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Education for Liberian Development  
project (EHELD)**

# Fast Start Manual

# 2012

**Teacher's Edition**

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# Schedule

## Week 1

### Monday

	All Teams
7:00	Breakfast
8:00	Introduction to the Program
9:00	Team Building
10:00	
11:00	Engineering and Agriculture
12:00	Lunch
13:00	
14:00	Exploratory Hands On Lab
15:00	
16:00	Computer Lab
17:00	
18:00	Dinner

### Tuesday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00	Lunch			
13:00				
14:00	Computer Lab	Exploratory	Hands On	Exploratory
15:00				
16:00	Exploratory	Computer Lab	Exploratory	Hands on
17:00				
18:00	Dinner			

### Wednesday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00	Lunch			
13:00				
14:00	Exploratory	Hands On	Exploratory	Computer Lab
15:00				
16:00	Hands On	Exploratory	Computer Lab	Exploratory
17:00				
18:00	Dinner			

## Thursday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00	Lunch			
13:00				
14:00	Computer Lab	Exploratory	Hands On	Exploratory
15:00				
16:00	Exploratory	Computer Lab	Exploratory	Hands On
17:00				
18:00	Dinner			

## Friday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00	Lunch			
13:00				
14:00	Exploratory	Hands On	Exploratory	Computer Lab
15:00				
16:00	Hands On	Exploratory	Computer Lab	Exploratory
17:00				
18:00	Dinner			

## Week 2

### Monday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00	Lunch			
13:00				
14:00	Computer Lab	Exploratory	Hands On	Exploratory
15:00				
16:00	Exploratory	Computer Lab	Exploratory	Hands On
17:00				
18:00	Dinner			

## Tuesday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00 13:00	Lunch			
14:00 15:00	Exploratory	Hands On	Exploratory	Computer Lab
16:00 17:00	Hands On	Exploratory	Computer Lab	Exploratory
18:00	Dinner			

## Wednesday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00 13:00	Lunch			
14:00 15:00	Computer Lab	Exploratory	Hands On	Exploratory
16:00 17:00	Exploratory	Computer Lab	Exploratory	Hands On
18:00	Dinner			

## Thursday

	Group 1	Group 2	Group 3	Group 4
7:00	Breakfast			
8:00	Life Skills	Life Skills	Life Skills	Life Skills
9:00	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture	Engineering and Agriculture
10:00	English	English	English	English
11:00	Math	Math	Math	Math
12:00 13:00	Lunch			
14:00 15:00	Exploratory	Hands On	Exploratory	Computer Lab
16:00 17:00	Hands On	Exploratory	Computer Lab	Exploratory
18:00	Dinner			



Friday

	All Teams
7:00	Breakfast
8:00	Keynote Speakers
9:00 10:00 11:00	Team Competitions
12:00 13:00	Special Lunch and Certificate Ceremony
14:00	Departure for Home

# Engineering and Agriculture

We'll begin with an outline of this curriculum, which will consist of 8 classes, each lasting 1 hour.

## **Objective:**

To expose you, the students, to the fields of engineering and agriculture, in order to convey the importance and interdependence of these fields and to initiate excitement about them. This will be done through several hands-on demonstrations, lectures, and real-life examples/problems. In-class discussions will allow the students to communicate their ideas and practice their presentation skills.

## **Lesson Plan:**

1. Introduction to Engineering
2. Introduction to Agriculture
3. Disciplines in Engineering
4. Disciplines in Agriculture
5. Interdependency of Engineering and Agriculture
6. Resources and Economics, Sustainability
7. Case Studies to relate Engineering, Agriculture, Resources and Economics
8. Hands-on Exhibition

## Lesson 1: Introduction to Engineering

- What is engineering?
- Why engineering?
- What do engineers do?
- Activity: Is this engineering?
- Activity: Identify problem/solution

**Figure 1:** What would the world be like without engineering? How would we talk to one another when we're not together?



Reference: "The World Without Engineers," Hasaam, <http://hassam.hubpages.com/hub/World-Without-Engineers>. Author undetermined. All Rights Reserved.

### Word Bank

Fill in the blanks below using these words:

Problem	Scientists
Irrigation system	airplane
Math	Tractor
Magnetic levitation	Engineers
Experimentation	Chemical
Designing	Physical
Math	Science
Creating	Boat
Components	Cancer
solves problems!	

### What is engineering?

*Class Discussion:* Can anyone tell us what they think engineering is?

“\_\_\_\_\_ study the world that is; \_\_\_\_\_ create the world that has never been.” – Theodore van Karman (aerospace engineer, 1881-1963)

Engineers are everywhere. In fact, we are all engineers in our own respects. Your mom is an engineer by creating a complete dinner from a variety of individual ingredients. Your dad is an

That is what engineering is: \_\_\_\_\_ and \_\_\_\_\_ a complex system from simple \_\_\_\_\_ to solve a \_\_\_\_\_.

So what are the fruits of engineering? What would an “engineered” product be? We already talked about a cell phone being one, and the building you’re sitting in too. Also, your home is an engineered system. The food you are provided is available because of an engineered system that was able to provide water to the plants/animals, harvest those items, and then transport them to your table.

*Class discussion:* What are some other engineered products?

What is the purpose of all these engineered things? Why is engineering even important? Because it

because it is a major problem we face as humans.



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ci%27 fu%27 lie%27 che.jpg](http://commons.wikimedia.org/wiki/File:The_Maglev_-_ci%27_fu%27_lie%27_che.jpg)

These are all solutions that are created in order to fix the problems we face, to meet the needs of our societies, and/or to make living life easier and more efficient.

### **How is engineering done?**

Finally, how might someone actually *engineer* something? What steps are required to go from having an issue, to creating the solution? First, engineers identify the problem, or the issue that needs to be dealt with or improved. This may be something like the need to provide more water for the crops on a farm. They then come up with various solutions (through brainstorming), and analyze which solution is the most feasible. To provide more water for the crops, engineers could: 1) make it rain more, 2) make the crops drink juice, or 3) collect rainwater and develop a system to distribute it to the crops. Once they have decided on a possible solution, the engineer(s) design a way to achieve it, using a combination of \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_. In the example, engineers would probably choose to develop a system using collected rainwater to water the crops. They would do this by using math and science principles to design a piping system that can access all the crops, and also pump water from the source. They can then test this system to see what works, and fix it to make it work efficiently. A system like this is actually in use everywhere today, it is called an \_\_\_\_\_.

In another example, when travel on land took too much time and effort, and limited the distance people could go, some engineers thought of making a way to fly through the air, in order to go faster and avoid the delay of land travel. So they thought of developing the \_\_\_\_\_, which is a very complex system that is based heavily on science and math. Airplanes can stay up in the air because of many concepts analyzed by engineers, such as \_\_\_\_\_ principles like gravity, drag, and force, or \_\_\_\_\_ principles, which determine what materials to make the airplane cabin, wings, and engines out of. Finally, \_\_\_\_\_ helps an engineer tie everything together – what size wings are needed to carry a cabin of 300 people, the engine power required to accelerate the airplane to the necessary speed for flight, etc. So engineering is once again, the compilation of a variety of individual concepts and ideas, such as those of basic science and math.

So now that we have talked to you about what engineering is in general, let's see if you guys and girls are able to identify if something is engineering or not.

### **Class Activity: Is this engineering?**

On the following worksheet, try to identify which items are engineered by humans, and which items are naturally occurring. This will help to see if you can determine what engineering is.

### **Summary:**

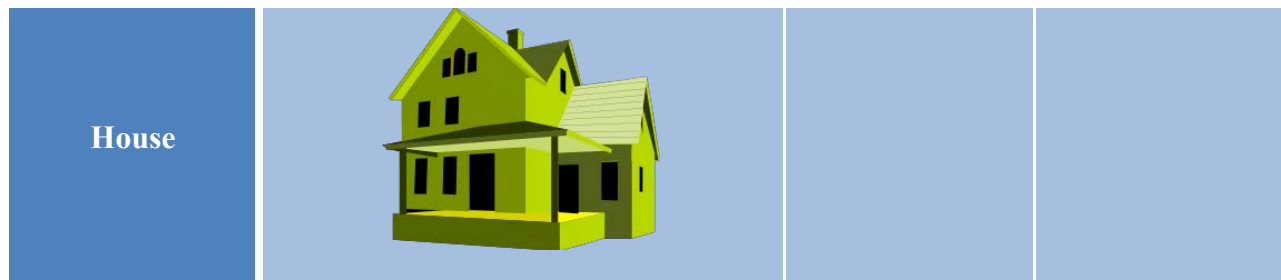
In this lesson, we learned that engineering is a very essential and useful field for humanity. It allows us to solve problems that we face in our everyday lives, as well as develop ways to make life easier and more efficient. The next lesson concerning engineering will dive deeper into the various disciplines within the field, where we will learn specifically what type of engineer it takes to solve various problems.

### Is this Engineering? Worksheet

Take a look at each of the items listed below. Is the item a product of engineering? Or not? Make your selection and check off the corresponding column.

		Engineering	Not Engineering
Sun			
Bicycle			
Apple			
Cow			
Mobile phone			

Oil Rig			
Lightning			
Table			
Gold			
Computer			
Electricity			



#### Image sources from table:

- Sun:  Nicubunu, OpenClipArt, <http://openclipart.org/detail/22012/weather-symbols:-sun-by-nicubunu>
- Bicycle:  Franck Doucet, OpenClipArt, <http://openclipart.org/detail/23878/blue-bike-by-anonymous-23878>
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- Mobile phone:  jhnri4, OpenClipArt, <http://openclipart.org/detail/163789/iphone-44s-by-jhnri4>
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- Electricity:  Liftarn, OpenClipArt <http://openclipart.org/detail/2437/plug-and-outlet-by-liftarn>
- House:  sheikh\_tuhin, OpenClipArt, [http://openclipart.org/detail/58441/house-by-sheikh\\_tuhin](http://openclipart.org/detail/58441/house-by-sheikh_tuhin)



## Lesson 2: Introduction to Agriculture

I. What does agriculture mean to you?

II. The World Around Us

- What is an Ecosystem?

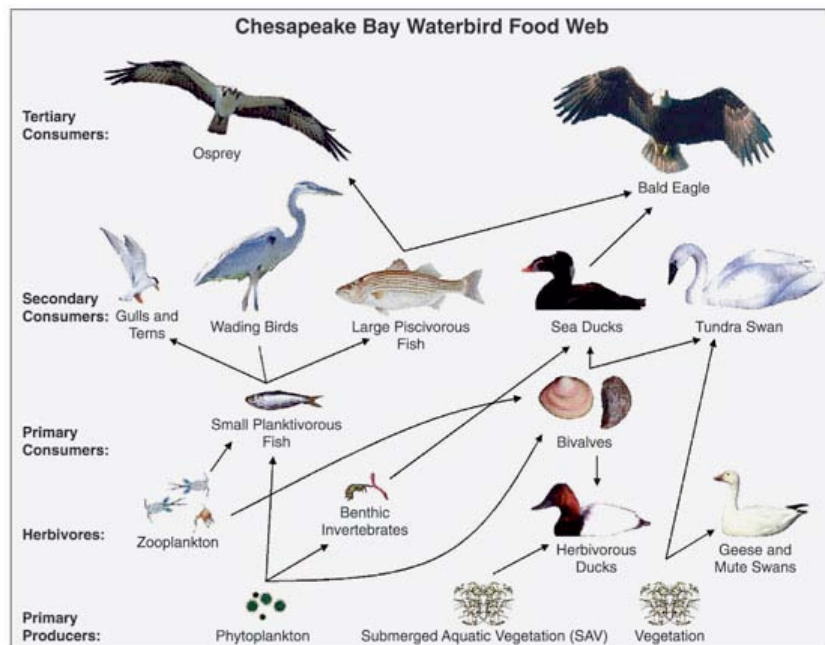
An **ecosystem** is a community of living and non-living things that work together.

- Where do our resources come from?

- Do we depend on the world around us? If so how?

- Food Chain
- Air Cycle
- Water Cycle

- a) **Food chain:** The food chain is a description of how food (energy and nutrients) flow through the ecosystem starting from the soil (along with energy from the sun, air and water) to plants and animals and then back to the soil.



USGS Circular 1316. Figure 14.1. Wikimedia Commons.

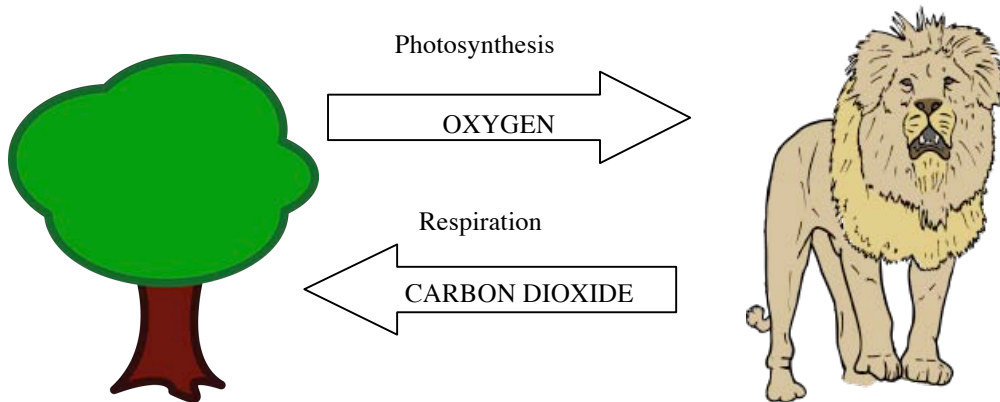
[http://commons.wikimedia.org/wiki/File:Chesapeake\\_Waterbird\\_Food\\_Web.jpg](http://commons.wikimedia.org/wiki/File:Chesapeake_Waterbird_Food_Web.jpg)

- The food chain starts with the sun, air, water and soil.



Reference: "Description of Food Chain," Geography4Kids,  
[http://www.geography4kids.com/files/land\\_foodchain.html](http://www.geography4kids.com/files/land_foodchain.html). Copyright 1997-2012  
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## b) Air Cycle



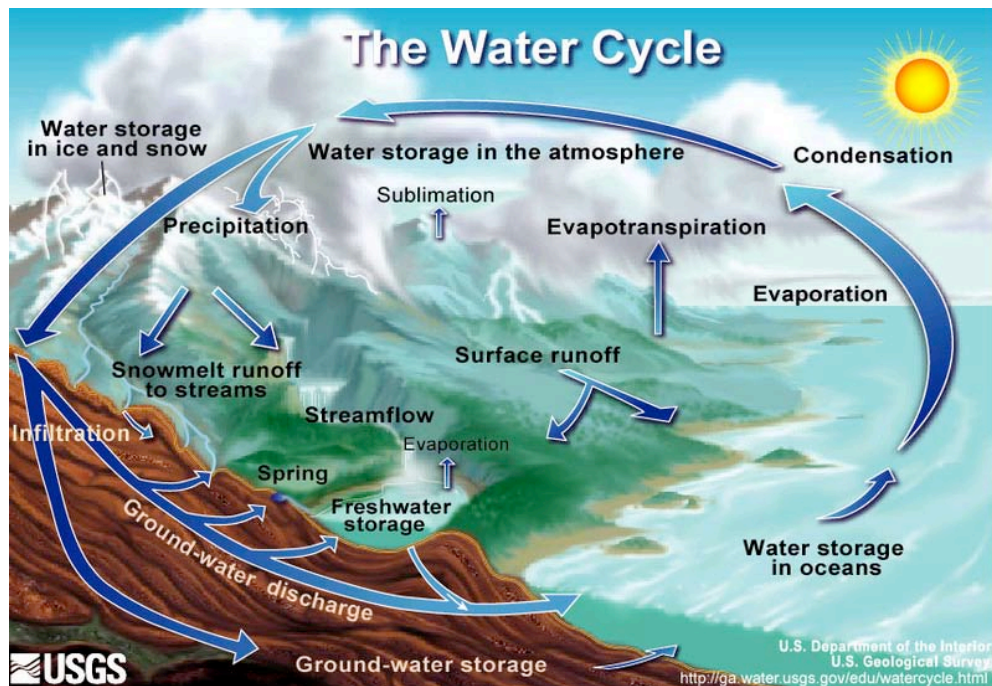
"A Simple Tree" by Peter M., OpenClipArt, <http://openclipart.org/detail/80/tree-by-peterm>



"Color Drawing of A Lion" by Steve Lambert, OpenClipArt, <http://openclipart.org/detail/6950/lion-by-stevelambert-6950>

- Plants use sunlight and carbon dioxide to make food and release oxygen into the atmosphere (Photosynthesis)
- Animals use oxygen for energy and release carbon dioxide into the atmosphere (Respiration)

c) Water cycle



U.S. Geological Survey, Wikimedia Commons,  
[http://commons.wikimedia.org/wiki/File:Water\\_cycle.png](http://commons.wikimedia.org/wiki/File:Water_cycle.png)

- The water cycle is an example of a naturally occurring system in which the substance can change form and location.
- Land topography influences the distribution of water and pollutants.
- Water pollution is caused by point and non-point sources.
- The quality of water sources, such as streams and drinking water, can be determined by measuring factors such as temperature, pH, turbidity, dissolved oxygen, and total dissolved solids.

### **Activity 1: Eco-Jar**

Objective: The students should be able to identify the life forms in the Eco-Jar and how they sustain each other.

Take a close look at the jar your instructor is passing around and answer the following questions

Does the Jar represent an Ecosystem?

- i. List the Producers, Consumers and Decomposers in the Eco-Jar

Consumers:

Producers:

Decomposers:

- ii. Sketch a food, air and water cycle for the Ecosystem in the Eco-Jar

## Make your own Eco-Jar at home!



Reference: Exercise adapted from "How to Make a Marine Ecosphere," CC BY NC SA WikiHow, available at <http://www.wikihow.com/Make-a-Marine-Ecosphere>



### Materials Required:

- Glass Jar
- Sand or Gravel
- Ocean water or de-chlorinated water and ocean salt
- Small ocean live rock
- Coral or other marine plant
- Shrimp, Plankton
- Sea shells

### Steps:

1. Grow algae with the sun on a few rocks, which you will add to the Jar. Take an algae sample (from a river or pond area) put it on the rocks and place it in the sun for a few days.
2. Get a Jar and make sure it's transparent so that sunlight can pass through.
3. **Wash the jar with ONLY warm water as soap will kill the organisms.** Then dry your jar using a towel.
4. **Collect sand from either the playground, or a very clean beach.** Then wash it with water for 70 seconds WITHOUT draining the sand. And dry it.
5. **Add ocean water.** It can be made by mixing de-chlorinated water & ONLY ocean salt. Table salt is too poisonous to organisms in your "ocean".
6. **After you put sand in (about 1" deep), fill you jar with seawater, leaving about 2" of airspace on the top.** Then add a small live sea rock, which should have both phyto & zooplankton. Now add the plants (algae).
7. **Always include small seashells.** It will not only stabilize pH levels, but also it stimulates the ocean floor.
8. **Now add animals (shrimp).**
9. **After you add the animals into your jar, seal it up and never open it again.** Just put on your windowsill and watch it.

### III. Agriculture

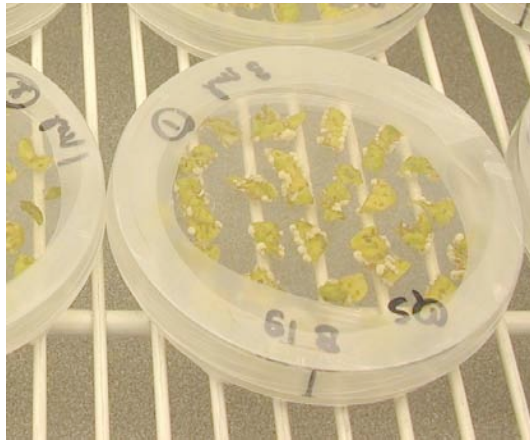
According to Wikipedia (<http://en.wikipedia.org/wiki/Agriculture>), agriculture is defined as: “the cultivation of animals, plants, fungi, and other life forms for food, fiber, and other products used to sustain life.”

- Prior to agriculture
  - People spent most of their time hunting and gathering food
    - Known as “Hunters and Gatherers”
  - Populations tended to be lower
  - People had to travel nearly all the time
    - Food sources would become depleted
    - Referred to as “nomadic”
    - Lived in non-permanent shelter
- The start of agriculture...
  - People began to plant seed and tame animals
    - Called “Domestication”
  - Soon after, they searched for better ways to grow food
    - Much early progress was made by “trial and error”
  - Began about 10,000 years ago
  - Allowed humans to settle down, develop villages, and form a society
- Modern Day Agriculture
  - **Affordability**
    - The goal of modern agriculture practices is to help farmers provide an affordable supply of food to meet the demands of a growing population.
    - With modern agriculture, more crops can be grown on less land allowing farmers to provide an increased supply of food at an affordable price.
  - **Sustainability**
    - Current farming methods have resulted in over-stretched water resources, high levels of erosion and reduced soil fertility. There is not enough water to continue farming using current practices; therefore how we use critical water, land, and ecosystem resources to boost crop yields must be reconsidered.
    - Technological advancements help provide farmers with tools and resources to make farming more sustainable.



## Activity 2: Timeline

Place the agricultural history events cards in the order in which you think they might have occurred. Along with your group, think and discuss about which event might have followed or led to which other event. Once you think you have the correct sequence of events get it checked by your instructor. Then attach the events together with a masking tape in the correct order.



Genetically modified plants are cultivated around the world.



With the market for agriculture produce growing beyond small communities, farmers looked to improving yields and efficiency of farming. Chemical fertilizers and gasoline powered tractors made an appearance.



People soon realized the potential of domesticating animals for food and as beasts of burden. First signs of domestication of cattle and chicken were found in India.



The first global exchange of crops also called the Medieval green revolution occurred. This led to the establishment of a global economy as traders travelled all over the world exchanging crops and farming ideas.



Birth of industrial agriculture. Industrial agriculture is a form of modern farming that refers to the industrialized production of livestock, poultry, fish and crops.



The earliest evidence of cultivation was found to have occurred in 9800BC. Wheat was grown in now what we call Syria.











As the supply of food from cultivation and domestication of animals grew, the population increased. The water from rains could no longer sustain the demand for cultivation; hence organized irrigation systems like canals began to emerge.



Humans at first obtained all their food from wild animals and plants (hunters and gatherers) and did not grow their own food.



### Image sources from table:

- Genetically modified plant:  Seb951, Wikimedia Commons, [http://en.wikipedia.org/wiki/File:Transformation\\_with\\_Agrobacterium.JPG](http://en.wikipedia.org/wiki/File:Transformation_with_Agrobacterium.JPG)
- Plow:  *Gas Power Age*, Winnipeg, 1910. Provided by the Manitoba Historical Society, <http://www.mhs.mb.ca/docs/features/timelinks/imageref/ref0419.shtml>.
- Domestication:  Image by Jan van Gool, [http://www.wikigallery.org/wiki/painting\\_208774/Jan-van-Gool/Cattle-in-a-Meadow](http://www.wikigallery.org/wiki/painting_208774/Jan-van-Gool/Cattle-in-a-Meadow)
- Crop Trade:  Vincenzo Campi, 1580, Wikimedia Commons, [http://commons.wikimedia.org/wiki/File:Vincenzo\\_Campi\\_-\\_The\\_Fruit\\_Seller.jpg](http://commons.wikimedia.org/wiki/File:Vincenzo_Campi_-_The_Fruit_Seller.jpg)
- Industrialization:  Image: Richard Croft, Wikimedia Commons, [http://commons.wikimedia.org/wiki/File:Agriculture\\_and\\_Industry\\_-\\_geograph.org.uk\\_-\\_209054.jpg](http://commons.wikimedia.org/wiki/File:Agriculture_and_Industry_-_geograph.org.uk_-_209054.jpg)
- Egyptian tomb:  Anonymous Egyptian tomb artist(s), Wikimedia Commons, [http://commons.wikimedia.org/wiki/File:Egyptian\\_harvest.jpg](http://commons.wikimedia.org/wiki/File:Egyptian_harvest.jpg)
- Irrigation:  by Nigel Mykura, Wikimedia Commons, [http://commons.wikimedia.org/wiki/File:Watercress\\_Bed\\_Irrigation\\_channel\\_-\\_geograph.org.uk\\_-\\_723290.jpg](http://commons.wikimedia.org/wiki/File:Watercress_Bed_Irrigation_channel_-_geograph.org.uk_-_723290.jpg)
- Hunter Gatherers:  by Pierre Barrère, Wikimedia Commons, [http://commons.wikimedia.org/wiki/File:Kalina\\_hunter\\_gatherer.jpg](http://commons.wikimedia.org/wiki/File:Kalina_hunter_gatherer.jpg)

## Lesson 3: Disciplines in Engineering

- **Society's Problems/Needs**
- **Disciplines of Engineering**
- **Meet the Disciplines Worksheet**
- **Identify the Problem and Assign Engineers**

### Word Bank

Fill in the blanks below

Construction  
Electrical/computer engineering  
Geology  
Mineral deposits  
Civil  
Diverse

Electrical engineer  
Computer engineering  
Demanding  
Biology and medicine  
Environment

### Society's Problems/Needs

Societies face a variety of problems that need to be addressed. One community may have issues that range from harvesting their crops to communicating with the nearby town. Just as in the physical sciences, where there are various disciplines for the wide range of specialties (a physicist may have a hard time doing the work of a biologist), engineering is also divided into many subjects. Having various groups of engineers that specialize in a certain field makes addressing the problems we face much easier to solve, since each group can focus on a specific problem, instead of everyone trying to spread their resources across all the problems.

For example, a community may be helped by one type of engineer to address their crop-harvesting issues, and another type of engineer to help them communicate with the nearby town. Other issues that can be addressed by engineers are:

- Accessing clean water
- Building a bridge
- Telecommunication
- Energy solutions
- Food shortages
- Better medical equipment
- Recycling and reusing materials
- Planning the layout of a city
- Waste management
- Transportation
- Treating of diseases
- Designing a building

As you can see, the fields where engineers are needed is very \_\_\_\_\_ and \_\_\_\_\_, and that is why we need a variety of different types of engineers. Let's take a look at the main disciplines of engineering and see how they each contribute to society.

## Engineering Disciplines

\_\_\_\_\_/\_\_\_\_\_  
**Engineering:**

As an \_\_\_\_\_,  
\_\_\_\_\_, you

could develop components for some of the most fun devices (MP3 players, digital cameras, or roller coasters) as well as the most essential to life (medical tests or communications systems). The largest field of engineering

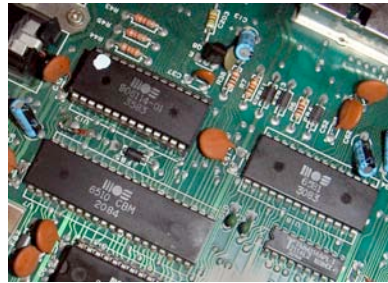
encompasses the macro (huge power grids that light up cities, for example) as well as the micro (including a device smaller than a millimeter that tells a car's airbags when to inflate). As an electrical engineer, you might work on robotics, computer networks, wireless communications, or medical imaging—areas that are at the very forefront of technological innovation (Fig. 1).

\_\_\_\_\_, a sub-field of electrical engineering, is the design, construction, implementation, and maintenance of computers and computer-controlled equipment for the benefit of humankind.

\_\_\_\_\_  
**Engineering:**

What would it feel like to have the expertise to build a school that could withstand an earthquake, a road system that puts an end to chronic traffic jams, or a sports stadium that offers everyone a great view? As a civil engineer, your job would be to oversee the -

\_\_\_\_\_ of the buildings and infrastructure that make up our world: highways, skyscrapers, railways, bridges, and water reservoirs, as well as some of the most spectacular and high-profile of all engineering feats—think of the world's tallest building, the towering Taipei 101 in Asia, or the Chunnel, the 31-mile-long tunnel beneath the English Channel. Civil engineers are fond of saying that it's architects who put designs on paper, but engineers who actually get things built.



**Figure 1:** A circuit board like the one shown here is crucial to almost all complex electronic devices, and is designed by electrical/computer engineers.



Image by Jörgen Nixdorf, source:  
[http://en.wikipedia.org/wiki/File:MOS\\_Technologies\\_large.jpg](http://en.wikipedia.org/wiki/File:MOS_Technologies_large.jpg)



**Figure 2:** The beautiful city of Hong Kong is lined with dozens of skyscrapers and buildings, all planned and designed by civil engineers.



Image by Kent Wang, source:

[http://commons.wikimedia.org/wiki/File:Hong\\_Kong\\_skyline\\_night\\_lights.jpg](http://commons.wikimedia.org/wiki/File:Hong_Kong_skyline_night_lights.jpg)

### **Geological and Geophysical Engineering:**

Geological and Geophysical Engineers draw on the science of \_\_\_\_\_ to study the earth, using engineering principles to seek and develop deposits of natural resources and design foundations for large buildings, bridges, and other structures. (Related engineering fields include Civil, Mineral, Mining, and Petroleum.)

### **Mining Engineering:**

Mining engineers study all phases of extracting \_\_\_\_\_ from the earth. They design mines and related equipment and supervise their construction and operation. They also work to minimize the environmental effects of mining. These engineers supply energy and rare materials to meet the world's needs.

### **Agricultural and Biological Engineering:**

Agricultural engineers apply knowledge of engineering technology and science to agriculture and the efficient use of biological resources. In addition to creating advances in farming and agriculture, agricultural engineers apply engineering design and analysis to protecting natural resources, develop power systems to support agriculture, and provide environmental controls.



**Figure 3:** Tractors built by agricultural engineers have revolutionized the farming industry.



Image by Lucarelli, source:

[http://commons.wikimedia.org/wiki/File:Same\\_Tiger\\_Six\\_105\\_tractor.jpg](http://commons.wikimedia.org/wiki/File:Same_Tiger_Six_105_tractor.jpg).

### **Mechanical Engineering:**

As a mechanical engineer, you might develop a bike lock or an aircraft carrier, a child's toy or a hybrid car engine, a wheelchair or a sailboat—in other words, just about anything you can think of that involves a mechanical process, whether it's a cool, cutting-edge product or a life-saving medical device. Mechanical engineers are often referred to as the general practitioners of the engineering profession, since they work in nearly every area of technology, from aerospace and automotive to computers and biotechnology.



**Figure 4:** Together with electrical engineers, mechanical engineers build robots like the one pictured here.

 Image by Milky, source: [http://commons.wikimedia.org/wiki/File:Robot\\_Asimo.jpg](http://commons.wikimedia.org/wiki/File:Robot_Asimo.jpg)

### **Chemical Engineering:**

Everything around us is made of chemicals. Chemical changes can be used to produce all kinds of useful products. Chemical Engineers discover and manufacture better plastics, paints, fuels, fibers, medicines, fertilizers, semiconductors, paper, and all other kinds of chemicals. Chemical Engineers also play an important role in protecting the environment, inventing cleaner technologies, calculating environmental impacts, and studying the fate of chemicals in the environment.

### **Environmental Engineering:**

Environmental Engineering is the study of ways to protect the \_\_\_\_\_. Most of us care deeply about stopping pollution and protecting

our natural resources. Imagine yourself having more than just a passion for saving our environment, but also possessing the actual know-how to do something about these alarming problems! As an environmental engineer, you'll make a real difference in the survival of our planet by finding ways of cleaning up our oceans, rivers, and drinking water, developing air pollution equipment, designing more effective recycling systems, or discovering safe ways to dispose of toxic waste.


### **Bioengineering/Biomedical Engineering:**

Bioengineers study living systems and apply that knowledge to solve various problems. They study the safety of food supplies, keep desirable organisms alive in fermentation processes, and design biologically based sensors. Bioengineering is widely used to destroy wastes and clean up contaminated soil and water. These engineers contribute greatly to human health and the environment.

Biomedical Engineers study \_\_\_\_\_ and \_\_\_\_\_ to develop



**Figure 5:** Biomedical engineers work with mechanical and materials engineers to develop prosthetic (artificial) limbs, such as the leg fitted to the man in this picture.

 Image by Virginia Reza, source: <http://commons.wikimedia.org/wiki/File:Army.mil-2007-02-07-103140.jpg>

technologies related to health care. They develop medical diagnostic machines, medical instruments, artificial organs, joint replacement parts, and prosthetic devices. Rapid advances in these areas will probably continue throughout your lifetime.

### **Materials Engineering:**

Materials Engineers solve problems by relying on their creative and technical skills - making useful products in many forms from common as well as exotic materials. Every day we use a multitude of these products. Each time we talk on the phone, use a computer, or heat food in a microwave oven, we are using products made possible by the inventions and designs of engineers working with ceramics and other materials.

### **Aerospace Engineering:**

Aerospace engineers design, analyze, model, simulate, and test aircraft, spacecraft, satellites, missiles, and rockets. Aerospace technology also extends to many other applications of objects moving within gases or liquids.

Examples are golf balls, high-speed trains, hydrofoil ships, or tall buildings in the wind.

As an aerospace engineer, you might work on the Orion space mission, which plans on putting astronauts back on the moon by 2020. Or, you might be involved in developing a new generation of space telescopes, the source of some of our most significant cosmological discoveries. But outer space is just one of many realms to explore as an aerospace engineer. You might develop commercial airliners, military jets, or helicopters for our airways. And getting even more down-to-earth, you could design the latest ground and sea transportation, including high-speed trains, racing cars, or deep-sea vessels that explore life at the bottom of the ocean.



**Figure 6:** Aerospace engineers develop the machines that allow us to fly through air, and into space.



Image by Kirbstr, source:  
[http://commons.wikimedia.org/wiki/File:Space\\_Shuttle\\_Discovery\\_Transport.jpg](http://commons.wikimedia.org/wiki/File:Space_Shuttle_Discovery_Transport.jpg).

### **Nuclear Engineering:**

Finally, nuclear engineers harness the power of the atom to benefit humankind. They search for efficient ways to capture and put to beneficial use those tiny natural bursts of energy resulting from sub-atomic particles that break apart molecules. As a nuclear engineer, you may be challenged by problems in consumer and industrial power, space exploration, water supply, food supply, environment and pollution, health, and transportation. Participation in these broad areas may carry you into many exciting and challenging careers. These may include interaction of radiation with matter, radiation measurements, radioisotope production and use, reactor engineering, and fusion reactors and materials.



**University of Liberia offers:**

- Civil engineering
- Mining engineering
- Electrical engineering
- Geology
- Mechanical Engineering

**Class Activity: Meet the Disciplines Worksheet**

Now that you have an introduction to the various disciplines of engineering, let us see if you can identify which ones would do certain jobs. To help you, you can use the flashcards provided for you at the end of this section. These flashcards have pictures to help identify what each discipline of engineering does. Take a look through them and see if you can point out the different things these specific engineers can create.

Once you have gone through the flashcards, work through the “Meet the Disciplines” worksheet at the end of this section. This worksheet is meant to help you guys identify the roles of the engineering disciplines, and how each one would be applied to certain situations. Go ahead and work on them together in your group, and see who can fill them out the fastest. The first 2 groups to get them completed with 3 or less wrong will get a prize!

**Class Activity: Identify Problems and Assign Engineers**

We have already mentioned a variety of problems that society faces, as seen in the following list in your handbook, as well as up on the board. Can you identify what the particular problem is? What engineers may be useful for solving these problems? Try filling out the following table and write down both the issue and the engineering disciplines that may be **most** useful.

- |                            |                                   |
|----------------------------|-----------------------------------|
| • Accessing clean water    | • Recycling and reusing materials |
| • Building a bridge        | • Planning the layout of a city   |
| • Telecommunication        | • Waste management                |
| • Energy solutions         | • Transportation                  |
| • Food shortages           | • Treating of diseases            |
| • Better medical equipment | • Designing a building            |

Keep in mind, there definitely is not *one* right answer, and in fact almost every process would require at least a few different types of engineers.

Finally, can **you** identify 2 issues you face here in Liberia? What is the problem and what type of engineers would it take to solve it?

## Identify Problems and Assign Engineers

Task	Issue/Problem	Disciplines of Engineering
Accessing clean water	Contamination Disease Famine	Chemical Agricultural Environmental
Building a bridge		
Telecommunication		
Energy solutions		
Food shortage		
Better medical equipment		
Recycling and reusing materials		
Planning the layout of a city		



Waste management		
Transportation		
Treating of diseases		
Designing a Spaceship		
Building a Mine		
Problem #1:		
Problem #2:		

## Meet the Disciplines Flashcards



Reference: eGFI cards for types of engineering. Copyright 2012 American Society for Engineering Education, All Rights Reserved. Workshop is accessible at: <http://teachers.egfi-k12.org/wp-content/uploads/2010/12/cards-worksheet-elementary-school.pdf>. Images for matching professions are accessible at: <http://www.egfi-k12.org/engineer-your-path/on-the-job/>.

## Lesson 4: Disciplines in Agriculture

### I. Agriculture is more than just growing plants.

Agriculture can be broadly divided into seven different disciplines.

- Agribusiness systems
- Animal systems
- Environmental Service Systems
- Food Products and Processing Systems
- Natural Resource Systems
- Plant Systems
- Power, Structural and Technical Systems

1. **Agribusiness Systems:** Agribusiness is the coordination of all activities that contribute to the production, processing, marketing, distribution, financing and development of agricultural commodities and resources. This includes food, fiber, wood products, natural resources, horticulture, and other plant and animal products and services. Agribusiness is a high-tech industry that uses satellite systems, computer databases and spreadsheets, biotechnology and many other innovations to increase efficiency and profitability. Sample occupations
  - Agricultural marketing specialists: Agricultural marketing specialists assist producers and distributors of agricultural products by providing product promotional services, monitoring and reporting economic conditions and coordinating and channeling information among producers, distributors and buyers
  - Agricultural Loan Officer or Insurance agent: Agricultural Loan Officers are the link between farmers and funding agencies. They help farmers plan for upcoming money needs by advising them about available loan opportunities and helping them complete financial records. They also educate farmers about crop insurances.
2. **Animal Systems:** People who work in the animal systems discipline work to develop better, more efficient ways of producing and processing meat, poultry, eggs and dairy products. They study genetics, nutrition, reproduction, growth and development of domesticated farm animals.
  - Animal Geneticist: Animal geneticists try to understand gene functions and how these affect important traits such as growth, reproduction, disease resistance, or behavior
  - Aquaculturist: Aquaculturists cultivate marine or freshwater food fish, such as salmon and trout, or shellfish, such as oysters and clams, under controlled conditions.
  - Animal Nutritionist: Animal nutritionists formulate diets for food, companion, and zoo animals. They work with mammals, birds, and fish. The diets they create must be nutritionally sound, good tasting, and economical for the ages and types of animals that will use them.

3. **Environmental service Systems:** People who work in the environmental service systems discipline are involved in water and air pollution control, recycling, waste disposal and public health issues. They design municipal sewage and industrial wastewater systems.
  - Toxicologist: Toxicologists study the adverse effects of chemicals on living organisms
  - Environmental Engineer: Environmental engineers and technicians conduct hazardous-waste management studies, evaluate the significance of the hazard, offer analysis on treatment and containment, and develop regulations to prevent mishaps.
  - Environmental Compliance Assurance Manager: Environmental Compliance Assurance Managers analyze scientific data, develop environment compliance policies and perform quality control checks
4. **Food Products and Processing Systems:** People who work in the food products and processing discipline discover new food sources, analyze food content and develop ways to process, preserve, package or store food according to industry and government regulations. They create new food products to meet consumer needs and inspect food-processing areas to ensure that sanitation, safety, quality and waste management standards are met
  - Food Bacteriologist: Food bacteriologists assist in controlling food pathogens by analyzing food and dairy products for contamination with microorganisms, biological toxins, and antibiotic residues
  - Food and Drug Inspector: Food and drug inspectors impose federal (national) grading standards on food and drug products for the purpose of ensuring consumer safety and fair pricing
  - Food Engineer: Food engineers develop and operate manufacturing, packaging and distribution systems for food products
5. **Natural Resource Systems:** This discipline works towards development and maintenance of natural resources like forests, wildlife, water bodies, soil etc. The protection and conservation of these natural resources is the challenge faced by people working in this discipline of agriculture.
  - Soil Scientist: Soil scientists examine the scientific composition of soil as it relates to plant or crop growth, and investigate effects of alternative soil treatment practices on crop productivity. They develop methods of conserving and managing soil that farmers and forestry companies can use.
  - Forestry: Conservation scientists and foresters manage, develop, use and help protect forests and rangelands, which supply wood products, livestock forage, minerals and water; serve as sites for recreational activities; and provide habitats for wildlife.
6. **Plant Systems:** People who work in the plant systems discipline study plants and their growth, helping producers of food, feed and fiber crops continue to feed a growing population while conserving natural resources and maintaining the environment. Individuals in this pathway also develop ways to improve the nutritional value of crops and the quality of seeds. They use genetic engineering to develop crops resistant to pest and drought.
  - Plant Breeder: Plant Breeders work with researchers to improve agricultural crops. They plant seeds, water and weed plant beds, plant-rooted plants, and nurture root cuttings for future planting. They monitor the plant's growth, the plant's productivity, and its pest

infestations and report observations back to the research team. They also make quality seeds and saplings available to farmers

- **Plant Pathologist:** Plant pathologists deal with the symptoms, causes, damage, spread, and control of plant diseases. They study disease processes and look for genetic, biological, chemical, or cultural controls for diseases of the plants we use for food and fiber.

7. **Power, Structural, and Technical Systems:** This discipline applies the knowledge of engineering, hydraulics, pneumatics, electronics, power, structure, and controls to the field of agriculture. They develop canal systems for irrigation, machinery for harvesting and processing of agricultural produce etc.

- Agricultural Engineer
- Civil Engineer
- Chemical Engineer

## II. University of Cuttington

The University of Cuttington in the College of Agriculture and Sustainable development offers the following three majors:

- Plant and Soil Science, BS Degree program
- Animal Science and Health, BS Degree program
- Natural Resource Management, BS Degree Program

### **Activity 1: Team Product**

You will work as a team in for this activity.

- Each member in your team should pick one discipline of agriculture from the seven disciplines introduced in today's lecture.
- Each member should pick a different discipline.
- Now pick one occupation each
- You can pick any occupation you know of if you think it can contribute to the product your team picks
- Complete Worksheet 1

### Worksheet 1

	Name	Discipline Chosen	Occupation
Member 1			
Member 2			
Member 3			
Member 4			

- Now identify any product which can be produced by the combined efforts of the occupations in your team
- Identify the contributions by each occupation in your team towards the development of your product
- Complete worksheet 2

## Worksheet 2

Team Product:		
	Occupation	Contribution
Member 1		
Member 2		
Member 3		
Member 4		

## Lesson 5: Interdependency of Engineering and Agriculture

### Word Bank

Fill in the blanks using the words below:

chemical  
Decrease  
Pollution  
chemical  
filtration  
genetic engineering

Watermill  
Chemical  
water cycle  
irrigation systems  
production costs  
insect-resistant

drip irrigation  
mechanical  
boiling  
chlorination  
genetically modified

### Introduction

So far, we have learned extensively about both engineering and agriculture by themselves. We know that engineering is the creation of solutions for society's problems, while agriculture is the cultivation of animals and plants to provide for the community. Each of these fields has their own disciplines – electrical, mining, and mechanical fields for engineering, agriculture has its waste management, food safety, crop and livestock managing, etc.

*Class Discussion:* What do these fields have in common? Are they related to each other at all? Do they actually depend on one another?

### Engineering in Agriculture

#### Tractors

Indeed agriculture and engineering are extremely interdependent, and they rely on each other to thrive and succeed. For example, in the early days, soil on a farm was cultivated and aerated by the use of a horse-drawn plow (Fig. 1a). When farmers noticed that this technique required a lot



**Figure 1:** **a)** A horse-drawn plow used up until the invention of the tractor. **b)** An early tractor powered by a steam engine. **c)** The modern day tractor, a remarkable engineering feat that is so crucial to agriculture.



“Horse-drawn plow” by Ferox Seneca, source:

[http://commons.wikimedia.org/wiki/File:Chinese\\_farmer\\_1.jpg](http://commons.wikimedia.org/wiki/File:Chinese_farmer_1.jpg)



“Old tractor powered by steam engine”

[http://commons.wikimedia.org/w/index.php?title=File:Photograph\\_with\\_caption\\_%22Excavator\\_on\\_Mile\\_52\\_being\\_pulled\\_by\\_traction-engine,\\_plow\\_side\\_August\\_8,\\_1904.%22\\_-\\_NARA\\_-\\_282335.tif&page=1](http://commons.wikimedia.org/w/index.php?title=File:Photograph_with_caption_%22Excavator_on_Mile_52_being_pulled_by_traction-engine,_plow_side_August_8,_1904.%22_-_NARA_-_282335.tif&page=1)



“Modern tractor” by Brian Robert Marshall, source:

[http://commons.wikimedia.org/wiki/File:A\\_field\\_near\\_Winterbourne\\_Monkton\\_-\\_geograph.org.uk\\_-\\_970926.jpg](http://commons.wikimedia.org/wiki/File:A_field_near_Winterbourne_Monkton_-_geograph.org.uk_-_970926.jpg)

of time and manpower, they imagined a machine that would require less energy and allow more efficient plowing. Engineers then invented the tractor in 1868, using a steam engine (Fig. 1b). This was a machine that strikingly increased the efficiency and production of agriculture, and is a

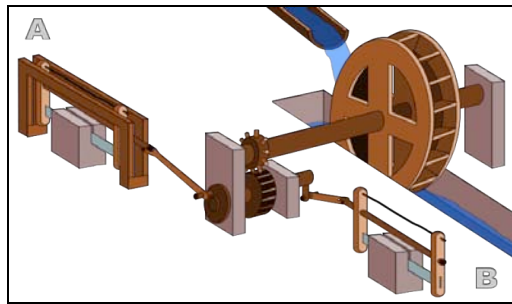


marvelously engineered system. Modern day tractors are able to plough even more land at one time, and are accordingly even more efficient at their task (Fig. 1c).

### Water

The necessity for water in agriculture is obvious, to feed the plants and animals, to run processes through the use of flowing water, and to maintain machinery *and* the farmers running them. But water is not just available whenever and wherever it is needed, right? Usually, it is either located in rivers, swamps, or provided by the rain. But a lake and or river may not be nearby, and who knows when it might rain next? So how do farmers actually get water to their plants and animals? Let's discuss this.

*Class Discussion:* Can you tell us how water has been stored and transported throughout the past in agriculture? Are there ways that are better than others (collecting rainwater vs. transporting from the river)?



**Figure 2:** The watermill (left) used in Belgium converts the translational energy of the flowing water into mechanical energy that can be used to run various processes, through the mechanism seen in the right picture.



“Water Mill in Belgium” by Spotter2, source:

[http://commons.wikimedia.org/wiki/File:Schorisse\\_%28Maarkedal%29\\_-\\_Water\\_mill.jpg](http://commons.wikimedia.org/wiki/File:Schorisse_%28Maarkedal%29_-_Water_mill.jpg)



“Water Mill Mechanism” by Chrkl, source:

<http://commons.wikimedia.org/wiki/User:Chrkl>

Many people have used engineering skills to figure out how to best provide water to their crops and animals, as well as how to use water for various mechanical processes. For over 2000 years, people have used the energy of flowing water to drive processes in their houses or industries, such as in textile production, through the use of a

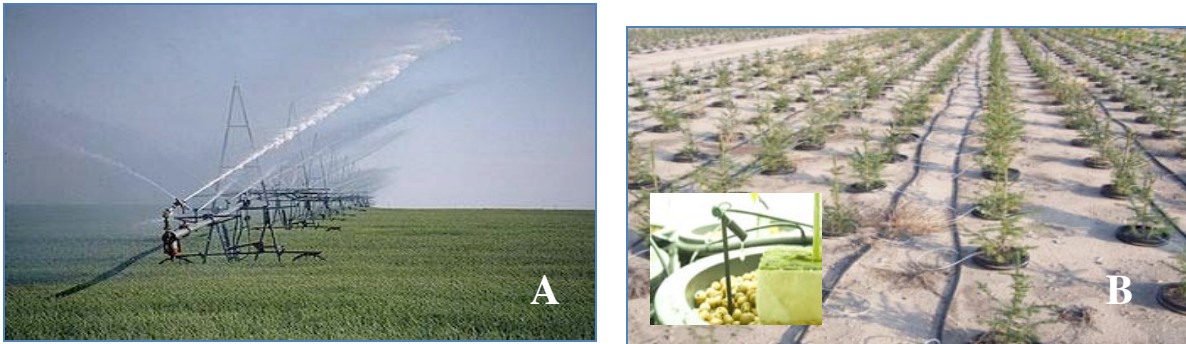
\_\_\_\_\_ (Fig. 2). For farmers that do not rely only on rainwater,

\_\_\_\_\_ have been created, which provides water

to the animals and crops through an engineered system (Fig. 3a). In such a system, water is transported from a main source and distributed throughout the entire plantation, allowing each plant to access water. One type of irrigation, called “\_\_\_\_\_,” literally “drips” water over each plant (Fig. 3b). This method was engineered because farmers noticed that water was being wasted when sprayed in large amounts, and the plants were not absorbing it all completely. Drip irrigation provides a way to minimize the water expenditure, while maximizing the water absorption by the plants. This is yet another example of how engineering is so essential to the development and advancement in agriculture.

### Water Purification

During our introduction to agriculture class, we learned about the \_\_\_\_\_. Basically, water in lakes and rivers evaporate into the atmosphere, and then precipitate back down as rain, creating the cycle. Ideally, this means that all 100% of the water on the planet is recycled during this process. However, not all of this water is “renewable.” This is because of the contamination that we as humans put into the water; once pollutants are introduced into the water



**Figure 3:** Irrigation systems have been engineered to provide water to crops without having to depend on rainfall. This engineering feat is greatly useful for the agricultural community. Various types of irrigation systems include (A) large sprinkler systems, and (B) small, focused drip systems, where water drips directly on to the root of the plant.



“Irrigation” by Paulkondratuk3194, source: <http://en.wikipedia.org/wiki/File:Irrigation1.jpg>



“Drip Systems”, source: <http://greenfieldgeography.wikispaces.com/Irrigation+and+agriculture>



“Drip Emitter” by Alan.ca, source: [http://commons.wikimedia.org/wiki/File:Drip\\_emitter.jpg](http://commons.wikimedia.org/wiki/File:Drip_emitter.jpg)

from industrial and agricultural processes, it cannot evaporate in the proper manner. This leads to a net \_\_\_\_\_ in the supply of freshwater around the world.

Water \_\_\_\_\_ may be very relevant to all of us. If we wash our clothes in the river, we are contaminating the rest of the river for anyone down the stream. If someone bathes in the river upstream of us, we are then drinking and bathing in already dirty water. Accordingly, there is an urgent need for purifying water, in order for it to be safe to drink and use in our everyday life, as well as promote its recycling in the water cycle.

A variety of engineering techniques has been useful for this. Before we go into them, let’s have a class discussion about it.

*Class Discussion:* Do you know of ways that water is purified? How do you make water safe to drink?

As we mentioned, there are many ways of purifying water. \_\_\_\_\_ is the use of chemicals to kill the bacteria within the water in order to make it safe. This is a form of \_\_\_\_\_ engineering. \_\_\_\_\_ is a mechanical process where only water molecules can pass through the openings, but larger molecules like dirt and bacteria are left behind. This is a process that draws from principles of \_\_\_\_\_ and \_\_\_\_\_ engineering. Finally, the third way we talked about was through \_\_\_\_\_. This works similar to chlorination, in that it kills the bacteria in the water, but through the use of high temperatures. This is a form of \_\_\_\_\_ engineering.

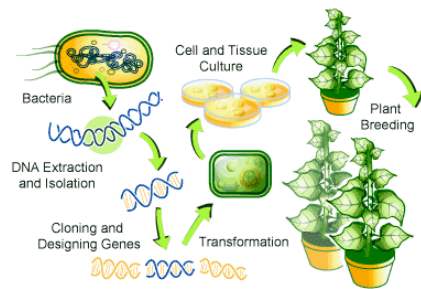
*Class Discussion:* What are other forms of engineering in agriculture?

## Agriculture in Engineering

It is obvious from our discussion that agriculture depends on engineering, but even though it may not be as obvious, engineering also depends on agriculture. When thinking about the general nature of engineering, it arises from the need to improve and fix problems faced in various industries, including agriculture. For example, when farmers noticed that their crops weren't getting enough water from just the normal rainfall, they set forth to invent a system that would allow them to provide water not supplied by the rain. Thus, they engineered the irrigation system. If the agricultural problem hadn't originated for the farmers, there would have been no need for any engineering. This clearly identifies the dependency of engineering on agriculture: without agriculture and its shortcomings, engineering would not be required nor useful to the industry.

## Genetic Engineering

In another example, we can look at the development of \_\_\_\_\_ and its dependence on agriculture (Fig. 4). Many areas, like Liberia, that depend on rice as their main source of nutrition, were noticing a common vitamin A deficiency in the diets. A vitamin A deficiency can lead to early blindness, and therefore was a problem that needed to be taken care of efficiently and quickly. This problem was not easily solvable, however; in poorer countries, it would be hard to establish a new diet, or add a rare component, that would increase the amount of vitamin A the citizens would receive. Thus arose a problem for engineering. Luckily, two scientists, Drs. Ingo Potrykus and Peter Beyer, who are genetic engineers, were able to transfer the genes for vitamin A into a strain of rice, thereby making the rice develop a valuable amount of vitamin A when grown. This strain of rice can then be crossbred with various strains from all over the world, allowing virtually all rice farmers access to vitamin A-containing rice. This would serve to be crucial to the countries where rice is the main diet, providing sufficient vitamin A for the citizens, and helping them avoid blindness.



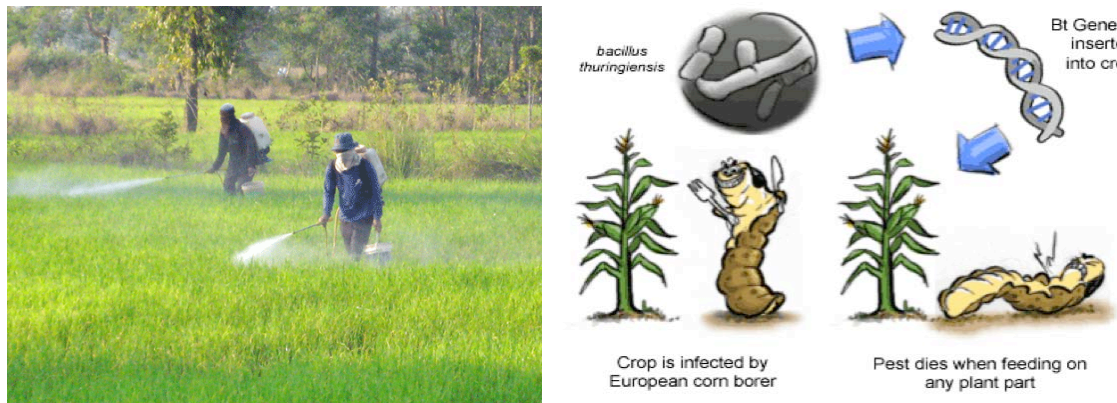
Source: DNA-Project-Cydney, <http://dna-project-cydney.wikispaces.com/Part+3>

**Figure 4:** The general process of genetic engineering. In order to force a plant to express a certain chemical or property, scientists transfer the necessary gene into the plant by extracting them from things that do express them (like bacteria). They then breed the original plant with plant cells that express the target property, and the resulting plant has the trait that they want!

From this example, it is evident that a problem faced in agriculture developed the need for an engineered solution. In general, the industry of genetic engineering relies heavily on agriculture, providing solutions to common problems that arise. Another example is the \_\_\_\_\_, \_\_\_\_\_ crops (Fig. 5). An insecticide gene, or gene that causes a natural repulsion to harmful insects, was transferred from a bacterium to cotton plants, so that the cotton plants would naturally resist harmful insect pests. This would prevent the plant from being infected and eventually killed by the pest, and thereby avoid future generations of plants from being infected as well.

A resistance to insects comes with many benefits for the farmer and the consumer: the reduction in need for insecticide would starkly decrease, consequently lowering the \_\_\_\_\_ of the crop. Also, having a natural resistance to pests will increase the crop's yield, ultimately leading to much lower purchasing costs for the consumer. It is estimated that the toxicity of the chemicals used to fend off bugs from plants leads to 3 million people being poisoned in the developing world (World Health Organization). Minimizing the use of these chemicals can clearly be beneficial for everyone.

It is thereby obvious the impact agriculture has on engineering. Engineering would not be



**Figure 5:** (A) Thai farmers spray chemical insecticides on their crops to prevent harmful pest infestation. The protective gear they were indicated the toxicity of such chemicals. (B) The genetic modification of crops by adding an insecticide gene prevents and kills any harmful pests that try to infect the plants.



"Thai farmers spray insecticides", source: <http://ricehoppers.net/2011/05/what-stimulates-farmers-in-chainat-thailand-to-apply-prophylactic-sprays-of-resurgence-causing-insecticides/>



"Bacillus Thuringiensis" by Hardy Hall, source: <http://www.scq.ubc.ca/bt-corn-is-it-worth-the-risk/>

necessary, nor possible, if there weren't problems arising in the agricultural field that needed solutions.

*Class Discussion:* The field of genetic engineering is very controversial. Can you think of why?

### Summary

In summary, the interdependency of engineering and agriculture is highly important, and evident. Agriculture depends on engineering to provide the right equipment and techniques useful to improve the industry and become more efficient. Irrigation systems created by engineers help farmers regulate the supply of water to their crops, without having to depend on rainfall. On the other hand, engineering depends on agriculture to provide problems that require solutions. The field of genetic engineering thrives substantially because of the needs of agriculturalists. In both cases, without one, the other would be severely hindered in its development and progress.

