Environmental Science

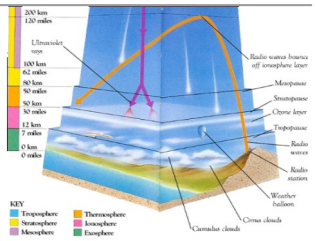
Earth Systems

Many things in Environmental Science involve non-living aspects of our world. This includes the atmosphere, water, soil, and even plate tectonics.

The Atmosphere

The layer of gases surrounding the Earth are known as the atmosphere. These are separated into many different layers.

Troposphere: The weather breeder
- Extends 17km (11 miles)
- Extends 8km (5 miles) above the two poles
- Is composed of 78% Nitrogen and 21% Oxygen



Stratosphere: Earth's Global Sunscreen
- Extends 17km - 48km (11 - 30 miles) above
- High concentration of ozone
- Stops about 95% of UV Radiation from reaching the surface

Mesosphere:
- Extends 50km - 85km (31 - 53 miles)
- Temperature drops with increasing altitude
- The third layer of the atmosphere

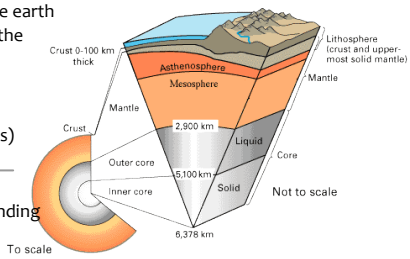
Earth

The earth is divided into sections similar to the atmosphere. These are sections of organic and inorganic areas.

Biosphere: Zone of earth where life is found (Extends 12 miles high)
- Contains the atmosphere, hydrosphere, and the lithosphere
- Where life is found
- Sometimes called the ecosphere

Hydrosphere: Earth's water supply
- Liquid water (oceans, lakes, and other bodies of surface water)
- Frozen water (polar ice caps, floating ice caps, and permafrost)
- Water vapor (in the atmosphere)

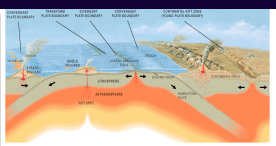
Lithosphere: Outer shell of the earth
- Composed of crust and the rigid, outermost part of the mantle, outside the asthenosphere.
- Hold the tectonic plates
- 10km - 65km (6 - 40 miles) deep



Mantle:
- Thick, solid zone surrounding the earth's core
- Mostly solid rock, however on the outer edge of the mantle there is a very hot zone of rock that is half melted
- This hot zone is known as the asthenosphere

Core: Inner Earth
- Very hot innermost part of the earth
- The two sections are the inner core and the outer core
- The inner core is solid although extremely hot because of the pressure
- The outer core is made up of molten metal

Plate Tectonics
The Earth's crust is made of many plates. Because of rising magma and heat, these plates are in constant motion. Depending on the type of motion, various geographic structures are produced by the crust running into other plates.

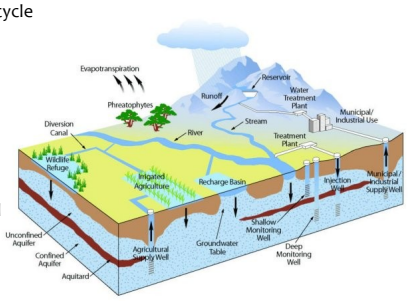


Transform Fault (Strike-slip fault) - Where the plates move in opposite but parallel directions.
Divergent Plates - Where the plates move apart in opposite directions.
Convergent Plates - Where the plates are pushed together.

Water

Surface Water: Water that does not penetrate into the ground or evaporate back into the atmosphere through evaporation and transpiration.
Ground Water: Water that sinks into the ground and remains in an underground aquifer. These aquifers are slowly renewed, and very susceptible to pollution.

Water Cycle: The hydrologic cycle
- Water is evaporated from the surface into the atmosphere
- It condenses, and then falls back to the ground
- When it falls back to the ground, some is runoff, some is used for power, some is used for plants, and some are absorbed into aquifers.
- Plants emit water back through their pores, and the water is then evaporated again, while ground water is just evaporated, and the cycle starts again.

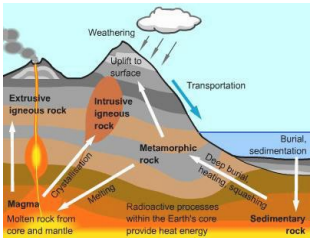


Ocean Currents:
- Ocean currents are very important to transferring heat throughout the world. It is predicted that if these currents were to stop, it would bring ice ages to many countries in Europe.

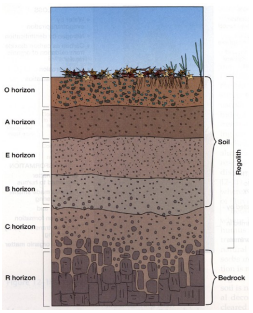
Soil

Soil is very important to our world today. Soil governs where we can grow food, the amount of water available, and the type of scenery that will exist.

