we know, and they are life-sustaining. Understanding the processes and reservoirs of the hydrologic cycle is fundamental to dealing with many issues, including pollution and global climate change.

As early as 800 BCE, Homer wrote in the Iliad of the ocean “from whose deeps every river and sea, every spring and well flows,” suggesting the interconnectedness of all of the earth’s water. It wasn’t until the 17th century, however, that the poetic notion of a finite water cycle was demonstrated in the Seine River basin by two French physicists, Edmé Mariotte and Pierre Perrault, who independently determined that the snowpack in the river’s headwaters was more than sufficient to account for the river’s discharge. These two studies marked the beginning of hydrology, the science of water, and also the hydrologic cycle.

Hydrologic cycle

The hydrologic cycle can be thought of as a series of reservoirs, or storage areas, and a set of processes that cause water to move between those reservoirs. The largest reservoir by far is the oceans, which hold about 97% of the earth’s water. The remaining 3% is the freshwater so important to our survival, but about 78% of that is stored in ice in Antarctica and Greenland. About 21% of freshwater on the earth is groundwater, stored in sediments and rocks below the
surface of the earth. The freshwater that we see in rivers, streams, lakes, and rain is less than 1% of the freshwater on the earth and less than 0.1% of all the water on the earth.

Figure 1: The hydrologic cycle. Arrows indicate volume of water that moves from reservoir to reservoir.

The ocean and the atmosphere
Water moves constantly between these reservoirs through the processes of evaporation, condensation and precipitation, surface and underground flow, and others. The driving force for the hydrologic cycle is the sun, which provides the energy needed for evaporation just as the flame of a gas stove provides the energy necessary to boil water and create steam. Water changes from a liquid state to a gaseous state as it evaporates from the oceans, lakes, streams, and soil (see our Water: Properties and Behavior module for a further explanation). Because the oceans are the largest reservoir of liquid water, that is where most evaporation occurs. The amount of water vapor in the air varies widely over time and from place to place; we feel these variations as humidity.

The presence of water vapor in the atmosphere is one of the things that makes earth livable for us. In 1859, Irish naturalist John Tyndall began studying the thermal properties of the gasses in the earth’s atmosphere. He found that some gasses, like carbon dioxide (CO₂) and water vapor, trap heat in the atmosphere (a property commonly called the greenhouse effect), while other gasses like nitrogen (N₂) and argon (Ar) allow heat to escape to space. The presence of water vapor in the atmosphere helps keep surface air temperatures on the earth range from about -40° C to 55° C. Temperatures on planets without water vapor in the atmosphere, like Mars, stay as low as -100° C.

Once water vapor is in the air, it circulates within the atmosphere. When an air package rises and cools, the water vapor condenses back to liquid water around particulates like dust, called condensation nuclei. Initially these condensation droplets are much smaller than raindrops and are not heavy enough to fall as precipitation. These tiny water droplets create clouds. As the droplets continue to circulate within the clouds, they collide and form larger droplets, which eventually become heavy enough to fall as rain, snow, or hail. Though the amount of precipitation varies widely over the surface of the earth, evaporation and precipitation are globally balanced. In other words, if evaporation increases, precipitation also increases; rising global temperature is one factor that can cause a worldwide increase in evaporation from the world’s oceans, leading to higher overall precipitation.
Since oceans cover around 70% of the earth’s surface, most precipitation falls right back into the ocean and the cycle begins again. A portion of precipitation falls on land, however, and it takes one of several paths through the hydrologic cycle. Some water is taken up by soil and plants, some runs off into streams and lakes, some percolates into the groundwater reservoir, some falls on glaciers and accumulates as glacial ice.

The hydrologic cycle on land
The amount of precipitation that soaks into the soil depends on several factors: the amount and intensity of the precipitation, the prior condition of the soil, the slope of the landscape, and the presence of vegetation. These factors can interact in sometimes surprising ways - a very intense rainfall onto very dry soil, typical of the desert southwest, often will not soak into the ground at all, creating flash-flood conditions. Water that does soak in becomes available to plants. Plants take up water through their root systems; the water is then pulled up through all parts of the plant and evaporates from the surface of the leaves, a process called transpiration. Water that soaks into the soil can also continue to percolate down through the soil profile into groundwater reservoirs, called aquifers. Aquifers are often mistakenly visualized as great underground lakes; in reality, groundwater fills the pore spaces within sediments or rocks.

Water that doesn’t soak into the soil collects and moves across the surface as run-off, eventually flowing into streams and rivers to get back to the ocean. Precipitation that falls as snow in glacial regions takes a somewhat different journey through the water cycle, accumulating at the head of glaciers and causing them to flow slowly down valleys.

Humans and the hydrologic cycle
The properties of water and the hydrologic cycle are largely responsible for the circulation patterns we see in the atmosphere and the oceans on the earth. Atmospheric and oceanic
circulation are two of the major factors that determine the distribution of climatic zones over the earth. Changes in the cycle or circulation can result in major climatic shifts. For example, if average global temperatures continue to increase as they have in recent decades, water that is currently trapped as ice in the polar ice sheets will melt, causing a rise in sea level. Water also expands as it gets warmer, further exacerbating sea level rise. Many heavily populated coastal areas like New Orleans, Miami, and Bangladesh will be inundated by a mere 1 meter increase in sea level. Additionally, the acceleration of the hydrologic cycle (higher temperatures mean more evaporation and thus more precipitation) may result in more severe weather and extreme conditions. Some scientists believe that the increased frequency and severity of El Niño events in recent decades is due to the acceleration of the hydrologic cycle induced by global warming.

![Figure 3: Areas in red would be flooded with a 1.5 m rise in sea level; areas in blue would be flooded by a 3.5 m rise in sea level. Image has been modified from the original from the U.S. Environmental Protection Agency (EPA).](image)

Even more immediately, the finitude of earth’s fresh water resources is becoming more and more apparent. Groundwater can take thousands or millions of years to recharge naturally, and we are using these resources far faster than they are being replenished. The water table in the Ogallala Aquifer, which underlies 175,000 square miles of the US from Texas to South Dakota, is dropping at a rate of 10-60 cm per year due to extraction to irrigate the nation’s bread basket. Surface waters around the world are largely contaminated by human and animal waste, most noticeably in countries like India and China, where untreated rivers provide the drinking and washing water for nearly 2 billion people. Although legislation like the Clean Water Act in the US and water conservation practices such as the use of low-flow toilets and showerheads in parts of the world has begun to address these issues, the problems will only grow as world population increases. Every spring and well, every river and sea does indeed flow from the same source, and changes affect not just one river or lake, but the whole hydrologic cycle.
Lesson 12
Life Cycle of Frogs

Frogs lay their eggs in water or wet places. A floating clump of eggs is called frog spawn. The large and slippery mass of eggs are too big to be eaten. This is nature's way of protecting them. But, the smaller clumps of eggs will be eaten by the creatures living near or in the pond. The egg begins as a single cell. Several thousand are sometimes laid at once. It becomes surrounded by a jellylike covering, which protects the egg. The female may or may not stay with the eggs to take care of the young after she has laid them. The egg slowly develops. But, only a few develop into adults. Ducks, fish, insects, and other water creatures eat the eggs.

The Cell Splits

The single cell in the egg eventually splits into two. These two split making four cells, and so on. Eventually, there are many cells in the egg.

The Embryo

The mass of cells in the egg come to form an embryo. Organs and gills begin to form, and in the meantime, the embryo lives off of its internal yolk. This supplies it with nutrients for 21 days.

Then . . . The Tadpole

After its 21 day development period, the embryo leaves its jelly shell, and attaches itself to a weed in the water. This quickly becomes a tadpole, a baby frog. The tadpoles grow until they are big enough to break free into the water. This can take from 3 days to 3 weeks, depending on what kind of frog they will become. They eat very small plants that stick to larger plants in the water. These tiny plants are called algae. The tadpole has a long tail, and lives in the water. It is extremely vulnerable, and must rely on its camouflage to protect it. The tadpole has a long tail, and lives in the water. It is extremely vulnerable, and must rely on its camouflage to protect it. The tadpoles also face danger by being eaten by other water animals. Sometimes the pond dries up. As a result the tadpoles die.

The Tadpole Begins To Change

After about five weeks, the tadpole begins to change. It starts to grow hind legs, which are soon followed with forelegs. Behind their heads bulges appear where their front legs are growing. Their tails become smaller. Lungs begin to develop, preparing the frog for its life on land. Now and then, they wiggle to the surface to breathe in air. The tail becomes larger and makes it now possible for the tadpole to swim around and catch food. They eat plants and decaying animal matter. Some tadpoles eat frogs eggs and other tadpoles. Almost There . . .

Over time, the tadpole becomes even more froglike. They have shed their skin and lips. Its
mouth widens, and it loses its horny jaws. The tail becomes much smaller, and the legs grow. The lungs are almost functioning at this point.

The Frog

Eleven weeks after the egg was laid, a fully developed frog with lungs, legs, and no tail emerges from the water. This frog will live mostly on land, with occasional swims. The tiny frogs begin to eat insects and worms. Eventually, it will find a mate. The way this is done varies depending on the species. The female lays the eggs, the male fertilizes them, and the whole process begins again.
Lesson 13
Landscape

Landscape art is a term that covers the depiction of natural scenery such as mountains, valleys, trees, rivers, and forests, and especially art where the main subject is a wide view, with its elements arranged into a coherent composition. In other works landscape backgrounds for figures can still form an important part of the work. Sky is almost always included in the view, and weather is often an element of the composition. Detailed landscapes as a distinct subject are not found in all artistic traditions, and develop when there is already a sophisticated tradition of representing other subjects. The two main traditions spring from Western painting and Chinese art, going back well over a thousand years in both cases. Landscape photography has been very important since the 19th century, and is covered by its own article.
The word landscape is from the Dutch, landschap originally meaning a patch of cultivated ground, and then an image. The word entered the English language at the start of the 17th century, purely as a term for works of art; it was not used to describe real vistas before 1725.[1] If the primary purpose of a picture is to depict an actual, specific place, especially including buildings prominently, it is called a topographical view.[2] Such views, extremely common as prints, are often seen as inferior to fine art landscapes, although the distinction is not always meaningful.[3]

History

Landscape with scene from the Odyssey, Rome, c. 60-40 BCE.

Zhan Ziqian, Strolling About in Spring, a very early Chinese landscape, c. 600
Shen Zhou, *Poet on a Mountain* c. 1500. Painting and poem by Shen Zhou: "White clouds encircle the mountain waist like a sash./Stone steps mount high into the void where the narrow path leads far./Alone, leaning on my rustic staff I gaze idly into the distance./My longing for the notes of a flute is answered in the murmurings of the gorge."[4]

Hand G, *Bas-de-page of the Baptism of Christ*, Turin-Milan Hours, Flanders c. 1425


Pieter Brueghel the Elder, *The Harvesters*, 1565: Peace and agriculture in a pre-Romantic ideal landscape, without sublime terrors

Jan van Goyen, *Dune landscape*, c. 1630-1635, an example of the "tonal" style in Dutch Golden Age painting.

Frederic Edwin Church, *The Heart of the Andes*, 1859. Church was part of the American Hudson River School.

The earliest forms of art around the world depict little that could really be called landscape, although ground-lines and sometimes indications of mountains, trees or other natural features are included. The earliest "pure landscapes" with no human figures are frescos from Minoan Greece of around 1500 BCE.\(^5\) Hunting scenes, especially those set in the enclosed vista of the reed beds of the Nile Delta from Ancient Egypt, can give a strong sense of place, but the emphasis is on individual plant forms and human and animal figures rather than the overall landscape setting.

For a coherent depiction of a whole landscape, some rough system of perspective, or scaling for distance, is needed, and this seems from literary evidence to have first been developed in Ancient Greece in the Hellenistic period, although no large-scale examples survive. More ancient Roman landscapes survive, from the 1st century BCE onwards, especially frescos of landscapes decorating rooms that have been preserved at Pompeii, Herculaneum and elsewhere, and mosaics.\(^6\)

The Chinese ink painting tradition of shan shui ("mountain-water"), or "pure" landscape, in which the only sign of human life is usually a sage, or a glimpse of his hut, uses sophisticated landscape backgrounds to figure subjects, and landscape art of this period retains a classic and much-imitated status within the Chinese tradition.

Both the Roman and Chinese traditions typically show grand panoramas of imaginary landscapes, generally backed with a range of spectacular mountains – in China often with waterfalls and in Rome often including sea, lakes or rivers. These were frequently used, as in the example illustrated, to bridge the gap between a foreground scene with figures and a distant panoramic vista, a persistent problem for landscape artists. The Chinese style generally showed only a distant view, or used dead ground or mist to avoid that difficulty.

A major contrast between landscape painting in the West and East Asia has been that while in the West until the 19th century it occupied a low position in the accepted hierarchy of genres, in East Asia the classic Chinese mountain-water ink painting was traditionally the most prestigious form of visual art. Aesthetic theories in both regions gave the highest status to the works seen to require the most imagination from the artist. In the West this was history painting, but in East Asia it was the imaginary landscape, whose most famous practitioners were, at least in theory,
amateur literati, including several Emperors of both China and Japan. They were often also poets whose lines and images illustrated each other. However in the West, history painting came to require an extensive landscape background where appropriate, so the theory did not entirely work against the development of landscape painting – for several centuries landscapes were regularly promoted to the status of history painting by the addition of small figures to make a narrative scene, typically religious or mythological.

Western tradition
In early Western medieval art interest in landscape disappears almost entirely, kept alive only in copies of Late Antique works such as the Utrecht Psalter; the last reworking of this source, in an early Gothic version, reduces the previously extensive landscapes to a few trees filling gaps in the composition, with no sense of overall space. A revival in interest in nature initially mainly manifested itself in depictions of small gardens such as the Hortus Conclusus or those in millefleur tapestries. The frescos of figures at work or play in front of a background of dense trees in the Palace of the Popes, Avignon are probably a unique survival of what was a common subject. Several frescos of gardens have survived from Roman houses like the Villa of Livia.

During the 14th century Giotto di Bondone and his followers began to acknowledge nature in their work, increasingly introducing elements of the landscape as the background setting for the action of the figures in their paintings. Early in the 15th century, landscape painting was established as a genre in Europe, as a setting for human activity, often expressed in a religious subject, such as the themes of the Rest on the Flight into Egypt, the Journey of the Magi, or Saint Jerome in the Desert. Luxury illuminated manuscripts were very important in the early development of landscape, especially series of the Labours of the Months such as those in the Très Riches Heures du Duc de Berry, which conventionally showed small genre figures in increasingly large landscape settings. A particular advance is shown in the less well-known Turin-Milan Hours, now largely destroyed by fire, whose developments were reflected in Early Netherlandish painting for the rest of the century. The artist known as "Hand G", probably one of the Van Eyck brothers, was especially successful in reproducing effects of light and in a natural-seeming progression from the foreground to the distant view. This was something other artists were to find difficult for a century or more, often solving the problem by showing a landscape background from over the top of a parapet or window-sill, as if from a considerable height. Landscape backgrounds for various types of painting became increasingly prominent and skilful during the century. The period around the end of the 15th century saw pure landscape drawings and watercolours from Leonardo da Vinci, Albrecht Dürer, Fra Bartolomeo and others, but pure landscape subjects in painting and printmaking, still small, were first produced by Albrecht Altdorfer and others of the German Danube School in the early 16th century. At the same time Joachim Patinir in the Netherlands developed a style of panoramic landscapes with a high aerial viewpoint that remained influential for a century, being used, for example, by Pieter Brueghel the Elder. The Italian development of a thorough system of graphical perspective was now known all over Europe, which allowed large and complex views to be painted very effectively. Landscapes were idealized, mostly reflecting a pastoral ideal drawn from classical poetry which was first fully expressed by Giorgione and the young Titian, and remained associated above all with hilly wooded Italian landscape, which was depicted by artists from Northern Europe who had never visited Italy, just as plain-dwelling literati in China and Japan painted vertiginous mountains. Though often young artists were encouraged to visit Italy to experience Italian light, many Northern European artists could make their living selling Italianate landscapes without...
ever bothering to make the trip. Indeed, certain styles were so popular that they became formulas that could be copied again and again.\[15\]

The popularity of exotic landscape scenes can be seen in the success of the painter Frans Post, who spent the rest of his life painting Brazilian landscapes after a trip there in 1636-1644. Other painters who never crossed the Alps could make money selling Rhineland landscapes, and still others for constructing fantasy scenes for a particular commission such as Cornelis de Man's view of Smeerenburg in 1639.

Compositional formulae using elements like the repoussoir were evolved which remain influential in modern photography and painting, notably by Poussin\[16\] and Claude Lorrain, both French artists living in 17th century Rome and painting largely classical subject-matter, or Biblical scenes set in the same landscapes. Unlike their Dutch contemporaries, Italian and French landscape artists still most often wanted to keep their classification within the hierarchy of genres as history painting by including small figures to represent a scene from classical mythology or the Bible. Salvator Rosa gave picturesque excitement to his landscapes by showing wilder Southern Italian country, often populated by banditti.\[17\]

The Dutch Golden Age painting of the 17th century saw the dramatic growth of landscape painting, in which many artists specialized, and the development of extremely subtle realist techniques for depicting light and weather. There are different styles and periods, and sub-genres of marine and animal painting, as well as a distinct style of Italianate landscape. Most Dutch landscapes were relatively small, but landscapes in Flemish Baroque painting, still usually peopled, were often very large, above all in the series of works that Peter Paul Rubens painted for his own houses.

The Dutch tended to make smaller paintings for smaller houses. Some Dutch landscape specialties named in period inventories include the Batalje, or battle-scene;\[18\] the Maneschijntje,\[19\] or moonlight scene; the Bosjes,\[20\] or woodland scene; the Boederijtje, or farm scene,\[21\] and the Dorpje or village scene.\[22\] Though not named at the time as a specific genre, the popularity of Roman ruins inspired many Dutch landscape painters of the period to paint the ruins of their own region, such as monasteries and churches ruined after the Beeldenstorm.\[23\]

The popularity of landscapes in the Netherlands was in part a reflection of the virtual disappearance of religious painting in a Calvinist society, and the decline of religious painting in the 18th and 19th centuries all over Europe combined with Romanticism to give landscapes a much greater and more prestigious place in 19th-century art than they had assumed before.

In England, landscapes had initially been mostly backgrounds to portraits, typically suggesting the parks or estates of a landowner, though mostly painted in London by an artist who had never visited his sitter's rolling acres; the English tradition was founded by Anthony van Dyck and other mostly Flemish artists working in England. In the 18th century, watercolour painting, mostly of landscapes, became an English speciality, with both a buoyant market for professional works, and a large number of amateur painters, many following the popular systems found in the books of Alexander Cozens and others. By the beginning of the 19th century the English artists with the highest modern reputations were mostly dedicated landscapists, showing the wide range of Romantic interpretations of the English landscape found in the works of John Constable, J.M.W. Turner and Samuel Palmer. However all these had difficulty establishing themselves in the contemporary art market, which still preferred history paintings and portraits. The German Caspar David Friedrich had a distinctive style, influenced by his Danish training, where a distinct national style, drawing on the Dutch 17th-century example, had developed. French painters were slower to develop landscape painting, but from about the 1830s Jean-Baptiste-Camille Corot and
other painters in the Barbizon School established a French landscape tradition that would become the most influential in Europe for a century, with the Impressionists and Post-Impressionists for the first time making landscape painting the main source of general stylistic innovation across all types of painting.

In Europe, as John Ruskin said, and Sir Kenneth Clark confirmed, landscape painting was the "chief artistic creation of the nineteenth century", and "the dominant art", with the result that in the following period people were "apt to assume that the appreciation of natural beauty and the painting of landscape is a normal and enduring part of our spiritual activity". In Clark's analysis, underlying European ways to convert the complexity of landscape to an idea were four fundamental approaches: the acceptance of descriptive symbols, a curiosity about the facts of nature, the creation of fantasy to allay deep-rooted fears of nature, and the belief in a Golden Age of harmony and order, which might be retrieved.

The nationalism of the new United Provinces had been a factor in the popularity of Dutch 17th-century landscape painting and in the 19th century, as other nations attempted to develop distinctive national schools of painting, the attempt to express the special nature of the landscape of the homeland became a general tendency. In Russia, as in America, the gigantic size of paintings was itself a nationalist statement.

In the United States, the Hudson River School, prominent in the middle to late 19th century, is probably the best-known native development in landscape art. These painters created works of mammoth scale that attempted to capture the epic scope of the landscapes that inspired them. The work of Thomas Cole, the school's generally acknowledged founder, has much in common with the philosophical ideals of European landscape paintings — a kind of secular faith in the spiritual benefits to be gained from the contemplation of natural beauty. Some of the later Hudson River School artists, such as Albert Bierstadt, created less comforting works that placed a greater emphasis (with a great deal of Romantic exaggeration) on the raw, even terrifying power of nature. The best examples of Canadian landscape art can be found in the works of the Group of Seven, prominent in the 1920s.

Although certainly less dominant in the period after World War I, many significant artists still painted landscapes in the wide variety of styles exemplified by Neil Welliver, Alex Katz, Milton Avery, Peter Doig, Andrew Wyeth, David Hockney and Sidney Nolan.

Gallery


Camille Pissarro, *Lordship Lane Station*, c. 1870. Impressionism


References

- Virtual Vault, an online exhibition of Canadian historical art at Library and Archives Canada

Further reading

Lesson 14
Economics

Economics is the social science that analyzes the production, distribution, and consumption of goods and services. The term economics comes from the Ancient Greek οἰκονομία (oikonomía, "management of a household, administration") from ὠίκος (oikos, "house") + νόμος (nomos, "custom" or "law"), hence "rules of the house(hold)".[1] Current economic models emerged from the broader field of political economy in the late 19th century. A primary stimulus for the development of modern economics was the desire to use an empirical approach more akin to the physical sciences.[2]

Economics aims to explain how economies work and how economic agents interact. Economic analysis is applied throughout society, in business, finance and government, but also in crime,[3] education,[4] the family, health, law, politics, religion,[5] social institutions, war,[6] and science.[7] At the turn of the 21st century, the expanding domain of economics in the social sciences has been described as economic imperialism.[8]

Common distinctions are drawn between various dimensions of economics. The primary textbook distinction is between microeconomics, which examines the behavior of basic elements in the economy, including individual markets and agents (such as consumers and firms, buyers and sellers), and macroeconomics, which addresses issues affecting an entire economy, including unemployment, inflation, economic growth, and monetary and fiscal policy. Other distinctions include: between positive economics (describing "what is") and normative economics (advocating "what ought to be"); between economic theory and applied economics; between mainstream economics (more "orthodox" dealing with the "rationality-individualism-equilibrium nexus") and heterodox economics (more "radical" dealing with the "institutions-history-social structure nexus");[9] and between rational and behavioral economics.

Microeconomics

Economists study trade, production and consumption decisions, such as those that occur in a traditional marketplace.
In Virtual Markets, buyer and seller are not present and trade via intermediaries and electronic information. Pictured: São Paulo Stock Exchange.

Microeconomics
Markets
Microeconomics, like macroeconomics, is a fundamental method for analyzing the economy as a system. It treats households and firms interacting through individual markets as irreducible elements of the economy, given scarcity and government regulation. A market might be for a product, say fresh corn, or the services of a factor of production, say bricklaying. The theory considers aggregates of quantity demanded by buyers and quantity supplied by sellers at each possible price per unit. It weaves these together to describe how the market may reach equilibrium as to price and quantity or respond to market changes over time.

Such analysis includes the theory of supply and demand. It also examines market structures, such as perfect competition and monopoly for implications as to behavior and economic efficiency. Analysis of change in a single market often proceeds from the simplifying assumption that relations in other markets remain unchanged, that is, partial-equilibrium analysis. General-equilibrium theory allows for changes in different markets and aggregates across all markets, including their movements and interactions toward equilibrium.\[10\]

Production, cost, and efficiency
Main articles: Production theory basics, Opportunity cost, Economic efficiency, and Production-possibility frontier
In microeconomics, production is the conversion of inputs into outputs. It is an economic process that uses inputs to create a commodity for exchange or direct use. Production is a flow and thus a rate of output per period of time. Distinctions include such production alternatives as for consumption (food, haircuts, etc.) vs. investment goods (new tractors, buildings, roads, etc.), public goods (national defense, small-pox vaccinations, etc.) or private goods (new computers, bananas, etc.), and "guns" vs. "butter".

Opportunity cost refers to the economic cost of production: the value of the next best opportunity foregone. Choices must be made between desirable yet mutually exclusive actions. It has been described as expressing "the basic relationship between scarcity and choice."\[11\] The opportunity cost of an activity is an element in ensuring that scarce resources are used efficiently, such that the cost is weighed against the value of that activity in deciding on more or less of it. Opportunity costs are not restricted to monetary or financial costs but could be measured by the real cost of output forgone, leisure, or anything else that provides the alternative benefit (utility).\[12\]

Inputs used in the production process include such primary factors of production as labour services, capital (durable produced goods used in production, such as an existing factory), and land (including natural resources). Other inputs may include intermediate goods used in production of final goods, such as the steel in a new car.

Economic efficiency describes how well a system generates desired output with a given set of inputs and available technology. Efficiency is improved if more output is generated without changing inputs, or in other words, the amount of "waste" is reduced. A widely-accepted general standard is Pareto efficiency, which is reached when no further change can make someone better off without making someone else worse off.
The production-possibility frontier (PPF) is an expository figure for representing scarcity, cost, and efficiency. In the simplest case an economy can produce just two goods (say "guns" and "butter"). The PPF is a table or graph (as at the right) showing the different quantity combinations of the two goods producible with a given technology and total factor inputs, which limit feasible total output. Each point on the curve shows potential total output for the economy, which is the maximum feasible output of one good, given a feasible output quantity of the other good.

Scarcity is represented in the figure by people being willing but unable in the aggregate to consume beyond the PPF (such as at X) and by the negative slope of the curve. If production of one good increases along the curve, production of the other good decreases, an inverse relationship. This is because increasing output of one good requires transferring inputs to it from production of the other good, decreasing the latter. The slope of the curve at a point on it gives the trade-off between the two goods. It measures what an additional unit of one good costs in units forgone of the other good, an example of a real opportunity cost. Thus, if one more Gun costs 100 units of butter, the opportunity cost of one Gun is 100 Butter. Along the PPF, scarcity implies that choosing more of one good in the aggregate entails doing with less of the other good. Still, in a market economy, movement along the curve may indicate that the choice of the increased output is anticipated to be worth the cost to the agents.

By construction, each point on the curve shows productive efficiency in maximizing output for given total inputs. A point inside the curve (as at A), is feasible but represents production inefficiency (wasteful use of inputs), in that output of one or both goods could increase by moving in a northeast direction to a point on the curve. Examples cited of such inefficiency include high unemployment during a business-cyclerecession or economic organization of a country that discourages full use of resources. Being on the curve might still not fully satisfy allocative efficiency (also called Pareto efficiency) if it does not produce a mix of goods that consumers prefer over other points.

Much applied economics in public policy is concerned with determining how the efficiency of an economy can be improved. Recognizing the reality of scarcity and then figuring out how to organize society for the most efficient use of resources has been described as the "essence of economics," where the subject "makes its unique contribution."
Specialization

Specialization is considered key to economic efficiency based on theoretical and empirical considerations. Different individuals or nations may have different real opportunity costs of production, say from differences in stocks of human capital per worker or capital/labour ratios. According to theory, this may give a comparative advantage in production of goods that make more intensive use of the relatively more abundant, thus relatively cheaper, input. Even if one region has an absolute advantage as to the ratio of its outputs to inputs in every type of output, it may still specialize in the output in which it has a comparative advantage and thereby gain from trading with a region that lacks any absolute advantage but has a comparative advantage in producing something else.

It has been observed that a high volume of trade occurs among regions even with access to a similar technology and mix of factor inputs, including high-income countries. This has led to investigation of economies of scale and agglomeration to explain specialization in similar but differentiated product lines, to the overall benefit of respective trading parties or regions.\textsuperscript{[15]}

The general theory of specialization applies to trade among individuals, farms, manufacturers, service providers, and economies. Among each of these production systems, there may be a corresponding division of labour with different work groups specializing, or correspondingly different types of capital equipment and differentiated land uses.\textsuperscript{[16]}

An example that combines features above is a country that specializes in the production of high-tech knowledge products, as developed countries do, and trades with developing nations for goods produced in factories where labor is relatively cheap and plentiful, resulting in different in opportunity costs of production. More total output and utility thereby results from specializing in production and trading than if each country produced its own high-tech and low-tech products.

Theory and observation set out the conditions such that market prices of outputs and productive inputs select an allocation of factor inputs by comparative advantage, so that (relatively) low-cost inputs go to producing low-cost outputs. In the process, aggregate output may increase as a by-product or by design.\textsuperscript{[17]} Such specialization of production creates opportunities for gains from trade whereby resource owners benefit from trade in the sale of one type of output for other, more highly valued goods. A measure of gains from trade is the increased income levels that trade may facilitate.\textsuperscript{[18]}
The supply and demand model describes how prices vary as a result of a balance between product availability and demand. The graph depicts an increase (that is, right-shift) in demand from \( D_1 \) to \( D_2 \) along with the consequent increase in price and quantity required to reach a new equilibrium point on the supply curve (S).

Prices and quantities have been described as the most directly observable attributes of goods produced and exchanged in a market economy.\[^{19}\] The theory of supply and demand is an organizing principle for explaining how prices coordinate the amounts produced and consumed. In microeconomics, it applies to price and output determination for a market with perfect competition, which includes the condition of no buyers or sellers large enough to have price-setting power.

For a given market of a commodity, demand is the relation of the quantity that all buyers would be prepared to purchase at each unit price of the good. Demand is often represented by a table or a graph showing price and quantity demanded (as in the figure). Demand theory describes individual consumers as rationally choosing the most preferred quantity of each good, given income, prices, tastes, etc. A term for this is 'constrained utility maximization' (with income and wealth as the constraints on demand). Here, utility refers to the hypothesized relation of each individual consumer for ranking different commodity bundles as more or less preferred.

The law of demand states that, in general, price and quantity demanded in a given market are inversely related. That is, the higher the price of a product, the less of it people would be prepared to buy of it (other things unchanged). As the price of a commodity falls, consumers move toward it from relatively more expensive goods (the substitution effect). In addition, purchasing power from the price decline increases ability to buy (the income effect). Other factors can change demand; for example an increase in income will shift the demand curve for a normal good outward relative to the origin, as in the figure.

Supply is the relation between the price of a good and the quantity available for sale at that price. It may be represented as a table or graph relating price and quantity supplied. Producers, for example business firms, are hypothesized to be profit-maximizers, meaning that they attempt to produce and supply the amount of goods that will bring them the highest profit. Supply is typically represented as a directly-proportional relation between price and quantity supplied (other things unchanged). That is, the higher the price at which the good can be sold, the more of it producers will supply, as in the figure. The higher price makes it profitable to increase production. Just as on the demand side, the position of the supply can shift, say from a change in the price of a productive input or a technical improvement.

Market equilibrium occurs where quantity supplied equals quantity demanded, the intersection of the supply and demand curves in the figure above. At a price below equilibrium, there is a shortage of quantity supplied compared to quantity demanded. This is posited to bid the price up. At a price above equilibrium, there is a surplus of quantity supplied compared to quantity demanded. This pushes the price down. The model of supply and demand predicts that for given supply and demand curves, price and quantity will stabilize at the price that makes quantity supplied equal to quantity demanded. Similarly, demand-and-supply theory predicts a new price-quantity combination from a shift in demand (as to the figure), or in supply.

For a given quantity of a consumer good, the point on the demand curve indicates the value, or marginal utility, to consumers for that unit. It measures what the consumer would be prepared to pay for that unit.\[^{20}\] The corresponding point on the supply curve measures marginal cost, the increase in total cost to the supplier for the corresponding unit of the good. The price in
equilibrium is determined by supply and demand. In a perfectly competitive market, supply and demand equate marginal cost and marginal utility at equilibrium.\[21]\n
On the supply side of the market, some factors of production are described as (relatively) variable in the short run, which affects the cost of changing output levels. Their usage rates can be changed easily, such as electrical power, raw-material inputs, and over-time and temp work. Other inputs are relatively fixed, such as plant and equipment and key personnel. In the long run, all inputs may be adjusted by management. These distinctions translate to differences in the elasticity (responsiveness) of the supply curve in the short and long runs and corresponding differences in the price-quantity change from a shift on the supply or demand side of the market.