*Class Activity:* Match the various engineering tools used in agriculture today.

mining machine	milking machine
cotton picker	windmill
plow/plough	greenhouse



**A.****B.****C.****D.****E.****F.**

Flashcard image attributions:

- A:  by Martin Pettitt, source: <http://www.flickr.com/photos/mdpettitt/8024352315/>
- B:  by David Monniaux, source: [http://en.wikipedia.org/wiki/File:Cow\\_milking\\_machine\\_in\\_action\\_DSC04132.jpg](http://en.wikipedia.org/wiki/File:Cow_milking_machine_in_action_DSC04132.jpg)
- C:  by Alex Kamweru, source: <http://www.flickr.com/photos/alexkamweru/4330285210/>
- D:  by kimberlykv, source: <http://www.flickr.com/photos/kimberlykv/4087951240/>
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## Lesson 6: Resources, Economics and Feasibility

Engineering and agriculture are two different fields, which are combined together to obtain results that meet the needs of society.

Can you think of a few basic needs of society (or yourself)?

i.

ii.

iii.

What are the resources needed to meet these demands?

- Raw materials
- Technology to process raw materials to products as per demand
- Human expertise

What happens if there is a shortage of any of the resources?

- Product cannot be supplied
- Resources have to be bought from external sources to meet demand
- If there is any product produced, price of product increases

Therefore the kind and amount of products produced should meet the consumer demands.

### Supply and Demand

**Demand** refers to the quantity of a good that is desired by buyers.

**Supply** is defined as the total quantity of a product or service that the marketplace can offer.

**Surplus** condition occurs when the quantity of a product supply is greater than the quantity of the product demand.

**Deficit** condition occurs when the quantity of a product supply is less than the quantity of the product demand.

**Equilibrium** occurs when the quantity supplied equals the quantity demanded.

### Value addition

Value addition is to add economic value to a product by changing its current place, time, and form characteristics to characteristics more preferred in the marketplace.

As a specific example, a more narrow definition would be to economically add value to an agricultural product (such as wheat) by processing it into a product (such as flour) desired by customers (such as bread bakers).

Engineering finds application in adding value to agriculture products.

What are the benefits of adding value?

- The price of the product increases; i.e. economic value increases
- A more desirable product is made available to the consumers

Activity: Let's add value

Fill in the following table by identifying any value added final product available in the market, which has been processed from the given agriculture products. Also think about what engineering

aspects were involved in the processing of the value added product.

Agriculture Product	Value added product	Engineering technology/expertise needed
Wheat	Bread	Machinery to grind wheat, bake bread
Cassava		
Rubber		
Rice		
Palm kernels		

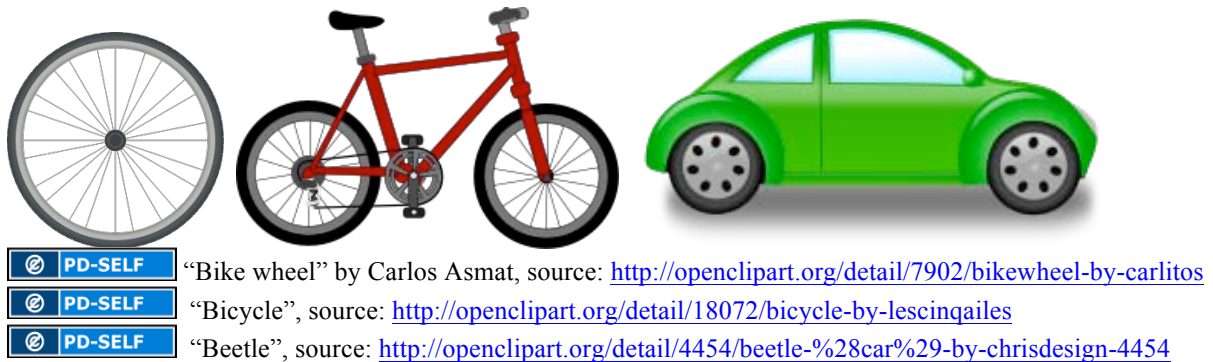
### Feasibility of a proposed plan

What is feasibility?

A plan is said to be feasible if it can be carried out successfully to meet a set of basic requirements.

Example: The basic requirements for an automobile will be to move, carry load and use as less fuel as possible. If a plan proposes a new automobile that can move very fast and carry a lot of load but requires very high cost fuel, it is feasible?

If you want to go to school faster, which of the following is more feasible?



The following questions should be evaluated to determine the feasibility of a proposed production plan

- Resource feasibility
  - Are all the raw materials needed for a particular product available?
  - Is the necessary technology for processing available?
  - Is human expertise readily available?
- Economic feasibility
  - Will the selling price of the product be greater than the cost price
  - Will the profits be enough to continue the production of the products?
- Demand feasibility
  - Does the community desire the product?



- How much of the product is desired?

## Lesson 7: Case Studies

Given below are 4 different case studies in the field of agriculture where sustainability, engineering and feasibility all play a role. As a group, choose and read one case study. Analyze the problem in the case study and find a solution. Then present your case to the other groups. The questions at the end of your case study will guide you to come up with a solution. For your presentation you can follow the order of the questions. Your instructor will clarify any doubts you may have while reading the passages.

### Case Study 1: Thongdee's energy crisis!

Thongdee Nantha owns a farm in the town of Abala in Uganda. He works the farm with his wife and children and produces more than enough for their needs. They have rice fields, a fishpond and a garden.

The main crop is rice, which occupies about two-thirds of the land. The other one third is not cultivated. Ducks and chickens provide eggs and meat for the family and some eggs for sale – they eat the weeds from the rice fields, vegetable waste and leftover food. There are seven different varieties of fish. Rice bran, duck and pig manure, and aquatic weeds from the rice fields are fed to the fish; insect- and fish-eating fish are kept in a separate pond in the corner.

Thongdee also grows trees on the farm, mostly mango, custard apple, banana and papaya. Then there are some cotton plants from which thread is spun and cloth woven for use by the family. Thongdee's integrated farming techniques with a combined production cycle of rice, fish, ducks and pigs are lucrative and stable.

But most of Thongdee's profit goes into buying electricity from the local power plants. What in your opinion could be a solution to Thongdee's problem? Remember Thongdee is a sustainable farmer!

Answer the questions below to help Thongdee:

1. Describe the situation in your own words (not more than 3 sentences)
2. Proposal
  - a. What can Thongdee do to overcome his energy crisis?
  - b. Is this a feasible option? Discuss Resource, Demand and Economic feasibility of the proposed solution
3. Engineering and Agriculture advise
  - a. What engineering services are involved in setting up the proposed solution?
  - b. What type of Engineers will be required to design and setup the proposed solution
  - c. What agriculture expertise will Thongdee need?
4. Value addition
  - a. Does the new system add value to his farm?
  - b. What are the reasons to your answer in part (a)
5. Other options
  - a. What alternative ideas can you suggest for Thongdee?
  - b. Compare your proposed solution to this alternative. Why is your proposed solution

better?

### **Case Study 2: Jim's plants need water!**

Jim's farm is entirely dependent on annual rainfall. If rain is consistent, the family will have a steady income and food all year round or else they are forced to survive on their savings during the no rain periods. But Jim no longer wants to be a victim to weather patterns and is looking for advice on how he can improve his farm conditions. Jim has a well on his farm. He had decided to surface irrigate his farm with the well water, but he is not sure if the well water can sustain his farm on a long-term basis without drying up. While trying to look for solutions Jim came across an advertisement for a new kind of irrigation system called Drip Irrigation. Can you help Jim decide if adapting this system in his farm will free him of his dependence on rain? Given below is the advertisement Jim found.

#### *Drip Irrigate! Save Water!*

Buy your Drip irrigation kit now and conserve water to grow more.

Drip irrigation is an improved irrigation system, which draws water from a well and sends it directly to the plants through a series of pipes, which are pierced with hundreds of small holes, restricting the overall flow of water, so that there is reduced waste. Drip irrigation systems are operational for 5-10 years, resulting in more profits for farmers long after the systems have been installed and paid for. With a drip system, the plant uses upwards of 90 percent of the water, while with surface irrigation this rate drops below 60 percent.

#### Advantages

- Drip irrigation uses precious water more efficiently - reducing runoff and evaporation and increasing percolation at the plant roots
- Reduces water contact with crop leaves, stems, and fruit, reducing diseases
- Increased yield and quality
- Agricultural chemicals can be applied more efficiently with drip irrigation

Answer the questions below to help Jim:

1. Describe the situation in your own words
2. Proposal
  - a. Do you think Jim landed on the right solution to his problem?
  - b. Is this a feasible option? Discuss Resource, Demand and Economic feasibility of the proposed solution
3. Engineering and Agriculture advise
  - a. What engineering services are involved in setting up the proposed solution?
  - b. What type of Engineers will be required to design and setup the proposed solution
  - c. What agriculture expertise will Jim need?
4. Value addition
  - a. Does the new system add value to his farm?
  - b. What are the reasons to your answer in part (a)
5. Other options
  - a. What alternative ideas can you suggest for Jim?
  - b. Which option is more sustainable?

### **Case study 3: Milk to Ice cream**

Mike has a 1-acre farmland where he keeps 30 cows. A quarter of the farm is used to grow hay and silage to supplement the cows' diet and feed them in the off-season. Mike rotates the cows

daily on pastures seeded in orchard grass, clover and ryegrass. The grazing season usually lasts from April through October. Through the winter, the cows eat from hay rings on the pasture. Mike also collects manure and composts it. Mike's cows are well fed and well taken care of, and hence give Mike milk to sell and make a profit. Mike owns five mechanized milking machines and also employees to farm helpers.

As this was a profitable industry, many other such dairy farmers started setting up farms in that area. The demand for milk fell as the number of suppliers grew and Mike was left with lots of milk and no buyers.

Mike then decided to invest more in his milk and convert it to a different product desired by consumers and which will increase his income. Mike invested in an ice cream machine! Mike bought 2 ice cream machines and two commercial freezers with the help of a loan and setup an ice cream parlor right on his farm. He employed 2 more workers and started creating more than 75 ice cream flavors all summer long. In 2010, Mike's ice cream parlor produced 25,000 gallons of ice cream. It's a lot of ice cream, and so is the gross revenue from \$9 per gallon wholesale and \$21 per gallon retail.

Mike also converted a small part of his farm to a picnic area where customers can enjoy their ice cream and children can see the cows and other farm animals.

The frozen dairy product is the icing for the farm. Without adding value to his milk, the dairy business wouldn't have lasted, Mike says.

"To be honest, I thought we could make a living just grazing and milking, but we're so limited on space and the size of the herd, we couldn't keep up with the rest of the new farmers," he says. "I was ready to sell the cows, but thought I would try ice cream. "We're profitable, but we weren't always. It's the ice cream that makes us so."

Apart from profits Mike's farm also has environmental benefits. On the pastures, the herd spreads its own manure during daily rotations, which keeps the pastures healthy without any chemical fertilizers. Mike also collects manure from the cowsheds and composts it and sells the compost to nearby gardeners. Mike also employees more than two-dozen from his community — four full-timers in the ice cream parlor and milking stations, and up to 25 teenagers part time in the summer in the ice cream parlor.

Answer the following questions:

1. Describe the situation in your own words
2. Proposal
  - a. Do you think Mike landed on the right solution to his problem?
  - b. Is this a feasible option? Discuss Resource, Demand and Economic feasibility of the proposed solution
3. Engineering and Agriculture advise
  - a. What engineering services are involved in setting up the proposed solution?
  - b. What type of Engineers will be required to design and setup the proposed solution
  - c. What agriculture expertise will Mike need?
4. Value addition
  - a. Does the new system add value to his farm?
  - b. What are the reasons to your answer in part (a)
5. Other options

- a. What alternative ideas can you suggest for Mike?

#### **Case study 4: Permaculture**

Permaculture is a branch of ecological design and engineering that develops self-sustaining agricultural systems modeled from natural ecosystems.

In this exercise your team is a group of Permaculturists who are required to design a farmhouse for a family of 5. The farm should be able to sustain itself by producing the energy needed and using any waste produced. In case an essential commodity should be purchased from an external source, the farm should be able to produce to sustain a barter system. For example, if you need to buy electricity from an external source, the farm should be able to produce enough grains to exchange for the electricity. Remember the farm's electricity needs will be year round so different types of grains should be produced to maintain a constant flow of electricity. Most importantly the farm should feed the family!

#### *Farmland Specifications:*

Size of the land for the new farm is 2 acres. The land has two wells, which together can irrigate 1 acre by surface irrigation. Water and electricity can be bought from a nearby municipality. There are big markets for food crops around the farm.

The following questions will guide you in designing your farm:

1. Describe the case in your own words
2. Initial Analysis
  - a. What the 3 basic requirements for the farm and the family
  - b. How can these requirements be supplied?
3. Grow it
  - a. What do you plan to grow on the farm? Remember the family would like to eat a variety of food (Grains, fruits, Vegetables etc). Also remember to have more than one type so that they have food all round the year. (At least 2 types of grains, fruits etc.)
  - b. Which crop will provide to buy commodities that cannot be produced on the farm? Remember to grow more of that crop.
  - c. How do you plan to irrigate the land?
  - d. How do you plan to fertilize the farm and get better yields?
  - e. What animals do you plan to have on the farm?
4. Produce it
  - a. What will be the source of energy?
  - b. What machinery will the farm need?
  - c. What fuel will the machinery run on? (Do you want to grow something more now?)
5. Engineering
  - a. What type of engineers will you need to construct this farm?
6. Value addition
  - a. Pick a product of your farm and discuss how you can add value to the product. What are the negative impacts of adding value? (Example: Machines will be

required, if machines are needed then more energy will be needed to run the machines)

7. Feasibility

- a. Do you think the amount of energy and water available is enough to produce food for the family and sustain the farm?

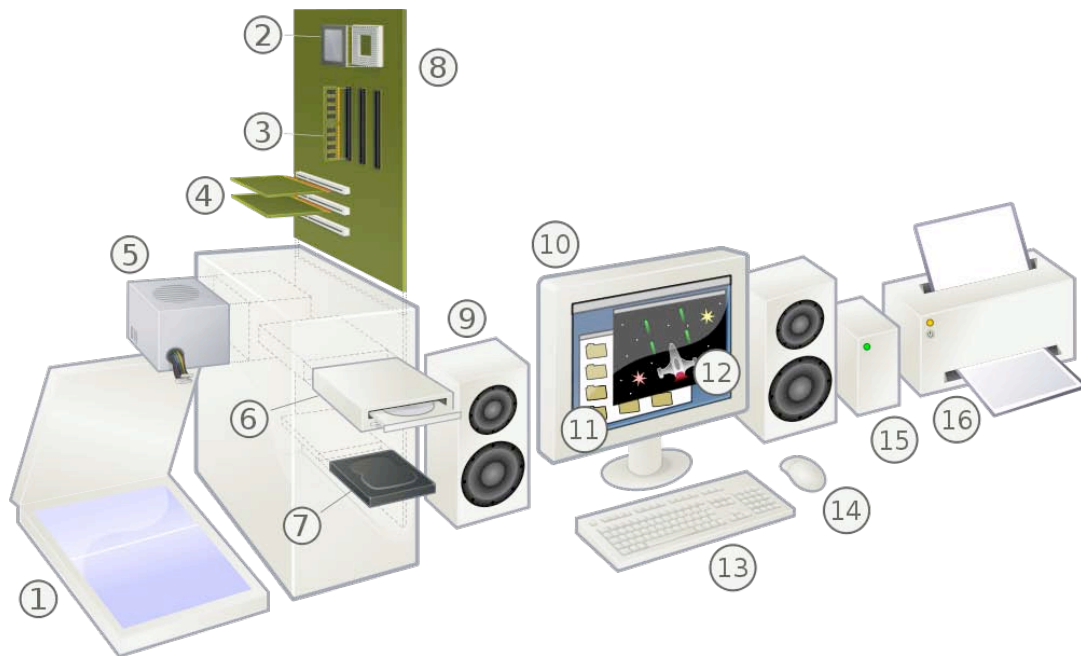
## Lesson 8: Hands-on Exhibition

Up until now, we have only been talking and reading about what engineering and agriculture are. Maybe now it is time to actually see the fruits of these disciplines in real life!

Today's lesson is a hands-on exhibition – basically a day for everyone to go around the classroom and play with the demonstrations we have set up. Each of these demonstrations shows the remarkable nature of engineering and agriculture, and aims to point out what lies beneath these items that makes them so useful to society today. The demos available to you today are the following:

### 1. Opened-up electronics

Each of these electronic pieces is a highly complex system that has been opened up for you to take a look at and go through. Notice the intense hardware and the small scale of all the components – it really goes to show the remarkable nature of electrical engineering!



Personal Computer Diagram: 1. Scanner, 2. CPU (Microprocessor), 3. Main memory (RAM), 4. Expansion Cards, 5. Power supply unit, 6. Optical disk drive, 7. Hard Disk Drive (HDD), 8. Motherboard, 9. Speaker, 10. Monitor, 11. System software, 12. Application software, 13. Keyboard, 14. Mouse, 15. External disk drive, 16. Printer.



Image by HereToHelp, source:

[http://en.wikipedia.org/wiki/File:Personal\\_computer\\_exploded\\_6.svg](http://en.wikipedia.org/wiki/File:Personal_computer_exploded_6.svg)

### 2. Lemon-battery

We learned that engineering is so important because it can use simple components to make a system that solves problems. So do you think you could power an electronic device, such as your cell phone, without using a battery? Could you make some kind of battery-like system from simple components, such as a few lemons? This demonstration will give you the answer.

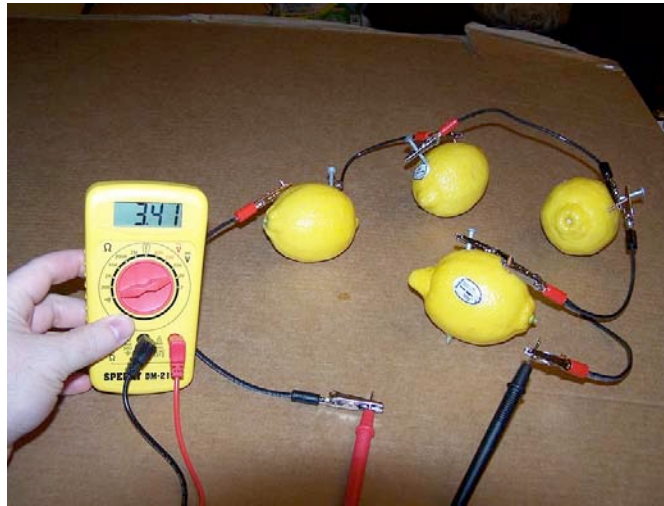
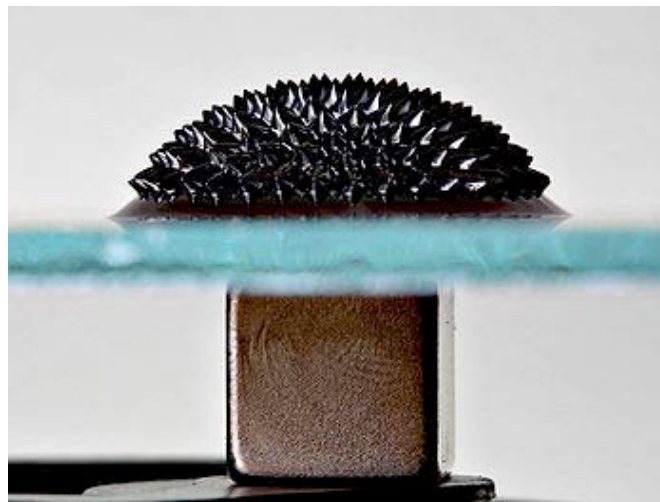


 Image by Jbruso, source: <http://commons.wikimedia.org/wiki/File:4LemonCircuit.jpg>

### 3. Ferrofluids

You probably already know what magnets are: a material that produces a magnetic field. Magnets have very interesting properties because of these magnetic fields – sometimes two magnets repel each other, sometime they attract one another, it all depends on how the magnetic fields are aligned. But you cannot see any kind of field coming out of the magnet, can you? Then how do you know it's there? Well, we can use a cool material called **ferrofluids** to show us the presence of magnetic fields!



 by Gregory F. Maxwell, source: [http://commons.wikimedia.org/wiki/File:Ferrofluid\\_Magnet\\_under\\_glass.jpg](http://commons.wikimedia.org/wiki/File:Ferrofluid_Magnet_under_glass.jpg)

### 4. Ecosphere

Have you ever thought about how the Earth sustains itself? Why doesn't our planet just run out of "gas" to run on, and end up destroying itself? The Earth exists forever because it is a self-sustaining system, or an **ecosystem**. An ecosystem is an environment where each of the components within that environment is able to provide for another, creating a cycle that is everlasting. In other words, the network of interactions between organisms and their environment create an ongoing nutrient and energy cycle. You can see an example of this in the Ecosphere.



by Helfmann, source: [http://commons.wikimedia.org/wiki/File:Ecosphere\\_Kugel.jpg](http://commons.wikimedia.org/wiki/File:Ecosphere_Kugel.jpg)

## 5. Non-Newtonian Fluid

What happens when you pour water out of a cup? It flows right? How about when you punch it? It splashes everywhere right? That's because water behaves like a normal liquid, which was termed a Newtonian fluid. But have you ever seen a liquid that also behaves like a solid? Well, for a **non**-Newtonian fluid, if you were to pour it slowly out of a cup, it would behave like a liquid, just like water. But if you were to punch it, it would behave like a solid! Check this demo out and see for yourself! Also, see the directions at the end of this section to see how you can make the demo at home for your friends and family!



by Rory Macleod, source: <http://www.flickr.com/photos/macri/5393221639/>

## 6. Aerogel

An aerogel is the world's lightest solid material. It is made up of 99.98% air by volume! It is essentially a gel in which the usual liquid (which makes up most of the volume) has been replaced by air. This results in an extremely funky material that looks and feels like nothing, but can actually be very useful in technology today!





Source: [http://commons.wikimedia.org/wiki/File:Aerogel\\_hand.jpg](http://commons.wikimedia.org/wiki/File:Aerogel_hand.jpg)

## 7. Shape Memory Alloy

A shape memory alloy is a metal alloy, or something made up of two or more different metals together, that you can bend and distort at one temperature but then return it to its original shape by heating it to another temperature. This “memory” does not actual depend on the memory we know, but it depends on the crystal structure of the material. At a low temperature, the material is soft and bendable, but after crossing a certain temperature, the crystal structure inside the material changes, and reverts to its original shape. Check it out!



by Wiertz Sébastien, source: <http://www.flickr.com/photos/wiertz/6111633558/>

## Non-Newtonian Fluid Demo at Home!



Reference: Activity: Lumpy Liquids and Squishy Solids in *CHEMICAL DEMONSTRATIONS: A Handbook for Teachers of Chemistry, Volume 3* by Bassam Z. Shakhashiri. Copyright 1989 University of Wisconsin Press, All Rights Reserved. Accessible at: <http://scifun.chem.wisc.edu/homeexpts/lumpyliquids.htm>.

## **Exploratory Lab**

# Exploratory Timeline

Day	Lesson	Activity
1	Getting to know you: Ice-breakers Introduction to Exploratory Lab and what it is all about! Introduction to Agriculture and Engineering	Human Rube Goldberg Activity Other Ice-breakers i.e. 'Reach & Grab' or 'All Aboard'
2	Renewable vs. Non-renewable energy Goals vs. Practice Millennium Development Goals (MDGs)	
3-10  ***Class divided into 4 groups, with smaller groups within those, focusing on one entire system. Will rotate through systems as they complete each one***	<i>Systems Group Work with Large Experiments:</i>  Group One: a. Food (Plants/Agriculture) b. Food (Animals)  Group Two: a. Water (Collection – Rain & Ground) a. Water (Purification & Distribution)  Group Three: b. Energy (Solar)  Group Four: a. Energy (Wind & Hydro) b. Energy (Biogas)	Farming Scenario Sugar Cane Activity  The Water Cycle & and Aquifer Water Distribution Exercise  The Hot Box  Turbines Manure, Food Scraps in Bottles
10	Summarize & Farewell	Farewell Activity

# Exploratory Lab

## Course Objectives:

To give students opportunities to learn about topics in food, water, and energy in light of agriculture and engineering through lessons, demonstrations, experiments, and group activities.

## Course Description:

Students will be divided into their 4 groups and will work through the 3 systems (food, water and energy). When they have finished one experiment, they will move into the next, making sure they complete all experiment stations, over the 8-day period.

## Important Concepts:

- Renewable vs. Non-Renewable Energy
- Millennium Development Goals
- Sustainability
- Food (Plants & Animals)
- Water (Collection, Purification & Distribution)
- Energy (Hydro, Wind, Solar & Biogas)
- Incorporating and applying core subjects of Math and English (WAEC) into practical experiments



 by Sammo, source:  
[http://openclipart.org/detail/172076/  
inspector-by-sammo241-172076](http://openclipart.org/detail/172076/inspector-by-sammo241-172076)

## Lesson 1: Exploratory Lab - Introduction to Agriculture & Engineering

### Objective:

- Students will understand how to apply agricultural and engineering strategies to real-world situations through hands-on activities.

**Everything has energy** but we need ...

Think of yourselves as a machine. What happens when you don't eat and drink? This can be scaled up to an entire country. What do you need energy for? Food for? Water for?

Agriculture helps us grow food and harness energy we can use to grow it, particularly if it's sustainable. There are so many benefits from economic and environmental standpoints. As a class, discuss and list some below:

Economic	Environmental

Engineering is a way of implementing methods of harnessing universal forms of energy in ways we can use them to do stuff, like mechanical – solar, wind, water energies.

## Lesson 2: Millennium Development Goals

### Objectives:

- Understand the relevant systems (food, water and energy) in regards to agriculture and engineering, and how to apply them to real-world situations
- Understand the origins of, and reasons for, the Millennium Development Goals (MDGs)
- Be able to describe the Millennium Development Goals in their own words
- Introduce the MDGs as a means of exploring concepts of development & sustainability
- Understand the context for the MDGs & become familiar with the eight goals
- Examine goal in more detail and make explicit the local-global connection

### Lesson:

*Renewable energy* – comes from sources that do not run out or that can be replenished within a short period of time. Sources of renewable energy include: Wind, water, sun, biomass (energy obtained from plants, animals or their products such as wood, corn, grasses and manure) and geothermal (heat from deep within the earth).

*Non-renewable energy* – comes from sources that cannot be replenished within a short period of time. Sources of non-renewable energy include: oil, natural gas, coal, nuclear energy

Activity: What is sustainability?



by Majin Cline, source: <http://openclipart.org/detail/29188/globe-by-majincline-29188>



Reference: “Three Pillars of Sustainability,” <http://yadadrop.com/about/sustainability>. Copyright 2011 Yada Drop LLC. All rights reserved.



by Andrew, source: <http://commons.wikimedia.org/wiki/File:Sustainability-diagram-v3.png>

### *Goals versus Practice*

Profitable economics, healthy environment, and vital communities are all *goals*. They are what we are trying to achieve. *Practices* are actions we take to achieve those goals. Why don't we define sustainable agriculture in terms of practices? There are two important reasons: First, we expect that our knowledge will increase in the future, so practices used now may not be considered the best practices ten years from now. Second, the effect of a practice can vary enormously depending on how and where it is performed. For example, plowing on a steep hillside is unsustainable because it causes too much soil erosion. However, occasional plowing on level ground can be a sustainable tool for some cropping systems.

In order to attain our goals, we need to take certain actions, that is, follow certain practices. So one of the things we'll explore in the next few days are examples of sustainable practices, such as crop rotation, riparian buffer strips, rotational grazing, and direct marketing. Keep in mind, though, that these are not all the possible practices and if they don't help us achieve our goals, they are not sustainable, no matter what the practice.

# Millennium Development Goals



Reference: The following texts and images are adapted from “Millennium Development Goals,” UNDP, <http://www.undp.org/content/undp/en/home/mdgoverview.html>, Copyright 2011 United Nations Development Program, All Rights Reserved. Extracts of the information in the web site may be reviewed, reproduced or translated for research or private study but not for sale or for use in conjunction with commercial purposes.

The United Nations Millennium Development Goals are eight goals that all 191 UN member states have agreed to try to achieve by the year 2015. The United Nations Millennium Declaration, signed in September 2000 commits world leaders to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. The MDGs are derived from this Declaration, and all have specific targets and indicators.

The MDGs are inter-dependent; all the MDG influence health, and health influences all the MDGs. For example, better health enables children to learn and adults to earn. Gender equality is essential to the achievement of better health. Reducing poverty, hunger and environmental degradation positively influences, but also depends on, better health.



## Poverty and Hunger

Cut the number of people in half who live on less than one US dollar a day and who suffer from hunger.



## Education

Make sure that all children start and finish primary school.



## Gender Equality

Be sure that as many girls as boys go to school.



## Reduce Child Mortality

Cut back by two-thirds the number of children who die before they reach the age of five.



## Improve Maternal Health

Cut back by three-quarters the number of women who die when they are having babies.



## Disease

Stop terrible diseases like HIV/AIDS, malaria, TB, from spreading and make them less common.



## Environment

Cut in half the number of people who lack clean water, improve the lives of people who live in slums, and promote policies that respect the goods of creation.



## Global Partnership

Promote greater cooperation among all nations with special concern for fairer deals for poor countries in trade, aid, debt, new technologies, etc.



by kattedkrab, source:

<http://openclipart.org/detail/16340/hand-prints-by-kattedkrab-16340>



## **Achieving the Millennium Development Goals in Liberia**



Reference: Republic of Liberia: Millennium Development Goals 2010 Report: Progress, Prospects and Challenges towards Achieving the MDGs. Copyright 2010 Government of Liberia, United Nations Development Program, All Rights Reserved. Accessible at:  
[http://www.lr.undp.org/Documents/RecentPublic/MDG%20Report%20\\_Final.pdf](http://www.lr.undp.org/Documents/RecentPublic/MDG%20Report%20_Final.pdf).

## The MDGS in Our Own Words

Images below are adapted from <http://www.undp.org/content/undp/en/home/mdgoverview.html>, Copyright 2011 United Nations Development Program, All Rights Reserved. Extracts of the information in the web site may be reviewed, reproduced or translated for research or private study but not for sale or for use in conjunction with commercial purposes.



**MY/OUR MDG IS:**

**MY/OUR MDG MEANS IN OUR OWN WORDS:**

## The MDGS Linking Worksheet



Reference: Matching facts to MDGs in *Integrated Literacy Activities*. Copyright 2012, Irish Aid, All Rights Reserved. Accessible at: <http://ourworldirishaidawards.ie/wp-content/uploads/2013/01/5th-6th-class-Our-World-Awards-lessons-with-logos.pdf>, page 10.

### Group Activity

If you had a chance to attend the United Nations Summit on Millennium Development Goals, what would you like say to the Governments, journalists and development organizations attending?

Write a speech or design a poster, which sends a message to the world's adults about what you would like in the future.

### Notes:

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## Lesson 3: Food (Plants, Animals & Agriculture)

### Objectives:

- Be able to define the term “sustainable”
- Distinguish between the goals and the practices used to achieve the goals of sustainable agriculture and food systems
- Demonstrate awareness of economic, environmental, and community impacts of agriculture.
- Understand the steps in the food system between the farm and their plates and the global nature of the food system
- Identify that machines can be used to make work progress more easily and quickly
- Introduce the idea that some things that are considered waste can be used for alternate purposes

### *What is Sustainable Agriculture?*

Sustainable agriculture is a journey rather than a destination. The word “sustainable” comes from the word “sustain” which means to maintain, support, or to endure. People involved in sustainable agriculture are trying to identify and solve the problems in our current agricultural system in order to provide food and fiber in a healthy environment for people over the long term. And that’s not to say agriculture necessarily has to be all about food. At least for now, no one has developed a fully sustainable agriculture, and for the foreseeable future there will always be room for improvement.

### Activity

As a group, brainstorm ideas about what you believe subsistence farming and commercial agriculture to be:

***Subsistence Farming***

***Commercial Agriculture***



“Goat” by Gerald\_G, source: [http://openclipart.org/detail/16228/goat-by-gerald\\_g](http://openclipart.org/detail/16228/goat-by-gerald_g)



“Medal” by Peter M, source: <http://openclipart.org/detail/3972/medallion-by-peterm>

## Important Sustainable Farming Terms & Definitions



Reference: “Aquaculture,” <http://www.clearsprings.com/school/lesson-plans/aquaculture/>. Copyright 2012-2013, Clear Springs Food, All rights reserved.



Reference: “Ethnobotany,” <http://extension.uga.edu/k12/science-behind-our-food/lesson-plans/Ethnobotany.pdf>. Copyright 2011-2012, University of Georgia Cooperative Extension, All rights reserved.



Reference: “Medicines that Changed the World,” <http://www.accessexcellence.org/RC/Ethnobotany/page4.php>. Copyright 1996-2012, Stephen R. King, All rights reserved.



Reference: “The Science of Ethnobotany with Dr. Paul Cox,” <http://sciencestage.com/v/16006/the-science-of-ethnobotany-with-dr-paul-cox-.html> or <http://youtu.be/9UYl6kmS8fQ>. Copyright 2010, ScienceStage.com, All rights reserved.

## Ethnobotany & Medicine

### *What is composting?*

According to the Commonwealth of Massachusetts Department of Environmental Protection, “In nature, soil organisms called decomposers digest organic material such as leaves, dead plants and animals.”



by Alan Levine, source:

<http://www.flickr.com/photos/cogdog/3475531992/>



by Kessner Photography, source:

[http://commons.wikimedia.org/wiki/File:Real\\_Compost.jpg](http://commons.wikimedia.org/wiki/File:Real_Compost.jpg)



Reference: “Composting Lesson Plan,” <http://www.thegreenteam.org/pdf/AdditionalLessonPlan-Compost.pdf>. Copyright 2012, Commonwealth of Massachusetts Department of Environmental Protection, All rights reserved.



Reference: “The Dirt on Soil,” <http://school.discoveryeducation.com/schooladventures/soil/>. Copyright 2012, Discovery Education, All rights reserved.



Reference: “Soil Basics,” Lindsay DeHartchuck, [http://edu.earthday.org/sites/default/files/Soil%20Basics\\_Lesson%20Plan.pdf](http://edu.earthday.org/sites/default/files/Soil%20Basics_Lesson%20Plan.pdf). Copyright 2012, Discovery Education, Earth Day Network, All rights reserved.



Reference: “Types of Soil,” <http://www.provident-living-today.com/Types-of-Soil.html>. Copyright 2009-2013 Provident-Living-Today.com, All rights reserved.



Sandy soil by Tess Watson, source: <http://www.flickr.com/photos/63603238@N00/3217753126>



Silt soil by Mongo, source: [http://commons.wikimedia.org/wiki/File:Silt\\_at\\_Boyers\\_Chute.jpg](http://commons.wikimedia.org/wiki/File:Silt_at_Boyers_Chute.jpg)



Clay soil by Rowena R., source: [http://commons.wikimedia.org/wiki/File:Clay\\_soil.jpg](http://commons.wikimedia.org/wiki/File:Clay_soil.jpg)



Source:  
<http://openclipart.org/detail/16947/farming-food-by-johnny-automatic-16947>

## Farming Simulation Game



Reference: Farming Simulation Game, Irish Aid,  
<http://www.irishaid.gov.ie/media/irishaid/allwebsitemedia/50teachingandlearning/teaching-and-learning-primary-5th6th-class-environment-lessonplan4.pdf>. The information published on this website is the copyright of the Office of the Information Commissioner unless otherwise stated. The information on this website may be re-used in any format, without application and free of charge. Retrieved on Nov. 10, 2012.

In teams, your class becomes African villages. The aim of the game is for your group to grow as much as they can for their village. Over 2 rounds, each team decides which crops to grow, and on a roll of dice, find out if they have a good or poor year for their harvest depending on the weather. At the end of each round each team is given a card outlining something, which will either increase or decrease their yield. The team with the biggest harvest for their village at the end of the 2 rounds wins the game.

#### Round 1:

- Divide into groups of 2 people. Each group represents a village. On the following worksheet are the crops that you will grow (Yams, Cassava, Maize, Millet, Groundnuts, Peas).
- Your village has 10 fields to plant. You must plant at least 3 different crops.
- Decide as a group which crops to grow and how many fields per crop. Fill in the number of fields for each crop in the 'No. of Fields' column on the worksheet. On the worksheet you'll see that some crops grow better in dry conditions, others in the wet conditions. Now roll the dice to find out if you have a wet or dry year. If you get a 1, 2, 3, 4 you have a dry year. If you roll a 5, 6 you have a wet year.
- If you have a wet year you calculate your yield (the amount of crops your village produces) by multiplying the number in the 'No. of fields' column with the figure in the 'Wet yield' column. Fill in your yield in the 'Total Yield' column.
- If you have a dry year, you calculate your yield (the amount of crops your village produces) by multiplying the number in the 'No. of fields' column with the figure in the 'Dry yield' column. Fill in your yield in the 'Total Yield' column.
- To find out how much your village has grown add up your 'Total Yield' column.
- Now, sometimes other things happen which can affect (have an impact on) your crops. These Impact Cards tell you what happens. Someone from each village in turn comes up to choose an Impact card and reads it out so that all the other villages can hear what has happened. (*Ask your teacher for a card*).
- Each village must now fill out the 'Impact loss' line on the worksheet and calculate the 'Total Yield After Impact'. To do this, you subtract the loss on the Impact Card from the Total Yield.



by USDA Farm Service Agency,  
source:

[http://openclipart.org/detail/26160/veggies-by-johnny\\_automatic-26160](http://openclipart.org/detail/26160/veggies-by-johnny_automatic-26160)



### **Yams:**



### **Cassava:**



Yams and cassava are root crops, which grow under the ground. They are high in carbohydrate, which provides energy and are a staple part of the diet in many African countries. While yams are cooked like potatoes, cassavas are usually dried and ground in flour to make porridge, which is eaten with a sauce.



### **Maize:**

In Africa, maize is ground into flour and made into a thick porridge. It is a staple food for millions of people in Sub-Saharan Africa. New varieties of maize are drought resistant.



### **Millet:**

Millet is native to the Ethiopian highlands, and is a main crop in Northeast Africa. It is seldom attacked by insects, and has a protein that other staple foods lack.

### **Ground Nuts And Chickpeas:**



Groundnuts and chickpeas provide people with a very important source of protein. Fish and meat are also a very good source of protein, but can be expensive for poor communities. Protein is a very important part of the diet to maintain health as it allows the body to grow and repair damage.



## WORK SHEET

STUDENT NAMES:

VILLAGE NAME

Type/Crop	Wet Yield Units	Dry Yield Units	No. of fields Year 1	Total Yield Year 1	No. of fields Year 2	Total Yield Year 2
Yams	70	20				
Cassava	40	60				
Maize	60	30				
Millet	30	60				
Groundnuts	50	30				
Chickpeas	50	30				

Total Yield Year 1 (Before Impact) (add Year 1)

Impact Year 1 (from the Impact Card) (subtract)

**Total Yield Year 1 (After Impact)**

Total Yield Year 2 (Before Solution) (add year 2)

Solution Year 2 (from the Solution Card) (add)

**Total Yield Year 2 (After Impact)**

Total Yield After Year 1:

Total Yield After Year 2:

Total Yield

Round 2:

Repeat the process (a-h) for Year Two

- j) In Year Two substitute Solution Cards for Impact cards. Solution Cards provide a positive surprise for the villages. Pupils calculate their 'Total Yield After Impact' by adding the gain from the Solution Card with the Total Yield figure.



Source:

<http://openclipart.org/detail/19589/little-green-tractor-by-yman>

**Evaluation Questions**

How did the Impact Cards affect their yield and how did they feel about this?

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How did the Solution Cards affect their yield and how did they feel about this?

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What were the main environmental factors affecting the amount of crops the villages could grow?

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What other factors affected the amount of crops the villages could grow?

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Where does our food come from?

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What happens if a certain food is not available here?

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## Impact Cards

<p><b>Normal Harvest</b></p> <p>Your village brings in a good harvest. But your village's storage has become damp, causing rot in half your yield.</p> <p><i>Your village loses half its crops</i></p>	<p><b>Climate Change</b></p> <p>Changes in the climate have caused the rain patterns to change. All of the villages experience very heavy rain. But your village is next to a river, which bursts its banks and floods your yields.</p> <p><i>Your village loses 50 units</i></p>
<p><b>War</b></p> <p>War breaks out in the region and soldiers from both sides overrun the fields in your village. They take stored crops and seeds for the following year.</p> <p><i>Your village loses 75 units</i></p>	<p><b>Soil Problems</b></p> <p>Deforestation has left the soil around your village lacking nutrients, so your crops don't grow as well as expected.</p> <p><i>Your village loses 70 units</i></p>
<p><b>Water Pollution</b></p> <p>Waste chemicals from a factory have leaked into the water. The water comes into your field through your irrigation system. Some of your crops die.</p> <p><i>Your village loses 50 units</i></p>	<p><b>Normal Harvest</b></p> <p>Your village brings in a normal harvest. But a local government official has demanded a bribe from your food supply.</p> <p><i>Your village loses 40 units</i></p>
<p><b>Elephant</b></p> <p>An elephant has come into your village at night and walked through a field of crops.</p> <p><i>Your village loses 20 units</i></p>	<p><b>Malaria Outbreak</b></p> <p>Several villages have become sick with malaria, reducing the number of workers available to harvest the crops.</p> <p><i>Your village loses 70 units</i></p>


## Solution Cards

<p><b>Farming Cooperative</b></p> <p>Your village sets up a cooperative with nearby villages to learn and share new farming practices. You have help from a local agricultural scientist whose work is funded by the UN.</p> <p><i>Your yield increases by 50 units</i></p>	<p><b>A Community Well</b></p> <p>Your village has had several years of drought. A development organization offers to work with your village to build a well.</p> <p><i>Your yield increases by 60 units</i></p>
<p><b>Tree Planting</b></p> <p>You plant your maize fields with fertilizer trees. The trees help the soil; they prevent erosion and provide nutrients to the maize crops.</p> <p><i>Your village loses 75 units</i></p>	<p><b>Literacy Classes</b></p> <p>Several women in your village join a literacy class. They are now able to read the directions on a natural pesticide sack and find that you need less than you have been using.</p> <p><i>Your yield increases by 60 units</i></p>
<p><b>New Seeds</b></p> <p>Your village decides to plant a new type of drought resistant seed. These seeds grow better in dry conditions.</p> <p><i>Your village doubles its dry crop units</i></p>	<p><b>Mosquito Nets</b></p> <p>A charity has bought mosquito bed nets for the village. This reduces the number of people who get malaria during the year, and it means that everyone is able to work.</p> <p><i>Your yield increases by 70 units</i></p>
<p><b>Water Supply</b></p> <p>Your government helps your village to build an irrigation system, which brings water to the fields. It also means that women don't have to carry the water to the fields anymore and can go to literacy classes.</p> <p><i>Your yield increases by 50 units</i></p>	

## Practical Exercise

Create a model using play dough to show a system with different things growing and how it can be split to sustain everything. When you have finished, draw a rough sketch in the space provided below:



 by Viscious Speed, source:  
<http://openclipart.org/detail/168743/african-women-with-vessels-by-viscious-speed>

# Oil Press Activity

Oil is a very common and important food source. The fats contained in oil are necessary for good nourishment of the body. Traditional methods of producing oil, such as palm kernel oil, are very labor intensive. This activity explores a machine called an oil press, which can make oil production much easier.

*How is palm kernel oil produced?*

Discuss with your group and list the steps in the space below:

- |    |     |
|----|-----|
| 1. | 6.  |
| 2. | 7.  |
| 3. | 8.  |
| 4. | 9.  |
| 5. | 10. |

## **Think about it:**

Which steps of this process are most difficult and why?

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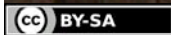
One job for engineers, especially mechanical engineers, is to take tasks that are difficult or time consuming, and find ways to make them easier. Machines, such as an oil press, or an oil expeller, can help us do our work easier and quicker than by other methods. In the picture below, you can see that we feed seeds in the top, and two products come out. One is oil, the other is called the “press cake.”



 PD-Self

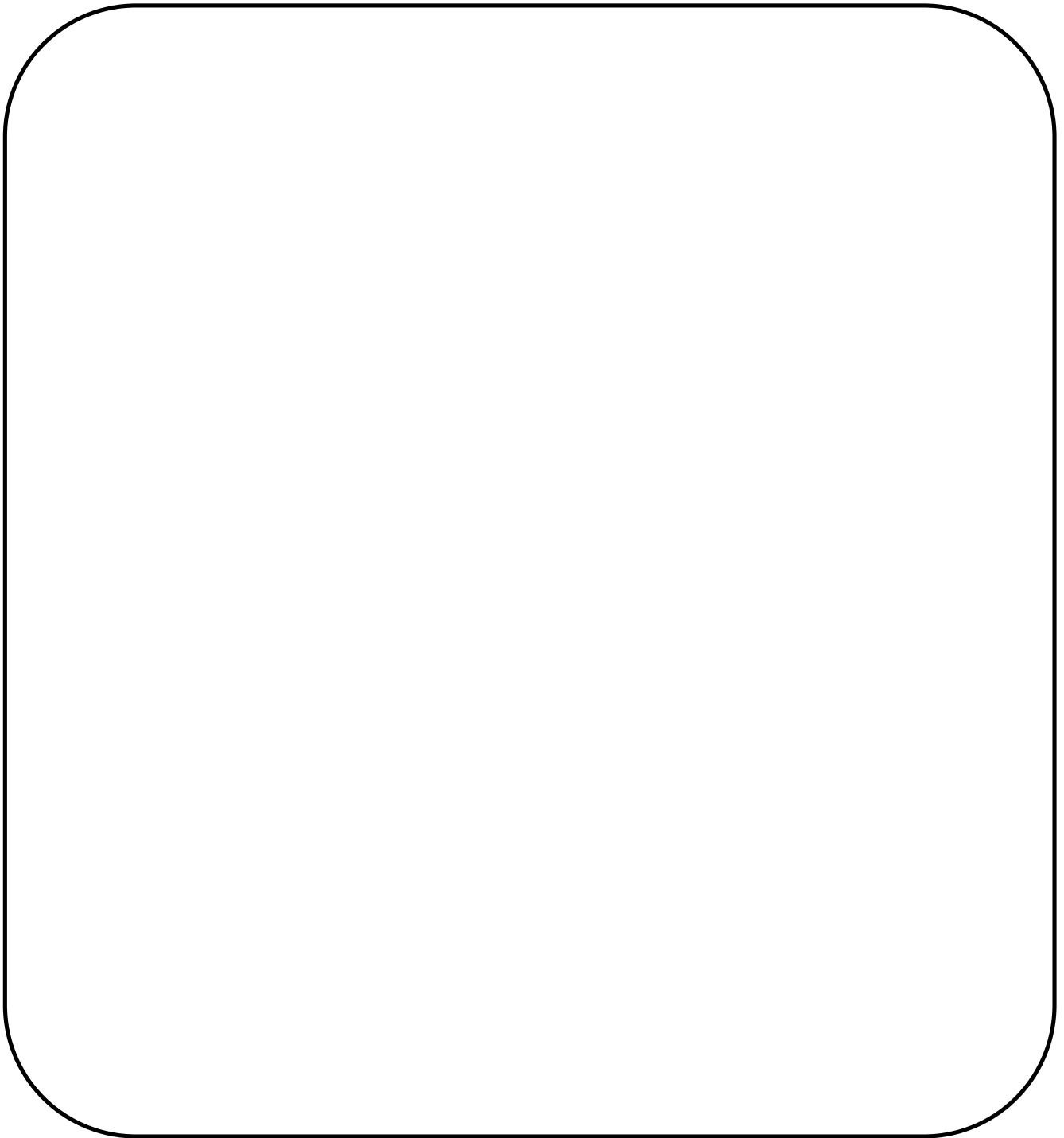
Source:

<http://openclipart.org/detail/27362/postcard-by-coredump-27362>



by Gerard van de Garde, source: [http://commons.wikimedia.org/wiki/File:Piteba\\_oliepers\\_-\\_Help\\_Ghana\\_op\\_gang.JPG](http://commons.wikimedia.org/wiki/File:Piteba_oliepers_-_Help_Ghana_op_gang.JPG)

Now use your imagination. How does this machine work? How can it take the seeds and change them into oil and press cake simply by turning the crank? What is going on inside? Using the box below, draw what you think the inside of this machine looks like. Label the parts and use arrows to indicate any motion. When you finish, share your drawing with a neighbor and compare.



Let's take this machine apart and see what's really going on inside. Ask an instructor to help you get started. Inspect each component and figure out its purpose. Each component is designed for a purpose! This process of taking a machine apart to understand how it works is called *reverse engineering*. Reverse engineering is very helpful for inspiration. You can reverse engineer anything - even nature! For example, how did someone find out that oil can come from the palm kernel? They took one apart!



We see that the press produces oil, which is good for food. What do we do with the press cake? Come up with some creative ideas and write them below:

- |   |   |
|---|---|
| ○ | ○ |
| ○ | ○ |
| ○ | ○ |



by Haarvey, source:

[http://commons.wikimedia.org/wiki/File:Oil\\_press\\_FAES.jpg](http://commons.wikimedia.org/wiki/File:Oil_press_FAES.jpg)

Discuss your ideas with your classmates. Ask an instructor to review your list and suggest any other ideas. Write different ideas from your class and teachers below.

This is a concept under the umbrella of *sustainability*: finding ways to use everything we produce, even if it looks like waste. Even though the main goal was to squeeze oil out of the palm kernel, our efforts produced the press cake also. The basic options are to pile it in a corner somewhere, or put it to good use. The former option gives us nothing but a pile we don't know what to do with; the latter allows us to use creative energy to make something out of nothing.

### Extended Activities:

What is the purpose of the flame?

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**Math activity:** Calculate the percent by weight of oil produced compared with the initial weight of the seed fed into the press. This is “percent extraction efficiency.” Higher extraction efficiency means you get more oil for every turn of the crank.

- Get a scale and use it to measure the weights of 3 small containers. Record the weights and a simple description of each container (e.g., blue, smallest, plastic, etc.). The weight of an empty storage container is called the *tare weight*.
  - $W_{1\text{tare}} =$
  - $W_{2\text{tare}} =$
  - $W_{3\text{tare}} =$
- Put a handful of oil seeds/nuts into container 1 and weigh it. The total weight of a container full of something is called the *gross weight*.
  - $W_{1\text{gross}} =$
- We don't want to use the weight of the container in our future calculations; we just want to know the weight of the seeds. The weight of the something inside the container is

called the *net weight*.

○  $W_{\text{seeds}} = W_{\text{Igross}} - W_{\text{Itare}} =$

- Now grind the oil seeds through the press. Carefully collect the oil in container 2 and the press cake in container 3.
- Use the force gauge and measure the weight of the oil and the press cake that you produced. (Hint: you need to come up with a formula to find the *net weight* of the oil and the press cake. Ask an instructor if you need help, but try to do it yourself!)
  - $W_{\text{oil}} =$
  - $W_{\text{cake}} =$
- Now we can find the *percent extraction efficiency* (%EE), which is a property of the oil seed and the press that was used to expel the oil.
  - $\%EE = (W_{\text{oil}})/(W_{\text{seeds}}) \times 100\% =$

Percent extraction efficiency gives us a number to compare the amount of oil which comes from certain types of seeds and certain oil extraction methods. High percent extraction efficiency means for the same amount of work, we get more oil than for lower percent extraction efficiency methods.

Compare your results with the oil press manufacturer supplied data, given below. Circle the value that the manufacture predicts you will achieve for the type of seed you used. Were you close or far? Why?

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“Performance of the PITEBA Oil Expeller with various oilseeds”,  
<http://www.piteba.com/eng/performance.htm>. Copyright 2012 Piteba, All Rights Reserved.

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## Lesson 4: Water (Collection - Rain & Ground)

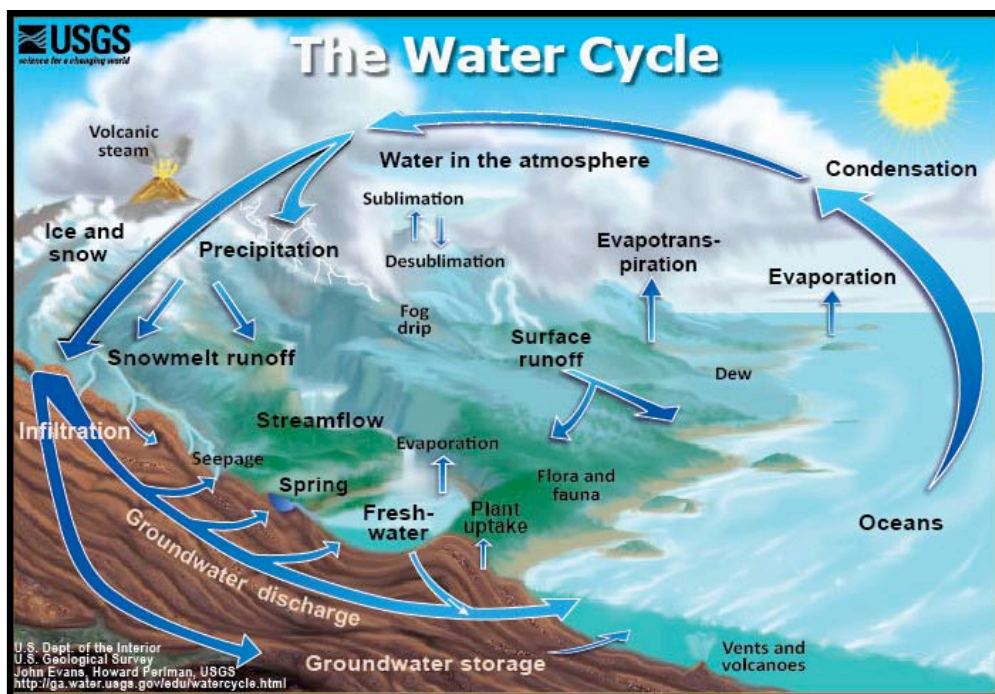
### Objective:

- Students will learn about the water cycle and how water can evaporate
- Students will then understand how this water evaporation can be collected as a water source
- Students will learn how water can become a source of energy
- To illustrate how water is stored in an aquifer
- Show how groundwater can become contaminated, and how this contamination ends up in the drinking water well.
- Students should get a clear understanding of what happens above the ground can potentially end up in the drinking water below the ground.

### The Water Cycle (Rain)

We know that water can be a liquid, a gas, or a solid. Outside, water is always changing from liquid to gas and back again. This process is called the water cycle. You can see how the water cycle works.

The sun's heat causes water to evaporate from streams, lakes, rivers, and oceans. The water vapor rises. When it reaches cooler air, it condenses to form clouds. When the clouds are full of water, or saturated, they release some of the water as rain.



PD-GOV U.S. Geological Survey, Wikimedia Commons,  
[http://commons.wikimedia.org/wiki/File:Water\\_cycle.png](http://commons.wikimedia.org/wiki/File:Water_cycle.png)


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# Water Cycle Experiment



Reference: "Make a Mini Water Cycle," The Water Project,  
<http://thewaterproject.org/resources/lesson-plans/create-a-mini-water-cycle.php>, Copyright 2012 The Water Project Inc., All Rights Reserved.

## Groundwater

 Excerpt from: "Build Your Own Aquifer", Louisiana Department of Environmental Quality,  
<http://www.deq.louisiana.gov/portal/Default.aspx?tabid=1966>

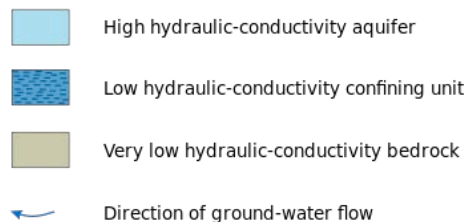
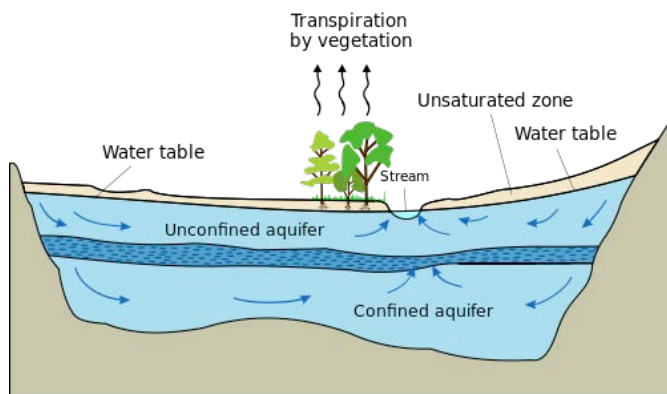


 Image: U.S. Geological Survey, Wikimedia Commons,  
[http://commons.wikimedia.org/wiki/File:Aquifer\\_en.svg](http://commons.wikimedia.org/wiki/File:Aquifer_en.svg).

Many communities obtain their drinking water from underground sources called **aquifers**. Water suppliers or utility officials drill wells through soil and rock into aquifers for the groundwater contained therein to supply the public with drinking water. Home-owners who cannot obtain their drinking water from a public water supply, will have their own private wells drilled on their property to tap this supply. Unfortunately, the groundwater can become contaminated by harmful chemicals, including improper disposal of household chemicals such as lawn care products and cleaners and any number of other pollutants.

These chemicals can percolate down through the soil and rock and into the aquifer - and eventually the well. Such contamination can pose a significant threat to human health. The measures that must be taken by well owners and operators to either protect or clean up contaminated aquifers is quite costly.

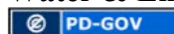
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# Aquifer Experiment



Reference: “Build Your Own Aquifer”,  
<http://www.deq.louisiana.gov/portal/Default.aspx?tabid=1966>, Copyright 2012 Louisiana Department of Environmental Quality, All Rights Reserved.