Rock Cycle:
The rock cycle does not have a step one. It is a constant recycling of rock matter placed in different conditions, which produce different products. These products are dependent on the time, pressure, and heat that they are exposed to.



Soil Types:
The soil is made out of many different types of materials. These, just like the atmosphere, are divided into categories.



- **O Horizon:** Fresh or decaying organic material, leaves, twigs, etc
- **A Horizon:** Topsoil, holds the organic matter, water, and nutrients needed for plants to grow
- **E Horizon:** Zone in which leeching occurs (not always present
- **B Horizon:** Subsoil, usually contains an accumulation of nutrients and some organic material
- **C Horizon:** Parent material, broken down bedrock. What soil is derived from
- **Bedrock:** Parent material to the C Horizon, very few nutrients and little organic matter

Living World

The other aspect of Environmental Science is the living aspect. This includes ecosystems, energy flow, and the cycle of nutrients that are vital to life.

Ecosystems

Ecosystems are the communities of different species that interact with each other, and the non-living factors.

Populations and Communities:
- A population is a group of individual organisms of the **same** species living in a particular are.
- A community is many populations of **all** species living and interacting in a particular area during a particular time.

Although there is a strong similarity between populations and communities, the difference is significant, and should be specially noted.

Niches:
- Way of life for a specific species in an ecosystem
- Includes all physical, chemical, and biological conditions a species needs to live and reproduce in an ecosystem
- Is very useful when describing a species, and when classifying a population.

(Living World Continued...)

LIVING WORLD (CONTINUED)

Species Interactions (Symbiosis)

- **Parasitism:** Parasitism is when one species (**parasite**) feeds by eating another organism (**host**). Parasite—Benefits Host– Harmed
- **Mutualism:** Two species involved, and interact in such a way that it is beneficial to both species. Species1—Benefits Species2—Benefits
- **Commensalism:** Benefits one species, but the other species is neither harmed nor benefits. Species1—Benefits Species2—Neither
- **Predation:** Two species involved, and interact so that one species preys on the other species.

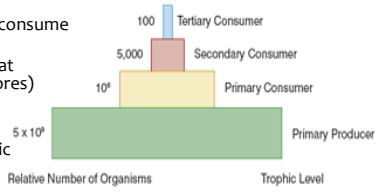
Interspecific competition is when organisms in two different species battle for the same resources. This creates stress among both organisms, and creates **competitive exclusion.**

ENERGY FLOW

Energy is a necessary aspect to any motion in the world. All living things need energy to function properly. How energy flows from species to species is very important.

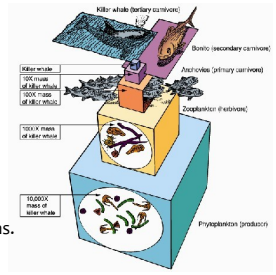
Trophic Levels:

- **Tertiary Consumers:** Organisms that consume secondary consumers. (Carnivores)
- **Secondary Consumers:** Organisms that consume primary consumers (Carnivores)
- **Primary Consumers:** Organisms that consume producers (Herbivores)
- **Producers:** Organisms that use organic and inorganic materials from the environment to grow



Energy Loss: Energy is always lost when it is transferred from one trophic level to another trophic level. Energy cannot be destroyed, but the quality of energy changes, and cannot be used as readily.

Biomass: The dry weight of all organic matter contained in its organisms
Pyramid of Energy Flow: A pyramid that illustrates the amount of energy lost when it is transferred from trophic level to trophic level.
Gross Primary Productivity: The rate at which the producers change solar energy into chemical energy for biomass.
Net Primary Productivity = Rate at which biomass is stored (GPP) - Rate at which chemical energy stored as biomass is used.



Food Chain: A food chain is a list of organisms that eat the organism that precedes it on the chain. Each member of a food chain is usually on a different trophic level. It is a good display of how energy is transferred through various animals.
Food Web: A food web is a complex network of food chains. They have many different organisms, and are connected to one another through a common organism. Trophic levels can also be assigned to food webs.

ECOSYSTEM DIVERSITY

Biodiversity: Biodiversity is a variety of different species, variability, ecosystems, and functions needed for living. There are many different types of biodiversity, and they are used to determine the health of a specific environment or a region.

- **Genetic Diversity:** A difference in the genetic makeup of a particular individuals in specific species.
- **Species Diversity:** A variety among the species or types of living organisms found in different habitats around the earth.
- **Ecological Diversity:** A number of different forests, deserts, grasslands, streams, lakes, oceans, coral reefs, wetlands, and other biological communities.
- **Functional Diversity:** Chemical or biological functions that are needed for organisms to survive. These include energy flow and matter recycling.

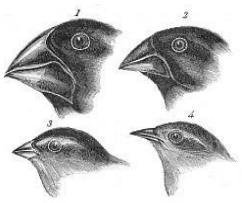
There are many risks to biodiversity. One of the main risk is the loss of habit, which is causing extinctions. Many studies show that one out of every eight known plant species is threatened with extinction. Many estimates place the number around 140,000 plants a year.