Marginalist theory, such as above, describes the consumers as attempting to reach most-preferred positions, subject to income and wealth constraints while producers attempt to maximize profits subject to their own constraints, including demand for goods produced, technology, and the price of inputs. For the consumer, that point comes where marginal utility of a good, net of price, reaches zero, leaving no net gain from further consumption increases. Analogously, the producer compares marginal revenue (identical to price for the perfect competitor) against the marginal cost of a good, with marginal profit the difference. At the point where marginal profit reaches zero, further increases in production of the good stop. For movement to market equilibrium and for changes in equilibrium, price and quantity also change 'at the margin': more-or-less of something, rather than necessarily all-or-nothing.

Other applications of demand and supply include the distribution of income among the factors of production, including labour and capital, through factor markets. In a competitive labour market for example the quantity of labour employed and the price of labour (the wage rate) depends on the demand for labour (from employers for production) and supply of labour (from potential workers). Labour economics examines the interaction of workers and employers through such markets to explain patterns and changes of wages and other labour income, labour mobility, and (un)employment, productivity through human capital, and related public-policy issues.\[22]\n
Demand-and-supply analysis is used to explain the behavior of perfectly competitive markets, but as a standard of comparison it can be extended to any type of market. It can also be generalized to explain variables across the economy, for example, total output (estimated as real GDP) and the general price level, as studied in macroeconomics.\[23]\n
Tracing the qualitative and quantitative effects of variables that change supply and demand, whether in the short or long run, is a standard exercise in applied economics. Economic theory may also specify conditions such that supply and demand through the market is an efficient mechanism for allocating resources.\[24]\n
Firms
Main articles: Theory of the firm, Industrial organization, Business economics, and Managerial economics

People frequently do not trade directly on markets. Instead, on the supply side, they may work in and produce through firms. The most obvious kinds of firms are corporations, partnerships and trusts. According to Ronald Coase people begin to organise their production in firms when the costs of doing business becomes lower than doing it on the market.\[25]\n
Firms combine labour and capital, and can achieve far greater economies of scale (when the average cost per unit declines as more units are produced) than individual market trading. In perfectly-competitive markets studied in the theory of supply and demand, there are many producers, none of which significantly influence price. Industrial organization generalizes from that special case to study the strategic behavior of firms that do have significant control of price. It considers the structure of such markets and their interactions. Common market structures
studied besides perfect competition include monopolistic competition, various forms of oligopoly, and monopoly.[26]

Managerial economics applies microeconomic analysis to specific decisions in business firms or other management units. It draws heavily from quantitative methods such as operations research and programming and from statistical methods such as regression analysis in the absence of certainty and perfect knowledge. A unifying theme is the attempt to optimize business decisions, including unit-cost minimization and profit maximization, given the firm's objectives and constraints imposed by technology and market conditions.[27]

Uncertainty and game theory
Main articles: Information economics, Game theory, and Financial economics
Uncertainty in economics is an unknown prospect of gain or loss, whether quantifiable as risk or not. Without it, household behavior would be unaffected by uncertain employment and income prospects, financial and capital markets would reduce to exchange of a single instrument in each market period, and there would be no communications industry. [28] Given its different forms, there are various ways of representing uncertainty and modelling economic agents' responses to it. [29]

Game theory is a branch of applied mathematics that considers strategic interactions between agents, one kind of uncertainty. It provides a mathematical foundation of industrial organization, discussed above, to model different types of firm behavior, for example in an oligopolistic industry (few sellers), but equally applicable to wage negotiations, bargaining, contract design, and any situation where individual agents are few enough to have perceptible effects on each other. As a method heavily used in behavioral economics, it postulates that agents choose strategies to maximize their payoffs, given the strategies of other agents with at least partially conflicting interests.[30][31] In this, it generalizes maximization approaches developed to analyze market actors such as in the supply and demand model and allows for incomplete information of actors. The field dates from the 1944 classic Theory of Games and Economic Behavior by John von Neumann and Oskar Morgenstern. It has significant applications seemingly outside of economics in such diverse subjects as formulation of nuclear strategies, ethics, political science, and evolutionary biology.[32]

Risk aversion may stimulate activity that in well-functioning markets smooths out risk and communicates information about risk, as in markets for insurance, commodity futures contracts, and financial instruments. Financial economics or simply finance describes the allocation of financial resources. It also analyzes the pricing of financial instruments, the financial structure of companies, the efficiency and fragility of financial markets, [33] financial crises, and related government policy or regulation.[34]

Some market organizations may give rise to inefficiencies associated with uncertainty. Based on George Akerlof's "Market for Lemons" article, the paradigm example is of a dodgy second-hand car market. Customers without knowledge of whether a car is a "lemon" depress its price below what a quality second-hand car would be. [35] Information asymmetry arises here, if the seller has more relevant information than the buyer but no incentive to disclose it. Related problems in insurance are adverse selection, such that those at most risk are most likely to insure (say reckless drivers), and moral hazard, such that insurance results in riskier behavior (say more reckless driving). Both problems may raise insurance costs and reduce efficiency in driving otherwise willing transactors from the market ("incomplete markets"). Moreover, attempting to reduce one problem, say adverse selection by mandating insurance, may add to another, say moral hazard. Information economics, which studies such problems, has relevance in subjects
such as insurance, contract law, mechanism design, monetary economics, and health care.\[^{36}\]

Applied subjects include market and legal remedies to spread or reduce risk, such as warranties, government-mandated partial insurance, restructuring or bankruptcy law, inspection, and regulation for quality and information disclosure.\[^{37}\][^30]\]

Market failure

Main articles: Market failure, Government failure, Information economics, Environmental economics, and Agricultural economics

Pollution can be a simple example of market failure. If costs of production are not borne by producers but are by the environment, accident victims or others, then prices are distorted. The term "market failure" encompasses several problems which may undermine standard economic assumptions. Although economists categorise market failures differently, the following categories emerge in the main texts.\[^{38}\]

Information asymmetries and incomplete markets may result in economic inefficiency but also a possibility of improving efficiency through market, legal, and regulatory remedies, as discussed above.

Natural monopoly, or the overlapping concepts of "practical" and "technical" monopoly, is an extreme case of failure of competition as a restraint on producers. The problem is described as one where the more of a product is made, the lower the unit costs are. This means it only makes economic sense to have one producer.

Public goods are goods which are undersupplied in a typical market. The defining features are that people can consume public goods without having to pay for them and that more than one person can consume the good at the same time.

Externalities occur where there are significant social costs or benefits from production or consumption that are not reflected in market prices. For example, air pollution may generate a negative externality, and education may generate a positive externality (less crime, etc.). Governments often tax and otherwise restrict the sale of goods that have negative externalities and subsidize or otherwise promote the purchase of goods that have positive externalities in an effort to correct the price distortions caused by these externalities.\[^{39}\] Elementary demand-and-supply theory predicts equilibrium but not the speed of adjustment for changes of equilibrium due to a shift in demand or supply.\[^{40}\]

In many areas, some form of price stickiness is postulated to account for quantities, rather than prices, adjusting in the short run to changes on the demand side or the supply side. This includes standard analysis of the business cycle in macroeconomics. Analysis often revolves around causes of such price stickiness and their implications for reaching a hypothesized long-run
equilibrium. Examples of such price stickiness in particular markets include wage rates in labour markets and posted prices in markets deviating from perfect competition.

Macroeconomic instability, addressed below, is a prime source of market failure, whereby a general loss of business confidence or external shock can grind production and distribution to a halt, undermining ordinary markets that are otherwise sound.

Environmental scientist sampling water

Some specialised fields of economics deal in market failure more than others. The economics of the public sector is one example, since where markets fail, some kind of regulatory or government programme is the remedy. Much environmental economics concerns externalities or "public bads".

Policy options include regulations that reflect cost-benefit analysis or market solutions that change incentives, such as emission fees or redefinition of property rights.\[41\]

Public sector

Main articles: Economics of the public sector and Public finance

Welfare economics

Public finance is the field of economics that deals with budgeting the revenues and expenditures of a public sector entity, usually government. The subject addresses such matters as tax incidence (who really pays a particular tax), cost-benefit analysis of government programs, effects on economic efficiency and income distribution of different kinds of spending and taxes, and fiscal politics. The latter, an aspect of public choice theory, models public-sector behavior analogously to microeconomics, involving interactions of self-interested voters, politicians, and bureaucrats.\[42\]

Much of economics is positive, seeking to describe and predict economic phenomena. Normative economics seeks to identify what economies ought to be like.

Welfare economics is a normative branch of economics that uses microeconomic techniques to simultaneously determine the allocative efficiency within an economy and the income distribution associated with it. It attempts to measure social welfare by examining the economic activities of the individuals that comprise society.\[43\]
Macroeconomics examines the economy as a whole to explain broad aggregates and their interactions "top down," that is, using a simplified form of general-equilibrium theory. Such aggregates include national income and output, the unemployment rate, and price inflation and subaggregates like total consumption and investment spending and their components. It also studies effects of monetary policy and fiscal policy.

In order to proceed with this examination it is necessary to envisage the macroeconomics system or (social organization of the greater community or nation) in a form that can be easily understood and appreciated. This is done by means of a macroeconomics model, which is a general expression of the system that is useful for purposes of discussion. The model can take a number of different forms including block diagrams, algebraic equations, mechanical analogy, electronic analogy, Leontief Matrix, etc. A suitable model for use in representing the macroeconomic system is shown in the illustration for a closed macroeconomics system without including "The Rest of The World". Money circulates around this model and goods, services, valuable legal documents etc. pass in return between the 6 entities or agents (also sometimes called sectors) that comprise the basic structure of the system. The system flows of money, goods etc., continuously try to self-adjust, in order to attain a condition of equilibrium.

Since at least the 1960s, macroeconomics has been characterized by further integration as to micro-based modeling of sectors, including rationality of players, efficient use of market information, and imperfect competition. This has addressed a long-standing concern about inconsistent developments of the same subject.

Macroeconomic analysis also considers factors affecting the long-term level and growth of national income. Such factors include capital accumulation, technological change and labor force growth.
Economic growth

*Growth economics* studies factors that explain economic growth – the increase in output per capita of a country over a long period of time. The same factors are used to explain differences in the level of output per capita between countries, in particular why some countries grow faster than others, and whether countries converge at the same rates of growth. Much-studied factors include the rate of investment, population growth, and technological change. These are represented in theoretical and empirical forms (as in the neoclassical and endogenous growth models) and in growth accounting. [48]

Business cycle

The economics of a depression were the spur for the creation of "macroeconomics" as a separate discipline field of study. During the Great Depression of the 1930s, John Maynard Keynes authored a book entitled *The General Theory of Employment, Interest and Money* outlining the key theories of Keynesian economics. Keynes contended that aggregate demand for goods might be insufficient during economic downturns, leading to unnecessarily high unemployment and losses of potential output. He therefore advocated active policy responses by the public sector, including monetary policy actions by the central bank and fiscal policy actions by the government to stabilize output over the business cycle. [49] Thus, a central conclusion of Keynesian economics is that, in some situations, no strong automatic mechanism moves output and employment towards full employment levels. John Hicks' IS/LM model has been the most influential interpretation of *The General Theory*. Over the years, the understanding of the business cycle has branched into various schools, related to or opposed to Keynesianism. The neoclassical synthesis refers to the reconciliation of Keynesian economics with neoclassical economics, stating that Keynesianism is correct in the short run, with the economy following neoclassical theory in the long run. The New classical school critiques the Keynesian view of the business cycle. It includes Friedman's permanent income hypothesis view on consumption, the "rational expectations revolution" [50] spearheaded by Robert Lucas, and real business cycle theory. In contrast, the New Keynesian school retains the rational expectations assumption, however it assumes a variety of market failures. In particular, New Keynesians assume prices and wages are "sticky", which means they do not adjust instantaneously to changes in economic conditions. Thus, the new classicals assume that prices and wages adjust automatically to attain full employment, whereas the new Keynesians see full employment as being automatically achieved.
only in the long run, and hence government and central-bank policies are needed because the "long run" may be very long.

Inflation and monetary policy

The Federal Reserve sets monetary policy as the central bank of the United States.

Inflation and Monetary policy
Money is a *means of final payment* for goods in most price system economies and the unit of account in which prices are typically stated. It includes currency held by the nonbank public and checkable deposits. It has been described as a social convention, like language, useful to one largely because it is useful to others.

As a medium of exchange, money facilitates trade. Its economic function can be contrasted with barter (non-monetary exchange). Given a diverse array of produced goods and specialized producers, barter may entail a hard-to-locate double coincidence of wants as to what is exchanged, say apples and a book. Money can reduce the transaction cost of exchange because of its ready acceptability. Then it is less costly for the seller to accept money in exchange, rather than what the buyer produces.[51]

At the level of an economy, theory and evidence are consistent with a positive relationship running from the total money supply to the nominal value of total output and to the general price level. For this reason, management of the money supply is a key aspect of monetary policy.[52]

Fiscal policy and regulation

Main articles: Fiscal policy, Government spending, Regulation, and National accounts
National accounting is a method for summarizing aggregate economic activity of a nation. The national accounts are double-entry accounting systems that provide detailed underlying measures of such information. These include the national income and product accounts (NIPA), which provide estimates for the money value of output and income per year or quarter. NIPA allows for tracking the performance of an economy and its components through business cycles or over longer periods. Price data may permit distinguishing nominal from real amounts, that is, correcting money totals for price changes over time.[53] The national accounts also include measurement of the capital stock, wealth of a nation, and international capital flows.[54]

International economics
International economics and Economic system
International trade studies determinants of goods-and-services flows across international boundaries. It also concerns the size and distribution of gains from trade. Policy applications include estimating the effects of changing tariff rates and trade quotas. International finance is a macroeconomic field which examines the flow of capital across international borders, and the
effects of these movements on exchange rates. Increased trade in goods, services and capital between countries is a major effect of contemporary globalization.\textsuperscript{[55]}

![World map showing GDP (PPP) per capita.](image)

The distinct field of \textit{development economics} examines economic aspects of the development process in relatively low-income countries focusing on structural change, poverty, and economic growth. Approaches in development economics frequently incorporate social and political factors.\textsuperscript{[56]}

Economic systems is the branch of economics that studies the methods and institutions by which societies determine the ownership, direction, and allocation of economic resources. An \textit{economic system} of a society is the unit of analysis.

Among contemporary systems at different ends of the organizational spectrum are socialist systems and capitalist systems, in which most production occurs in respectively state-run and private enterprises. In between are mixed economies. A common element is the interaction of economic and political influences, broadly described as political economy. \textit{Comparative economic systems} studies the relative performance and behavior of different economies or systems.\textsuperscript{[57]}

Practice

Main articles: Mathematical economics, Economic methodology, and Schools of economics

Contemporary economics uses mathematics. Economists draw on the tools of calculus, linear algebra, statistics, game theory, and computer science.\textsuperscript{[58]} Professional economists are expected to be familiar with these tools, while a minority specialize in econometrics and mathematical methods.

Theory

Mainstream economic theory relies upon a priori quantitative economic models, which employ a variety of concepts. Theory typically proceeds with an assumption of \textit{ceteris paribus}, which means holding constant explanatory variables other than the one under consideration. When creating theories, the objective is to find ones which are at least as simple in information requirements, more precise in predictions, and more fruitful in generating additional research than prior theories.\textsuperscript{[59]}

In microeconomics, principal concepts include supply and demand, marginalism, rational choice theory, opportunity cost, budget constraints, utility, and the theory of the firm.\textsuperscript{[60][61]} Early macroeconomic models focused on modeling the relationships between aggregate variables, but as the relationships appeared to change over time macroeconomists were pressured to base their models in microfoundations.
The aforementioned microeconomic concepts play a major part in macroeconomic models – for instance, in monetary theory, the quantity theory of money predicts that increases in the money supply increase inflation, and inflation is assumed to be influenced by rational expectations. In development economics, slower growth in developed nations has been sometimes predicted because of the declining marginal returns of investment and capital, and this has been observed in the Four Asian Tigers. Sometimes an economic hypothesis is only qualitative, not quantitative.\[62\]

Expositions of economic reasoning often use two-dimensional graphs to illustrate theoretical relationships. At a higher level of generality, Paul Samuelson's treatise *Foundations of Economic Analysis* (1947) used mathematical methods to represent the theory, particularly as to maximizing behavioral relations of agents reaching equilibrium. The book focused on examining the class of statements called *operationally meaningful theorems* in economics, which are theorems that can conceivably be refuted by empirical data.\[63\]

Empirical investigation
Econometrics and Experimental economics
Economic theories are frequently tested empirically, largely through the use of econometrics using economic data.\[64\] The controlled experiments common to the physical sciences are difficult and uncommon in economics,\[65\] and instead broad data is observationally studied; this type of testing is typically regarded as less rigorous than controlled experimentation, and the conclusions typically more tentative. However, the field of experimental economics is growing, and increasing use is being made of natural experiments.
Statistical methods such as regression analysis are common. Practitioners use such methods to estimate the size, economic significance, and statistical significance ("signal strength") of the hypothesized relation(s) and to adjust for noise from other variables. By such means, a hypothesis may gain acceptance, although in a probabilistic, rather than certain, sense. Acceptance is dependent upon the falsifiable hypothesis surviving tests. Use of commonly accepted methods need not produce a final conclusion or even a consensus on a particular question, given different tests, data sets, and prior beliefs.
Criticism based on professional standards and non-replicability of results serve as further checks against bias, errors, and over-generalization,\[61\][66] although much economic research has been accused of being non-replicable, and prestigious journals have been accused of not facilitating replication through the provision of the code and data.\[67\] Like theories, uses of test statistics are themselves open to critical analysis,\[68\] although critical commentary on papers in economics in prestigious journals such as the *American Economic Review* has declined precipitously in the past 40 years. This has been attributed to journals’ incentives to maximize citations in order to rank higher on the Social Science Citation Index (SSCI).\[69\]

In applied economics, input-output models employing linear programming methods are quite common. Large amounts of data are run through computer programs to analyze the impact of certain policies; IMPLAN is one well-known example.
Experimental economics has promoted the use of scientifically controlled experiments. This has reduced long-noted distinction of economics from natural sciences allowed direct tests of what were previously taken as axioms.\[70\] In some cases these have found that the axioms are not entirely correct; for example, the ultimatum game has revealed that people reject unequal offers.
In behavioral economics, psychologist Daniel Kahneman won the Nobel Prize in economics in 2002 for his and Amos Tversky’s empirical discovery of several cognitive biases and heuristics.
Similar empirical testing occurs in neuroeconomics. Another example is the assumption of narrowly selfish preferences versus a model that tests for selfish, altruistic, and cooperative preferences.\[^{71}\] These techniques have led some to argue that economics is a "genuine science."\[^{8}\]

Profession
Economist

The professionalization of economics, reflected in the growth of graduate programs on the subject, has been described as "the main change in economics since around 1900."\[^{72}\] Most major universities and many colleges have a major, school, or department in which academic degrees are awarded in the subject, whether in the liberal arts, business, or for professional study; see Master of Economics.

The Nobel Memorial Prize in Economic Sciences (commonly known as the Nobel Prize in Economics) is a prize awarded to economists each year for outstanding intellectual contributions in the field. In the private sector, professional economists are employed as consultants and in industry, including banking and finance. Economists also work for various government departments and agencies, for example, the national Treasury, Central Bank or Bureau of Statistics.

Related subjects
Philosophy of economics, Law and Economics, Political economy, and Natural resource economics

Economics is one social science among several and has fields bordering on other areas, including economic geography, economic history, public choice, energy economics, cultural economics, and institutional economics.

Law and economics, or economic analysis of law, is an approach to legal theory that applies methods of economics to law. It includes the use of economic concepts to explain the effects of legal rules, to assess which legal rules are economically efficient, and to predict what the legal rules will be.\[^{73}\] A seminal article by Ronald Coase published in 1961 suggested that well-defined property rights could overcome the problems of externalities.\[^{74}\]

Political economy is the interdisciplinary study that combines economics, law, and political science in explaining how political institutions, the political environment, and the economic system (capitalist, socialist, mixed) influence each other. It studies questions such as how monopoly, rent-seeking behavior, and externalities should impact government policy.\[^{75}\] Historians have employed political economy to explore the ways in the past that persons and groups with common economic interests have used politics to effect changes beneficial to their interests.\[^{76}\]

Energy economics is a broad scientific subject area which includes topics related to energy supply and energy demand. Georgescu-Roegen reintroduced the concept of entropy in relation to economics and energy from thermodynamics, as distinguished from what he viewed as the mechanistic foundation of neoclassical economics drawn from Newtonian physics. His work contributed significantly to thermoeconomics and to ecological economics. He also did foundational work which later developed into evolutionary economics.\[^{77}\]

The sociological subfield of economic sociology arose, primarily through the work of Émile Durkheim, Max Weber and Georg Simmel, as an approach to analysing the effects of economic phenomena in relation to the overarching social paradigm (i.e. modernity).\[^{78}\] Classic works include Max Weber's The Protestant Ethic and the Spirit of Capitalism (1905) and Georg
Simmel's *The Philosophy of Money* (1900). More recently, the works of Mark Granovetter, Peter Hedstrom and Richard Swedberg have been influential in this field.

History
Economic writings date from earlier Mesopotamian, Greek, Roman, Indian subcontinent, Chinese, Persian, and Arab civilizations. Notable writers from antiquity through to the 14th century include Aristotle, Xenophon, Chanakya (also known as Kautilya), Qin Shi Huang, Thomas Aquinas, and Ibn Khaldun. The works of Aristotle had a profound influence on Aquinas, who in turn influenced the late scholastics of the 14th to 17th centuries. Joseph Schumpeter described the latter as "coming nearer than any other group to being the 'founders' of scientific economics" as to monetary, interest, and value theory within a natural-law perspective.

Two groups, later called 'mercantilists' and 'physiocrats', more directly influenced the subsequent development of the subject. Both groups were associated with the rise of economic nationalism and modern capitalism in Europe. Mercantilism was an economic doctrine that flourished from the 16th to 18th century in a prolific pamphlet literature, whether of merchants or statesmen. It held that a nation's wealth depended on its accumulation of gold and silver. Nations without access to mines could obtain gold and silver from trade only by selling goods abroad and restricting imports other than of gold and silver. The doctrine called for importing cheap raw materials to be used in manufacturing goods, which could be exported, and for state regulation to impose protective tariffs on foreign manufactured goods and prohibit manufacturing in the colonies.

Physiocrats, a group of 18th century French thinkers and writers, developed the idea of the economy as a circular flow of income and output. Physiocrats believed that only agricultural production generated a clear surplus over cost, so that agriculture was the basis of all wealth. Thus, they opposed the mercantilist policy of promoting manufacturing and trade at the expense of agriculture, including import tariffs. Physiocrats advocated replacing administratively costly tax collections with a single tax on income of land owners. In reaction against copious mercantilist trade regulations, the physiocrats advocated a policy of laissez-faire, which called for minimal government intervention in the economy.

Modern economic analysis is customarily said to have begun with Adam Smith (1723–1790). Smith was harshly critical of the mercantilists but described the physiocratic system "with all its imperfections" as "perhaps the purest approximation to the truth that has yet been published" on the subject.

Classical political economy
Classical economics
Publication of Adam Smith's *The Wealth of Nations* in 1776, has been described as "the effective birth of economics as a separate discipline."[85] The book identified land, labor, and capital as the three factors of production and the major contributors to a nation's wealth.

Adam Smith wrote *The Wealth of Nations*

Smith discusses the benefits of the specialization by division of labour. His "theorem" that "the division of labor is limited by the extent of the market" has been described as the "core of a theory of the functions of firm and industry" and a "fundamental principle of economic organization."[86] To Smith has also been ascribed "the most important substantive proposition in all of economics" and foundation of resource-allocation theory – that, under competition, owners of resources (labor, land, and capital) will use them most profitably, resulting in an equal rate of return in equilibrium for all uses (adjusted for apparent differences arising from such factors as training and unemployment).[87]

In Smith's view, the ideal economy is a self-regulating market system that automatically satisfies the economic needs of the populace. He described the market mechanism as an "invisible hand" that leads all individuals, in pursuit of their own self-interests, to produce the greatest benefit for society as a whole. Smith incorporated some of the Physiocrats' ideas, including laissez-faire, into his own economic theories, but rejected the idea that only agriculture was productive.

In his famous invisible-hand analogy, Smith argued for the seemingly paradoxical notion that competitive markets tended to advance broader social interests, although driven by narrower self-interest. The general approach that Smith helped initiate was called political economy and later classical economics. It included such notables as Thomas Malthus, David Ricardo, and John Stuart Mill writing from about 1770 to 1870.[88] The period from 1815 to 1845 was one of the richest in the history of economic thought.[89]

While Adam Smith emphasized the production of income, David Ricardo focused on the distribution of income among landowners, workers, and capitalists. Ricardo saw an inherent conflict between landowners on the one hand and labor and capital on the other. He posited that the growth of population and capital, pressing against a fixed supply of land, pushes up rents and holds down wages and profits.
Malthus cautioned law makers on the effects of poverty reduction policies

Thomas Robert Malthus used the idea of diminishing returns to explain low living standards. Human population, he argued, tended to increase geometrically, outstripping the production of food, which increased arithmetically. The force of a rapidly growing population against a limited amount of land meant diminishing returns to labor. The result, he claimed, was chronically low wages, which prevented the standard of living for most of the population from rising above the subsistence level.

Malthus also questioned the automatic tendency of a market economy to produce full employment. He blamed unemployment upon the economy's tendency to limit its spending by saving too much, a theme that lay forgotten until John Maynard Keynes revived it in the 1930s.

Coming at the end of the Classical tradition, John Stuart Mill parted company with the earlier classical economists on the inevitability of the distribution of income produced by the market system. Mill pointed to a distinct difference between the market's two roles: allocation of resources and distribution of income. The market might be efficient in allocating resources but not in distributing income, he wrote, making it necessary for society to intervene.

Value theory was important in classical theory. Smith wrote that the "real price of every thing ... is the toil and trouble of acquiring it" as influenced by its scarcity. Smith maintained that, with rent and profit, other costs besides wages also enter the price of a commodity. Other classical economists presented variations on Smith, termed the 'labour theory of value'. Classical economics focused on the tendency of markets to move to long-run equilibrium.
Marxism

The Marxist school of economic thought comes from the work of German economist Karl Marx. Marxist (later, Marxian) economics descends from classical economics. It derives from the work of Karl Marx. The first volume of Marx's major work, *Das Kapital*, was published in German in 1867. In it, Marx focused on the labour theory of value and what he considered to be the exploitation of labour by capital. The labour theory of value held that the value of an exchanged commodity was determined by the labor that went into its production.

Neoclassical economics
A body of theory later termed 'neoclassical economics' or 'marginalism' formed from about 1870 to 1910. The term 'economics' was popularized by such neoclassical economists as Alfred Marshall as a concise synonym for 'economic science' and a substitute for the earlier, broader term 'political economy'. This corresponded to the influence on the subject of mathematical methods used in the natural sciences.

Neoclassical economics systematized supply and demand as joint determinants of price and quantity in market equilibrium, affecting both the allocation of output and the distribution of income. It dispensed with the labour theory of value inherited from classical economics in favor of a marginal utility theory of value on the demand side and a more general theory of costs on the supply side. In the 20th century, neoclassical theorists moved away from an earlier notion suggesting that total utility for a society could be measured in favor of ordinal utility, which hypothesizes merely behavior-based relations across persons. In microeconomics, neoclassical economics represents incentives and costs as playing a pervasive role in shaping decision making. An immediate example of this is the consumer theory of individual demand, which isolates how prices (as costs) and income affect quantity demanded. In macroeconomics it is reflected in an early and lasting neoclassical synthesis with Keynesian macroeconomics.
Neoclassical economics is occasionally referred as *orthodox economics* whether by its critics or sympathizers. Modern mainstream economics builds on neoclassical economics but with many refinements that either supplement or generalize earlier analysis, such as econometrics, game theory, analysis of market failure and imperfect competition, and the neoclassical model of economic growth for analyzing long-run variables affecting national income.

Keynesian economics

John Maynard Keynes (right), was a key theorist in economics.

Keynesian economics derives from John Maynard Keynes, in particular his book *The General Theory of Employment, Interest and Money* (1936), which ushered in contemporary macroeconomics as a distinct field. The book focused on determinants of national income in the short run when prices are relatively inflexible. Keynes attempted to explain in broad theoretical detail why high labour-market unemployment might not be self-correcting due to low "effective demand" and why even price flexibility and monetary policy might be unavailing. Such terms as "revolutionary" have been applied to the book in its impact on economic analysis.