## Water & Energy



(Excerpt from: “Renewable Energy Activities - Choices for Tomorrow”, National Renewable Energy Laboratory, 2001, <http://www.nrel.gov/docs/gen/fy01/30927.pdf>)

When water is collected behind dams on large rivers, it provides a source of energy for the production of electricity. The enormous power of falling water is capable of turning giant turbines. These turbines drive the generators, which produce electricity. The degree of power is determined by the amount of water and the distance it falls. Hydroelectric power plants do not cause pollution, but there are fewer and fewer places to build dams. The environmental problem arises because a dam is typically built on a river creating a lake where land once stood. Water is a renewable energy source.



by Alberto Miranda Dencowski, source:  
<http://openclipart.org/detail/170124/ecology-by-mrallowski>



Reference: Water Crossword Puzzle, [www.groundwater.org/kc/docs/water\\_crossword\\_puzzle.pdf](http://www.groundwater.org/kc/docs/water_crossword_puzzle.pdf).  
Copyright 2012 The Groundwater Foundation, All Rights Reserved.



Reference: Groundwater Word Search,  
[www.groundwater.org/kc/docs/groundwater\\_word\\_search.pdf](http://www.groundwater.org/kc/docs/groundwater_word_search.pdf). Copyright 2012 The Groundwater Foundation, All Rights Reserved.

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## Lesson 5: Water Distribution (Purification & Irrigation)

### Objectives:

- Understand the process of condensation and evaporation in the purification of water
- Understand how and why solar energy can also be used to purify water
- Understand and develop effective water distribution strategies
- Explore civil engineering, engineering design, planning, construction, teamwork, and working in groups.
- Operationally define irrigation, while observing and classifying irrigation systems.
- Infer the need for irrigation systems & describe the different types.
- Construct a model and identify the model by observing the characteristics

## Water Purification Experiment



Reference: “Water Purification Experiment”,  
<http://learningtogive.org/lessons/unit389/lesson2.html>. Copyright 2012 LearningtoGive.org. All rights reserved. Permission is granted to freely use this information for nonprofit, noncommercial, educational purposes only.

### Materials:

- Large Strainer
- Coffee Filter
- ½ inch layer of sand
- 1 Inch of topsoil
- Clear glass for water



Source:

<http://openclipart.org/detail/38857/water-droplet-by-mbalax>

### Directions

1. Line a medium-size strainer with a coffee filter. Add a 1/2 inch layer of sand and an inch of topsoil. Put the strainer over a clear jar. Tell the students that this demonstration represents the natural water treatment process. This is how nature treats storm water flowing over a natural area with healthy drainage. Stir 2 tablespoons of dirt into a cup of water, then pour the dirty water through the sand and soil in the filter. Ask the students to observe the water in the bottom of the container and the condition of the sand and soil.
2. How does the water look different after it goes through the ground filter?

- 
3. What other kinds of dirt or waste do you think this filter system will clean up? Try some of the students proposals/ideas, if possible.

**Questions:**

What kinds of pollution do you think might not be filtered out by this natural process?

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The Earth is a closed system—no water is ever added to the system over time, and we share the water with everyone in the world. For that reason, we need to be responsible with the water we use. Look at a glass of filtered water. The H<sub>2</sub>O molecules of water in this glass may have fallen on the heads of dinosaurs, washed the hands of **Civil** War soldiers, satisfied the thirst of Olympic athletes or flowed down the Amazon River along with the crocodiles.

How can this be?

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Polluted water affects us all now and in the future because water is a common resource we share with all people and animals. What we do locally ends up in the global water system. Water is never created; it is recycled and shared repeatedly. Water is a common resource and its quality must be sustained for the **common good**.

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# Water Distribution Experiment



Reference: Lesson Focus, Lesson Synopsis, Student Worksheet including Ethical Implications and Design Your Own Irrigation Systems, [http://tryengineering.org/lesson\\_detail.php?lesson=53](http://tryengineering.org/lesson_detail.php?lesson=53). Copyright 2012 IEEE, All rights reserved.



Reference: The Different Irrigation Systems and Their Uses, [http://www.crwcd.org/page\\_144](http://www.crwcd.org/page_144), Copyright 2012 Colorado River Water Conservation District, All rights reserved.



by Brendel, source:  
[http://commons.wikimedia.org/wiki/File:Irrigation\\_system.JPG](http://commons.wikimedia.org/wiki/File:Irrigation_system.JPG)



by cybergedeon,

source:  
<http://openclipart.org/detail/170521/eco-green-watering-icon-by-cybergedeon-170521>



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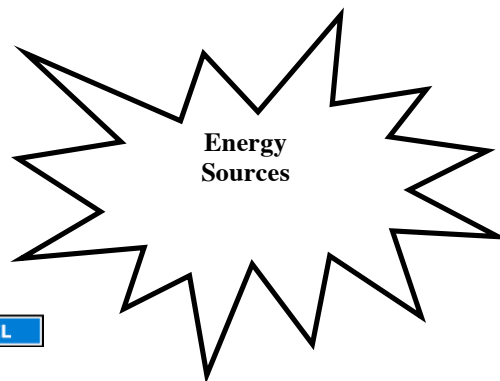
## Lesson 6: Energy (Solar)

### Objectives:

- Review the basic needs for alternative energy sources.
- Identify at least 3 different materials that will produce maximum heat.
- Identify at least 3 different colors that will produce maximum heat.
- Solve a design problem for a solar hot box.

### Lesson:

Brainstorm as many energy sources as you can in the space below:



Discuss which of the energy sources are used every day and which ones are alternative sources. Why do we consider some energy sources alternate and some not?

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by Alberto  
Miranda Dencowski, source:  
[http://openclipart.org/detail/169592/  
/green-earth-by-mrallowski](http://openclipart.org/detail/169592/green-earth-by-mrallowski)

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# Solar Experiment



Reference: “Solar Oven”, <http://www.energyforeducators.org/lessonplans5/solaroven.pdf>.  
Copyright 2009 Idaho National Laboratory, All Rights Reserved.

Today you will experiment with solar heating. During this activity you will be able to:

- Predict and discuss why/which colors will absorb or reflect heat.
- Define what a solar hotbox is.
- Define what a solar collector is.



Source:  
<http://openclipart.org/detail/2012/weather-symbols:-sun-by-nicubunu>

Predict and discuss why/which colors you feel will absorb or reflect heat.

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Define what a solar hotbox is.

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Source:  
[http://commons.wikimedia.org/wiki/File:Fours\\_solaires\\_ULOG\\_sun\\_oven\\_horno\\_solar.jpg](http://commons.wikimedia.org/wiki/File:Fours_solaires_ULOG_sun_oven_horno_solar.jpg)

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Define what a solar collector is.

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## Experiment:

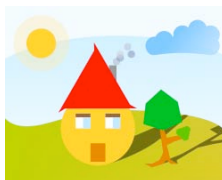


Reference: Solar Oven Experiment, Mrs. Adams,  
<http://mrsadamsthirdgrade.class.blogspot.com/p/science.html>. All Rights reserved.

## Activity:

List conditions outside that would help or hinder the solar heating process:

Help Solar Heating	Hinder Solar Heating



Source: <http://openclipart.org/detail/110173/face-house-by-mlampret>

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## Lesson 7: Energy (Wind & Hydro)

### Objectives:

- Analyze the importance of energy and how we use energy in our daily lives
- Describe difference between renewable and non-renewable sources of energy

### Hydropower



Reference: Excerpt from Water Power Program, U.S. Department of Energy,

[http://www1.eere.energy.gov/water/how\\_hydropower\\_works.html](http://www1.eere.energy.gov/water/how_hydropower_works.html).

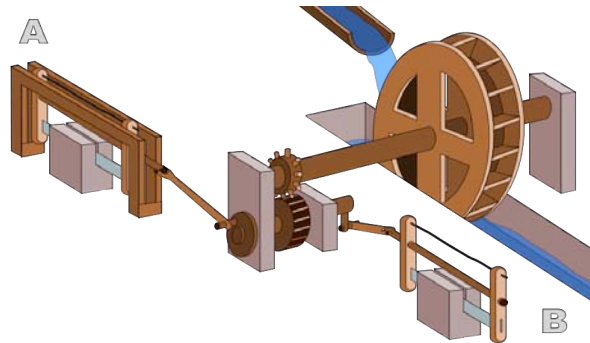


Hydropower is using water to power machinery or make electricity. Water constantly moves through a vast global cycle, evaporating from lakes and oceans, forming clouds, precipitating as rain or snow, and then flowing back down to the ocean. The energy of this water cycle, which is driven by the sun, can be tapped to produce electricity or for mechanical tasks like grinding grain. Hydropower uses a fuel—water—that is not reduced or used up in the process. Because the water cycle is an endless, constantly recharging system, hydropower is considered a renewable energy. We learned about this in Lesson 4: Water (Collection - Rain & Ground). This is called the hydrologic cycle, also known as the water cycle.

When flowing water is captured and turned into electricity, it is called hydroelectric power or hydropower. There are several types of hydroelectric facilities; they are all powered by the kinetic energy of flowing water as it moves downstream. Turbines and generators convert the energy into electricity, which is then fed into the electrical grid to be used in homes, businesses, and by industry.

### Hydropower Experiment

This activity will let you investigate the *water wheel*, one of the simplest and oldest methods for capturing the energy, which is stored in flowing water. The image below shows a water wheel. Water flows over the wheel, making it turn. In this case, the turning motion is converted to reciprocating (back and forth) motion, which drives a pair of saws for cutting wood.



Saws powered by a water wheel.

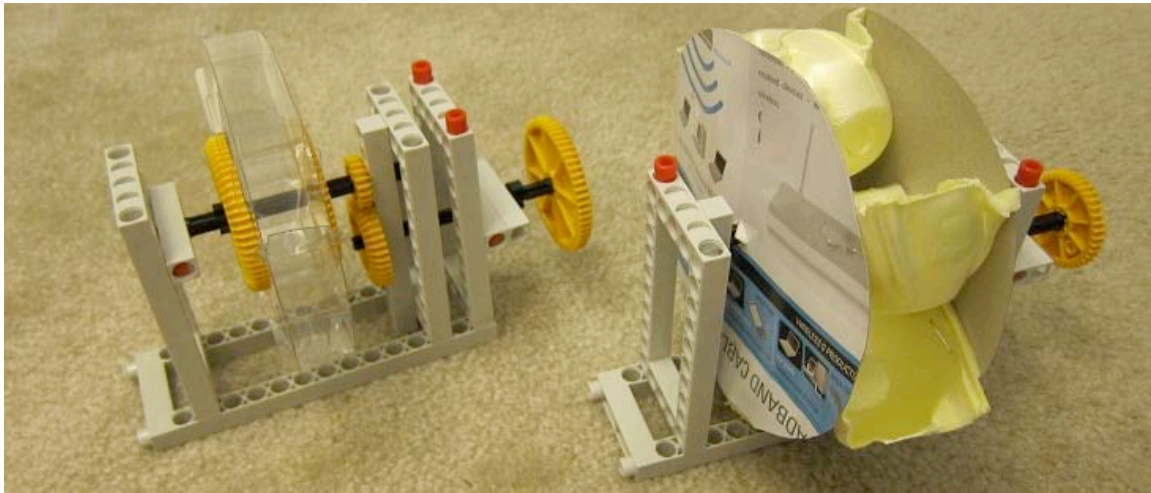


by Chris, source:

[http://en.wikipedia.org/wiki/File:R%C3%B6mische\\_S%C3%A4gem%C3%BChle.svg](http://en.wikipedia.org/wiki/File:R%C3%B6mische_S%C3%A4gem%C3%BChle.svg)

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The water wheel you will investigate looks like one the image below. Use a container to slowly pour water onto the water wheel from the top. Pour it so the sections of the water wheel fill up with water, and watch the system as a whole as each section fills up. This causes the wheel to turn, and then the section empties out the water near the bottom. This cycle continues as long as you keep pouring water!



Photographs of water wheels for experiment



Photo by University of Michigan

Play with it a little bit. Pour water near the edge of the wheel or closer to the center. Where is the best location to direct the flow of water to get the fastest wheel speed? Why?

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Now pour water faster or slower. Again, what makes the wheel spin the fastest? Why?

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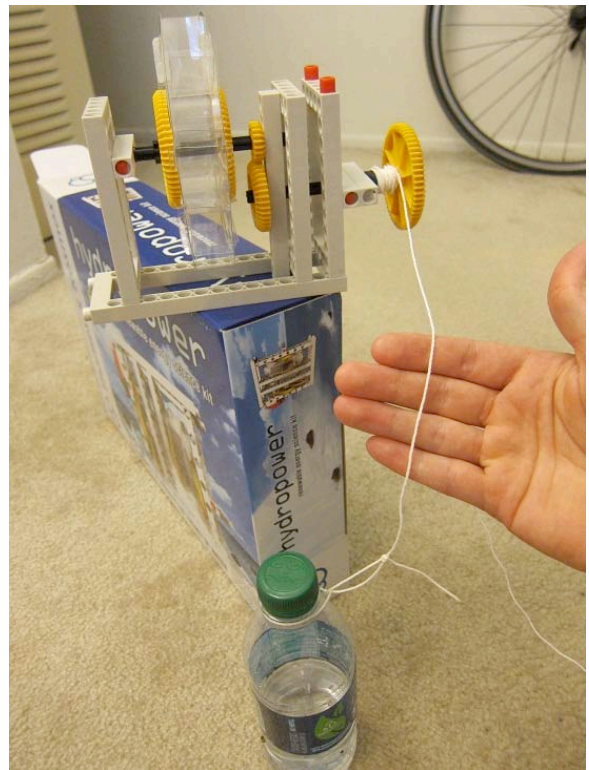
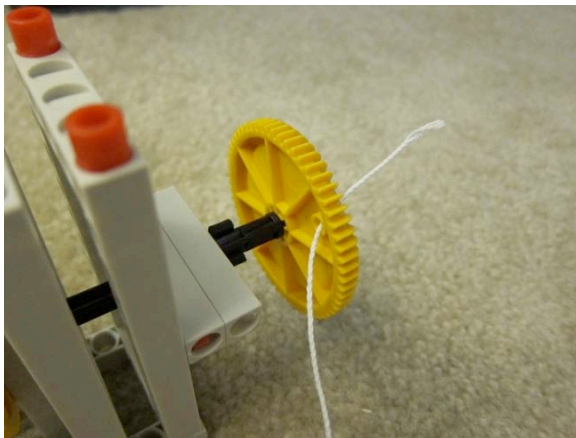
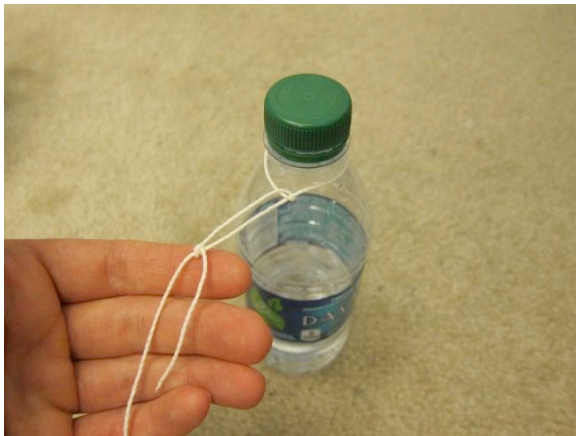
Can you think of any other factors, which could make the wheel spin faster? Write your ideas below, try them out, and record your results and observations.

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Now use the water wheel to try to do some work. Get a light object, such as a partially filled water bottle, and tie one end of a string around the top of the bottle and the other end of the string around the output shaft of the water wheel (see the images below). Make sure to wind the string

around the output shaft a few times. Pour water over the wheel as you did before and see if the rotation of the wheel can lift the object.



Images of tying a string to the water wheel in order to lift a light object, such as a water bottle.



Photos by University of Michigan

Were you successful in lifting your object? Why or why not?

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Could you change anything to make your attempt at lifting the object more successful? If so, what could you do? If you have time, try it!

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## Wind Power

Blow a puff of air out of your mouth – using your muscles, you created an area of high *pressure* inside your lungs. Pressure means that a fluid has been pressed – energy is stored inside it. You can contain this pressure by keeping your mouth closed instead of letting the puff of air out! When you open your mouth, the pressurized air flowed out into the atmosphere and the pressure was *balanced*. Fluids such as air always travel from regions of high pressure to regions of low pressure in an effort to balance pressure.

In the Earth's atmosphere, regions of high pressure are created by the heat of the sun. Air in high pressure regions flows to regions of lower pressure, and this flow is known as wind. Unlike the puff of air you produced using your mouth, the wind around the world never stops! Solar heating of our planet keeps the air moving. Therefore, like hydropower, wind power is also considered a renewable energy source.

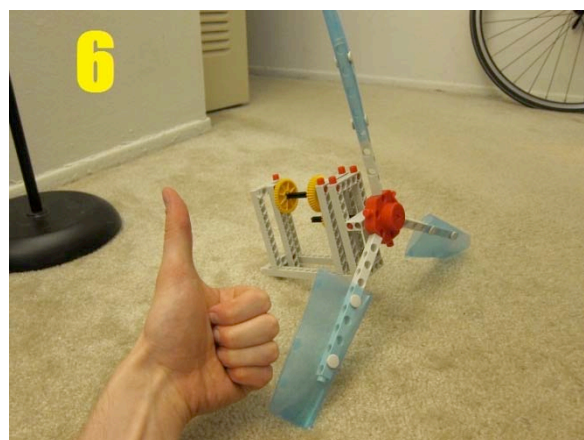
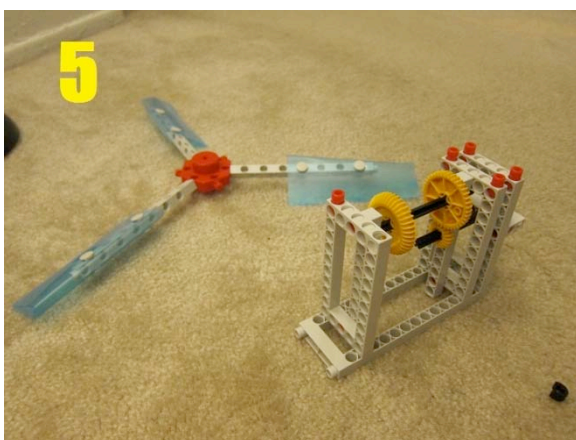
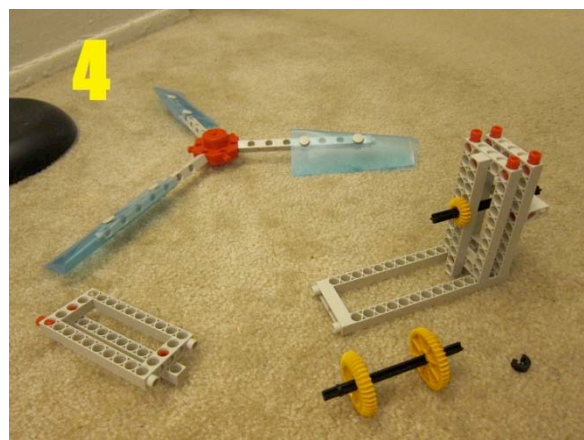
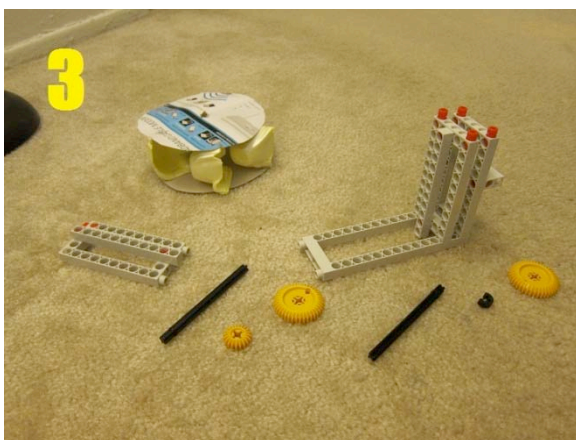
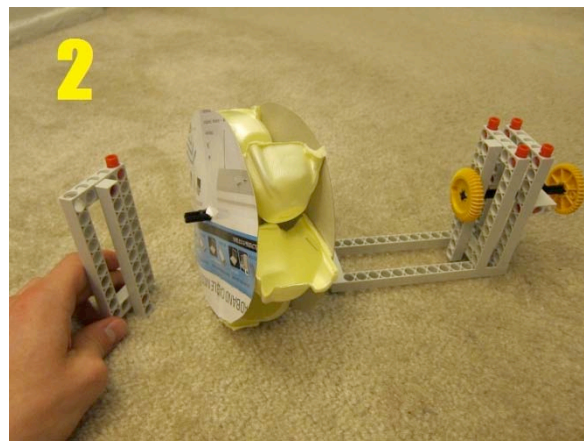
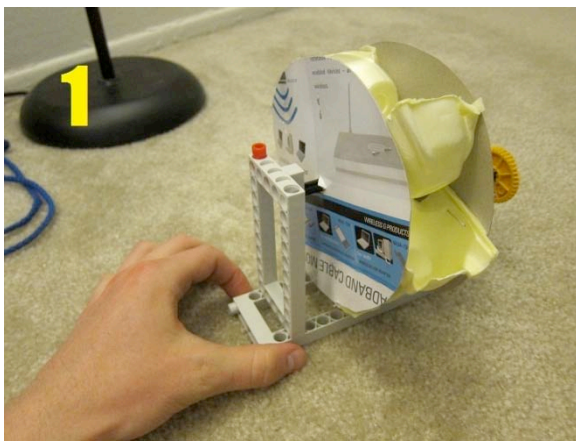
To harness this power, wind turbines are constructed in locations where wind speeds are high. Wind flows over the blades, creating a force which turns the rotor disk. This turning rotor disk supplies power which can be harnessed and used in many different ways.



 “Windmills in Spain” by Jesus Martinez, source [http://en.wikipedia.org/wiki/File:Toro\\_de\\_osborne.jpg](http://en.wikipedia.org/wiki/File:Toro_de_osborne.jpg).

## Wind Power Experiment

This experiment will give you the opportunity to explore how wind power can be harvested to do useful work. You will use the same experimental setup as you used for the hydropower experiment, but you will need to reconfigure it. Use the images below to help you make the conversion.



Steps to convert from hydropower experiment to wind power experiment.



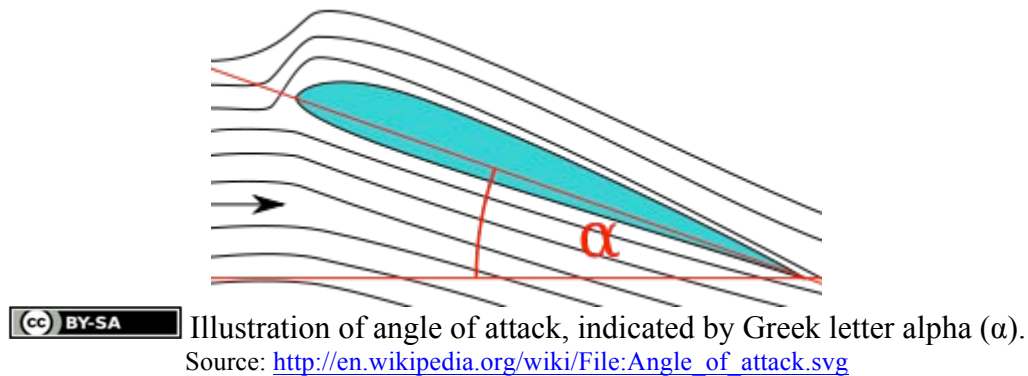
Photos taken by the University of Michigan

Place the windmill in front of a fan and turn the fan on. If it is a windy day, just take it outside and let the wind drive the windmill. Watch how the blades of the windmill are able to generate a force and spin in a circle. Put your fingers on the driveshaft and feel the power generated. When the windmill is spinning freely, after a few seconds, it reaches its maximum rotational speed.

The blades on this windmill can pivot on the red hub. Rotate the blades to different angles (try to keep them all nearly the same angle) and place the windmill in the airflow again. The angle between the wind direction and the lengthwise direction of the blade is called the *angle of attack*



– see the illustration below. The black lines are called *streamlines* – they indicate the direction of the flow. In other words, the air flows along the streamlines. The blue shape is a cross-sectional view of the blade – as if you were looking down the length of a single blade.



For different angles of attack, you will observe different maximum rotational speeds. Try extreme cases where the blades are perfectly parallel or perfectly perpendicular to the wind. Try to find an *optimal*, or best, angle which produces the highest maximum rotational speed. In the space below, draw a picture, similar to the illustration above, showing your blade orientation with respect to the wind. Indicate the angle of attack also.

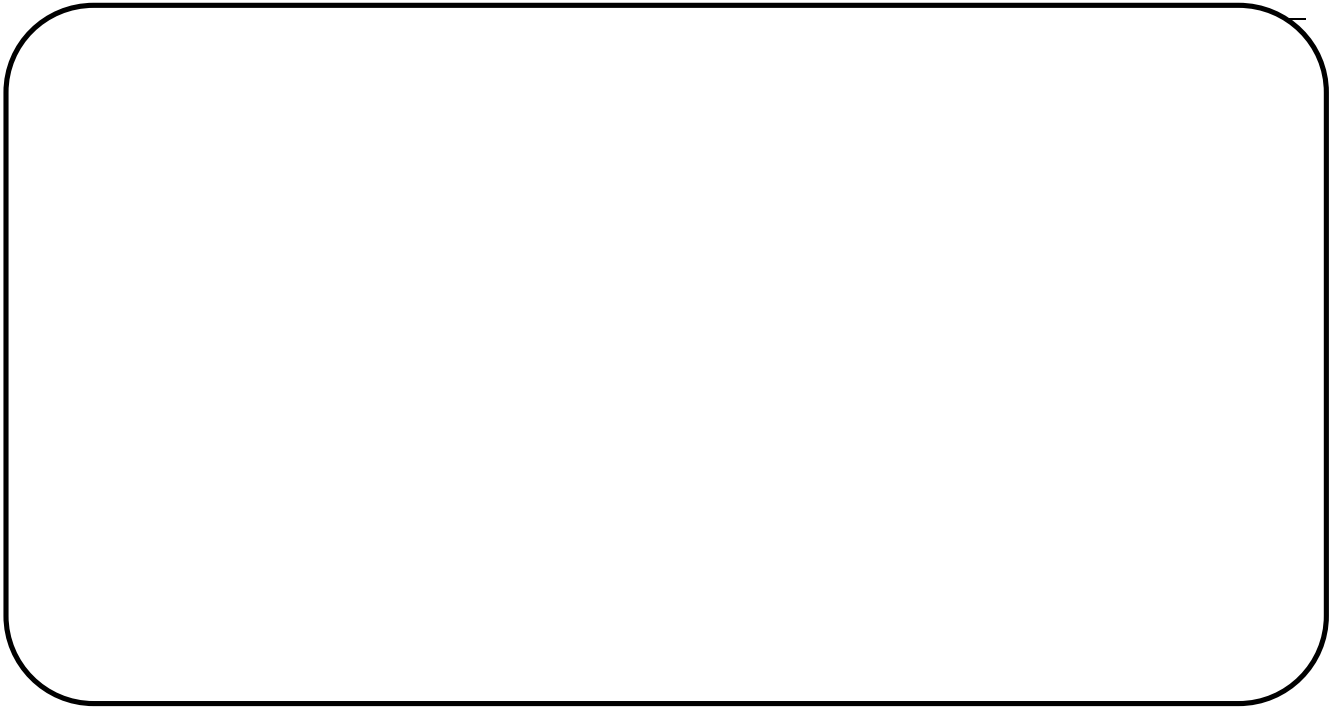
Move the windmill closer to or farther away from the fan (if you are using a fan). Can you find an optimal distance from the fan which produces the highest rotational speed of the blades? Please explain below.

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Similar to the hydropower experiment, fasten a string and a light object to the output shaft of the windmill. Note that this time, the output shaft is on the *inside* of the frame (hint: it's the shaft which has two gears on it). Holding the setup in the wind, attempt to lift the object using wind power.

Were you successful in lifting your object? Why or why not?

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Could you change anything to make your attempt at lifting the object more successful? If so, what could you do? If you have time, try it!

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### **Follow Up Questions**

Why are hydropower and wind power considered renewable forms of energy?

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Do you feel that hydropower or wind power is more effective? Why? Under what circumstances would the other one become more effective?

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Where does the water come from which drives a hydropower plant? In other words, how does the hydrologic cycle, also known as the water cycle, work? (You might want to review Lesson 4 if you need some help)

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Why does wind exist and how is it created?

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In this lesson, we used hydropower and wind power to lift (or try to lift) an object. What other uses can you think of for hydropower and wind power?

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### **Extension Activity**

Try to make your own windmill blades! Look around in the camp and in nature and see what creative ideas you can come up with. Build the blades, and if possible, try them out on the experimental setup to see if they work.

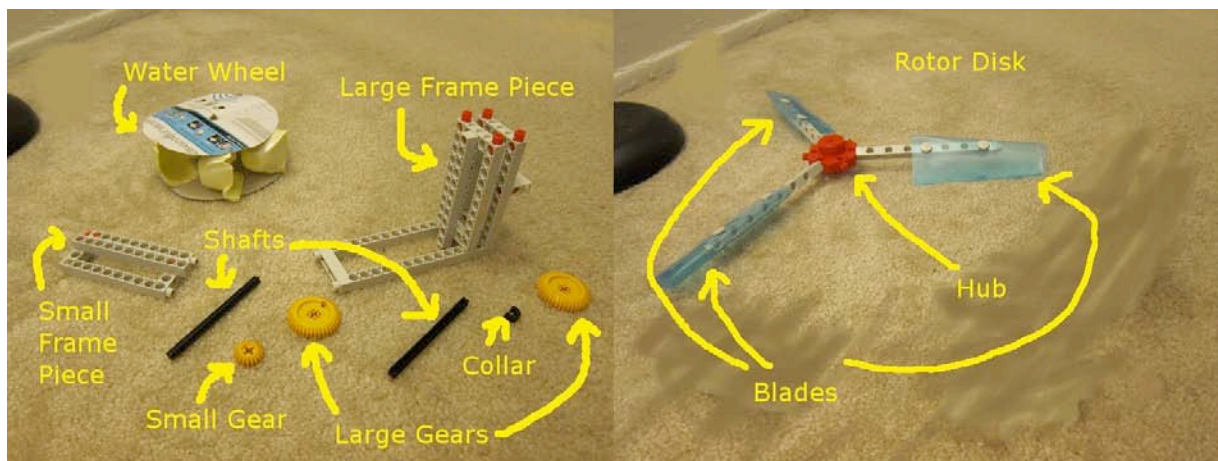
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## IMPORTANT NOTE!!!

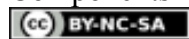
When you finish the activity, make sure you have all of the components for this activity. The component list is below; use it as a checklist, and check in with your instructor. Use the picture to help you.

Component checklist:

- ☐ 1 Water wheel
- ☐ 1 Large frame piece
- ☐ 1 Small frame piece
- ☐ 2 Shafts (black)
- ☐ 1 Small gear (yellow)
- ☐ 2 Large gears (yellow)
- ☐ 1 Collar (black)
- ☐ 1 Rotor disk
  - 3 blades (blue)
  - 1 hub (red)



Components in the wind/hydro experiment kits



Photos taken by University of Michigan

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## Hydro Power Activity



Reference: Hydro Power Activity.

<http://www.need.org/needpdf/Elementary%20Infobook%20Activities.pdf>. Copyright 2012 National Energy Education Development, All rights reserved. NEED materials may be reproduced for non-commercial educational purposes.

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## Lesson 8: Energy (Biogas)

### Objective:

- Analyze the importance of energy and how they use energy in their lives
- Describe the difference between renewable and non-renewable energy
- Experiment with creating and capturing biogas

### Lesson:

#### *Introduction*

In China, and in many other areas of the world, biogas digesters have been introduced into rural communities. People learn how to build and maintain biogas digesters to provide a cheap and simple way to get energy from a renewable source, that they have easy access to – animal manure. By using biogas digesters, people no longer need to cut down trees for firewood. This in turn helps stabilize and protect the environment. In addition, by not having to collect firewood, each household saves up to three hours a day of work that they can now direct towards other productive activities.



Reference: Winter in Songming, <https://shop.heifer.org/shop/books-and-dvds/winter-in-songming.html>, Copyright Heifer International, All rights reserved.

#### *Biogas as a form of Energy*

Zadou uses a gas burner to cook breakfast. Just like those in Songming County, people have recently started to use a source of energy called biogas to fuel their gas burners.

#### *What is biogas? What is methane gas?*

Biogas is a form of energy that comes from living things. Biogas is generally made from animal manure. In Songming County, the biogas comes from pig and cattle manure. The people use biogas digesters to convert the manure into methane gas, which is a type of biogas.

Look at the “Diagram of Biogas Digester” on the below and, as a group, discuss how the biogas digester works

## Diagram of Biogas Digester

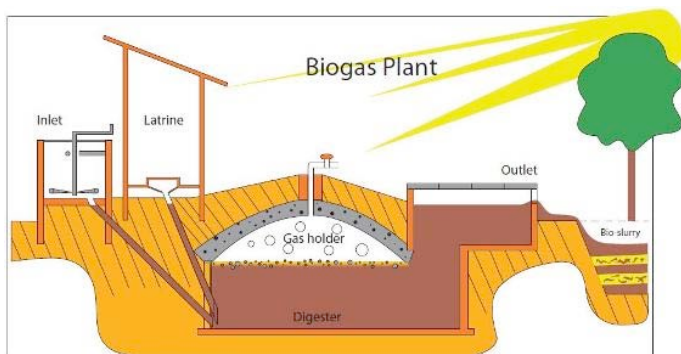


Reference: “Biogas As A Source Of Energy”, [http://www.heifer.org/PDF/GERK\\_Kits/Grades\\_3-4\\_Lesson\\_3.pdf](http://www.heifer.org/PDF/GERK_Kits/Grades_3-4_Lesson_3.pdf). Copyright 2012 Heifer International, All Rights Reserved.

# Creating Biogas Experiment



Reference: “Biogas As A Source Of Energy”, [http://www.heifer.org/PDF/GERK\\_Kits/Grades\\_3-4\\_Lesson\\_3.pdf](http://www.heifer.org/PDF/GERK_Kits/Grades_3-4_Lesson_3.pdf). Copyright 2012 Heifer International, All Rights Reserved.



“Biogas plant sketch” Source:

[http://commons.wikimedia.org/wiki/File:Biogas\\_plant\\_sketch.jpg](http://commons.wikimedia.org/wiki/File:Biogas_plant_sketch.jpg)



“Biogas plant, South Africa” by SuSanA Secretariat, source:

[http://commons.wikimedia.org/wiki/File:Biogas\\_plant\\_South\\_Africa\\_%282941813674%29.jpg](http://commons.wikimedia.org/wiki/File:Biogas_plant_South_Africa_%282941813674%29.jpg)

*Manure & Soil*



*Food Scraps & Soil*



*Just Soil*



Source: <http://simplytheclassroom.blogspot.com/2012/01/matter-experiments-or-magic-tricks.html>

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## Methane Production Chart

**Question:** What will happen if we combine microbes with food? \_\_\_\_\_

**Group Hypothesis:**

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People can use methane gas to create energy to power their stoves and cook food. Let's see if we can make methane gas. Follow your teacher's directions for the experiment, and keep track of your data using this chart.

**Questions:**

As the days went by, what happened to the level of the mixture in the bottle?

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As the days went by, what happened to the circumference of the balloon?

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Day	Level of Mixture in Bottle	Circumference

What caused the level of the mixture to change?

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What caused the circumference of the balloon to change?

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How did microbes get into the bottle?

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Was your hypothesis correct? How do you know?

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**Discuss biogas as a renewable form of energy...**

With your group, discuss how Zadou's family was able to create energy by using manure from their pigs and water buffalo. They used this energy to cook their meals on their gas burner.

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**Is biogas a renewable source of energy or not?**

Discuss how this source of energy is a cheap and easy way for people in Songming County and in many parts of the world to get energy.

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by Alberto Miranda Dencowski, source:  
<http://openclipart.org/detail/169592/green-earth-by-mrallowski>

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# Extra Experiments & Activities

(Time/Equipment Permitting)

## Ethnobotany



Reference: Ethnobotany, <http://extension.uga.edu/k12/science-behind-our-food/lesson-plans/Ethnobotany.pdf>. Copyright 2005, Georgia Agriculture Education, All Rights Reserved.



Source:

<http://pixabay.com/en/tree-branches-aesthetic-tribe-log-51367/>

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## **Computer Lab**

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## Computer Lab (4 - 2 hour sessions)

**Objective:** To introduce students to the use of computers and computer's ability to simplify tasks of importance to engineers and agriculturalists.

### Lesson Summary:

#### Lesson 1 – Introduction to computers

**Objectives:** To get familiarized with computers and its use.

**Description:** The topics will include: A) History of computers from its first invention and its evolution to modern global networks. B) Parts of a computer: Input Devices, Hardware, Software, Operating System. C) Exploring the operating system: File system, Accessories (paint, calculator, notepad), basic functionality like opening and closing programs and windows.

**Important concepts:** Internet, Networks, Input Devices, Hardware, Vacuum Tubes, Transistors, Microprocessor, CPU, Software, Operating System, File System, Programs and Programming, Windows, File, Properties.

#### Lesson 2 – Explore office programs

**Objectives:** To learn how to use basic but important Microsoft Office or Open Office software.

**Description:** We will explore how to open: a) Writer (similar to Word), b) Calc (similar to Excel), c) Impress (similar to PowerPoint) and navigate throughout the Menu bars, explain the different commands, formatting a document, insert pictures, plot excel data, use functions to make calculations, edit text, set up a template for presentations, make figures, and basic PowerPoint animations.

**Important concepts:** Menu Bar, Commands, Formatting, Plot, Formulas, Template, Animation.

#### Lesson 3 – Typing tutor and Google Sketch up

**Objectives:** To learn basic typewriting skills and drawing skills.

**Description:** this will be a 30 min introduction/explanation and 30 min practice lesson for each topic. We will use open source/free software to teach the students basic typing skills and basic drawing skills.

**Important concepts:** Typing, Typewriting, Sketch, Sketching, Draw, Drawing, Software, Lines, Contour.

#### Lesson 4 – Internet and introduction to programming.

**Objectives:** To learn basic concepts about the Internet and programming.

**Description:** We will explore the use of internet for learning purposes, the use of search engines, Wikipedia and communication systems like MSN Messenger and Skype, we will also give an introduction to programming using Scratch, which is a tool to learn programming skills to kids, they will make their own small computer game using Scratch

**Important concepts:** Internet, Intranet, Program, Programming, Search Engine, Web Page, Communication Systems

NOTE: All screenshots in this section are included under Fair Use exceptions. 

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## Lesson 1a: History of Computers



Reference: History of Computers,  
<http://www.computersciencelab.com/ComputerHistory/History.htm>. Copyright 2002 John Kopplin, All rights reserved.

## Lesson 1b: Parts of a Computer

We will show you a video that explains the parts of a Computer.

### II. Parts of a Computer

**Vacuum Tubes** are devices that control electric current through a vacuum (no air) in a sealed container. They are very fragile and bulky. Thousands of these had to be used in the ENIAC computers in the 1940s, which contributed to its gigantic size.



Figure 2A. Miniature Vacuum Tubes  by Stefan Riepl, source: <http://en.wikipedia.org/wiki/File:Elektronenroehren-auswahl.jpg>

**Transistors** are [semiconductor devices](#) (a material that allows electricity to flow through it) used to [amplify](#) and [switch electronic](#) signals and power. The reason we don't have 100 foot long computers anymore is because of the invention of the transistor! Since being developed in the 1950s, the transistor is the fundamental building block of modern [electronic devices](#). It was the gateway to make computers miniature.



Figure 2B. Transistor  source: <http://commons.wikimedia.org/wiki/File:Transistors.agr.jpg>

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**Integrated Circuit** (or micro chip) consists of many complex electrical circuits which have been etched onto tiny chips of semiconductor. They do the “thinking” and calculations that need to be done by a computer.

**Central Processing Unit (CPU)** is the “brain” of the computer. A CPU’s job is to execute a sequence of stored instructions called a program. These instructions are carried out in the blink of an eye.

**Microprocessor** incorporates the functions of a CPU on a single integrated circuit. This was another step into making computers and other electrical devices so small.

**Software** is a term used to describe the computer programs and instructions used to tell the hardware what to do.

**Computer Programming** is the iterative process of writing computer programs (or software). Programming involves testing, analyzing and refining the computer program.

**Hard Disk Drive** holds all of the computers information.

**CD Drives** use lasers to read (retrieve) data from a CD (just like a walkman).

A computer **Monitor** displays information in visual form.

A **mouse** is used to select objects on the monitor.

A **keyboard** is a board used to input data (numbers or letters) into the computer.

**Hardware** is a term used to describe all the physical things on a computer that you can see and touch.

**Input Devices** are any piece of computer hardware equipment used to provide data. A mouse and a keyboard are input devices that allow users to provide data to the computer.

An **operating system (OS)** is a set of software that manages computer hardware resources and provides common services for computer programs. The operating system is a vital component of the system software in a computer system. Application programs require an operating system to function.

Common Operating Systems: Microsoft Windows and Apple’s Macintosh OS X

A computer uses a **File System** as a way to organize its’ information. Each file has a name used to reference the storage location in the file system.

**Properties** of a file show its’ location in the computer or network, the date that it was created or last modified, the size of the file (just like a book, each file has information in it and the amount of information determines the size of the file)

---

A **Computer Network** is a collection of computers interconnected by communication channels that allow sharing of resources and information

The **Internet** is a worldwide collection of computer networks (worldwide web), cooperating with each other to exchange data using a common software standard. Through telephone wires and satellite links, Internet users can share information.

**Teachers:** From the donated computers, let the students touch and feel the hard drive and the different parts inside the computer.

---

## Lesson 1c: Exploring the Operating System

Exploring the operating system: File system, Accessories (paint, calculator, notepad), basic functionality like opening and closing programs and windows.

### How to manage your files and folders

To use a computer effectively, the user must learn how to navigate through its files and programs.

Just like the things that you own, it is nice to know where to find things. Staying organized can be tedious, but after you have made countless amounts of files, stored all over your computer and you have many "New Folder"s, you'll see the point in being organized!

The windows operating system helps to organize files for you by giving you several pre-made folders. One example is the folder called "My Documents." Inside this folder, you will find "My Music", "My Pictures," etc. You can also make your own folders for whatever category you desire.

Double-click your "My Documents" icon on your desktop or in the START menu and you will see all the folders already provided for you.



Figure 1C. My Documents icon as it appears on the Desktop

Most information on a computer can be accessed from the Hard Disk Drive on the **Local Disk (C:)**. If you know the file path (the files to look through to get to a certain file), you can start here.

The section labeled **Devices with Removable Storage** is an example of an input device.

The section labeled **Network Drives** is an example of how computers communicate with each other.

To view the **File System** on the computer, click on the start menu,  >> **My Computer**



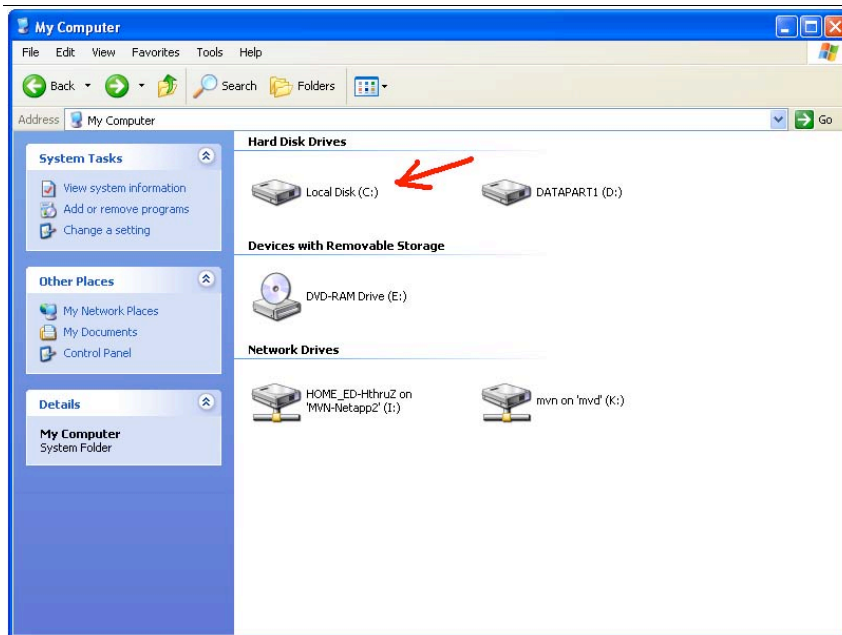


Figure 2C. Computer Storage Files

To open a file, typically the user double clicks on the icon or the file. The following figure shows a typical view of a computer file.

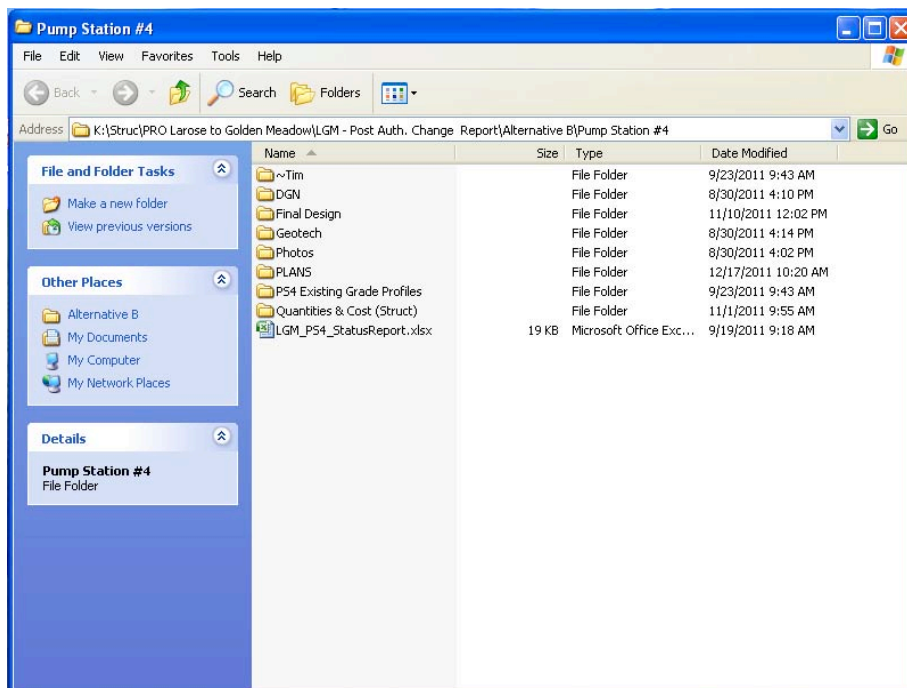




Figure 3C. Typical View of a Computer File

At the top right of each file, there are usually 3 buttons that you can click.

If you are done using the file, click the  to close the file.

To maximize or adjust the view of a file, click .

---

To minimize the screen so that the file name only appears in your toolbar, click



### Using computer programs

Some of the most useful programs on a computer are very basic. These programs include Notepad, Paint, and Calculator. In Notepad, you can type a document.

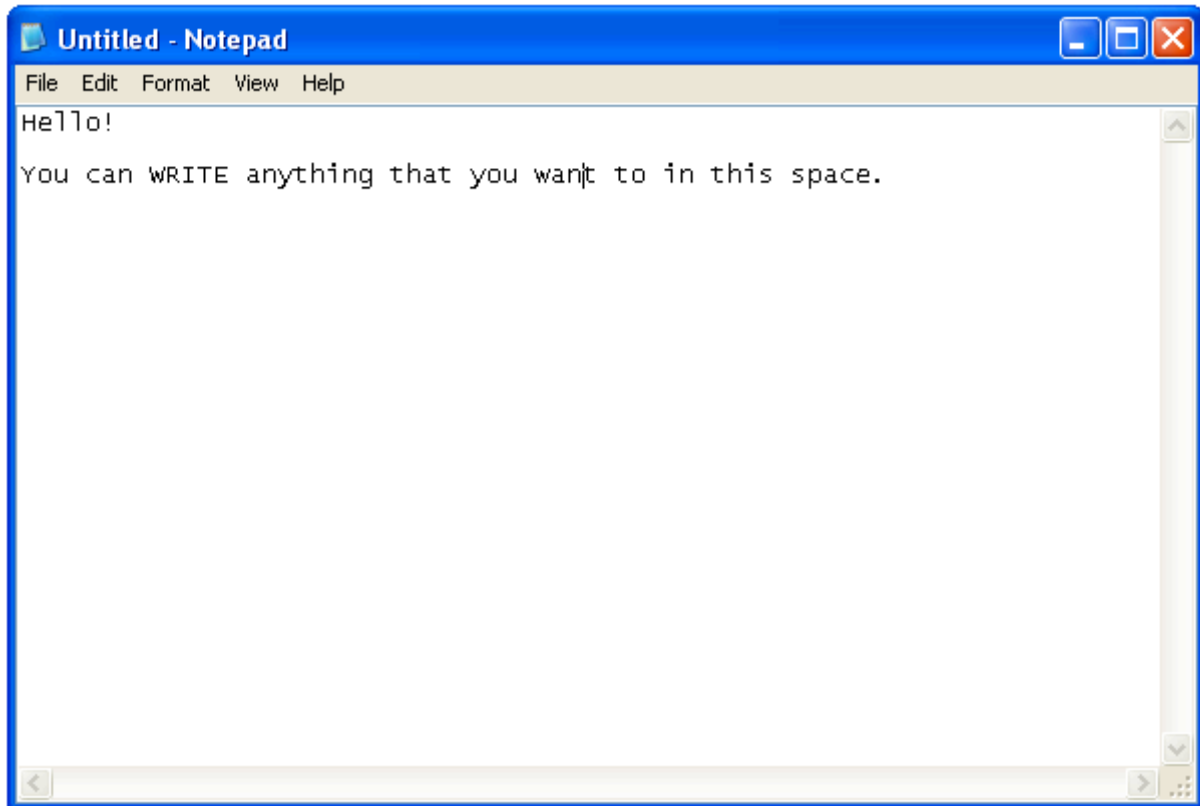


Figure 4C. Notepad

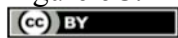
In Microsoft Paint, you can test your creativity by drawing. See if you can draw animals as well as these people have!



Figure 5C. Microsoft Paint



Figure 6C. Picture of a Woman drawn using Microsoft Paint



by Lindz Graham, source:

<http://www.flickr.com/photos/lindzgraham/1296071847/sizes/o/in/photostream/>

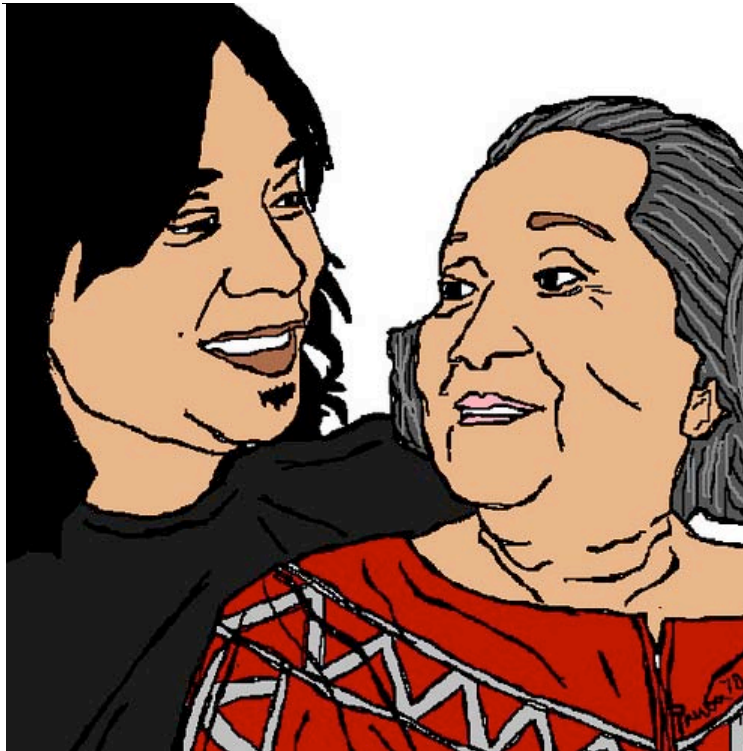


Figure 7C. Picture of a Man and an Old Woman drawn using Microsoft Paint



by Paulinebalba, source:

<http://www.flickr.com/photos/paulinebalba/5011990606/sizes/m/in/photostream/>

You can use this calculator to do basic math.

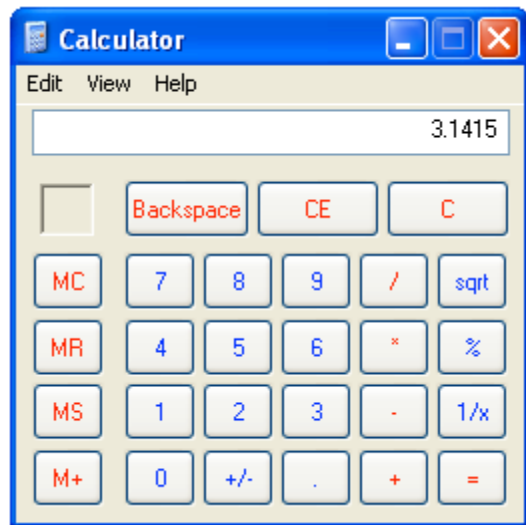


Figure 8C. Calculator

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## Lesson 2a: Writer tutorial

Writer is a word processor, is very similar to Microsoft Office Word, which is used for many people in school and in work to make documents, homework or reports. Writer is a free program; you can do many features to make an impressive report using Writer.

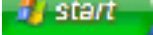
Question: For what purposes can you use Writer: \_\_\_\_\_

---



Reference: The following tutorial is excerpted from Tutorials for OpenOffice,  
[http://www.tutorialsforopenoffice.org/tutorial/No\\_Computer\\_Experience.html](http://www.tutorialsforopenoffice.org/tutorial/No_Computer_Experience.html).

First, let's start by creating a new text document:

1. IF on the desktop, click  > All Programs > OpenOffice.org 2.3 > OpenOffice.org Writer.
2. IF you are in OpenOffice.org Writer, click **File** > **New** > **Text Document**. On the **Main Menu**

Notice that the **Main Menu** is at the top of the screen. It has the words **File**, **Edit**, **View** etc.

3. In either case, the text document



appears on your screen.

## Screen



The **Screen** is where you see things happen. The screen is like a TV screen.

## Keyboard



4. The **Keyboard** has keys that can be pressed to make characters (letters, numbers, and symbols) appear on the screen.
5. **Press** means to touch a key on the keyboard hard enough to cause the character to appear on the screen and then immediately release it.

- 
6. Press the **H** key now. (An **h** appears on the screen) Next to the "h" is a flashing vertical line. That flashing line is the **Cursor** which indicates the place on the page where something will be placed when you press a key. Press the **E** key, then press the **L** key and the **P** key. (The word **help** appears on the screen)

## Space bar



The **Space Bar** key is the long key in the middle at the bottom of the keyboard. Press the **Space bar** key. (The cursor moves one space to the right)

## Shift key



The **Shift Key** causes letters to be capitalized.

7. Type the word **Help** by doing the following:
8. Press and hold down the **Shift** key as you press the **H** key. Release the Shift key. (The capitalized letter **H** appears on the screen)
9. Press the **E** key, then press **L**, then press **P**. (the word **Help** appears on the screen)

## Mouse



The device next to the keyboard is called a **Mouse**.

10. Rolling the mouse causes the pointer, **I** to move on your screen.
11. Roll the mouse up and down on the mouse pad. Notice that the pointer, **I**, moves up or down on your screen as you rolled the mouse up or down.
12. If you roll the mouse off of the mouse pad, pick up the mouse and place it back on to the mouse pad.
13. Roll the mouse to the left and to the right on your desk. Notice that the pointer, **I**, moves to the left or to the right on your screen as you rolled the mouse left or right.
14. Roll the mouse so the pointer, **I**, is somewhere on the word **Help**.
15. Without moving the mouse, **click** with the mouse. (To click, put your right hand on the mouse. The mouse is divided into two or three parts. The parts are called buttons. Put your index finger (the finger that you use to point) on the left button and press the left button with your index finger then release the button.)

- 
16. Notice that the cursor (flashing vertical line) moved to where you clicked the mouse. Press the letter **X** (an X will appear at the place where the flashing cursor is located)

### Optimize the Writer window

You can increase or decrease the size of what you see on the screen

1. Click **View > Zoom > Optimal** (A dot appears before the word, **Optimal**) Click **OK**.
2. “Optimal” can be replaced with other choices.

### Name and Save a file

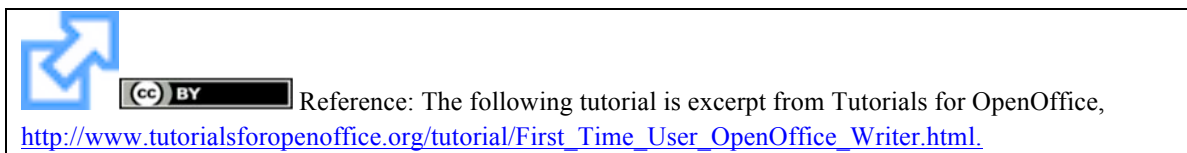
1. Click **File > Save As**. (The **Save As** window appears)
2. In the “Save in:” pull-down menu, select **My Documents**. (Click on the ▼ to open the pull-down menu then select “My Documents”)
3. In the “File name:” pull-down menu, type **My first file** then click **Save**.
4. **My first file – OpenOffice.org Writer** appears at the top of the screen.  
The file named “My first file” is still opened on your computer and is the OpenOffice text file format. The file is also saved in the “My Documents” folder by the name “My first file”.)

### Close a file

1. Click **File > Close**. (The “My first file” file has been closed)

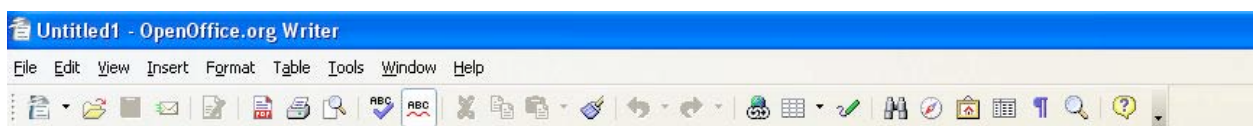
### Open a file

1. Click **File > Open**. (the **Open** window appears)
2. Open the **Look in:** box by clicking the ▼. Select **My Documents**. Click on **My first file**. Click **Open**.