One major threat to biodiversity is the easy types of travel. Many animals that have diversified through the years are now coming in contact with each other by riding a boat overseas, or being brought as a pet across the country. This is causing less and less genetic biodiversity, and the risk of these animals becoming extinct grow rapidly.

Natural Selection:
Natural selection is the process where some individuals of a specific population have genetically based traits that increase their chances of survival and their ability to produce offspring. Favorable traits become more common, because they are the ones who survive to pass on their genes, while unfavorable traits become less common because they are not passed on.

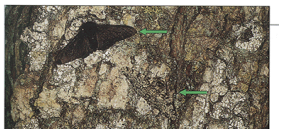
Three necessary conditions:

- **Variability:** There must be a variety of the trait that is to change already available in the population.
- **Heritable:** The trait must be able to be passed down from generation to generation.
- **Differential Reproduction:** The trait must help the organisms to somehow increase its ability to reproduce more rapidly, or create more offspring.



Finches from Galapagos Archipelago

Peppered Moth:
One of the most famous examples of natural selection through microevolution is the peppered moth in England. This moth has camouflaged into two different appearances. One moth is white, to blend in with white lichen that grows on trees in their native habitat, white the dark colored moth blends into the dark colored bark. The number of these moths has varied over time. During a time when the lichen was very prevalent, the white moth was the dominant moth. When the Industrial Revolution started, soot covered the lichen, making the trees dark in color, and the dark moth became prevalent. This is because the prevalent moth could blend into their habitat, and avoid being eaten by predators.



Galapagos Finches:
These finches are also known as Darwin's Finches. They are found on the Galapagos Islands, and they have evolved drastically. They difference that they have encountered are the shapes of their beaks. Depending on what type of food and flower they are around, the finches have different types of beaks to allow them to reach into the stem of the flower they eat from.

NATURAL ECOSYSTEMS CHANGE

Ecological Succession:

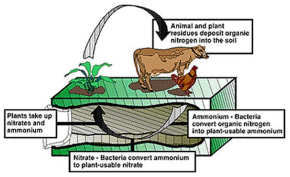
- A gradual change in the species composition of a given area
- **Primary Succession** - The first sign of life moving into lifeless ground. Pioneer species.
- **Secondary Succession** - When some life is present on the ground. Larger plants begin to move into the area, these plants are slower growing, but have more resistance.

Climate Change: See global warming (Global Change)

NATURAL BIOCHEMICAL CYCLES

Carbon Cycle: Based on CO_2 in the atmosphere. Carbon cycles from all living things either into the earth, or into the bottom of the ocean. After enough heat and pressure, the carbon transforms into fossil fuels that contain carbon. When these fossil fuels are extracted and burnt, the carbon is released back into the atmosphere. The carbon cycle is a very long-term, and slow cycle.

Nitrogen Cycle: The nitrogen cycle is broken down into many steps.



- **Nitrogen Fixation** - Bacteria convert N_2 gas into ammonia that can be used by plants
- **Nitrification** - Most of the ammonia is converted to nitrite ions (toxic to plants) and nitrates (taken up by plants).
- **Assimilation** - Plant roots take up ammonia and nitrate ions to make nitrogen-containing organic molecules like DNA, amino acids, and proteins.
- **Ammonification** - Bacteria converts the organic matter that contains nitrogen into simpler compounds of ammonia and salts containing ammonia ions.
- **Denitrification** - Bacteria converts the nitrogen and nitrogen containing salts into nitrite and nitrate ions, and then into nitrogen gas and nitrous oxide gas.

POPULATION

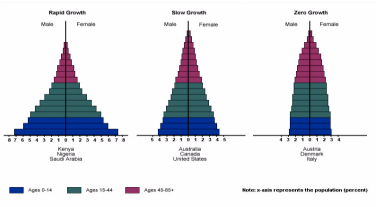
Population is a very serious issue when it comes to our world and our earth. The earth's human population is growing at a very fast rate. It is predicted to double again in around fifty years. A serious issue of our world is where all the people are going to live, and where all the food is going to be produced. This concern is pushing many countries to create laws on how the amount of children allowed, and other laws trying to slow the growth rates.

DEMOGRAPHICS

Age Structure Diagrams: A diagram showing the proportion of the population of each sex at each age level. They show either both percentages or number of a specific gender at each age group.

There are four main types of growth patters that can seen in an age structure diagram.