Keynesian economics has two successors. Post-Keynesian economics also concentrates on macroeconomic rigidities and adjustment processes. Research on micro foundations for their models is represented as based on real-life practices rather than simple optimizing models. It is generally associated with the University of Cambridge and the work of Joan Robinson. New-Keynesian economics is also associated with developments in the Keynesian fashion. Within this group researchers tend to share with other economists the emphasis on models employing micro foundations and optimizing behavior but with a narrower focus on standard Keynesian themes such as price and wage rigidity. These are usually made to be endogenous features of the models, rather than simply assumed as in older Keynesian-style ones.
The Chicago School of economics is best known for its free market advocacy and monetarist ideas. According to Milton Friedman and monetarists, market economies are inherently stable if the money supply does not greatly expand or contract. Ben Bernanke, current Chairman of the Federal Reserve, is among the economists today generally accepting Friedman's analysis of the causes of the Great Depression.\[99\]

Milton Friedman effectively took many of the basic principles set forth by Adam Smith and the classical economists and modernized them. One example of this is his article in the September 1970 issue of The New York Times Magazine, where he claims that the social responsibility of business should be “to use its resources and engage in activities designed to increase its profits...(through) open and free competition without deception or fraud.” \[100\]

Other schools and approaches
Schools of economics
Other well-known schools or trends of thought referring to a particular style of economics practiced at and disseminated from well-defined groups of academicians that have become known worldwide, include the Austrian School, the Freiburg School, the School of Lausanne, post-Keynesian economics and the Stockholm school. Contemporary mainstream economics is sometimes separated into the Saltwater approach of those universities along the Eastern and Western coasts of the US, and the Freshwater, or Chicago-school approach.
Within macroeconomics there is, in general order of their appearance in the literature; classical economics, Keynesian economics, the neoclassical synthesis, post-Keynesian economics, monetarism, new classical economics, and supply-side economics. Alternative developments include ecological economics, institutional economics, evolutionary economics, dependency theory, structuralist economics, world systems theory, econophysics, and biophysical economics.\[101\]

Criticism
"The dismal science" is a derogatory alternative name for economics devised by the Victorian historian Thomas Carlyle in the 19th century. It is often stated that Carlyle gave economics the nickname "the dismal science" as a response to the late 18th century writings of The Reverend Thomas Robert Malthus, who grimly predicted that starvation would result, as projected population growth exceeded the rate of increase in the food supply. However, the actual phrase was coined by Carlyle in the context of a debate with John Stuart Mill on slavery, in which Carlyle argued for slavery, while Mill opposed it.
Some economists, like John Stuart Mill or Leon Walras, have maintained that the production of wealth should not be tied to its distribution. The former is in the field of "applied economics" while the latter belongs to "social economics" and is largely a matter of power and politics.\[102\]
In *The Wealth of Nations*, Adam Smith addressed many issues that are currently also the subject of debate and dispute. Smith repeatedly attacks groups of politically aligned individuals who attempt to use their collective influence to manipulate a government into doing their bidding. In Smith's day, these were referred to as factions, but are now more commonly called special interests, a term which can comprise international bankers, corporate conglomerations, outright oligopolies, monopolies, trade unions and other groups.\[103\]
Economics per se, as a social science, is independent of the political acts of any government or other decision-making organization, however, many policymakers or individuals holding highly ranked positions that can influence other people's lives are known for arbitrarily using a plethora
of economic concepts and rhetoric as vehicles to legitimize agendas and value systems, and do not limit their remarks to matters relevant to their responsibilities.\[^{104}\] The close relation of economic theory and practice with politics\[^{104}\] is a focus of contention that may shade or distort the most unpretentious original tenets of economics, and is often confused with specific social agendas and value systems.\[^{105}\] Notwithstanding, economics legitimately has a role in informing government policy. It is, indeed, in some ways an outgrowth of the older field of political economy. Some academic economic journals are currently focusing increased efforts on gauging the consensus of economists regarding certain policy issues in hopes of effecting a more informed political environment. Currently, there exists a low approval rate from professional economists regarding many public policies. Policy issues featured in a recent survey of AEA economists include trade restrictions, social insurance for those put out of work by international competition, genetically modified foods, curbside recycling, health insurance (several questions), medical malpractice, barriers to entering the medical profession, organ donations, unhealthy foods, mortgage deductions, taxing internet sales, Wal-Mart, casinos, ethanol subsidies, and inflation targeting.\[^{106}\]

In *Steady State Economics* 1977, Herman Daly argues that there exist logical inconsistencies between the emphasis placed on economic growth and the limited availability of natural resources.\[^{107}\]

Issues like central bank independence, central bank policies and rhetoric in central bank governors discourse or the premises of macroeconomic policies\[^{108}\] (monetary and fiscal policy) of the state, are focus of contention and criticism.\[^{109}\]

Deirdre McCloskey has argued that many empirical economic studies are poorly reported, and while her critique has been well-received, she and Stephen Ziliak argue that practice has not improved.\[^{110}\] This latter contention is controversial.\[^{111}\]

A 2002 International Monetary Fund study looked at “consensus forecasts” (the forecasts of large groups of economists) that were made in advance of 60 different national recessions in the ’90s: in 97% of the cases the economists did not predict the contraction a year in advance. On those rare occasions when economists did successfully predict recessions, they significantly underestimated their severity.\[^{112}\]

### Criticism of assumptions

Economics has been subject to criticism that it relies on unrealistic, unverifiable, or highly simplified assumptions, in some cases because these assumptions simplify the proofs of desired conclusions. Examples of such assumptions include perfect information, profit maximization and rational choices.\[^{113}\][^114] The field of information economics includes both mathematical-economical research and also behavioral economics, akin to studies in behavioral psychology.\[^{115}\]

Nevertheless, prominent mainstream economists such as Keynes\[^{116}\] and Joskow have observed that much of economics is conceptual rather than quantitative, and difficult to model and formalize quantitatively. In a discussion on oligopoly research, Paul Joskow pointed out in 1975 that in practice, serious students of actual economies tended to use "informal models" based upon qualitative factors specific to particular industries. Joskow had a strong feeling that the important work in oligopoly was done through informal observations while formal models were "trotted out ex post". He argued that formal models were largely not important in the empirical work, either, and that the fundamental factor behind the theory of the firm, behavior, was neglected.\[^{117}\]
Despite these concerns, mainstream graduate programs have become increasingly technical and mathematical.\textsuperscript{[118][119]}
Lesson 16

Bookkeeping

Bookkeeping is the recording of financial transactions. Transactions include sales, purchases, income, and payments by an individual or organization. Bookkeeping is usually performed by a bookkeeper. Bookkeeping should not be confused with accounting. The accounting process is usually performed by an accountant. The accountant creates reports from the recorded financial transactions recorded by the bookkeeper and files forms with government agencies. There are some common methods of bookkeeping such as the Single-entry bookkeeping system and the Double-entry bookkeeping system. But while these systems may be seen as "real" bookkeeping, any process that involves the recording of financial transactions is a bookkeeping process. A bookkeeper (or book-keeper), also known as an accounting clerk or accounting technician, is a person who records the day-to-day financial transactions of an organization. A bookkeeper is usually responsible for writing the "daybooks." The daybooks consist of purchases, sales, receipts, and payments. The bookkeeper is responsible for ensuring all transactions are recorded in the correct day book, suppliers ledger, customer ledger and general ledger. The bookkeeper brings the books to the trial balance stage. An accountant may prepare the income statement and balance sheet using the trial balance and ledgers prepared by the bookkeeper.

Bookkeeping process

The bookkeeping process refers primarily to recording the financial effects of financial transactions only into accounts. The variation between manual and any electronic accounting system stems from the latency between the recording of the financial transaction and its posting in the relevant account. This delay, absent in electronic accounting systems due to instantaneous posting into relevant accounts, is not replicated in manual systems, thus giving rise to primary books of accounts such as Sales Book, Cash Book, Bank Book, Purchase Book for recording the immediate effect of the financial transaction.

In the normal course of business, a document is produced each time a transaction occurs. Sales and purchases usually have invoices or receipts. Deposit slips are produced when lodgements (deposits) are made to a bank account. Cheques are written to pay money out of the account. Bookkeeping involves, first of all, recording the details of all of these source documents into multi-column journals (also known as a books of first entry or daybooks). For example, all credit sales are recorded in the Sales Journal, all Cash Payments are recorded in the Cash Payments Journal. Each column in a journal normally corresponds to an account. In the single entry system, each transaction is recorded only once. Most individuals who balance their cheque-book each month are using such a system, and most personal finance software follows this approach.

After a certain period, typically a month, the columns in each journal are each totaled to give a summary for the period. Using the rules of double entry, these journal summaries are then transferred to their respective accounts in the ledger, or book of accounts. For example the entries in the Sales Journal are taken and a debit entry is made in each customer’s account (showing that the customer now owes us money) and a credit entry might be made in the account for "Sale of Class 2 Widgets" (showing that this activity has generated revenue for us). This
process of transferring summaries or individual transactions to the ledger is called *posting*. Once the posting process is complete, accounts kept using the "T" format undergo balancing, which is simply a process to arrive at the balance of the account.

As a partial check that the posting process was done correctly, a working document called an *unadjusted trial balance* is created. In its simplest form, this is a three column list. The first column contains the names of those accounts in the ledger which have a non-zero balance. If an account has a debit balance, the balance amount is copied into column two (the debit column). If an account has a credit balance, the amount is copied into column three (the credit column). The debit column is then totalled and then the credit column is totalled. The two totals must agree - this agreement is not by chance - because under the double-entry rules, whenever there is a posting, the debits of the posting equal the credits of the posting. If the two totals do not agree, an error has been made either in the journals or during the posting process. The error must be located and rectified and the totals of debit column and credit column recalculated to check for agreement before any further processing can take place.

Once the accounts balance, the accountant makes a number of adjustments and changes the balance amounts of some of the accounts. These adjustments must still obey the double-entry rule. For example, the "inventory" account asset account might be changed to bring them into line with the actual numbers counted during a stock take. At the same time, the expense account associated with usage of inventory is adjusted by an equal and opposite amount. Other adjustments such as posting depreciation and prepayments are also done at this time. This results in a listing called the *adjusted trial balance*. It is the accounts in this list and their corresponding debit or credit balances that are used to prepare the financial statements.

Finally financial statements are drawn from the trial balance, which may include:

- the income statement, also known as the *statement of financial results*, *profit and loss account*, or *P&L*
- the balance sheet, also known as the *statement of financial position*
- the cash flow statement
- the statement of retained earnings, also known as the *statement of total recognised gains and losses* or *statement of changes in equity*

**Bookkeeping systems**

Two common bookkeeping systems used by businesses and other organizations are the single-entry bookkeeping system and the double-entry bookkeeping system. Single-entry bookkeeping uses only income and expense accounts, recorded primarily in a revenue and expense journal. Single-entry bookkeeping is adequate for many small businesses. Double-entry bookkeeping requires posting (recording) each transaction twice, using debits and credits.

**Single-entry system**

The primary bookkeeping record in single-entry bookkeeping is the cash book, which is similar to a checking (cheque) account register but allocates the income and expenses to various income and expense accounts. Separate account records are maintained for petty cash, accounts payable and receivable, and other relevant transactions such as inventory and travel expenses. These days, single entry bookkeeping can be done with DIY bookkeeping software to speed up manual calculations.
### Sample revenue and expense journal for single-entry bookkeeping

<table>
<thead>
<tr>
<th>No.</th>
<th>Date</th>
<th>Description</th>
<th>Revenue</th>
<th>Expense</th>
<th>Sales Tax</th>
<th>Service</th>
<th>Inventory</th>
<th>Advertising</th>
<th>Freight</th>
<th>Office Supplies</th>
<th>Misc Supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/3</td>
<td>Balance forward</td>
<td></td>
<td>1,826.0</td>
<td>835.00</td>
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### Double-entry system

#### Daybooks

A daybook is a descriptive and chronological (diary-like) record of day-to-day financial transactions also called a book of original entry. The daybook's details must be entered formally into journals to enable posting to ledgers. Daybooks include:
- Sales daybook, for recording all the sales invoices.
- Sales credits daybook, for recording all the sales credit notes.
- Purchases daybook, for recording all the purchase invoices.
- Purchases credits daybook, for recording all the purchase credit notes.
- Cash daybook, usually known as the cash book, for recording all money received as well as money paid out. It may be split into two daybooks: receipts daybook for money received in, and payments daybook for money paid out.
Petty cash book
A petty cash book is a record of small value purchases usually controlled by imprest system. Items such as coffee, tea, birthday cards for employees, stationery for office working, a few dollars if you're short on postage, are listed down in the petty cash book.

Journals
A journal is a formal and chronological record of financial transactions before their values are accounted for in the general ledger as debits and credits. A company can maintain one journal for all transactions, or keep several journals based on similar activity (i.e. sales, cash receipts, revenue, etc.) making transactions easier to summarize and reference later. For every debit journal entry recorded there must be an equivalent credit journal entry to maintain a balanced accounting equation.[2]

Ledgers
A ledger is a record of accounts. These accounts are recorded separately showing their beginning/ending balance. A journal lists financial transactions in chronological order without showing their balance but showing how much is going to be charged in each account. A ledger takes each financial transactions from the journal and records them into the corresponding account for every transaction listed. The ledger also sums up the total of every account which is transferred into the balance sheet and income statement. There are 3 different kinds of ledgers that deal with book-keeping. Ledgers include:

- Sales ledger, which deals mostly with the Accounts Receivable account. This ledger consists of the financial transactions made by customers to the business.
- Purchase ledger is a ledger that goes hand and hand with the Accounts Payable account. This is the purchasing transaction a company does.
- General ledger representing the original 5 main accounts: assets, liabilities, equity, income, and expenses

Abbreviations used in bookkeeping
- A/C - Account
- Acc - Account
- A/R - Accounts Receivable
- A/P - Accounts Payable
- B/S - Balance Sheet
- c/d - Carried down
- b/d - Brought down
- c/f - Carried forward
- b/f - Brought forward
- Dr - Debit record
- Cr - Credit record
- G/L - General Ledger; (or N/L - Nominal Ledger)
- P&L - Profit & Loss; (or I/S - Income Statement)
- PP&E - Property, Plant and Equipment
- TB - Trial Balance
- GST - Goods and Services Tax
- VAT - Value Added Tax
- CST - Central Sale Tax
- TDS - Tax Deducted at Source
- AMT - Alternate Minimum Tax
- EBITDA - Earnings before Interest, Taxes, Depreciation and Amortisation
- EBDTA - Earnings before Depreciation, Taxes and Amortisation
- EBT - Earnings before Taxes
- EAT - Earnings after Tax
- PAT - Profit after tax
- PBT - Profit before tax
- Depr - Depreciation
- Dep’n - Depreciation

Chart of accounts
A chart of accounts is a list of the accounts codes that can be identified with numeric, alphabetical, or alphanumeric codes allowing the account to be located in the general ledger.

Computerized bookkeeping
Computerized bookkeeping removes many of the paper "books" that are used to record transactions and usually enforces double entry bookkeeping.

Online bookkeeping
Online bookkeeping, or remote bookkeeping, allows source documents and data to reside in web-based applications which allow remote access for bookkeepers and accountants. All entries made into the online software are recorded and stored in a remote location. The online software can be accessed from any location in the world and permit the bookkeeper or data entry person to work from any location with a suitable data communications link.

Trivia
"Bookkeeping" and "bookkeeper" are the only two words in English that have three sets of consecutive double letters.

Reference
Lesson 17
Housekeeping

Housekeeping is the act of cleaning the rooms and furnishings of a home. It is one of the many chores included in the term *housework*. Housecleaning includes activities such as disposing of rubbish, cleaning dirty surfaces, dusting and vacuuming. It may also involve some outdoor chores, such as removing leaves from rain gutters, washing windows and sweeping doormats. The term is often used also figuratively in politics and business, for the removal of unwanted personnel, methods or policies in an effort at reform or improvement.[1] Housecleaning is done to make the home look better and be safer and easier to live in. Without housecleaning limescale can build up on taps, mold grows in wet areas, bacterial action make the garbage disposal and toilet smell and cobwebs accumulate.[2] Tools used in housecleaning include vacuum cleaners, brooms, mops and sponges, together with cleaning products such as detergents, disinfectants and bleach.

Removal of litter

Disposal of rubbish is an important aspect of house cleaning. Plastic bags are designed and manufactured specifically for the collection of litter. Many are sized to fit common waste baskets and trash cans. Paper bags are made to carry aluminum cans, glass jars and other things. Recycling is possible with some kinds of litter.[3]

Dusting

Over time dust accumulates on household surfaces. As well as making the surfaces dirty, when dust is disturbed it can become suspended in the air, causing sneezing and breathing trouble. It can also transfer from furniture to clothing, making it unclean. Various tools have been invented for dust removal; Feather and lamb’s wool dusters, cotton and polyester dust cloths, furniture
Removal of dirt

Examples of dirt or "soil" are detritus and common spills and stains that exists in the home. Equipment used with a cleaner might be a bucket and sponge. A modern tool is the spray bottle, but the scientific principle is the same.

Household chemicals

Various household cleaning products have been developed to facilitate the removal of dust and dirt, for surface maintenance, and for disinfection. Products are available in powder, liquid or spray form. The basic ingredients determine the type of cleaning tasks for which they are suitable. Some are packaged as general purpose cleaning materials whilst others are targeted at specific cleaning tasks such as drain clearing, oven cleaning, lime scale removal and polishing furniture. Household cleaning products provide aesthetic and hygiene benefits but are also associated with health risks for the users, and building occupants. The US Department of Health and Human Services offers the public access to the Household Products Database. This database provides consumer information for over 4,000 products based on information provided by the manufacturer through the material safety data sheet.

Surfactants lower the surface tension of water, making it able to flow into smaller tiny cracks and crevices in soils making removal easier. Alkaline chemicals break down known soils such as grease and mud. Acids break down soils such as lime scale, soap scum, and stains of mustard, coffee, tea, and alcoholic beverages. Some solvent-based products are flammable and some can dissolve paint and varnish. Disinfectants stop smell and stains caused by bacteria.

When multiple chemicals are applied to the same surface without full removal of the earlier substance, the chemicals may interact. This interaction may result in a reduction of the efficiency of the chemicals applied (such as a change in pH value caused by mixing alkalis and acids) and
in cases may even emit toxic fumes. An example of this is the mixing of ammonia-based cleaners (or acid-based cleaners) and bleach. This causes the production of chloramines that volatilize (become gaseous) causing acute inflammation of the lungs (toxic pneumonitis), long-term respiratory damage, and potential death. Residue from cleaning products and cleaning activity (dusting, vacuuming, sweeping) have been shown to impact indoor air quality (IAQ) by redistributing particulate matter (dust, dirt, human skin cells, organic matter, animal dander, particles from combustion, fibers from insulation, pollen, and polycyclic aromatic hydrocarbons) that gaseous or liquid particles become adsorbed to. The particulate matter and chemical residual will of be highest concentrations right after cleaning but will decrease over time depending upon levels of contaminants, air exchange rate, and other sources of chemical residual. Of most concern are the family of chemicals called VOCs such as formaldehyde, toluene, and limonene. 

Volatile organic compounds (VOCs) are released from many household cleaning products such as disinfectants, polishes, floor waxes, air-freshening sprays, all purpose cleaning sprays, and glass cleaner. These products have been shown to emit irritating vapors. VOCs are of most concern due to their tendency to evaporate and be inhaled into the lungs or adsorbed to existing dust, which can also be inhaled. It has been found that aerosolized (spray) cleaning products are important risk factors and may aggravate symptoms of adult asthma, respiratory irritation, childhood asthma, wheeze, bronchitis, and allergy. Other modes of exposure to potentially harmful household cleaning chemicals include absorption through the skin (dermis), accidental ingestion, and accidental splashing into the eyes. Products for the application and safe use of the chemicals are also available, such as nylon scrub sponge and rubber gloves. It is up to the consumer to keep themselves safe while using these chemicals. Reading and comprehending the labels is important.

There is a growing consumer and governmental interest in natural cleaning products and green cleaning methods. The use of nontoxic household chemicals is growing as consumers become more informed of the health effects of many household chemicals, and municipalities are having to deal with the expensive disposal of household hazardous waste (HHW).

Tools
Brooms remove debris from floors and dustpans carry dust and debris swept into them, buckets hold cleaning and rinsing solutions, vacuum cleaners and carpet sweepers remove surface dust and debris, chamois leather and squeegees are used for window-cleaning, and mops are used for washing floors.

Yard
A home's yard and exterior are sometimes subject to cleaning. Exterior cleaning also occurs for safety, upkeep and usefulness. It includes removal of paper litter and grass growing in sidewalk cracks. Rain gutters, doormats, pools and the screens and glass of windows are also cleanable. Yard junk-removal might occur and porch clutter removal. The paint of door frames might be washed or an old piñata thrown away.
Lesson 18
Ecosystem
Dr. Erle Ellis

Introduction
Ecosystems are composed of organisms interacting with each other and with their environment such that energy is exchanged and system-level processes, such as the cycling of elements, emerge. The ecosystem is a core concept in Biology and Ecology, serving as the level of biological organization in which organisms interact simultaneously with each other and with their environment. As such, ecosystems are a level above that of the ecological community (organisms of different species interacting with each other) but are at a level below, or equal to, biomes and the biosphere. Essentially, biomes are regional ecosystems, and the biosphere is the largest of all possible ecosystems.

Levels of organization of Ecology, highlighting ecosystems. (Credit: Erle Ellis)
Ecosystems include living organisms, the dead organic matter produced by them, the abiotic environment within which the organisms live and exchange elements (soils, water, atmosphere), and the interactions between these components. Ecosystems embody the concept that living organisms continually interact with each other and with the environment to produce complex systems with emergent properties, such that "the whole is greater than the sum of its parts" and "everything is connected".

The spatial boundaries, component organisms and the matter and energy content and flux within ecosystems may be defined and measured. However, unlike organisms or energy, ecosystems are inherently conceptual, in that different observers may legitimately define their boundaries and components differently. For example, a single patch of trees together with the soil, organisms and atmosphere interacting with them may define a forest ecosystem, yet the entirety of all organisms, their environment, and their interactions across an entire forested region in the Amazon might also be defined as a single forest ecosystem. Some have even called the interacting system of organisms that live within the guts of most animals as an ecosystem, despite their residence within a single organism, which violates the levels of organization definition of ecosystems. Moreover, interactions between ecosystem components are as much a
part of the definition of ecosystems as their constituent organisms, matter and energy. Despite
the apparent contradictions that result from the flexibility of the ecosystem concept, it is just this
flexibility that has made it such a useful and enduring concept.
History of the Ecosystem Concept
The term "ecosystem" was first coined by Roy Clapham in 1930, but it was ecologist Arthur
Tansley who fully defined the ecosystem concept. In his classic article of 1935, Tansley defined
ecosystems as "The whole system,... including not only the organism-complex, but also the
whole complex of physical factors forming what we call the environment". The ecosystem
concept marked a critical advance in the science of ecology, as Tansley specifically used the
term to replace the "superorganism" concept, which implied that communities of organisms
formed something akin to a higher-level, more complex organism—a mistaken conception that
formed a theoretical barrier to scientific research in ecology. Though Tansely and other
ecologists also used the ecosystem concept in conjunction with the now defunct concept of the
ecological "climax" (a "final", or "equilibrium" type of community or ecosystem arising under
specific environmental conditions), the concept of ecosystem dynamics has now replaced this.
Eugene Odum, a major figure in advancing the science of ecology, deployed the ecosystem
concept in a central role in his seminal textbook on ecology, defining ecosystems as: "Any unit
that includes all of the organisms (ie: the "community") in a given area interacting with the
physical environment so that a flow of energy leads to clearly defined trophic structure, biotic
diversity, and material cycles (ie: exchange of materials between living and nonliving parts)
within the system is an ecosystem."
Ecosystem Structure and Function
Illustration of the flow of matter and energy in ecosystems. (Credit: Erle Ellis)
Ecosystems may be observed in many possible ways, so there is no one set of components that
make up ecosystems. However, all ecosystems must include both biotic and abiotic components,
their interactions, and some source of energy. The simplest (and least representative) of
ecosystems might therefore contain just a single living plant (biotic component) within a small
terrarium exposed to light to which a water solution containing essential nutrients for plant
growth has been added (abiotic environment). The other extreme would be the biosphere, which
comprises the totality of Earth's organisms and their interactions with each other and the earth
systems (abiotic environment). And of course, most ecosystems fall somewhere in between these
extremes of complexity.
At a basic functional level, ecosystems generally contain primary producers capable of harvesting energy from the sun by photosynthesis and of using this energy to convert carbon dioxide and other inorganic chemicals into the organic building blocks of life. Consumers feed on this captured energy, and decomposers not only feed on this energy, but also break organic matter back into its inorganic constituents, which can be used again by producers. These interactions among producers and the organisms that consume and decompose them are called trophic interactions, and are composed of trophic levels in an energy pyramid, with most energy and mass in the primary producers at the base, and higher levels of feeding on top of this, starting with primary consumers feeding on primary producers, secondary consumers feeding on these, and so on. Trophic interactions are also described in more detailed form as a food chain, which organizes specific organisms by their trophic distance from primary producers, and by food webs, which detail the feeding interactions among all organisms in an ecosystem. Together, these processes of energy transfer and matter cycling are essential in determining ecosystem structure and function and in defining the types of interactions between organisms and their environment. It must also be noted that most ecosystems contain a wide diversity of species, and that this diversity should be considered part of ecosystem structure.

Ecosystem processes (function)
By definition, ecosystems use energy and cycle matter, and these processes also define the basic ecosystem functions. Energetic processes in ecosystems are usually described in terms of trophic levels, which define the role of organisms based on their level of feeding relative to the original energy captured by primary producers. As always, energy does not cycle, so ecosystems require a continuous flow of high-quality energy to maintain their structure and function. For this reason, all ecosystems are "open systems" requiring a net flow of energy to persist over time—without the sun, the biosphere would soon run out of energy!

Energy input to ecosystems drives the flow of matter between organisms and the environment in a process known as biogeochemical cycling. The biosphere provides a good example of this, as it interacts with and exchanges matter with the lithosphere, hydrosphere and atmosphere, driving the global biogeochemical cycles of carbon, nitrogen, phosphorus, sulfur and other elements. Ecosystem processes are dynamic, undergoing strong seasonal cycles in response to changes in solar irradiation, causing fluctuations in primary productivity and varying the influx of energy from photosynthesis and the fixation of carbon dioxide into organic materials over the year, driving remarkable annual variability in the carbon cycle—the largest of the global biogeochemical cycles. Fixed organic carbon in plants then becomes food for consumers and decomposers, who degrade the carbon to forms with lower energy, and ultimately releasing the carbon fixed by photosynthesis back into carbon dioxide in the atmosphere, producing the global carbon cycle. The biogeochemical cycling of nitrogen also uses energy, as bacteria fix nitrogen gas from the atmosphere into reactive forms useful for living organisms using energy obtained from organic materials and ultimately from plants and the sun. Ecosystems also cycle phosphorus, sulfur and other elements. As biogeochemical cycles are defined by the exchange of matter between organisms and their environment, they are classic examples of ecosystem-level processes.
Prairie ecosystem and Prairie dog (*Zapus trinotatus*). (Source: USDA Forest Service)

Scientists who study entire ecosystems are generally called systems ecologists. However, most ecologists use the ecosystem concept and make measurements on ecosystem properties even if their work focuses on a single species or population.

**Methods**

**Observing ecosystems**

Researchers can make direct observations on ecosystems in the field and indirect observations using remote sensing. Direct measurements include sampling and measurement of soils and vegetation, characterization of community structure and biodiversity, and the use of instruments for observing gas exchange and the fluxes of nutrients and water. As ecosystems can be very challenging to recreate under laboratory conditions, observational studies on existing ecosystems are a core methodology of ecosystem science.

**Ecosystem experiments**

Though it has historically been difficult, ecosystems are now often studied using the classic experimental methods of science. For example, small- and meso-scale ecosystems containing a significant set of interacting organisms and their environment may be created in the laboratory, or in enclosures in the field. There are also methods for excluding organisms or altering environmental conditions in the field, such as the addition of nutrients and artificially enhancing carbon dioxide concentrations, temperature or moisture.

**Modeling**

To better understand how ecosystems function and change, modeling is often used to simulate ecosystem dynamics, including the biogeochemical cycles of carbon and other elements, the role of specific species or functional groups in controlling ecosystem function, and even dynamic changes in ecosystem structure and function across landscapes and the entire biosphere.

**The Future**

Ecosystem science is evolving rapidly in both methodology and focus. Human alteration of ecosystems is now so pervasive globally that ecologists are working to integrate humans into
ecosystem science at many levels—including the study of urban ecology, agroecology and global ecology. New techniques for ecosystem modelling are being developed all the time, as are new methods for observing ecosystems from space by remote sensing and aerial platforms, and even by networks of sensors embedded in soils and plants across ecosystems and on towers that can make observations on ecosystem exchanges with the atmosphere on a continuous basis. Examples of cutting edge ecosystem research are the Carnegie Airborne Observatory—an aerial remote sensing system capably of precisely mapping ecosystem carbon and species diversity, and the development of the National Ecological Observatory Network (NEON), a continental-scale research platform for discovering and understanding the impacts of climate change, land-use change, and invasive species on ecosystems.

More About Ecosystems
- Biosphere
- Biome
- Ecology
- Biogeochemical cycles
- Ecological energetics
- Biodiversity
- Millennium Ecosystem Assessment
- International Geosphere-Biosphere Programme (IGBP)

Further Reading
Lesson 19
Tourism in Indonesia

Tourism in Indonesia is an important component of the Indonesian economy as well as a significant source of its foreign exchange revenues. The vast country of sprawling archipelago has so much to offer; from natural beauty, historical heritage to cultural diversity. In 2009, the number of international tourists arriving in Indonesia climbed 3.6% to 6.45 million arrivals from 6.43 million in 2008. The subsequent economical impact of this tourist influx in 2009 saw $6.3 billion US dollars spent by international tourists in Indonesia, at an average spend of US$129.57 per day and US$995.93 per visit. Whilst the number of arrivals increased in 2009 the total spent per visitor decreased leading to a revenues shortfall of US$1.07 billion when compared to the previous year.[1][2]

Overview

Both nature and culture are major components of Indonesian tourism. The natural heritage can boast a unique combination of a tropical climate, a vast archipelago of 17,508 islands, 6,000 of them being inhabited,[3] the third longest shoreline in the world (54,716 km) after Canada and the European Union.[4] It is the world's largest and most populous country situated only on islands.[5] The beaches in Bali, diving sites in Bunaken, Mount Rinjani in Lombok and various national parks in Sumatra are just a few examples of popular scenic destinations. These natural attractions are complemented by a rich cultural heritage that reflects Indonesia's dynamic history and ethnic diversity. One fact that exemplifies this richness is that 719 living languages are used across the archipelago.[6] The ancient Prambanan and Borobudur temples, Toraja, Yogyakarta, Minangkabau, and of course Bali, with its many Hindu festivities, are some of the popular destinations for cultural tourism.

Tourism in Indonesia is currently overseen by the Ministry of Culture and Tourism.[7] International tourism campaigns have been focusing largely on its tropical destinations with white sand beaches, blue sky, and cultural attractions. Beach resorts and hotels have been developed in some popular tourist destinations, especially Bali island as the primary destination. At the same time, the integration of cultural affairs and tourism under the scope of the same ministry shows that cultural tourism is considered an integral part of Indonesia's tourism industry, and conversely, that tourism is used to promote and preserve the cultural heritage.

Some of the challenges Indonesia's tourism industry has to face include the development of infrastructure to support tourism across the sprawling archipelago, incursions of the industry into local traditions (adat), and the impact of tourism development on the life of local people. In 2010, based on World Economic Forum survey, Indonesia got Tourism Competitiveness Index at number 74 (up from number 81) from 139 countries.[8] The tourism industry in Indonesia has also faced setbacks due to problems related to security. Since 2002, warnings have been issued by some countries over terrorist threats and ethnic as well as religious conflicts in some areas, significantly reducing the number of foreign visitors for a few years. However, the number of international tourists has bounced back positively since 2007, and reached a new record in 2008.[1][9]

Branding

Garuda Indonesia airplane with Visit Indonesia logo
In late January 2011 Culture and Tourism Minister Jero Wacik announced that "Wonderful Indonesia" would replace the previous “Visit Indonesia Year” branding used by the nations official tourism promotional campaigns. The minister announced that in 2010, foreign tourists visiting Indonesia touched 7 million and made predictions of 7.7 million in 2011. He was reported as describing the new branding as reflecting "the country’s beautiful nature, unique culture, varied food, hospitable people and price competitiveness. “We expect each tourist will spend around US$1,100 and with an optimistic target of 7.7 million arrivals, we will get $8.3 billion,” from this. The Culture and Tourism Minister added that 50 percent of the revenue would be generated from about 600 meetings, conventions and exhibitions that were expected to take place in various places throughout the country 2011. He further added in the announcements of January 2011 that his ministry would be promoting the country’s attractions under the eco-cultural banner.

Statistics

Indonesian Tourism Statistics

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Tourist Arrivals in Indonesia 2009

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<td>7</td>
<td>Taiwan</td>
<td>203,239</td>
<td>-2</td>
</tr>
</tbody>
</table>
Ten most tourist destinations in Indonesia recorded by Central Statistics Agency (BPS) are Bali, West Java, Central Java, East Java, Jakarta, North Sumatra, Lampung, South Sulawesi, South Sumatra, Banten and West Sumatra (actually there are 11 provinces due to Banten is part of West Java before).\(^{12}\)

As with most countries, domestic tourists are by far the largest market segment. The biggest movement of domestic tourists is during the annual Eid ul-Fitr, locally known as "lebaran". During this period, which is a two-week holiday after the month of fasting during Ramadan, many city-dwelling Muslim Indonesians visit relatives in their home towns. Intercity traffic is at its peak and often an additional surcharge is applied during this time.

Over the five years up to 2006, attention has been focused on generating more domestic tourism. Competition amongst budget airlines has increased the number of domestic air travellers throughout the country. Recently, the Ministry of Labour legislated to create long weekends by combining public holidays that fall close to weekends, except in the case of important religious holidays. During these long weekends, most hotels in popular destinations are fully booked.

Since 2000, on average, there have been five million foreign tourists each year (see table), who spend an average of US$100 per day. With an average visit duration of 9–12 days, Indonesia gains US$4.6 billion of foreign exchange income annually.\(^{[1]}\) This makes tourism Indonesia's third most important non-oil–gas source of foreign revenue, after timber and textile products.\(^{[3]}\)

Three quarters of Indonesia's visitors come from the Asia-Pacific region, with Singapore, Malaysia, Australia, Japan and China among the top countries of origin.\(^{[13]}\) The United Kingdom, France, and Germany are the largest sources of European visitors.\(^{[14]}\) Although Dutch visitors are at least in part keen to explore the historical relationships, many European visitors are seeking the tropical weather at the beaches in Bali.