### Toolbars

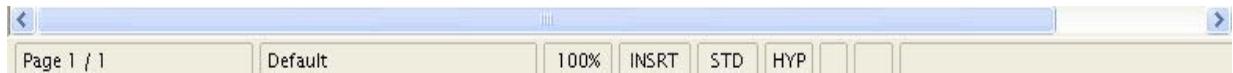
1. The line that starts with the word **File** is called the **Menu Bar**. (Clicking on a word in the Menu Bar shows a list of things that you can choose to do in Writer. This list is called a **Menu**.)
2. The second line down is the **Standard Toolbar**. (Clicking on a small picture will make available a specific function that can be done in Writer.)



- 
3. The third line down is the **Formatting Toolbar**. (Additional specific functions that can be done in Writer are on this line.)



4. The **Horizontal Scroll bar** (by clicking and holding the pointer, you can navigate a document left and right) is located at the bottom of the page above the **Status Bar** which is the line at the bottom of the screen that starts with **Page 1/1**. (This line gives you information about the document you are presently using.)



5. The **Vertical Scroll Bar** (by clicking and holding the pointer, you can navigate up and down) is located on the right side of your screen.





Reference: The following tutorial is excerpted from Tutorials for OpenOffice,  
[http://www.tutorialsforopenoffice.org/tutorial/First\\_Time\\_User\\_OpenOffice\\_Writer.html](http://www.tutorialsforopenoffice.org/tutorial/First_Time_User_OpenOffice_Writer.html).



---

## Icons, Click, Right-click, Insert

1. The small pictures on the **Standard Toolbar** and some of the other toolbars are called **icons**. Click on each icon. (**Click** means to press and release the button on the left side of the mouse with your index (pointer) finger. Click only one time unless instructed to “double- click”.)
2. Find the **Gallery** icon, . Click on the **Gallery** icon. (The **Gallery** window appears on the screen. The background changes color when the icon is in use. Some users may see a white background and some may see a blue background.)
3. Click on the **Gallery**  icon again to close the window. (There is no background color on the “Gallery” icon.)
4. **Right-click** anywhere on the printed or white page area of this tutorial. (**Right-click** means to press and release the button on the right side of the mouse with your middle finger. Click only one time unless instructed to double-click. A menu appears on the page. To close the window, click anywhere on the page other than on the menu.)
5. On the **Menu Bar**, click on **I**nsert. (The “Insert” menu appears. This is a list of the various things you can choose to do in Writer.)

## Turn Off the Word Completion Feature

1. Click **T**ools > **A**utoCorrect > **W**ord Completion tab. (The “AutoCorrect” window appears.)
2. Remove the check-mark in the box, if it is there, before the words **E**nable word **c**ompletion. Click on the **O**K button.

## Undo Entries

Entries can be undone (can be deleted) in the reverse order in which the entries were made. Word(s), graphic(s), and paragraph(s) can be deleted and “Undo” can be used to put them back in your document. Type the three paragraphs below.

**This is the first paragraph.**

**This is the second paragraph.**

**This is the third paragraph.**

## Delete Word(s)

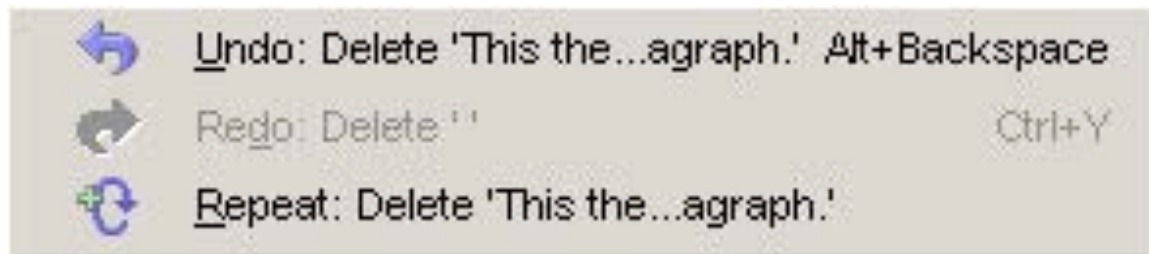
1. In the first paragraph, (**This is the first paragraph.**), click on the beginning of the word, **f**irst. Press the **d**elete key. The first letter is deleted, do so until the whole word first, is deleted.
2. Click **E**dit. (You will see the menu below.)



1. Click on **Undo: Delete 'first'**. (The word, "first", that was deleted is placed back in the document and the menu will close.)

### Delete One Paragraph

1. Highlight the first paragraph, **This is the first paragraph**. Press the **Delete** key to delete the paragraph. Click **Edit**. (When you delete one paragraph and you click **Edit**, you will see the menu below,



1. Click **Undo: Delete 'This is ...agraph.'** (The paragraph, "This is the first paragraph" is placed back in the document. The length of the sentences in the paragraph determines how much of the paragraph is shown after the "Undo: Delete".)

### Delete More Than One Paragraph

1. Highlight the three paragraphs (This is the first paragraph. This is the second paragraph. This is the third paragraph.) at the beginning of the section, **Undo Entries**. Press the **delete** key to delete the paragraphs. (The three paragraphs are deleted.)
2. Click **Edit**. (You will see the menu below.)



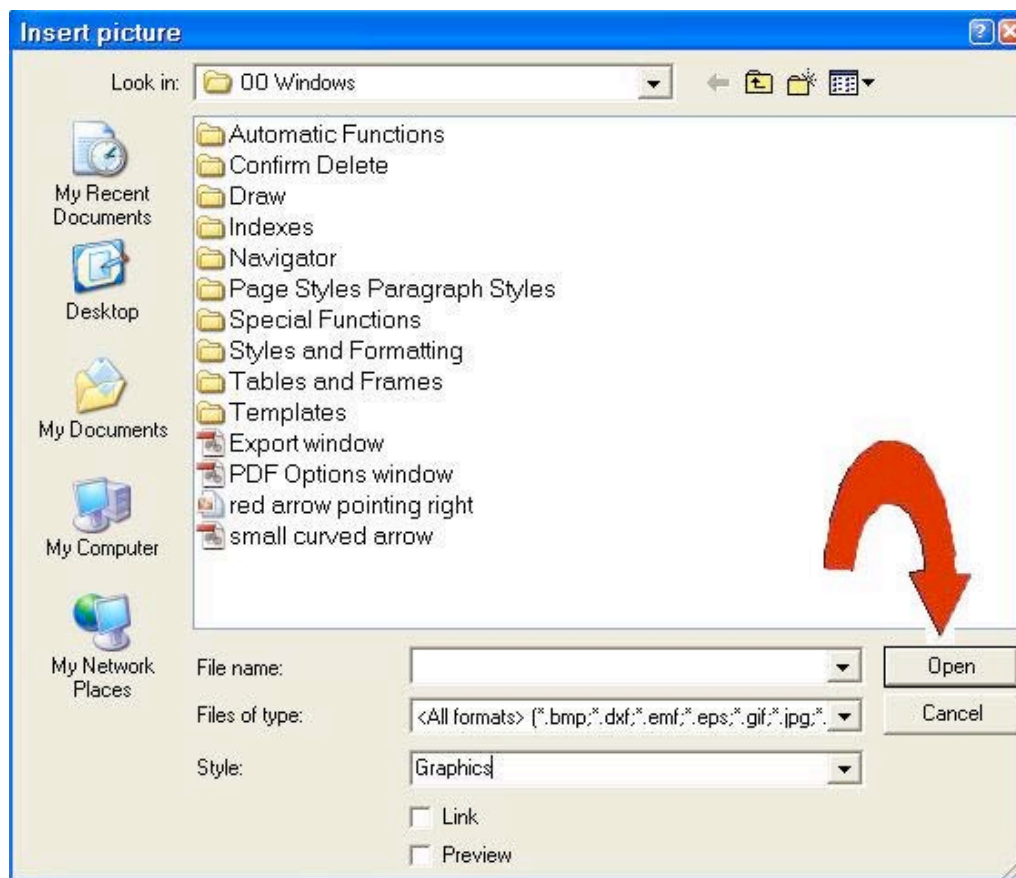
1. Click on the **Undo: Delete 'Paragraphs'**. (The deleted paragraphs are placed back in the document.)



Reference: The following tutorial is excerpted from Tutorials for OpenOffice,  
[http://www.tutorialsforopenoffice.org/tutorial/Pictures\\_In\\_Text\\_Files.odt](http://www.tutorialsforopenoffice.org/tutorial/Pictures_In_Text_Files.odt)

## Insert an Image (Picture)

1. Click **I**nsert > **P**ictures > **F**rom File. (The “Insert picture” window will appear.)



1. Click on Desktop. And select the file named “image.jpg” from the **I**nsert picture window. Click the **O**pen button. The image (picture) appears on your document. There are small green squares called handles at the edges of the image (picture) that indicate the image (picture) can be manipulated.





1. To anchor the image (picture) above or below the text, click **F**ormat > **A**nchor > **A**s Character.

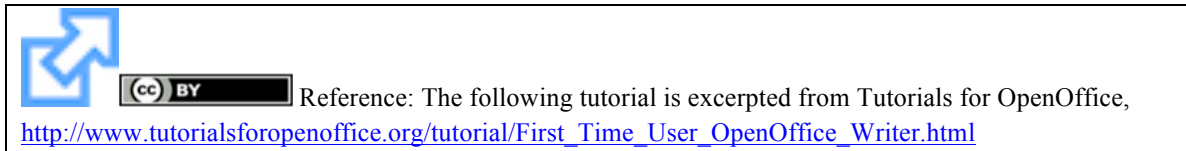
---

## 2. Insert Image (Picture) In Your Text

### Adjust the Height of the Image (Picture)

If the height of the selected item is greater than the current font size, the height of the line containing the item is increased. Adjust the height of the image (picture) so that it has little effect on the text line by resizing the image.

1. Click on the image (picture). (An anchor, , will appear. Eight points (green squares), called "handles", will appear along the sides of the image [picture].)
2. Place your pointer on any of the **handles** (points). To keep the proportions of the image (picture), press and hold the **Shift** key. Click and drag a **handle of the image (picture)** to modify the image (picture). (A double-headed arrow. , will appear.) Release the mouse button to complete the resize.
3. When you have changed the image (picture) to the desired size, **click anywhere on the page except on the image (picture)**. (The image [picture] will be the desired size.)



### Delete Graphic(s)

1. Click on the picture. (The green handles will appear.)



1. Press the **Delete** key. (The graphic is no longer on your document.)
2. Click **Edit**. (You will see the menu below.)



1. Click **Undo: Delete graphics Alt+Backspace**. (The graphic reappears on the document.)

---

## Text Alignment (Left, Centered, Right)

1. Select the first paragraph by clicking the left button of the mouse and holding the cursor at the beginning of the paragraph, dragging the mouse up to the end of the paragraph and releasing the left button. The text is selected and should look like this:

This is the first paragraph.  
This is the second paragraph.  
This is the third paragraph.

2. On the formatting toolbar select Right text orientation button



3. The text should go to the right side of the page.

This is the second paragraph.  
This is the third paragraph.

This is the first paragraph.

4. Now, let's center the second paragraph, select again the second paragraph, the text should be highlighted

This is the second paragraph.  
This is the third paragraph.

This is the first paragraph.

5. Click the center text orientation button



6. The text should go to the center of the page.

This is the third paragraph.

This is the second paragraph.

This is the first paragraph.

## Change Text Size

1. Select the second paragraph, should the text should be highlighted

This is the third paragraph.

This is the second paragraph.

This is the first paragraph.

2. Click on the drop-down menu next to the text style the number 12 by clicking on the arrow and select the number 18



3. The text should look like this (the second paragraph is bigger)

This is the third paragraph.

This is the second paragraph.

This is the first paragraph.

---

## Lesson 2b - Open Office Calc



Reference: The following tutorial is excerpted from Tutorials for OpenOffice, [http://www.tutorialsforopenoffice.org/tutorial/Spreadsheet\\_Basics.html](http://www.tutorialsforopenoffice.org/tutorial/Spreadsheet_Basics.html)

### The Word Spreadsheet



The term **spreadsheet** was derived from a large piece of paper that accountants used for business finances. The accountant would **spread** information like costs, payments, taxes, income, etc. out on a single, big, oversized **sheet** of paper to get a complete financial overview.

### Spreadsheets Today

Some examples of spreadsheet usage:

- Spreadsheets act like a calculator by automatically doing calculations.
- Spreadsheets are used for tracking personal investments, budgeting, invoices, inventory tracking, statistical analysis, numerical modeling, address books, telephone books, printing labels, etc.
- Spreadsheets are used in almost every profession to calculate, graph, analyze and store information.
- Spreadsheets are used for What-if calculations. Change one number in a spreadsheet and all the calculations in a large spreadsheet will re-calculate, will automatically change.

### Open a Spreadsheet

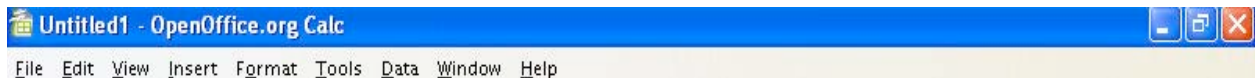
1. **IF** on the desktop, click  > **All Programs > OpenOffice.org 2.3 > OpenOffice.org Calc.**
2. **IF** you are in an Open Office program, click **File > New > Spreadsheet.**
3. In either case a spreadsheet called  **Untitled1 - OpenOffice.org Calc** appears on our screen.

### The Calc Toolbars

The following four Calc Toolbars appear at the top of all Calc screens:

#### Main Menu Toolbar

The first toolbar is the **Main Menu** toolbar that gives you access to many of the basic commands used in Calc.







---

## Function Toolbar

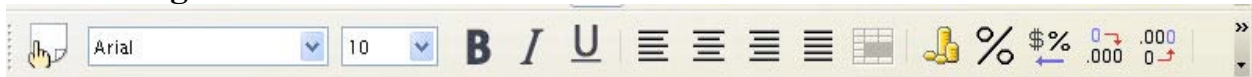
The second toolbar down is the **Function Toolbar**. The **Function Toolbar** contains **icons** (pictures) to provide quick access to commands like **New**, **Open**, **Print**, **Copy**, **Paste**, etc. When you place your mouse cursor over any of the elements of a toolbar, the name of the element appears on your screen.



**Activity:** let the kids move the cursor above the different icons to see what is each of them.

Move your cursor over the icon . (The word “New” appears. Clicking on  opens a new spreadsheet.)

## Formatting Toolbar




The third toolbar down is the **Formatting Toolbar**. The **Formatting Toolbar** has **icons** plus drop-down menus that allow you to select a **font**, **font color**, **alignments**, **number formats**, **border options** and **background colors**.

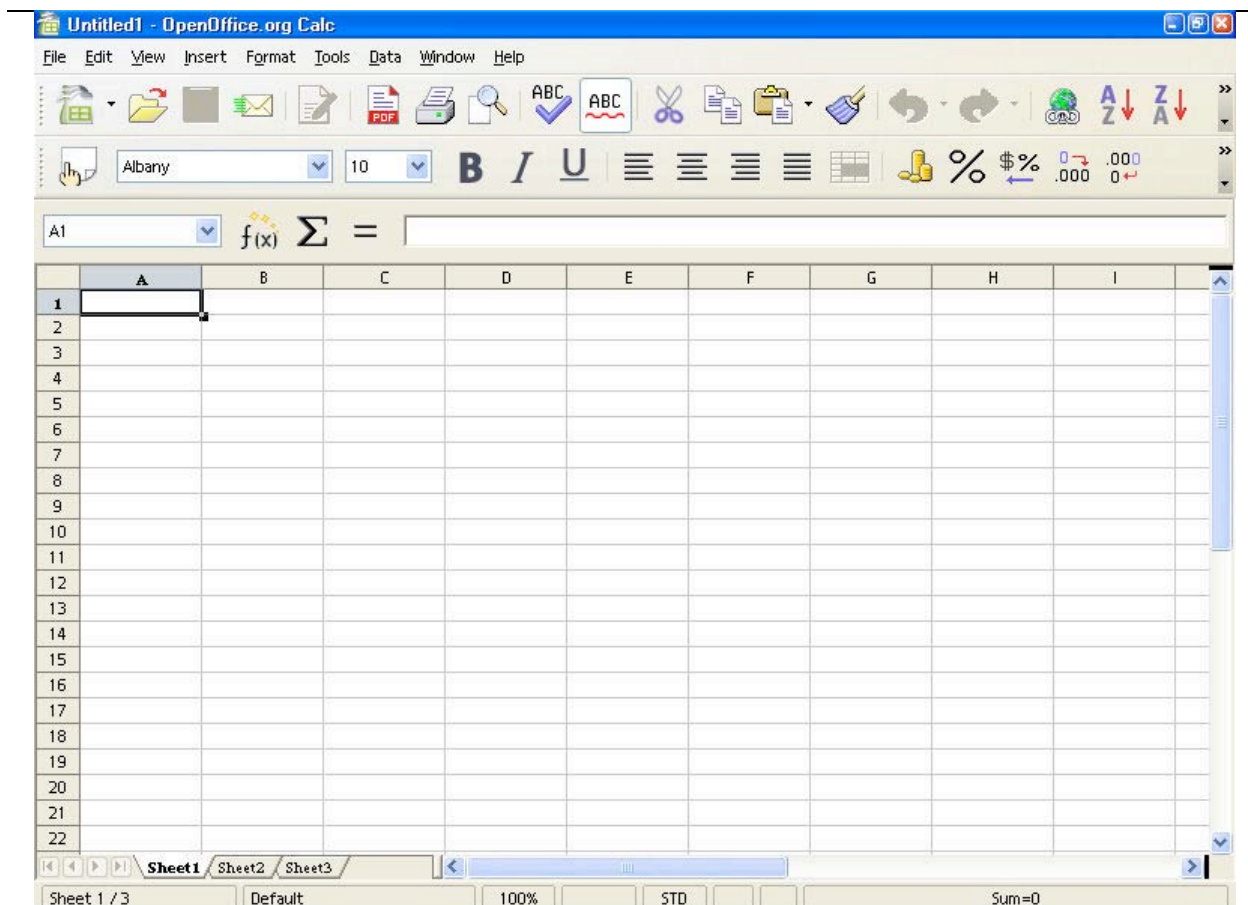
## Formula Toolbar



The fourth toolbar down is the **Formula Toolbar**. The **Formula Toolbar** contains the **Name Box** drop-down menu and a long white box called the **Input Line**.

Note: If your Toolbars look different, it is because these toolbars are in 800x600 screen resolution and the last eight icons are not shown but are available by clicking on the  on the far right of the toolbar.

# The Spreadsheet Itself



The rest of the window contains the **spreadsheet**. The spreadsheet is divided into rows that have a number at the left of each row and divided into columns with letters at the top of each column.

## Cells

A **cell** is the fundamental element of a worksheet. This is where things are added and where things are seen. A **cell address** in a spreadsheet identifies the location of the cell in the spreadsheet. A **cell address** is a combination of the column letter and the row number of a cell, such as **A2** or **B16**, etc. When identifying a cell by its address, the column letter is always listed first followed by the row number. The cell address of the example below is **A5**.

	A	B
1		
2		
3		
4		
5		
6		

← This is cell A5

## Enter Data

1. Click on the **A1** cell (The cell at the very top left of the spreadsheet).
2. Notice the heavy black border around the **A1** cell. The heavy black border indicates that **A1** is the **active cell**. (A is at the top of the first column and 1 is on the first row. Both are highlighted. The highlighting also indicates that **A1** is the **active cell**.)

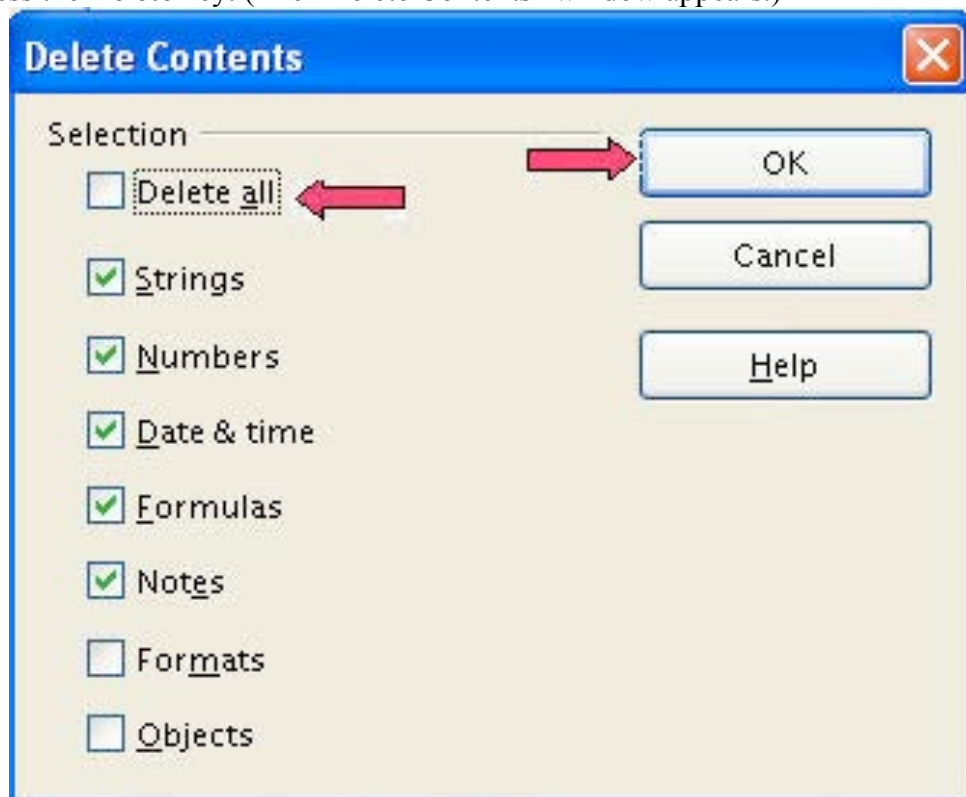


	A	B
1		

1. Type **Hello World** and press **Enter**.
2. The active cell is now **A2**. (The words “Hello World” are in A1.)

	A	B
1	Hello World	
2		

1. When you type something in a cell and press **Enter**, what you typed is seen in that cell and the cell below becomes the next active cell.
2. **Delete Data**
3. Click on **A1** again.
4. Press the **Delete** key. (The “Delete Contents” window appears.)

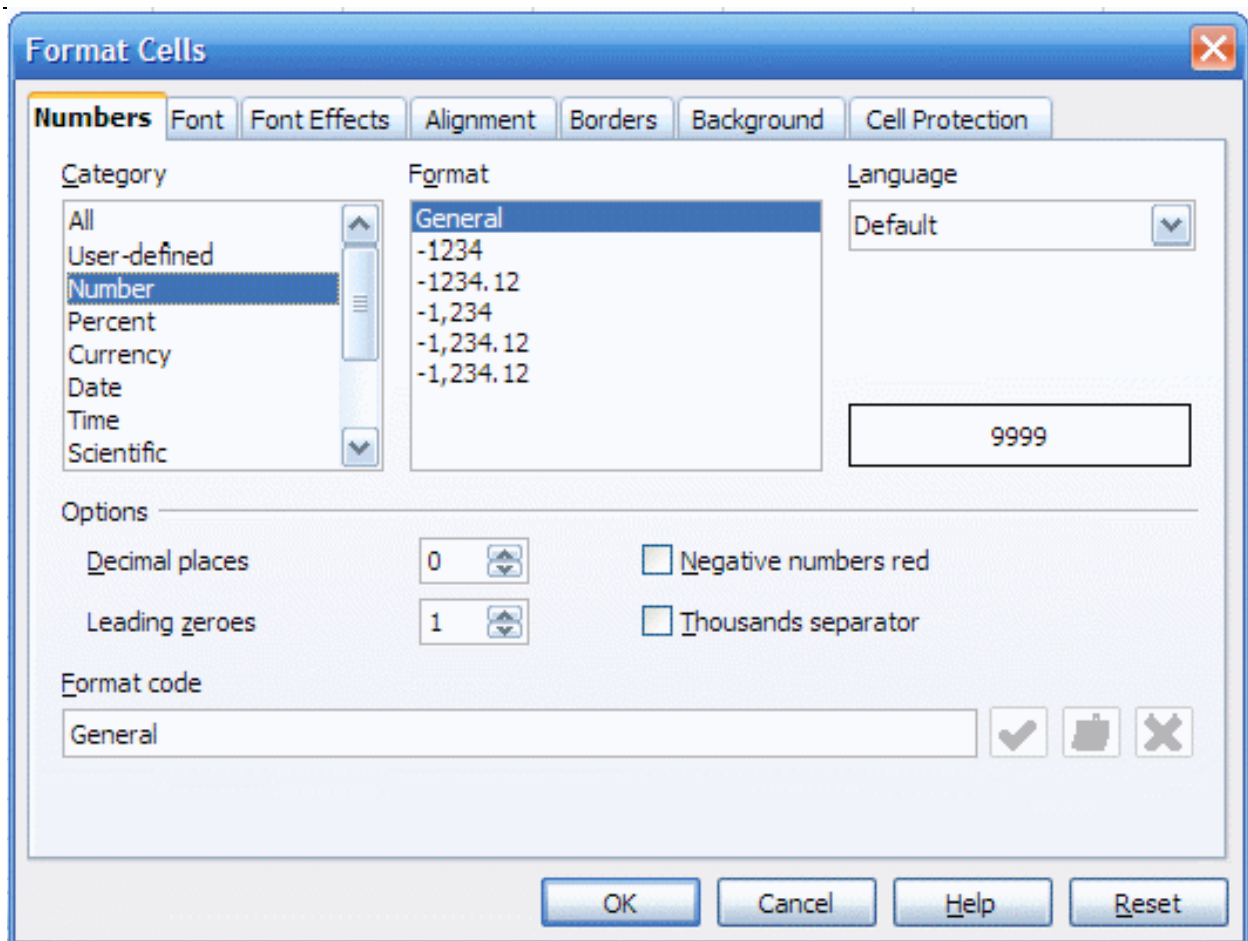


1. Check the **Delete all** box then click **OK**. (“Hello World” is deleted from A1)


## Format Data

### Separate Thousands, Two Decimal Places, Red Negative Numbers

1. Click cell **A1**. > Type the number **-9999.129** > Press **Enter**. (The cursor moves to cell A2)
2. **Right-click** cell A1. (A small menu appears) > click **Format cells**. (The “Format cells” window appears)




1. Click **Numbers** tab. Under “Category”, click on **Number**. Under “Format”, click on -1,234.12. Click In the small box before “Negative numbers red”. (A check-mark appears in the box) > Click OK. (The number '-9,999.13' appears in cell A1.)
2. **Align Left**
3. Click Alignment tab. In the “Horizontal” pull-down menu, select Left. Click OK. (the numbers move to the left edge of the cell.)







Reference: The following tutorial is excerpt from Tutorials for OpenOffice,  
[http://www.tutorialsforopenoffice.org/tutorial/Spreadsheet\\_Math.html](http://www.tutorialsforopenoffice.org/tutorial/Spreadsheet_Math.html)

## Addition

The + sign is used for addition. To enter the + sign, press the **Shift** key and the +, , key.



1. Click on **A6**.
2. Type the number **10**, then press **Enter**. ("10" appears in "A6" and the active cell is "A7".)
3. Type the number **5**, then press **Enter**. ("5" appears in "A7" and the active cell is "A8".)


- 
4. Type **=A6+A7** (Or click the “Function”, , icon. The “=” appears in “A8”. The “Function”, , icon changes to the “Accept”, , icon. Then type "A6+A7".).
  5. Press **Enter** (or click the “Accept”, , icon). The answer, **15**, appears in **A8**.

### Sum (Calculate The Total Of A Column)

1. In **A1**, type **5**, press **Enter**.
2. In **A2**, type **5**, press **Enter**,
3. In **A3**, type **5**, press **Enter**,
4. In **A4**, type **5**, press **Enter**
5. In **A5**, type **5**, press **Enter**.
6. Click In **A6**, the last cell in the column of numbers you want to add. ("A6" has a heavy dark border and is the "Active Cell.")

	A	B
1	5	
2	5	
3	5	
4	5	
5	5	
6		

1. Click on the **Sum**, **Σ**, ("Σ" is the mathematics symbol for sum.) icon on the **Formula** **Toolbar** just left of the **Input Line**. The **Function**, , icon changes to the **Accept**, , icon.

2. Click the **Accept**, , icon (green check mark) or press **Enter**. The formula, **=SUM(A1:A5)**, appears in the **A6** cell.
3. Press **Enter**. The sum, **25**, will appear in **A6**. **A7** becomes the **active cell**.


<div> <div>A7</div> <div>▼</div> <div><math>f(x)</math></div> <div><math>\Sigma</math></div> </div>		
	A	B
1	5	
2	5	
3	5	
4	5	
5	5	
6	25	
7		





### Cell Range

In the section above, the **SUM** function appears as **=SUM(A1:A5)**. The **A1:A5** in the parenthesis is called a **Cell Range**. It is shorthand for "*from A1 to A5*".


## Subtraction







The - sign is used for subtraction. To enter the – sign, press the  key.

1. Click on **A8**. To clear cell **A8**, press the **Delete** key. (The “Delete Contents” window appears.) Check the **Delete all** box and click **OK**.
2. Type **=A6-A7** (Or click the “Function”, , icon. The “=” appears in “A8” The “Function”, , icon changes to the “Accept”, , icon. Then type "A6-A7").
3. Press **Enter** (Or click the “Accept”, , icon.) The answer, **20**, appears in **A8**.


## Multiplication





The star, \*, sign is used for multiplication. To enter the \* sign, press the **Shift** key and the number **8**  key.

1. Click on **A8**. To clear cell **A8**, press the **Delete** key. (The “Delete Contents” window appears.) Check the **Delete all** box and click **OK**.
2. Type **=A6\*A7** (Or click the “Function”, , icon. The “=” appears in “A8”. The “Function”, , icon changes to the “Accept”, , icon. Then type "A6\*A7").
3. Press **Enter** (Or click the “Accept”, , icon.) The answer, **125**, appears in **A8**.

---

## Division

The slash, /, sign is used for division. To enter the slash, /, sign, press the  key [F3 And /].

1. Click on **A8**. To clear cell **A8**, press the **Delete** key. (The “Delete Contents” window appears.) Check the **Delete all** box and click **OK**.
2. Type **=A6/A7** (Or click the “Function”, , icon. The “=” appears in “A8”. The “Function”, , icon changes to the “Accept”, , icon. Then type "A6/A7").
3. Press **Enter** (Or click the “Accept”, , icon.) The answer, **5**, appears in **A8**.

## Average



1. In **A1**, type **5**, press **Enter**.
2. In **A2**, type **5**, press **Enter**,
3. In **A3**, type **5**, press **Enter**,
4. In **A4**, type **5**, press **Enter**
5. In **A5**, type **5**, press **Enter**.
6. In **A6**, type **25**, press **Enter**.
7. In **A7**, type **=Average(A1:A6)**, press **Enter**. (8.33 appears in A7)


## Enter Formulas

When you type in formulas, the order of operations must be correct. The correct order is: exponentiation, multiplication, division, addition, then subtraction. Let's pretend we want to perform a calculation using the equation:

$x + 10$
$y + 20$

and suppose we entered it into Calc as follows:


1. Select the **A** column. (Click on the letter "A." The whole "A "column is selected)
2. Press **Delete**. (Make sure the "Delete all" box is checked.)
3. Press **OK**.
4. Click on **A1**.
5. Type **20** in **A1** and press **Tab**.
6. Type **10** in **B1** and press **Tab**. (Cell C1 becomes active)
7. Type the formula **=A1+10/B1 + 20**. (Or click the “Function”, , icon which changes to the “Accept”, , icon. Type "A1+10/B1+20").

8. Press **Enter** (Or click the “Accept”, , icon. The answer, **41**, appears in **C1**.)  
The answer **should be 1**, using **x = 20** and **y = 10**, but we got **41** for an answer! Why? Because Calc interpreted the equation as:

---

$$20 + (10/10) + 20$$

which equals **41**. If you use formulas with equations in the numerator and denominator, you need to use parenthesis ( ) to force the spreadsheet to calculate them properly. Make the following changes:

1. Click on **C1**.
2. Click on the **Input Line**.
3. Edit the formula to read **=(A1+10)/(B1+20)**. (Click just before the **A**, then Press the ( key [Shift-9]. Click after the **0** in 10, then press the ) key [Shift-0]. Click just before the **B**, then Press the ( key [Shift-9]. Click after the **0** in 20, then press the ) key [Shift-0]).
4. Click the **Accept**, , icon (green check mark.) The correct answer, **1**, appears in **C1**.

## Copy Formulas

You can copy a formula so that the formula itself is copied OR that the answer to the formula is copied.


### Copy The Formula Itself





1. **Select** (click on) the cell(s) that is to be copied.
2. **Right-click**, then click **Copy**. (The material is copied to the clipboard)
3. **Select** (click on) the cell where the material is to appear.
4. **Right-click**, then click **Paste**.

### Copy The Answer of a Formula

1. **Select** (click on) the cell(s) that has a formula.
2. **Right-click**, then click **Copy**. (The material is copied to the clipboard)
3. **Select** (click on) the cell where the material is to appear.
4. **Right-click**, then click **Paste Special**. (The “Paste Special” window appears)
5. Remove the check mark at **Paste all**.
6. Remove the check mark at **Formulas** and add a check mark at **Numbers**. Click **OK**.

## Exponentiation

The number **102** is written as **10^2**. To enter the ^ sign, press the **Shift** key and the number **6**, , key.

1. Click on **A9**.
2. Type **=A6^A7** (Or click the “Function”, , icon. The “=” appears in “A9”. The “Function”, , icon changes to the “Accept”, , icon. Then type “A6^A7”).
3. Press **Enter** (Or click the “Accept”, , icon.) The answer, **100000**, appears in **A8**.



CC BY

Reference: The following tutorial is excerpt from Tutorials for OpenOffice.  
<http://www.tutorialsforopenoffice.org/tutorial/Columns.html>

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## Add A Label To Columns

1. Make **A1** the active cell. (Click in cell **A1**)
2. Type **Check No** then press the **Tab** key (The cursor moves to B1)
3. Type **Paid To** then press **Tab**. (The cursor moves to C1.)
4. Type **Description** then press **Tab**.
5. Type **Deposit** then press **Tab**.
6. Type **Withdrawal** then press **Tab**.
7. Type **Balance** then press **Enter**.

## Insert An Additional Column

Insert a Date column in the first column.

1. Select column **A**. (Click on the "A" at the top of the column. The column turns black.)
2. Click **Insert > Columns**. (The cell contents in columns "A" through "F" shift to the right and becomes columns "B" through "G". Column "A" cells are empty.)
3. Select **A1**.
4. Type **Date** then press **Enter**.

## Change The Appearance of Column Labels

### Center The Column Labels



#### Use An Icon From The Formatting Toolbar

1. Select cells **A1** through **G1** by dragging the mouse from cell **A1** to cell **G1** (Click on **A1** and without releasing the click, move the cursor over **B1**, **C1** etc until the cursor is in cell **G1**. Release the click)



1. On the **Formatting** toolbar, click the **Align Center Horizontally** icon. (The column labels become centered)

### Select "Bold" And "Light Blue" For The Column Labels

1. While the cells are still selected, move to the left and click the **Bold**, , icon.
2. Move to the right to the **Font Color**  icon and pick **Light Blue**. (At the "Font Color", icon, click and hold the click until a choice of colors appears. Select [click on] the "blue" square). Press **Enter**.

## Make Entries In the Check Register

### Enter An Initial Balance:

1. Select **A2**.
2. Enter a date, **07/12/07**. (type **07/12/07**)
3. Select **G2**.
4. Enter **5000**.

### Format Columns For Currency

The **Deposit**, **Withdrawal** and **Balance** columns will contain dollars with a \$ appearing in front of the numbers. All three columns can be formatted at the same time.



1. Use **Drag** to select columns “E” through “G”. Click on E. (The cursor is at the top of column “E”) Press and hold down the left mouse button. Move the mouse pointer to **G** by moving the mouse. Release the mouse button. (Columns “E”, “F”, and “G” are highlighted)

Continue by using either of the following two methods:

### Use A Icon From The Formatting Toolbar

1. Click the **Number Format Currency**, , icon. (The three columns will show the \$ when they have numbers in them.)

### Use Format From The Main Menu

This method is more complex than using the icon.

1. Select columns **E** through **G**.

Untitled1 - OpenOffice.org Calc

File Edit View Insert Format Tools Data Window Help

1. Click **Format > Cells...** (The "Format Cells" dialog box appears.)
2. Click the **Numbers** tab.

**Format Cells**

**Numbers** Font Font Effects Alignment Borders Background Cell Protection

Category: All, User-defined, Number, Percent, **Currency**, Date, Time, Scientific

Format: \$ English (USA), -\$1,234, -\$1,234.00, **-\$1,234**, -\$1,234.00, -\$1,234.--, -1,234.00 USD, -1,234.00 USD

Language: Default

Options: Decimal places: 2, Leading zeroes: 1, ☒ Negative numbers red, ☒ Thousands separator

Format code: [\$-\$-409]#,##0.00;[RED]-[\$-\$-409]#,##0.00

OK Cancel Help Reset

1. In the **Category** box, click **Currency**.
2. In the **Options** section, make sure that **Decimal places** is set to **2**, **Leading zeros** is set to **1**, and **both** check boxes are checked.
3. Click **OK**.



---

## Borders And Shading

Borders can be used to separate data, mark certain cells or anything else you want. They are typically used to draw attention or separate. Add some borders to the check register worksheet:

### Select A Block Of Cells

Use either of the following two methods;

#### *Use Drag To Select A Block Of Cells*

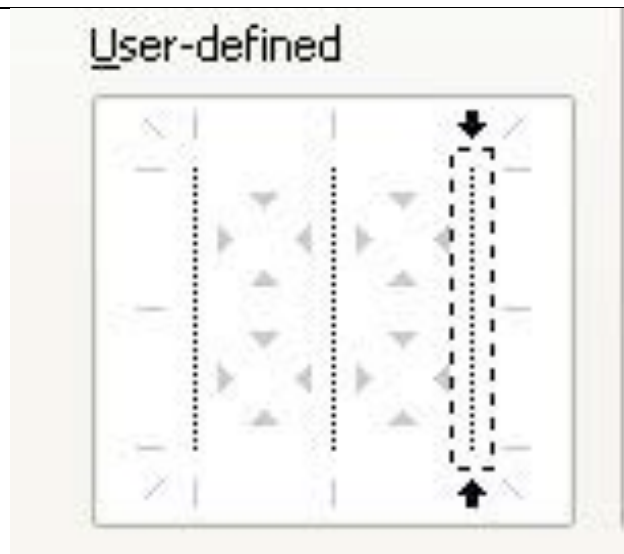
1. In **A1**, click and hold the click, then move the cursor onto **G25**.


#### *Use The Shift Key To Select A Block Of Cells*

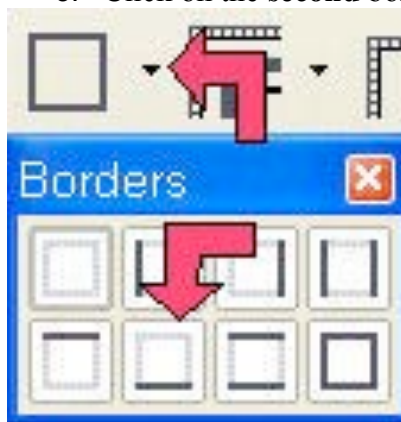
1. Click **A1**. Press and hold down the **Shift** key then click **G25**.
2. **Add A Border**
3. Click **Format > Cells...**
4. Click on the **Borders** tab. Find the **User-defined** box. Notice that there are four boxes created by inward facing triangles.
5. Click to the **left** of the **top left** box . (Toward the middle of the box side.) (1)
6. Click **between** the **top two** boxes. (Toward the middle of the box sides.) (2)
7. Click to the **right** of the **top right** box. (3)



1. You should have 3 vertical lines. Click **OK**.

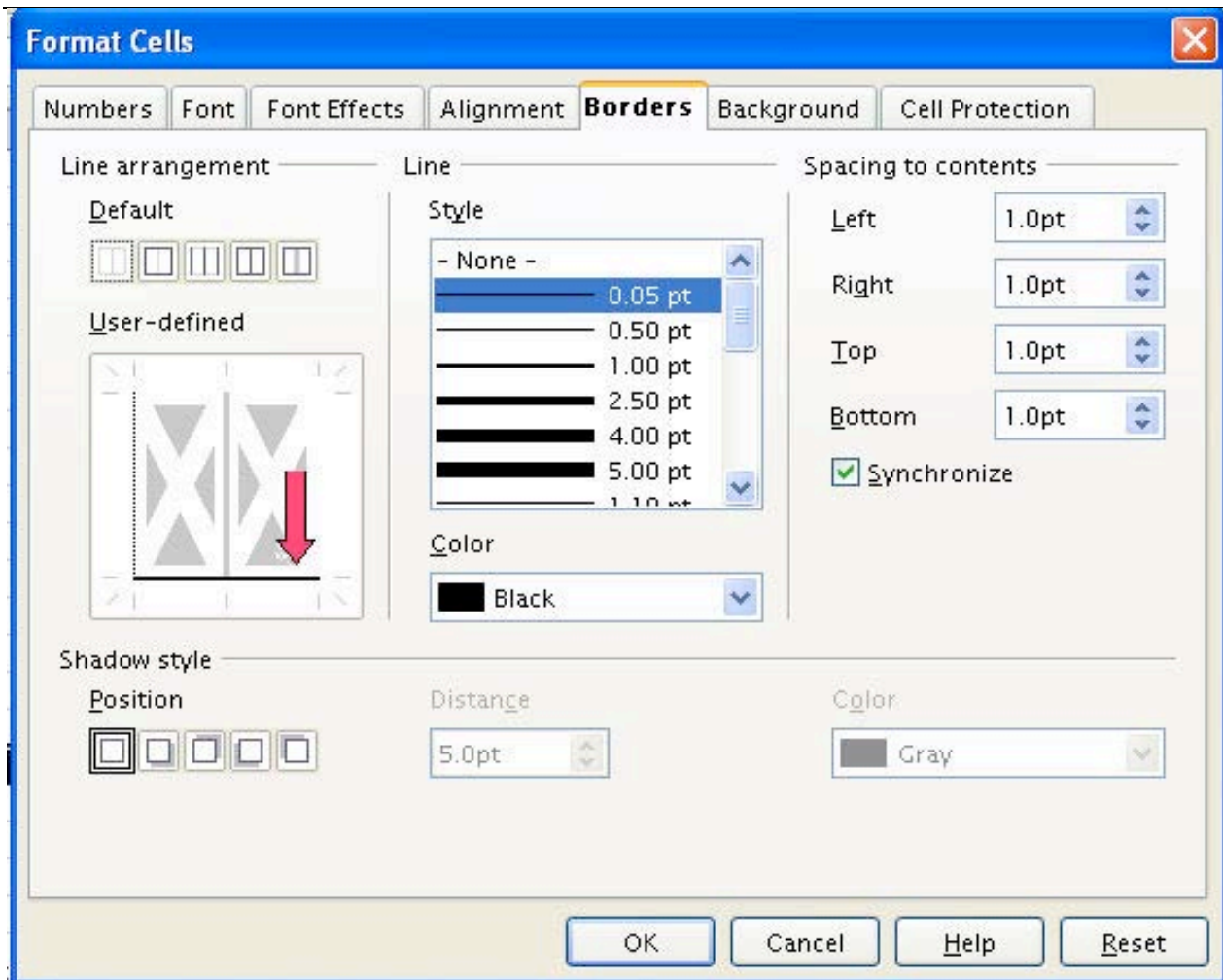


1. Select **A1:G1**. (Click "A1". Drag copy to "G1".)
2. Click the **Borders**, , icon on the **Formatting Toolbar**.
3. Click on the **second** box from the left on the **second** row.



### Add A Background Color

1. Click **Format > Cells...**
2. Click the **Background** tab.
3. Click on **Gray 20%**. (Use tool tips to find it.)
4. Click the **Borders** tab.
5. Click on the bottom **horizontal** line in the **User-defined** box.



1. Click the **2.5 pt** line weight in the **Style** box.
2. Click **OK**.




Reference: The following tutorial is excerpt from Tutorials for OpenOffice,  
[http://www.tutorialsforopenoffice.org/tutorial/Charting\\_Data.html](http://www.tutorialsforopenoffice.org/tutorial/Charting_Data.html)

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# Data Relationship

The first thing you need is data that shows a relationship. Examples include mathematical functions, stock market prices over time, rainfall over time, statistical divisions of a population, or divisions of an income that make up a budget. Since math is something that anyone can duplicate, we'll use the **sine** function:

1. Go to the bottom of your workbook and click on **Sheet2**.
2. Type **X** in **A1**.
3. Type **Sine(X)** in **B1**.
4. Enter **0** in **A2**. (That's a zero. Click anywhere on the Spreadsheet to unselect "A2" after entering the "0".)
5. Select **A2**. (Click on A2 again to select it.) Drag-copy A2 down until you see the tool tip number read **90**. (Put the cursor over the box at the bottom right corner of "A2". When you see a , click on it and drag it down until you see the tool tip number read **90** then release the click. The numbers will increase by 1 for every line you drag over.) (The number 90 will be in cell A92)
6. Go back to the top and Select **B2**. (Ctrl+up arrow is a quick way to move up.)
7. Enter **=SIN(A2)**.
8. Click on the bottom right corner of the **B2** cell. (The "B2" cell contents change from the formula "**=SIN(A2)**" into a "0".) Drag-copy the formula all the way down to the **90** in the **A** column.

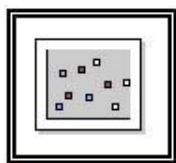
Don't worry if you don't know what the numbers mean; we aren't concerned with that. The order of the columns matters. Spreadsheet programs typically assume that the column on the left is the variable that is plotted on the horizontal (x) axis of the chart, and the column on the right is the variable that is plotted on the vertical (y) axis.

## Insert Chart

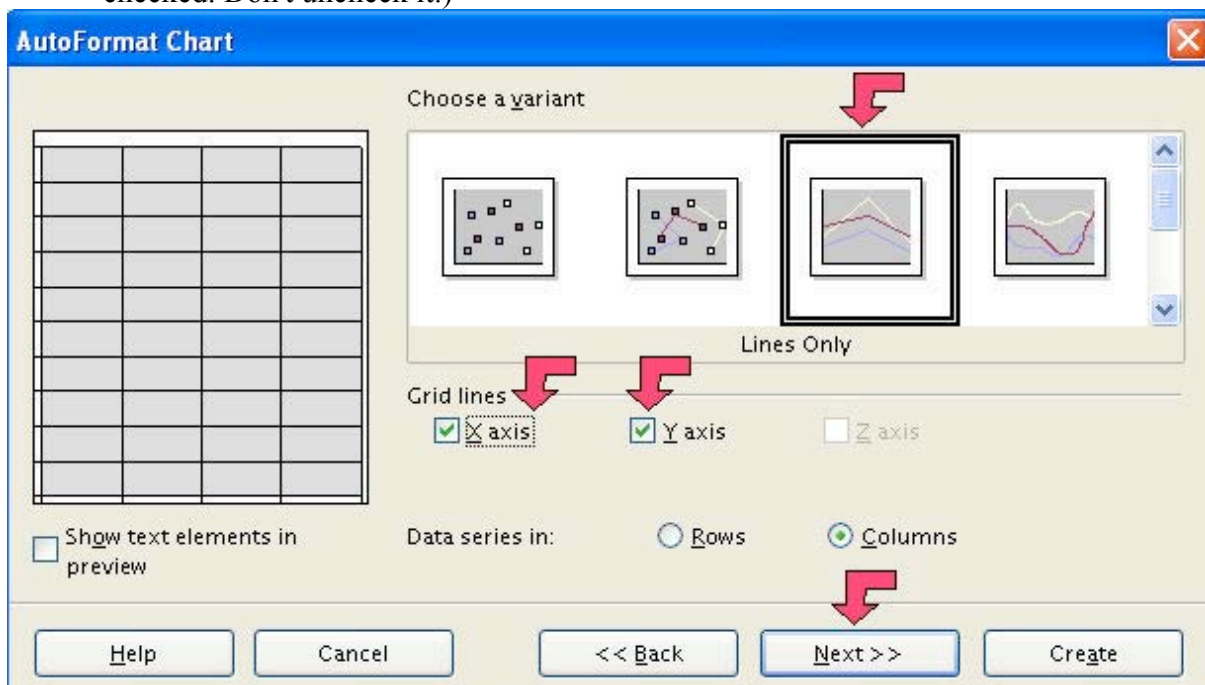
1. Select columns **A** and **B**.
2. Click the **Insert Chart**, , icon on the **Function Toolbar**. (The pointer changes to . Click anywhere on the spreadsheet. Or Click **Insert > Chart...** The "AutoFormat Chart" window appears.)
3. Select **-New Sheet-** from the drop-down box labeled **Chart results in worksheet**.



1. Click **Next>>>**.

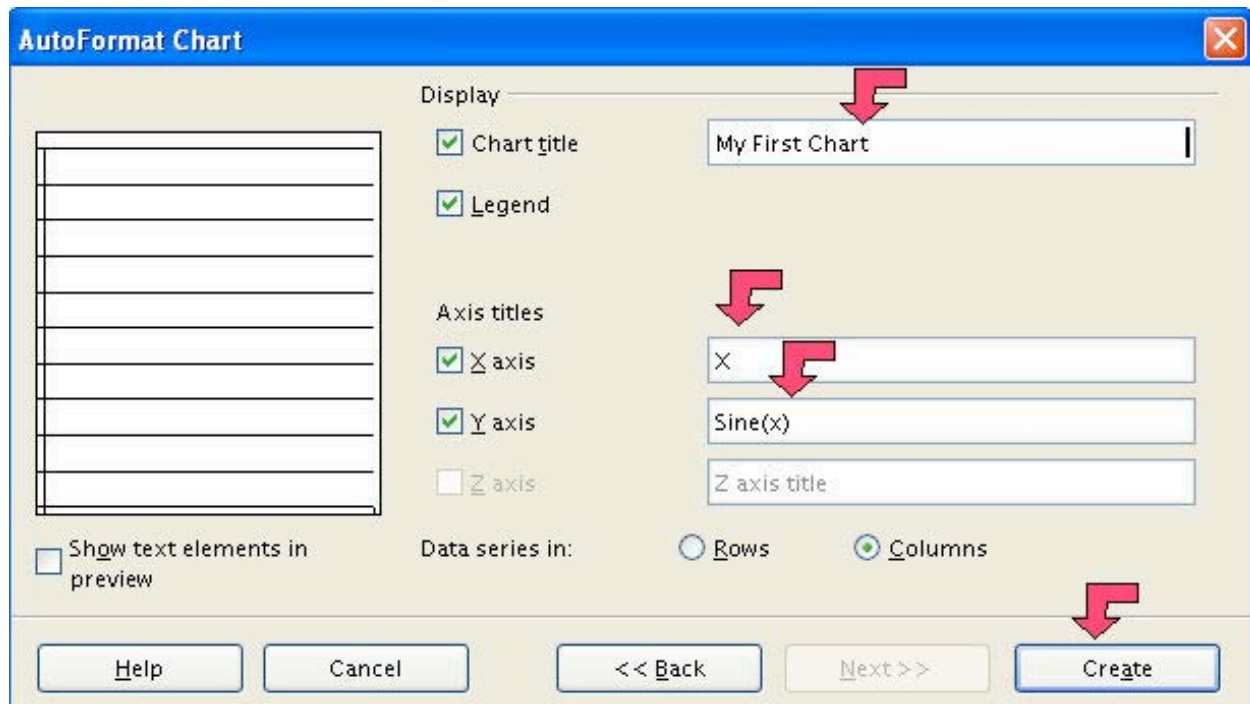


2. Select **XY Chart**. (Hold the cursor over the icons to find it.)
3. Click **Next>>>**.
4. Select **Lines Only** and check the **X axis** and **Y axis** grid line boxes. ("Y" may already be checked. Don't uncheck it.)



1. Click **Next>>>**.
2. Give the chart a title, **My First Chart**, in the box that has **Main Title** in it. (Replace text.)

3. Click the **X axis** and **Y axis** check boxes.
4. Type **X** for X axis title, and **Sine(x)** for Y axis title. (Replace existing text.)
5. Click **Create**.



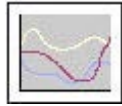
1. Look at the worksheet tabs at the bottom.
2. Click on the last tab. (Probably labeled Sheet4.)
3. Use the little boxes on the corners to resize the chart by clicking on them and dragging them until you like the proportions.

## Appearance Of Chart

Charts created by spreadsheet programs are unappealing most of the time. You have to mess with the format of the chart elements to make them look better.



The first thing I notice is a jagged plot line. That is appropriate for some data, but the sine function is a smooth function, so make the following changes:

1. **Double-click** somewhere on the chart if you see green boxes or no boxes.
2. Click **Format > Chart Type...**



3. Select **Cubic Spline**, from the **Variants** box at the bottom.
4. Click **OK**.

That's better, but it could still use some improvement. Try:

1. Click **Format > Chart Wall**.
2. Click the **Area** tab. In the dialog box below Fill, click the  and select **None**. Click **OK**.
3. Place the cursor over the **data plot line** and double-click. (The smooth Purple line.)
4. Click the **Line** tab. In the **Color** dialog box, change the color to **Sea Blue**.
5. In the **Width** dialog box, change the width to **.02**. (Click the  repeatedly or highlight the number in the dialog box and type ".02".) Click **OK**.
6. Select **Format > Grid > All Axis Grids...**
7. Change the **Color** to **Gray 40%**. (You have to scroll down the palette.) Click **OK**.

- 
8. The chart still seems busy. Select **Format > Axis > X Axis**. Click the **Scale** tab.
  9. Clear the **Maximum** check box and replace **90** with **45**. Click **OK**.
  10. Change the main title text to **Sine Function** by double-clicking on it and editing it.
  11. When you are done, click somewhere else on the chart to accept the changes.
  12. Click on a worksheet cell. Click **Format > Sheet > Rename**. (The “Rename Sheet” window appears.) Rename the sheet, **Sine Graph**.
  13. Save your work. (Click “File > Save”.)

---

## Lesson 2c – Open Office Impress



Reference: The following tutorial is excerpt from Tutorials for OpenOffice,  
[http://www.tutorialsforopenoffice.org/tutorial/What\\_Is\\_Impress.html](http://www.tutorialsforopenoffice.org/tutorial/What_Is_Impress.html).

**IMPRESS** is the presentation feature in OpenOffice. A presentation is pages that can be seen on the computer screen as normal and, with the use of a projector, the page can be seen on the wall or on an external screen. Normally, a laptop is used since it has good portability.

Impress is like a SLIDE SHOW. One page after the other is projected.

A page that is projected is called a SLIDE. The following can be included in a Slide:

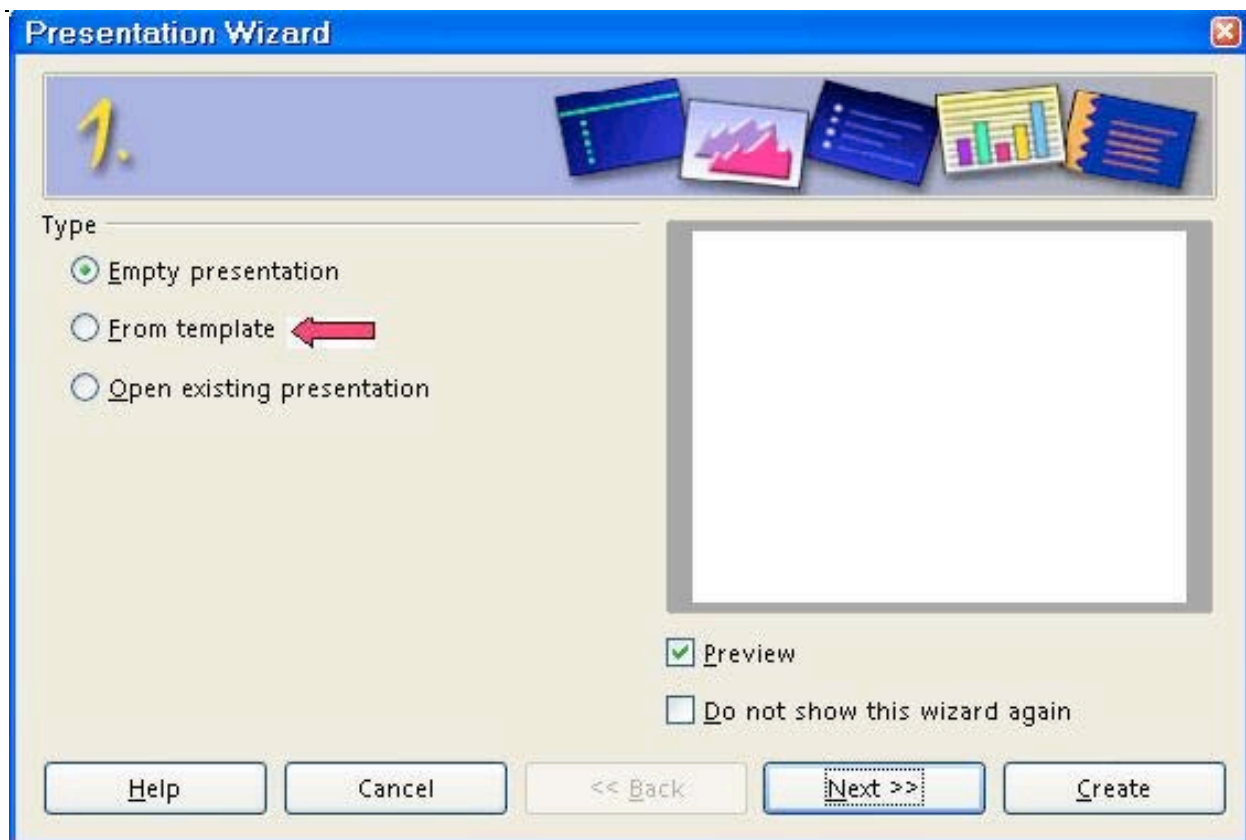
1. Animation
2. 3-D graphics
3. Bullets and Numbered Lists
4. All the normal stuff that is in a word processor (Writer) and in spreadsheets such as bold, colors, text alignment, borders, drawing, templates (master slide) , etc.