- **Rapid Growth** - Rapid growth is seen when a very high percentage of the population are newborns. The population is increasing exponentially, and very rapidly. This type of growth is going on in countries such as Guatemala, Nigeria, and Saudi Arabia.
- **Slow Growth** - This growth pattern has a population that is spread how a slowly growing country's population should. The highest percentage is the youngest, but not by very much. This type of growth is happening in the United States, Australia, and Canada.
- **Zero Growth** - This pattern shows no growth happening at all. The percentage of the population is almost equally spread out through the whole population. This growth is occurring in Spain, Austria, and Greece.
- **Negative Growth** - Negative growth shows a lower percentage of the population in the young than in the old. This is a very bad sign for countries because their future in uncertain. Some of these countries are German, Bulgaria, and Sweden.



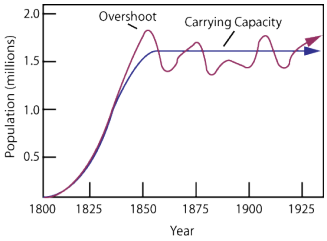
(Population Continued...)

POPULATION (CONTINUED)

Biotic Potential - A population's capacity for growth. The maximum rate of growth if there are no limitations on the population.
Environmental Resistance - All the factors acting together to limit the growth of a population.

CARRYING CAPACITY

Carrying Capacity - The biotic potential and the environmental resistance combined. The carrying capacity is the number of individuals a of a particular species that can live in a set area.

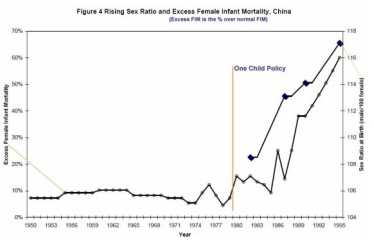


Isle Royal National Park
One of the most famous study sites of carrying capacity and predator prey relations. This is a closed park to dogs in order keep the death variables low. In the park, there are usually 25 wolves, and 1000 moose, but the numbers change every year. This is used to study how the carrying capacity changes based on the amount of a certain species.

Easter Island
When Easter Island was first inhabited 1000 years ago, the island had plentiful natural resources, and only 100 humans living there. Some time later, the island was reported of having 3000 inhabitants, and very few natural resources. Because the carrying capacity was lower than 3000 people, the population dropped rapidly because of disease, cannibalisms, and invasive species. By 1877 the island only had only 110 inhabitants.

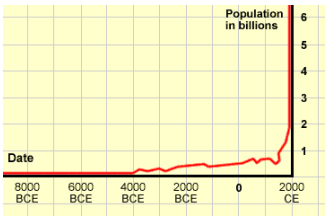
CULTURAL AND ECONOMIC EFFECTS

Cultural Effects
Population greatly effects the culture of many different societies. On example of this is the One Child policy in China. Because of the quickly growing population in China, most families are only allowed to have one child per household. This is an attempt to slow the birth rate so that it does not become too much higher than the death rate.
This has caused many problems in China. Because heritage is very important in China, most households want to have a boy to carry on the family name. Also, boys are viewed higher than girls in China. This causes many problems because families are receiving many legal and illegal abortions in an attempt to choose the gender of their only child. Parents are also abandoning their girls on the sides of roads, in trash cans, and many other horrific types of murder. The death rate of girls has increased dramatically. The ration of boys to girls has also increased rapidly. This is going to cause many problems when these children are trying to find someone to marry.



Economic Effects
There are many potential economic effects with rapid population growth. One of these effects are an increased cost of buying real estate in the world. With a decrease in available land and an increase in demand, the cost of most items will rise rapidly. Another economic issue is if and when we overshoot our human carrying capacity, and the population crashes, the supply of all products will be very high, but the demand will be low. This will cause many companies to loose profits, and many to go bankrupt.

HUMAN POPULATION ISSUES



The main issue with human population is the population is growing exponentially. Because of advancements in human rights, medical technology, and standard of living, the population in the past 1000 years has increased more rapidly than ever before. We do not completely understand how far the population will go, or how long it will take it to reach it's maximum capacity.

Doubling Time: The equation for calculating the time for a population to double is dividing 70 by the percentage growth rate. The growth rate of the world is currently approximately 1.14%. This means that the doubling time of the population of the world is 61.4 years. The earth's growth rate was the highest it had ever been in the 1960's, when the growth rate was 2% and the doubling time was approximately 35 years.

The undeveloped nations are suffering the worst from over population. The medical care and the facilities available are not sufficient to sustain the current population.

LAND & WATER USE

The use of land and water in our world is very important. Food and water are one of the three necessities of life. In order for these to be consumed for us, we must ensure that we are protecting them, or else we could potentially run out. Humans have depended on three different systems in the past for food: Croplands, Rangelands, and Oceanic Fisheries.

AGRICULTURE

There are two main types of agriculture. Agriculture is very important to the growing of our foods, and without it, most of the world's population would stave to death.

Industrialized Agriculture (High-input Agriculture) - Needs large amounts of fossil fuels, water, commercial fertilizers, and pesticides to produce large quantities of a single crop (monoculture).

- Used on 25% of cropland (mostly in developed countries)
- **Plantation Agriculture:** A type of Industrialized Agriculture in developing tropical countries. They grow cash crops on large monoculture plantations, mostly to sell to developed countries.
- Livestock is being produced companies in a similar way. They are being taken care of as a mass, not as individuals.