Around 59% of all visitors are traveling to Indonesia for holiday, while 38% for business purposes.\(^{[15]}\)

In 2005, tourism accounted for 7% of job opportunities and 5% of Indonesian GDP.\(^{[15]}\) In January 2010 the Coordinating Minister for the Economy Hatta Rajasa was reported as announcing that he expected "the tourism sector to contribute 4.8 percent of the gross domestic product" in the 2010 year.\(^{[16]}\)

Historical context

Hotel des Indes in Batavia, 1910

Initially the tourism, service and hospitality sector in Dutch East Indies were developed to cater the lodging, entertainment and leisure needs of domestic visitors, especially the wealthy Dutch plantation owners and merchants during their stay in the city. In 19th century, colonial heritage hotels equipped with dance hall, live musics and fine dining restaurant were established in Dutch East Indies urban areas, such as Hotel des Indes (est. 1829) in Batavia, Savoy Homann Hotel (est. 1871) in Bandung, and Hotel Oranje (est. 1910) in Surabaya. Much of the international tourism of the 1920s and 1930s was by international visitors on oceanic cruises. The 1930s did see a modest but significant influx of mainly European tourists and longer term stayers to Bali.
Many came for the blossoming arts scene in the Ubud area, which was as much a two-way exchange between the Balinese and outsiders as it was an internal phenomenon.\[17\] Tourism more or less disappeared during World War II, Indonesian National Revolution and in the early years of the Sukarno era. National pride and identity in the late 1950s and early 1960s was incorporated into the monumentalism of Sukarno in Jakarta — and this included the development of grand multi-storied international standard hotels and beach resorts, such as Hotel Indonesia in Jakarta (est. 1962), Ambarrukmo Hotel in Yogyakarta (est. 1965), Samudra Beach Hotel in Pelabuhan Ratu beach West Java (est. 1966), and Inna Grand Bali Beach Hotel in Bali (est. 1966). The political and economic instability of the mid-1960s saw tourism decline radically again. Bali, and in particular the small village of Kuta, was however, in the 1960s, an important stopover on the overland hippy trail between Australia and Europe, and a "secret" untouched surf spot.\[18\] In the early-to-mid 1970s, high standard hotels and tourist facilities began to appear in Jakarta and Bali. After the completion of Borobudur restoration project in 1982, Yogyakarta become a popular tourist attraction in Indonesia after Bali, mostly attracted to this 8th century Buddhist monument, surrounding ancient Javanese temples and Yogyakarta Sultanate palace. From this period to the end of the Suharto era, governmental policies of the tourism industry included an array of regulations and developments to encourage increasing numbers of international tourists to both visit Indonesia and stay longer.

The beach at Gili Meno with Lombok in the distant background

Indonesia has a well-preserved, natural ecosystem with rainforests that stretch over about 57% of Indonesia's land (225 million acres), approximately 2% of which are mangrove systems.\[19\][20] One reason why the natural ecosystem in Indonesia is still well-preserved is because only 6,000 islands out of 17,000 are permanently inhabited.\[21\] Forests on Sumatra and Java are examples of popular tourist destinations. Moreover, Indonesia has one of longest coastlines in the world, measuring 54,716 kilometres (33,999 mi),\[22\] with a number of beaches and island resorts, such as those in southern Bali, Lombok,\[23\] Bintan and Nias Island.\[24\] However, most of the well-preserved beaches are those in more isolated and less developed areas, such as Karimunjawa, the Togian Islands, and the Banda Islands.

Dive sites

With more than 17,508 islands, Indonesia presents ample diving opportunities. With 20% of the world's coral reefs, over 3,000 different species of fish and 600 coral species, deep water trenches, volcanic sea mounts, World War II wrecks, and an endless variety of macro life, scuba diving in Indonesia is both excellent and inexpensive.\[25\] Bunaken National Marine Park, at the northern tip of Sulawesi, claims to have seven times more genera of coral than Hawaii,\[26\] and has more than 70% of all the known fish species of the Indo-Western Pacific.\[27\] According to Conservation International, marine surveys suggest that the marine life diversity in the Raja Ampat area is the highest recorded on Earth.\[28\] Moreover, there are over 3,500 species living in Indonesian waters, including sharks, dolphins, manta rays, turtles, morays, cuttlefish, octopus and scorpionfish, compared to 1,500 on the Great Barrier Reef and 600 in the Red Sea.\[29\] Tulamben Bay in Bali boasts the wreck of the 120 metres (390 ft) U.S. Army commissioned transport vessel, the Liberty.\[30\] Other popular dive sites on Bali are at Candidasa and Menjangan. Across the Badung Strait from Bali, there are several popular dive sites on Nusa Lembongan and Nusa Penida. Lombok's three Gilis (Gili Air, Gili Meno and Gili Trawangan) are popular as is Bangka. Some of the most famous diving sites in Indonesia are also the most
difficult to reach, with places like Biak off the coast of Papua and the Alor Archipelago among the popular, more remote, destinations for divers.

Surf breaks
Surfers in Kuta beach, Bali
Surfing is also a popular water activity in Indonesia and the sites are recognised as world class.[3] The well-known spots are mostly located on the southern, Indian Ocean side of Indonesia, for example, the large oceanic surf breaks on southern Java. However, the north coast does not receive the same surf from the Java Sea. Surf breaks can be found all the way along Sumatra, down to Nusa Tenggara, including Aceh, Bali, Banten, Java, Lombok, the Mentawai Islands, and Sumbawa. Although Indonesia has many world-class surfing spots, the majority of surfers are from abroad, especially Australia and the United States. However, the seed of local surfing enthusiast began to develop in Bali and West Java's Pelabuhan Ratu and Pangandaran beach, mostly from nearby cities of Jakarta and Bandung. On Bali, there are about 33 surf spots, from West Bali to East Bali including four on the offshore island of Nusa Lembongan. In Sumbawa, Hu'u and Lakey Beach in Cempi Bay is popular surfing spots among surfing enthusiast. Sumatra is the second island with the most number of surf spots, with 18 altogether. The common time for surfing is around May to September with the trade winds blowing from east to south-east. From October to April, winds tend to come from the west to north-west, so the east coast breaks get the offshore winds.[1]

Two well-known surf breaks in Indonesia are the G-Land in the Bay of Grajagan, East Java, and Lagundri Bay at the southern end of Nias island. G-Land was first identified in 1972, when a surfer saw the break from the window of a plane. Since 6 to 8 foot (Hawaiian scale) waves were discovered by surfers at Lagundri Bay in 1975, the island has become famous for surfing worldwide.

National parks
List of national parks of Indonesia
Lesser Bird of Paradise
Bogor Botanical Gardens established in 1817, and Cibodas Botanical Gardens established in 1862, is one of the oldest botanical gardens in Asia. With rich collections of tropical plants, these gardens is the center of botanical research as well as tourism attraction since colonial era.

There are 50 national parks in Indonesia, of which six are World Heritage listed. The largest national parks in Sumatra are the 9,500-square-kilometre (3,700 sq mi) Gunung Leuser National Park, the 13,750-square-kilometre (5,310 sq mi) Kerinci Seblat National Park and the 3,568-square-kilometre (1,378 sq mi) Bukit Barisan Selatan National Park, all three recognised as Tropical Rainforest Heritage of Sumatra on the UNESCO World Heritage list. Other national parks on the list are Lorentz National Park in Papua, Komodo National Park in the Lesser Sunda Islands, and Ujung Kulon National Park in the west of Java.

Komodo dragon
To be noticed, different national parks offer different biodiversity, as the natural habitat in Indonesia is divided into two areas by the Wallace line. The Wallace biogeographical distinction means the western part of Indonesia (Sumatra, Java, Kalimantan) have the same flora and fauna characteristics as the Asian continent, whilst the remaining eastern part of Indonesia has similarity with the Australian continent.[23]
Many native species such as Sumatran elephants, Sumatran tigers, Sumatran rhinoceros, Javan rhinoceros and Orangutans are listed as endangered or critically endangered, and the remaining populations are found in national parks and other conservation areas. Sumatran orangutan can be visited in the Bukit Lawang conservation area, while the Bornean orangutan can be visited in Tanjung Puting national park, Central Kalimantan. The world’s largest flower, rafflesia arnoldii, and the tallest flower, titan arum, can be found in Sumatra.

The east side of the Wallacea line offers the most remarkable, rarest, and exotic animals on earth. Birds of Paradise, locally known as cendrawasih, are plumed birds that can be found among other fauna in Papua New Guinea. The largest bird in Papua is the flightless cassowary. One species of lizard, the Komodo dragon can easily be found on Komodo, located in the Nusa Tenggara lesser islands region. Besides Komodo island, this endangered species can also be found on the islands of Rinca, Padar and Flores.

Volcanoes
Mount Bromo
Hiking and camping in the mountains are popular adventure activities. Some mountains contain ridge rivers, offering rafting activity. Though volcanic mountains can be dangerous, they have become major tourist destinations. Several tourists have died on the slopes of Mount Rinjani, Indonesia’s second highest volcano and a popular destination for climbers visiting Lombok in eastern Indonesia. Popular active volcanoes are the 2,329-metre (7,641 ft) high Mount Bromo in the East Java province with its scenic volcanic desert around the crater, the upturned boat shaped Tangkuban Perahu on the outskirts of Bandung with drive-in access up to the crater, the most active volcano in Java, Mount Merapi and the legendary Krakatau with its new caldera known as anak krakatau (the child of Krakatau). Gede Pangrango volcano in West Java also a popular hiking destination, especially among domestic hikers.

In Sumbawa, Mount Tambora with its historical massive volcanic eruption back in 1815 that produced massive caldera also had gained attention among hikers. In neighboring island of Flores, the three-colored volcanic cratere-lake of Kelimutu is also hailed as one of Indonesia’s natural wonder and had attracted visitors worldwide. Puncak Jaya in the Lorentz National Park, the highest mountain in Indonesia and one of the few mountains with ice caps at the (tropical) equator offers the opportunity of rock climbing. In Sumatra, there are the remains of a supervolcano eruption that have created the landscape of Lake Toba close to Medan in North Sumatra.

Cultural tourism
Culture of Indonesia
Bali is famous for its rich culture, Hindu festivals and dances
Indonesia consists of an entire 300 ethnic groups, spread over a 1.8 million km² area of 6,000 inhabited islands. This creates a cultural diversity, further compounded by Hindu, Buddhist, Islamic and European colonialist influences. In Bali, where most of Indonesian Hindus live, cultural and religious festivals with Balinese dance-drama performances in Balinese temples are major attractions to foreign tourists.

Despite foreign influences, a diverse array of indigenous traditional cultures is still evident in Indonesia. The indigenous ethnic group of Toraja in South Sulawesi, which still has strong animistic beliefs, offers a unique cultural tradition, especially during funeral rituals. The Minangkabau ethic group retain a unique matrilineal culture, despite being devoted Muslims.
Other indigenous ethnic groups include the Asmat and Dani in Papua, the Dayak in Kalimantan and the Mentawai in Sumatra, where traditional rituals are still observed.

A discussion of cultural tourism is not complete without a mention of Yogyakarta, a special province in Indonesia known as centre of classical Javanese fine art and culture. The rise and fall of Buddhist, Hindu, and Islamic kingdoms in Central Java has transformed Yogyakarta into a melting pot of Indonesian culture.

For Indonesian and foreign visitors that probably unable to visit the whole of Indonesian provinces, Taman Mini Indonesia Indah in East Jakarta provides a comprehensive representation of Indonesian culture. Established in 1975 by Tien Suharto, this park displaying separate pavilions with the collections of Indonesian architecture, clothing, dances and traditions are all depicted impeccably.

Ancient temples
Candi of Indonesia
Borobudur temple in Central Java
From the 3rd century until the 13th century, Hinduism and Buddhism shaped the culture of Indonesia. Kingdoms rise and fall, such as Medang Kingdom, Srivijaya, Kediri, Singhasari and Majapahit. Along the Indonesian classical history of Hindu-Buddhist era, they produced some temples and monuments called candi. The best-preserved Buddhist shrine, which was built during the Sailendra dynasty in the 8th century, is Borobudur temple in Central Java. A giant stone mandala stepped pyramid adorned with bell-shaped stupas, richly adorned with bas-reliefs telling the golden stories and teachings of Buddha.

A few kilometers to the southeast is the Prambanan complex, the largest Hindu temple in Indonesia built during the second Mataram dynasty. The Prambanan temple is dedicated to Trimurti; Shiva, Vishnu and Brahma, three highest gods in Hinduism. Both the Borobudur and the Prambanan temple compounds have been listed in the UNESCO World Heritage list since 1991. Both temple are the largest and the most popular, conveniently accesible from Yogyakarta, the heartland of Javanese culture. The RamayanaJavanese dance is performed routinely on the stage near Prambanan temple, provides the visitors the glimpse of Javanese classical culture.

In and around Yogyakarta, the ancient Javanese archaeology and temple enthusiast may still discover numerous ancient temples, accessible by car or motorcycle. Although not as grand and popular as Borobudur and Prambanan, these smaller temples provides glimpse of ancient Javanese culture and the intricate details of ancient Javanese temple architecture. Mendut and Pawon temples are located near Borobudur, while Ratu Boko, Sewu, Lumbung, Plaosan, Kalasan, and Sari are located in Prambanan Plain near Prambanan temple.

Islamic heritage
Baiturrahman Grand Mosque
Islam has also contributed greatly to the cultural society in Indonesia. As of 2006, 88% of Indonesia's recorded population were Muslim. Islamic culture is prominent in Sumatra, and a few of the remaining sultanate palaces can be seen in Medan and Tanjung Pinang. The Islamic heritage tourism is also popular, especially among Indonesian muslims and muslims from neighboring countries such as Malaysia, Singapore and Brunei that shared common Southeast Asian Islamic heritage. The activity usually linked with Islamic ziyarat pilgrimage to historical Islamic sites, such as historical mosques and tombs of venerated Islamic figures. However for visitors in Islamic sites, either local or foreign, muslim or non-muslim, the rules of
conduct and dress modesty is applied, such as removing the footwear while entering mosques or makam (tombs), visitor should not entering the site wearing shorts (sarong usually lended near the entrance to cover lower torso of the visitors), and wearing kerudung (head-dress covering) for women.

In Aceh the Baiturrahman Grand Mosque and tombs of Aceh Sultanate kings is popular destination, while in Medan the Medan Great Mosque and Maimun Palace is also major Islamic heritage destination. Most of Indonesian major cities have their own historical or monumental Masjid Agung (Grand Mosque) that become city's landmark as well as tourism attraction. Istiqlal mosque, the Indonesian national mosque and the largest in Southeast Asia is Jakarta's major landmark as well as tourist attraction. In Java the ziyarat pilgrimage is usually linked to historically important Islamic figures of Wali Sanga (Nine Saints), they are important because of their historic role in the Spread of Islam in Indonesia. Their tombs and mosques scattered along Java's north coast towns, such as Demak, Kudus, Cirebon, Gresik, to Ampel in Surabaya. The 15th century Agung Demak Mosque hailed as the first mosque established in Java. Menara Kudus Mosque is notable for incorporating Majapahit Hindu-Javanese architecture. The tomb of Sunan Gunungjati near Cirebon, is also the important ziyarat site in West Java.

Colonial heritage
Former Batavia Stadhuis now Jakarta History Museum in Jakarta Old Town
Fort Rotterdam in Makassar
The heritage tourism is focussed on specific interest on Indonesian history, such as colonial architectural heritage of Dutch East Indies era in Indonesia. The colonial heritage tourism mostly attracted visitors from the Netherlands that share historical ties with Indonesia, as well as Indonesian or foreign colonial history enthusiast.

The activities among others are visiting museums, churches, forts and historical colonial buildings, as well as spend some nights in colonial heritage hotels. The popular heritage tourism attractions is Jakarta Old Town — the city center of old Batavia, with its Maritime Museum, Kota Intan drawbridge, Gereja Sion, Wayang Museum, Stadhuis Batavia, Fine Art and Ceramic Museum (Former Court of Justice of Batavia), Toko Merah (Red Store), Bank Indonesia Museum, Bank Mandiri Museum, Jakarta Kota Station, and Glodok (Jakarta Chinatown). In the old ports of Sunda Kelapa in Jakarta and Paotere in Makassar the tall masted pinisi ship still sailed. The Jakarta Cathedral with neo-gothic architecture in Central Jakarta also attracted architecture enthusiast.

Bandung historical avenue around Asia Afrika and Braga Street displays rich collections of Indies and Art deco architecture from early 20th century. Several hotels such as Savoy Homann in Bandung and Hotel Majapahit in Surabaya are colonial heritage hotels suitable for those whom interested in Dutch East Indies colonial history. The VOC forts can be found in Yogyakarta, Makassar, Bengkulu and Ambon. The colonial buildings might also be found in old town parts of Indonesian cities, such as Semarang, Surabaya, Malang, and Medan. The heritage tourism might also focussed on the era of 17th to 19th century royal Javanese courts of Yogyakarta Sultanate, Surakarta Sunanate and Mangkunegaran.

Metropolitan tourism
Bandung with its boutiques, distribution stores and factory outlets is well-known by locals and foreign visitors as shopping heaven in Indonesia

National Monument in Jakarta
Metropolitan tourism activities are shopping, sightseeing in big cities, and enjoying modern amusement parks. Ancol Dreamland with Dunia Fantasi theme park and Atlantis Water Adventure is Jakarta's answer to Disneyland-style amusement park and water park. Several similar theme parks also developed in other cities, such as Trans Studio Makassar and Trans Studio Bandung. The nation's capital, Jakarta, offers many places for shopping. Mal Kelapa Gading, the biggest one with 130 square kilometres (50 sq mi), Plaza Senayan, Senayan City, Grand Indonesia, EX, and Plaza Indonesia are some of the shopping malls in the city. Next to high-end shopping centers with branded products, Indonesia is also a popular destination for handycraft shopping in the region. Certain Indonesian traditional crafts such as batik, songket, ikat weaving, embroidery, wooden statue and fashion products are popular souvenirs for visitors. Indonesian textile and fashion products are known for its good value; good quality with relatively cheap and reasonable price. Bandung is a popular shopping destination for fashion products among Malaysians and Singaporeans.[38]

Another popular tourist activity is golfing, a favorite sport among the upper class Indonesians and foreigners. Some notable golf courses in Jakarta are the Cengkareng Golf Club, located in the airport complex, and Pondok Indah Golf and Country Club. Bali has many shopping centers, for instance, the Kuta shopping center and the Galeria Nusa Dua. Nightlife of Indonesia is also popular among foreigners, especially in the big cities like Jakarta, Bandung, Surabaya, Manado, Denpasar and Medan.[39]

International tourist arrivals
International airports
List of airports in Indonesia
Each of the larger Indonesian islands have at least one international airport. The biggest airport in Indonesia, Soekarno-Hatta International Airport, is located in Tangerang Regency, Banten. There are five more international airports on Java, Adisumarmo International Airport (IATA: SOC) in Solo, Central Java, Juanda International Airport (IATA: SUB) in Surabaya, East Java, Achmad Yani International Airport (IATA: SRG) in Semarang, Central Java, Husein Sastranegara International Airport (IATA: BDO) in Bandung, West Java and Adisucipto International Airport (IATA: JOG) in Yogyakarta. On Kalimantan, there is one international airport and there are two on Sumatra. Bali, which is part of the Nusa Tenggara Islands, has the Ngurah Rai International Airport (IATA: DPS). Selaparang Airport (IATA: AMI) is located on the west coast of Lombok. The new Lombok International Airport is due to open in 2011[40][41] at which time Selaparang Airport will either close or may be retained for close regional operations such as DPS-AMI and may possibly be developed as Indonesia's first General Aviation hub airport. There are three major tourists international airports arrivals, i.e. Ngurah Rai International Airport (IATA: DPS) with 2.54 million, Soekarno-Hatta Airport (IATA: CGK) with 1.82 million and Hang Nadim Airport (IATA: BTH), also known as Hang Nadim International Airport, in Batam, Riau Islands with 1.007 million from 7.002 million international tourists recorded as arriving in Indonesia during 2010.[42]

Visa regulations
Visa policy of Indonesia
On February 1, 2004, Indonesia introduced unpopular and tighter tourist visa regulations. Although tourist visas were formerly free and valid for 60 days, visitors from certain countries were now required to purchase one of two visas on arrival (VOA): a US$15 visa valid for 10 days or a US$25 visa valid for 30 days. This was heavily protested by the tourist industry, which
pointed out that this cost adds up for families and 30 days is a very limited time to travel in Indonesia with a number of remote and hard to reach locations. The countries now subject to these tighter regulations include Argentina, Australia, Brazil, Canada, Denmark, Finland, France, Germany, Hungary, Italy, Japan, New Zealand, Norway, Poland, South Africa, South Korea, Switzerland, Taiwan, United Arab Emirates, the United Kingdom and the United States. On July 14, 2004, the Indonesian tourism ministry granted permission for more countries to be included on the VOA list, including Iran, Saudi Arabia, Kuwait, Belgium, Spain, Portugal, Russia, Egypt, Austria, Ireland, Qatar and Luxembourg. These visa were not valid for extension of conversion into any other kind of visa and the visa holder was required to leave the country on or before the 30th day of the stay.

As of January 2010 the regulations changed again and the only type of visa on arrival (VOA) available was for 30 days for a fee of US$25.00. This new version of the VOA may be extended later at a local Immigration office for a further once only period of up to 30 days for a fee of Rp 250,000. The previous 7 day visa on arrival was no longer available from January 2010. Currently Indonesia allows visa free entry to the citizens of 12 countries. The nationals of these countries who are going on holiday, attending conventions or engaging in similar such activities are allowed to stay in Indonesia of up to 30 days without visa. This type of visa cannot be extended, transferred or converted to any other kind of visa; nor can it be used as a working permit. Those visitors eligible under the visa waiver program have a visa issued at the Indonesian border checkpoints with that issuance subject to the discretion of the visa officer. The visa is not for employment and is not extendable. The citizens of the following countries are eligible: Brunei Darussalam, Chile, Ecuador, Hong Kong SAR (Special Administrative Region), Macau SAR (Special Administrative Region), Malaysia, Morocco, Peru, Philippines, Singapore, Thailand, Vietnam. These visas cannot be extended or converted to another type of visa.

The citizens of 17 countries need to obtain an approval from the immigration services head office the Direktorat Jenderal Imigrasi in Jakarta. The 17 countries are: Afghanistan, Israel, Albania, North Korea, Angola, Nigeria, Bangladesh, Pakistan, Cameroon, Somalia, Cuba, Sri Lanka, Ethiopia, Tanzania, Ghana, Tonga, Iraq and those effected must have a sponsor in Indonesia either a personal or company, the sponsor must go in person to the Immigration Head Office in South Jakarta (Jakarta Selatan) and must produce a photocopy of applicant's passport, a supporting letter and the applicant's photograph. When it is approved, the Immigration Head Office will sends a copy of approval letter to the applicant. Visitors to Indonesia are required to be in possession of valid passport with minimum of 6 months validity and a return or an onwards journey ticket at the time of arrival.

Other visa classes are available for entry into Indonesia including:

- Transit visa
- Visit Visa
  Tourist, Social, Business - for single and multiple journey
- Working visa (including dependants)
- Diplomatic service visa.

Diplomatic service passport holders of 9 nations can obtain a 14 day visit visa; Cambodia, Mongolia, Cuba, Montenegro, Croatia, People's Republic of China, India, Peru, Iran, Serbia, North Korea, Turkey, South Korea, Vietnam, Laos, Equador and Myanmar.
Indonesian tourism campaign

Indonesian tourism promotion in internet

The Rhino was the mascot of Visit Indonesia Year, 1991

The official Indonesian government authority that is responsible for tourism sector in Indonesia is the Ministry of Culture and Tourism of Indonesia. Several campaign to promote Indonesian tourism has been launched, either by government or private sectors through various medias; printed media, television and internet.

Visit Indonesia Year 1991

Learning from neighboring countries success, such as Thailand, Singapore and Malaysia, that successfully gained benefit and exploited their tourism sector through intensive promotions, in early 90's Indonesian government launched integrated efforts to promote Indonesian tourism worldwide. The first integrated campaign was coined as Visit Indonesia Year, the first year was the Visit Indonesia Year 1991.[51]

Visit Indonesia Year 2008

The Indonesian Ministry of Culture and Tourism, declared 2008 as a Visit Indonesia Year.[52] Visit Indonesia Year 2008 was officially launched on 26 December 2007.[53] The figure of Visit Indonesia Year 2008 branding took the concept of Garuda Pancasila as the Indonesian way of life. The 5 components of pancasila were represented by 5 different colored lines and symbolized the Indonesian Unity in Diversity. The targeted number was 7 million. Visit Indonesia Year 2008 was also commemorating 100 years of Indonesia's national awakening in 1908.

Visit Indonesia Year 2009

TIME 2009 was held at Santosa Villas & Resort in Senggigi on the west coast Of Lombok NTB. Entering its 16th years of conduct, TIME 2009 was organised by the Indonesian Tourism Promotion Board (ITPB) and received the support of a wide number of tourism participants in Indonesia. TIME 2009 attracted 127 Buyers from 25 countries. The top five buyers were from Korea, India, Malaysia, Indonesia, the United States, and the Netherlands. TIME 2009 also attracted a total of 250 delegates of Sellers from 97 companies of Indonesia occupying 84 booths at the Exhibition. Sellers came from 15 provinces dominated by West Nusa Tenggara, Jakarta, Bali, Central Java, and East Kalimantan as top five Sellers. The percentage of Sellers based on industry was Hotel, Resort & Spa (75%), NTO (10%), Tour Operator/Travel Agent (7%), Adventure/Activity Holiday (3%), Airline (1.5%), and Others (Hotel Management, Tourism Board, Tourism Organization & Travel Portal (8.5%). Amidst current global financial crisis, TIME 2009 booked an estimated of transaction of USD 17.48 million, or increasing 15% from the previous TIME held in Makassar, South Sulawesi in 2008.[54]

Visit Indonesia Year 2010

Following the hosting on the island of Lombok in 2009 the event was again hosted in Lombok-Sumbawa on 12–15 October 2010 at Santosa Villas & Resort in Senggigi on the west coast of Lombok. Entering its 16th years, TIME is organized by the Indonesian Tourism Promotion Board (ITPB) and supported by a wide number of tourism participants in Indonesia. TIME 2010 was supported by the travel and tourism industry in Indonesia, including the Ministry of Culture & Tourism, the Provincial Government of West Nusa Tenggara, West Nusa Tenggara Culture
Tourism Office, Lombok Sumbawa Promo, Garuda Indonesia as Official Airlines, other supporting airlines, Indonesia National Air Carriers Association (INACA), Board of Airline Representatives Indonesia (BARINDO), Association of Indonesian Tours & Travel Agencies (ASITA), Indonesia Hotels and Restaurant Association (PHRI), Indonesian Conference and Convention Association (INCCA), Pacto Convex as the event organizer, supported by national and international media. Lombok and Sumbawa in West Nusa Tenggara have set a target of wooing one million tourists to visit the islands by 2012.

Threats to the tourism industry

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<tr>
<th>Country</th>
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<tr>
<td>Australia</td>
<td>2006-08-21</td>
<td>All Indonesia</td>
<td>Terrorist threats</td>
</tr>
<tr>
<td>UK</td>
<td>2006-08-21</td>
<td>Maluku, Central Sulawesi, Aceh</td>
<td>Regional conflicts</td>
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The initial terrorist attack was the 2002 Bali bombing. This was a major blow to Indonesia’s tourism industry. A series of travel warnings were issued by a number of countries. Subsequently, the rate of tourism in Bali decreased by 32%. After this 2002 attack, the following 3 years also suffered 3 major terrorist bombings: the 2003 Marriott Hotel bombing, the 2004 Australian embassy bombing in Jakarta, and a second bombing in Bali. Fortunately in 2008, no major terrorist attack occurred since 2005, and the United States Government lifted its warning against travel to Indonesia. In 2006, 227,000 Australians visited Indonesia, and in 2007, this tourist rate continued to rise with a recorded 314,000 tourists entering Indonesia. An outbreak of bird flu throughout the country has affected the numbers of foreign visitors. As of 2006, the outbreak had killed at least 46 people since 2005, making Indonesia the country with the highest death-toll from the recent epidemic. However, since the disease has not yet been proven to mutate into a form that can transfer from human to human, the U.S. embassy, for example, has not yet issued a travel warning regarding the outbreak.

Another major threat to the tourism industry are sectarian and separatist conflicts in Indonesia. Papua is still affected by Papuan separatism, while Maluku and Central Sulawesi have suffered in recent years from serious sectarian conflicts. Conversely, decades of separatism-related violence in Aceh ended in 2005 with the signing of a peace agreement between the Indonesia Government and the Free Aceh Movement. In 2008, the U.S. government lifted their travel warning on Indonesia.

Guide books
Guide books and travel accounts with details of the country and people have had a long history - some books from the 19th century and early 20th century being classics with description of places that were perceived as things to see. Both private authors and government publications (such as the 1920s Come to Java books produced in Batavia by the government tourist bureau of the time) have been made each decade through to the present. There were restrictions to tourism during World War II and the mid-to-late 1960s - other than those two periods - travel accounts and guide books have been produced regularly. James Rush's and Adrian Vickers' texts mentioned below are excellent introductions to the range of writing that has been created.
The most popular Guide book on Indonesia in English from the 1970s to the 1990s was Bill Dalton's *Indonesia Handbook*, while from the 1990s onward, the Lonely Planet's edition *Indonesia* has gone to its tenth edition in 2010. Many other guide books have also been produced in English and other languages. Additionally, major international newspapers regularly have travel sections and stories about Indonesia.\[23\]

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Further reading

Lesson 20
Forestry
Forestry is the art and science of tree resources, including plantations and natural stands. The main goal of forestry is to create and implement systems that allow forests to continue a sustainable provision of environmental supplies and services.[1] The challenge of forestry is to create systems that are socially accepted while sustaining the resource and any other resources that might be affected.[2]

Silviculture, a related science, involves the growing and tending of trees and forests. Modern forestry generally embraces a broad range of concerns, including assisting forests to provide timber as raw material for wood products, wildlife habitat, natural water quality management, recreation, landscape and community protection, employment, aesthetically appealing landscapes, biodiversity management, watershed management, erosion control, and preserving forests as 'sinks' for atmospheric carbon dioxide. A practitioner of forestry is known as a forester. The word "forestry" can also refer to a forest itself.

Forest ecosystems have come to be seen as the most important component of the biosphere,[3] and forestry has emerged as a vital field of science, applied art, and technology.

A deciduous beech forest in Slovenia.

History
In the 4th century monks established a plantation of Stone pine, for use as a source of fuel and food, in the then Byzantine Romagna on the Adriatic coast.[4] This was the beginning of the massive forest mentioned by Dante Alighieri in his 1308 poem Divine Comedy.[4] Formal forestry practices were developed by the Visigoths in the 7th century when, faced with the ever increasing shortage of wood, they instituted a code concerned with the preservation of oak and pine forests.[4] The use and management of many forest resources has a long history in China, dating from the Han Dynasty and taking place under the landowning gentry. It was also later written of by the Ming Dynasty Chinese scholar Xu Guangqi (1562–1633). In Europe, control of the land included hunting rights, and though peasants in many places were permitted to gather firewood and building timber and to graze animals, hunting rights were retained by the members of the nobility. Systematic management of forests for a sustainable yield of timber is said to have begun in the 16th century in both the German states and Japan.[5] Typically, a forest was divided into specific sections and mapped; the harvest of timber was planned with an eye to regeneration.
Timber harvesting is a common component of forestry

The practice of establishing tree plantations in the British Isles was promoted by John Evelyn, though it had already acquired some popularity. Louis XIV’s minister Jean-Baptiste Colbert’s oak forest at Tronçais, planted for the future use of the French Navy, matured as expected in the mid-19th century: "Colbert had thought of everything except the steamship," Fernand Braudel observed. Schools of forestry were established after 1825; most of these schools were in Germany and France. During the nineteenth and early twentieth centuries, forest preservation programs were established in the United States, Europe, and British India. Many foresters were either from continental Europe (like Sir Dietrich Brandis), or educated there (like Gifford Pinchot).