Notes can be added to a slide that are not projected but can be seen by the presenter.

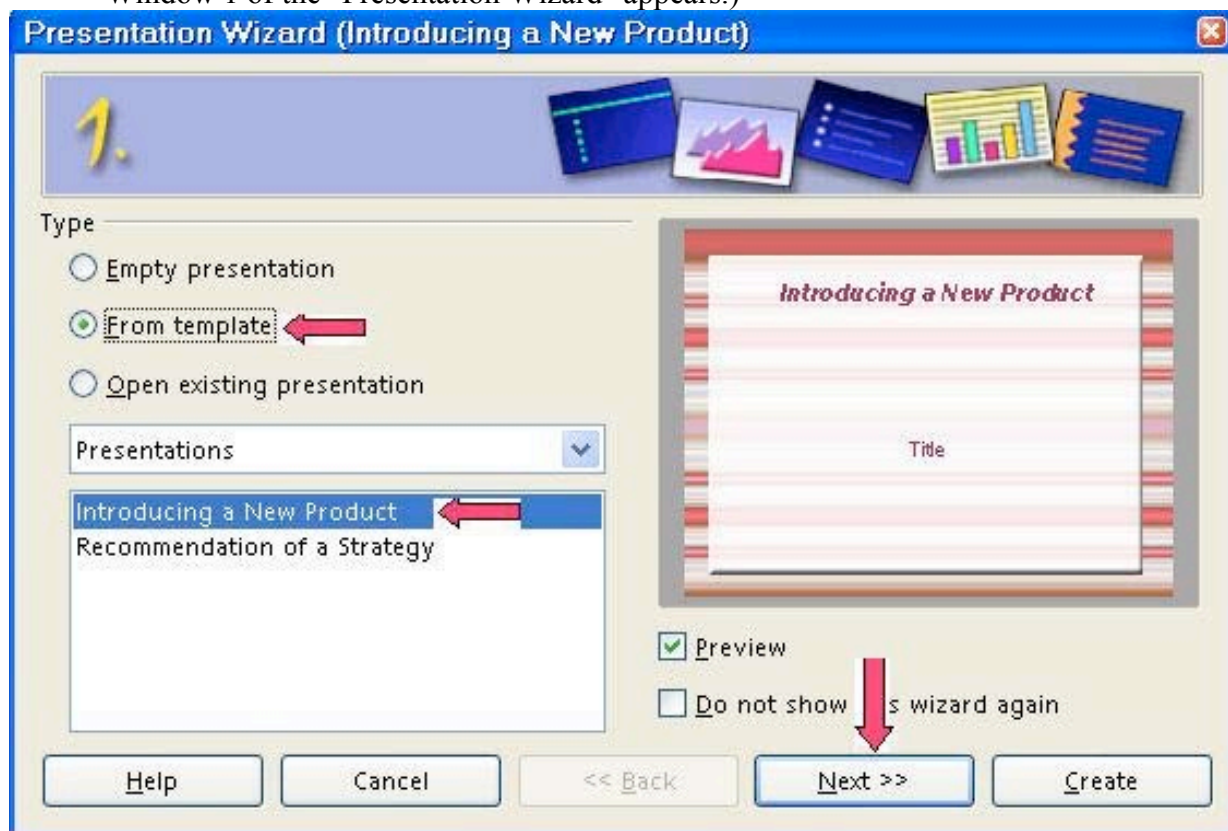
## Use A Template

1. OpenOffice has two ready-made templates, **Introducing A New Product** and **Recommendation Of A Strategy**.
2. Click **File > New > Presentation > From Template**. (Part 1 of Window 1 of the “Presentation Wizard” appears.)

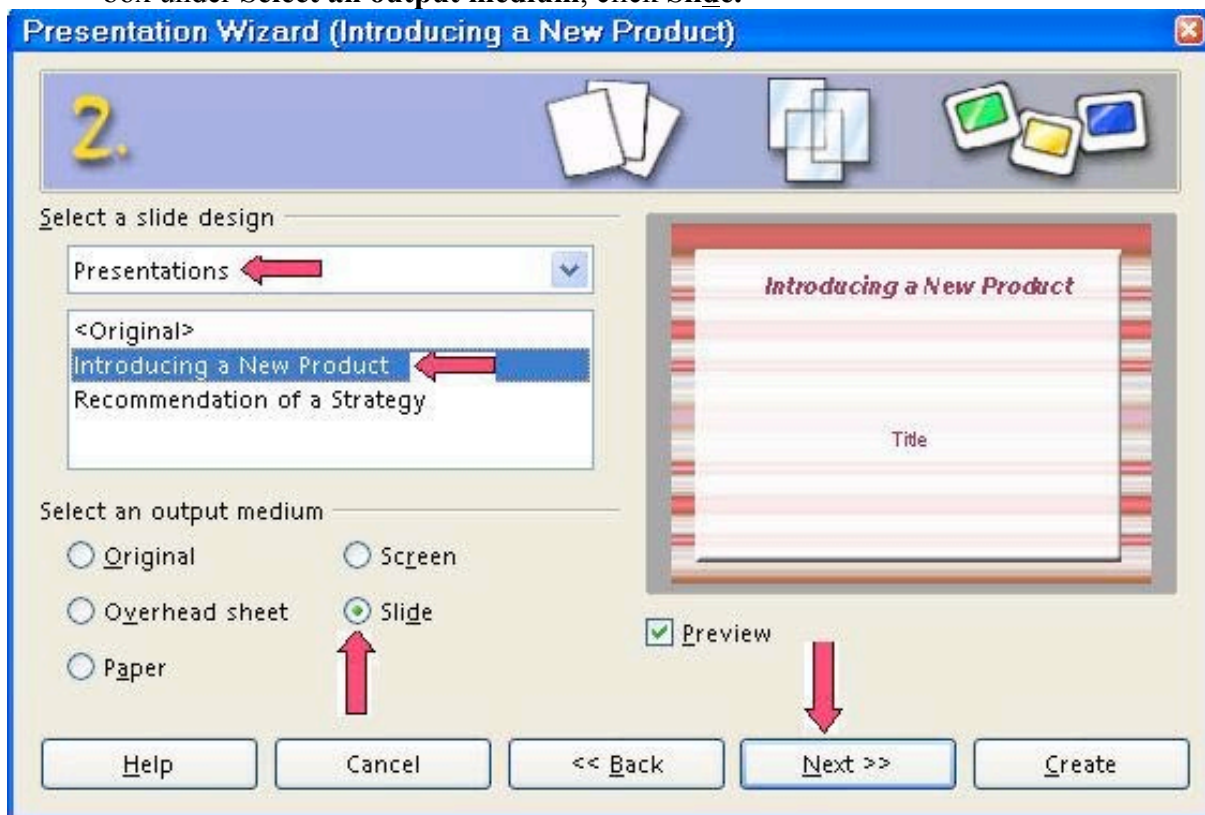





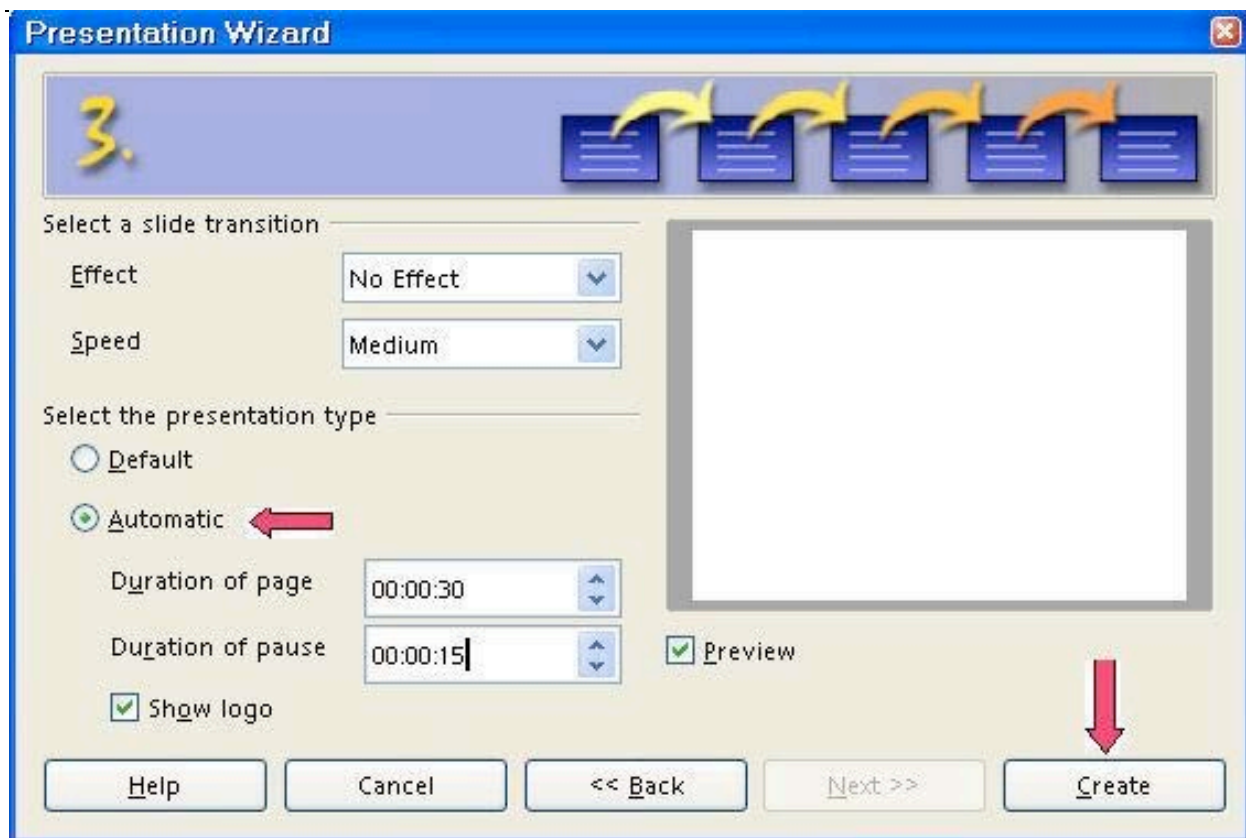
1. If not already selected, select **Introducing a New Product**. Click **Next** (Part 2 of Window 1 of the "Presentation Wizard" appears.)



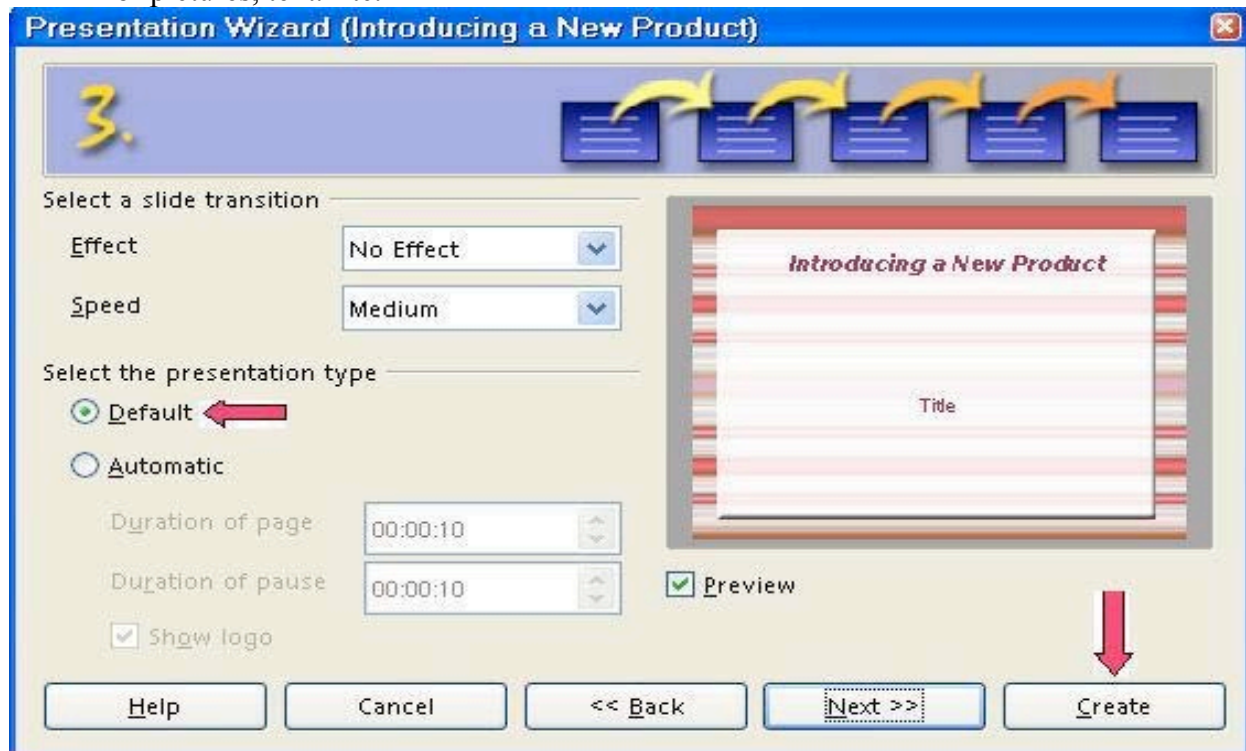
1. In the dialog box under **Select a slide design**, click **Presentation** if it is not already selected. (Window 2 of the "Presentation Wizard" appears. Note that "Introducing a New Product" is highlighted. If you prefer another background than the default, under "Select a slide design", click "Presentation backgrounds" and select your choice.) In the dialog box under **Select an output medium**, click **Slide**.



1. Click **Next**. (Window 3 of "Presentation Wizard" appears.) Under **Select a slide transition**, use the default for **Effect** and **Speed**. Under **Select Presentation Type**, click **Automatic**. In the **Duration of pages** dialog box, type **11** in the seconds place. In the **Duration of pause**, type **11** in the seconds place. (Highlight and type the numbers or use the  to select a number. The format for the numbers is: 00.00.11. The "hours setting" is before the first decimal (period). The "minutes setting" is before the second decimal. The "seconds setting" is before the third decimal.)



1. Note: If you use the default settings, click **Create** and you have your presentation ready for pictures, text. Etc.



1. Under **Describe your basic ideas**, in the dialog box under **What is your name or the name of your company?**, type **The Save Time Company**. In the dialog box under **What is the subject of your presentation?**, type **A New Watch**. In the dialog box under

---

Further ideas to be presented, type **Use the Stopwatch Function** and **Use The Date Function**.

2. Click **Next**. (Window 4 of the 'Presentation Wizard' appears.)

**4.**

Describe your basic ideas

What is your name or the name of your company?

The Save Time Company

What is the subject of your presentation?

A New Watch

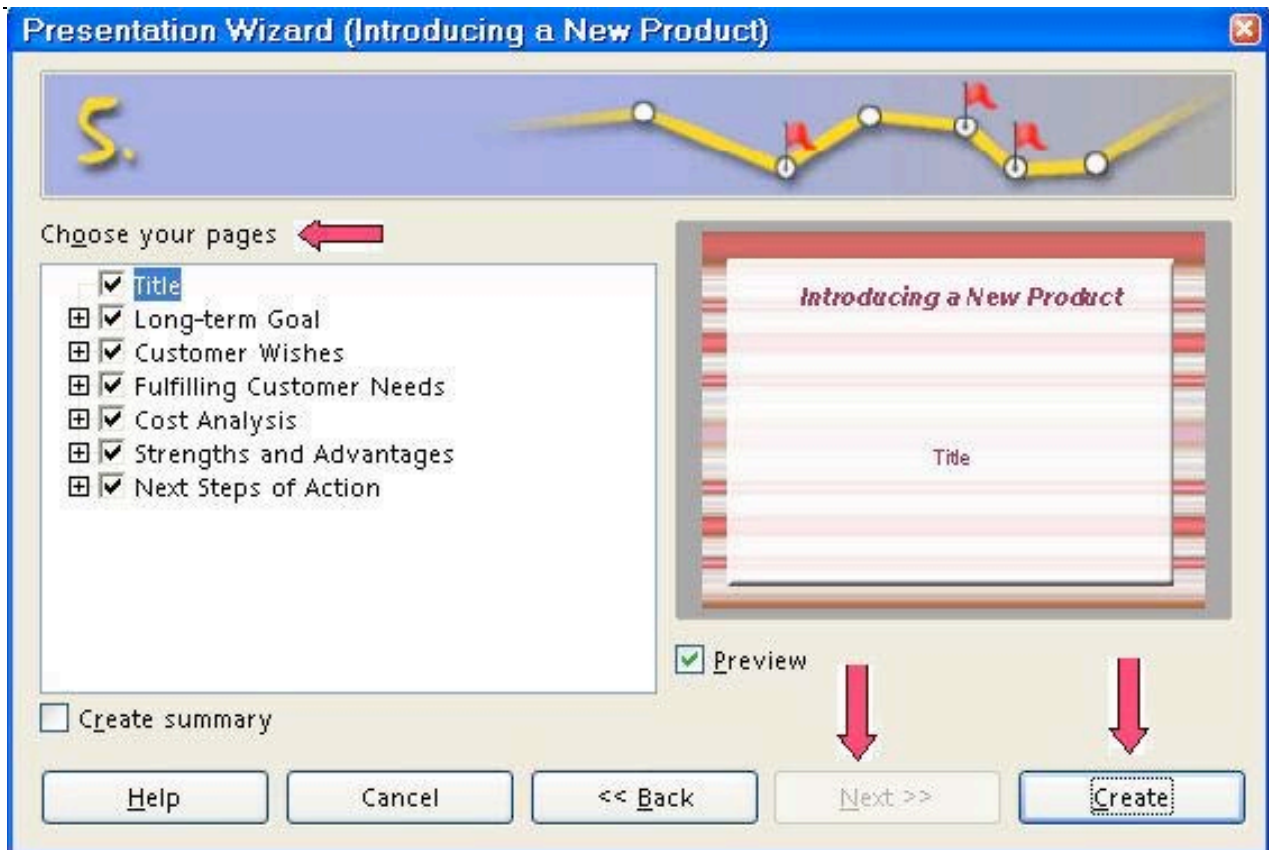
Further ideas to be presented?

Use The Stopwatch Function  
Use The Date Function

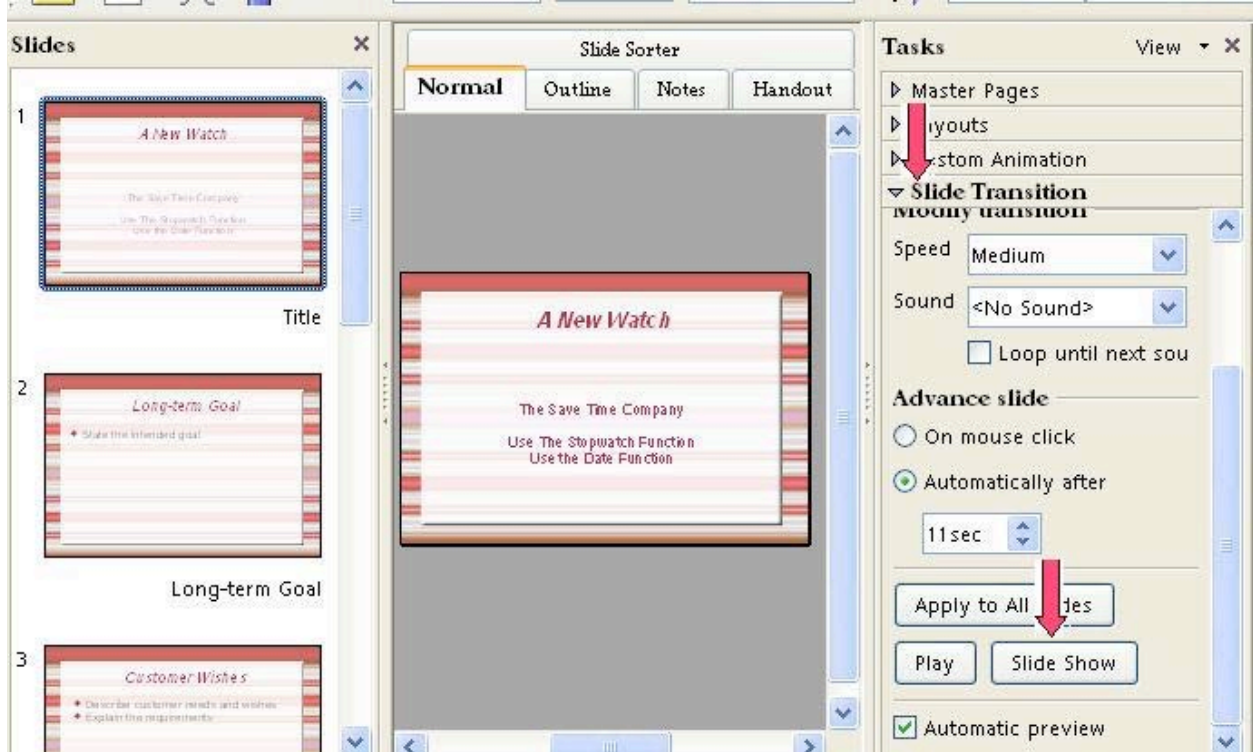
Help Cancel << Back **Next >>** Create

1. Under **Choose your pages**, select what you want in your presentation or use the default settings. Click **Create**. (Note: "Next" is grayed. "Create" is the next step.)





1. Click **Slide Transition** if it is not already selected. To see your presentation that you just made, click **Slide Show**.



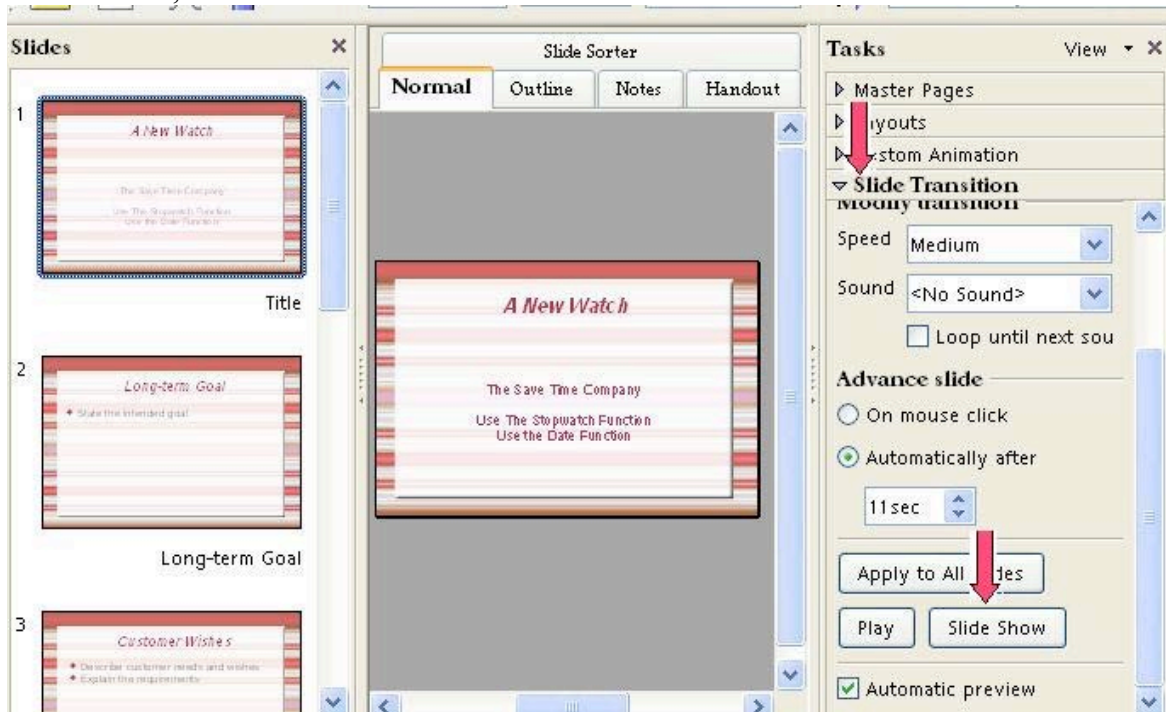
---

# Save And Close Your Presentation

1. Click **File > Save As**. In the **Save in:** pull-down menu box, click **My Documents** (if it is not already selected). In the **Save as type:** box, click **OpenDocument Presentation (.odp)** (if it is not already selected).
2. In the **File name:** box, type **My Slide Show**.
3. Click **Save**. ("My Slide Show" is saved. The file, "My Slide Show" is still on the screen.)
4. Click **File > Close**. (The file, "My Slide Show", is no longer on the screen.)

## To Watch "My Slide Show" at a Later Time

1. Click **File > Open**. (The "Open" window appears.)
2. In the menu below the "**Look in:**" dialog box, click **My Documents** if it is not already there. In the menu below the **File name:** dialog box, click **My Slide Show**. ("My Slide Show" appears on your screen.)
3. Click **Slide Transition** if it is not already selected. To see your presentation that you just made, click **Slide Show**.


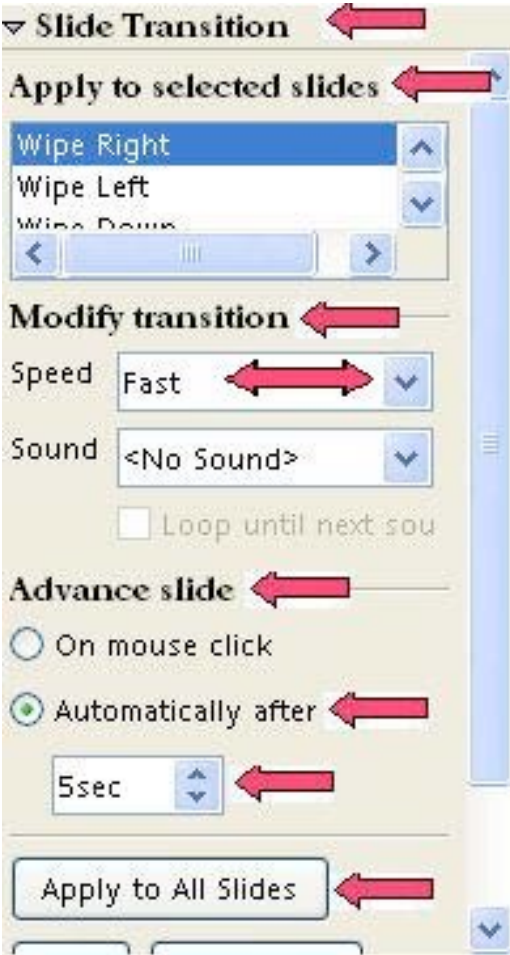




Reference: The following tutorial is adapted from

[http://www.tutorialsforopenoffice.org/tutorial/Automate\\_Slides\\_In\\_Your\\_Presentation.html](http://www.tutorialsforopenoffice.org/tutorial/Automate_Slides_In_Your_Presentation.html).

## Automate Slides In Your Presentation

Once you have created your Impress Presentation you might now want to automate the slides so that you don't have to click the mouse to move to the next slide every time.

Activity	Explanation
1. Click <b>File &gt; Open</b> .	The "Open" window appears.
1. In the menu below the <b>Look in:</b> dialog box, click <b>My Documents</b> if it is not already there. In the menu below the <b>File name:</b> dialog box, click the name of your Presentation. .	Your Presentation appears on your screen.
In the <b>Tasks</b> window, click <b>Slide Transition</b> .	The "Tasks" window is on the right side of your "Impress Presentation" screen.
<p>Under <b>Apply to selected slides</b>, click the  to scroll to select a transition like <b>Wipe Down</b> or <b>Wipe right</b>.</p>	
Click the  to scroll to <b>Fast</b> in the dialog box to the right of <b>Speed</b> under <b>Modify transition</b> . Click <b>Fast</b> .	In the "Speed "dialog box, you have three choices for the speed of the transition. The choices are "Slow", "Medium", and "Fast".
Click <b>Automatically after</b> in the dialog box below <b>Advance slide</b> . Click the  to set the	You can also highlight the number in the dialog box and type the number of seconds.

<b>Seconds to 5sec.</b>	
Click <b>Apply to All Slides.</b>	
Press <b>F5</b> to view your presentation to see if you have the speed and format the way you want it. If you want to change the speed or the type of transition you simply apply the process again.	

## **Lesson 3a - Introduction to Computer Aided Drafting (CAD)**

Using a computer program to help you draw is called “Computer Aided Drafting.” Learning how to draft on a computer is a very powerful skill. Drafting helps you present your information clearly and neatly.

Most CAD Drafting programs have the same basic functions like drawing lines and circles. Google SketchUp is a basic drafting program that we will use to teach you how to draft. Once you become proficient with Google SketchUp, you will be able to adapt easily to other CAD programs.

### **Lesson 1. Familiarize yourself with Google SketchUp**

In this lesson you will first learn how to draw objects by hand on isometric sketching paper. You will learn the standard practices for drawing and the standard views of your drawing. Finally you will be introduced to Sketchup software and how it can help you with the general concepts you learned.

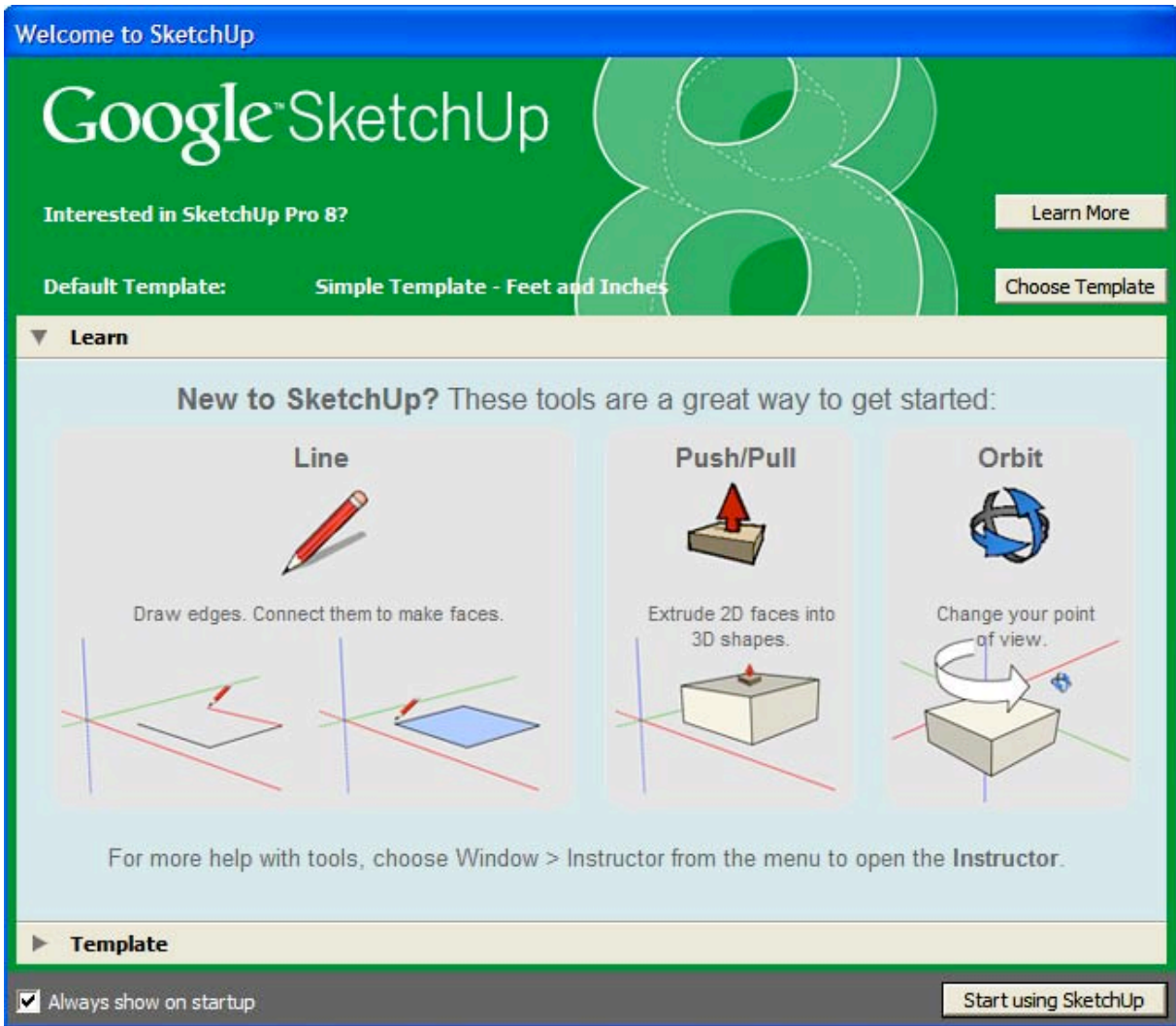
#### **Instructions:**

Open Google Sketchup:

1. Go to the START button
2. Click PROGRAMS
3. Click the left button on GOOGLE SketchUp

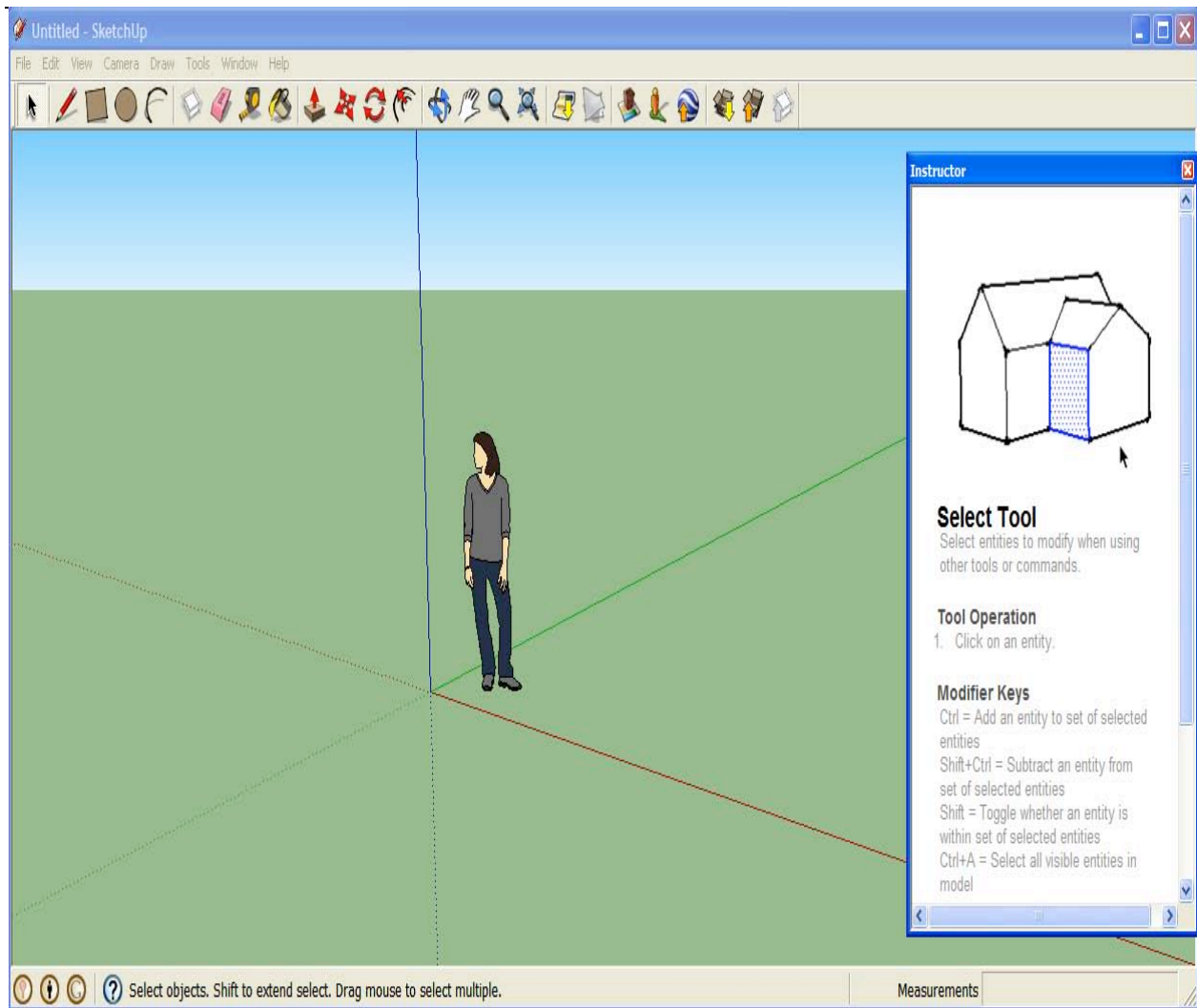


You will see the following screen:



**Figure 1. Google SketchUp start up screen**

1. Click on the button at the bottom right corner that says "Start Using Sketchup"
2. You will see the following screen:



**Figure 2. Google SketchUp 3-D (three dimensional) view**

Notice that the opening screen looks three-dimensional.

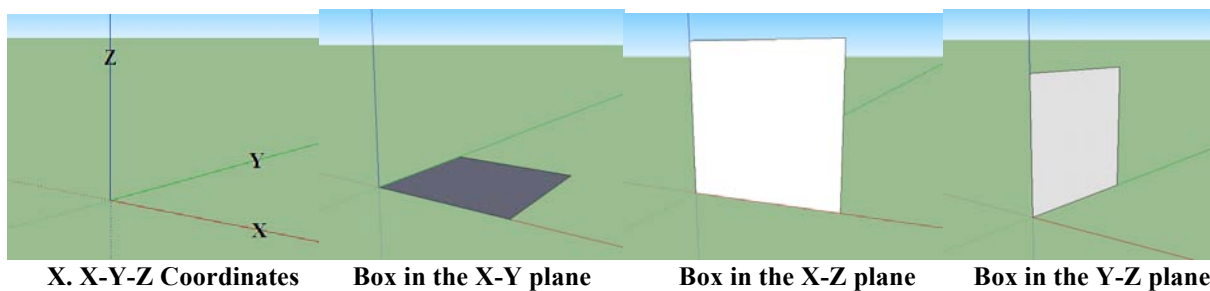
There are three different axes on the screen (LENGTH, WIDTH, and HEIGHT) with solid lines marking the positive axes and dotted lines marking the negative axis.

- The picture of the woman on the screen is provided for you to get reference of the depth and height of the screen. Notice the horizon line at the back of the picture.
- You are looking at a picture of an empty world just ready for you to fill it up with drawings!
- Click on the picture of the woman and press the DELETE button on your keyboard
- To draw in Google Sketchup, use the command bar (the command bar has the pictures) at the top of the page
- Google Sketchup uses 4 major commands to draw: drawing a Line, Rectangle, Circle and Arc.
- To draw those features you can click on their corresponding buttons at the top of your screen:



**Figure 3. Command window at the top left**

- You can also see that there is a tool called “Select”. Every time you click on a drawing tool your cursor becomes that drawing tool and you will not be able to select other lines or objects until you click on the select tool
- Follow along with your instructor as you learn to draw those different shapes in Sketchup
- Make sure that every shape is in a plane. A plane is a two dimensional imaginary surface. There are three main reference planes, the X-Y plane, the X-Z plane and the Y-Z plane. They are the planes created by the surface limited by the x and y axis, the x and z axis and the y and z axis respectively.
- For example, note the following rectangles aligned parallel with each of the three main planes
- To draw a line parallel to each axis, move the line until it is the color of the axis line that you want to draw parallel to. NOTE: If the line is black, then it is not parallel to an axis line.



Note: The concept of planes will be very important in Google Sketchup. So make sure you keep up with your planes

#### Activity: Draw a Box in the X-Y plane

1. Click “Line” in the command bar
2. Click on the point where the 3 axes intersect
3. Drag the line parallel to the X axis until your line turns RED
4. Type “ 10’ ” on your keyboard
5. Press ENTER on your keyboard
1. Click on the end of the line you just drew
2. Drag the line parallel to the Y axis until your line turns GREEN
3. Type “ 10’ ” on your keyboard
4. Press ENTER on your keyboard
1. Click on the end of the line you just drew
2. Drag the line parallel to the X axis until your line turns RED
3. Type “ 10’ ” on your keyboard
4. Press ENTER on your keyboard
1. Click on the end of the line you just drew
2. Drag the line parallel to the Y axis until your line turns GREEN
3. Type “ 10’ ” on your keyboard
4. Press ENTER on your keyboard

Once you have a closed shape, the object will become shaded

---

## Drawing and Modifying Shapes

- With the Four Major shapes in Sketchup- lines, rectangle, circles, and arcs-- you will be able to create almost any shape.
- Everything in Sketchup, no matter how complicated, is a point, a line or a face. You will really have to master these concepts to able to modify your shapes.
  - A point is a single dot in space.
  - A line is a series of points.
  - A face is the surface encompassed by lines that do not have a break in between them and which are all co-planar (all lines are on the same plane).
- Try drawing a circle, a rectangle and a face of your choosing

## Lesson 2. Build a House

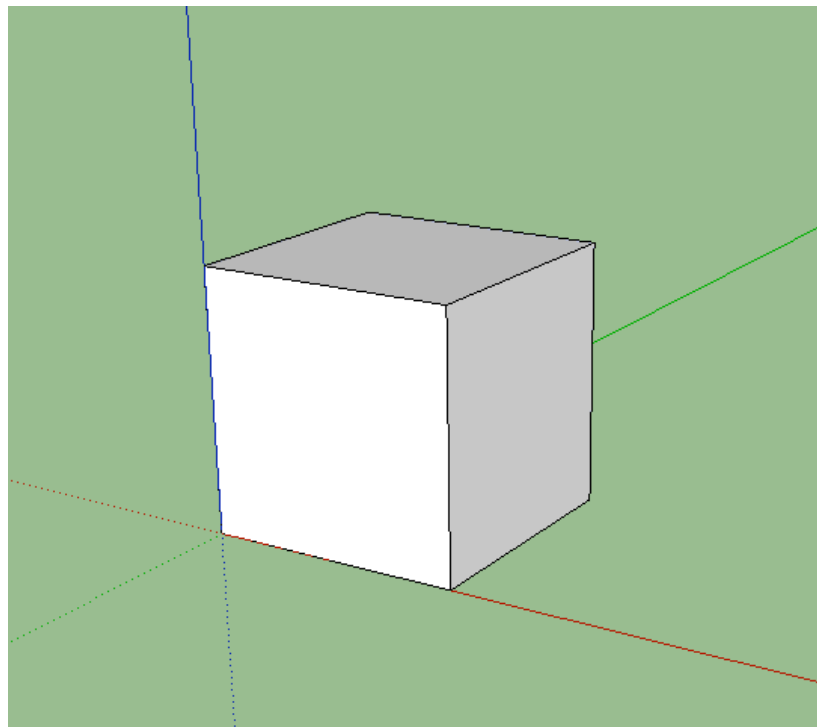
### I. Push and Pull Tool

So far we have played in 2D (2 Dimensions). But the beauty of Sketchup is how quickly you can turn your drawings into a 3D model. Let's design a house. It all starts with the push/pull tool.

- Open the file with the faces we drew before.
- Now, click on the push/pull tool.



- Once you have selected the tool, your cursor turns into a miniature push/pull icon. Hover with the cursor over the face you want to extrude into 3D.
- The face turns dotted. You can now click on it and move your mouse to expand it into a 3D model.



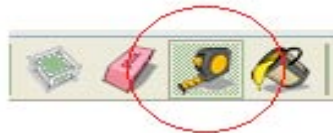
**Three Dimensional Box created using the 'Push/Pull' button**

- 
- If you want to extrude (push/pull) the shape to a particular exact dimension you can just type that dimension and click Enter. The face pops to that exact dimension.
  - Notice now that there are many more faces once you have extruded the original shape into 3D. You can now push or pull on any of those faces!

Once the object is drawn, more objects can be drawn on it.

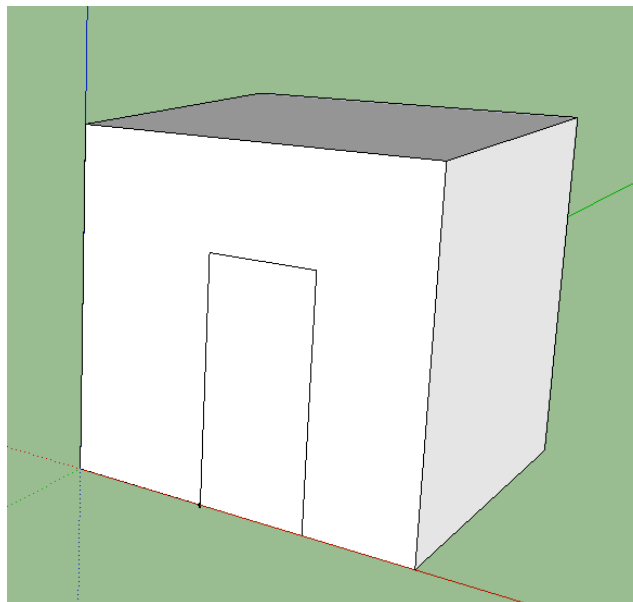
## II. Let's make a Door

1. Click on the 'tape measure' tool



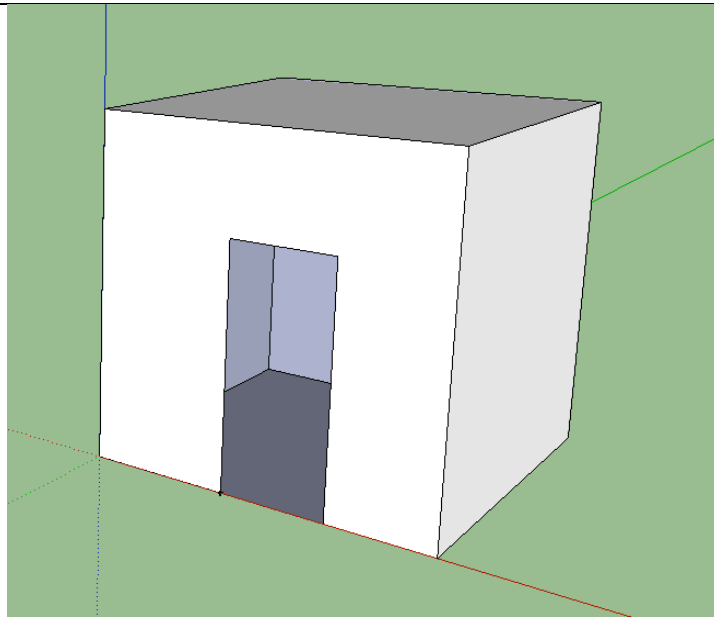
**Tape Measure**

2. Click on the bottom left corner of the box and measure 4 feet over, parallel to the red line
3. Press Enter
4. Draw a line 7 feet at the measurement point you just created
5. Draw the top of the door by drawing a line 3 feet over—parallel to the red line
6. Complete the door



**Box with door outline**

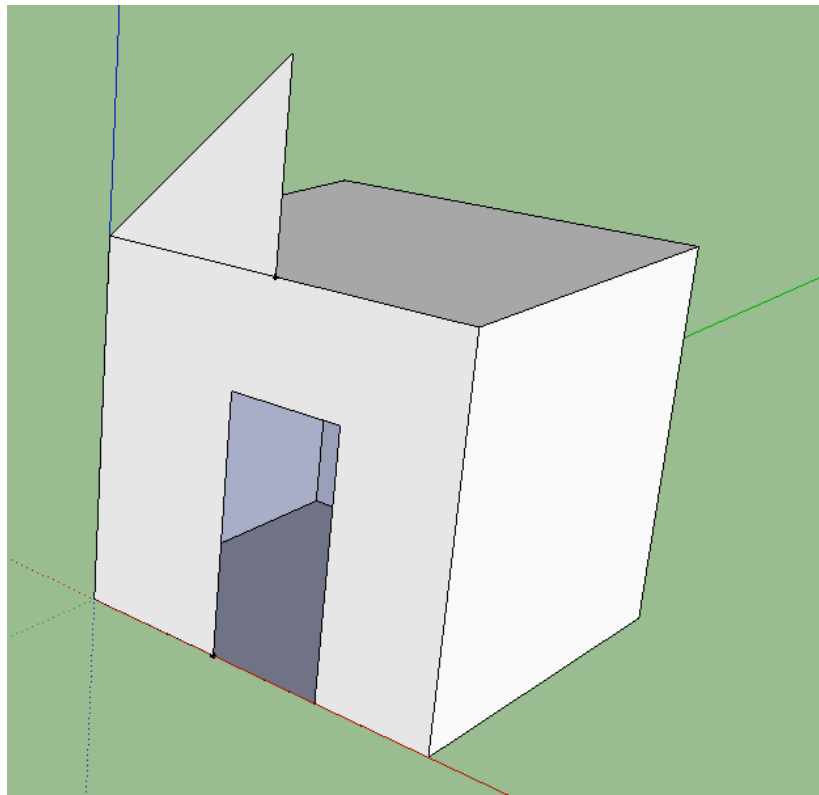
7. Click the 'SELECT' button in the command bar (the arrow)
8. Click on the face of the door and hit the DELETE button on your keyboard



**Box with door**

### **III. Draw the Roof**

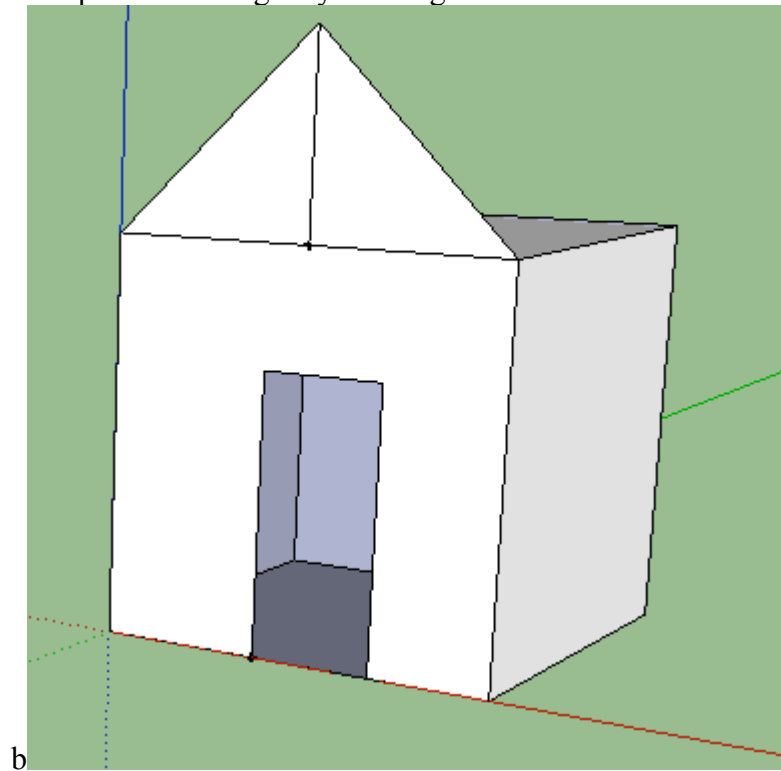
1. Click on the 'tape measure' tool
2. Click the top left corner of the box and measure 5 feet over-- parallel to the red line
3. Draw a line 5 feet up at the measurement point you just created
4. Draw a line from the top of the line you just created to the top left corner of the box



**Box with part of the roof**

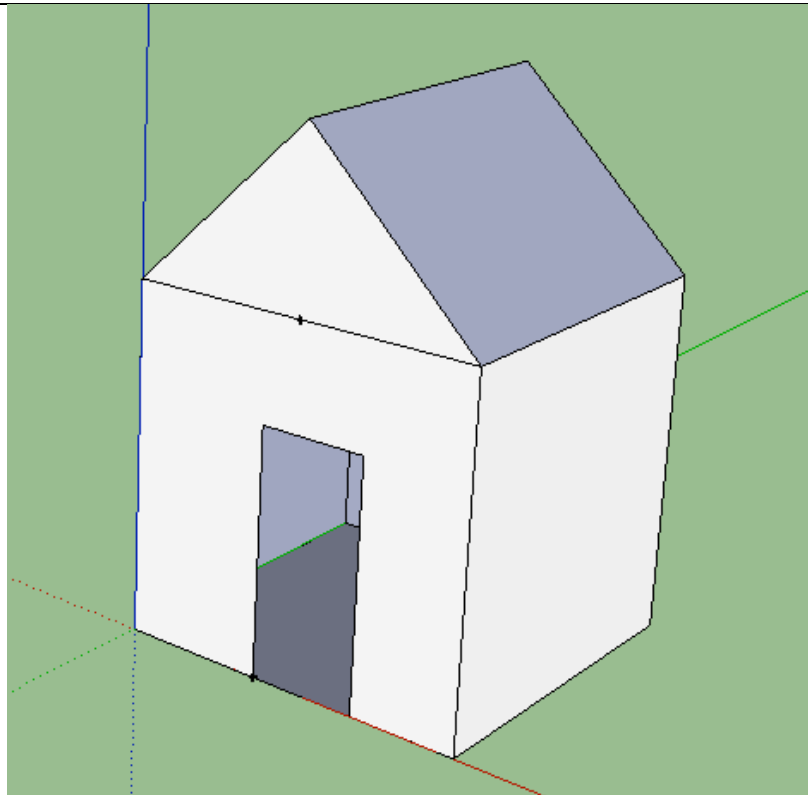
© FAIR USE

- 
1. Now complete the triangle by drawing a line to the other corner of the



#### **Box with part of the roof**

1. DELETE the vertical line in the middle of the roof by clicking on it with the arrow and hitting the DELETE button on your keyboard
2. Use the 'Push/Pull' button to make the roof
  - If the triangle does not have a face when you push it to make the roof, draw a line along one of the existing lines of the triangle



**House**

1. DELETE the horizontal line on top of the box by clicking on it with the arrow and hitting the DELETE button on your keyboard

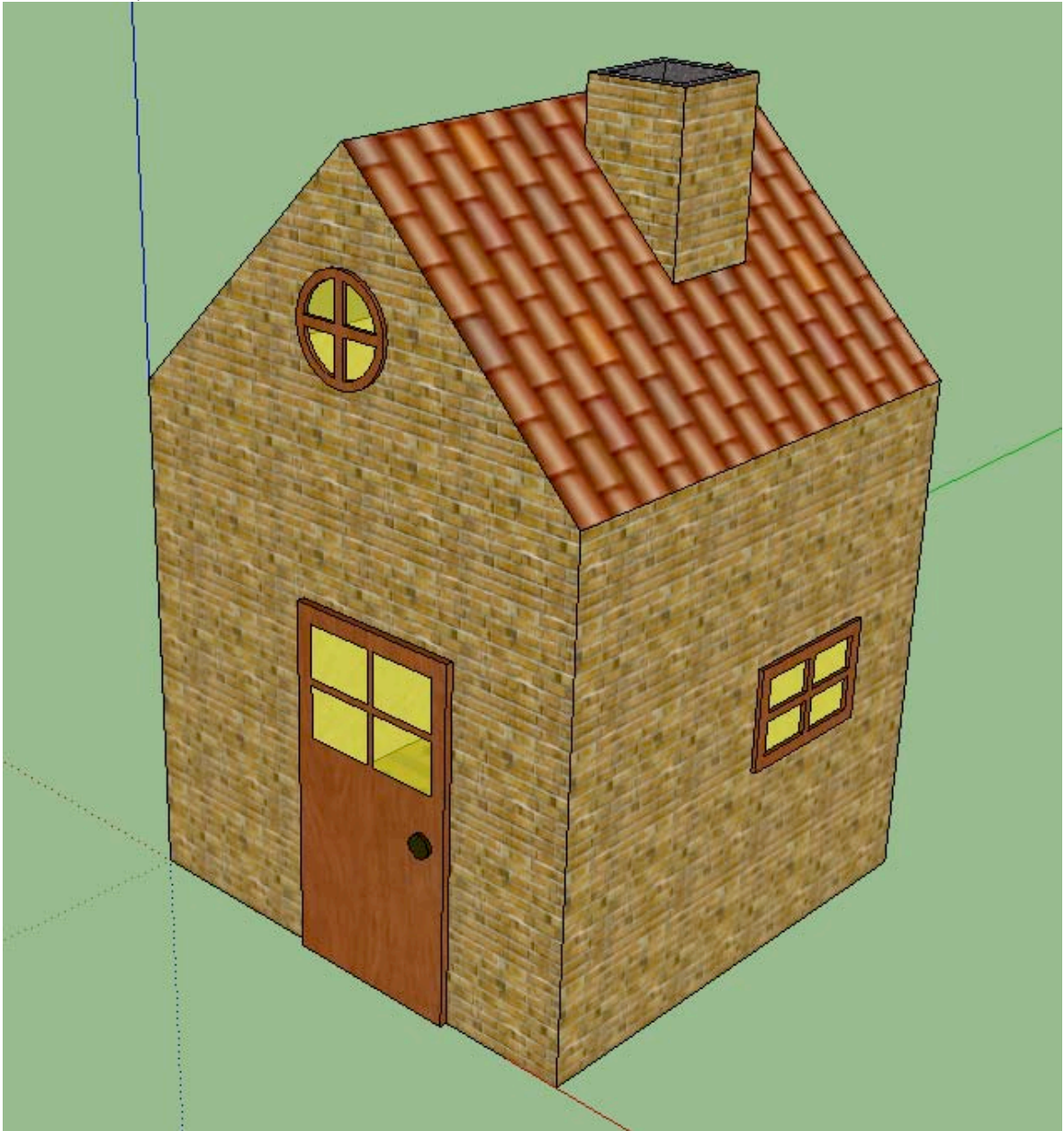
#### **IV. Get Creative!**

1. Draw windows using the 'rectangle' command and the 'circle' command
2. Make a chimney
3. Create a door with a window



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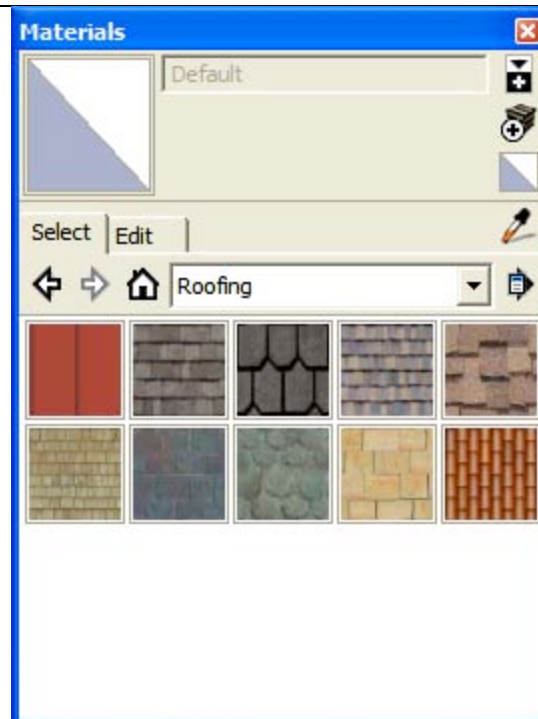
4. 'Paint' the House (see next section for instructions)



**Painted house with door, chimney, and windows**

Up until now all our shapes and geometries look a solid color and we don't get to choose it. Our drawings can use colors to help explain what we are trying to get across, like material choice (using metal, concrete, bricks or sand). They can also help differentiate or emphasize parts of our drawings.