Traditional Agriculture - There are two main types of this type of agriculture. Traditional agriculture is used by about 2.7 billion people in the world (44%) in developing countries and provides for about 20% of the worlds food supply.

- **Traditional Substance Agriculture:** Uses mostly human labor and draft animals to make only enough crops that are necessary for the farmer and his family to survive.
  - Very low amount of energy are needed to grow the food, but the outcome is also very small
  - Profits are very low if there are any.
- **Traditional Intensive Agriculture**
  - Farmers increase their input of human and animal labor, fertilizer, and water
  - Higher yield per area of cultivated land
  - Able to produce enough to feed family, and some to sell for a profit

Sustainable Agriculture
Sustainable agriculture is being pushed by environmentalists so that this is the only type of farming that is done.

- The amount of land available is only going to decrease with a growing population
- It may also be limited by a lack of water for irrigation, lower genetic diversity, and existing cropland degradation.
- Produces equivalent yields with lower carbon dioxide emissions
- Uses about 50% less energy than conventional farming

Increase	Decrease
High-yield polyculture	Soil erosion
Organic Fertilizers	Soil salinization
Biological pest control	Aquifer depletion
IPM	Loss of biodiversity
Crop rotation	Loss of prime cropland
Soil Conservation	Food waste
Use of more water -efficient crops	Population growth

- Improves soil fertility
- Provides more habitat for wild plant and animal species
- Generally more profitable for the farmer than high-input farming

Preventing Soil Erosion

- **Conventional-tillage farming:** farmers plow and break up the soil to make a planting surface. Very vulnerable to erosion, and much is washed away in the winter.

- **Conservation-tillage farming:** (minimum-tillage or no-tillage farming) The soil is disturbed as little as possible to help prevent soil erosion. In minimum – tillage farming, special machines loosen the subsurface without turning over the soil.
- **Terracing:** Useful when planting on a hillside, flat tiers are cut into the hillside, and the crops are grown row by row.

- **Contour farming:** Planting rows of crops along the contours of a gentle hill. Each crop helps to slow water and reduce erosion.

- **Establishing windbreaks (shelter belts):** Trees that reduce wind erosion, help retain soil moisture, supply some wood for fuel, and provide habitats for birds and other animals.
- **Gully Reclamation:** Restoring severely eroded bare land by planting fast-growing shrubs, vines, and trees to stabilize the soil, build small dams to collect silt and replacing the soil, and building channels to divert the water.

FORESTRY

Old Growth Forests - Uncut forests or regenerated forests that have gone undisturbed by humans or natural disasters for at least several hundred years. They provide many ecological niches for many different species.
Secondary-Growth Forests - From secondary ecological succession, after trees have been removed due to human activities such as clear cutting, or from natural disasters such as hurricanes.

Tree Plantations

- Tracks of same-aged trees of one species
- Replanted and cut again on regular cycles
- Occupy 5% of the worlds tree cover
- Are mostly placed where old growth and secondary-growth forests existed

(Land and Water Use Continued…)

LAND & WATER USE (CONTINUED)

FOREST FIRES

Forest fires can be very important to the ecosystem in forests. They can help clear material on the forest floor, and can help control the growth in a forest.

Surface Fires: These fires are small, and only burn the brush on the ground. These fires can kill seedlings, but does not effect most of the larger, stronger trees. This process can:

- Remove a buildup of flammable material, that if left for a long time, could cause a much more destructive fire.
- Release minerals into the ground that were in slowly decomposing plants.
- Increase the activity of nitrogen-fixing bacteria.
- Stimulate the germination of certain tree seeds (giant sequoia, lodgepole pine, and jack pine)
- Help control pathogens and insects

Crown Fires: Extremely hot fires

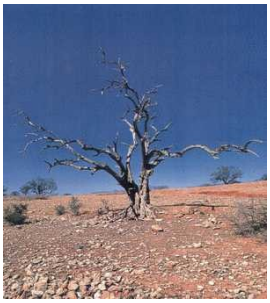
- Start on ground, but eventually burn entire trees
- Leaps from treetop to treetop
- Usually occur in forests where no fires have occurred for many years because flammable sticks and leaves, along with other material builds up on the ground, creating more fuel.
- Destroys most vegetation
- Kills wildlife
- Increase soil erosion

RANGELANDS

- About 40% of the land on earth that is not covered by ice is **rangeland**.
  - Too dry
  - Too sloped
  - Too infertile
- Supplies land and food for grazing animals
- 3.3 billion cattle graze on 42% of the worlds rangeland

Over Grazing: When too many animals graze for too long. The animal population exceeds the carrying capacity.