The enactment and evolution of forestry laws and binding regulations occurred in most Western nations in the 20th century in response to growing conservation concerns and the increasing technological capacity of logging companies.

Tropical forestry is a separate branch of forestry which deals mainly with equatorial forests that yield woods such as teak and mahogany. Sir Dietrich Brandis is considered the father of tropical forestry.

Today

Today a strong body of research exists regarding the management of forest ecosystems and genetic improvement of tree species and varieties. Forestry also includes the development of better methods for the planting, protecting, thinning, controlled burning, felling, extracting, and processing of timber. One of the applications of modern forestry is reforestation, in which trees are planted and tended in a given area.

In many regions the forest industry is of major ecological, economic, and social importance. Third-party certification systems that provide independent verification of sound forest stewardship and sustainable forestry have become commonplace in many areas since the 1990s. These certification systems were developed as a response to criticism of some forestry practices, particularly deforestation in less developed regions along with concerns over resource
management in the developed world. Some certification systems are criticised for primarily acting as marketing tools and lacking in their claimed independence.

In topographically severe forested terrain, proper forestry is important for the prevention or minimization of serious soil erosion or even landslides. In areas with a high potential for landslides, forests can stabilize soils and prevent property damage or loss, human injury, or loss of life.

Public perception of forest management has become controversial, with growing public concern over perceived mismanagement of the forest and increasing demands that forest land be managed for uses other than pure timber production, for example, indigenous rights, recreation, watershed management, and preservation of wilderness, waterways and wildlife habitat. Sharp disagreements over the role of forest fires, logging, motorized recreation and others drives debate while the public demand for wood products continues to increase.

Foresters

Forester

Foresters of UACH in the Valdivian forests of San Pablo de Tregua, Chile

Foresters work for the timber industry, government agencies, conservation groups, local authorities, urban parks boards, citizens' associations, and private landowners. The forestry profession includes a wide diversity of jobs, with educational requirements ranging from college bachelor's degrees to PhDs for highly specialized work. Industrial foresters plan forest regeneration starting with careful harvesting. Urban foresters manage trees in urban green spaces. Foresters work in tree nurseries growing seedlings for woodland creation or regeneration projects. Foresters improve tree genetics. Forest engineers develop new building systems. Professional foresters measure and model the growth of forests with tools like geographic information systems. Foresters may combat insect infestation, disease, forest and grasslandwildfire, but increasingly allow these natural aspects of forest ecosystems to run their course when the likelihood of epidemics or risk of life or property are low. Increasingly, foresters participate in wildlife conservation planning and watershed protection. Foresters have been mainly concerned with timber management, especially reforestation, maintaining forests at prime conditions, and fire control.[7]

Forestry plans

Foresters develop and implement forest management plans relying on tree inventories showing an area's topographical features as well as its distribution of trees (by species) and other plant cover. Plans also include roads, culverts, proximity to human habitation, hydrological conditions,
and soil reports. Forest management plans include the projected use of the land and a timetable for that use. Traditional forest management plans focus on providing logs used for timber, veneer, plywood, paper, wood fuel or other industries. Hence, considerations of product quality and quantity, employment, and profit have been of central, though not always exclusive, importance. Foresters frequently develop post-harvest site plans for reforestation, weed control, fertilization, or thinning. The objectives of landowners and leaseholder influence plans for harvest and subsequent site treatment. In Britain, plans featuring "good forestry practice" must always consider the needs of other stakeholders such as nearby communities or rural residents living within or adjacent to woodland areas. Foresters consider tree felling and environmental legislation when developing plans. Plans instruct the sustainable harvesting and replacement of trees. They indicate whether road building or other forest engineering operations are required. Agriculture and forest leaders are also trying to understand how the climate change legislation will affect what they do. The information gathered will provide the data that will determine the role of agriculture and forestry in a new climate change regulatory system.\[8\]

Education

Prescribed burning is used by foresters to reduce fuel loads

The first dedicated forestry school was established by Georg Hartig at Dillenburg in Germany in 1787, though forestry had been taught much earlier in central Europe. In 1877, the first issue of Šumarski list (Forestry Review) was published in Croatia by Croatian Forestry Society.\[9\]

In 1886, the first issue of Revista Pădurilor (Forestry Review) was published in Romania.\[10\]

The first in North America, the Biltmore Forest School was established near Asheville, North Carolina, by Carl A. Schenck on September 1, 1898, on the grounds of George W. Vanderbilt's Biltmore Estate. Another early school was the New York State College of Forestry, established at Cornell University just a few weeks later, in September 1898. Early 19th century North American foresters went to Germany to study forestry. Some early German foresters also emigrated to North America.

In South America the first forestry school was established in Brazil, specifically in Viçosa, Minas Gerais, and later moved to Curitiba, Paraná.\[11\]

Today, an acceptably trained forester must be educated in general biology, botany, genetics, soil science, climatology, hydrology, economics and forest management. Education in the basics of sociology and political science is often considered an advantage.

In India, forestry education is imparted in the agricultural universities and in Forest Research Institutes (deemed universities). Four year degree programmes are conducted in these universities at the undergraduate level. Masters and Doctorate degrees are also available in these universities.
In the United States, postsecondary forestry education leading to a Bachelor's degree or Master's degree is accredited by the Society of American Foresters.[12]

In Canada the Canadian Institute of Forestry awards silver rings to graduates from accredited university BSc programs, as well as college and technical programs.[13]

The International Union of Forest Research Organizations is the only international organization that coordinates forest science efforts world-wide.[14] Organizations such as the Forest Policy Education Network are dedicated to facilitating international forest politics and exchanging information on the subject.

Outline of forestry

- Afforestation
- Agroforestry
- Close to nature forestry
- Community forestry
- Deforestation
- Dendrology
- Forest farming
- Forest informatics
- Silvology
- List of forestry universities and colleges

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The Society of American Foresters grants accreditation only to specific educational curricula that lead to a first professional degree in forestry at the bachelor's or master's level.

Further reading


Lesson 21
Plantation

A plantation is a large artificially established forest, farm or estate, where crops are grown for sale, often in distant markets rather than for local on-site consumption. The term *plantation* is informal and not precisely defined. Crops grown on plantations include fast-growing trees (often conifers), cotton, coffee, tobacco, sugar cane, sisal, some oil seeds (notably oil palms) and rubber trees. Farms that produce alfalfa, Lespedeza, clover, and other forage crops are usually not called plantations. The term "plantation" has usually not included large orchards (except for banana plantations), but does include the planting of trees for lumber. A plantation is always a monoculture over a large area and does not include extensive naturally occurring stands of plants that have economic value. Because of its large size, a plantation takes advantage of economies of scale. Protectionist policies and natural comparative advantage have contributed to determining where plantations have been located.

Among the earliest examples of plantations were the latifundia of the Roman Empire, which produced large quantities of wine and olive oil for export. Plantation agriculture grew rapidly with the increase in international trade and the development of a worldwide economy that followed the expansion of European colonial empires. Like every economic activity, it has changed over time. Earlier forms of plantation agriculture were associated with large disparities of wealth and income, foreign ownership and political influence, and exploitative social systems such as indentured labor and slavery. The history of the environmental, social and economic issues relating to plantation agriculture are covered in articles that focus on those subjects.

Forestry

Industrial plantations

![A plantation of Douglas-fir in Washington, U.S.](image)

Industrial plantations are established to produce a high volume of wood in a short period of time. Plantations are grown by state forestry authorities (for example, the Forestry Commission in Britain) and/or the paper and wood industries and other private landowners (such as Weyerhaeuser and International Paper in the United States, Asia Pulp & Paper (APP) in Indonesia). Christmas trees are often grown on plantations as well. In southern and southeastern Asia, rubber, oil palm, and more recently teak plantations have replaced the natural forest. Industrial plantations are actively managed for the commercial production of forest products. Industrial plantations are usually large-scale. Individual blocks are usually even-aged and often consist of just one or two species. These species can be exotic or indigenous. The plants used for the plantation are often genetically improved for desired traits such as growth and resistance to
pests and diseases in general and specific traits, for example in the case of timber species, volumic wood production and stem straightness. Forest genetic resources are the basis for genetic improvement. Selected individuals grown in seed orchards are a good source for seeds to develop adequate planting material.

Wood production on a tree plantation is generally higher than that of natural forests. While forests managed for wood production commonly yield between 1 and 3 cubic meters per hectare per year, plantations of fast-growing species commonly yield between 20 and 30 cubic meters or more per hectare annually; a Grand Fir plantation at Craigvinean in Scotland has a growth rate of 34 cubic meters per hectare per year (Aldhous & Low 1974), and Monterey Pine plantations in southern Australia can yield up to 40 cubic meters per hectare per year (Everard & Fourt 1974). In 2000, while plantations accounted for 5% of global forest, it is estimated that they supplied about 35% of the world's roundwood.[1]

Growth cycle

- In the first year, the ground is prepared usually by the combination of burning, herbicide spraying, and/or cultivation and then saplings are planted by human crew or by machine. The saplings are usually obtained in bulk from industrial nurseries, which may specialize in selective breeding in order to produce fast growing disease- and pest-resistant strains.
- In the first few years until the canopy closes, the saplings are looked after, and may be dusted or sprayed with fertilizers or pesticides until established.
- After the canopy closes, with the tree crowns touching each other, the plantation is becoming dense and crowded, and tree growth is slowing due to competition. This stage is termed 'pole stage'. When competition becomes too intense (for pine trees, when the live crown is less than a third of the tree's total height), it is time to thin out the section. There are several methods for thinning, but where topography permits, the most popular is 'row-thinning', where every third or fourth or fifth row of trees is removed, usually with a harvester. Many trees are removed, leaving regular clear lanes through the section so that the remaining trees have room to expand again. The removed trees are delimbed, forwarded to the forest road, loaded onto trucks, and sent to a mill. A typical pole stage plantation tree is 7–30 cm in diameter at breast height (dbh). Such trees are sometimes not suitable for timber, but are used as pulp for paper and particleboard, and as chips for oriented strand board.
- As the trees grow and become dense and crowded again, the thinning process is repeated. Depending on growth rate and species, trees at this age may be large enough for timber milling; if not, they are again used as pulp and chips.
- Around year 10-60 the plantation is now mature and (in economic terms) is falling off the back side of its growth curve. That is to say, it is passing the point of maximum wood growth per hectare per year, and so is ready for the final harvest. All remaining trees are felled, delimbed, and taken to be processed.
- The ground is cleared, and the cycle is repeated.

Some plantation trees, such as pines and eucalyptus, can be at high risk of fire damage because their leaf oils and resins are flammable to the point of a tree being explosive under some conditions. Conversely, an afflicted plantation can in some cases be cleared of pest species cheaply through the use of a prescribed burn, which kills all lesser plants but does not significantly harm the mature trees.
Criticism of industrial plantations

Bushfires pose a high risk to Eucalyptus plantations.

In contrast to a naturally regenerated forest, plantations are typically grown as even-aged monocultures, primarily for timber production.

- Plantations are usually near- or total monocultures. That is, the same species of tree is planted across a given area, whereas a natural forest would contain a far more diverse range of tree species.

- Plantations may include tree species that would not naturally occur in the area. They may include unconventional types such as hybrids, and genetically modified trees may be used sometime in the future[1]. Since the primary interest in plantations is to produce wood or pulp, the types of trees found in plantations are those that are best-suited to industrial applications. For example, pine, spruce and eucalyptus are widely planted far beyond their natural range because of their fast growth rate, tolerance of rich or degraded agricultural land and potential to produce large volumes of raw material for industrial use.

- Plantations are always young forests in ecological terms. Typically, trees grown in plantations are harvested after 10 to 60 years, rarely up to 120 years. This means that the forests produced by plantations do not contain the type of growth, soil or wildlife typical of old-growth natural forest ecosystems. Most conspicuous is the absence of decaying dead wood, a crucial component of natural forest ecosystems.

In the 1970s, Brazil began to establish high-yield, intensively managed, short rotation plantations. These types of plantations are sometimes called fast-wood plantations or fiber farms and often managed on a short-rotation basis, as little as 5 to 15 years. They are becoming more widespread in South America, Asia and other areas. The environmental and social impacts of this type of plantation has caused them to become controversial. In Indonesia, for example, large multi-national pulp companies have harvested large areas of natural forest without regard for regeneration. From 1980 to 2000, about 50% of the 1.4 million hectares of pulpwood plantations in Indonesia have been established on what was formerly natural forest land.
The replacement of natural forest with tree plantations has also caused social problems. In some countries, again, notably Indonesia, conversions of natural forest are made with little regard for rights of the local people. Plantations established purely for the production of fiber provide a much narrower range of services than the original natural forest for the local people. India has sought to limit this damage by limiting the amount of land owned by one entity and, as a result, smaller plantations are owned by local farmers who then sell the wood to larger companies. Some large environmental organizations are critical of these high-yield plantations and are running an anti-plantation campaign, notably the Rainforest Action Network and Greenpeace.

Farm or home plantations
Farm or home plantations are typically established for the production of timber and fire wood for home use and sometimes for sale. Management may be less intensive than with Industrial plantations. In time, this type of plantation can become difficult to distinguish from naturally regenerated forest.

Teak and bamboo plantations in India have given good results and an alternative crop solution to farmers of central India, where conventional farming was popular. But due to rising input costs of farming many farmers have done teak and bamboo plantations which require very little water (only during first two years). Teak and bamboo have legal protection from theft. Bamboo, once planted, gives output for 50 years till flowering occurs. Teak requires 20 years to grow to full maturity and fetch returns. Indirectly it also contributes to the positive impact on the climate change problem.

Environmental plantations
These may be established for watershed or soil protection. They are established for erosion control, landslide stabilization and windbreaks. Such plantations are established to foster native species and promote forest regeneration on degraded lands as a tool of environmental restoration.

Ecological impact
Probably the single most important factor a plantation has on the local environment is the site where the plantation is established. If natural forest is cleared for a planted forest then a reduction in biodiversity and loss of habitat will likely result. In some cases, their establishment may involve draining wetlands to replace mixed hardwoods that formerly predominated with pine species. If a plantation is established on abandoned agricultural land, or highly degraded land, it can result in an increase in both habitat and biodiversity. A planted forest can be profitably established on lands that will not support agriculture or suffer from lack of natural regeneration.

The tree species used in a plantation is also an important factor. Where non-native varieties or species are grown, few of the native fauna are adapted to exploit these and further biodiversity loss occurs. However, even non-native tree species may serve as corridors for wildlife and act as a buffer for native forest, reducing edge effect.

Once a plantation is established, how it is managed becomes the important environmental factor. The single most important factor of management is the rotation period. Plantations harvested on longer rotation periods (30 years or more) can provide similar benefits to a naturally regenerated forest managed for wood production, on a similar rotation. This is especially true if native species are used. In the case of exotic species, the habitat can be improved significantly if the impact is mitigated by measures such as leaving blocks of native species in the plantation, or retaining corridors of natural forest. In Brazil, similar measures are required by government regulations.
Plantations and natural forest loss
Many forestry experts claim that the establishment of plantations will reduce or eliminate the need to exploit natural forest for wood production. In principle this is true because due to the high productivity of plantations less land is needed. Many point to the example of New Zealand, where 19% of the forest area provides 99% of the supply of industrial round wood. It has been estimated that the world's needs for fiber could be met by just 5% of the world forest (Sedjo & Botkin 1997). However, in practice, plantations are replacing natural forest, for example in Indonesia. According to the FAO, about 7% of the natural closed forest being lost in the tropics is land being converted to plantations. The remaining 93% of the loss is land being converted to agriculture and other uses. Worldwide, an estimated 15% of plantations in tropical countries are established on closed canopy natural forest.
In the Kyoto Protocol, there are proposals encouraging the use of plantations to reduce carbon dioxide levels (though this idea is being challenged by some groups on the grounds that the sequestered CO₂ is eventually released after harvest).

Other types of plantation

Crops may be called plantation crops because of their association with a specific type of farming economy. Most of these involve a large landowner, raising crops with economic value rather than for subsistence, with a number of employees carrying out the work. Often it referred to crops newly introduced to a region. In past times it has been associated with slavery, indentured labour, and other economic models of high inequity. However, arable and dairy farming are both usually (but not always) excluded from such definitions. A comparable economic structure in antiquity was the latifundia that produced commercial quantities of olive oil or wine, for export. One plantation crop is bananas and there are others as well.

High value food crops
Plantings of a number of trees or shrubs grown for food or beverage, including tea, coffee, and cacao are generally called plantations. Some spice and high value crops grown from permanent perennial stock, such as black pepper may also be so called. When the holding belongs to a single individual, that person may be called a planter.

Sugar
Sugar plantations in the Caribbean
Sugar plantations were highly valued in the Caribbean by the British and French colonists in the 19th and 20th centuries and the use of sugar in Europe rose during this period. Sugarcane is still...
an important crop in Cuba. Sugar plantations also arose in countries such as Barbados and Cuba because of the natural endowments that they had. These natural endowments included soil that was conducive to growing sugar and a high marginal product of labor realized through the increasing number of slaves.

Rubber

Plantings of para rubber, the tree *Hevea brasiliensis*, are usually called plantations.

Orchards

Fruit orchards are sometimes considered to be plantations.

Arable crops

These include tobacco, sugarcane, pineapple, and cotton, especially in historical usage. Before the rise of cotton in the American South, indigo and rice were also sometimes called plantation crops.

Fishing plantations in Newfoundland and Labrador

When Newfoundland was colonized by England in 1610, the original colonists were called "Planters" and their fishing rooms were known as "fishing plantations". These terms were used well into the 20th century. The following three plantations are maintained by the Government of Newfoundland and Labrador as provincial heritage sites:

- **Sea-Forest Plantation** was a 17th-century fishing plantation established at Cuper's Cove (present-day Cupids) under a royal charter issued by King James I.
- **Mockbeggar Plantation** is an 18th-century fishing plantation at Bonavista.
- **Pool Plantation** a 17th-century fishing plantation maintained by Sir David Kirke and his heirs at Ferryland. The plantation was destroyed by French invaders in 1696.

Other fishing plantations:

- **Bristol's Hope Plantation**, a 17th-century fishing plantation established at Harbour Grace, created by the Bristol Society of Merchant-Adventurers.
- **Benger Plantation**, an 18th-century fishing plantation maintained by James Benger and his heirs at Ferryland. It was built on the site of Georgia plantation.
- **Piggeon's Plantation**, an 18th-century fishing plantation maintained by Ellias Piggeon at Ferryland.

Slavery, para-slavery and plantations

Plantation economy and Slavery
African slave labor extracted from forcibly transported Africans was used extensively to work on early plantations (such as cotton and sugar plantations) in the United States, throughout the Caribbean, the Americas and in European-occupied areas of Africa. Several notable historians and economists such as Eric Williams, Walter Rodney and Karl Marx contend that the global capitalist economy was largely founded on the creation and produce of thousands of slave labour camps based in colonial plantations exploiting tens of millions of abducted Africans.

In modern times, the low wages typically paid to plantation workers are the basis of plantation profitability in some areas with minimal employee-protection legislation. Sugarcane plantations in the Caribbean and Brazil, worked by slave labour, were also examples of the plantation system.

In more recent times, overt slavery has been replaced by "para-slavery" or slavery-in-kind, including the sharecropping system. At its most extreme, workers are in "debt bondage": they must work to pay off a debt at such punitive interest rates that it may never be paid off. Others work unreasonably long hours and are paid subsistence wages that (in practice) may only be spent in the company store.

In Brazil, a sugarcane plantation was termed an engenho ("engine"), and the 17th-century English usage for organized colonial production was "factory". Such colonial social and economic structures are discussed at Plantation economy. Sugar workers on plantations in Cuba and elsewhere in the Caribbean lived in company towns known as Bateys.

Plantations in the antebellum American South

In the American South, antebellum plantations were centered on a "plantation house", the residence of the owner, where important business was conducted. Slavery and plantations had different characteristics in different regions of the South. As the Upper South of the Chesapeake Bay Colony developed first, historians of the antebellum South defined planters as those who held 20 or more slaves. Major planters held many more, especially in the Deep South as it developed.[2] The majority of slaveholders held 10 or fewer slaves, often just a few to labor
domestically. By the late 18th century, most planters in the Upper South had switched from
exclusive tobacco cultivation to mixed crop production, both because tobacco had exhausted the
soil and because of changing markets. The shift away from tobacco meant they had slaves in
excess of the number needed for labor, and they began to sell them in the internal slave trade.
There was a variety of domestic architecture on plantations. The largest and wealthiest planter
families, for instance, those with estates fronting on the James River in Virginia, constructed
mansions in brick and Georgian style, e.g. Shirley Plantation. Common or smaller planters in the
late 18th and 19th century had more modest wood frame buildings, such as Southall Plantation in
Charles City County.
In the Low Country of South Carolina, by contrast, even before the American Revolution,
planters holding large rice and cotton plantations in South Carolina typically owned hundreds of
slaves. In Charleston and Savannah, the elite also held numerous slaves to work as household
servants. The 19th-century development of the Deep South for cotton cultivation depended on
large plantations with much more acreage than was typical of the Chesapeake Bay area, and for
labor, planters held hundreds of slaves.

Until December 1865 slavery was legal in parts of the United States. Most slaves were employed
in agriculture, and "planter" was a term commonly used to describe a farmer with many slaves.
The term "planter" has no universally accepted definition but academic historians have defined it
to identify the elite class, "a landowning farmer of substantial means."[2] In the "Black Belt"
counties of Alabama and Mississippi, the terms ""planter" and "farmer" were often
synonymous.[3] Robert Fogel and Stanley Engerman define large planters as owning over 50
slaves, and medium planters as owning between 16 and 50 slaves.[4] In his study of Black Belt
counties in Alabama, Jonathan Wiener defines planters by ownership of real property, rather than
of slaves. A planter, for Wiener, owned at least 10,000 dollars worth of real estate in 1850 and
32,000 dollars' worth in 1860, equivalent to about the top 8 percent of landowners.[5] In his study
of southwest Georgia, Lee Formwalt also defines planters in size of land holdings rather than
slaves. Formwalt's planters are in the top 4.5 percent of landowners, translating into real estate
worth six thousand dollars or more in 1850, 24,000 dollars or more in 1860, and eleven thousand
dollars or more in 1870.[6] In his study of Harrison County, Texas, Randolph B. Campbell
classifies large planters as owners of 20 slaves, and small planters as owners of between ten and
19 slaves.[7] In Chicot and Phillips Counties, Arkansas, Carl H. Moneyhon defines large planters
as owners of twenty or more slaves, and six hundred or more acres.[8]

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Lesson 22
Palm Oil Processing
General processing description
Research and development work in many disciplines - biochemistry, chemical and mechanical engineering - and the establishment of plantations, which provided the opportunity for large-scale fully mechanised processing, resulted in the evolution of a sequence of processing steps designed to extract, from a harvested oil palm bunch, a high yield of a product of acceptable quality for the international edible oil trade. The oil winning process, in summary, involves the reception of fresh fruit bunches from the plantations, sterilizing and threshing of the bunches to free the palm fruit, mashing the fruit and pressing out the crude palm oil. The crude oil is further treated to purify and dry it for storage and export.

Large-scale plants, featuring all stages required to produce palm oil to international standards, are generally handling from 3 to 60 tonnes of FFB/hr. The large installations have mechanical handling systems (bucket and screw conveyers, pumps and pipelines) and operate continuously, depending on the availability of FFB. Boilers, fuelled by fibre and shell, produce superheated steam, used to generate electricity through turbine generators. The lower pressure steam from the turbine is used for heating purposes throughout the factory. Most processing operations are automatically controlled and routine sampling and analysis by process control laboratories ensure smooth, efficient operation. Although such large installations are capital intensive, extraction rates of 23 - 24 percent palm oil per bunch can be achieved from good quality Tenera. Conversion of crude palm oil to refined oil involves removal of the products of hydrolysis and oxidation, colour and flavour. After refining, the oil may be separated (fractionated) into liquid and solid phases by thermo-mechanical means (controlled cooling, crystallization, and filtering), and the liquid fraction (olein) is used extensively as a liquid cooking oil in tropical climates, competing successfully with the more expensive groundnut, corn, and sunflower oils.

Extraction of oil from the palm kernels is generally separate from palm oil extraction, and will often be carried out in mills that process other oilseeds (such as groundnuts, rapeseed, cottonseed, shea nuts or copra). The stages in this process comprise grinding the kernels into small particles, heating (cooking), and extracting the oil using an oilseed expeller or petroleum-derived solvent. The oil then requires clarification in a filter press or by sedimentation. Extraction is a well-established industry, with large numbers of international manufacturers able to offer equipment that can process from 10 kg to several tonnes per hour.

Alongside the development of these large-scale fully mechanised oil palm mills and their installation in plantations supplying the international edible oil refining industry, small-scale village and artisanal processing has continued in Africa. Ventures range in throughput from a few hundred kilograms up to 8 tonnes FFB per day and supply crude oil to the domestic market. Efforts to mechanise and improve traditional manual procedures have been undertaken by research bodies, development agencies, and private sector engineering companies, but these activities have been piecemeal and uncoordinated. They have generally concentrated on removing the tedium and drudgery from the mashing or pounding stage (digestion), and improving the efficiency of oil extraction. Small mechanical, motorised digesters (mainly scaled-down but unheated versions of the large-scale units described above), have been developed in most oil palm cultivating African countries.

Palm oil processors of all sizes go through these unit operational stages. They differ in the level of mechanisation of each unit operation and the interconnecting materials transfer mechanisms.
that make the system batch or continuous. The scale of operations differs at the level of process and product quality control that may be achieved by the method of mechanisation adopted. The technical terms referred to in the diagram above will be described later.

The general flow diagram is as follows:

**PALM OIL PROCESSING UNIT OPERATIONS**

1. BUNCH RECESSION
2. BUNCH STERILIZATION
3. BUNCH THRESHING
4. FRUIT DIGESTION
5. PULP PRESSING
6. OIL CLARIFICATION
7. OIL DRYING
8. OIL PACKING
9. NUT RECOVERY
10. NUT DRYING
11. NUT CRACKING
12. KERNEL SEPARATION
13. KERNEL STORAGE

Harvesting technique and handling effects

In the early stages of fruit formation, the oil content of the fruit is very low. As the fruit approaches maturity the formation of oil increases rapidly to about 50 percent of mesocarp weigh. In a fresh ripe, un-bruised fruit the free fatty acid (FFA) content of the oil is below 0.3 percent. However, in the ripe fruit the exocarp becomes soft and is more easily attacked by lipolytic enzymes, especially at the base when the fruit becomes detached from the bunch. The enzymatic attack results in an increase in the FFA of the oil through hydrolysis. Research has shown that if the fruit is bruised, the FFA in the damaged part of the fruit increases rapidly to 60
percent in an hour. There is therefore great variation in the composition and quality within the bunch, depending on how much the bunch has been bruised. Harvesting involves the cutting of the bunch from the tree and allowing it to fall to the ground by gravity. Fruits may be damaged in the process of pruning palm fronds to expose the bunch base to facilitate bunch cutting. As the bunch (weighing about 25 kg) falls to the ground the impact bruises the fruit. During loading and unloading of bunches into and out of transport containers there are further opportunities for the fruit to be bruised. In Africa most bunches are conveyed to the processing site in baskets carried on the head. To dismount the load, the tendency is to dump contents of the basket onto the ground. This results in more bruises. Sometimes trucks and push carts, unable to set bunches down gently, convey the cargo from the villages to the processing site. Again, tumbling the fruit bunches from the carriers is rough, resulting in bruising of the soft exocarp. In any case care should be exercised in handling the fruit to avoid excessive bruising. One answer to the many ways in which harvesting, transportation and handling of bunches can cause fruit to be damaged is to process the fruit as early as possible after harvest, say within 48 hours. However the author believes it is better to leave the fruit to ferment for a few days before processing. Connoisseurs of good edible palm oil know that the increased FFA only adds ‘bite’ to the oil flavour. At worst, the high FFA content oil has good laxative effects. The free fatty acid content is not a quality issue for those who consume the crude oil directly, although it is for oil refiners, who have a problem with neutralization of high FFA content palm oil.

Bunch reception
Fresh fruit arrives from the field as bunches or loose fruit. The fresh fruit is normally emptied into wooden boxes suitable for weighing on a scale so that quantities of fruit arriving at the processing site may be checked. Large installations use weighbridges to weigh materials in trucks. The quality standard achieved is initially dependent on the quality of bunches arriving at the mill. The mill cannot improve upon this quality but can prevent or minimise further deterioration. The field factors that affect the composition and final quality of palm oil are genetic, age of the tree, agronomic, environmental, harvesting technique, handling and transport. Many of these factors are beyond the control of a small-scale processor. Perhaps some control may be exercised over harvesting technique as well as post-harvest transport and handling.

Threshing (removal of fruit from the bunches)
The fresh fruit bunch consists of fruit embedded in spikelets growing on a main stem. Manual threshing is achieved by cutting the fruit-laden spikelets from the bunch stem with an axe or machete and then separating the fruit from the spikelets by hand. Children and the elderly in the village earn income as casual labourers performing this activity at the factory site. In a mechanised system a rotating drum or fixed drum equipped with rotary beater bars detach the fruit from the bunch, leaving the spikelets on the stem (Fig. 3). Most small-scale processors do not have the capacity to generate steam for sterilization. Therefore, the threshed fruits are cooked in water. Whole bunches which include spikelets absorb a lot of water in the cooking process. High-pressure steam is more effective in heating bunches without losing much water. Therefore, most small-scale operations thresh bunches before the fruits are cooked, while high-pressure sterilization systems thresh bunches after heating to loosen the fruits.
Small-scale operators use the bunch waste (empty bunches) as cooking fuel. In larger mills the bunch waste is incinerated and the ash, a rich source of potassium, is returned to the plantation as fertilizer.

Sterilization of bunches
Sterilization or cooking means the use of high-temperature wet-heat treatment of loose fruit. Cooking normally uses hot water; sterilization uses pressurized steam. The cooking action serves several purposes.

· Heat treatment destroys oil-splitting enzymes and arrests hydrolysis and autoxidation.
· For large-scale installations, where bunches are cooked whole, the wet heat weakens the fruit stem and makes it easy to remove the fruit from bunches on shaking or tumbling in the threshing machine.
· Heat helps to solidify proteins in which the oil-bearing cells are microscopically dispersed. The protein solidification (coagulation) allows the oil-bearing cells to come together and flow more easily on application of pressure.
· Fruit cooking weakens the pulp structure, softening it and making it easier to detach the fibrous material and its contents during the digestion process. The high heat is enough to partially disrupt the oil-containing cells in the mesocarp and permits oil to be released more readily.
· The moisture introduced by the steam acts chemically to break down gums and resins. The gums and resins cause the oil to foam during frying. Some of the gums and resins are soluble in water. Others can be made soluble in water, when broken down by wet steam (hydrolysis), so that they can be removed during oil clarification. Starches present in the fruit are hydrolyzed and removed in this way.
· When high-pressure steam is used for sterilization, the heat causes the moisture in the nuts to expand. When the pressure is reduced the contraction of the nut leads to the detachment of the kernel from the shell wall, thus loosening the kernels within their shells. The detachment of the kernel from the shell wall greatly facilitates later nut cracking operations. From the foregoing, it is obvious that sterilization (cooking) is one of the most important operations in oil processing, ensuring the success of several other phases.
· However, during sterilization it is important to ensure evacuation of air from the sterilizer. Air not only acts as a barrier to heat transfer, but oil oxidation increases considerably at high temperatures; hence oxidation risks are high during sterilization. Over-sterilization can also lead to poor bleach ability of the resultant oil. Sterilization is also the chief factor responsible for the discolouration of palm kernels, leading to poor bleach ability of the extracted oil and reduction of the protein value of the press cake.