- To introduce color and texture to our design we can use the "Paint Bucket" tool. Click on it in your upper toolbar.
- The following tool box appears.



**Paint Tool Box**

- Notice the dropdown menu in the box (it says 'Roofing'). The menu allows you to pick different colors and patterns.

So far we have focused on simple geometries. Soon, we will be working on crafting our own bridges, machines and creations. One of the best ways to create these machines is to visualize them in 3D. As engineers we often follow the technique of thinking about a problem, creating a possible solution, testing that solution and possibly iterating again until we find the best solution possible. Part of testing a solution involves creating a prototype. You will be building prototypes in your hands on lab. However, to create a prototype you must show others what your idea involves. This is an example of where Google Sketchup can be used to make models of those designs and communicate to other what we want to do.

This means that the closer our drawing is to what we want or imagine in our heads, the better others will be able to follow that.

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## Lesson 3b - Typing Skills



Reference: The excerpt below is from: The Importance of Daily Typing Practice, Burt Cotton, [http://www.articles3k.com/article/319/110879/The\\_Importance\\_Of\\_Daily\\_Typing\\_Practice/](http://www.articles3k.com/article/319/110879/The_Importance_Of_Daily_Typing_Practice/). Copyright 2010 Articles3K.com, All Rights Reserved.

Like anything in life, \_\_\_\_\_ makes perfect. I am sure that you have heard that saying before. There is great truth to this fact. If you want to achieve anything in life, you will need to \_\_\_\_\_ yourself to daily practice. This includes everything from playing the piano, competing in sports, and even mastering your typing skills. If you want to improve your typing skills then you will need to commit yourself to daily typing practice. Daily typing practice is the key to your typing success. Neglecting to practice will ensure that whatever gains you have made in speed and accuracy will be lost over time. There is no doubt about it. To keep up with your new skills and to improve your typing, you will need daily typing practice.

In today's society, typing is the key to getting \_\_\_\_\_. Most jobs require some degree of computer work, and knowing how to type quickly and efficiently will make you more marketable than your fellow worker who simply "finger pecks" at the keyboard. You can honestly state, that learning to type is an investment in your career future. Many public schools have embraced the importance of typing and they are encouraging children to schedule a time set aside for daily typing practice. Teaching children the correct methods of typing while they are young is an important step to ensuring their future success.

### Why is better typing productive for business and employees?



Reference: Why is better typing productive for business and employees?, <http://www.typinginstituteofamerica.org/how-you-benefit.html>. Copyright 2010, Typing Institute of America, All Rights Reserved.



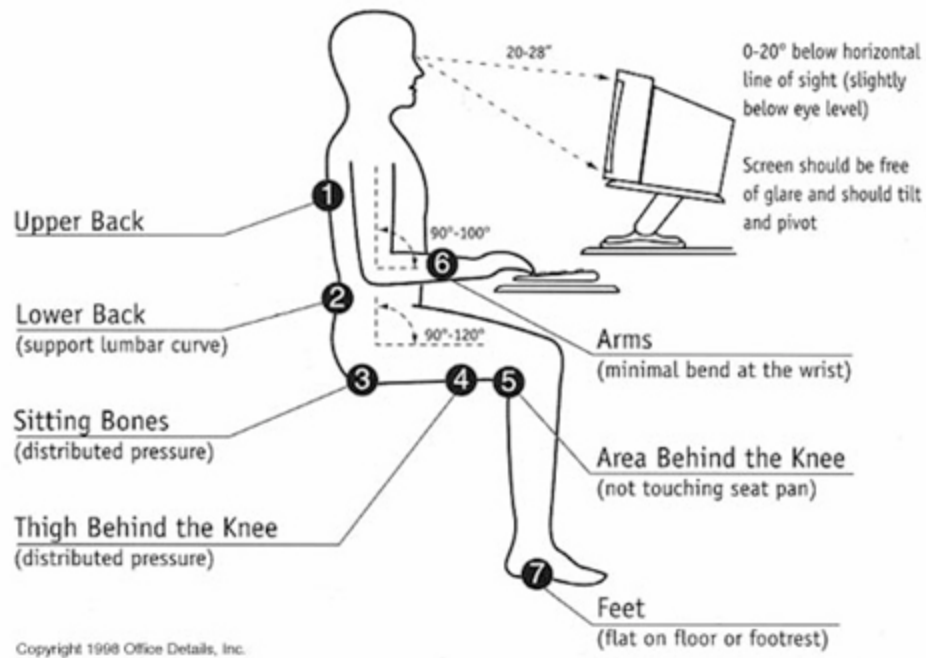
Reference: Excerpts below from article "Reap the Benefits of Good Typing Skills" by Courtne Packer, <http://typing-tutor-review.toptenreviews.com/reap-the-benefits-of-good-typing-skills.html>. Courtesy of Tech Media Network website. All rights reserved.

### Save Yourself and Your Boss Some Time


When you type properly at a faster pace, avoiding the hunt-and-peck technique, you can get a lot more done in a smaller amount of time.

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## It's Not Only About the Keys



### This is the correct posture to type

Image: , source: <http://www.nismat.org/ptcor/ergo>

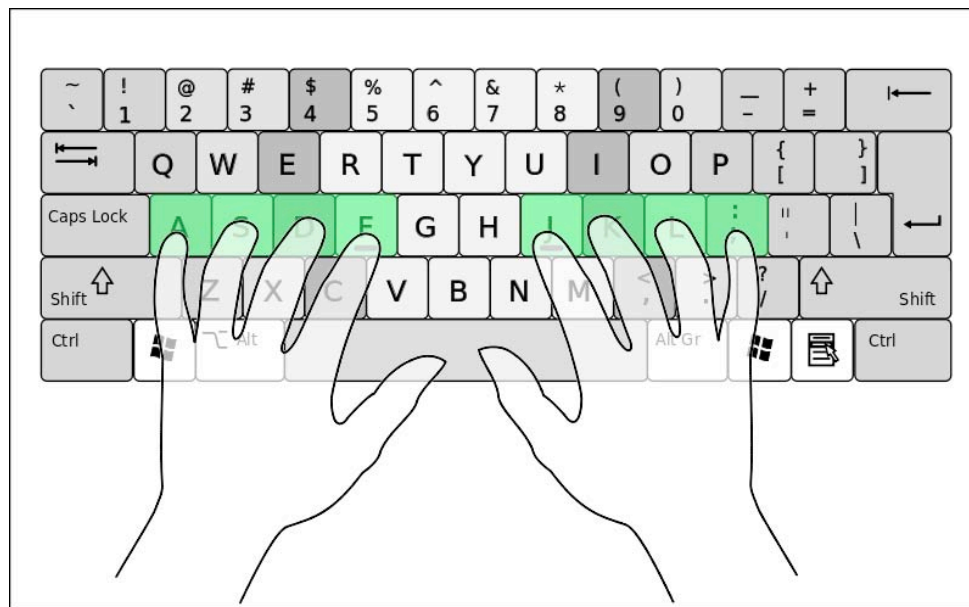
## Hands on practice

Let's start with our typing lessons, the objective is to get familiarized with the keyboard layout memorize where are keys located.

1. Open Tux4Kids Typing tutor program. (Remember from previous lessons, we learned how to open computer programs in two ways: a) using the start menu to open the program and b) using the desktop shortcut to open the program)



Navigation: to enter each section click the icon with the mouse. To exit each section press the ESC key on the keyboard.



(CC BY-SA) from <http://commons.wikimedia.org/wiki/File:QWERTY-home-keys-position.svg>

This is the correct way of placing your fingers over the keyboard, using all the fingers properly will allow us to type much faster.

### Exercise # 1

1. Click on Lessons
2. Click on Lesson 1
3. Start typing!!!

---

### Exercise #2

1. Click on fish cascade
2. Select easy
3. Select any category that you like.
4. Start typing!!!

### Exercise #3

1. Click on Comet Zap
2. Select Space Cadet
- 3 Select any category that you like.
4. Start typing!!!

### Contest

1. Click on Comet Zap
2. Click on Pilot
3. Start typing!!!

## Lesson 4a – Introduction to the Internet

**This is a brief history of the creation and evolution of the Internet.**



Reference: The History of the Internet in a Nutshell by Cameron Chapman,  
<http://sixrevisions.com/resources/the-history-of-the-internet-in-a-nutshell/>. Copyright 2008-2012 Six  
Revisions, All rights reserved.

### 2012: Liberia's High Speed Internet!!



Reference: Liberians hope long wait for the web is finally over  
By Bonnie Allen and Rob Hugh-Jones, PRI's The World, <http://www.bbc.co.uk/news/world-africa-15692430>. Copyright 2011 BBC, All rights reserved.

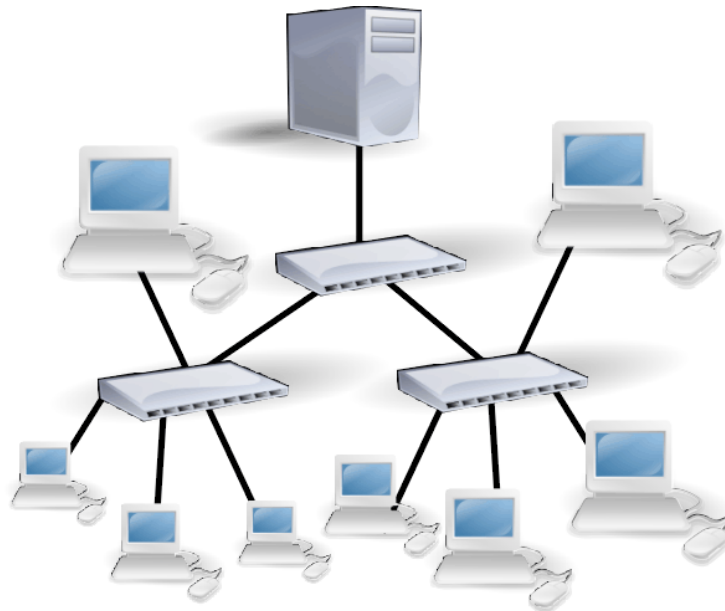
### The Future?


Where is the future of the Internet headed? Share your opinions in the comments section.

Other basic concepts: Intranet or Local Area Network, comparison with Internet.



A local area network (LAN) is a group of computers and associated devices that share a common communications line or wireless link. Typically, connected devices share the resources of a single processor or server within a small geographic area (for example, within an office building).



( by Dominio público, source: [http://commons.wikimedia.org/wiki/File:Topolox%C3%ADa\\_en\\_%C3%A1rbore.png](http://commons.wikimedia.org/wiki/File:Topolox%C3%ADa_en_%C3%A1rbore.png))

Internet is.... Another definition of Internet



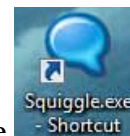
Reference: What is the Internet, <http://www.yourmaindomain.com/web-articles/what-is-internet.asp>. Copyright 1998 - 2008 www.yourmaindomain.com, All rights reserved.

## Lesson 4c: Instant Messaging and Chat Systems

Computer instant messaging is a very commonly used way people communicate, collaborate and interact with friends, workmates or classmates. It allows people to exchange any type of information. With instant messaging systems a person can communicate using text messages with someone in the other side of the world!

There are many instant messaging communications software; some of them allow voice and video communication as well. It can be used to send files to the person you are talking to, or just to talk with.

Since our computer lab does not have Internet access, we are going to use “Squiggle Messenger” which is a chat system for an **intranet** or **Local Area Network**. This program will allow you to communicate using text messages with another person across the room. Let’s Get started:



1. Start “Squiggle Messenger” by a double-click on the icon on the desktop

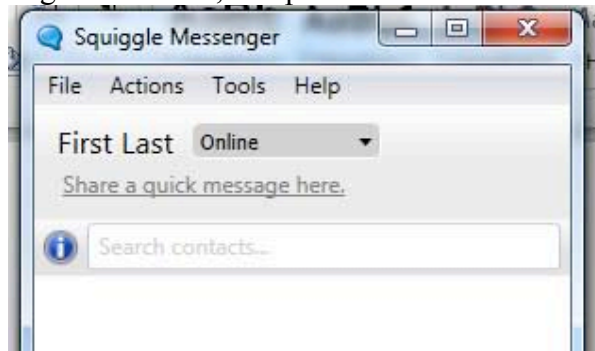
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2. The program will open; type your first name and your last name, and the name of the camp as shown below. Check that it is spelled correctly, otherwise your peer will not be able to find you on the network.



3. Press the button.

4. The chat window will open. On the “search contacts” section, type the name of the person that you are going to chat with, and press enter.



5. Introduce yourself, tell your name and share your hobbies and interests.

6. We will discuss the following topics:

- A. Topic one
- B. Topic two
- C. Topic three



---

## Software

- Tux Typing tutor, <http://sourceforge.net/projects/tuxtype/>
- Squiggle LAN chat, <http://squiggle.codeplex.com/>

## Further Reading

- Open Office Writer User Guide, Linuxtopia, 2006, [http://www.linuxtopia.org/online\\_books/office\\_guides/openoffice\\_writer\\_user\\_guide/index.html](http://www.linuxtopia.org/online_books/office_guides/openoffice_writer_user_guide/index.html). CC:BY.
- Writer (Word processing) tutorials, Tutorials for OpenOffice, 2008, [http://www.tutorialsforopenoffice.org/category\\_index/wordprocessing.html](http://www.tutorialsforopenoffice.org/category_index/wordprocessing.html). CC:BY.
- Reap the Benefits of Good Typing Skills By Courtnie Packer, <http://typing-tutor-review.toptenreviews.com/reap-the-benefits-of-good-typing-skills.html>
- The Importance Of Daily Typing Practice, <http://www.articledashboard.com/Article/The-Importance-Of-Daily-Typing-Practice/83385>
- Why is better typing productive for business and employees?, Typing Institute of America, <http://www.typinginstituteofamerica.org/how-you-benefit.html>
- Mr. Peralta's Media Lab, [http://www.emersonms.org/apps/pages/index.jsp?uREC\\_ID=50343&type=u&pREC\\_ID=307139](http://www.emersonms.org/apps/pages/index.jsp?uREC_ID=50343&type=u&pREC_ID=307139)
- Introduction to Computer Local Area Network (LAN) by Malik, 2010, <http://en.ridwanaz.com/3301/gadget/networking/articles-introduction-to-local-computer-network-lan-local-area-network/>.
- The History of the Internet in a Nutshell by Cameron Chapman, 2009, <http://sixrevisions.com/resources/the-history-of-the-internet-in-a-nutshell/>.
- Liberians hope long wait for the web is finally over by Bonnie Allen and Rob Hugh-Jones, <http://www.bbc.co.uk/news/world-africa-15692430>
- An Illustrated History of Computers - Part 4 by John Kopplin, 2002, <http://www.computersciencelab.com/ComputerHistory/HistoryPt4.htm>

## Videos

- How Computers Work - Journey Into The Walk-Through Computer, Computer History Museum, 1990, <http://www.youtube.com/watch?v=CoxQLJkLq1c>
- When Computers Changed the World from the Revolution Exhibition, Computer History Museum, 2011, <http://www.youtube.com/watch?v=aLg4MHyyqL0>

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## **Hands On Lab**

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## **Hands on Lab**

### **Course Objectives:**

To introduce students to the design process and allow them to practice basic science and math concepts through a Tractor Pull Competition.

### **Course Description:**

This lab will introduce students to the design process through basic experimentation. The students will learn basic science and math principles through practice and utilize them to design a final product. Students will be split into teams and each team will design and build a tractor that must pull a weight and perform work. The team with the best performing tractor will win.

### **Important Concepts:**

Students will be able to learn and apply the following concepts:

Force

Free Body Diagrams

Energy

Work

Friction

Mechanical Advantage

Pulleys

Simple Machines

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## Lesson 1: Introduction to Important Concepts

### Objective:

To become familiar with the concepts of Force, Free Body Diagram, Work, Friction, Simple Machines, and Mechanical Advantage.

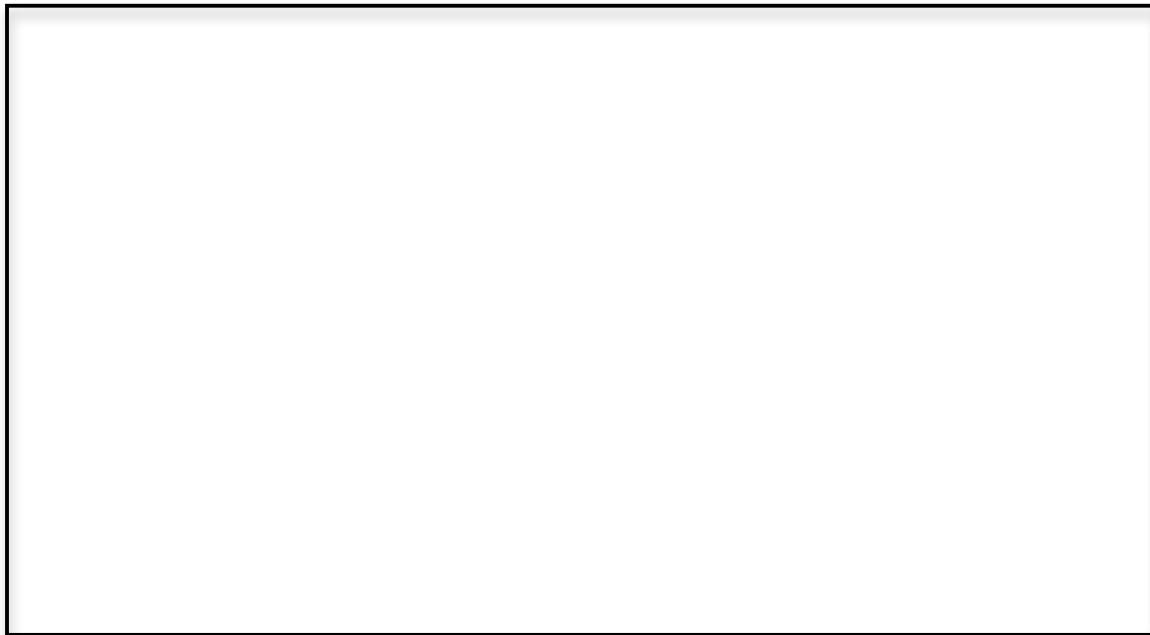
### Force

A force is kind of an abstract concept. Think of it as *something that acts on objects*. Forces have two characteristics: magnitude and direction. They are what are known as vectors. The magnitude of a force is how large it is. Its direction shows where the force is moving. We measure the magnitude of a force in Newtons (N). A Newton is the magnitude that a force needs to accelerate 1 kg at 1 m/s<sup>2</sup>. So 1 N = 1 kg\*m/s<sup>2</sup>.

Forces don't just appear. In fact they must be applied, or generated, by something as well. Right now there are at least two forces acting on you. Can you guess what they are?

Many things apply forces from obvious things like our muscles to seemingly impossible things like air! The forces exerted by air are key to allow planes to fly!

Can you come up with some examples of forces? What are their magnitudes and directions?



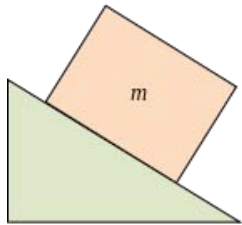
### Free Body Diagram

Now that you know what a force is you need to be able to think about forces in a more concrete way. This is important for both Engineering and Agriculturalists. A Free Body Diagram is a representation of an object and the forces acting on it. For example: imagine I am holding a

book on my hand. What are the forces acting on it? What direction are they going towards? A Free Body Diagram (FBD) tells us that information. A FBD can represent the object forces are acting on as a point and the forces as arrows. The arrows' length and direction correspond to the forces magnitudes and direction.

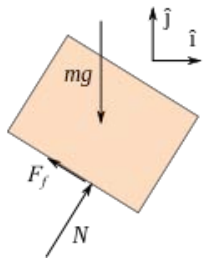
### *Example of a FBD*

A block on a ramp



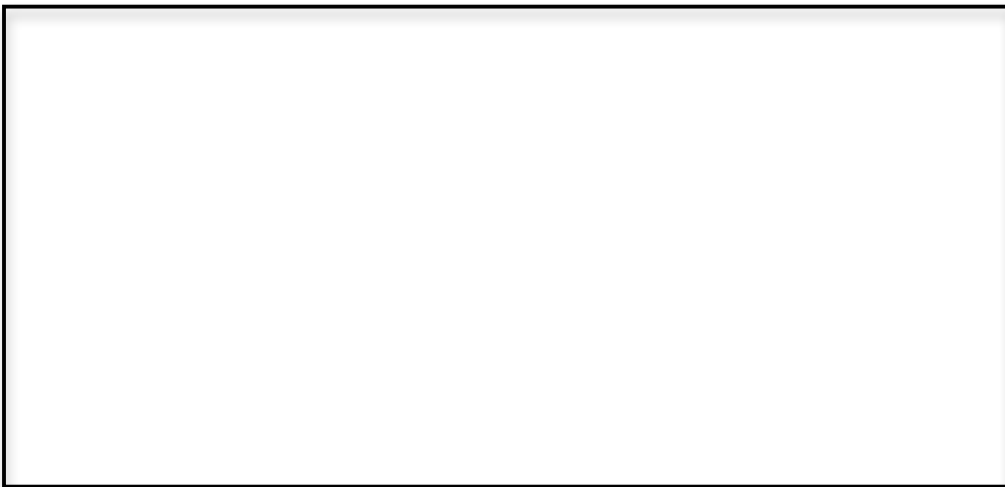
( by Andrew Dressel, source: [http://commons.wikimedia.org/wiki/File:Free\\_body\\_diagram.svg](http://commons.wikimedia.org/wiki/File:Free_body_diagram.svg) )

Free body diagram of just the block

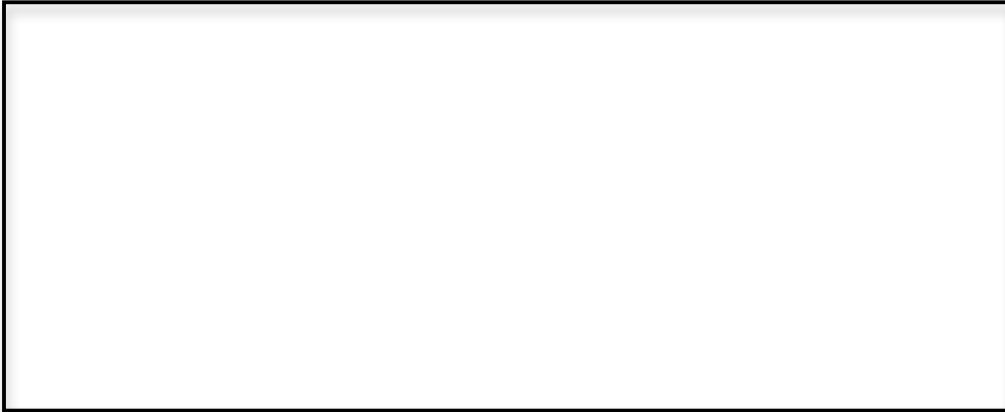


Now that we know how to draw free body diagrams (FDG) draw the forces acting on the following objects:

You sitting on a chair

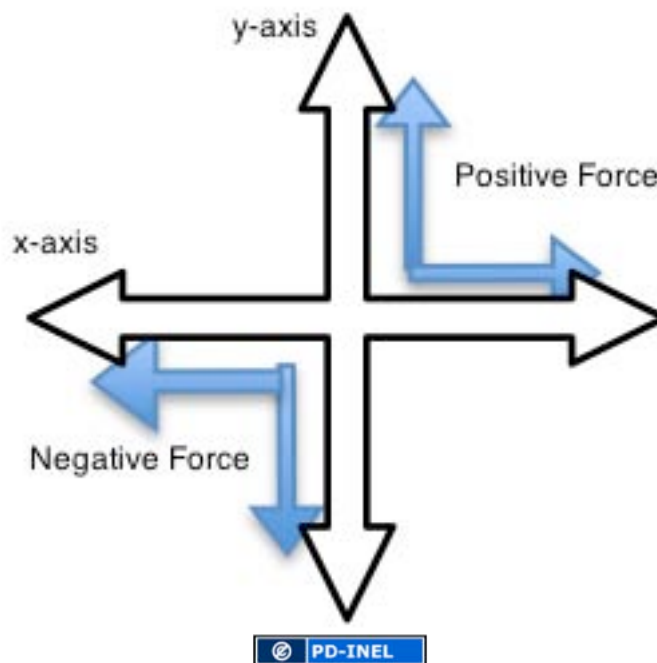


A dog being yanked by a leash but not moving

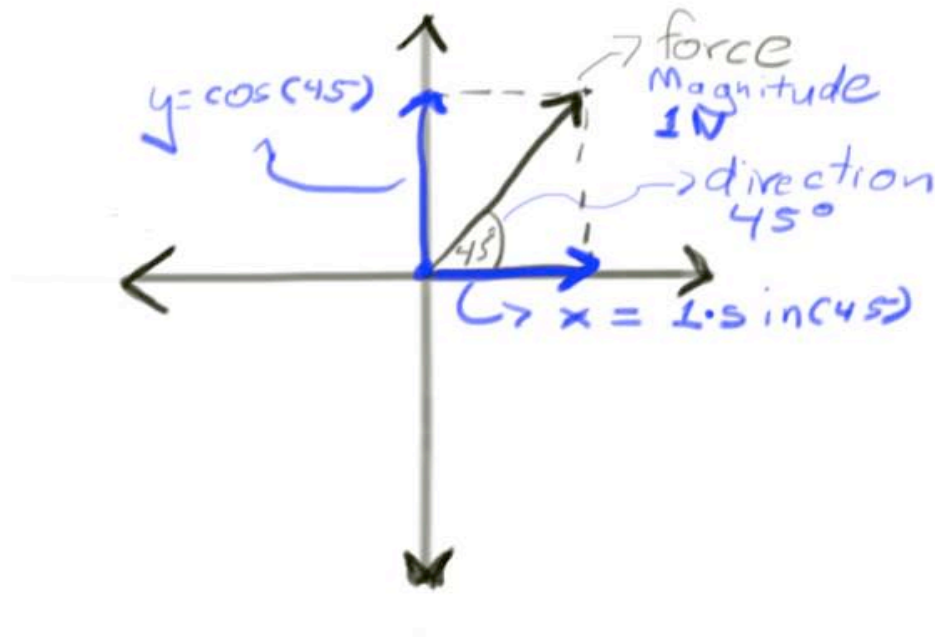


### Sign Convention:

We want to be able to calculate the magnitudes and effects of forces. To do that we need a convention on what their sign is. A convention is something we agree on. For example, altitude is generally described as being positive starting with zero at the level of the sea. This is arbitrary. We could just as well have defined altitude as being negative from the top of the atmosphere! Conventions make things easier for us to communicate with each other. By convention, forces are positive if their direction is in the positive x-axis or if they are going from left to right according to the observer. They are negative if they are going in the opposite direction. In the same way if forces are going in the direction of the positive y-axis, then they are considered positive. They are negative if they are going in the negative y-axis.

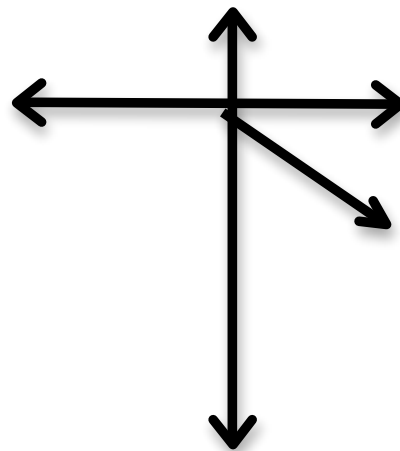
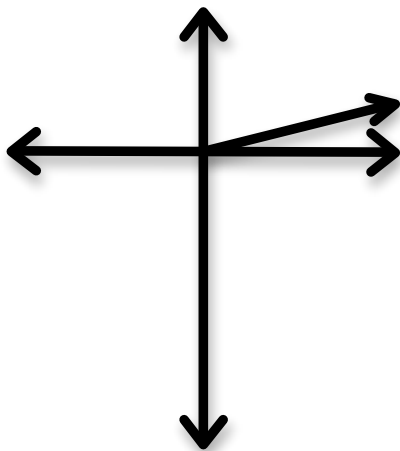


Of course, forces often don't point in the easiest direction. They may point at different angles. How can we deal with that so that we can make calculations? The answer is trigonometry! Every force can "decomposed" into its normal components, or the components pointing in the same direction as the x and y axis.



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Now, practice decomposing some forces:

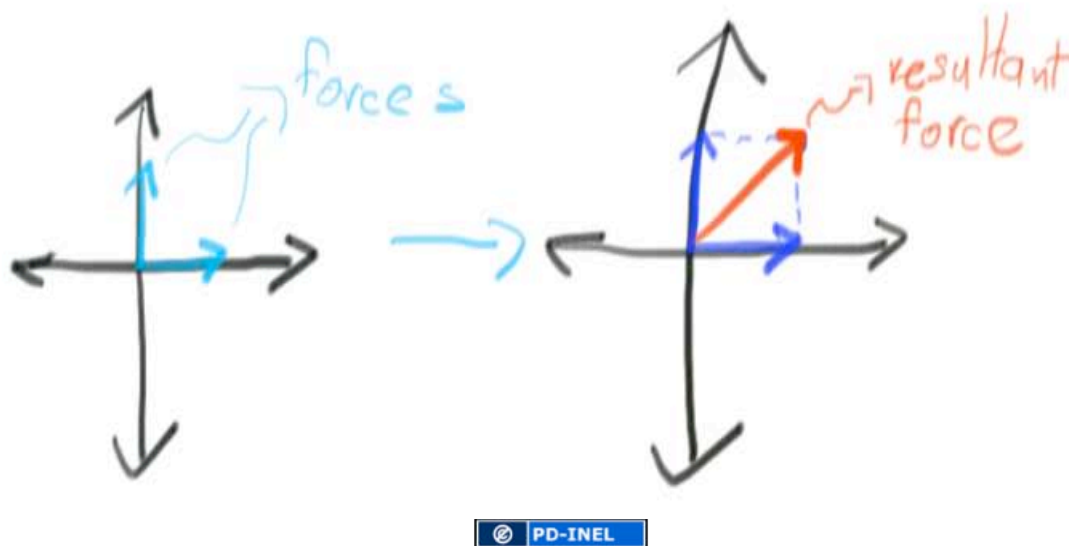


© PD-INEL

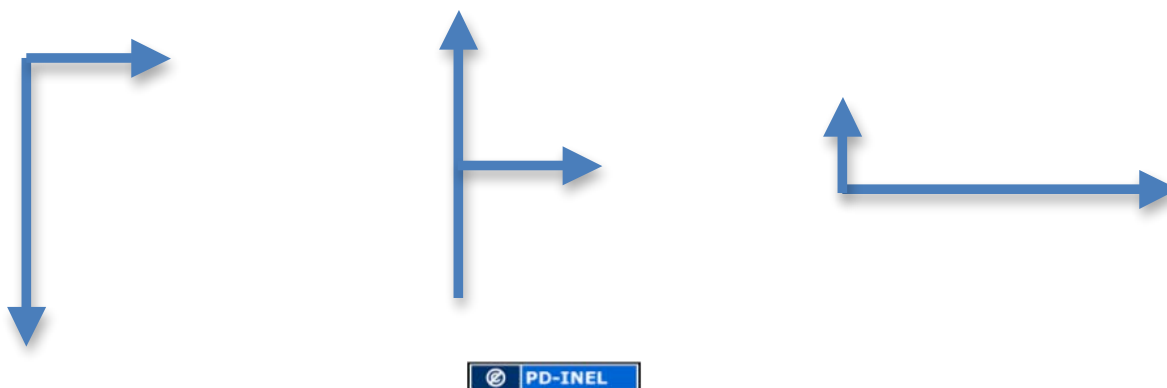




The same process can be done in reverse to determine a “resulting force”. A resulting force is the force with the magnitude and direction that you have if you put two or more forces together.



Draw the resulting force in the following figures:



### Work

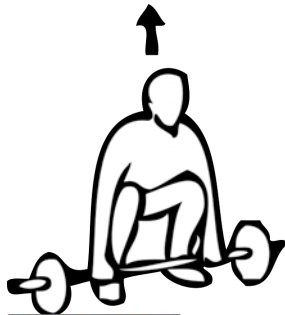
Work is a little more concrete than forces. You may think of work as things you do, like homework or cleaning. However, in physics, work is the result of a force acting over a particular distance. It is key that both things are present. You could have a huge force but if the object the force is acting on does not move then there is no work! Look at the following images and decide if there is work being done or not.



by Yutaka Kachi, source:  
<http://openclipart.org/detail/23624/bluema-n-108-by-anonymous-23624>



Source:  
<http://openclipart.org/detail/74761/man-push-by-aungkarns-74761>



PD-SELF

Source:

<http://pixabay.com/en/outline-bar-sport-recreation-25791/>

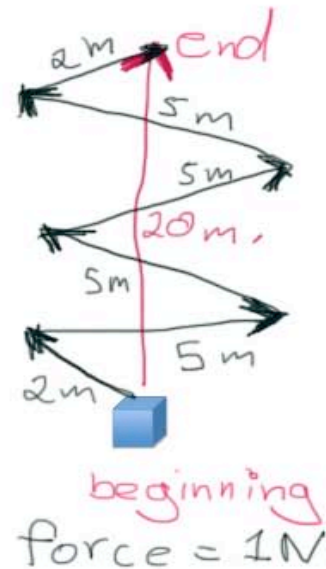
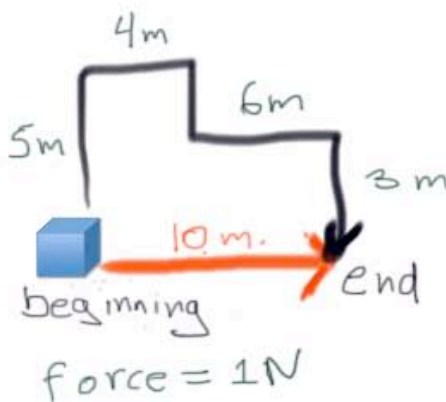


PD-SELF

Source:

<http://openclipart.org/detail/20044/paratrooper-chibi-by-wsnaccad>

We measure work in Nm or Joules (J). Work, unlike forces, is a scalar and it only has a magnitude. It does not have a direction. So, if you move a box in whatever direction for 10 meters, you still did positive work. (At least for now, we will consider this true, wait till you do thermodynamics!). In our example, let's say that you use a force of 1 N to move that box. That means you did 10 Nm of work or 10 J of work.



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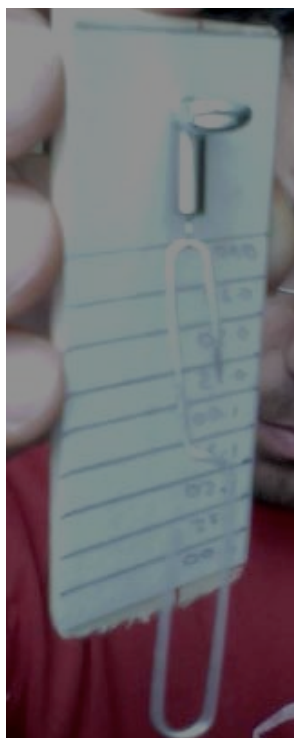
Work does not have a direction but it IS actually PATH dependent. That means you can move a box 10 meters horizontally but if you moved it in a particular path then the work done was actually more. Look at the following figures and determine what the work done was.

## Friction

Friction is a very important force. As a matter of fact, it touches almost everything we do! One reason you can walk is because of friction. Friction is also very interesting because it depends on two surfaces rubbing on each other. The magnitude of friction is dependent on the nature of the two surfaces you are rubbing together.

Another thing that makes friction interesting is that there are two types. When an object is sitting still the force required to make it move is actually **HIGHER** than the force required to keep that same object moving once it has started to move.

Finally, friction also depends on how much weight is resting on the object. For example, if you were trying to slide a chair



along a tile floor you will need little force. But if you sat somebody on the chair and tried to slide the chair across the

Material A	Material B	Weight	Static Friction	Kinetic Friction
Glass	Glass			
Glass	Glass			
Glass	Wood			
Glass	Wood			
Glass	Rubber			
Glass	Rubber			
Rubber	Wood			
Rubber	Wood			

floor, you would need a lot higher force to move it.

You will now conduct a series of experiments to see how this is true. We will use a simple gauge to measure a force. You will then use it to pull objects made of different materials over different surfaces. Record your results in the table below.



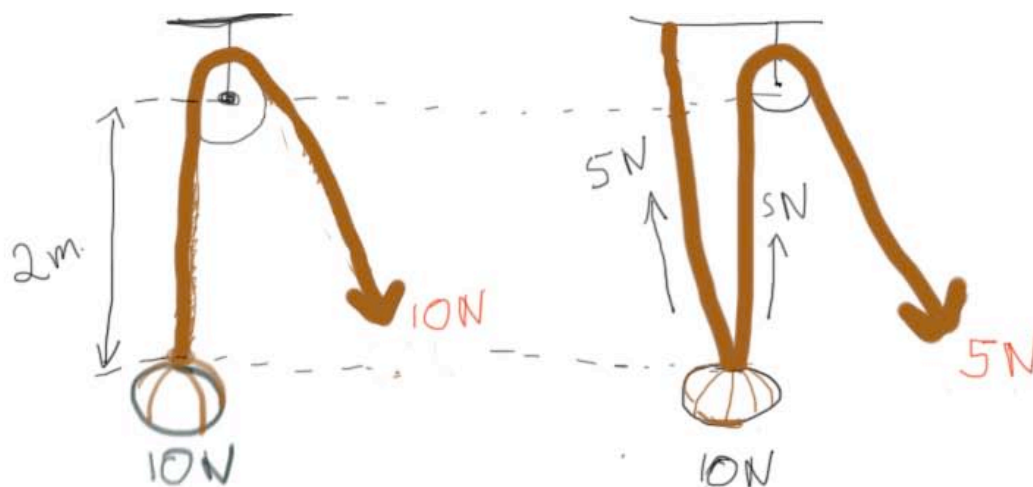
Photo taken by University of Michigan

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## Simple Machines and Mechanical Advantage

As you saw, forces can do work. A small force can only do small work, right? No! Small forces can do a lot of work. Remember that work depends on distance. So a small force acting over a long distance can do a lot of work. However, how can we get a small force to do a specific task that requires a large force? The answer is in something called “Simple Machines.”

Simple Machines allow us to use a smaller force to do the amount of work that would have required a larger force. For example, look at the picture below of a rock weighing 10 N and a rope moving it 2 meters up. This would mean 20 Nm of work and we would have to use a force of 10 N. However, the picture on the right uses a simple machine called a pulley. Using this machine you achieve the same amount of work using a force of only 5 N! That is half the force!



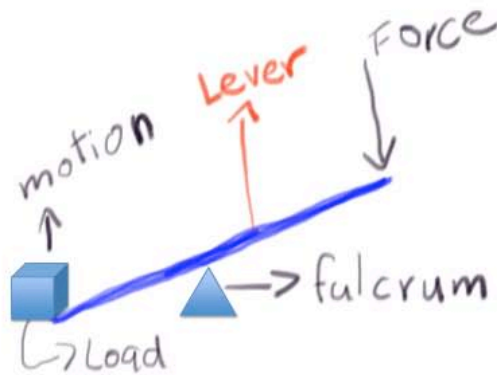
There are 6 types of simple machines: levers, incline planes, wedges, screws, pulleys, and wheel and axles. These great inventions allow us to exert much less force to achieve the same amount of work. But wait, how can that be? Isn't work dependent on the magnitude of the force and the distance it acts on it? If you decrease the force then... Yep! Somehow the smaller force has to act through a larger distance for these machines to work. The reason the simple machines are so important is because of the ingenious ways in which they increase the distance for the force to act on. And on top of that, they allow us to apply forces in more comfortable ways so we can be more effective. In other words they change the direction of the force as well. Let's visit them one by one.

### Levers:

Levers are basically a bar that can be used to increase the force that you produce. There are three types of levers, but they all have a fulcrum, a load and an effort. The basic idea is that you use a fulcrum to transfer the effort or force you put in so that it will increase the force delivered to the load. Some examples of levers are a crow bar, wheelbarrow, scissors, nutcracker, nail clippers, and a seesaw.

*Type 1:*

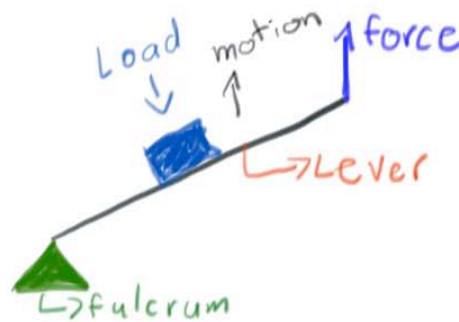
In a type 1 lever the load rests at one end, the fulcrum in the middle and the load is applied to the other end.



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*Type 2:*

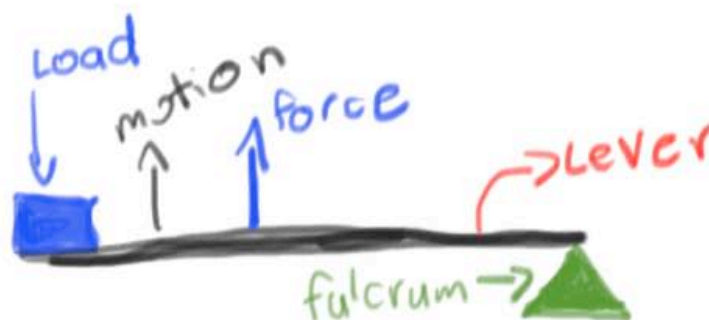
In a type 2 lever the fulcrum rests at one end of the lever while the force is applied at the other end and the load rests in the middle.



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*Type 3:*

Type 3 levers have the load at one side the fulcrum at the other and the force is applied in the middle.



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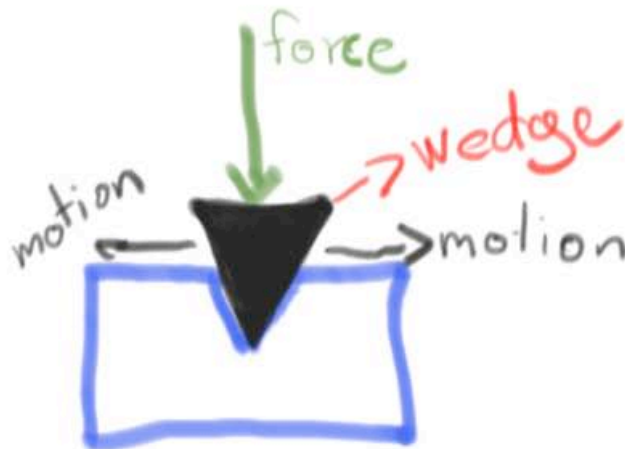
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**Incline Planes:**

Inclined planes are flat surfaces that allow us to move objects up or down with ease. Some examples of inclined planes are loading ramps, roads and tailgates.

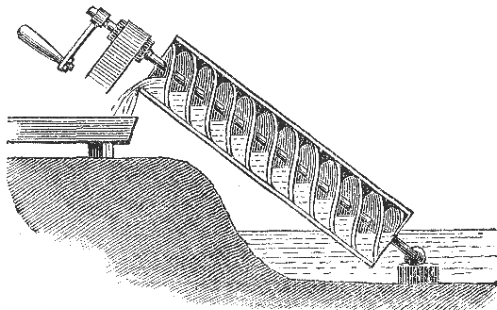
**Wedges:**

Wedges allow you to push apart two objects or loads. They can also be used to hold objects in place or to break through surfaces. The wedge increases the distance between the objects through the translation of a perpendicular force. Some examples of wedges are nails, chisels, and knives.



## Screws:

Screws can be thought of as a bent incline plane. Screws can be used to translate a rotational force to a perpendicular force. Because of this they can be used to insert objects onto others or to move objects from one place to another.



Archimedean Screw.



Source:

[http://commons.wikimedia.org/wiki/File:Chambers\\_1908\\_Archimedean\\_Screw.png](http://commons.wikimedia.org/wiki/File:Chambers_1908_Archimedean_Screw.png)

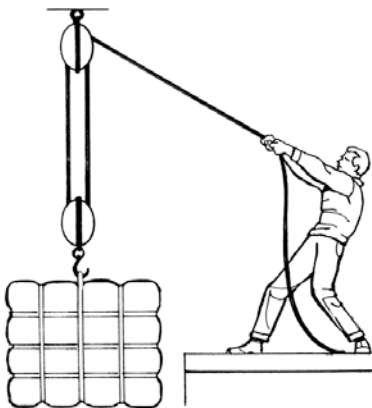


“Drive Screw” Source:

<http://openclipart.org/detail/12324/wood-screw---blue-by-rfc1394>

## Pulleys:

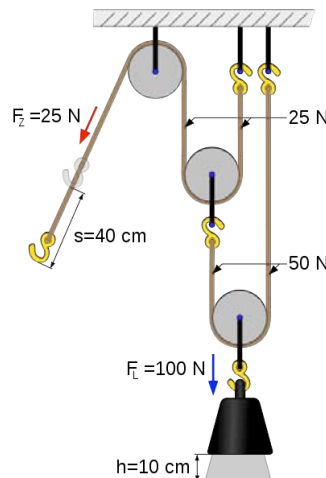
Pulleys are usually circular pieces that rotate around a center axle or eye. They usually have a rope or other tension device (chain, thread, belt) that is used to change the direction of the force applied and/or increase the force applied. Pulleys allow us to pick up things or even move them across large spans laterally with very little effort. One of the most exciting uses of pulleys is in high angle rescue. Rescuers sometimes use sets of pulleys and ropes to extract injured people off the face of rocks, bottom of wells, or even the ocean.



“Block and Tackle” by

Pearson Scott Foresman, source:

[http://commons.wikimedia.org/wiki/File:Block\\_and\\_tackle\\_%28PSF%29.png](http://commons.wikimedia.org/wiki/File:Block_and_tackle_%28PSF%29.png)



“Movable Pulleys” Source:

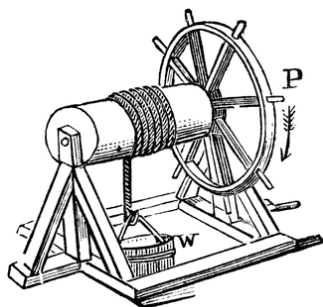
[http://commons.wikimedia.org/wiki/File:Power\\_pulley.svg](http://commons.wikimedia.org/wiki/File:Power_pulley.svg)



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## Wheel and axles:

Wheels and axles allow us to move things reducing the friction required to slide them. This machine can also help us move things vertically as in a wheel and axle used to lift a bucket from a well.




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“Wheel and Axle to Lift Bucket”

Published before Jan.1, 1923. Source:

[http://commons.wikimedia.org/wiki/File:Wheelaxle  
\\_quackenbos.gif](http://commons.wikimedia.org/wiki/File:Wheelaxle_quackenbos.gif)



 BY

“Wheel and Axle to Move Forward” by  
Clem Rutter, Rochester, Kent, source:

[http://commons.wikimedia.org/wiki/File:Higgins\\_3503.J  
PG](http://commons.wikimedia.org/wiki/File:Higgins_3503.JPG)

Simple machines allow us to use smaller forces. The ratio of the original force to the force you utilize is what is called the Mechanical Advantage. For example if you cut your force by half, then the machine is said to give you a 2:1 advantage. If you cut your force by 3 it is said to give you a 3:1 advantage.

There is an ideal mechanical advantage that is defined by the properties of the idealized design of the simple machines. However, in real life we often experience losses of energy to friction and other phenomena. Because of that we have an Actual Mechanical Advantage (AMA). The AMA can be calculated by measuring the force that was applied to the machine. We can then divide the actual load by the force applied.

We will experiment with a couple of different machines. You will then calculate the AMA based on the loads you are given. You will be split into teams for this exercise. Your team will rotate through the machines until you have conducted all the experiments.

Record your results in the table provided. You can see instructions and images of the experiments below.

Experiment	Load	Force Used	AMA
Lever			
Pulley			
Incline Plane			

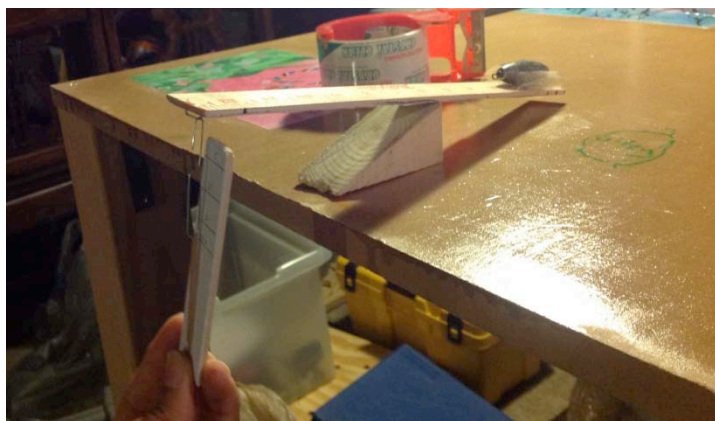
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## Experiments

The following experiments are pretty simple. They will show you how the mechanical advantage of simple machines reduces the force required to perform a task. You will need the same gauge you used for the friction experiment earlier. Your instructor will help you set up the experiments. With your group start at one experiment and rotate around the stations to get the data you need.

### Levers:

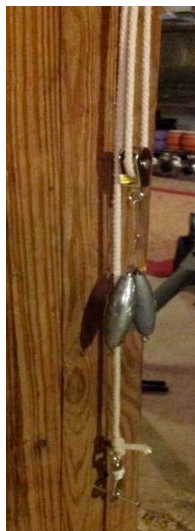
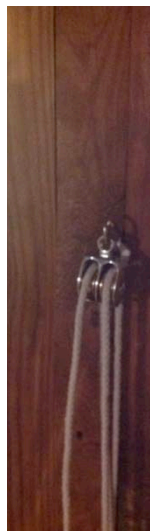
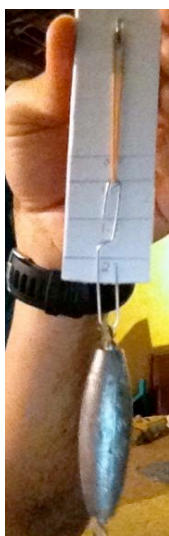
With your gauge determine the force it takes to lift the load provided. Then place the load on a lever (Type 1). You may need to use some tape to keep the load in place. Now measure the force it takes to lift the load. Record your results in the table above.



Photos taken by University of Michigan

### Pulleys:

Using your gauge measure the load you will be picking up with the pulley. Then attach the load to the pulley system. Now measure the force it takes to lift the load using the pulley system. Record your results in the table above.



 Photos taken by University of Michigan

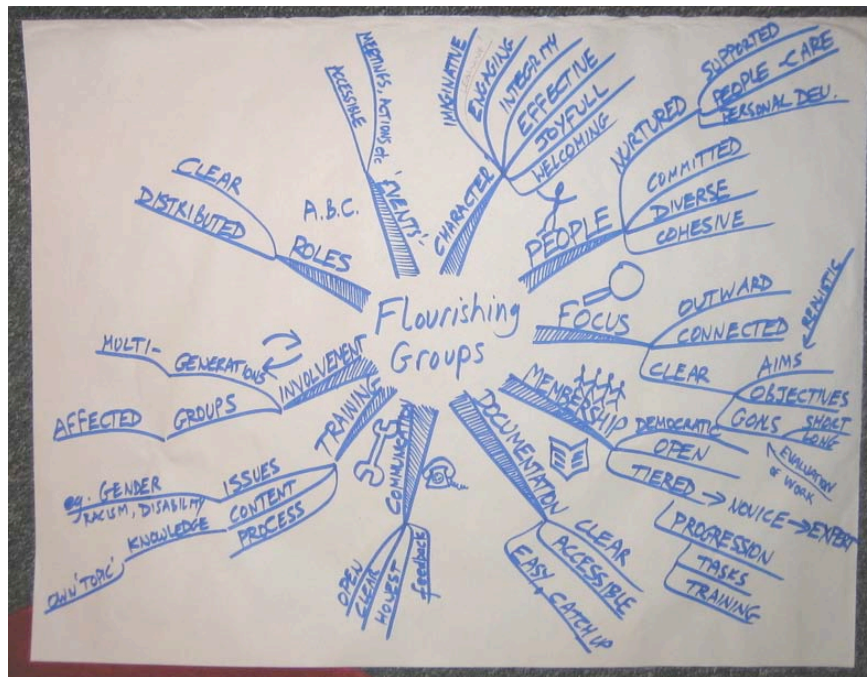
### **Incline Plane:**

Using the your gauge measure the load you are supposed to move. Notice that for the incline plane experiment you are trying to raise the load to a certain level and not necessarily move it in the horizontal direction. Using the incline plane set up measure the force it takes to move the load. Record your results in the table above.



 Photos taken by University of Michigan

## Lesson 2: Brainstorming and Design



by Leeds Tidal, source:

<http://www.flickr.com/photos/30296430@N03/5156113247/sizes/l/in/photostream/>

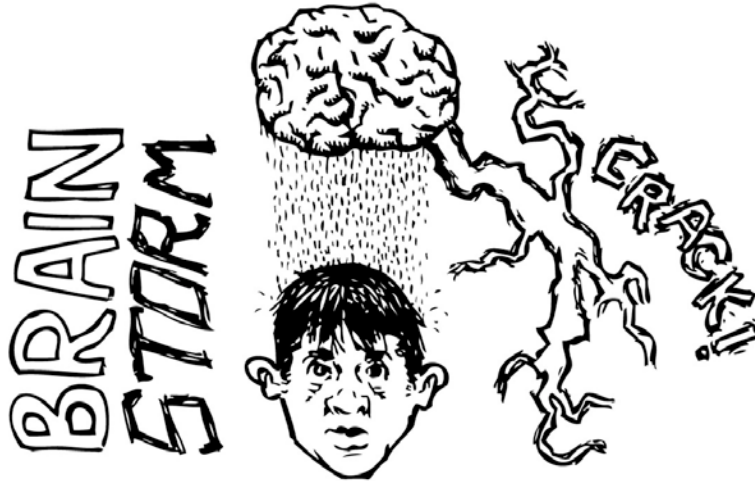
### Objective:

To introduce the students to the brainstorming and design process

### Outline:

- What is Brainstorming?
- Why is Brainstorming good?
- Brainstorming Techniques
- Brainstorming rules





by Ariel Dovas, source: <http://www.flickr.com/photos/eviloars/2926037204/>

**Class Discussion:** What is brainstorming?

Brainstorming Definition:

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\_\_\_\_\_. The term was popularized by [Alex Faickney Osborn](#) in the 1953 book *Applied Imagination*. Osborn claimed that brainstorming was more effective than individuals working alone in generating ideas.

Or to put it simply, brainstorming is the \_\_\_\_\_.

**Class Discussion:** Why is it called brainstorming?

**Class Discussion:** Why is brainstorming useful?

(Removed paragraphs, all-rights-reserved by Infinite Innovations Ltd., accessible at: <http://www.brainstorming.co.uk/tutorials/benefitsofbrainstorming.html>)

**What is achieved throughout brainstorming?**

- \_\_\_\_\_
- \_\_\_\_\_

- 
- \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_

For Business and companies better brainstorming means better ideas leading to:

- More money
- Faster promotion
- Increased creativity
- Better society
- More pleasant working environment
- Better employee relations
- A more responsive company
- Taking advantages of gaps in the market
- Creating new markets
- New products and services
- Better products and services
- Better management
- Less conflicts and arguments
- Improvements in productivity and reliability

### Brainstorming Rules:



Reference: Rules of Brainstorming,  
<http://www.brainstorming.co.uk/tutorials/brainstormingrules.html>. Copyright 1997-2011 Infinite Innovations Ltd. All rights reserved.)



Reference: Benefits of Brainstorming,  
<http://www.brainstorming.co.uk/tutorials/benefitsofbrainstorming.html>. Copyright 1997-2011 Infinite Innovations Ltd. All rights reserved.)

### Size of the brainstorming group:

\_\_\_\_\_ people: Perfect size for brainstorming. All participants can sit in a circle and feel equally involved in the session, while a facilitator guides the process and writes down the contributed ideas. In order for all ideas to be kept, participants should have a notepad to write down their ideas, in case another participant is talking or the facilitator is writing an idea on the main board.