- Lowers the net primary productivity of grassland vegetation
- Increases erosion of the soil
- Compacts the soil, lowering the porosity



Desertification: The potential productivity falls by 10% or more because of

- Natural climate change
- Human activities that change the soil composition
- Moderate Desertification: 10-25% drop in productivity
- Severe Desertification: 25-50% drop in productivity
- Very Severe Desertification: 50% or more drop in productivity.

Rangeland Management: There are three basic steps to rangeland management:

1. Control the number, types, and distribution of livestock on grazing land
2. Deferred grazing
3. Rangeland restoration and improvement

The most popular method for rangeland management is controlling the number of grazing animals that are on the grazing lands, but short term profits are lost that way, so persuading people to switch is very difficult.

OTHER LAND USE

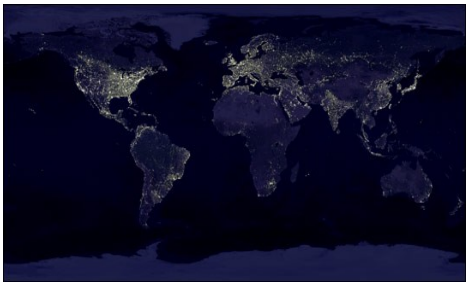
Urban Land Development

Urban Growth: The rate of increase of urban populations

- **Natural Increase:** More births than deaths
- **Immigration:** People moving out of rural areas and being *pushed* into urban areas by factors such as poverty, lack of land, and declining agricultural jobs available in the rural land.

The proportion of people living in urban areas is increasing. Everyday 16,000 move to an urban city. Also, the number of large cities has increased rapidly in the last 100 years. Problems that arise with large cities are

- Severe air pollution
- High Unemployment
- Deafening noise
- High crime rate



MINING

A mountaintop removal site

Open Pit Mining: Machines dig holes to remove ores, sand, gravel, and stone (limestone and marble)
Dredging: Chain buckets and drag lines are pulled and scraped underwater to pull up underwater mineral deposits
Area Strip Mining: Flat terrain only. Earth mover removes all the trees and brush, and then a power shovel digs a hole to remove the mineral deposit. The hole is then filled with dirt, and a new hole is dug parallel to the original. This process is repeated over the entire site.
Contour Strip Mining: On hilly sites, a power shovel cuts a series of terraces into the side of the hill. The minerals are removed, and then they move up, dumping the soil from the new hole into the old hole.
Mountaintop Removal: The top of a mountain is removed through the use of explosives and heavy machinery, exposing seams of coal underneath. This is very popular in West Virginia, but it cause considerable environmental land damage.

FISHING

Fisheries: Areas of specific aquatic animals that are suitable for commercial resale in a given ocean or inland body of water.

Most of the commercial fishing is done by industrial fishing fleets that use:

- GPS
- Sonar
- Large Nets
- Spotter Planes
- Factory ships that can process and freeze their catches

This gives the large companies a huge advantage over the smaller companies that cannot afford the equipment and the services necessary to compete.

Fishing Types:

Purse-seine fishing: Catches surface dwelling fish by pulling up a large net the shuts through the use of a drawstring like system
Longlining: Fishing ships put out lines up to 80 miles long with thousands of baited hooks to catch open-ocean species like swordfish, tuna, and sharks
Drift-net fishing: Fish are caught in huge drift nets. These nets can be up to 50ft underwater, and be up to 34 miles long

POLLUTION

Pollution is defined as an "undesirable change in the physical, chemical, or biological characteristics of air, water, soil, or food that can adversely affect the health, survival, or activities of humans or other living organisms.

POLLUTION TYPES

Air Pollution:

Air pollution is one of the most common types of pollution that effects us constantly. This is because we are always breathing air, and we have the more contact with it than any other substance.

Sources:

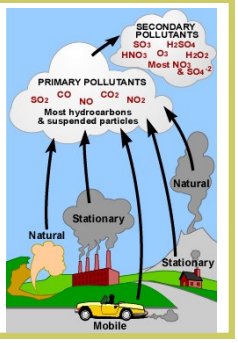
Human Activity (Burning Fuel): These activities include combustion-fired power plants, controlled burns in agriculture and forest management, motor vehicles, and burning wood, fireplaces, stoves, furnaces, and incinerators, and marine vessels and related port air pollution.

Other Human Activities: Other things that we do to create air pollution include oil refining, chemicals from farming, dust from farming, paint fumes, aerosol sprays, waste deposition in landfills, and military uses like weapons and gasses.
Natural Sources: Humans are not the only source of pollution. Other sources include dust from erosion, methane from animal digestion, radon gas, smoke and carbon monoxide from wildfires, and volcanic activity.

Primary v. Secondary

Primary Pollutants: Emitted directly into the troposphere in a *potentially* harmful form. These include carbon dioxide, carbon monoxide, sulfur dioxide, nitric oxide, and nitrogen dioxides.
Secondary Pollutants: Primary pollutants that react with one another or with basic components of air to form new pollutants. These include sulfur trioxide, ozone, and dihydrodioxide.

(Pollution Continued...)