Fig. 3 Bunch thresher (Centre de Formation Technique Steinmetz-Benin)
Fig. 4 Fruit sterilizer (Centre de Formation Technique Steinmetz-Benin)
Digestion of the fruit
Digestion is the process of releasing the palm oil in the fruit through the rupture or breaking down of the oil-bearing cells. The digester commonly used consists of a steam-heated cylindrical vessel fitted with a central rotating shaft carrying a number of beater (stirring) arms. Through the action of the rotating beater arms the fruit is pounded. Pounding, or digesting the fruit at high temperature, helps to reduce the viscosity of the oil, destroys the fruits’ outer covering (exocarp), and completes the disruption of the oil cells already begun in the sterilization phase. Unfortunately, for reasons related to cost and maintenance, most small-scale digesters do not have the heat insulation and steam injections that help to maintain their contents at elevated temperatures during this operation. Contamination from iron is greatest during digestion when the highest rate of metal wear is encountered in the milling process. Iron contamination increases the risk of oil oxidation and the onset of oil rancidity.

Pressing (Extracting the palm oil)
There are two distinct methods of extracting oil from the digested material. One system uses mechanical presses and is called the ‘dry’ method. The other called the ‘wet’ method uses hot water to leach out the oil.
In the ‘dry’ method the objective of the extraction stage is to squeeze the oil out of a mixture of oil, moisture, fibre and nuts by applying mechanical pressure on the digested mash. There are a large number of different types of presses but the principle of operation is similar for each. The presses may be designed for batch (small amounts of material operated upon for a time period) or continuous operations.

Batch presses
In batch operations, material is placed in a heavy metal ‘cage’ and a metal plunger is used to press the material. The main differences in batch press designs are as follows: a) the method used to move the plunger and apply the pressure; b) the amount of pressure in the press; and c) the size of the cage.
The plunger can be moved manually or by a motor. The motorised method is faster but more expensive.
Different designs use either a screw thread (spindle press) (Fig. 4, 5, 6) or a hydraulic system (hydraulic press) (Fig. 7, 8, 9) to move the plunger. Higher pressures may be attained using the hydraulic system but care should be taken to ensure that poisonous hydraulic fluid does not contact the oil or raw material. Hydraulic fluid can absorb moisture from the air and lose its effectiveness and the plungers wear out and need frequent replacement. Spindle press screw threads are made from hard steel and held by softer steel nuts so that the nuts wear out faster than the screw. These are easier and cheaper to replace than the screw.
The size of the cage varies from 5 kg to 30 kg with an average size of 15 kg. The pressure should be increased gradually to allow time for the oil to escape. If the depth of material is too great, oil will be trapped in the centre. To prevent this, heavy plates’ can be inserted into the raw material. The production rate of batch presses depends on the size of the cage and the time needed to fill, press and empty each batch.
Hydraulic presses are faster than spindle screw types and powered presses are faster than manual types. Some types of manual press require considerable effort to operate and do not alleviate drudgery.
Continuous systems
The early centrifuges and hydraulic presses have now given way to specially designed screw-presses similar to those used for other oilseeds. These consist of a cylindrical perforated cage through which runs a closely fitting screw. Digested fruit is continuously conveyed through the cage towards an outlet restricted by a cone, which creates the pressure to expel the oil through the cage perforations (drilled holes). Oil-bearing cells that are not ruptured in the digester will remain unopened if a hydraulic or centrifugal extraction system is employed. Screw presses, due to the turbulence and kneading action exerted on the fruit mass in the press cage, can effectively break open the unopened oil cells and release more oil. These presses act as an additional digester and are efficient in oil extraction.

Moderate metal wear occurs during the pressing operation, creating a source of iron contamination. The rate of wear depends on the type of press, method of pressing, nut-to-fibre ratio, etc. High pressing pressures are reported to have an adverse effect on the bleach ability and oxidative conservation of the extracted oil.

Clarification and drying of oil
The main point of clarification is to separate the oil from its entrained impurities. The fluid coming out of the press is a mixture of palm oil, water, cell debris, fibrous material and ‘non-oily solids’. Because of the non-oily solids the mixture is very thick (viscous). Hot water is therefore added to the press output mixture to thin it. The dilution (addition of water) provides a barrier causing the heavy solids to fall to the bottom of the container while the lighter oil droplets flow through the watery mixture to the top when heat is applied to break the emulsion (oil suspended in water with the aid of gums and resins). Water is added in a ratio of 3:1.

The diluted mixture is passed through a screen to remove coarse fibre. The screened mixture is boiled from one or two hours and then allowed to settle by gravity in the large tank so that the palm oil, being lighter than water, will separate and rise to the top. The clear oil is decanted into a reception tank. This clarified oil still contains traces of water and dirt. To prevent increasing FFA through autocatalytic hydrolysis of the oil, the moisture content of the oil must be reduced to 0.15 to 0.25 percent. Re-heating the decanted oil in a cooking pot and carefully skimming off the dried oil from any engrained dirt removes any residual moisture. Continuous clarifiers consist of three compartments to treat the crude mixture, dry decanted oil and hold finished oil in an outer shell as a heat exchanger. (Fig. 10, 11, 12)

Fig. 5 Spindle press (Luapula, Zambia)
Fig. 6 Spindle press (Luapula, Zambia)

Fig. 7 Another model of spindle press (Nova Technologies Ltd., Nigeria)

Fig. 8 Hydraulic press (manual)
The wastewater from the clarifier is drained off into nearby sludge pits dug for the purpose. No further treatment of the sludge is undertaken in small mills. The accumulated sludge is often collected in buckets and used to kill weeds in the processing area.

Oil storage
In large-scale mills the purified and dried oil is transferred to a tank for storage prior to dispatch from the mill. Since the rate of oxidation of the oil increases with the temperature of storage the oil is normally maintained around 50°C, using hot water or low-pressure steam-heating coils, to prevent solidification and fractionation. Iron contamination from the storage tank may occur if the tank is not lined with a suitable protective coating.
Small-scale mills simply pack the dried oil in used petroleum oil drums or plastic drums and store the drums at ambient temperature.

Kernel recovery
The residue from the press consists of a mixture of fibre and palm nuts. The nuts are separated from the fibre by hand in the small-scale operations. The sorted fibre is covered and allowed to heat, using its own internal exothermic reactions, for about two or three days. The fibre is then pressed in spindle presses to recover a second grade (technical) oil that is used normally in soap-making. The nuts are usually dried and sold to other operators who process them into palm kernel oil. The sorting operation is usually reserved for the youth and elders in the village in a deliberate effort to help them earn some income.
Large-scale mills use the recovered fibre and nutshells to fire the steam boilers. The super-heated steam is then used to drive turbines to generate electricity for the mill. For this reason it makes economic sense to recover the fibre and to shell the palm nuts. In the large-scale kernel recovery process, the nuts contained in the press cake are separated from the fibre in a depericarper. They are then dried and cracked in centrifugal crackers to release the kernels (Fig. 13, 14, 15, 16). The kernels are normally separated from the shells using a combination of winnowing and
hydrocyclones. The kernels are then dried in silos to a moisture content of about 7 percent before packing.

During the nut cracking process some of the kernels are broken. The rate of FFA increase is much faster in broken kernels than in whole kernels. Breakage of kernels should therefore be kept as low as possible, given other processing considerations.

Fig. 9 Manual vertical press (O.P.C., Cameroon)

Fig. 10 Motorised horizontal screw press (Centre Songhai, Benin)
Fig. 11 Combined digester and motorised hydraulic press (Technoserve/Cort Engineering, Ghana)

Fig. 12 Flushing extractor (Cort Engineering Services, Ghana)
## Summary of Unit operations

<table>
<thead>
<tr>
<th>Unit operation</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fruit fermentation</td>
<td>To loosen fruit base from spikelets and to allow ripening processes to abate</td>
</tr>
<tr>
<td>2. Bunch chopping</td>
<td>To facilitate manual removal of fruit</td>
</tr>
<tr>
<td>3. Fruit sorting</td>
<td>To remove and sort fruit from spikelets</td>
</tr>
<tr>
<td>4. Fruit boiling</td>
<td>To sterilize and stop enzymatic spoilage, coagulate protein and expose microscopic oil cells</td>
</tr>
<tr>
<td>5. Fruit digestion</td>
<td>To rupture oil-bearing cells to allow oil flow during extraction while separating fibre from nuts</td>
</tr>
<tr>
<td>6. Mash pressing</td>
<td>To release fluid palm oil using applied pressure on ruptured cellular contents</td>
</tr>
<tr>
<td>7. Oil purification</td>
<td>To boil mixture of oil and water to remove water-soluble gums and resins in the oil, dry decanted oil by further heating</td>
</tr>
<tr>
<td>8. Fibre-nut separation</td>
<td>To separate de-oiled fibre from palm nuts.</td>
</tr>
<tr>
<td>9. Second Pressing</td>
<td>To recover residual oil for use as soap stock</td>
</tr>
<tr>
<td>10. Nut drying</td>
<td>To sun dry nuts for later cracking</td>
</tr>
</tbody>
</table>

Fig. 13 Clarifier tank (O.P.C., Cameroon)
Fig. 14 Clarifier tank (Nova Technologies Ltd., Nigeria)

Fig. 15 Oil filter (Faith Engineering Workshop, Nigeria)
Fig. 16 Palm nut cracker (AGRICO, Ghana)

Fig. 17 Palm nut cracker (NOVA, Technologies, Nigeria)

Fig. 18 Palm nut cracker (Ogunoroke Steele Construction Works Ltd, Nigeria)
Process equipment design and selection criteria

In designing equipment for small-scale oil extraction one of the key factors to consider is the quality required. ‘Quality’ is entirely subjective and depends on the demands of the ultimate consumer. For the edible oil refining industry the most important quality criteria for crude oil are:

- low content of free fatty acids (which are costly to remove during oil refining);
- low content of products of oxidation (which generate off-flavours);
- readily removed colour.

The most critical stages in the processing sequence for a processor seeking to satisfy these criteria are: bunch sterilization as soon as possible after harvest; and effective clarification and drying of the crude oil after extraction.

By contrast, for the domestic consumer of crude palm oil, flavour is the primary quality factor. This is boosted by the fermentation that takes place within the fruit when the bunches are allowed to rest for three or more days after harvesting. Thus sterilization immediately after harvesting is not a crucial consideration. Herbs and spices for flavour are introduced during the oil-drying phase of operations to mask off-flavours. Therefore rigid process control during oil clarification need not be prescribed or incorporated in the design.

The free fatty acids and the trace tocopherols contained in the crude palm oil after natural fermentation also have a laxative effect, which is desirable for African consumers for whom synthetic substitutes are a luxury. The acidity imparts a ‘bite’ to the oil which some consumers prefer. Thus the quality requirements of one market, leading to certain processing imperatives, may conflict with those of another market.

The traditional manual methods are normally referred to as ‘low technology’ production. The mechanised units are likewise referred to as ‘intermediate technology’ production.

The village traditional method of extracting palm oil involves washing pounded fruit mash in warm water and hand squeezing to separate fibre and nuts from the oil/water mixture. A colander, basket or a vessel with fine perforated holes in the bottom is used to filter out fibre and nuts. The wet mixture is then put on the fire and brought to a vigorous boil. After about one or two hours, depending on the volume of material being boiled, the firewood is taken out and the boiled mixture allowed to cool. Herbs may be added to the mixture at this point just before reducing the heat. On cooling to around blood temperature, a calabash or shallow bowl is used to skim off the palm oil. Because of the large quantities of water used in washing the pulp this is called the ‘wet’ method.

A mechanical improvement, based on the traditional wet method process, is achieved by using a vertical digester with perforated bottom plate (to discharge the aqueous phase) and a side chute for discharging the solid phase components. The arrangement combines digestion, pressing and hot water dilution into one mechanical unit operation.

The ‘dry’ method uses a digester to pound the boiled fruit, which is a considerable labour-saving device. The oil in the digested or pounded pulp is separated in a press that may be manual or mechanical. Motorised mechanical presses are preferred, whether hydraulic or screw type.

Most medium- and large-scale processing operations adopt the ’dry’ method of oil extraction. This is because the fibre and nut shells may immediately used to fire the boiler to generate steam for sterilization and other operations, including electricity generation. If the huge volumes of fibre and shells are not used as boiler fuel, serious environmental pollution problems may result.

Too much water in the fibre increases the amount and cost of steam required to dry the fibre. Hence the preference for the dry method in plants handling more than six tonnes FFB per hour.

Processing machinery manufacturers tend to make machines to fit individual processing operations. However, recent developments have been toward the manufacture of integrated machines, combining several process operations such as digestion, pressing and fibre/nut separation into one assembly. It is found that these machines fit into two key process groupings: batch and semi-continuous processes.

Schematic of processing models and associated machinery
NB: NOS = Non-oily solids entrained in oil such as coagulated protein, gums and resins, etc.
The extraction of palm oil from boiled palm fruit can be accomplished by handling successive batches of materials or continuously feeding material to the machines.

Batch systems
The batch systems work directly on successive loads of boiled fruit to extract oil in one operation for clarification. The ‘wet’ method uses a vertical digester (Fig. 11) with a perforated bottom plate to pound a batch of fruit and then flush out the oil and other non-oil solids from the mashed pulp with hot water. The direct screw-press is designed to pound a batch of boiled fruit in the entry section of the machine while exerting pressure on the mashed pulp in another section to expel the palm oil in one operation.
The advantage of the wet system is that it is simple and completely leaches all oil and non-oily solid substances that can be carried in the fluid stream out of the digested mash to give clean and separated nuts and fibre. The aqueous effluent from the vertical digester goes directly to the clarification stage of processing. The amount of water needed to flush the pulp is normally the same as that required for diluting the viscous oil that comes from the mechanical press in preparation for clarification. An inexperienced operator may use too much hot water to leach out the oil and thus consume unnecessary wood fuel.
The ‘wet’ method yield of palm oil is severely reduced when the wash water is cold. In the course of digesting the fruit mash, in the presence of water, there is increased tendency to form an oil/water emulsion that is difficult to separate from the fibre mass. The emulsified oil loss in the fibre can be substantial if care is not taken to ensure full loading of the digester. Vertical
flushing digesters, requiring loading and discharging of a specific amount of material, can thus only be used in a batch operation.

Semi-continuous systems
Continuous systems work sequentially, with one operation feeding directly into another, related to the arrangement and timing of machine operations. Careful engineering of unit operations is required to minimise discontinuities in the feeding of one stage into another. Otherwise some machines have to be stopped periodically for other stations to catch up. When there are discontinuities in the flow of materials between process stations the operations are known as semi-continuous. The dry extraction systems with separate digestion and pressing stations are usually semi-continuous.
Also when digestion and pressing stations are combined into an integrated unit and there is discontinuous feeding of boiled fruit to the digester inlet the operation is termed “semi-continuous”. Once operations have been integrated to attain full continuity the capital investment capacity of small-scale operators has been surpassed, because both machinery and working capital for raw material increases greatly with the increased level of mechanisation.

The dry systems do not need much water for processing, although they have the disadvantage of leaving substantial residual oil in the press cake. The oil content of the press cake can be quite considerable (2-3 percent), depending on the type of press used and the strength of manual operators.

The efficiency with which the various presses can extract oil ranges from 60 to 70 percent for spindle presses, 80-87 percent for hydraulic presses and 75-80 percent for the Caltech screw presses. The first-pressing oil extraction rates also range from 12 to 15 percent for the spindle presses, 14-16 percent for hydraulic presses and 17-19 percent for the motorised screw presses. (Rouziere, 1995)

In many instances the first press cake is then sorted to remove the nuts, and the fibre is subsequently subjected to a second pressing to obtain more oil (an additional 3 to 4 percent on FFB). The second press oil is generally of lower quality, in terms of free fatty acid content and rancidity. Such low-grade oil is used in soap making. Some village processors undertake the traditional hot water washing of the entire press cake immediately after pressing instead of sorting fibre and second pressing.

Local manufacturers have developed a wide range of machinery and equipment for processing palm oil and palm kernel to fit any budget. All the relevant unit operational machines can be produced to various degrees of finish and quality in the Sub-Region. It is the combination of the unit operation into an affordable process chain that distinguishes the manufacturers and their supplies.

From traditional technologies that rely solely on manual labour and simple cooking utensils, raising the level of mechanization depends largely on a balance between the quantity of bunches available for processing in a given locality and the money available for investment in machines. The first consideration should be the availability of raw materials and how to compute the processing scale. Knowing the optimum scale of operations, it is then possible to consider the type of processing techniques. The higher the technology, the more skilful operators will be required to handle the machines. These technical considerations should lead to the equipment selection and examination of the capital investments needed to acquire the necessary machines.

Plant sizing

Assume a Village Group decides to plant oil palm and establishes a program to plant a certain number of seedlings each year over a seven-year period. In the third year the first set of trees
begin to bear fruit. The community wants to establish a processing mill and they call an expert. How is the estimation made of the size and type of processing unit required by the community? Start by establishing the block of planted areas by year so the age of the trees may be determined. The oil palm tree begins to bear fruit from the third year and the yield per tree increases progressively with age until it peaks around 20 years. The yield begins to decline from year 25 through 40 when the economic life of the tree ebbs.

Table 3 describes the potential yields of palm fruit bunches (in metric tonnes) from the planted hectares per year. Estimates in Table 3 are used to calculate the expected annual yield for each annual block. For example, 8 700 seedlings planted in 1998 began to yield fruit in 2000 at the rate of 3 tonnes per hectare to give 198 tonnes for the year. By Year 7 all planted areas will be in production, at different yield rates. The estimated annual yield per planting block is calculated and then the column for the year is added to give the potential raw materials available for processing. For example, in Year 7, when all planted blocks are yielding fruit, the total is 8 919 metric tonnes (see the row designated ‘TOTAL’). How the annual yield is distributed over the entire year needs to be determined in order to know which period demands the attention of processors.

The oil palm tree yield is distributed over the entire year. Most of Central and West Africa experience two rainfall seasons. The oil palm bears fruit in response to the rainfall pattern and hence there are two peak harvesting periods in these regions. Southern hemisphere tropical monsoon regions such as Malawi, Zambia and South East Asia experience only one long rainy season and therefore tend to have a single peak-harvesting season.

For Central and West Africa the annual monthly distribution pattern for produce is expected to show the following variations:

<table>
<thead>
<tr>
<th>Month</th>
<th>Percent yield</th>
<th>Seasonal contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>16</td>
<td>50 %</td>
</tr>
<tr>
<td>June</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>8</td>
<td>34 %</td>
</tr>
<tr>
<td>October</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>February</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

In the peak harvesting month it is estimated that 12 to 16 percent of the annual yield is generally available for processing. The plant that is installed must be capable of processing the peak month output, which is generally estimated as 15 percent of the annual output. Conservatively, it is estimated that the plant will work two shifts during the peak season.

Table 3: Estimated annual yield per hectare (from year of planting)
Table 4: Estimated FFB yields after planting and related plant capacity

<table>
<thead>
<tr>
<th>Hectares</th>
<th>Year/yield in metric tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>198 281 363 396 479 541 568 627 693 726 825 891</td>
</tr>
<tr>
<td>190</td>
<td>- - 570 808 1,045 1,140 1,378 1,558 1,634 1,805 1,995 2,375 2,565</td>
</tr>
<tr>
<td>800</td>
<td>- - 2 400 3 400 4 400 4,800 5,800 6,560 6,880 7,600 8,800 10,000</td>
</tr>
<tr>
<td>400</td>
<td>- - 1 200 1 700 2,200 2,400 2,900 3,280 3,440 4,400 5,200</td>
</tr>
<tr>
<td>400</td>
<td>- - 1 200 1,700 2,200 2,400 2,900 3,280 3,440 5,000</td>
</tr>
<tr>
<td>Total</td>
<td>198 851 3 571 6 041 8 919 10,619 12,526 14,121 15,558 17,041 19,840 23,656</td>
</tr>
<tr>
<td>Peak Month</td>
<td>29.7 128 536 906 1 338 1,593 1,879 2 118 2 334 2,556 2,976 3,548</td>
</tr>
<tr>
<td>Plant Capacity/hr Plant</td>
<td>0.09 0.4 1.7 2.8 4.2 5.0 6.0 6.6 7.5 8.0 9.5 11.0</td>
</tr>
</tbody>
</table>

Source: Poku, K. Feasibility study on Malawi palm oil mill establishment

In Year 3 there is the potential of processing 198 tonnes of fresh fruit bunches. Assuming that the total quantity were to be processed in one location over a 20-day period using 8 hours in the day, we would need a processing unit that handles 186 kg per hour, or 93 kilos/hr if the choice was made to operate 16-hours per day. Table 4 shows capacity based on a 16-hour working day. For this capacity a wet type digester or the dry spindle-press operation would be recommended. By Year 5 the community would require a fully mechanised mill using motorised digesters and presses.

Before the sixth year the community would have to decide whether they want to stay in the small-scale milling category or move up to a medium-scale operation using a continuous system of machines. If the option is to stay small-scale then the community will need to place orders for additional small-scale processing modules. The new set of processing machines can be placed to run alongside the existing facility or located in another village to minimise bunch transportation costs.

The best plant size option for rural Africa is still unknown. Large-scale operations normally require high-skilled labour and management expertise. Most villages do not have such a pool of skilled labour. The villages also lack the social infrastructure such as good accommodation, schools and hospitals that would attract high-skilled labour. Thus, in order to establish a large-
scale processing operation, labour needs to be imported from other parts of the country. To maintain these ‘alien’ workers and managers a provision must be made in the capital investment for housing, schools and clinics near the processing estate. Some of the schooling and medical services must be extended to the whole community or there will be resentment towards the ‘alien’ workers.

Large-scale operations also require rapid transportation of harvested bunches to the processing site, hence the need for investment in roads and civil works. The establishment of large-scale operations creates an overhead burden that is beyond the capacity of a village community. Many of the large-scale operations established in the early 1970s have declined along with the national economies of African nations. The cost structure of these establishments has rendered the output products non-competitive on the international market.

Today decentralised small-scale processing operations are preferred in most parts of Africa.

### Process technology/capital investment considerations

Once the required plant size has been determined, the next item to consider is the amount of money required to buy the necessary machinery. The more money available, the more units can be bought, to minimise the drudgery of processors.

The wide array of machinery options makes it possible for a processor to start operations with a manual spindle-press used to pound the palm fruit. Another may start with a single motorised vertical wet process digester. Further up the investment scale are those who can afford the combination horizontal digester and screw-press or combination horizontal digester and hydraulic press along with the associated sterilizers, threshers, and oil clarifiers. Another combination that is yet to be tried is the combination of a horizontal motorised screw-press in combination with a second stage vertical flushing digester for maximum palm oil extraction and fibre/nut separation.

<table>
<thead>
<tr>
<th>Type of unit</th>
<th>Key machines</th>
<th>Rated capacity (k g FFB/hr)</th>
<th>Extraction efficiency (%)</th>
<th>Capital investment (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single batch unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>Spindle</td>
<td>100-200</td>
<td>55</td>
<td>150-200</td>
</tr>
<tr>
<td></td>
<td>Hydraulic</td>
<td>200-300</td>
<td>67-74</td>
<td>5 000-7 000</td>
</tr>
<tr>
<td></td>
<td>Screw</td>
<td>250-400</td>
<td>77.4</td>
<td>1 500-6 000</td>
</tr>
<tr>
<td>Wet</td>
<td>Vertical digester</td>
<td>500-800</td>
<td>80-90</td>
<td>1 500-2 500</td>
</tr>
<tr>
<td>Dry</td>
<td>Motorised horizontal digester (only)</td>
<td>500-1000</td>
<td>55</td>
<td>2 500-3 000</td>
</tr>
<tr>
<td>Dual separate units</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>Digester + Spindle presses</td>
<td>200-300</td>
<td>60-70</td>
<td>3 000-5 000</td>
</tr>
<tr>
<td></td>
<td>Digester + hydraulic press</td>
<td>400-800</td>
<td>67-78</td>
<td>7 000-10 000</td>
</tr>
<tr>
<td>Semi-continuous combined units</td>
<td>Motorised digester +</td>
<td>500-850</td>
<td>70-87</td>
<td>10 000</td>
</tr>
</tbody>
</table>
Dry hydraulic + spindle-press
Digester + screw-press

<table>
<thead>
<tr>
<th>Source: Compiled from various sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>The extraction efficiency refers to the percentage of oil that the machine can extract in relation to the total oil in the boiled fruit. The type of fruit mix (Dura/Tenera) presented for processing greatly influences the extraction efficiency of all units.</td>
</tr>
<tr>
<td>Many of the installations that use single spindle and manual hydraulic press units require manual pounding with wooden mortars and pestles, foot stomping, etc. Thus the throughput capacity of such a mill is determined by the manual pounding rate. The presses are usually not mechanised and hence the processing capacity of the press is also limited by the size of the press cage and the operator’s energy level for turning the press screw or pumping the hydraulic fluid mechanism.</td>
</tr>
<tr>
<td>Another limiting condition is the affordability of capital equipment. Where the capital equipment cost exceeds a certain value villagers will shy away from taking loans to purchase the combination of operations. The designer must bear in mind that until the rural/urban migration of village youth is reversed the villages will be mainly populated by the elderly. These elders are naturally reluctant to take up long-term loans and the local banks are reluctant to lend to a predominantly aged community group. In Ghana, for instance, capital equipment costs should be around US$10 000 to be affordable to village-based individuals or groups.</td>
</tr>
<tr>
<td>Because of the need to keep initial capital investment to a bare minimum it is imperative that unnecessary mechanised unit operations are eliminated. Work that can be done manually - without overly taxing profitability - should be, thereby taking advantage of surplus labour and creating a stream of wages and salaries in the local community. Operations that are usually associated with drudgery by processors, such as fruit digestion and oil extraction, can be mechanised. Other less strenuous tasks, such as fruit separation and fibre/nut separation, can be contracted out to elderly women and unemployed youth.</td>
</tr>
<tr>
<td>“Small-scale” does not necessarily mean a significant decrease in efficiency. It does, however, mean a reduction in working capital and operating costs. The small mills can be placed at the heart of local communities, minimising reliance on vehicular transport that is normally unavailable in rural communities, given the poor condition of road networks and other infrastructure. This increased accessibility serves to dramatically reduce fruit spoilage and consequent post-harvest losses.</td>
</tr>
<tr>
<td>Culturally, men cultivate or produce while women process and sell. Traditionally, women decide the form in which the produce is to be traded and hence determine the degree of processing they are willing to undertake. These decisions form the basis of traditional technologies upon which innovations are to be derived.</td>
</tr>
<tr>
<td>The operating philosophy for equipment innovation should therefore be an attempt to develop machinery to alleviate the drudgery of female processors while providing additional avenues for the employment of those displaced by the improved technologies, keeping some operations labour-intensive. It is therefore important to mechanise the key drudgery-alleviation equipment that can be easily handled by women.</td>
</tr>
<tr>
<td>Prime mover power is also a major consideration. Most villages do not have electricity and hence the diesel engine is the main source of power. Thus, for cost reasons there cannot be a multiplicity of these engines to drive the required unit operations. Where there is the need to drive several machines the answer could be to use diesel power to generate electricity. The cost</td>
</tr>
</tbody>
</table>
and maintenance of this power source would eliminate most small-scale processors and communities. The power source in such instances acts as a limitation to the number of unit operations that can be mechanised and powered. Systems of pulleys and gears to drive operational machines should be actively considered when designing for village based groups.
Lesson 23
Money Laundry

*The process of taking the proceeds of criminal activity and making them appear legal.*

Laundering allows criminals to transform illegally obtained gain into seemingly legitimate funds. It is a worldwide problem, with approximately $300 billion going through the process annually in the United States. The sale of illegal narcotics accounts for much of this money. Those who commit the underlying criminal activity may attempt to launder the money themselves, but increasingly a new class of criminals provides laundering services to Organized Crime. This new class consists of lawyers, bankers, and accountants.

Criminals want their illegal funds laundered because they can then move their money through society freely, without fear that the funds will be traced to their criminal deeds. In addition, laundering prevents the funds from being confiscated by the police.

Money laundering usually consists of three steps: placement, layering, and integration. Placement is the depositing of funds in financial institutions or the conversion of cash into negotiable instruments. Placement is the most difficult step. The easiest way to begin laundering large amounts of cash is to deposit them into a financial institution. However, under the federal Bank Secrecy Act of 1970 (BSA), 31 U.S.C.A. §§ 5311 et seq., financial institutions are required to report deposits of more than $10,000 in cash made by an individual in a single day. To disguise criminal activity, launderers route cash through a "front" operation; that is, a business such as a check-cashing service or a jewelry store. Another option is to convert the cash into negotiable instruments, such as cashier's checks, money orders, or traveler's checks.

Layering involves the wire transfer of funds through a series of accounts in an attempt to hide the funds' true origins. This often means transferring funds to countries outside the United States that have strict bank-secrecy laws. Such countries include the Cayman Islands, the Bahamas, and Panama. Once deposited in a foreign bank, the funds can be moved through accounts of "shell" corporations, which exist solely for laundering purposes. The high daily volume of wire transfers makes it difficult for law enforcement agencies to trace these transactions.

Integration involves the movement of layered funds, which are no longer traceable to their criminal origin, into the financial world, where they are mixed with funds of legitimate origin. Many banks did not comply with the BSA during the 1970s and early 1980s. Following several federal investigations where it was revealed that banks had failed to report billions of dollars of cash transactions, reporting requirements were strengthened. Congress also enacted the Money Laundering Control Act of 1986 (MLCA), 18 U.S.C.A. §§ 1956 et seq. This statute criminalizes money laundering itself. It centers its attention on the criminals and conspirators who seek to launder the proceeds of illegal activity, including merchants, bankers, and members of the professions who assist criminals with money laundering. Another provision of the MLCA authorizes the government to confiscate all property that is traceable to violations of laws against money laundering.

After the September 11th Attacks on the United States in 2001, the federal government began to investigate more closely the connection between Terrorism and the sale of illegal drugs. According to President GEORGE W. BUSH, "[T]errorists use drug profits to fund their cells to commit acts of murder. If you quit drugs, you join the fight against terror in America." Terrorists have laundered money through such foreign countries as Colombia and Afghanistan. In
September 2002, the Drug Enforcement Administration opened a museum exhibit in New York entitled "Target America: Traffickers, Terrorists and You" in an effort to educate the American public about the connection between drug sales and terrorism.

Further readings
Lesson 24
Sodium Hydroxide

Sodium hydroxide (NaOH), also known as lye and caustic soda, is a caustic metallic base. It is used in many industries, mostly as a strong chemical base in the manufacture of pulp and paper, textiles, drinking water, soaps and detergents and as a drain cleaner. Worldwide production in 2004 was approximately 60 million tonnes, while demand was 51 million tonnes.[1] Pure sodium hydroxide is a white solid available in pellets, flakes, granules, and as a 50% saturated solution. It is hygroscopic and readily absorbs water from the air, so it should be stored in an airtight container. It is very soluble in water with liberation of heat. It also dissolves in ethanol and methanol, though it exhibits lower solubility in these solvents than does potassium hydroxide. Molten sodium hydroxide is also a strong base, but the high temperature required limits applications. It is insoluble in ether and other non-polar solvents. A sodium hydroxide solution will leave a yellow stain on fabric and paper.

Properties
Sodium hydroxide is predominantly ionic, containing sodium cations and hydroxide anions. The hydroxide anion makes sodium hydroxide a strong base which reacts with acids to form water and the corresponding salts.

\[ \Delta H^\circ_{\text{dissolution}} \text{ for aqueous dilution is } -44.45 \text{ kJ / mol; from aqueous solutions at 12.3–61.8 °C, it crystallizes in monohydrate, with a melting point 65.1 °C and density of 1.829 g/cm}^3\]. The standard enthalpy change of formation ( \( \Delta H^\circ_{\text{form}} \)) is −734.95 kJ / mol.

Reactions
With acids
Sodium hydroxide reacts with protic acids to give water and the corresponding salts. For example, with hydrochloric acid, sodium chloride is formed:

\[ \text{NaOH(aq)} + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)} \]

In general such neutralization reactions are represented by one simple net ionic equation:

\[ \text{OH}^- (aq) + \text{H}^+ (aq) \rightarrow \text{H}_2\text{O(l)} \]

This type of reaction with a strong acid releases heat, and hence is referred to as exothermic. Such acid-base reactions can also be used for titrations. However, sodium hydroxide is not used as a primary standard because it is hygroscopic and absorbs carbon dioxide from air.