\_\_\_\_\_ people: A smaller group will be easier to manage, but there may be less ideas to keep the session rolling. Participants should be seated around a smaller table, and contribution may be greater for each individual.

\_\_\_\_\_ people: A larger group makes it much more difficult to arrange everyone in a circle while still allowing them to feel included. In this case, theatrical-type seating may be more beneficial, and each participant should be required to write their ideas down on a notepad. Once the session is over, the ideas can be turned in to the facilitator and presented to the entire group,

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either anonymously or by identifying the contributor.

**Class Activity:** Brainstorming Session

Let us all practice some brainstorming now. We can identify a problem, such as what properties are required in a boat, and then brainstorm ideas together. Another example that we can brainstorm is the benefits of recycling. Can you guys think of why recycling is useful?

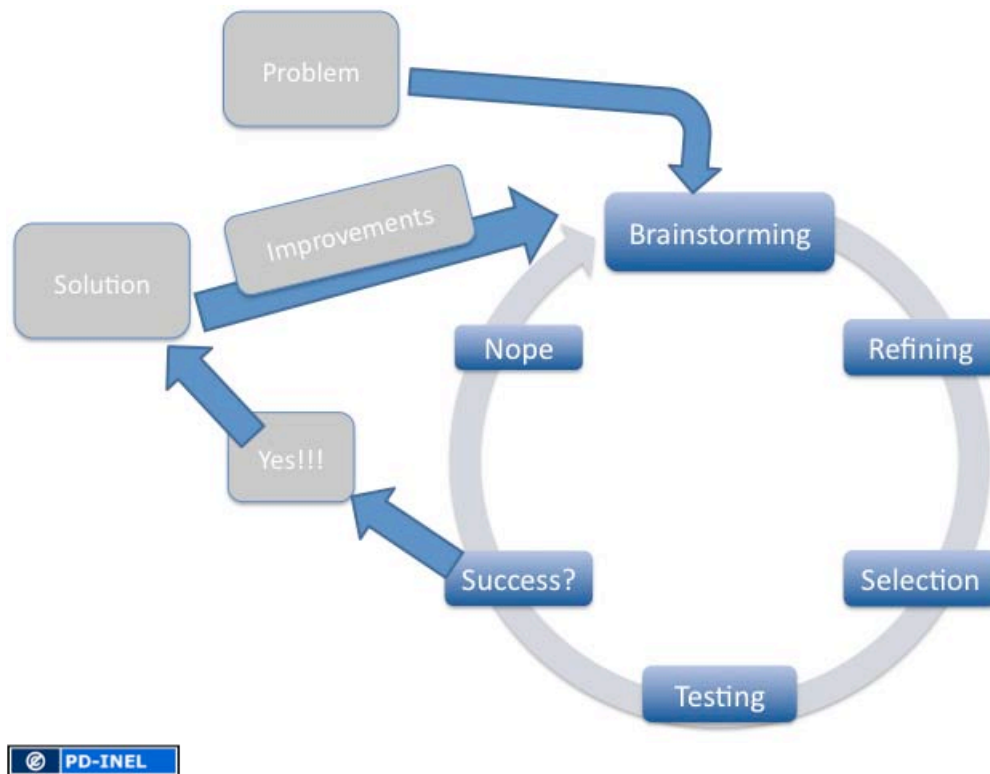
**Group Activity:** Brainstorming Session

Now let's divide into groups, and try brainstorming amongst ourselves. Try to brainstorm answers to the following questions, and make sure each student writes all answers done. Remember, it's quantity, not quality at this stage.

- What properties would a tractor require?
- What physics principles would be used in the design of a tractor?
- How would you design a tractor out of raw materials?

**Design Process**

Coming up with ideas is not enough to solve a problem. We must find one that actually works. This is what we call the design process. Brainstorming is key to this process since it allows us to have ideas to start with. The design process is iterative. That means you may need to go through the process over and over again until you find an acceptable solution. The following figure illustrates the process.



## Lesson 3: Material Presentation and Competition Rules and Building Time

### Objective:

To allow the students to understand the materials they will be working with and their options for their use.

To present the rules for the Tractor Pull Competition and the use of building equipment and materials.

### Tractor Pull Competition Rules

For the competition you will be working in your teams. Each team will receive the same access to materials and tools. However, you do not need to use all the materials if you do not want to.

1. Your team must create a machine that we will call a tractor.
2. Your tractor must be able to move a load vertically.
3. The load will be attached to a pulley system so that your tractor can move horizontally while lifting the load.



- 
4. There will be a testing rig provided by your instructors.
  5. The testing rig will consist of the pulley system, the load and a track for your tractor.
  6. Your machine cannot attach itself to any part of the rig other than the provided chain ring.
  7. Your team will be able to examine the testing rig before the competition.
  8. Your team will be able to perform at least two test runs on the rig.
  9. Once competition starts each team will be given three attempts at moving the load.
  10. To begin your attempt you must prepare your tractor, attach it to the chain ring, and place it on the starting line.
  11. On the signal you must let go completely of the tractor and not provide forward motion to it.
  12. The instructor will measure how far the load has moved vertically on the rig.
  13. The final reading will be made after the forward momentum of your tractor has stopped (if your tractor begins to slide back it will not count against you).
  14. The best of the three attempts will be your final score.
  15. You will be allowed to place ballast weight on your tractor. The instructor will provide the weight.
  16. Your tractor will be taken to central offices after the competition.

#### **Material List**

You will receive a series of materials. Each team will receive the same initial amount of each material. You may request additional materials but may not receive them if supplies have run out. The additional materials will be given on a first come first served basis. Instructors may deny your request if they deem that you are wasting materials.

Materials you will receive are:

- Wheels and axle
- Towing rig or ring
- Cardboard
- Plastic bottle
- Rubber bands
- Sand paper
- Nails
- Staples
- Duck tape
- Scotch tape
- Twine

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## Lesson 4: Building Time

### **Objective:**

To allow students time to ask questions of the instructors about their design and receive help with the building process.

### **GLOSSARY**

Force: An influence that causes an object to move or change in form.

Free Body Diagrams: a way to represent the forces acting on a body.

Energy: the ability to do work.

Work: A force acting on an object over a distance. It is measured in  $\text{N}\cdot\text{m}$  or J.

Friction: A special force that acts on objects resisting their movement at contact points.

Mechanical Advantage: The ability of a simple machine to reduce the force required to perform a task.

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Simple Machines: Six instruments that were recognized during the renaissance as capable of reducing the force needed to perform a task. The six simple machines are levers, incline planes, wedges, screws, pulleys, and wheels and axles.

Brain Storming: A process that can be used to generate ideas and possible solutions to a problem.

Design Process: A series of steps used to come up with a desired solution for a problem.

## **Life Skills**

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## Lesson 1: The Importance of Teamwork

**Objectives:** Students will continue to develop – here more intentionally – their skills as colleagues and classmates working together towards a common goal.

### Lesson:

#### I. Teamwork, Team Building, Group Development, and Group Dynamic

*Coming together is a beginning.*

*Keeping together is progress.*

*Working together is success.*

- Henry Ford

A team is a group of people who come together temporarily to achieve a \_\_\_\_\_  
\_\_\_\_\_

There is no magic formula for "building a team" because teams are organic - they \_\_\_\_\_  
and \_\_\_\_\_

By studying how individuals, groups and teams work you will enhance your \_\_\_\_\_  
of helping teams learn how to work together \_\_\_\_\_. Improving teams  
usually requires a combination of improving \_\_\_\_\_, \_\_\_\_\_ of  
others, \_\_\_\_\_ and negotiation skills, and \_\_\_\_\_  
skills. Experiential learning offers a rich framework and methodology for real-life and real-  
situation development of teamwork.

Team building is tied to \_\_\_\_\_ -- team development  
requires individual team members to \_\_\_\_\_ and \_\_\_\_\_ -- as an  
individual's personal growth unfolds, so too does their \_\_\_\_\_ to participate  
in and thrive in group situations.

The closer the correspondence between \_\_\_\_\_ goals and \_\_\_\_\_ goals,  
the greater the sum of individual motivations for \_\_\_\_\_.

Team building is not easy, but there are several techniques, principles and methods which  
can make a real difference, including:

### Stages of Group Development

Bruce Tuckman (1965) developed a 5-stage model of group development:

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1. \_\_\_\_\_: The group comes together and gets to initially know one other and form as a group.

2. \_\_\_\_\_: A chaotic vying for leadership and trialing of group processes.

3. \_\_\_\_\_: Eventually agreement is reached on how the group operates (norming)

4. \_\_\_\_\_: The group practices its craft and becomes effective in meeting its objectives.

5. \_\_\_\_\_: The process of "unforming" the group, that is, letting go of the group structure and moving on.

### **Group Dynamics**

1. **Group development** - How does a groups' pattern of behavior evolve and change over time?

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2. **Group size** - Does the size of the group matter? How do the experiences of a group of 3 differ from a group of 30 from a group of 300 or 3000?

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3. **Risky shift** - Do people tend to take risks in groups that they would be less likely to take alone? How so?

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4. **Social support** - How important is fostering social support within personal development groups? What ingredients need to be combined with social support to effectively facilitate personal and group growth and development? e.g., Growth = Challenge + Support

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5. **Group games & activities** - What kinds of games and activities can be used to help people get to know one another and develop their interrelationships?

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6. **Group mix** - What is the effect of having groups consisting of people from one ethnicity compared to groups which are multi-ethnic? Is it better to create groups with diverse (heterogenous) or narrow (homogenous) membership?

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7. **Group norms** - What kinds of group norms evolve? What role does the facilitator play in the formation of group norms? What kinds of group norms should be established? (e.g., through a group contract and organizational culture) In what kinds of situations should a participant be excluded from a group?

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Group dynamics can be brazenly characterized as explosively positive, dull/neutral, or explosively negative. So watch out if you're going to tinker with groups -- anything can and usually does happen. The more experience you have the better, but experience is no cause for complacency or conceit, since every group situation is unique.

## II. Game Time!

See teachers for further instructions ☺

## III. Discussion

In small groups discuss the following questions about the activities:

1. What links exist between the teamwork activities and how they relate to skills for college courses or employment?

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2. What are some examples of other activities that may help others learn to be ready for teamwork?

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3. What problems can happen in a team setting if someone lacks the skills needed to get along with the team?

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4. Overall, how did you feel during the blindfold game? How well did your partner guide you? How well did you guide your partner?

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5. How can you carry on your team building skills throughout everyday activities? At school? At home? During sports? Doing chores?

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## Lesson 2: The Importance of College and the Application Process

**Objective:** Students will understand why and how a college education is important to obtain. They will review the admissions requirements of a few Liberian colleges, as well as practice filling out a college application.

**Lesson:**

**I. As a group, answer the following questions. As answers are given, write down the ones that are most important for you on the following lines.**

a. Why should I go to college?

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b. What are the benefits of going to college?

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c. What are the drawbacks?

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d. How can I overcome these drawbacks?

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## **II. Admissions Requirements for Various Colleges:**

### **Cuttington University:**

- \$20 application fee
- Must have at least a 2.00 cumulative High School GPA
- Required Units:
- English: 4 Units
- Math: 3 Units (2 years of Algebra and 1 year of Plane Geometry)
- Social Science: 3 Units
- Entrance Exam
- WAEC Certificate
- High School diploma
- Two letters of recommendation from his/her previous school and community, church or mosque
- Two passport size photos
- Application letter
- Health certificate from the University's Clinic

### **University of Liberia:**

- Autobiography a page or two
- Health Certificate
- Two letters of recommendation (one from a church or community)
- High School Diploma
- Transcript
- WAEC Certificate
- Application form that you pick up at the university
- Two photos
- Entrance Exam
- \$25-\$30
- 

### **Tubman University:**

- High School transcript (showing evidence of graduation)
- WAEC Certificate with (copy of scores)
- Recommendation
- Three passport size photos
- Health Certificate
- Birth Certificate
- Autobiography
- Placement Test for Math and Language Arts

### **Stella Maris Polytechnic:**

- Entrance Exam
- Interview at Mother Patern College of Health Sciences

- 
- WAEC Certificate
  - High School Transcript and Diploma
  - Two letters of recommendation
  - One from last attended school
  - One from pastor, parish priest or Imam
  - Two passport size photos
  - Application Letter

**Answer the following questions about how you can prepare for college:**

- a. What am I going to do to prepare for an entrance exam and/or placement tests?

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- b. When and where am I going to take the WAEC?

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- c. How am I going to obtain my High School diploma and transcripts?

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- a. Do I have the GPA I need to apply to my college of choice?

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- d. What is a letter of recommendation?

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- a. Who can I ask to write a letter of recommendation?

- i. School faculty:

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ii. Community members:

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iii. Church/mosque members:

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b. Are there inappropriate ways of seeking recommendation letters? How do you ensure you maintain your own sense of self-respect and character in the face of the challenges of a strong application?

e. Where can I obtain passport size photos?

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f. Have I taken the right amount of units required for my college of choice?

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a. What other units do I still need?

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g. How do I plan on paying for college?

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### III. Filling out a College Application

Look over this application and fill out only the forms titled PLACEMENT TEST REGISTRATION FORM and ADMISSION APPLICATION. The rest are just for your viewing to give you an idea of what types of forms you may be required to fill out. Be sure to use legible handwriting and if you have any questions, please ask.

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## Lesson 3: General Placement Tests

**Objectives:** Students will gain understanding about placement and standardized tests, including what they mean, how they are structured, and why they are important. They will also learn practical tips for successfully completing a standardized test. Finally, students will be given the opportunity to put those tips to use in a short, mock exam.

### I. The WAEC Exam

- Exams take place May/June or November/December
- Students must provide pencils, math sets, etc. unless the school provides them.
- Answers must be written in pen and ink, pencils are allowed only for diagrams and objective answers.
- Simple calculators are allowed.

More details about the Exam is available at: <http://www.liberiawaec.org/lshsce.html>

### II. General Test Taking Tips: Preparations:

Study concepts you do not know or understand and review concepts you do understand every day leading up to the exam:

- Math concepts:
  - Algebra, geometry, statistics, etc.
- Language concepts:
  - Writing formal letters, writing an article, writing an effective argument
  - Mastery of the English language
- Science concepts:
  - Biology: balancing equations, definitions
  - Physics: force, viscosity, speed of electrons, collisions
  - Chemistry: atomic numbers, states of matter, equilibrium, different laws
- Social Science concepts:
  - Geography: topographical maps, graphs, definitions, earth science
  - Economics: total revenue calculations, ratios
  - History

**Answer the following questions:**

- a. In which areas am I most familiar?

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- b. In which areas do I still need to improve?

- 
- 
- 
- c. How am I going to make sure I do my best in all areas?
- 
- 

**Day before the exam:**

- Review concepts
- Set everything out to take with you to the exam. This includes packing a bag of test-taking necessities (e.g. pens, pencils, scrap paper, calculator, etc.), even the clothes you are going to wear to the test. This way, you won't have to scramble around looking for everything the day of the test.
- Get a good night's rest! Relax before you hit the sack and don't cram for the test before you go to bed. If you have studied well in the days and weeks preceding the exam, you should be able to rest well, being confident that you have prepared the best you could.

**Morning of the exam:**

- Eat breakfast- especially a high protein/high carbohydrate meal (e.g. eggs and toast, meat and a fruit). This will fuel your body and your brain to stay as alert and active during the exam as much as they can. Besides, there is nothing worse than trying to focus on something important when your stomach is growling.
- Fill up a water bottle and take it with you to stay hydrated during the exam. If possible, take a small snack to munch on during breaks. This will help stave off hunger during the exam.
- Leave with enough time to get to the exam 20 minutes early. When you arrive at the exam site, take a walk around and become familiar with the place. Seek out restrooms, drinking fountains, etc. so you do not waste valuable time looking for them. If possible, find a seat in the exam room farthest from any possible distractions so you can focus on your own exam and not what is happening outside the window or what your fellow test-takers are doing.

**During the exam:**

- Read all the directions and make sure you understand what is being asked. If you are unsure of any directions, ask for assistance and clarification.
- Relax! You were made for this moment and, with all your preparation, you will do fine.

- 
- Pace yourself. Don't rush through the questions to be the first one done, but don't linger longer than you have to on any one question. If a question is too difficult or time consuming at the moment, skip it and come back if there is time. Use all the time allotted for the test.
  - Determine how much time you can spend on each question. For example, if you have 60 minutes to complete 120 questions, you should only spend 30 seconds on each question. However, if there are several questions you know the answer to right away, then you can use those extra seconds to answer more difficult questions.
  - Relax your hand, neck, shoulders and back. Every so often, take a break to pull your shoulders back, take a deep breathe, and shake out your hand.
  - Write as neatly as you can and fill out bubble sheets as neatly as possible.
  - Double check your question numbers every few questions to make sure you are answering the right question on the right line.

**For multiple choice questions:**

- Read the whole question and **all** the answer choices before you mark anything. Make sure you understand what the question is asking and if you do not understand any directions, **ask** for help.
- Try to answer every question. Make the most educated guesses that you can.
- Think about what you know concerning the question. Use prior knowledge to your advantage.
- Eliminate answers you know are obviously wrong. This narrows down your choices and can really help you make a better choice
  - Beware of answer choices using qualifiers (e.g. always, never, often, sometimes). Generally, if a statement has a general qualifier (often, sometimes, probably) it is true. If the statement has an absolute qualifier (always, never, everyone, no one) there is a good chance the statement is false.
- If a statement gives a reason (e.g. because, due to, since) it is most likely false.
- When you have reached the end of the section, go back through and make sure you have answered all the questions
  - With that said, do not second- guess yourself. Your first guess is usually the right guess. Unless you are absolutely, without a doubt, 100% sure another option is the answer, **DO NOT CHANGE YOUR ANSWER**. All too often students second- guess themselves and put down the wrong answer- don't make the same mistake.

**Math sections:**

- Before you begin answering questions, it may be helpful to write down any formulas you know off the top of your head to create a small list to refer to during the exam. Make sure you understand what the question is asking. If not, then **ask**.

- 
- Write down any important values, terms, and draw any pictures or diagrams to help organize your thoughts before answering.
  - Line up place values, etc. otherwise you will come out with the wrong answer.
  - If your answer does not match any of the choices given, reread the problem, recopy the numbers and try again. If you find yourself spending too much time on one problem, come back to it later.
  - Make sure your answer choice makes sense for the problem.

**Science sections:**

- As with the math tips, it may be helpful to write down any formulas you know.
- If an excerpt is involved, make sure to read it carefully and even take some notes to keep yourself on track.
- Cross out information that is irrelevant to the question, *or* write down information that is important to the answering of the question on a piece of scrap papers
- Don't get caught up in technical terms as they rarely have anything to do with the answer.

**Language sections:**

- Plan your thoughts before you write your official answer. Brainstorm ideas of what you can write about, and then organize them into logical sections.
- Make sure you stay on topic. What you are talking about at the beginning of the essay should be the same thing you are talking about at the end of the essay.
- Remember, the organization of your essay is just as important as the content. Make sure you have an introduction to the topic, a substantial body, and a conclusion.
- Use specific examples when possible.
- If time is available, proofread and check spelling and grammar.
- Absolutely DO NOT copy anything word for word. You are smart, so put passages in your own words.

**Social Science sections:**

- Make sure to read and understand what the question is asking.
- Write down any formulas you already know to create a reference list.
- As with math, make sure the answer you have selected makes sense for the problem being asked.
- Draw graphs, histograms, and charts neatly. Make sure they are readable.
- Answer each question as best you can and use prior knowledge to help answer.

**Answer the following questions:**

- a. What other tips can you think of to help you successfully pass this exam?



- 
- 
- 
- b. You are one month away from taking the WAEC. Use this space to make a study schedule to help you stay on track throughout the month.



Reference: WAEC Practice Exam, <http://waeconline.org.ng/e-learning/index.htm>. Copyright 2008 The West African Examinations Council, All rights reserved.

## Further Reading:

- How to Balance a Chemical Equation by Anne Marie Helmenstine, Ph.D., About.com Guide, <http://chemistry.about.com/od/chemistryquickreview/a/balanceequation.htm>. All rights reserved.
- Atomic Mass from Atomic Abundance Example Chemistry Problem by Anne Marie Helmenstine, Ph.D., About.com Guide, <http://chemistry.about.com/od/workedchemistryproblems/a/atomabundance.htm>. All rights reserved.
- High School physics question about horizontal force, <http://answers.yahoo.com/question/index?qid=20111003173308AARdMos>. All rights reserved.
- Momentum and Collisions: Problem Set, <http://www.physicsclassroom.com/calcpad/momentum/problems.cfm>. Copyright 1996-2013 The Physics Classroom, All rights reserved.
- Free Mathematics Tutorials, Problems and Worksheets (with applets) By Abdelkader Dendane. Copyright 2003-2013, All rights reserved:
  - Probability Exercises, [http://www.analyzemath.com/statistics/probability\\_questions.html](http://www.analyzemath.com/statistics/probability_questions.html).
  - Algebra Exercises, [http://www.analyzemath.com/high\\_school\\_math/grade\\_11/algebra.html](http://www.analyzemath.com/high_school_math/grade_11/algebra.html)
  - Geometry Exercises, [http://www.analyzemath.com/high\\_school\\_math/grade\\_11/geometry.html](http://www.analyzemath.com/high_school_math/grade_11/geometry.html)
  - Trigonometry Exercises, [http://www.analyzemath.com/high\\_school\\_math/grade\\_11/trigonometry.html](http://www.analyzemath.com/high_school_math/grade_11/trigonometry.html)
  - Math Word Problems, [http://www.analyzemath.com/high\\_school\\_math/grade\\_11/problems.html](http://www.analyzemath.com/high_school_math/grade_11/problems.html)

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## Lesson 4: Managing Time, Study Skills and Relationships in College

**Objectives:** Students will learn and share time management, study skills and relationship maintenance while in college.

**Lesson:**



Reference: Time Management for Teens by Deborah Erbach Burger, <http://www.homeschool-by-design.com/time-management-for-teens.html>. Copyright 2004, All Rights Reserved.

### I. Study Skills: Specifying what skills are important for effective studying



Reference: Study Skills For College That You Want To Have, <http://www.study-skills-for-all-ages.com/study-skills-for-college.html>. Copyright 2008-2009, All rights reserved.



Reference: High School Study Skills, <http://www.study-skills-for-all-ages.com/high-school-study-skills.html>. Copyright 2008-2009, All rights reserved.



Reference: Study Skills Activities, <http://www.study-skills-for-all-ages.com/study-skills-activities.html>. Copyright 2008-2009, All rights reserved.

**What other study skills not mentioned have worked well for you?**

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## II. Basic Classes for Success

**Objective:** Students will be exposed to the areas of coursework they should enroll in for the best chance of entering the fields of engineering and agriculture.

### Lesson:

#### Boeing List of “Desired Attributes of an Engineer”

- A good understanding of engineering science fundamentals: Mathematics (including statistics) – Physical and life sciences – Information technology (far more than “computer literacy”)
- A good understanding of design and manufacturing processes (i.e. understands engineering)
- A multi-disciplinary, systems perspective
- A basic understanding of the context in which engineering is practiced: Economics (including business practice) – History – The environment – Customer and societal needs
- Good communication skills: Written – Oral – Graphic – Listening
- High ethical standards
- An ability to think both critically and creatively, independently and cooperatively
- Flexibility. The ability and self-confidence to adapt to rapid or major change
- Curiosity and a desire to learn for life
- A profound understanding of the importance of teamwork.

- \* *This is a list, begun in 1994, of basic durable attributes into which can be mapped specific skills reflecting the diversity of the overall engineering environment in which we in professional practice operate.*
- \* *This current version of the list can be viewed on the Boeing web site as a basic message to those seeking advice from the company on the topic. Its contents are also included for the most part in ABET EC 2000.*
- \*  Excerpt from: Mechanical Engineering: How and Why Machines Work, Massachusetts Institute of Technology, 2002 [http://ocw.mit.edu/courses/mechanical-engineering/2-000-how-and-why-machines-work-spring-2002/lecture-notes/lecture3MEoverview\\_fixed.pdf](http://ocw.mit.edu/courses/mechanical-engineering/2-000-how-and-why-machines-work-spring-2002/lecture-notes/lecture3MEoverview_fixed.pdf)

## I. Science Courses

Agricultural engineers are often called biological and agricultural engineers, and most agricultural engineering careers require not only technological and engineering knowledge and skills, but also a thorough familiarity with the sciences. At the University of North Carolina, for example, the agricultural engineering concentration includes three chemistry courses, including a lab, two biology courses and two courses in physics. These basic science courses are supplemented with more specialized science classes, such as soil science and thermodynamics.

### Example syllabi of basic science courses offered at the Massachusetts Institute of Technology (MIT)

 <http://ocw.mit.edu/>

## Introduction to Inorganic Chemistry II:

### Course Meeting Times

Lectures: 3 sessions / week, 1 hours / session

Recitations: 1 session / week, 1 hour / session

## Overview

This course provides a systematic presentation of the chemical applications of group theory with emphasis on the formal development of the subject and its applications to the physical methods of inorganic chemical compounds. Against the backdrop of electronic structure, the electronic, vibrational, and magnetic properties of transition metal complexes are presented and their investigation by the appropriate spectroscopy described.

## Textbook

### Required

Cotton, Frank A. *Chemical Applications of Group Theory*. 3rd ed. New York, NY: John Wiley & Sons, Inc., 1990. ISBN: 9780471510949.

### Recommended

Albright, Thomas A., Jeremy K. Burdett, and Myung-Hwan Whangbo. *Orbital Interactions in Chemistry*. New York, NY: John Wiley & Sons, 1985. ISBN: 9780471873938.

Harris, Daniel C., and Michael D. Bertolucci. *Symmetry and Spectroscopy: An Introduction to Vibrational and Electronic Spectroscopy*. New York, NY: Dover Publications, 1989. ISBN: 9780486661445.

Tsukerblat, Boris S. *Group Theory in Chemistry and Spectroscopy: A Simple Guide to Advanced Usage*. New York, NY: Dover Publications, 2006. ISBN: 9780486450353.

## Assignments

There are 5 problem sets: 4 graded and one optional. They are worth 10% of the final grade, and will be graded on a 0-3 grading scale, with 3 being the highest score.

## Exams

There are three exams, two during the semester and one final exam. Each is worth 30% of the final grade.

## Grading

ACTIVITIES	PERCENTAGES
Three exams (30% each)	90%
Problem sets	10%

## Schedule

LEC #	TOPICS	KEY DATES
1	Symmetry elements and operations	

LEC #	TOPICS	KEY DATES
2	Operator properties and mathematical groups	
3	Irreducible representations and character tables	
4	Molecular point groups I	
5	Molecular point groups II	
6	LCAO and Hückel theory I	
7	Hückel theory II	
8	N-dimensional cyclic systems	Problem set 1 due
9	Band theory in solids	
10	General electronic considerations of metal-ligand complexes	
11	Frontier molecular orbitals of $\sigma$ -donor, $\pi$ -donor and $\pi$ -acceptor ligands	
12	Octahedral $ML_6$ $\sigma$ complexes	Problem set 2 due
13	Octahedral $ML_6$ $\pi$ complexes	
14	Angular overlap method and M-L diatomics	
15	AOM for $ML_n$ ligand fields	
	Exam review	Problem set 3 due
	Exam 1	
16	Introduction to spectroscopy	
17	The weak field	
18	The strong field	
19	Tanabe-Sugano diagrams	
20	Selection rules for electronic spectroscopy	
21	Descent in symmetry	
22	Metal-ligand multiple bonds ( $M=L$ )	
23	Metal-ligand multiplebonds ( $L=M=L$ )	Problem set 4 due
	Exam review	
	Exam 2	
24	Cyclopentadienyl compounds	
25	Metal-metal bonded complexes	
26	Vibrational spectroscopy	
27	Raman spectroscopy	
28	Normal coordinate analysis	
29	Spin orbit coupling, double groups, and ligand fields	

LEC #	TOPICS	KEY DATES
30	Magnetic susceptibility and the Van Vleck equation	Problem set 5 assigned
31	Transition metal magnetism	
32	Transition metal magnetism (cont.)	
	Exam review	
	Exam 3	

## Physics I: Classical Mechanics

### Introduction

### Prerequisites

*Physics I* is a first-year, first-semester course at MIT. Students usually take this course at the same time as *18.01 Single Variable Calculus*.

This course is ideal for motivated high school students, college students, and anyone interested in learning the basics of physics.

### Course Overview

*Physics I* is an introduction to Classical Mechanics. The noun “mechanics” here refers to the motion of objects: we will study how the motion of an object can be understood and predicted in terms of the forces that are acting on the object. The adjective “classical,” in this context, means that we will restrict our study to speeds that are slow compared to the speed of light, so we will not have to take into account the effects of relativity. It also means that we will restrict our study to objects which are generally large, compared to atoms or molecules, so that we will not need to consider the effects of quantum theory. Fortunately, almost any situation we are likely to meet in everyday life satisfies these restrictions, so the results of classical mechanics have a wide variety of applications in science and engineering.

### Course Goals

The overall goal of this course is to convey the excitement of the physicist's quest to understand nature at its deepest level, and at the same time to provide the knowledge and tools that you will need to continue your studies in science or engineering.

There are three main reasons why the study of Classical Mechanics is important, one obvious and two more subtle.

1. The physical laws and principles you will learn, and the methods of applying them to practical problems, are important and relevant in many other fields. A civil engineer designing a bridge, an automobile designer laying out the specifications for the engine or the safety air-bag of a new model, or a geologist

estimating the likely severity of the next earthquake all are using, directly or indirectly, the principles of classical mechanics.

2. The structure and development of classical mechanics is a good example of the aims and methods of science. You will see how experimental results and mathematical representations are combined to create testable scientific theories, and how the impossible complexities of most real-life physical situations can be reduced to soluble problems by identifying the essential physical features and ignoring the rest. This way of working is what distinguishes the scientific approach to situations from the many other ways of looking at them (e.g. artistic, political, business, etc.).
3. Because the same basic principles can be used in a wide variety of different applications, the study of classical mechanics is an excellent introduction to the art of problem solving. By the end of the course you should be able to extract the essential features of a problem, use them to set up and solve the appropriate mathematical equations, and make quick and easy checks on your answer to catch simple mistakes.

The course will have succeeded in its aims if you come away from it with a grasp of the basic principles governing the motion of objects, a feel for the scientific method, and an understanding of the techniques of problem solving.

### Course Format

This course combines the content of two key versions of Classical Mechanics taught at MIT and previously published on OCW: a "classroom lecture style" course and a "studio physics" course. The content of those two courses are still available in their original form:

- *Physics I* with 35 video lectures by Professor Lewin, recorded on the MIT campus during the Fall of 1999.
- *Physics I* as taught in the Studio Physics, or TEAL (Technology Enabled Active Learning), format

MIT students can expect to spend about 150 hours learning Classical Mechanics. That number comes from a combination of attending lectures, studying independently, and time spent in the lab. It's difficult to estimate how long it will take you to complete all of the modules in this particular course because it's never been taught at MIT in this format. But you can probably expect to spend an hour on practice problems, readings and assessment for each hour of video you watch.

### Optional Textbook

Everything you need to complete this course is included on this site. However, if you would like to use a textbook in addition to the material provided, the following is recommended:

#### **Sears and Zemansky's University Physics: with Modern Physics. 12th edition**

Young, Hugh D., Roger A. Freedman, and A. Lewis Ford. San Francisco, CA: Addison Wesley, 2007. ISBN: 9780805321876.

## II. Math Courses

All engineering careers require training in higher mathematics. At the undergraduate level, most agricultural engineering students will be required to complete courses in calculus and statistics. The University of North Carolina requires three semesters of calculus and two semesters of specialized mathematics courses.

## Prerequisites

*Single Variable Calculus* is a first-year, first-semester course at MIT. The prerequisites are high school algebra and trigonometry. Prior experience with calculus is helpful but not essential.

## Course Overview

Calculus is a foundational course at MIT; it plays an important role in the understanding of science, engineering, economics, and computer science, among other disciplines. This introductory calculus course covers differentiation and integration of functions of one variable, with applications. Topics include:

- Concepts of Function, Limits and Continuity
- Differentiation Rules, Application to Graphing, Rates, Approximations, and Extremum Problems
- Definite and Indefinite Integration
- The Fundamental Theorem of Calculus
- Applications to Geometry: Area, Volume, and Arc Length
- Applications to Science: Average Values, Work, and Probability
- Techniques of Integration
- Approximation of Definite Integrals, Improper Integrals, and L'Hôpital's Rule

## Course Goals

After completing this course, students should have developed a clear understanding of the fundamental concepts of single variable calculus and a range of skills allowing them to work effectively with the concepts.

The basic concepts are:

1. Derivatives as rates of change, computed as a limit of ratios
2. Integrals as a "sum," computed as a limit of Riemann sums

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Sketch the graph of a function using asymptotes, critical points, the derivative test for increasing/decreasing functions, and concavity.
- Apply differentiation to solve applied max/min problems.
- Apply differentiation to solve related rates problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute arc lengths, volumes of revolution and surface areas of revolution.



- Evaluate integrals using advanced techniques of integration, such as inverse substitution, partial fractions and integration by parts.
- Use L'Hopital's rule to evaluate certain indefinite forms.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Determine the convergence/divergence of an infinite series and find the Taylor series expansion of a function near a point.

## Course Structure

This course, designed for independent study, has been organized to follow the sequence of topics covered in an MIT course on Single Variable Calculus. The content is organized into five major units:

1. Differentiation
2. Applications of Differentiation
3. The Definite Integral and its Applications
4. Techniques of Integration
5. Exploring the Infinite

Each unit has been further divided into parts (A, B, C, etc.), with each part containing a sequence of sessions. Because each session builds on knowledge from previous sessions, it is important you progress through the sessions in order. Each session covers an amount you might expect to complete in one sitting.

Within each unit you will be presented with sets of problems at strategic points, so you can test your understanding of the material. As you begin each part of a unit, review the problem set at its end so that you may work toward solving those problems as you learn new material.

MIT expects its students to spend about 150 hours on this course. More than half of that time is spent preparing for class and doing assignments. It's difficult to estimate how long it will take you to complete the course, but you can probably expect to spend an hour or more working through each individual session.

## Readings, Assignments and Exams

No textbook is required for this OCW Scholar course.

The notes that accompany the video clips present their content slightly more formally than Professor Jerison does. If you are wondering exactly what conditions must hold for a statement to be true or if you wish to see the details of the calculations displayed on the blackboard, check the notes.

"Worked examples" present a problem or problems to be solved; many of these problems have appeared on homework assignments at MIT. After you have solved these problems you can check your answer against a detailed solution.

Some worked examples will be accompanied by a Mathlet. These interactive learning tools will improve your geometric intuition and illustrate how changes in certain factors affect the results of different calculations.

Problem sets occur at the end of each part; these were taken directly from homework assigned at MIT in the Fall of 2009. As you start each part, familiarize yourself with the problems in the problem set. This will enable you to work on each problem as you gain the knowledge you need to solve it. Once you have completed the problem set you can check your answers against the solutions provided. (The problem sets are carefully selected from a longer list of questions available to you. Do not hesitate to work any problem that piques your interest.)

Each unit ends in an exam. To prepare for an exam, check that you are proficient in each of the topics listed in the exam review lecture and review your work on the unit's examples and problem sets. Allow yourself one hour to work each exam and three hours to complete the final. The exams are quite challenging; do not be surprised if you are unable to complete all of the questions correctly in the time allowed.

**Example of an Undergraduate Calculus Assignment from MIT** ( <http://ocw.mit.edu/>):

## 18.01 EXERCISES

### Unit 1. Differentiation

1. By completing the square, use translation and change of scale to sketch

$$\text{a) } y = x^2 - 2x - 1 \quad \text{b) } y = 3x^2 + 6x + 2$$

2. Sketch, using translation and change of scale 2

$$\text{a) } y = 1 + |x + 2| \quad \text{b) } y = (x - 1)^2$$

4.

a) Show that every polynomial is the sum of an even and an odd function.

b) Generalize part (a) to an arbitrary function  $f(x)$  by writing

$$f(x) = [(f(x) + f(-x))/2] + [(f(x) - f(-x))/2]$$

Verify this equation, and then show that the two functions on the right are respectively even and odd.

c) How would you write  $1/x + a$  as the sum of an even and an odd function?

5. Find the inverse to each of the following, and sketch both  $f(x)$  and the inverse function  $g(x)$ . Restrict the domain if necessary. (Write  $y = f(x)$  and solve for  $y$ ; then interchange  $x$  and  $y$ .)

$$\text{a) } (x - 1)/(2x + 3) \quad \text{b) } x^2 + 2x$$

6. Express in the form  $A \sin(x + c)$

$$\text{a) } \sin x + \sqrt{3} \cos x \quad \text{b) } \sin x - \cos x$$

7. Find the period, amplitude, and phase angle, and use these to sketch

a)  $3\sin(2x-\pi)$

b)  $-4\cos(x + \pi/2)$

### III. Technology and Mechanics Courses

Courses in technology and mechanics will combine the agricultural engineering major's knowledge of mathematics and science. Courses might include engineering mechanics, engineering dynamics, hydraulics, fluid mechanics, geomatics, mechanics of solids, bioinstrumentation and engineering design. These specialized courses are usually introduced in the latter part of the degree program, after basic requirements have been met. Students will take courses in computer technology and systems modeling.

**Example Course Descriptions from MIT** ( <http://ocw.mit.edu/>):

#### **Mechanics & Materials I:**

This course provides an introduction to the mechanics of solids with applications to science and engineering. We emphasize the three essential features of all mechanics analyses, namely: (a) the geometry of the motion and/or deformation of the structure, and conditions of geometric fit, (b) the forces on and within structures and assemblages; and (c) the physical aspects of the structural system (including material properties) which quantify relations between the forces and motions/deformation.

#### **Hydrodynamics:**

This course covers the development of the fundamental equations of fluid mechanics and their simplifications for several areas of marine hydrodynamics and the application of these principles to the solution of engineering problems. Topics include the principles of conservation of mass, momentum and energy, lift and drag forces, laminar and turbulent flows, dimensional analysis, added mass, and linear surface waves, including wave velocities, propagation phenomena, and descriptions of real sea waves. Wave forces on structures are treated in the context of design and basic seakeeping analysis of ships and offshore platforms. Geophysical fluid dynamics will also be addressed including distributions of salinity, temperature, and density; heat balance in the ocean; major ocean circulations and geostrophic flows; and the influence of wind stress. Experimental projects conducted in ocean engineering laboratories illustrating concepts taught in class, including ship resistance and model testing, lift and drag forces on submerged bodies, and vehicle propulsion.

#### **Mechatronics:**

This course teaches the design of mechatronic systems which integrate mechanical, electrical, and control systems engineering. A computer hard disk drive is an example of a complex mechatronic system discussed in the class. Laboratories form the core of the course. They cover topics such as aliasing, quantization, electronic feedback, power amplifiers, digital logic, encoder interfacing, and motor control. The labs make extensive use of Simulink®, a MATLAB® toolbox which allows for graphical simulation and programming of real-time control systems. The new lab facilities feature dSPACE digital signal processors which are programmed through Simulink®. Each student builds circuits on a breadboard kit which is issued to them.

#### **Solid Mechanics:**

This course introduces students to the fundamental principles and methods of structural mechanics. Topics covered include: static equilibrium, force resultants, support conditions, analysis of determinate planar structures (beams, trusses, frames), stresses and strains in structural elements, states of stress (shear, bending, torsion), statically indeterminate systems, displacements and deformations, introduction to matrix methods, elastic stability, and approximate methods. Design exercises are used to encourage creative student initiative and systems thinking.

#### **Thermodynamics of Materials:**

Treatment of the laws of thermodynamics and their applications to equilibrium and the properties of materials. Provides a foundation to treat general phenomena in materials science and engineering, including chemical reactions, magnetism, polarizability, and elasticity. Develops relations pertaining to multiphase equilibria as determined by a treatment of solution thermodynamics. Develops graphical constructions that are essential for the interpretation of phase diagrams. Treatment includes electrochemical equilibria and surface thermodynamics. Introduces aspects of statistical thermodynamics as they relate to macroscopic equilibrium phenomena.

#### **Advanced Soil Mechanics:**

This class presents the application of principles of soil mechanics. It considers the following topics: the origin and nature of soils; soil classification; the effective stress principle; hydraulic conductivity and seepage; stress-strain-strength behavior of cohesionless and cohesive soils and application to lateral earth stresses; bearing capacity and slope stability; consolidation theory and settlement analysis; and laboratory and field methods for evaluation of soil properties in design practice.

### **IV. Communications Courses: Public Speaking, English and Writing**

These courses are outside the realm of engineering courses; however, they are incredibly important to take because within the field of engineering, you will be expected to communicate both verbally through public speaking and in writing through scientific essays, papers and articles.

### **V. Elective Courses**

It will also be important to take courses such as art, physical education, literature, or social science courses. Although these are not directly related to engineering, they will broaden your course base and give you experience in other fields. Additionally, while you are engaged in these courses, always consider how they can further your prospects as an engineer. In other words, ask yourself: “In what ways can this course help in my future as an engineer?” Not only will asking yourself this keep you focused on the course, it will also help you determine how to use other disciplines within your career.

## Lesson 5: Intelligence, Aptitudes, Interests and Personalities

**Objectives:** Students will learn how to begin to assess their learning preferences, personal traits and qualities and how to take stock of their personal inventory/resources and career possibilities.

**Lesson:**

- I. Multiple Intelligences: What are they and Why are they Important?



Reference: Excerpt from: Theory of multiple intelligences, Wikipedia.  
[http://en.wikipedia.org/wiki/Theory\\_of\\_multiple\\_intelligences](http://en.wikipedia.org/wiki/Theory_of_multiple_intelligences).

### Logical-mathematical

This area has to do with logic, abstractions, reasoning and numbers and critical thinking. While it is often assumed that those with this intelligence naturally excel in mathematics, chess, computer programming and other logical or numerical activities, a more accurate definition places less emphasis on traditional mathematical ability and more on reasoning capabilities, recognizing abstract patterns, scientific thinking and investigation and the ability to perform complex calculations. Logical reasoning is closely linked to fluid intelligence and to general ability.

### Spatial

This area deals with spatial judgment and the ability to visualize with the mind's eye. A spatial person is also good with puzzles.

### Linguistic

This area has to do with words, spoken or written. People with high verbal-linguistic intelligence display a facility with words and languages. They are typically good at reading, writing, telling stories and memorizing words along with dates. They tend to learn best by reading, taking notes, listening to lectures, and by discussing and debating about what they have learned. Those with verbal-linguistic intelligence learn foreign languages very easily as they have high verbal memory and recall, and an ability to understand and manipulate grammar and structure.

### Bodily-kinesthetic

The core elements of the bodily-kinesthetic intelligence are control of one's bodily motions and the capacity to handle objects skillfully (206). Gardner elaborates to say that this intelligence also includes a sense of timing, a clear sense of the goal of a physical action, along with the ability to train responses so they become like reflexes.

In theory, people who have bodily-kinesthetic intelligence should learn better by involving muscular movement (e.g. getting up and moving around into the learning experience), and are generally good at physical activities such as sports or dance. They may enjoy acting or performing, and in general they are good at building and making things. They often learn best by doing something physically, rather than by reading or hearing about it. Those with strong bodily-kinesthetic intelligence seem to use what might be termed "muscle memory", drawing on it to supplement or in extreme cases even substitute for other skills such as verbal memory.

## **Musical**

This area has to do with sensitivity to sounds, rhythms, tones, and music. People with a high musical intelligence normally have good pitch and may even have absolute pitch, and are able to sing, play musical instruments, and compose music. Since there is a strong auditory component to this intelligence, those who are strongest in it may learn best via lecture. Language skills are typically highly developed in those whose base intelligence is musical. In addition, they will sometimes use songs or rhythms to learn. They have sensitivity to rhythm, pitch, meter, tone, melody or timbre.

Research measuring the effects of music on second language acquisition is supportive of this music-language connection. In an investigation conducted on a group of elementary-aged English language learners, music facilitated their language learning. This theory may help to explain why music and its sub-components (i.e., stress, pitch, and rhythm) may be viable vehicles for second language learning.

## **Interpersonal**

This area has to do with interaction with others. Interpersonal intelligence is the ability to understand others. In theory, individuals who have high interpersonal intelligence are characterized by their sensitivity to others' moods, feelings, temperaments and motivations, and their ability to cooperate in order to work as part of a group. "Inter- and Intra- personal intelligence is often misunderstood with being extroverted or liking other people..." Interpersonal intelligence means that you understand what people need to work well. Individuals with this intelligence communicate effectively and empathize easily with others, and may be either leaders or followers. They typically learn best by working with others and often enjoy discussion and debate.

## **Intrapersonal**

This area has to do with introspective and self-reflective capacities. This refers to having a deep understanding of the self; what your strengths/ weaknesses are, what makes you unique, being able to predict your own reactions/emotions. Philosophical and critical thinking is common with this intelligence.

**Before taking the assessment on the next page, what intelligence level do you think is dominant in your life? What leads you to believe this?**

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**Why is it important to understand which intelligence level is dominant for you? That is, how can knowing which intelligence level is dominant help in your work in high school, college, and your career?**

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## II. Multiple Intelligence Test



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Reference: Multiple Intelligence Test by BHS Learning Center,  
<http://bhslearningcenter.wikispaces.com/Multiple+Intelligence+Test>.

Where does your true intelligence lie? This quiz will tell you where you stand and what to do about it. Read each statement. If it expresses some characteristic of yours and sounds true for the most part, jot down a "T." If it doesn't, mark an "F." If the statement is sometimes true, sometimes false, leave it blank.

- |   |  |
|---|--|
| 1. ____ I'd rather draw a map than give someone verbal directions.                    | 16. ____ I often see patterns and relationships between numbers faster and easier than others. |
| 2. ____ I can play (or used to play) a musical instrument.                            | 17. ____ I enjoy building models (or sculpting).   |
| 3. ____ I can associate music with my moods.  | 18. ____ I'm good at finding the fine points of word meanings.                                 |
| 4. ____ I can add or multiply in my head.   | 19. ____ I can look at an object one way and see it sideways or backwards just as easily.      |
| 5. ____ I like to work with calculators and computers.                                | 20. ____ I often connect a piece of music with some event in my life.                          |
| 6. ____ I pick up new dance steps fast.   | 21. ____ I like to work with numbers and figures.  |
| 7. ____ It's easy for me to say what I think in an argument or debate.                | 22. ____ Just looking at shapes of buildings and structures is pleasurable to me.              |
| 8. ____ I enjoy a good lecture, speech or sermon.                                     | 23. ____ I like to hum, whistle and sing in the shower or when I'm alone.                      |
| 9. ____ I always know north from south no matter where I am.                          | 24. ____ I'm good at athletics.  |
| 10. ____ Life seems empty without music.  | 25. ____ I'd like to study the structure and logic of languages.                               |
| 11. ____ I always understand the directions that come with new gadgets or appliances. | 26. ____ I'm usually aware of the expression on my face.                                       |
| 12. ____ I like to work puzzles and play games.                                       | 27. ____ I'm sensitive to the expressions on other people's faces.                             |
| 13. ____ Learning to ride a bike (or skates) was easy.                                | 28. ____ I stay "in touch" with my moods. I have no trouble identifying them.                  |
| 14. ____ I am irritated when I hear an argument or statement that sounds illogical.   | 29. ____ I am sensitive to the moods of others.  |
| 15. ____ My sense of balance and coordination is good.                                |  |

30. \_\_\_\_\_ I have a good sense of what others think of me.
31. \_\_\_\_\_ I belong to a club or other group organization.
32. \_\_\_\_\_ I give advice to my friends who have problems.
33. \_\_\_\_\_ I prefer to work alone instead of in a group
34. \_\_\_\_\_ I have an interest or hobby that I don't talk a lot about.
35. \_\_\_\_\_ I have high self-esteem.

### Scoring Sheet

Place a check mark by each item you marked as "true." Add your totals.  
A total of four in any of the categories indicates strong ability.

	Linguistic	Logical-Mathematical	Musical	Spatial	Bodily-Kinesthetic	Intra-personal	Inter-personal
	7 _____	4 _____	2 _____	1 _____	6 _____	26 _____	27 _____
	8 _____	5 _____	3 _____	9 _____	13 _____	28 _____	29 _____
	14 _____	12 _____	10 _____	11 _____	15 _____	33 _____	30 _____
	18 _____	16 _____	20 _____	19 _____	17 _____	34 _____	31 _____
	25 _____	21 _____	23 _____	22 _____	24 _____	35 _____	32 _____
Totals:	_____	_____	_____	_____	_____	_____	_____



### The Seven Multiple Intelligences Characteristics

If you are strongly:	Think	Love	Need
<b>Linguistic</b>	in words	reading, writing, telling stories, playing word games, etc.	books, tapes, writing tools paper diaries, dialogues, discussion, debate stories
<b>Logical-Mathematical</b>	by reasoning	experimenting, questioning, figuring out puzzles, calculating, etc.	things to explore and think about, science materials, manipulatives, trips to the planetarium and science museum
<b>Spatial</b>	in images and pictures	designing, drawing, visualizing, doodling, etc.	art, building blocks, video, movies, slides, imagination games, mazes, puzzles, illustrated books, trips to art museums
<b>Bodily-Kinesthetic</b>	through somatic sensations	dancing, running, jumping, building, touching, gesturing, etc.	role play, drama, movement, things to build, sports and physical games, tactile experiences, hands-on learning
<b>Musical</b>	via rhythms and melodies	Singing, whistling, humming, tapping feet and hands, listening, etc..	sing-along time, trips to concerts, music playing at home and school, musical instruments
<b>Interpersonal</b>	by bouncing ideas off other people	leading, organizing, relating, manipulating, mediating, partying, etc.	friends, group games, social gatherings, community events, clubs, mentors/apprenticeships
<b>Intrapersonal</b>	deeply inside themselves	setting goals, meditating, dreaming, being quiet,	secret places, time alone, self-paced projects, choices



Now that you know what intelligence level is dominant, how will you apply it to your education and career?

### III. The four domains of a career assessment:



Reference: Mapping a Career Path: Know Your Aptitude, Interests, Values & Personality by the Learning Seed, 2011,  
[http://www.learningseed.com/\\_guides/1154\\_Career\\_Assessment\\_Guide.pdf](http://www.learningseed.com/_guides/1154_Career_Assessment_Guide.pdf)

Every career has strengths in each domain: aptitude, interest, value, and personality. Analyzing a career before mapping a career path is an excellent way to start.

**1. Aptitude:** is a \_\_\_\_\_ to do something well, especially one that can be further developed. Essentially, your aptitude for something depends on how quickly and easily you learn something.

#### **Aptitude versus Intelligence/Achievement:**

**Intelligence** is the ability to \_\_\_\_\_ facts and skills and \_\_\_\_\_ them, especially when this ability is highly developed. **You do not have to have aptitude to have intelligence.** However, both are incredibly important for success.

**2. Interest:** a feeling of \_\_\_\_\_ or concern about something that makes your attention turn toward it. How interested you are in a career will often determine how much you enjoy it and how well you perform in it.

Interests may include (**circle which interests you have**):

1. Realistic (“doers” – work with hands, mechanically inclined)
2. Investigative (thinkers- work information)
3. Artistic (creators – value independence and creativity)
4. Social (helpers – prefer being supportive to others)
5. Enterprising (persuaders – enjoy competition)
6. Conventional (organizers – like order and detail)

**3. Value:** the worth, importance or usefulness of something to somebody. Values in career assessment refer to how one feels about certain types of work.

#### **Intrinsic versus Extrinsic Values:**

**Extrinsic Values** relate to values \_\_\_\_\_ of work itself such as: job security, earning potential, or job location.

**Intrinsic Values** relate to values \_\_\_\_\_ the work itself such as: helping others, making a difference, or being part of a team.

**4. Personality:** the totality of somebody's \_\_\_\_\_, interests, behavioral patterns, emotion responses, social roles, and other individual traits that endure over long periods of time. Personality types act as crucial factor into \_\_\_\_\_ a career path. Personality assessments measure personal traits, needs and attitudes to a fitting career.

Personalities include (**circle which you are more prone to**):

1. Introverted – reserved and task orientated
2. Extroverted – outgoing and action orientated

#### **IV. You Say, I Say: Practice Interview for Aptitude Discovery**

The four domains of career assessment are: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

**Part A: Interview your partner using the questions below. Write down their responses.**

1. What are some things you are naturally good at (aptitude)?

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2. What are some things you have to work really hard at or put a lot of effort towards to be good at them (intelligence)?

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3. Do you think it is more important for a job to fulfill extrinsic or intrinsic values?

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4. Why?

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**Part B:** Use the information above to fill in the template below. You will use this template to guide the way you introduce your partner to the class.

\_\_\_\_\_ has a natural ability or aptitude for \_\_\_\_\_.  
(insert partner's name) (insert answers from question 1)



While in order to achieve high results at \_\_\_\_\_, he/she  
(insert answers from question 2)

must put forth effort and hard work.



When it comes to values, \_\_\_\_\_ believes \_\_\_\_\_.  
(insert partner's name) (insert answer from question 3)

values are more important because \_\_\_\_\_.  
(insert answers from question 4)

## Lesson 6: Relationships: Effective Communication and Fostering Valuable Connections



Reference: Communication Skills,  
<http://www.pamf.org/teen/abc/buildingblocks/skills.html>. Copyright 2012 Palo Alto Medical Foundation,  
All Rights Reserved.



Reference: Eight Things to do to Practice Better Communication,  
<http://www.pamf.org/teen/abc/buildingblocks/eightthings.html>. Copyright 2012 Palo Alto Medical  
Foundation, All Rights Reserved.

### A. Pre-Conversation

On the following chart, rephrase the statement on the left with an “I” statement.

Instead of saying...	I should say...
You always tell me what to do and never let me do what I want to do.	
You never let anyone else go first.	
Why do you always ignore me? You never listen when I have anything important to say.	
You need to get off my back!	
You need to stop insulting me!	

### B. During the Conversation

On the following chart, write down what you think is important to your parent without using yourself in the statement. That is, rephrase each statement to explain your parent’s reasoning without using yourself in the statement.

Instead of...	My parent really means...
He wants me to check in with him every 5 minutes.	
He wants me to turn my music down at night.	
He is always on my case about doing my homework and getting my chores done.	

Even if you're wrong, thinking about what's important to them before the conversation will make it easier to listen during the conversation.


### C. Post-Conversation

1. Keep your end of the agreement.
2. Reflect.

## Lessons 7 and 8: Public Speaking

**Objectives:** Students will learn how to deliver confident presentations and communicate effectively in front of large groups.

### Lesson:



Reference: Exercise adapted from: How to Write a Speech, Teach like a Peace Corps Volunteer, <http://teachlikeapcv.files.wordpress.com/2012/06/how-to-write-a-speech.pdf>

### I. Steps for Writing a Successful Speech:

1. \_\_\_\_\_: Assess how much time your speech should take. If you don't have a time limit, try to keep your speech brief yet informative.
2. \_\_\_\_\_: Think about your audience and let your \_\_\_\_\_ of the audience shape the tone of your speech as you write it.
3. **Introduction:** Begin with an introduction that establishes \_\_\_\_\_, what your \_\_\_\_\_ is, what you'll be talking about and how long you're going to take. The introduction should make up about \_\_\_\_\_ of the total speech.

You may want to include a joke, anecdote (story) or interesting fact to grab the audience's attention.

4. \_\_\_\_\_ : Organize your information into \_\_\_\_\_ main points and prioritize them according to importance and \_\_\_\_\_.
  - a. Start with your \_\_\_\_\_ point and then go to your least important point and move slowly back toward the most important. For example, if you have five points with No. 5 being the most important and No. 1 being the least important, your presentation order would be 5-1-2-3-4.
  - b. \_\_\_\_\_ points that aren't crucial to your speech if you have too many for your time frame.
5. \_\_\_\_\_ : Add support to each point using statistics, facts, examples, anecdotes, quotations or other supporting material.
6. Link your introduction, points and conclusions together with smooth \_\_\_\_\_.
7. \_\_\_\_\_ : Write a conclusion that \_\_\_\_\_ each of your points, restates your main purpose and leaves the audience with a lasting \_\_\_\_\_. The conclusion should make up \_\_\_\_\_ of your total speech.
8. When preparing your speech, make your notes easy to read by writing or printing them in large, clear letters.

## II. Tips to control nervousness



Reference: 10 Tips for Public Speaking, <http://www.toastmasters.org/tips.asp>. Copyright 2012 Toastmasters International, All rights reserved.



Reference: Gestures: Get Moving, <http://www.toastmasters.org/MainMenuCategories/FreeResources/NeedHelpGivingaSpeech/TipsTechniques/GesturesGetMoving.aspx>. Copyright 2012 Toastmasters International, All rights reserved.

## III. Write your own Speech

Prepare a *one minute* speech about one of the following subjects:

- 1) Your family
- 2) Your professional goals
- 3) A story from your childhood (rated G)
- 4) Something from the history of your village

On the following page is the rubric which will be used to assess your speech. Look over the rubric before you begin your speech to understand what needs to be included in the speech. Be sure to cover every area within the rubric.

Follow the steps and tips presented in this lesson to help you create a successful speech. Use the rest of this page to write down and organize ideas for your speech, but write your speech or speech outline **in your journal**.

## Public Speaking Assessment Rubric



Reference: Rubric for Public Speaking,  
<http://www.tusculum.edu/research/documents/PublicSpeakingCompetencyRubric.pdf>. Copyright 2010,  
Tusculum College, All rights reserved.

## Lesson 9: Effective Writing Skills: A Guide and Examples

**Objectives:** Students learn how to convey their ideas, analyze what they read and hear, and present their thoughts in writing.

### Lesson:

#### 1. Know the assignment

Without fully understanding the details of their homework, it can be difficult to start writing. Therefore, explain the assignment in your own words, and, if unable to, consult the assignment sheet provided by the instructor. Always ask any questions you have to be sure you know what is being asked of you!