POLLUTION

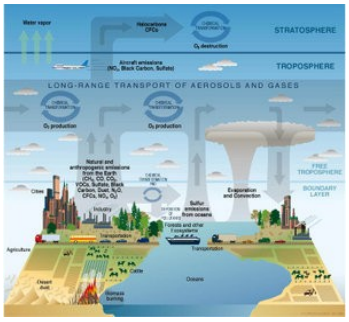
Smog:

Smog consists mostly of sulfur dioxide, suspended solid particles, and suspended droplets of sulfuric acid. It is created mainly through the burning of fossil fuels such as oil and coal. When two sulfur dioxide molecules react with one oxygen molecule, sulfur trioxide is formed that then reacts with water vapor to form sulfuric acid.

$2\ SO_2\ (g) + O_2\ (g) \rightarrow 2SO_3\ (g)$

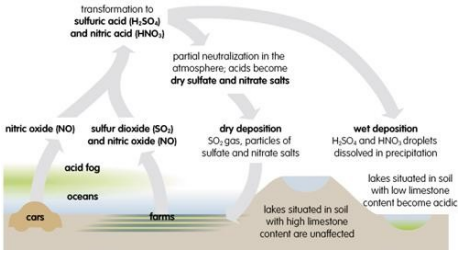
$SO_3\ (g) + H_2O\ (l) \rightarrow$ **H_2SO_4 (aq)**

Industrial smog is not a large problem today because most of the coal burning is done in large boilers with descent pollution control. It is, however, still a problem in parts of urban China, India, Ukraine, and a few Eastern European countries.



Acid Deposition

Pollutants such as nitric oxide (NO) and sulfur dioxide (SO_2) are emitted into the atmosphere as gasses. They then react with water vapor in the atmosphere to create nitric acid (HNO_3) and sulfuric acid (H_2SO_4). The wind commonly blows them away from cities and their place where they were emitted, and they fall as acid rain and snow into lakes and soils. If the water or soil is high in limestone or other high pH materials, then the acid rain will be neutralized, and the effects will be minimal. If the water or the soil has nothing to buffer the acidity, they will also become acidic, and could cause harm to many organisms.



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Noise Pollution:

A common hazard to residents of urban areas, noise pollution is any unwanted disturbing, or harmful sound that impairs or interferes with hearing, causes stress, hampers concentration and work efficiency, or causes accidents.

Reducing Noise Pollution

Possible ways to reduce noise pollution include modifying noisy activities and devices to produce less noise, shielding noisy devices or processes, shielding workers from noise, moving noisy operations or things away from people, and using anti-noise.

Water Pollution:

Water pollution can be very dangerous because it can spread so easily in water. It can also be harder to know if water is clean or not because many things dissolve into it.

Sources

Some possible sources of water pollution are industrial discharge of chemical wastes, discharge of poorly treated sewage, surface runoff containing pesticides or fertilizers, surface runoff containing petroleum products, acid rain, eutrophication due to runoff, and underground storage tanks leaking

Contaminants

Possible contaminants that might be included in water pollution are insecticides, herbicides, bacteria (sewage), pathogens, heavy metals, acidity, chemical waste, fertilizers (nitrates and phosphates), and silt.

Groundwater

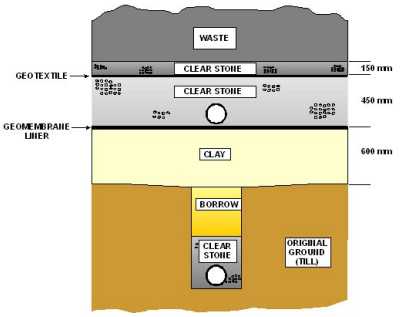
Groundwater is very important to our agriculture system and to our nation, but it is also very easy to contaminate. Because the water is located underground, it is very difficult for us to determine if the groundwater is contaminated with any pollutants or not. This can be very dangerous to many organisms if the water is not checked periodically to ensure the safety of the water.

Solid Waste:

Solid Waste is any unwanted or discarded material that is not a liquid or a gas. The United States composes only 4.7 % of the world's population , but produces 33% of the world's solid waste, and about 98.5% of this comes from mining. The other 1.5% comes from homes and businesses, and usually goes strait to landfills.

Solid Waste Disposal

Originally, dumps were places where people just threw their trash into a large pile, and let it sit. This caused many environmental problems such as contaminated ground water. More recently, methods have been developed so that the waste is separate from the ground. This includes a waste cell. There are substantial layers between the waste and the ground to prevent leaking. Also, everyday, the waste is covered with soil to prevent the waste from blowing away, or leaking into the atmosphere.



IMPACTS OF POLLUTION

Pollution has many negative impacts on all types of life. There are no good things that can come out of pollution , and if we keep polluting our planet, we may ruin it ourselves.