Sodium hydroxide reacts readily with carboxylic acids to form their salts and is even a strong enough base to form salts with phenols. It is not, however, strong enough to quantitatively produce enolates from carbonyl compounds or deprotonate amines; this would require a superbase.

With acidic oxides
Sodium hydroxide also reacts with acidic oxides, such as sulfur dioxide. Such reactions are often used to "scrub" harmful acidic gases (like SO\textsubscript{2} and H\textsubscript{2}S) produced in the burning of coal and thus prevent their release into the atmosphere. For example,

\[ 2 \text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} \]
With amphoteric metals and oxides
Sodium hydroxide slowly reacts with glass to form sodium silicate, so glass joints and stopcocks exposed to NaOH have a tendency to "freeze". Flasks and glass-lined chemical reactors are damaged by long exposure to hot sodium hydroxide, and the glass becomes frosted. Sodium hydroxide does not attack iron since iron does not have amphoteric properties (i.e., it only dissolves in acid, not base). A few transition metals, however, may react vigorously with sodium hydroxide.
In 1986, an aluminium road tanker in the UK was mistakenly used to transport 25% sodium hydroxide solution\cite[citation needed]{1}, causing pressurization of the contents and damage to the tanker. The pressurization was due to the hydrogen gas which is produced in the reaction between sodium hydroxide and aluminium:
\[
2 \text{Al} + 2 \text{NaOH} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaAlO}_2 + 3 \text{H}_2
\]

Precipitant
Unlike NaOH, the hydroxides of most transition metals are insoluble, and therefore sodium hydroxide can be used to precipitate transition metal hydroxides. Aluminium hydroxide is used as a gelatinous flocculant to filter out particulate matter in water treatment. Aluminium hydroxide is prepared at the treatment plant from aluminium sulfate by reacting it with NaOH:
\[
\text{Al}_2(\text{SO}_4)_3 + 6 \text{NaOH} \rightarrow 2 \text{Al(OH)}_3 + 3 \text{Na}_2\text{SO}_4
\]

Saponification
NaOH can be used for the base-driven hydrolysis of esters (as in saponification), amides and alkyl halides. However, the limited solubility of NaOH in organic solvents means that the more soluble KOH is often preferred.

Electrolysis
In the laboratory, with careful control of conditions, sodium metal can be isolated from the electrolysis of the molten monohydrate according to the following reaction:
\[
4 \text{NaOH·H}_2\text{O(l)} \rightarrow 4 \text{Na(l)} + \text{O}_2(\text{g}) + 6 \text{H}_2\text{O(g)}
\]
The monohydrate does not need to be heated in order to melt, as the process produces enough heat due to ohmic heating. However, it must be initiated with a small quantity of liquid water to create an electrically conductive electrolyte. As the system's temperature increases, the monohydrate will start to melt at about 65 °C as stated above. Only when the temperature reaches about 100 °C can sodium be isolated. Below this temperature, the water produced will react with the sodium, above this point, any water formed will be driven off in the vapour phase, creating an essentially anhydrous reaction. While this process has some advantages over other electrolytic processes, it is not preferred by most chemists for several reasons: a marginal quantity of sodium produced boils at the electrode interface, the vapour thus given off consists primarily of fumed sodium oxide, which tends to settle on any surface in close proximity with corrosive consequences.

Production
Sodium hydroxide is industrially produced as a 50% solution by variations of the electrolytic chloralkali process. Chlorine gas is also produced in this process. Solid sodium hydroxide is
obtained from this solution by the evaporation of water. Solid sodium hydroxide is most commonly sold as flakes, prills, and cast blocks.\footnote{1}

In 2004, world production was estimated at 60 million dry metric tonnes of sodium hydroxide, and demand was estimated at 51 million tonnes.\footnote{1} In 1998, total world production was around 45 million tonnes. North America and Asia collectively contributed around 14 million tonnes, while Europe produced around 10 million tonnes. In the United States, the major producer of sodium hydroxide is the Dow Chemical Company, which has annual production around 3.7 million tonnes from sites at Freeport, Texas, and Plaquemine, Louisiana. Other major US producers include Oxychem, PPG, Olin, Pioneer Companies (which was purchased by Olin), Inc. (PIONA), and Formosa. All of these companies use the chloralkali process.\footnote{2}

Of historic interest is the Leblanc process, which produced sodium carbonate, followed by roasting to create carbon dioxide and sodium oxide, which readily absorbs water to create sodium hydroxide. This method is still occasionally used. It helped establish sodium hydroxide as an important commodity chemical. The Leblanc process was superseded by the Solvay process in the late 19th century.

Sodium hydroxide may be formed by the metathesis reaction between calcium hydroxide (also known as lime) and sodium carbonate (also known as soda ash):\footnote{3}

\[
\text{Ca(OH)}_2 + \text{Na}_2\text{CO}_3 \rightarrow \text{CaCO}_3 + 2 \text{NaOH}
\]

Chloralkali electrolysis

Basic membrane cell used in the electrolysis of brine.

Chloralkali process
Sodium hydroxide is produced (along with chlorine and hydrogen) via the chloralkali process. This involves the electrolysis of an aqueous solution of sodium chloride. The sodium hydroxide builds up at the cathode, where water is reduced to hydrogen gas and hydroxide ion:

\[
2 \text{Na}^+ + 2 \text{H}_2\text{O} + 2 \text{e}^- \rightarrow \text{H}_2 + 2 \text{NaOH}
\]

More accurately:

\[
2 \text{Na}^+\text{Cl}^- + 2 \text{H}_2\text{O} + 2 \text{e}^- \rightarrow \text{H}_2 + 2 \text{Cl}^- + 2 \text{NaOH}
\]

The Cl\(^-\) ions are oxidized to chlorine gas at the anode.

To produce NaOH it is necessary to prevent reaction of the NaOH with the chlorine. This is typically done in one of three ways, of which the membrane cell process is economically the most viable.

- Mercury cell process (also called the Castner-Kellner process); sodium ions are reduced to sodium metal, which forms an amalgam with a mercury cathode; this sodium is then reacted with water to produce NaOH. There have been concerns about mercury releases, although modern plants claim to be safe in this regard.\footnote{4}
• Diaphragm cell process; uses a steel cathode, and the reaction of NaOH with Cl₂ is prevented using a porous diaphragm, often made of asbestos fibers. In the diaphragm cell process the anode area is separated from the cathode area by a permeable diaphragm. The brine is introduced into the anode compartment and flows through the diaphragm into the cathode compartment. A diluted caustic brine leaves the cell. The sodium hydroxide must usually be concentrated to 50% and the salt removed. This is done using an evaporative process with about three tonnes of steam per tonne of sodium hydroxide. The salt separated from the caustic brine can be used to saturate diluted brine. The chlorine contains oxygen and is purified by liquefaction and evaporation.[5][6]

• Membrane cell process; similar to the diaphragm cell process, with a Nafion membrane to separate the cathode and anode reactions. Only sodium ions and a little water pass through the membrane. It produces a higher quality of NaOH. Of the three processes, the membrane cell process requires the lowest consumption of electric energy and the amount of steam needed for concentration of the caustic is relatively small (less than one tonne per tonne of sodium hydroxide).[5][7]

Uses

Sodium hydroxide is the principal strong base used in the chemical industry. In bulk it is most often handled as an aqueous solution, since solutions are cheaper and easier to handle. Sodium hydroxide, a strong base, is responsible for most of these applications. Another strong base such as potassium hydroxide is likely to yield positive results as well.

56% of sodium hydroxide produced is used by the chemical industry, with 25% of the same total used by the paper industry. Sodium hydroxide is also used for the manufacture of sodium salts and detergents, for pH regulation, and for organic synthesis. It is used in the Bayer process of aluminium production.[1]

Sodium hydroxide is used in all sorts of scenarios where it is desirable to increase the alkalinity of a mixture, or to neutralize acids.

For example, sodium hydroxide is used as an additive in drilling mud to increase alkalinity in bentonite mud systems increases the mud viscosity, as well as to neutralise any acid gas (such as hydrogen sulfide and carbon dioxide) which may be encountered in the geological formation as drilling progresses.

In the same industry, poor quality crude oil can be treated with sodium hydroxide to remove sulfurous impurities in a process known as caustic washing. As above, sodium hydroxide reacts.
with weak acids such as hydrogen sulfide and mercaptans to give the non-volatile sodium salts which can be removed. The waste which is formed is toxic and difficult to deal with, and the process is banned in many countries because of this. In 2006, Trafigura used the process and then dumped the waste in Africa.[8][9]

Hydrodesulfurization

Paper making

Sodium hydroxide was also widely used in making paper. Along with sodium sulfide, NaOH is a key component of the white liquor solution used to separate lignin from cellulose fibers in the Kraft process. It also plays a key role in several later stages of the process of bleaching the brown pulp resulting from the pulping process. These stages include oxygen delignification, oxidative extraction, and simple extraction, all of which require a strong alkaline environment with a pH > 10.5 at the end of the stages.

Tissue digestion

In a similar fashion, sodium hydroxide is used to digest tissues, such as in a process that was used with farm animals at one time. This process involved placing a carcass into a sealed chamber, then adding a mixture of sodium hydroxide and water (which breaks the chemical bonds that keep the flesh intact). This eventually turns the body into a coffee-like liquid, and the only solid that remains are bone hulls, which could be crushed between one’s fingertips. Sodium hydroxide is frequently used in the process of decomposing roadkill dumped in landfills by animal disposal contractors. Sodium hydroxide has also been used by criminals to dispose of their victims’ bodies.

Dissolving amphoteric metals and compounds

Strong bases attack aluminium. Sodium hydroxide reacts with aluminium and water to release hydrogen gas. The aluminium takes the oxygen atom from sodium hydroxide (NaOH), which in turn takes the oxygen atom from the water, and releases the two hydrogen atoms. The reaction thus produces hydrogen gas and sodium aluminate. In this reaction, sodium hydroxide acts as an agent to make the solution alkaline, which aluminium can dissolve in. This reaction can be useful in etching, removing anodizing, or converting a polished surface to a satin-like finish, but without further passivation such as anodizing or alodining the surface may become degraded, either under normal use or in severe atmospheric conditions.

In the Bayer process, sodium hydroxide is used in the refining of alumina containing ores (bauxite) to produce alumina (aluminium oxide) which is the raw material used to produce aluminium metal via the electrolytic Hall-Héroult process. Since the alumina is amphoteric, it dissolves in the sodium hydroxide, leaving impurities less soluble at high pH such as iron oxides behind in the form of a highly alkaline red mud.

Ajka alumina plant accident

Other amphoteric metals are zinc and lead which dissolve in concentrated sodium hydroxide solutions to give sodium zincate and sodium plumbate respectively.

Esterification and transesterification reagent

Sodium hydroxide is traditionally used in soap making (cold process soap, saponification). It was made in the nineteenth century for a hard surface rather than liquid product because it was easier to store and transport.

For the manufacture of biodiesel, sodium hydroxide is used as a catalyst for the transesterification of methanol and triglycerides. This only works with anhydrous sodium hydroxide, because combined with water the fat would turn into soap, which would be tainted...
with methanol. It is used more often than potassium hydroxide because it is cheaper and a smaller quantity is needed.

Cleaning agent
Sodium hydroxide is frequently used as an industrial cleaning agent where it is often called "caustic". It is added to water, heated, and then used to clean the process equipment, storage tanks, etc. It can dissolve grease, oils, fats and protein based deposits. Surfactants can also be added to the sodium hydroxide solution in order to stabilize dissolved substances and thus prevent redeposition. A sodium hydroxide soak solution is used as a powerful degreaser on stainless and glass bakeware. It is also a common ingredient in oven cleaners.
A common use of sodium hydroxide is in the production of parts washer detergents. Parts washer detergents based on sodium hydroxide are some of the most aggressive parts washer cleaning chemicals. The sodium hydroxide based detergent include surfactants, rust inhibitors and defoamers. A parts washer heats water and the detergent in a closed cabinet and then sprays the heated sodium hydroxide and hot water at pressure against dirty parts for degreasing applications. Sodium hydroxide used in this manner replaced many solvent based systems in the early 1990s\textsuperscript{[citation needed]} when trichloroethane was outlawed by the Montreal Protocol. Water and sodium hydroxide detergent based parts washers are considered to be an environmental improvement over the solvent based cleaning methods.

Food preparation
Food uses of sodium hydroxide include washing or chemical peeling of fruits and vegetables, chocolate and cocoa processing, caramel coloring production, poultry scalding, soft drink processing, and thickening ice cream. Olives are often soaked in sodium hydroxide for softening; or, if soaked longer, for transformation into black olives. Pretzels and German lye rolls are glazed with a sodium hydroxide solution before baking to make them crisp. Owing to the difficulty in obtaining food grade sodium hydroxide in small quantities for home use, sodium carbonate is often used in place of sodium hydroxide.\textsuperscript{[15]}
Specific foods processed with sodium hydroxide include:

- The Pinoy or Filipino dessert (kakanin) called kutsinta uses a bit of lye water to help give the rice flour batter a jelly like consistency.
- A similar process is also used in the kakanin known as pitsi-pitsi or pichi-pichi (pit-chi-pit-chi) except that the mixture uses grated cassava instead of rice flour.
- The Scandinavian delicacy known as lutefisk (from lutfisk, "lye fish").
- Hominy is dried maize (corn) kernels reconstituted by soaking in lye-water. These expand considerably in size and may be further processed by frying to make corn nuts or by drying and grinding to make grits. Nixtamal is similar, but uses calcium hydroxide instead of sodium hydroxide.
- Sodium hydroxide is also the chemical that causes gelling of egg whites in the production of Century eggs.
- German pretzels are poached in a boiling sodium carbonate solution or cold sodium hydroxide solution before baking, which contributes to their unique crust.
- Lye-water is an essential ingredient in the crust of the traditional baked Chinese moon cakes.
- Most yellow coloured Chinese noodles are made with lye-water but are commonly mistaken for containing egg.
- Black olives result from normal (green) olives being subjected to a lye-based chemical bath.

Domestic uses

Hardware store grade NaOH to be used as drain cleaner

Paint stripping with caustic soda

Sodium hydroxide is used in the home as a drain cleaning agent for clearing clogged drains. It is distributed as a dry crystal or as a thick liquid gel. The chemical mechanism employed is the conversion of grease to a form of soap. Soap is water-soluble, and can be dissolved by flushing with water. This conversion occurs far more rapidly at high temperatures, so commercial drain cleaners may also contain chemicals that react with water to generate heat. Sodium hydroxide also decomposes complex molecules such as the protein that composes hair. Such drain cleaners and their acidic versions are highly caustic and should be handled with care.

Sodium hydroxide is used in some relaxers to straighten hair. However, because of the high incidence and intensity of chemical burns, manufacturers of chemical relaxers use other alkaline chemicals in preparations available to average consumers. Sodium hydroxide relaxers are still available, but they are used mostly by professionals.
A solution of sodium hydroxide in water was traditionally used as the most common paint stripper on wooden objects. Its use has become less common, because it can damage the wood surface, raising the grain and staining the colour.

Safety

Solid sodium hydroxide and solutions of more than 2% by weight (0.5 M) should be labeled as corrosive.

Chemical burn caused by exposure to a sodium hydroxide solution.

Solid sodium hydroxide or solutions of sodium hydroxide may cause chemical burns, permanent injury or scarring if it contacts unprotected human, or other animal, tissue. It may cause blindness if it contacts the eye. Protective equipment such as rubber gloves, safety clothing and eye protection should always be used when handling the material or its solutions. Dissolution of sodium hydroxide is highly exothermic, and the resulting heat may cause heat burns or ignite flammables. It also produces heat when reacted with acids. Sodium hydroxide is corrosive to some metals, e.g. aluminum, which produces flammable hydrogen gas on contact. Sodium hydroxide is also mildly corrosive to glass, which can cause damage to glazing or freezing of ground glass joints.

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Lesson 25
Potential Energy
In physics, potential energy is the energy stored in a body or in a system due to its position in a force field or due to its configuration.\textsuperscript{[1]} The SI unit of measure for energy and work is the Joule (symbol J). The term "potential energy" was coined by the 19th century Scottish engineer and physicist William Rankine.\textsuperscript{[2],[3]}

Overview

Potential energy exists when a force acts upon an object that tends to restore it to a lower energy configuration. This force is often called a restoring force. For example, when a spring is stretched to the left, it exerts a force to the right so as to return to its original, unstretched position. Similarly, when a mass is lifted up, the force of gravity will act so as to bring it back down. The action of stretching the spring or lifting the mass requires energy to perform. The energy that went into lifting up the mass is stored in its position in the gravitational field, while similarly, the energy it took to stretch the spring is stored in the metal. According to the law of conservation of energy, energy cannot be created or destroyed; hence this energy cannot disappear. Instead, it is stored as potential energy. If the spring is released or the mass is dropped, this stored energy will be converted into kinetic energy by the restoring force, which is elasticity in the case of the spring, and gravity in the case of the mass. Think of a roller coaster. When the coaster climbs a hill it has potential energy. At the very top of the hill is its maximum potential energy. When the car speeds down the hill potential energy turns into kinetic. Kinetic energy is greatest at the bottom.
The more formal definition is that potential energy is the energy difference between the energy of an object in a given position and its energy at a reference position. There are various types of potential energy, each associated with a particular type of force. More specifically, every conservative force gives rise to potential energy. For example, the work of an elastic force is called elastic potential energy; work of the gravitational force is called gravitational potential energy; work of the Coulomb force is called electric potential energy; work of the strong nuclear force or weak nuclear force acting on the baryoncharge is called nuclear potential energy; work of intermolecular forces is called intermolecular potential energy. Chemical potential energy, such as the energy stored in fossil fuels, is the work of the Coulomb force during rearrangement of mutual positions of electrons and nuclei in atoms and molecules. Thermal energy usually has two components: the kinetic energy of random motions of particles and the potential energy of their mutual positions.
As a general rule, the work done by a conservative force $F$ will be
\[ W = -\Delta U \]
where $U$ is the change in the potential energy associated with that particular force. Common notations for potential energy are $U, V, E_p$, and $PE$.

Reference level
The potential energy is a function of the state a system is in, and is defined relative to that for a particular state. This reference state is not always a real state, it may also be a limit, such as with the distances between all bodies tending to infinity, provided that the energy involved in tending to that limit is finite, such as in the case of inverse-square law forces. Any arbitrary reference state could be used, therefore it can be chosen based on convenience.
Typically the potential energy of a system depends on the relative positions of its components only, so the reference state can also be expressed in terms of relative positions.

Gravitational potential energy
Gravitational potential and Gravitational energy
Gravitational energy is the potential energy associated with gravitational force. If an object falls from one point to another point inside a gravitational field, the force of gravity will do positive work on the object, and the gravitational potential energy will decrease by the same amount.

Gravitational force keeps the planets in orbit around the Sun.

A trebuchet uses the gravitational potential energy of the counterweight to throw projectiles over long distances.
Consider a book placed on top of a table. When the book is raised from the floor to the table, some external force works against the gravitational force. If the book falls back to the floor, the same work will be done by the gravitational force. Thus, if the book falls off the table, this potential energy goes to accelerate the mass of the book and is converted into kinetic energy. When the book hits the floor this kinetic energy is converted into heat and sound by the impact. The factors that affect an object's gravitational potential energy are its height relative to some reference point, its mass, and the strength of the gravitational field it is in. Thus, a book lying on a table has less gravitational potential energy than the same book on top of a taller cupboard, and less gravitational potential energy than a heavier book lying on the same table. An object at a certain height above the Moon's surface has less gravitational potential energy than at the same height above the Earth's surface because the Moon's gravity is weaker. Note that "height" in the common sense of the term cannot be used for gravitational potential energy calculations when gravity is not assumed to be a constant. The following sections provide more detail.
Local approximation
The strength of a gravitational field varies with location. However, when the change of distance is small in relation to the distances from the center of the source of the gravitational field, this
variation in field strength is negligible and we can assume that the force of gravity on a particular object is constant. Near the surface of the Earth, for example, we assume that the acceleration due to gravity is a constant \( g = 9.81 \text{ m/s}^2 \) ("standard gravity"). In this case, a simple expression for gravitational potential energy can be derived using the \( W = Fd \) equation for work, and the equation

\[
W_F = -\Delta U_F.
\]

When accounting only for mass, gravity, and altitude, the equation is:

\[
U = mg h
\]

where \( U \) is the potential energy of the object relative to its being on the Earth's surface, \( m \) is the mass of the object, \( g \) is the acceleration due to gravity, and \( h \) is the altitude of the object.\(^4\) If \( m \) is expressed in kilograms, \( g \) in meters per second squared and \( h \) in meters then \( U \) will be calculated in joules.

Hence, the potential difference is

\[
\Delta U = mg \Delta h.
\]

General formula

Gravitational field potential energy is determined using Newton's law of universal gravitation. :

\[
U = m_1 \phi_2 = m_1 \left( -\frac{GM_2}{r} \right)
\]

However, over large variations in distance, the approximation that \( g \) is constant is no longer valid, and we have to use calculus and the general mathematical definition of work to determine gravitational potential energy. For the computation of the potential energy we can integrate the gravitational force, whose magnitude is given by Newton's law of gravitation, with respect to the distance \( r \) between the two bodies. Using that definition, the gravitational potential energy of a system of masses \( m_1 \) and \( M_2 \) at a distance \( r \) using gravitational constant \( G \) is

\[
U = -G \frac{m_1 M_2}{r} + K,
\]

where \( K \) is the constant of integration. Choosing the convention that \( K=0 \) makes calculations simpler, albeit at the cost of making \( U \) negative; for why this is physically reasonable, see below.
Given this formula for $U$, the total potential energy of a system of $n$ bodies is found by summing,

$$U = -m \left( G \frac{M_1}{r_1} + G \frac{M_2}{r_2} \right)$$

for all $\frac{n(n-1)}{2}$ pairs of two bodies, the potential energy of the system of those two bodies.

Gravitational potential summation

Considering the system of bodies as the combined set of small particles the bodies consist of, and applying the previous on the particle level we get the negative gravitational binding energy. This potential energy is more strongly negative than the total potential energy of the system of bodies as such since it also includes the negative gravitational binding energy of each body. The potential energy of the system of bodies as such is the negative of the energy needed to separate the bodies from each other to infinity, while the gravitational binding energy is the energy needed to separate all particles from each other to infinity.

therefore,

$$U = -m \sum G \frac{M}{r}$$

Why choose a convention where gravitational energy is negative?

Gravitational potential is a scalar potential energy per unit mass at each point in space associated with the force fields. Notice at $r$ tends to infinity, $\phi$ tends to 0:

$$\phi = -\left( \frac{GM}{r} \right).$$
As with all potential energies, only differences in gravitational potential energy matter for most physical purposes, and the choice of zero point is arbitrary. Given that there is no reasonable criterion for preferring one particular finite \( r \) over another, there seem to be only two reasonable choices for the distance at which \( U \) becomes zero: \( r = 0 \) and \( r = \infty \). The choice of \( U = 0 \) at infinity may seem peculiar, and the consequence that gravitational energy is always negative may seem counterintuitive, but this choice allows gravitational potential energy values to be finite, albeit negative.

The singularity at \( r = 0 \) in the formula for gravitational potential energy means that the only other apparently reasonable alternative choice of convention, with \( U = 0 \) for \( r = 0 \), would result in potential energy being positive, but infinitely large for all nonzero values of \( r \), and would make calculations involving sums or differences of potential energies beyond what is possible with the real number system. Since physicists abhor infinities in their calculations, and \( r \) is always nonzero in practice, the choice of \( U = 0 \) at infinity is by far the more preferable choice, even if the idea of negative energy appears to be peculiar at first.

The negative value for gravitational energy also has deeper implications that make it seem more reasonable in cosmological calculations where the total energy of the universe can meaningfully be considered; see inflation theory for more on this.

**Uses**

Gravitational potential energy has a number of practical uses, notably the generation of hydroelectricity. For example in Dinorwig, Wales, there are two lakes, one at a higher elevation than the other. At times when surplus electricity is not required (and so is comparatively cheap), water is pumped up to the higher lake, thus converting the electrical energy (running the pump) to gravitational potential energy. At times of peak demand for electricity, the water flows back down through electrical generator turbines, converting the potential energy into kinetic energy and then back into electricity. (The process is not completely efficient and much of the original energy from the surplus electricity is in fact lost to friction.) See also pumped storage.

Gravitational potential energy is also used to power clocks in which falling weights operate the mechanism.

**Elastic potential energy**

![Springs](Image)

Springs are used for storing elastic potential energy

**Elastic potential energy**

Elastic potential energy is the potential energy of an elastic object (for example a bow or a catapult) that is deformed under tension or compression (or stressed in formal terminology). It arises as a consequence of a force that tries to restore the object to its original shape, which is most often the electromagnetic force between the atoms and molecules that constitute the object. If the stretch is released, the energy is transformed into kinetic energy.
Calculation of elastic potential energy
The elastic potential energy stored in a stretched spring can be calculated by finding the work necessary to stretch the spring a distance $x$ from its un-stretched length:

$$U_e = -\int \vec{F} \cdot d\vec{x}$$

an ideal spring will follow Hooke's Law:

$$F = -kx$$

The work done (and therefore the stored potential energy) will then be:

$$U_e = -\int \vec{F} \cdot d\vec{x} = -\int -kx\, dx = \frac{1}{2}kx^2.$$

The units are in Joules.
The equation is often used in calculations of positions of mechanical equilibrium. More involved calculations can be found at elastic potential energy.

Chemical potential energy
Chemical energy
Chemical potential energy is a form of potential energy related to the structural arrangement of atoms or molecules. This arrangement may be the result of chemical bonds within a molecule or otherwise. Chemical energy of a chemical substance can be transformed to other forms of energy by a chemical reaction. As an example, when a fuel is burned the chemical energy is converted to heat, same is the case with digestion of food metabolized in a biological organism. Green plants transform solar energy to chemical energy through the process known as photosynthesis, and electrical energy can be converted to chemical energy through electrochemical reactions.
The similar term chemical potential is used to indicate the potential of a substance to undergo a change of configuration, be it in the form of a chemical reaction, spatial transport, particle exchange with a reservoir, etc.

Electric potential energy
Electric potential energy
An object can have potential energy by virtue of its electric charge and several forces related to their presence. There are two main types of this kind of potential energy: electrostatic potential energy, electrodynamic potential energy (also sometimes called magnetic potential energy).

![Plasma formed inside a gas filled sphere](image)

Electrostatic potential energy
In case the electric charge of an object can be assumed to be at rest, it has potential energy due to its position relative to other charged objects.
The electrostatic potential energy is the energy of an electrically charged particle (at rest) in an electric field. It is defined as the work that must be done to move it from an infinite distance away to its present location, in the absence of any non-electrical forces on the object. This energy is non-zero if there is another electrically charged object nearby. The simplest example is the case of two point-like objects $A_1$ and $A_2$ with electrical charges $q_1$ and $q_2$. The work $W$ required to move $A_1$ from an infinite distance to a distance $r$ away from $A_2$ is given by:

$$W = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r},$$

where $\varepsilon_0$ is the electric constant.

This equation is obtained by integrating the Coulomb force between the limits of infinity and $r$. A related quantity called electric potential (commonly denoted with a $V$ for voltage) is equal to the electric potential energy per unit charge.

Electrodynamic potential energy

In case a charged object or its constituent charged particles are not at rest, it generates a magnetic field giving rise to yet another form of potential energy, often termed as magnetic potential energy. This kind of potential energy is a result of the phenomenon magnetism, whereby an object that is magnetic has the potential to move other similar objects. Magnetic objects are said to have some magnetic moment. Magnetic fields and their effects are best studied under electrodynamics.

Nuclear potential energy

Nuclear potential energy is the potential energy of the particles inside an atomic nucleus. The nuclear particles are bound together by the strong nuclear force. Weak nuclear forces provide the potential energy for certain kinds of radioactive decay, such as beta decay.

Nuclear particles like protons and neutrons are not destroyed in fission and fusion processes, but collections of them have less mass than if they were individually free, and this mass difference is liberated as heat and radiation in nuclear reactions (the heat and radiation have the missing mass, but it often escapes from the system, where it is not measured). The energy from the Sun is an example of this form of energy conversion. In the Sun, the process of hydrogen fusion converts about 4 million tonnes of solar matter per second into electromagnetic energy, which is radiated into space.

Relation between potential energy, potential and force

Potential energy is closely linked with forces. If the work done moving along a path which starts and ends in the same location is zero, then the force is said to be conservative and it is possible to define a numerical value of potential associated with every point in space. A force field can be re-obtained by taking the negative of the vector gradient of the potential field.

For example, gravity is a conservative force. The associated potential is the gravitational potential, often denoted by $\phi$ or $V$, corresponding to the energy per unit mass as a function of position. The gravitational potential energy of two particles of mass $M$ and $m$ separated by a distance $r$ is

$$U = -\frac{G M m}{r},$$

The gravitational potential (specific energy) of the two bodies is
\[ \phi = - \left( \frac{GM}{r} + \frac{Gm}{r'} \right) = - \frac{G(M+m)}{r} = - \frac{GMm}{\mu r} = \frac{U}{\mu}. \]

where \( \mu \) is the reduced mass.

The work done against gravity by moving an infinitesimal mass from point A with \( U = a \) to point B with \( U = b \) is \( (b - a) \) and the work done going back the other way is \( (a - b) \) so that the total work done in moving from A to B and returning to A is

\[ U_{A \rightarrow B \rightarrow A} = (b - a) + (a - b) = 0. \]

If the potential is redefined at A to be \( a + c \) and the potential at B to be \( b + c \), where \( c \) is a constant (i.e. \( c \) can be any number, positive or negative, but it must be the same at A as it is at B) then the work done going from A to B is

\[ U_{A \rightarrow B} = (b + c) - (a + c) = b - a \]
as before.

In practical terms, this means that one can set the zero of \( U \) and \( \phi \) anywhere one likes. One may set it to be zero at the surface of the Earth, or may find it more convenient to set zero at infinity (as in the expressions given earlier in this section).

A thing to note about conservative forces is that the work done going from A to B does not depend on the route taken. If it did then it would be pointless to define a potential at each point in space. An example of a non-conservative force is friction. With friction, the route taken does affect the amount of work done, and it makes little sense to define a potential associated with friction.

All the examples above are actually force field stored energy (sometimes in disguise). For example in elastic potential energy, stretching an elastic material forces the atoms very slightly further apart. The equilibrium between electromagnetic forces and Pauli repulsion of electrons (they are fermions obeying Fermi statistics) is slightly violated resulting in a small returning force. Scientists rarely discuss forces on an atomic scale. Often interactions are described in terms of energy rather than force. One may think of potential energy as being derived from force or think of force as being derived from potential energy (though the latter approach requires a definition of energy that is independent from force which does not currently exist).

A conservative force can be expressed in the language of differential geometry as a closed form. As Euclidean space is contractible, its de Rham cohomology vanishes, so every closed form is also an exact form, and can be expressed as the gradient of a scalar field. This gives a mathematical justification of the fact that all conservative forces are gradients of a potential field.

Notes
4. Hyperphysics - Gravitational Potential Energy
References


Lesson 26
Product Marketing
Product marketing deals with the first of the "7P"s of marketing, which are Product, Pricing, Place, and Promotion, Packaging, Positioning & People.

Product marketing, as opposed to product management, deals with more outbound marketing tasks. For example, product management deals with the nuts and bolts of product development within a firm, whereas product marketing deals with marketing the product to prospects, customers, and others. Product marketing, as a job function within a firm, also differs from other marketing jobs such as marketing communications ("marcom"), online marketing, advertising, marketing strategy, public relations, etc.

A Product market is something that is referred to when pitching a new product to the general public. The people you are trying to make your product appeal to is your consumer market. For example: If you were pitching a new video game console game to the public, your consumer market would probably be the adult male Video Game market (depending on the type of game). Thus you would carry out market research to find out how best to release the game. Likewise, a massage chair would probably not appeal to younger children, so you would market your product to an older generation.