#### 2. Brainstorm!

\_\_\_\_\_. Writing will be much easier if you can explain your ideas verbally before putting pen to paper.

\_\_\_\_\_ that support your topic or main points. Strong evidence makes a paper that much better, so use facts, data, real life examples, journal articles, school book examples, etc. Do the examples support your main idea? Are they accurate? Engaging?

Answer the five W's:

Who? \_\_\_\_\_.

What? \_\_\_\_\_.

When? \_\_\_\_\_.

Where? \_\_\_\_\_.

Why? \_\_\_\_\_.

What is your thesis statement?

The thesis statement is a sentence or two that \_\_\_\_\_.

It gives the audience a sense of what is to come in the following paragraphs.

The thesis statement is *not* a fact or an observation.

A thesis statement *is* a statement that:

- Can be \_\_\_\_\_.
- Portrays an \_\_\_\_\_ one way or another
- \_\_\_\_\_.
- Expresses only \_\_\_\_\_ main idea

**Decide what is wrong with each of these thesis statements and rephrase them to provide a stronger statement:**

**1) There are some negative and positive aspects to the Banana Herb Tea Supplement.**

What is wrong with this statement?

\_\_\_\_\_

What is a better way to phrase the statement?

\_\_\_\_\_

**2) My family is an extended family and I want to get married someday.**

What is wrong with this statement?

\_\_\_\_\_



What is a better way to phrase the statement?

---

---

**3) World hunger has many causes and effects.**

What is wrong with this statement?

---

What is a better way to phrase the statement?

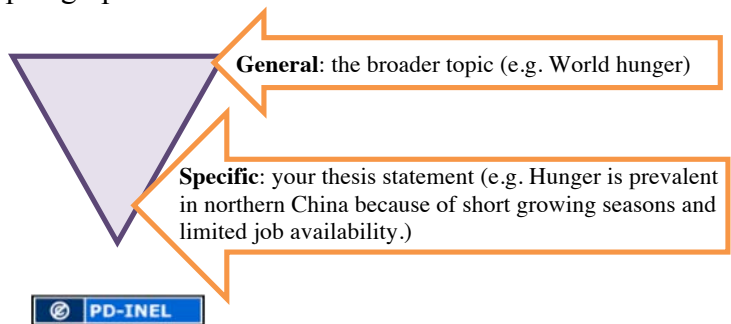
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### 3. Organize

Organization is the key to what separates a good paper from an excellent paper. Once you have all of your ideas written down, you can begin putting them in a logical order within your paper.

**Introduction:** Think of your introduction as an inverted triangle. Start with a broad explanation, narrowing it down to your specific topic. This gives the audience a sense of what is coming in the following paragraphs.



**Body:** As the meat of your essay, this is where you organize all of the facts and examples you have listed to support your thesis. While there is no standard as to how many paragraphs you have within the body (e.g. 3 paragraphs versus 30 paragraphs), you do want to make sure you have enough to fill the space you are assigned. Therefore, judging on how long your essay is required to be will determine what supporting material you include. For example, a one-page essay will obviously need less supporting material than a ten-page essay. Depending on the side of the size of the essay, you may need to add or subtract information.

Make sure you have a \_\_\_\_\_ to the body of your essay. If one idea flows into another, make sure to put them next to each other. Don't jump around topics, because the last thing you want your reader to feel is motion sickness. Make sure the flow of your paper is fluid.

With that said, pay attention to \_\_\_\_\_ as these can make or break a paper. **Transitions are key words that help tie one idea to the next** and help create a smoother flow throughout the paper. For example consider the following paragraphs and determine which flows better:

### Example A:

“Moving towards an authentic dialogue in public health is definitely going to take some changing of attitudes. Participants in the dialogue must be willing to set aside any desire to prove themselves through debate. Dialogue is not a type of debate; the goal is neither to present arguments nor to seek immediate solutions. It is the pursuit of mutual understanding between participants. Dialogue must aim towards welcoming different viewpoints while directly highlighting common purposes. If dialogue participants enter the arena with guns fully loaded, nothing is ever going to be accomplished. Participants must be willing to ‘seek to understand, not to be understood.’”

### Example B:

“Moving towards an authentic dialogue in public health is definitely going to take some changing of attitudes. First, participants in the dialogue must be willing to set aside any desire to prove themselves through debate. As described, dialogue is not a type of debate; meaning, the goal is not to present arguments and seek immediate solutions. Rather, it is the pursuit of mutual understanding between participants. Additionally, dialogue must aim towards welcoming different viewpoints while directly highlighting common purposes. If dialogue participants enter the arena with guns fully loaded, nothing is ever going to be accomplished. Therefore, participants must be willing to “seek to understand, not to be understood.”

One can present excellent ideas in a logical way, but if the transitions are choppy, the whole paper can fall apart. The following is a list of common transitions to make your paper as smooth as glass.

### Agreement / Addition / Similarity

These transitional devices **add information**, **reinforce ideas**, and **express agreement** with preceding material.

in the first place	not to mention	equally
not only ... but also	to say nothing of	identically
as a matter of fact	equally important	uniquely
in like manner	by the same token	like
in addition	again	as
coupled with	to	too
in the same fashion / way	and	as well as
first, second, third	also	together with
in the light of	then	of course

likewise	correspondingly	furthermore
comparatively	similarly	additionally

### Opposition / Limitation / Contradiction

Transition phrases like ***but, rather*** and ***or***, express that there is evidence to the **contrary** or point out **alternatives**, and thus introduce a change the line of reasoning (**contrast**).

although this may be true	above all	although
in contrast	in reality	instead
different from	after all	whereas
of course ..., but	but	despite
on the other hand	(and) still	conversely
on the contrary	unlike	otherwise
at the same time	or	however
in spite of	(and) yet	rather
even so / though	while	nevertheless
be that as it may	albeit	regardless
then again	besides	notwithstanding

### Examples / Support / Emphasis

These transitional devices (like ***especially***) are used to introduce examples as **support**, to indicate **importance** or as an **illustration** so that an idea is cued to the reader.

in other words	to point out	expressively
to put it differently	on the positive / negative side	surprisingly
for one thing	with this in mind	frequently
as an illustration	notably	significantly
in this case	including	in fact
for this reason	like	in general
to put it another way	to be sure	in particular
that is to say	namely	in detail
with attention to	chiefly	for examplefor instance
by all means	truly	to demonstrate
important to realize	indeed	to emphasize
another key point	certainly	to repeat
first thing to remember	surely	to clarify
most compelling evidence	markedly	to explain
must be remembered	especially	to enumerate
point often overlooked	specifically	such as

### Cause / Condition / Purpose

These transitional phrases present specific **conditions** or **intentions**.

in the event that	in view of	lest
granted (that)	If	in case
as / so long as	... then	provided that
on (the) condition (that)	unless	given that
for the purpose of	when	only / even if
with this intention	whenever	so that
with this in mind	since	so as to
in the hope that	while	owing to
to the end that	because of	inasmuch as
for fear that	as	due to
in order to	since	
seeing / being that	while	

### Effect / Consequence / Result

Some of these transition words (***thus, then, accordingly, consequently, therefore, henceforth***) are time words that are used to show that ***after*** a particular time there was a **consequence** or an **effect**.

Note that ***for*** and ***because*** are placed before the cause/reason. The other devices are placed before the consequences or effects.

as a result	thus	therefore
under those circumstances	because the	thereupon
in that case	then	forthwith
for this reason	hence	accordingly
for	consequently	henceforth

### Conclusion / Summary / Restatement

These transition words and phrases **conclude, summarize** and/or **restate** ideas, or a indicate a final **general statement**. Also some words (like ***therefore***) from the **Effect / Consequence** category can be used to summarize.

as can be seen	given these points	in summary
generally speaking	as has been noted	in conclusion
in the final analysis	in a word	in short
all things considered	for the most part	in brief
as shown above	after all	in essence
in the long run	in fact	to summarize

on balance	usually	in any event
altogether	by and large	in either case
overall	to sum up	all in all
ordinarily	on the whole	

### Time / Chronology / Sequence

These transitional words (like *finally*) have the function of limiting, restricting, and defining **time**. They can be used either alone or as part of *adverbial expressions*.

at the present time	finally	shortly
from time to time	after	henceforth
sooner or later	later	whenever
at the same time	last	eventually
up to the present time	until	meanwhile
to begin with	since	further
in due time	then	during
until now	before	first, second
as soon as	hence	in time
in the meantime	since	prior to
in a moment	when	forthwith
without delay	once	straightaway
in the first place	about	instantly
all of a sudden	next	presently
at this instant	now	occasionally
immediately	formerly	
quickly	suddenly	

### Space / Location / Place

These transition words are often used as part of *adverbial expressions* and have the function to restrict, limit or qualify **space**. Quite a few of these are also found in the **Time** category and can be used to describe spatial order or spatial reference.

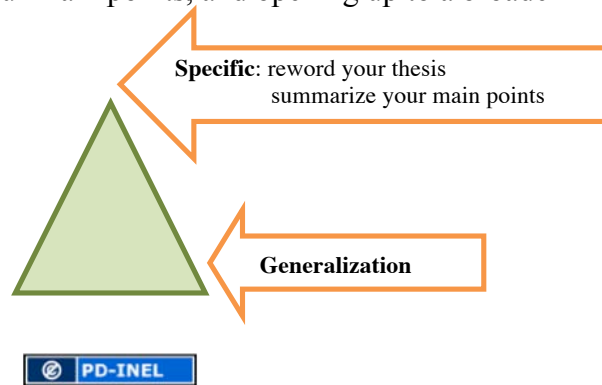
in the middle	in the center of	over
to the left/right	adjacent to	near
in front of	opposite to	above
on this side	here	below
in the distance	there	down
here and there	next	up
in the foreground	where	under
in the background	from	further

beyond  
nearby  
wherever  
around  
between

before  
alongside  
amid  
among  
beneath

beside  
behind  
across

**Conclusion:** The conclusion is the \_\_\_\_\_ of the paper. Within the conclusion, you will need to \_\_\_\_\_ your points and \_\_\_\_\_ your thesis statement. In contrast to the inverted triangle of the introduction, the conclusion can be considered a right-side up triangle, in that it should begin with a rewording of your thesis, followed by a summary of your main points, and opening up to a broader generalization.



#### 4) Writing the First Draft

Once you have gathered your supporting material and organized them in a logical way, it is time to put them all together into the first draft of your paper. When writing your first draft, do not spend a lot of time worrying about grammar, punctuation or spelling. This is just the time to get everything written down in an essay format.

#### 5) Editing and Proofreading

After you have finished your first draft, you will want to go back through what you have written and correct any mistakes and/or add anything to the paper as needed. This is the time to ask yourself:

Does what I have written make sense logically? Or are there gaps?

Do I need to add or remove anything to make my topic clearer?

Do I need transitions to link paragraphs together?

Does the introduction command the reader's attention?

Does the conclusion include a thesis and summarize the ideas presented in the paper?

There are multiple strategies to help you have a successful editing session:

1) If time allows, **take a** \_\_\_\_\_ from looking at your paper and **come back to it** \_\_\_\_\_. Following this strategy allows your mind to refocus and find more mistakes than if you were to write it and edit all in one sitting. Even a 15 or 20 minute break can make a difference.

2) **Read your paper** \_\_\_\_\_. This will allow you to *hear* what you have written and determine if your paper makes sense to your ear. You are also more likely to find obvious mistakes when reading out loud.

3) To help find spelling errors, **read your paper** \_\_\_\_\_. In doing this, you will be able to focus on each word individually, instead of how it relates to its surrounding words.

4) **Enlist the help of** \_\_\_\_\_. It is always beneficial to have an extra pair of eyes look at what you have written. They have an open mind going into it and can offer some suggestions that you might not have thought of on your own.

#### **6) Writing and Proofreading the Final Draft**

You may find that you will write multiple drafts for your paper, especially if it is an exceptionally long paper. This is okay! Just make sure you have the time for multiple edits. When you are satisfied with how the paper looks and sounds, read through it one last time, making any last minute corrections. Once these corrections are made, write a final, clean copy to turn in.

#### **7) Homework!**

For Lesson 10, you will be asked to write a 5- paragraph essay about one topic listed on Lesson 10. Look ahead at that lesson and decide which topic you would like to write about. Use the following space and the next page to brainstorm your ideas. Do not actually write your essay here, you will do that tomorrow. Just write down your ideas.

## **Lesson 10: Putting it All Together**

**Objectives:** Students will evaluate what they have learned throughout this course through a well-written essay. They will then participate in activities designed to reinforce team work and community building.

### **Lesson:**

I. In your journal, write a 5 paragraph essay concerning **one** of the following topics:

**A. Write about your favorite lesson(s) during the past two weeks.**

**B. Discuss how you will use what you have learned during this program to help you achieve success in college and/or your future career.**

**C. Explain how this program has given you confidence as a future engineer.**

**D. Write a letter to a future student explaining the importance of what you have learned during this program.**

Feel free to look back through your student manual and journal to refresh your memory on what you have learned throughout the program and steps to writing an essay. Be sure to follow the basic essay format, including an introduction, a three-paragraph body with facts and smooth transitions, and a conclusion.

## **II. A Final Fun Activity!**



# English

## Lesson 1: Introducing a Classmate

### Identity Card: Introducing a Classmate

Name:

Home Town:

Family (siblings, parents, etc.)

:

Three Things I Like:

Hobbies:

Something I'd Like to Do:

Three Things I Don't Like:



## Lesson 2: Giving Expression to Your Original Thoughts

**Objectives:** Students will choose an object to write about creatively and originally. This will enable them to continue to develop their skills in bringing forth original, imaginative, and innovative ideas. The goal is to get students thinking, writing, and dialoguing creatively and critically.

### Lesson:

#### I. Let's talk about originality!

*It is better to fail in originality  
than to succeed in imitation.*

- Herman Melville

*Originality does not consist in saying what no one has ever said before, but in saying exactly  
what you think yourself.*


- James Stephens

*Creativity involves breaking out of established patterns in order to look at things  
in a different way.*


- Edward de Bono

#### II. Quick Puzzles

1. Acting on an anonymous phone call, the police raid a house to arrest a suspected murderer. They don't know what he looks like, but they know his name is John. Inside they find a carpenter, a taxi driver, a car mechanic and a fireman all playing cards. Without even asking his name, they immediately arrest the fireman. How do they know they've got their man?

( Source: <http://www.funonthenet.in/content/view/163/31/>)


2. A murderer is condemned to death. He has to choose between three rooms. The first is full of raging fires, the second is full of assassins with loaded guns, and the third is full of lions that haven't eaten in 3 years. Which room is safest for him?

( Source: <http://wilk4.com/humor/humore14.htm>)

3. How could a baby fall out of a twenty-story building onto the ground and live?

4. A man and his son are in a car crash. The father is killed and the child is taken to hospital gravely injured. When he gets there, the surgeon says, 'I can't operate on this boy - for he is my son!!!' How can this possibly be?

5. A man lives in the penthouse of an apartment building. Every morning he takes the elevator down to the lobby and leaves the building. Upon his return, however, he can only travel halfway up in the lift and has to walk the rest of the way - unless it's raining. What is the explanation for this?

( Source for 3, 4 and 5: <http://www.folj.com/lateral/>)

### III. Random Word Bridge Technique

Soon, we are going to work on an exercise where you will work to describe something in an original, creative way – but first we'll discuss a technique where you can create a new bridge between ideas to help you when you're stuck.

Let's say you're given a topic, but you are not sure how to talk about it. What do you do? Well, using the random word technique you can come up with unexpected ideas. First you'll need a random word. It can be from anywhere: the cover of a book, an advertisement, flipping through a dictionary or magazine. But don't look for a "good" word – just make sure it's random.

- Look around you. What can you see? Can you see any words? What about things? What else is happening?
- Open a book at a random page. Run your finger around the page and stop at a random point. Look for a suitable word near your finger.
- Ask the people you are with to give you a random word.
- Select a word from a prepared list of evocative words (fire, child, brick, sausage, etc.)

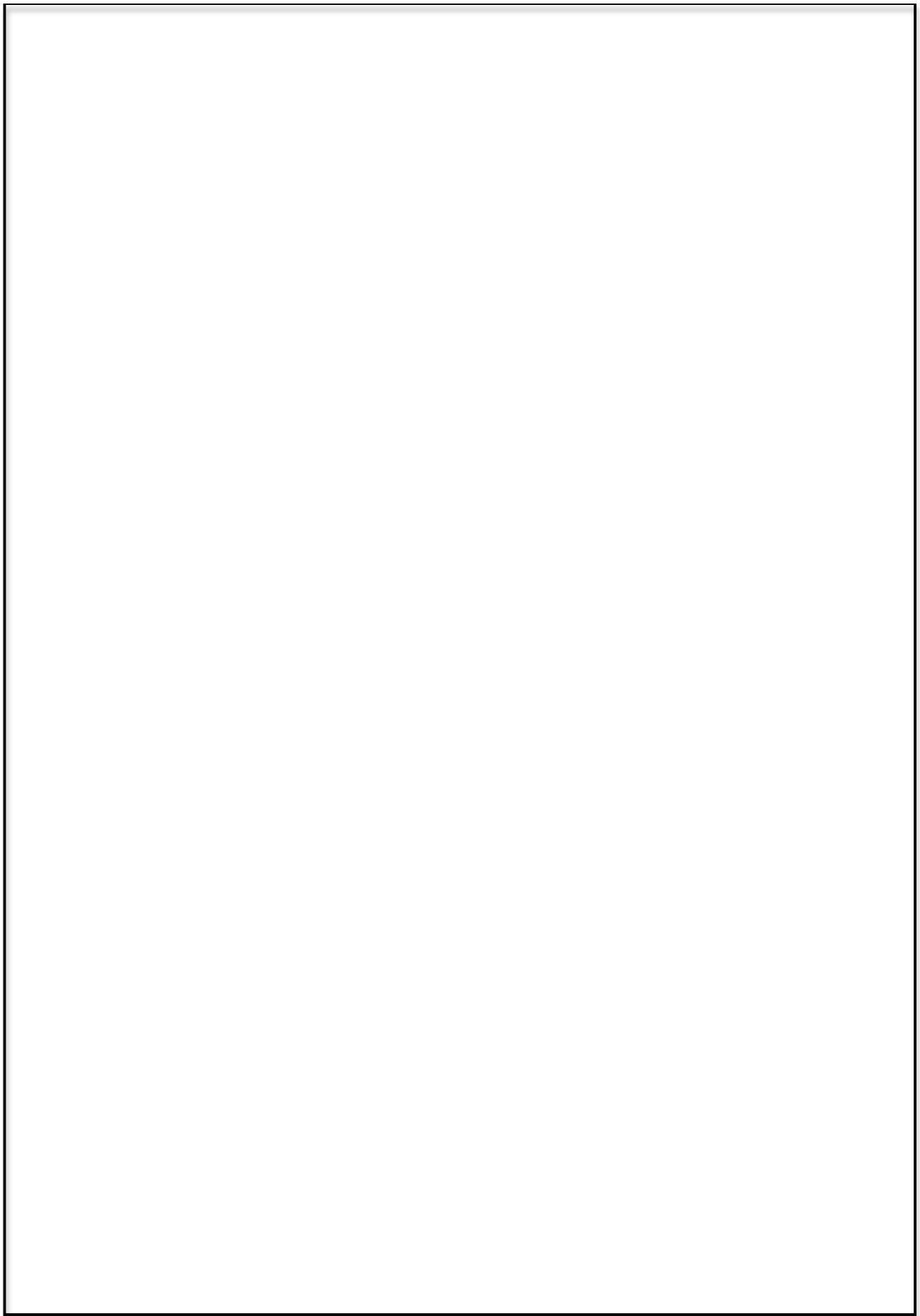
The next step is establishing a bridge idea...



Reference. How to use the Random Word technique,  
<http://www.infinn.com/randomwordtutorial.html>. Copyright 1997-2011 Infinite Innovations Ltd, All right reserved.

### IV. Doing it Yourself

You have seen one way of coming up with new ideas. You can also explore your own. Select an object (person, place or thing) that is physically present. Spend fifteen minutes writing about it below and on the next page. Be as conservative or imaginative as you wish. Just make sure the ideas and thoughts you express are from within your head – think about what you want to say, and without curbing or over evaluating, talk about the object and your own flowing ideas.



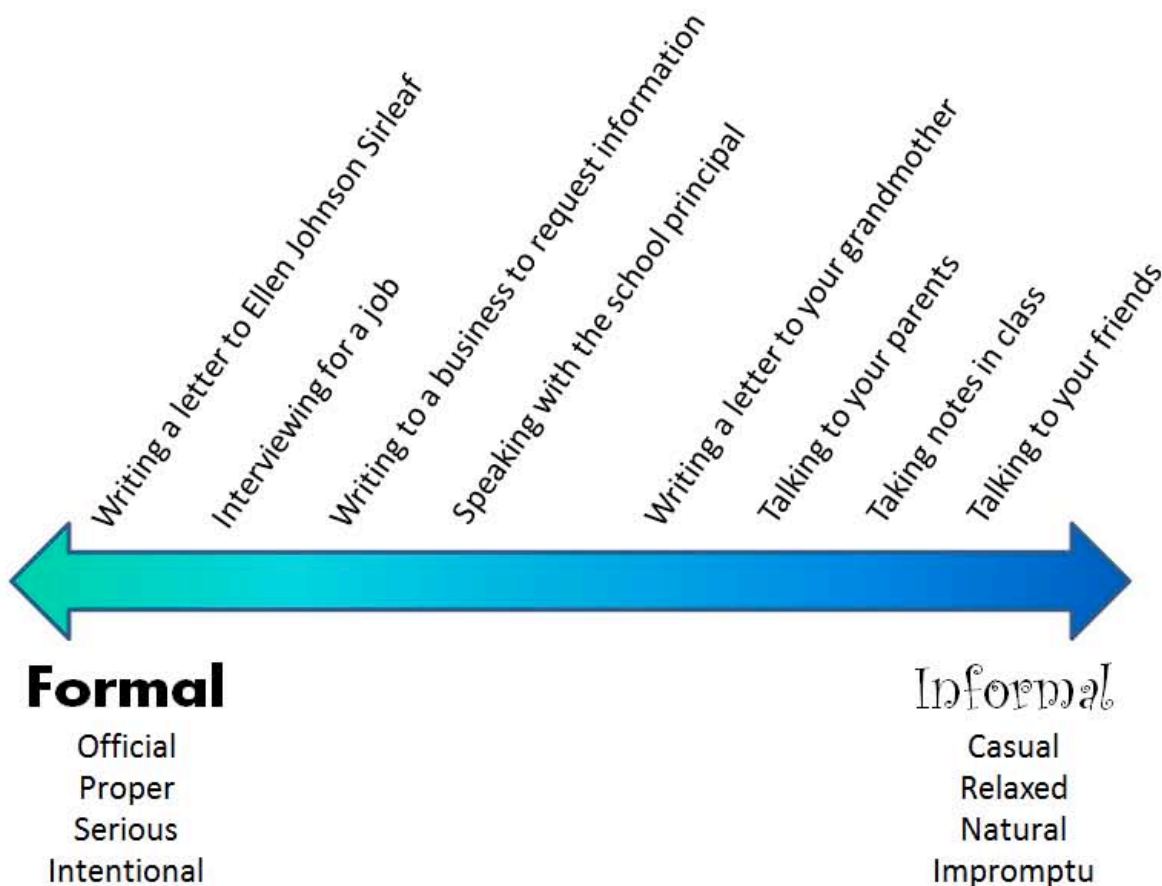
## Lesson 3: Reading Articles

Refer to Annex for articles.

## Lesson 4: Letter Writing

### Formal vs. Informal Language

Different styles of speaking and writing are appropriate in different situations and contexts. For example, you typically would not talk to your employer at work in the same way that you talk to your friend while playing sports. These types of speech can be categorized as either *formal language* or *informal language*. The figure below gives some examples to help you think about these differences.



© PD-INEL

We can summarize some important differences between formal and informal language, along with some more specific examples (in *italics*):

<i>Formal</i>	<i>Informal</i>
Passive voice <i>More information is requested by the student.</i> <i>Dinner is served by the waiter.</i>	Active voice <i>The student requests more information.</i> <i>The waiter serves dinner.</i>
Sophisticated words and sentences <i>Therefore, I request that you carefully consider my application for employment.</i>	Simple words and sentences <i>I want to apply for a job.</i>
Contractions should not be used <i>They will arrive soon.</i> <i>I am a great soccer player.</i>	Ok to use contractions <i>They'll arrive soon.</i> <i>I'm a great soccer player.</i>
Clear enunciation (clear, proper, and complete pronunciation) is important <i>I have something important to discuss with you.</i> <i>Please buy some red oil from me.</i>	Clear enunciation is not important  <i>I kuh' to spe' to yaw. (I come to speak to you.)</i> <i>Plea' buy suh' re' oi' fruh me.</i>
Slang should not be used <i>American man, mister, sir, etc.</i>	Slang is ok <i>White man</i>



### Activity – is it formal or informal language?

Your teacher will guide you through the following words and phrases. In the blank space, mark each one either with an “F” for formal language or “I” for informal language. In each pair, one is formal and one is informal.

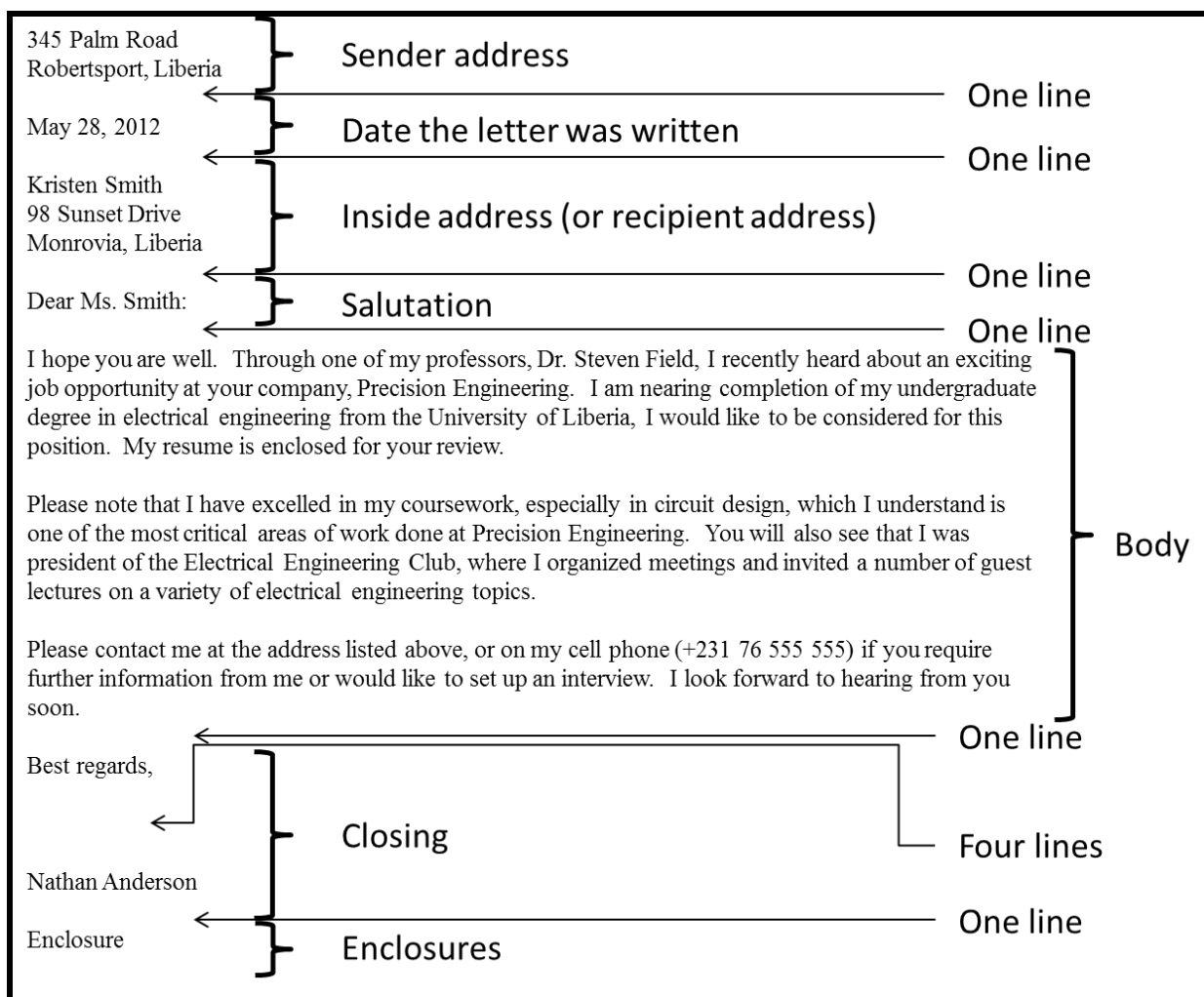
<i>Word or phrase</i>	<i>F/I</i>	<i>Word or phrase</i>	<i>F/I</i>
Can't		Cannot	
The engineer tested a theory		A theory was tested by an engineer	
The rice is finish		There is no more rice	
I need		I require	
Everything		E'ry'tin'	
Regarding your letter		About your letter	
Is not		Isn't	
Boieh		Boiled egg	
Mary fixed the problem		The problem was fixed by Mary	



### Sections of a letter

#### Lesson

A formal letter consists of several sections. Each section has a purpose and a placement within the letter. This lesson is presented as would be common in the United States, so the addressing sections may not be as relevant here in Liberia. The key point is to focus on the structure of the letter, and also the use of formal vs. informal language, depending on your audience. Below is an example letter, and each section is indicated. Whether typing or handwriting, take note of the number of lines between each section. An explanation of each section is provided below the example letter.



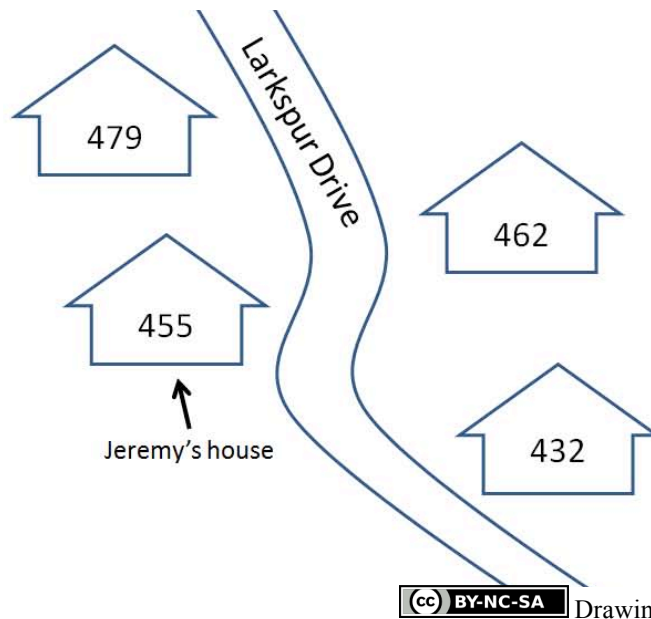
Example letter by University of Michigan

## Address

First of all, an *address* is a collection of information that identifies a location. Each country around the world has a different way of presenting this information. In the United States, the address format is as follows:

<b>Format</b>	<b>Example</b>
Name of addressee	Jeremy Martinson
House number and street name	455 Larkspur Dr.
Name of town, State abbreviation + ZIP code	California Springs, CA 92926





In the United States, you can write a letter, pay a small fee, and workers will deliver your letter anywhere in the country! In Liberia, communication is more challenging, so if you want to write a letter to someone, you may have to come up with some creative ways to deliver the message to that person!

### **Sender Address**

The sender address is the address of the person who is sending the letter. The sender should not include their name in this section. Reading down farther, note that the sender's name is included in the closing section.

### **Date the letter was written**

This can also be the day the letter was completed if the letter took several days to write.

### **Inside address (or recipient address)**

This is the address of the recipient – the person who is receiving the message.

### **Salutation**

Formal salutations contain a formal addressing word, such as “Dear,” followed by the addressee’s name. If you don’t know the addressee well, you would generally use a personal title (e.g., Dear Mr. William White or Dear Mr. White). If you are quite familiar with the addressee and usually call them by their first name, you may address them by first name (e.g., Dear William or Dear Bill). In a formal letter, follow the addressee’s name with a colon (:). If you don’t know the person at all (you are writing to a company to request information) or you are unsure of the addressee’s gender (e.g., Sudarshan Chopra or Xiasong Ming), you may use something like “To Whom It May Concern:” as the salutation.

Informal salutations are much looser, but follow the same structure. Use an addressing word, such as “Hello” or “Hey” (“Dear” is also common and acceptable). You will generally use the person’s first name, followed by a comma (,).

### **Body**

In a formal letter, use formal language! Also, be concise – some people are very busy and have limited time, so make the best use of their time. The first paragraph should be a greeting (e.g., “I hope this letter finds you well.”), and then make the main point of the letter (e.g., “I would like to

apply for a job.”). Following paragraphs should contain supporting information and important details, and the last paragraph should wrap up the letter – restate the purpose and possibly request an action or other follow up.

In an informal letter, again, the format is very loose. You may be writing to a friend – make it fun and interesting for them to read!

## Closing

This is a phrase used to close out the letter. The phrase is followed by a comma (,), and only the first word of the phrase is capitalized. Some examples of formal closing phrases are “Respectfully,” “Sincerely,” and “Best regards,”. Informal phrases could include “Love,” “Sunny days,” and “Your sugar pie,”. The 4 spaces between the closing and the sender’s name are for the sender’s signature.

## Enclosures

You might include some external documents with your letter. If you are applying for a job, you might include a resume. If you are applying for college, you might include your grades from high school or a photocopy of an award you received. If you include any documents, write “Enclosures” one line below the sender’s name.

## Activity – identify the parts of the letter

Below are two example letters. Circle and label the sections of each letter. Also, identify what type of letter each one is by writing a big “F” for formal or “I” for informal near the letter.

613 Fort Street New York, NY 10001
June 4, 2012
Dave Short 444 Tucson Drive Baltimore, MD 21201
Dear Dave:
I will update the quote and send it to you early next week. If possible I would like to speak with you first to insure the items I quote are the best configuration for your testing needs.
If you have any questions or need information quicker, please do not hesitate to call my direct line.
Best Regards,
Beth Moore
Enclosures



Example letter by University of Michigan

3344 Wayne Road  
Detroit, MI 48201

June 1, 2012

Fred May  
11 Eleven Street  
Pittsburgh, PA 15122

Hi Fred,

It has dawned upon me that we haven't done anything sweet in a while. Having just returned from a glorious week-long journey into southwestern Utah, I am ready to plan another adventure!

So, should we try to fit something in this summer, perhaps in July or August? I might be pretty busy from the end of August until the end of October with a variety of work and family stuff.

Let me know what your schedule is like and we'll start planning!

Peace,

Billy Bob Cluck



Example letter by University of Michigan

## Formal letter writing

Now it's your turn to write a letter!

Choose a topic below and write a *formal* letter to the person. Remember to use proper language and also to assemble the letter as discussed earlier. You probably don't have an address – so make one up! It can be based on reality or totally fun and inventive. Also make up an address for your recipient. Remember that this is a *formal* letter – be short and to the point!

When you finish, trade your letter with a partner. Read your partner's letter and try to find any mistakes in language or in letter structure. If you have a dispute, ask your instructor!

### Topics

1. Write to President Ellen Johnson Sirleaf, requesting that schools have more athletic programs so that Liberia can have better athletes to compete in the Olympic Games.
2. Write to the University of Liberia to request information about an academic program like electrical engineering or agriculture.
3. Write to Firestone Natural Rubber Company to apply for a recent employment opportunity you heard about. (Don't forget – you may want to *enclose* a resume!)

## Further Reading



Reference: “Writing skills: formal and informal writing by Jackie McAvoy.  
<http://www.onestopenglish.com/skills/writing/lesson-plans/writing-skills-formal-and-informal-writing/146337.article>. Copyright 2000-2013 Macmillan Publishers Ltd, All rights reserved.



Reference: Formal and Informal English,  
[http://www.blssl.com/assets/Formal\\_Informal\\_English.pdf](http://www.blssl.com/assets/Formal_Informal_English.pdf). Copyright 2012 Business Language Services, All rights reserved.



Reference: Liberian English, <http://reedsinliberia.blogspot.com/2007/10/liberian-english.html>.  
Copyright 2007 The Reed Family, All rights reserved.

## Lesson 5: Data Collection and Write-Up

**Objectives:** Students will learn to collaboratively collect data and write a short report concerning the data.

### I. Collecting the Data:

The following chart is a list of *Dominant* and *Recessive* traits in humans. Your mission is to figure out a way to determine how many people in your group possess each trait. You may use the following page to develop your ideas and record your data.



Reference: Mendelian Traits in Humans,  
[http://education.sdsc.edu/download/enrich/mendelian\\_traits.pdf](http://education.sdsc.edu/download/enrich/mendelian_traits.pdf). Copyright 2005 The Regents of the University of California, All rights reserved.

### II. Draw a Graph:

In the space below, draw a graph depicting the data you collected.

### III. Write it up:

As a group, write your observations from this project using the following questions as a guide. Be sure to use complete sentencing and paragraph structure:

**Introduction:** What was the purpose of this project? What traits are considered dominant? What traits are recessive?

**Method:** How was the data collected; that is, what steps were taken to collect the data? How many participants were involved? What were the questions asked about the data?

**Results:** What were the results of the project? What traits were the most frequent? Which were the least?

**Discussion:** Why was this project important? What was done well? What could have been done differently? What did you learn about data collection through this project?

## Lesson 6: Problem Solving and Experimental Solutions

**Objective:** Students will brainstorm difficulties within their country, village, school or family and develop a solution to help solve this problem.

**Lesson:**

### I. Group Brainstorm

With your instructor's guidance, and as a class, develop a list of difficulties within your country, village, school or family, or a difficulty you may have personally. These can be physical, cultural, sociological, emotional, or any other type of difficulty you can think of.

### II. Questions to Stir Your Creativity

**Which item from the class list did you find most intriguing?**

---

---

**How is this item a difficulty for you or your country/village/school/family? Who is most affected by this difficulty (this is your *target audience*)?**

---

---

---

**Given unlimited resources (including money), what would you do to relieve this difficulty?**

---

---

---

---

### III. Write it out

You are given an opportunity to present your idea for easing this difficulty to your village leader. In your journal, write a short essay to your village leader describing your difficulty, your target audience (who will be most helped by your solution), and, of course, your solution.

## Lesson 7: Reading Comprehension

Name: \_\_\_\_\_

Date: \_\_\_\_\_

# KWL

*Complete the first two columns below (K and W) before reading.*

*Complete the third column below (L) after reading.*

*Name of Text:* \_\_\_\_\_



<b>K</b>	<b>W</b>	<b>L</b>
<b>What I <u>Know</u></b>	<b>What I <u>Want</u> to Learn</b>	<b>What I <u>Learned</u></b>

## Lesson 8: The Lady, or the Tiger?

**Objective:** Students will listen to the beginning of a story and develop their own ideas about the ending.

**Lesson:**

### I. The Story

Read along as the following story is read.



PD-SELF

Reference: The Lady, or the Tiger? by Frank R. Stockton, Voices of America,  
<http://learningenglish.voanews.com/content/a-23-2009-04-17-voa3-83140447/129441.html>.

### The Lady, or the Tiger?

Transcript of radio broadcast:

“Long ago, in the very olden time, there lived a powerful king. Some of his ideas were progressive. But others caused people to suffer.

One of the king's ideas was a public arena as an agent of poetic justice. Crime was punished, or innocence was decided, by the result of chance. When a person was accused of a crime, his future would be judged in the public arena.

All the people would gather in this building. The king sat high up on his ceremonial chair. He gave a sign. A door under him opened. The accused person stepped out into the arena. Directly opposite the king were two doors. They were side by side, exactly alike. The person on trial had to walk directly to these doors and open one of them. He could open whichever door he pleased.

If the accused man opened one door, out came a hungry tiger, the fiercest in the land. The tiger immediately jumped on him and tore him to pieces as punishment for his guilt. The case of the suspect was thus decided.

Iron bells rang sadly. Great cries went up from the paid mourners. And the people, with heads hanging low and sad hearts, slowly made their way home. They mourned greatly that one so young and fair, or so old and respected, should have died this way.

But, if the accused opened the other door, there came forth from it a woman, chosen especially for the person. To this lady he was immediately married, in honor of his innocence. It was not a problem that he might already have a wife and family, or that he might have chosen to marry another woman. The king permitted nothing to interfere with his great method of punishment and reward.

Another door opened under the king, and a clergyman, singers, dancers and musicians joined the man and the lady. The marriage ceremony was quickly completed. Then the bells made cheerful noises. The people shouted happily. And the innocent man led the new wife to his home, following children who threw flowers on their path.

This was the king's method of carrying out justice. Its fairness appeared perfect. The accused person could not know which door was hiding the lady. He opened either as he pleased, without knowing whether, in the next minute, he was to be killed or married.



Sometimes the fierce animal came out of one door. Sometimes it came out of the other.

This method was a popular one. When the people gathered together on one of the great trial days, they never knew whether they would see a bloody killing or a happy ending. So everyone was always interested. And the thinking part of the community would bring no charge of unfairness against this plan. Did not the accused person have the whole matter in his own hands?

The king had a beautiful daughter who was like him in many ways. He loved her above all humanity. The princess secretly loved a young man who was the best-looking and bravest in the land. But he was a commoner, not part of an important family.

One day, the king discovered the relationship between his daughter and the young man. The man was immediately put in prison. A day was set for his trial in the king's public arena. This, of course, was an especially important event. Never before had a common subject been brave enough to love the daughter of the king.

The king knew that the young man would be punished, even if he opened the right door. And the king would take pleasure in watching the series of events, which would judge whether or not the man had done wrong in loving the princess.

The day of the trial arrived. From far and near the people gathered in the arena and outside its walls. The king and his advisers were in their places, opposite the two doors. All was ready. The sign was given. The door under the king opened and the lover of the princess entered the arena.

Tall, beautiful and fair, his appearance was met with a sound of approval and tension. Half the people had not known so perfect a young man lived among them. No wonder the princess loved him! What a terrible thing for him to be there!

As the young man entered the public arena, he turned to bend to the king. But he did not at all think of the great ruler. The young man's eyes instead were fixed on the princess, who sat to the right of her father.

From the day it was decided that the sentence of her lover should be decided in the arena, she had thought of nothing but this event.

The princess had more power, influence and force of character than anyone who had ever before been interested in such a case. She had done what no other person had done. She had possessed herself of the secret of the doors. She knew behind which door stood the tiger, and behind which waited the lady. Gold, and the power of a woman's will, had brought the secret to the princess.

She also knew who the lady was. The lady was one of the loveliest in the kingdom. Now and then the princess had seen her looking at and talking to the young man.

The princess hated the woman behind that silent door. She hated her with all the intensity of the blood passed to her through long lines of cruel ancestors.

Her lover turned to look at the princess. His eye met hers as she sat there, paler and whiter than anyone in the large ocean of tense faces around her. He saw that she knew behind which door waited the tiger, and behind which stood the lady. He had expected her to know it.

The only hope for the young man was based on the success of the princess in discovering this mystery. When he looked at her, he saw that she had been successful, as he knew she would succeed.

Then his quick and tense look asked the question: "Which?" It was as clear to her as if he shouted it from where he stood. There was not time to be lost.

The princess raised her hand, and made a short, quick movement toward the right. No one but her lover saw it. Every eye but his was fixed on the man in the arena.

He turned, and with a firm and quick step he walked across the empty space. Every heart stopped beating. Every breath was held. Every eye was fixed upon that man. He went to the door on the right and opened it." –End story

Now, the point of the story is this: Did the tiger come out of that door, or did the lady?

The more we think about this question, the harder it is to answer. It involves a study of the human heart. Think of it not as if the decision of the question depended upon yourself. But as if it depended upon that hot-blooded princess, her soul at a white heat under the fires of sadness and jealousy. She had lost him, but who should have him?

How often, in her waking hours and in her dreams, had she started in wild terror, and covered her face with her hands? She thought of her lover opening the door on the other side of which waited the sharp teeth of the tiger!

But how much oftener had she seen him open the other door? How had she ground her teeth, and torn her hair, when she had seen his happy face as he opened the door of the lady! How her soul had burned in pain when she had seen him run to meet that woman, with her look of victory. When she had seen the two of them get married. And when she had seen them walk away together upon their path of flowers, followed by the happy shouts of the crowd, in which her one sad cry was lost!

Would it not be better for him to die quickly, and go to wait for her in that blessed place of the future? And yet, that tiger, those cries, that blood!

Her decision had been shown quickly. But it had been made after days and nights of thought. She had known she would be asked. And she had decided what she would answer. And she had moved her hand to the right.

The question of her decision is one not to be lightly considered. And it is not for me to set myself up as the one person able to answer it. And so I leave it with all of you:

Which came out of the open door – the lady, or the tiger?

# Math

## Overview:

Day	Topic	Activities
1	Why Math? What are equations? The “Language” of math	Math is all around us! Examples.  The “equation” machine  How to read an equation like a sentence.
2	Basic Algebra practice	Play the “game” of solving for x.  - Several in-class examples  Review of some common terminologies. - Square roots - Exponents - Fractions - Order of Operations
3	More algebra practice - Factoring - The quadratic equation	
4	Analytical: Turning words into pictures and equations	Split into groups, each has a problem to turn into a picture or equation
5	Graphing Equations The x-y plane Graphing lines Making data tables	Agriculture example: Graphing supply and demand; money payback problem
6	Geometry - Angles - Basics of shapes - Right Triangles - The Pythagorean Theorem - 3D shapes - Volume	Engineering example: Building a straight road between two points
7	Trigonometry: It’s all about Right Triangles! - Sine, Cosine, and Tangent - SOHCAHTOA	Engineering Example: Finding the angle on a bridge or a ramp; angle of solar rays on a solar panel
8	More trigonometry - More SOHCAHTOA practice - The Unit Circle	Example problems in class
9	Group Work Day	Engineering or agriculture-related problem to solve in groups of 5
10	Group Work Day	Engineering or agriculture-related problem to solve in group of 5

Day 1 Homework:  
NO HOMEWORK

Day 2 Homework:  
Solve the following equations for x:

$$2x + 3 = 11$$

$$10x - 4 = 16$$

$$25 = x^2$$

$$x/2 = 6$$

$$x + 2x + 7 = 10$$

Challenge question:  
 $(10 - x) / 2 = 4$

Day 3 Homework:

Solve for x in the following equations:

$$x^2 + 3x + 2 = 0$$

$$x^2 + 8x + 15 = 0$$

$$x^2 = 7x - 10$$

$$3x^2 + 2x + 9 = 0$$

$$4x^2 + 6x + 10 = 6$$

Challenge Question:  
 $10x^2 + 42x + 150 = 9x^2 + 40x + 148$

Day 4 Homework:

A story problem. Good ones include:

- Population dynamics. Day 1 you start with one bunny, then one more each day...
- You pay 500 dollars upfront for a big basket of plums at the market. But you know you can re-sell them and make 10 dollars for every plum. How many plums do you need in the basket to make your purchase worth it?
- Interest rate problem. Down payment plus interest rate over how many years
- Augustine is 3 more than twice the age of Francis. If Augustine is 25 years old, how old is Francis?

Day 5 Homework:

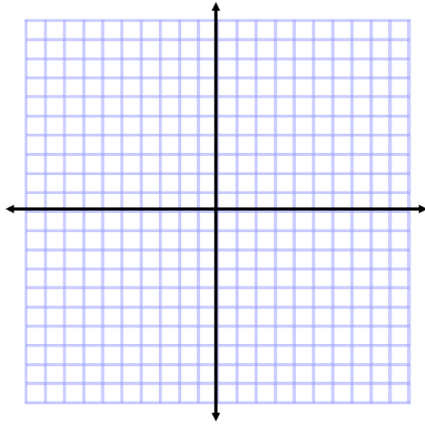
Identify and label the following points on the x-y plane below.

Point A: (2, 3)

Point B: (-7, 1)

Point C: (5, -5)

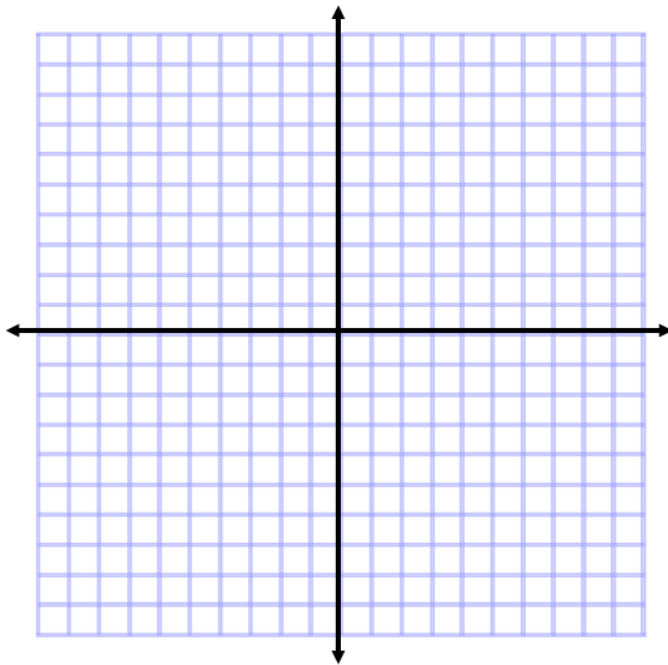
Point D: (-4, -6)



Make a data table with 5 data points for the following function:

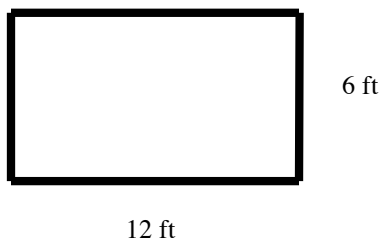
$$y = (1/2)x + 3$$

Now graph the function on the given x-y plane

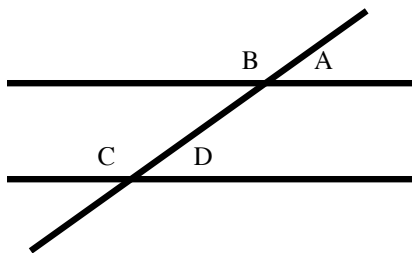


Day 6 Homework:

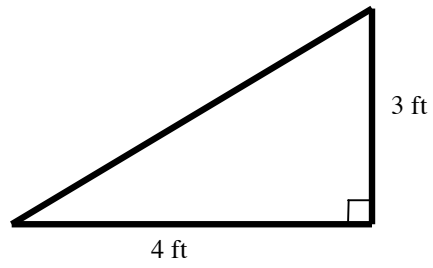
Find the perimeter of the rectangle below. Next, find the area.



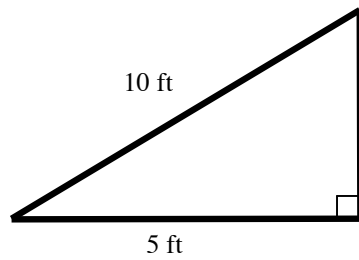
If Angle A is 60 degrees, what are the angles for angles B, C, and D?



Find the length of the missing side of this triangle:



Find the length of the missing side of this triangle:

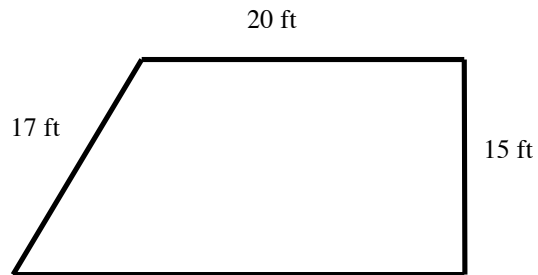




Challenge Question:

From WAEC 2011:  **FAIR USE**

Find the area of the trapezoid below:



Day 7 Homework:

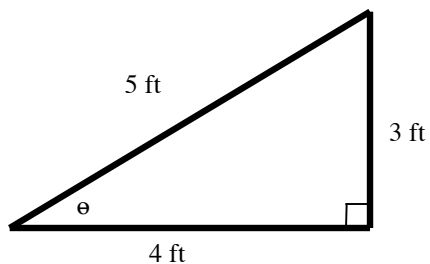
Define what SOHCAHTOA means. Please draw a diagram to help explain.

Using the triangle below, please find the following:

$\sin(\theta)$

$\cos(\theta)$

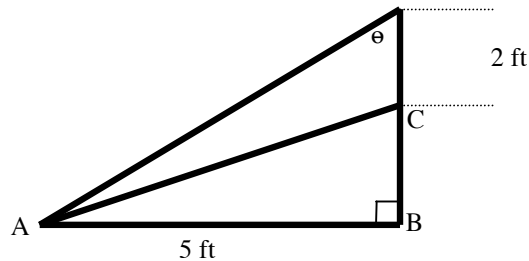
$\tan(\theta)$




Using the words you know from SOHCAHTOA, please simplify the expression:

$$\frac{\sin(\theta)}{\cos(\theta)}$$

What is  $\cos(\theta)$  in the following figure, if the area of triangle ABC is 5 square feet?

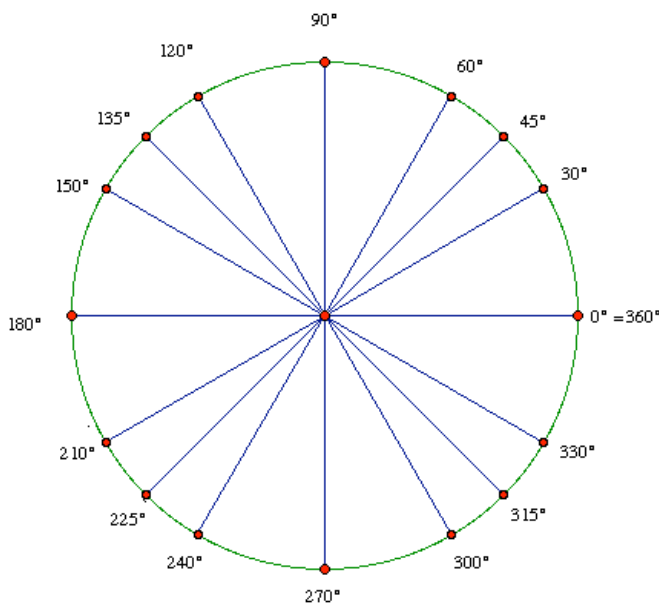


Day 8 Homework: 

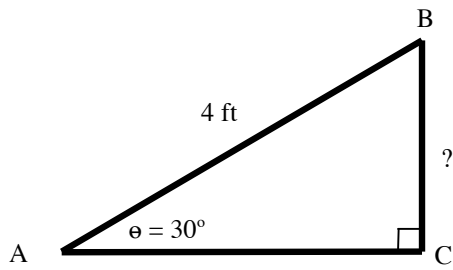
From WAEC 2011:

Given that  $\tan \theta = 5/12$  and that  $0^\circ < \theta < 90^\circ$ , what is the value of  $\cos \theta - \sin \theta$ ?

Fill in the values for cosine and sine for each angle shown on the Unit Circle below. Give your answer in the form of (\_\_\_\_,\_\_\_\_) the first number being cosine, and the second number being sine.



Find the length of side BC.



Day 9 Homework:

GROUP ACTIVITY #1: 10 MINUTES

What is the value of the area of a square whose diagonals measure 8 cm?

GROUP ACTIVITY #2: 30 MINUTES

A little boy is flying a kite. The string of the kite makes an angle of  $30^\circ$  with the ground. If the height of the kite is  $h = 21$  m, find the length (in meters) of the string that the boy has used.

Group activity #3: 30 minutes

A ship of height  $h = 12$  m is sighted from a lighthouse. From the top of the lighthouse, the angle of depression to the top of the mast and the base of the ship equal  $30^\circ$  and  $45^\circ$  respectively. How far is the ship from the lighthouse (in meters)?

# **Annexes**

## Reading: Winter In Songming



Reference: Winter in Songming, <https://shop.heifer.org/shop/books-and-dvds/winter-in-songming.html>, Copyright Heifer International, All rights reserved.

## UN Millennium Development Goal Posters



Reference: UN Millennium Development posters,  
<http://www.oxfam.org.uk/education/resources/change-the-world-in-eight-steps>. Copyright 2012-2013  
Oxfam, All Rights Reserved.

## Research Articles

The articles below are from the American Chemical Society, Copyright 2006-2012, All Rights Reserved.

- “Erosion – Soil on the Move,”  
[http://portal.acs.org/preview/fileFetch/C/CSTA\\_015154/pdf/CSTA\\_015154.pdf](http://portal.acs.org/preview/fileFetch/C/CSTA_015154/pdf/CSTA_015154.pdf)
- “The First Airplane,”  
[http://portal.acs.org/preview/fileFetch/C/CSTA\\_015175/pdf/CSTA\\_015175.pdf](http://portal.acs.org/preview/fileFetch/C/CSTA_015175/pdf/CSTA_015175.pdf)
- “Dynamic Soil,”  
[http://portal.acs.org/preview/fileFetch/C/CSTA\\_015152/pdf/CSTA\\_015152.pdf](http://portal.acs.org/preview/fileFetch/C/CSTA_015152/pdf/CSTA_015152.pdf)
- “Green grass, Green beans, Green thumb, but Green chemistry,”  
[http://portal.acs.org/preview/fileFetch/C/CSTA\\_015156/pdf/CSTA\\_015156.pdf](http://portal.acs.org/preview/fileFetch/C/CSTA_015156/pdf/CSTA_015156.pdf)
- “Washing Water,”  
[http://portal.acs.org/preview/fileFetch/C/CSTA\\_015178/pdf/CSTA\\_015178.pdf](http://portal.acs.org/preview/fileFetch/C/CSTA_015178/pdf/CSTA_015178.pdf)
- “Milli Recycles & You Can, Too,”  
[http://portal.acs.org/preview/fileFetch/C/CSTA\\_015164/pdf/CSTA\\_015164.pdf](http://portal.acs.org/preview/fileFetch/C/CSTA_015164/pdf/CSTA_015164.pdf)



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