Role of product marketing

Product marketing in a business addresses five important strategic questions:¹

- *What* products will be offered (i.e., the breadth and depth of the product line)?
- *Who* will be the target customers (i.e., the boundaries of the market segments to be served)?
- How will the products *reach* those (i.e., the distribution channel and are there viable possibilities that create a solid business model)?
- At what *price* should the products be offered?
- How will customers be *introduced* to the products (i.e., advertising)?

Product marketing vs. product management

Product marketing frequently differs from product management in high-tech companies. Whereas the product manager is required to take a product's requirements from the sales and marketing personnel and create a product requirements document (PRD),² which will be used by the engineering team to build the product, the product marketing manager can be engaged in the task of creating a Marketing Requirements Document (MRD), which is used as source for the product management to develop the PRD.

In other companies the product manager creates both the MRDs and the PRDs, while the product marketing manager does outbound tasks like giving product demonstrations in trade shows, creating marketing collateral like hot-sheets, beat-sheets, cheat sheets, data sheets, and white papers. This requires the product marketing manager to be skilled not only in competitor analysis, market research, and technical writing, but also in more business oriented activities like conducting ROI and NPV analyses on technology investments, strategizing how the decision criteria of the prospects or customers can be changed so that they buy the company's product vis-a-vis the competitor's product, etc.

One issue that faces Product Marketers is that they are chartered with developing much of the content for the various constituents (sales, marcom, customers, blogs, etc.). Creating content tends to be given more value than the actual research and thinking that is behind all the content. In smaller high-tech firms or start-ups, product marketing and product management functions can be blurred, and both tasks may be borne by one individual. However, as the company grows
someone needs to focus on creating good requirements documents for the engineering team, whereas someone else needs to focus on how to analyze the market, influence the "analysts", and understand longer term market direction. When such clear demarcation becomes visible, the former falls under the domain of product management, and the latter, under product marketing. In Silicon Valley, in particular, product marketing professionals have considerable domain experience in a particular market or technology or both. Some Silicon Valley firms have titles such as Product Marketing Engineer, who tend to be promoted to managers in due course. The trend that is emerging in Silicon Valley is for companies to hire a team of a product marketing manager with a technical marketing manager. The Technical marketing role is becoming more valuable as companies become more competitive and seek to reduce costs and time to market. Another trend is to have one Product Marketing Manager per group of Product Managers. This is the model that leads to the issue of PMMs being pressured to write content instead of connecting with the market.

Qualifications
The typical education qualification for this area of business is a high level Marketing or Business related degree, e.g. an BBA, MBA, not forgetting sufficient work experience in related areas. As a key skill is to be able to interact with technical staff, a background in engineering or computing is also an asset.

Types
- Value (marketing)
- shopper marketing
- Product management

References
1. This is described in further detail by S. Wheelright and K. Clark in Revolutionizing Product Development (1992), p. 40-41; at the beginning of the section titled "Product/Market Planning and Strategy".
Lesson 27
Midwifery

Midwifery is a health care profession in which providers offer care to childbearing women during pregnancy, labour and birth, and during the postpartum period. They also care for the newborn and assist the mother with breastfeeding.

A practitioner of midwifery is known as a midwife, a term used in reference to both women and men, although the majority of midwives are female.\[^1\] In addition to providing care to women during pregnancy and birth, many midwives also provide primary care to women, well-woman care related to reproductive health, annual gynecological exams, family planning, and menopausal care.

In the term *midwife*, the form -wife is pronounced as expected, but *midwifery* normally sounds like *mid-wiff-ry* or *mid-wiff-ery*.\[^2\]

Midwives are autonomous practitioners who are specialists in low-risk pregnancy, childbirth, and postpartum. They generally strive to help women to have a healthy pregnancy and natural birth experience. Midwives are trained to recognize and deal with deviations from the normal. Obstetricians, in contrast, are specialists in illness related to childbearing and in surgery.\[^3\] The two professions can be complementary, but often are at odds because obstetricians are taught to "actively manage" labor, while midwives are taught not to intervene unless necessary.\[^4\]

Midwives refer women to general practitioners or obstetricians when a pregnant woman requires care beyond the midwives’ area of expertise. In many jurisdictions, these professions work together to provide care to childbearing women. In others, only the midwife is available to provide care. Midwives are trained to handle certain more difficult deliveries, including breech births, twin births and births where the baby is in a posterior position, using non-invasive techniques.

Not only do midwives give the option for a natural birth, they offer lower maternity care cost, reduced mortality and morbidity related to cesarean and other interventions, lower intervention rates, and fewer recovery complications.\[^5\]

Definition

A woman giving birth on a birth chair, from a work by Eucharius Rößlin.

According to the International Confederation of Midwives (a definition that has also been adopted by the World Health Organization and the International Federation of Gynecology and Obstetrics):

A midwife is a person who, having been regularly admitted to a midwifery educational program that is duly recognized in the country in which it is located, has successfully completed the prescribed course of studies in midwifery and has acquired the requisite qualifications to be registered and/or legally licensed to practice midwifery.

The midwife is recognized as a responsible and accountable professional who works in partnership with women to give the necessary support, care and advice during pregnancy, labor and the postpartum period, to conduct births on the midwife's own responsibility and to provide care for the infant. This care includes preventive measures, the promotion of normal birth, the detection of complications in mother and child, accessing of medical or other appropriate assistance and the carrying out of emergency measures.
The midwife has an important task in health counseling and education, not only for the woman, but also within the family and community. This work should involve antenatal education and preparation for parenthood and may extend to women's health, sexual or reproductive health and childcare, and to gain the knowledge to counteract the lack of pain relievers and antiseptics.

A midwife may practice in any setting including in the home, the community, hospitals, clinics or health units.

**Etymology**

The term *midwife* is derived from Middle English: *midwyf*, literally "with-woman", i.e. "the woman with, the woman assisting"[8] (in Middle English and Old English, *mid* = "with", *wīf* = "woman").

**Early Historical Perspective**

Midwives are mentioned in the Old Testament: Exodus, Chapter 1. The Bible describes how the children of Israel (Hebrews) were enslaved in Egypt and they multiplied greatly. The Egyptians became fearful of the potential power of so many Hebrews. Pharaoh, therefore, commanded the Hebrew midwives (named Shiphrah and Puah) to kill all male babies delivered to the Hebrew women. The midwives, however, "feared God" and disobeyed Pharaoh by allowing the male babies to live. When Pharaoh asked the midwives why they had disobeyed his orders, the midwives told him the Hebrew women had easier labors than Egyptian women and delivered their babies before the midwife arrived. "And God dealt well with the midwives" (Exodus, Chap. 1, verse 20).

In ancient Egypt, midwifery was a recognized female occupation, as attested by the Ebers papyrus which dates from 1900 to 1550 BCE. Five columns of this papyrus deal with obstetrics and gynecology, especially concerning the acceleration of parturition and the birth prognosis of the newborn. The Westcar papyrus, dated to 1700 BCE, includes instructions for calculating the expected date of confinement and describes different styles of birth chairs. Bas reliefs in the royal birth rooms at Luxor and other temples also attest to the heavy presence of midwifery in this culture.[9]

Midwifery in Greco-Roman antiquity covered a wide range of women, including old women who continued folk medical traditions in the villages of the Roman Empire, trained midwives who garnered their knowledge from a variety of sources, and highly trained women who were considered female physicians.[10] However, there were certain characteristics desired in a “good” midwife, as described by the physician Soranus of Ephesus in the 2nd century. He states in his work, *Gynecology*, that “a suitable person will be literate, with her wits about her, possessed of a good memory, loving work, respectable and generally not unduly handicapped as regards her senses [i.e., sight, smell, hearing], sound of limb, robust, and, according to some people, endowed with long slim fingers and short nails at her fingertips.” Soranus also recommends that the midwife be of sympathetic disposition (although she need not have borne a child herself) and that she keep her hands soft for the comfort of both mother and child.[11] Pliny, another physician from this time, valued nobility and a quiet and inconspicuous disposition in a midwife.[12] A woman who possessed this combination of physique, virtue, skill, and education must have been difficult to find in antiquity. Consequently, there appears to have been three “grades” of midwives present in ancient times. The first was technically proficient; the second may have read some of the texts on obstetrics and gynecology; but the third was highly trained and reasonably considered a medical specialist with a concentration in midwifery.[12]

Midwives were known by many different titles in antiquity, ranging from *iatrine* (Gr. nurse), *maia* (Gr., midwife), *obstetric* (Lat., obstetrician), and *medica* (Lat., doctor).[13] It appears as
though midwifery was treated differently in the Eastern end of the Mediterranean basin as opposed to the West. In the East, some women advanced beyond the profession of midwife (maia) to that of gynaecologist (iatros gynaikeios, translated as women's doctor), for which formal training was required. Also, there were some gynecological tracts circulating in the medical and educated circles of the East that were written by women with Greek names, although these women were few in number. Based on these facts, it would appear that midwifery in the East was a respectable profession in which respectable women could earn their livelihoods and enough esteem to publish works read and cited by male physicians. In fact, a number of Roman legal provisions strongly suggest that midwives enjoyed status and remuneration comparable to that of male doctors.\[11\] One example of such a midwife is Salpe of Lemnos, who wrote on women’s diseases and was mentioned several times in the works of Pliny.\[12\]

However, in the Roman West, our knowledge of practicing midwives comes mainly from funerary epitaphs. Two hypotheses are suggested by looking at a small sample of these epitaphs. The first is the midwifery was not a profession to which freeborn women of families that had enjoyed free status of several generations were attracted; therefore it seems that most midwives were of servile origin. Second, since most of these funeral epitaphs describe the women as freed, it can be proposed that midwives were generally valued enough, and earned enough income, to be able to gain their freedom. It is not known from these epitaphs how certain slave women were selected for training as midwives. Slave girls may have been apprenticed, and it is most likely that mothers taught their daughters.\[11\]

The actual duties of the midwife in antiquity consisted mainly of assisting in the birthing process, although they may also have helped with other medical problems relating to women when needed. Often, the midwife would call for the assistance of a physician when a more difficult birth was anticipated. In many cases the midwife brought along two or three assistants.\[14\] In antiquity, it was believed by both midwives and physicians that a normal delivery was made easier when a woman sat upright. Therefore, during parturition, midwives brought a stool to the home where the delivery was to take place. In the seat of the birthstool was a crescent-shaped hole through which the baby would be delivered. The birthstool or chair often had armrests for the mother to grasp during the delivery. Most birthstools or chairs had backs which the patient could press against, but Soranus suggests that in some cases the chairs were backless and an assistant would stand behind the mother to support her.\[11\] The midwife sat facing the mother, encouraging and supporting her through the birth, perhaps offering instruction on breathing and pushing, sometimes massaging her vaginal opening, and supporting her perineum during the delivery of the baby. The assistants may have helped by pushing downwards on the top of the mother’s abdomen.

Finally, the midwife received the infant, placed it in pieces of cloth, cut the umbilical cord, and cleansed the baby.\[12\] The child was sprinkled with “fine and powdery salt, or natron or aphronitre” to soak up the birth residue, rinsed, and then powdered and rinsed again. Next, the midwives cleared away any and all mucus present from the nose, mouth, ears, or anus. Midwives were encouraged by Soranus to put olive oil in the baby’s eyes to cleanse away any birth residue, and to place a piece of wool soaked in olive oil over the umbilical cord. After the delivery, the midwife made the initial call on whether or not an infant was healthy and fit to rear. She inspected the newborn for congenital deformities and testing its cry to hear whether or not it was robust and hearty. Ultimately, midwives made a determination about the chances for an infant’s survival and likely recommended that a newborn with any severe deformities be exposed.\[11\]
A 2nd-century terracotta relief from the Ostian tomb of Scribonia Attice, wife of physician-surgeon M. Ulpius Amerimnus, details a childbirth scene. Scribonia was a midwife and the relief shows her in the midst of a delivery. A patient sits in the birthing chair, gripping the handles and the midwife’s assistant stands behind her providing support. Scribonia sits on a low stool in front of the woman, modestly looking away while also assisting the delivery by dilating and massaging the vagina, as encouraged by Soranus.\[12\]

The services of a midwife were not inexpensive; this fact that suggests poorer women who could not afford the services of a professional midwife often had to make do with female relatives. Many wealthier families had their own midwives. However, the vast majority of women in the Greco-Roman world very likely received their maternity care from hired midwives. They may have been highly trained or only possessed a rudimentary knowledge of obstetrics. Also, many families had a choice of whether or not they wanted to employ a midwife who practiced the traditional folk medicine or the newer methods of professional parturition.\[11\] Like a lot of other factors in antiquity, quality gynecological care often depended heavily on the socioeconomic status of the patient.

During the Christian era in Europe, midwives became important to the church due to their role in emergency baptisms, and found themselves regulated by Roman Catholic canon law.\[15\] In Medieval times, childbirth was considered so deadly that the Christian Church told pregnant women to prepare their shrouds and confess their sins in case of death. The Church pointed to Genesis 3:16 as the basis for pain in childbirth, where Eve's punishment for her role in disobeying God was that he would "multiply thy sorrows, and thy conceptions: in sorrow shalt thou bring forth children." A popular medieval saying was, "The better the witch; the better the midwife"; to guard against witchcraft, the Church required midwives to be licensed by a bishop and swear an oath not to use magic when assisting women through labour.\[16\]

Later historical perspective

In the 18th century, a division between surgeons and midwives arose, as medical men\[who?\] began to assert that their modern scientific processes were better for mothers and infants than the folk-medical midwives. At the outset of the 18th century in England, most babies were caught by a midwife, but by the onset of the 19th century, the majority of those babies born to persons of means had a surgeon involved. A number of excellent full-length studies\[which?\] of this historical shift have been written.

German social scientists Gunnar Heinsohn and Otto Steiger theorize that midwifery became a target of persecution and repression by public authorities because midwives not only possessed highly specialized knowledge and skills regarding assisting birth, but also regarding contraception and abortion.\[17\] According to Heinsohn and Steiger's theory, the modern state persecuted the midwives as witches in an effort to repopulate the European continent which had suffered severe loss of manpower as a result of the bubonic plague (also known as the black death) which had swept over the continent in waves, starting in 1348. They thus interpret the witch hunts as attacking midwifery and knowledge about birth control with a demographic goal in mind. Indeed, after the witch hunts, the number of children per mother rose sharply, giving rise to what has been called the "European population explosion" of modern times, producing an enormous youth bulge that enabled Europe to colonize large parts of the rest of the world.\[18\]

While historians specializing in the history of the witch hunts have generally remained critical of this macroeconomic approach and continue to favor micro level perspectives and explanations, prominent historian of birth control John M. Riddle has expressed agreement.\[19\]
There are two main divisions of modern midwifery in the US: nurse-midwives and direct-entry midwives.

Nurse-midwives were introduced in the United States in 1925 by Mary Breckinridge for use in the Frontier Nursing Service (FNS). Breckinridge chose the nurse-midwifery model used in England and Scotland because she expected these nurse-midwives on horseback to serve the health care needs of the families living in the remote hills of eastern Kentucky. This combination of nurse and midwife was very successful. The Metropolitan Life Insurance Company studied the first seven years of the service and reported a substantially lower maternal and infant mortality rate than for the rest of the country. The report concluded that if this type of care was available to other women in the U.S., thousands of lives would be saved, and suggested nurse-midwife training should be made available in the U.S. Breckinridge founded the Frontier Nursing University in 1939, the first nurse-midwifery education program in the U.S. [citation needed]

The Frontier School is still educating nurse-midwives and has added distance learning to its methodology. In 1989 the program became the first distance option for nurses to become nurse-midwives without leaving their home communities. The students do their academic work on-line with the Frontier Nursing University faculty members and they do their clinical practice with a nurse-midwife in their community who is credentialled by Frontier as a clinical faculty member. This community based model has graduated over 1500 nurse-midwives. [20]

In the United States, nurse-midwives are variably licensed depending on the state as advanced practice nurses, midwives or nurse-midwives. Certified Nurse-Midwives are educated in both nursing and midwifery and provide gynecological and midwifery care of relatively healthy women. In addition to licensing, many nurse-midwives have a master's degree in nursing, public health, or midwifery. Nurse-midwives practice in hospitals, medical clinics and private offices and may deliver babies in hospitals, birth centers and at home. They are able to prescribe medications in all 50 states. Nurse-midwives provide care to women from puberty through menopause. Nurse-midwives may work closely with obstetricians, who provide consultation and assistance to patients who develop complications. Often, women with high risk pregnancies can receive the benefits of midwifery care from a nurse-midwife in collaboration with a physician. Currently, 2% of nurse-midwives are men. The American College of Nurse-Midwives accredits nurse-midwifery/midwifery education programs and serves as the national professional society for the nation's certified nurse-midwives and certified midwives. Upon graduation from these
Direct-entry midwives
A direct-entry midwife is educated in the discipline of midwifery in a program or path that does not require prior education as a nurse. Direct-entry midwives learn midwifery through self-study, apprenticeship, a private midwifery school, or a college- or university-based program distinct from the discipline of nursing. A direct-entry midwife is trained to provide the Midwives Model of Care\cite{21} to healthy women and newborns throughout the childbearing cycle primarily in out-of-hospital settings.

Under the umbrella of "direct-entry midwife" are several types of midwives:
A Certified Professional Midwife (CPM) is a knowledgeable, skilled and professional independent midwifery practitioner who has met the standards for certification set by the North American Registry of Midwives\cite{22} (NARM) and is qualified to provide the midwives model of care. The CPM is the only US credential that requires knowledge about and experience in out-of-hospital settings. As of November 2010, there are approximately 1800 CPMs practicing in the US.\cite{23}

A Licensed Midwife is a midwife who is licensed to practice in a particular state. Currently, licensure for direct-entry midwives is available in 24 states.\cite{24}

The term "Lay Midwife" has been used to designate an uncertified or unlicensed midwife who was educated through informal routes such as self-study or apprenticeship rather than through a formal program. This term does not necessarily mean a low level of education, just that the midwife either chose not to become certified or licensed, or there was no certification available for her type of education (as was the fact before the Certified Professional Midwife (CPM) credential was available).\cite{25}

The American College of Nurse-Midwives (ACNM) also provides accreditation to non-nurse midwife programs, as well as colleges that graduate nurse-midwives. This credential, called the Certified Midwife, is currently recognized in only three states (New York, New Jersey, and Rhode Island). All CMs must pass the same certifying exam administered by the American Midwifery Certification Board for CNMs.

The North American Registry of Midwives (NARM) is a certification agency whose mission is to establish and administer certification for the credential "Certified Professional Midwife" (CPM). The CPM certification process validates entry-level knowledge, skills, and experience vital to responsible midwifery practice. This certification process encompasses multiple educational routes of entry including apprenticeship, self-study, private midwifery schools, college- and university-based midwifery programs, and nurse-midwifery. Created in 1987 by the Midwives' Alliance of North America (MANA), NARM is committed to identifying standards and practices that reflect the excellence and diversity of the independent midwifery community in order to set the standard for North American midwifery.

Practice
Midwives work with women and their families in many different settings. While the vast majority of nurse-midwives work in hospitals\cite{26}, some nurse-midwives and virtually all direct-entry midwives\cite{26} work within the community or home. In many states, midwives form birthing centers where a group of midwives work together. Midwives generally support and
encourage natural childbirth in all practice settings. Laws regarding who can practice midwifery and in what circumstances vary from state to state.

United Kingdom
Midwives are practitioners in their own right in the United Kingdom, and take responsibility for the antenatal, intrapartum and postnatal care of women, up until 28 days after the birth, or as required thereafter. Midwives are the lead health care professional attending the majority of births, mostly in a hospital setting, although home birth is a perfectly safe option for many births. There are a variety of routes to qualifying as a midwife. Most midwives now qualify via a direct entry course, which refers to a three- or four-year course undertaken at university that leads to a degree [diploma courses in midwifery have been discontinued] in midwifery and entitles them to apply for admission to the register. Following completion of nurse training, a nurse may become a registered midwife by completing an eighteen-month post-registration course (leading to a degree qualification), however this route is only available to adult branch nurses, and any child, mental health, or learning disability branch nurse must complete the full three-year course to qualify as a midwife. Midwifery students do not pay tuition fees and are eligible for financial support for living costs while training. Funding varies depending on which country within the UK the student is located and whether they are taking a degree or diploma course. Midwifery degrees are paid for by the National Health Service (NHS). Some students may also be eligible for NHS bursaries.\(^{[27]}\)

All practising midwives must be registered with the Nursing and Midwifery Council and also must have a Supervisor of Midwives through their local supervising authority. Most midwives work within the National Health Service, providing both hospital and community care, but a significant proportion work independently, providing total care for their clients within a community setting. However, recent government proposals to require insurance for all health professionals is threatening independent midwifery in England.\(^{[28]}\)

Midwives are at all times responsible for the woman for whom they are caring, to know when to refer complications to medical staff, to act as the woman's advocate, and to ensure the mother retains choice and control over her childbirth experience.

Midwifery training
Midwifery training is considered one of the most challenging and competitive courses amongst other healthcare subjects\(^{[citation needed]}\). Most midwives undergo a 32 month vocational training program, or an 18 month nurse conversion course (on top of the 32 month nurse training course). Thus midwives potentially could have had up to 5 years of total training. Midwifery training consists of classroom based learning provided by select Universities\(^{[29]}\) in conjunction with hospital and community based training placements at NHS Trusts. Midwives may train to be community Health Visitors (as may Nurses).

Community midwives
Many midwives also work in the community. The role of community midwives include the initial appointments with pregnant women, managing clinics, postnatal care in the home, and attending home births.\(^{[30]}\) A community midwife would typically have a pager and be responsible for a particular area, contacted by ambulance control when needed. Sometimes they are paged to help out in the hospital when there are insufficient midwives available.

Canada
Midwifery was reintroduced as a regulated profession in Canada in the 1990s.\(^{[31]}\) After several decades of intensive political lobbying by midwives and consumers, fully integrated, regulated
and publicly funded midwifery is now part of the health system in the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Nova Scotia, and in the Northwest Territories and Nunavut. Midwifery legislation has recently been proclaimed in New Brunswick where the government is in the process of integrating midwifery services there. Only Prince Edward Island, Yukon and Newfoundland and Labrador do not have legislation in place for the practice of midwifery.

Midwives in Canada come from a variety of backgrounds including: Aboriginal, post nursing certification, direct-entry and "lay" or traditional midwifery. However, after a process of assessment by the provincial regulatory bodies, registrants are all simply known as 'midwives', 'registered midwives' or by the French-language equivalent, 'sage femme', regardless of their route of training. From the original 'alternative' style of midwifery in the 1960s and 1970s, midwifery practice is offered in a variety of ways within regulated provinces: midwives offer continuity of care within small group practices, choice of birthplace, and a focus on the woman as the primary decision-maker in her maternity care. When women or their newborns experience complications, midwives will work in consultation with an appropriate specialist. Registered midwives have access to appropriate diagnostics like blood tests and ultrasounds and can prescribe a limited schedule of medications. Founding principles of the Canadian model of midwifery include informed choice, choice of birth place, continuity of care from a small group of midwives and respect for the woman as the primary decision maker. Midwives typically have hospital privileges and support women's right to choose where she will have her baby. As fully integrated health care providers, Canada's midwifery homebirth outcomes have been excellent.

Five provinces offer a four year university baccalaureate degree in midwifery. In British Columbia, the program is offered at the University of British Columbia. Mount Royal University in Calgary, Alberta offers a Bachelor of Midwifery program. In Ontario, the Midwifery Education Program (MEP) is offered by a consortium of McMaster University, Ryerson University and Laurentian University. In Manitoba the program is offered by University College of the North. In Quebec, the program is offered at the Université du Québec à Trois-Rivières. In northern Quebec and Nunavut, Inuit women are being educated to be midwives in their own communities. A Bridging program for internationally educated midwives is in place in Ontario at Ryerson University. A federally funded Multi-jurisdictional Midwifery Bridging Program is offered in Western Canada. Regulated provinces and territories admit internationally educated midwives to their regulatory body if they can demonstrate competency through a Prior Learning and Experience Assessment (PLEA) process.

The legal recognition of midwifery has brought midwives into the mainstream of health care with universal funding for services, hospital privileges, rights to prescribe medications commonly needed during pregnancy, birth and postpartum, and rights to order blood work and ultrasounds for their own clients and full consultation access to physicians. To protect the tenets of midwifery and support midwives to provide woman-centered care, the regulatory bodies and professional associations have legislation and standards in place to provide protection, particularly for choice of birth place, informed choice and continuity of care. All regulated midwives have malpractice insurance. Any unregulated person who provides care with 'restricted acts' in regulated provinces or territories is practicing midwifery without a license and is subject to investigation and prosecution.

Prior to legislative changes, very few Canadian women had access to midwifery care, in part because it was not funded by the health care system. Legalizing midwifery has made midwifery services available to a wide and diverse population of women and in many communities the
number of available midwives does not meet the growing demand for services. Midwifery services are free to women living in midwifery regulated provinces.

British Columbia
The BC government announced on March 16, 1995 the approval of regulations governing midwifery and establishing the College of Midwives of BC. In 1996, the Health Professional Council released a draft of Bylaws for the College of Midwives of BC which received Cabinet approval on April 13, 1997. In 1998, midwives were officially registered with the College of Midwives of BC.

In BC midwives are primary care providers for women in all stages of pregnancy, from prenatal phase to six weeks postpartum. To see the approximate proportion of women whose primary birth attendant was a midwife in British Columbia see, "What Mothers Say: The Canadian Maternity Experiences Survey. Public Health Agency of Canada. Ottawa, 2009, p. 115. [34]

In BC midwives deliver natural births in hospitals or homes and if a complication arises in a pregnancy, labour, birth or postpartum, a midwife will consult with a specialist such as an obstetrician or paediatrician. Midwives also care for newborns.

Core competencies and restricted activities are included in the BC Health Professions Act

Midwives Regulation.
As of April 2009, the scope of practice for midwives allows them to prescribe certain prescription drugs, use acupuncture for pain relief, assist a surgeon in a Caesarean section delivery and to perform a vacuum extraction delivery. These specialized practices require additional education and certification.

Current Supply: As of May 3, 2011, the College of Midwives of BC reported 202 registrants: 168 General, 1 Conditional, 33 Non-practicing Registrants.

There were 2 midwives per 100,000 people in BC in 2006. [35]

A midwife must be registered with the College of Midwives of BC in order to practice. There are three routes to registration in BC:

To continue licensure midwives must maintain regular recertification in neonatal resuscitation and management of maternal emergencies, maintain the minimum volume of clinical care (40 women), participate in peer case reviews and continuing education activities. [36]

Midwives Education in BC: The University of British Columbia (UBC) has a four year Bachelors of Midwifery program.

Professional Association/College:
College of Midwives of BC.
Midwives Association of BC.
Canadian Association of Midwives.

New Zealand
Midwifery regained its status as an autonomous profession in New Zealand in 1990. The Nurses Amendment Act restored the professional and legal separation of midwifery from nursing, and established midwifery and nursing as separate and distinct professions. Nearly all midwives gaining registration now are direct entry midwives who have not undertaken any nursing training. Registration requires a degree in midwifery. This is a three year full time programme of 45 weeks per year.
Women must choose one of a midwife, a General Practitioner or an Obstetrician to provide their maternity care. About 78 percent choose a midwife (8 percent GP, 8 percent Obstetrician, 6 percent unknown.[37]). Midwives provide maternity care from early pregnancy to 6 weeks postpartum. The midwifery scope of practice covers normal pregnancy and birth. The midwife will either consult or transfer care where there is a departure from normal. Antenatal and postnatal care is normally provided in the woman’s home. Birth can be in the home, a primary birthing unit, or a hospital. Midwifery care is fully funded by the Government. (GP care may be fully funded. Private obstetric care will incur a fee in addition to the government funding.)

Netherlands
Midwives are called vroedvrouw (female midwives), vroedmeester (male midwives), or verloskundige (general) in Dutch. Midwives are independent specialists in physiologic birth. In the Netherlands, home birth is still a common practice, although rates have declined during the past decades. In the period of 2005-2008, 29% of babies were delivered at home rather than in a hospital.[38] Midwives are generally organized as private practices, some of those are hospital-based. In-hospital outpatient childbirth is available in most hospitals. In this case, a woman's own midwife delivers the baby at the delivery room of a hospital, without intervention of an obstetrician.[39] In all settings, midwives will transfer care to an obstetrician in case of a complicated childbirth or need for emergency intervention.

Apart from childbirth and immediate postpartum care, midwives are the first line of care in pregnancy control and education of mothers-to-be. Typical information that is given to mothers includes information about food, alcohol, life style, travel, hobbies, sex, etc.[40] Some midwifery practices give additional care in the form of preconceptional care and help with fertility problems.[41]

Education in midwifery is direct entry, i.e. no previous education as a nurse is needed. A 4-year education program can be followed at four colleges, in Groningen, Amsterdam, Rotterdam and Maastricht. [42]

All care by midwives is legal and it is totally reimbursed by all insurance companies. This includes prenatal care, childbirth (by midwives or obstetricians, at home or in the hospital), as well as postpartum/postnatal care for mother and baby at home.[43][44]

Japan
In Japan, midwifery was first regulated in 1868. Today, midwives must pass a national certification exam. Up until March 1, 2003 only women could be midwives.[45]

Balochistan (Tribal Pakistan)
In Balochistan, midwives are the third most powerful leaders in the community, and the most powerful among women. People say that they give life to a child as the majority of tribal areas have no doctors. Midwives also solve problems between women. If there is a conflict between a man and a woman, the man has more power, and he will go to the tribal chief instead.[46]

Mozambique
When a 16-year-long civil war ended in 1992, Mozambique's health care system was devastated and one in ten women were dying in childbirth. There were only 18 obstetricians for a population of 19 million. In 2004, Mozambique introduced a new health care initiative to train midwives in emergency obstetric care in an attempt to guarantee access to quality medical care during
pregnancy and childbirth. These midwives now perform major surgeries including Cesareans and hysterectomies. As the figures now stand, Mozambique is one of the few countries on track to achieve the United Nations Millennium Development Goal (MDG) of reducing the maternal death rate by 75 percent by 2015.[47]

Traditional Non-Western Societies
The Karbis of Goria Ghuli
The village of Goria Ghuli is an example of a rural and traditional village. The village has no electricity, and they have no access to a telephone. The primary health facility is in Sonapur, which is about 7 km from the village. This health facility has 3 doctors, 2 lady health visitors, 6 auxiliary nurse midwives, 3 microscopists, and 2 pharmacists. The Karbis believe that good health “is the outcome of a pious life and illness is the punishment meted out by spirits”[48] The Karbis have specialists or healers who are not alike; midwives, or ethnogynacologists are one of these specialists. The village has two different categories of midwives. The first is known as the ‘traditional’ midwife, who is also an herbalist. The second is the ‘nurse’ midwife; these are the ‘government’ midwives.[48] Traditional midwives are favored in the village. They receive some informal training that is used to help with before, during, and after pregnancy care of villagers. This information is transferred from generation to generation. In the village there are 3 ethnogynacologist, which can be approached at any time for assistance at the time of delivery. She, and usually another elderly woman in the village help during and after the delivery. If for any reason there are complications, the village midwife will forward the ‘patient’ to the ‘nurse’, and if she is unable to help then they are forwarded to the Primary Health Center. These midwives do not take on the traditional role of a midwife that we may see in the United States, for example. Rather, a huge role of the midwife is as an herbalist for the village.

The Maya of Guatemala
This study was specifically in San Pedro. The midwives of San Pedro have many roles in the society, and are respected highly for them. The shamans of San Pedro are rapidly declining which has caused an increase in the number of midwives, in order to care for the people. They call the midwife, “iyom”. The Maya believe that being pregnant is to be “yawa”, meaning ill.[49] The midwife is an obstetrical and religious specialist all at once. She provides prenatal care, massage, attends delivery, and takes care “takes charge of” mother and child after birth. Midwives in this society are similar to shamens, in that her calling is divine. She is the connection between the spiritual and real world, and in order to protect her ‘patients’ she performs rituals to keep them safe. The load of work for these midwives is huge. There are not many, and they serve most women in the village.[49] (This case study was done in 1975, this society has changed since)

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