Human

- Bad air quality can kill many organisms
- Ozone can cause respiratory disease, cardiovascular disease, throat inflammation , chest pain, and congestion
- Water pollution causes about 14,000 deaths a day usually due to contamination of drinking water
- Oil spills can cause skin irritations and rashes
- Noise pollution causes hearing loss, high blood pressure, stress, and sleep disturbance

Environmental

- Sulfur dioxide and nitrogen causes acid rain, which reduces the pH of the soil and water
- Soil can become infertile, and unusable by plants
- Smog can reduce sunlight that reaches the plants, and restrict their ability to photosynthesize

Hazardous chemicals in the environment can cause many deaths to organisms. Also, nuclear waste is extremely hazardous, and it is difficult for us to find a place to store it.

Biomagnification: Causes many deaths in animals that are high in the food chain. If a lake becomes slightly contaminated with a hazardous chemical, the frogs will also then become slightly contaminated. It might not harm them very quickly, but then when they are eaten by a snake, the snake will eat many, contaminating himself greater than the frogs were contaminated. When an eagle eats some snakes, it has even further contaminated itself, and it may die from the contamination.

ECONOMIC IMPACTS

There are many economic impacts of pollution. One factor that plays into the cost of pollution is prevention v. clean up. It is much more economically sound to prevent the pollution at the beginning than to pay for the clean up of the pollution later. Although it may seem more expensive to produce something using an environmentally safe procedure, in the long run, it will become very advantageous.

ENERGY

Energy is one of the most important concepts in the environment. It is the capacity to do work by performing mechanical, physical, chemical, or electrical tasks or to cause a heat transfer between two objects at two different temperatures.

ENERGY CONCEPTS

Kinetic Energy: Energy that matter has when it has mass or velocity. Examples of kinetic energy are anything in motion such as wind, flowing streams, heat flowing from a body at a high temperature, and electricity.

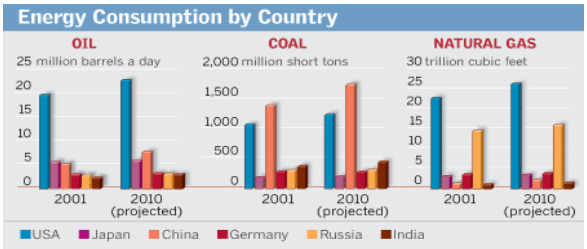
Potential Energy: Energy that is stored and could potentially be used. Examples of potential energy are a rock held in your hand, an unlit stick of dynamite, water behind a dam, chemical energy in gasoline molecules, and nuclear energy stored in the nuclei of atoms.

Conservation: Conserving energy is very important because not all types of commercial energy are renewable. Most of our energy that we use in our homes today comes from non-renewable resources. This is very important because if we run out of fuel for our energy, we will have to do without until we can find a new source of energy.

ENERGY CONSUMPTION

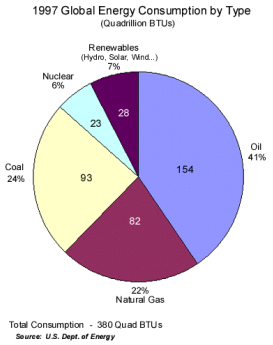
The United States is the largest consumer of energy. Although our population is much less than other countries, our high standard of living calls for a high use of electricity.

(Energy Continued...)



ENERGY (CONTINUED)

The world is very dependent on non-renewable fossil fuels. Almost 1/2 of the energy that is consumed is produced by oil. If we continue to work on renewable resources, the world will be in a much better situation, and we will not have to worry about running out of resources.



NUCLEAR ENERGY

Nuclear energy is not a renewable resource, but so little matter creates so much energy, that it is almost impossible for us to run out. Nuclear energy still produces 6% of the world's energy today. Although we have the capabilities to create more, it is expensive and also very dangerous because of the radiation and the nuclear waste.

Pros:

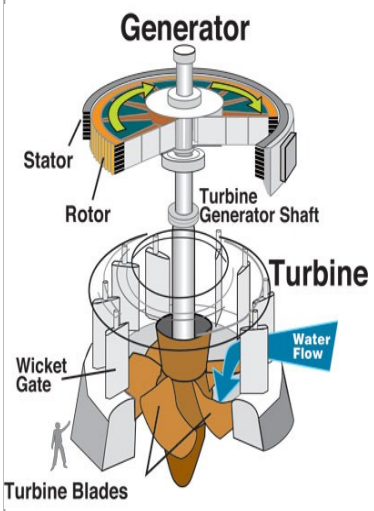
- Large fuel supply
- Low environmental impact
- Emits 1/6 the CO_2 as coal
- Moderate land disruption and water pollution
- Moderate land use
- Low risk of accidents because of multiple safety systems

Cons

- High cost (even with subsidies)
- Low net energy yield
- High environmental impacts with accidents
- Catastrophic events can occur
- No acceptable solution for long-term storage of radioactive wastes and decommissioning worn-out plants
- Spreads knowledge and technology for building nuclear weapons

HYDROPOWER ENERGY

Hydropower is one of the most promising forms of energy because there is little cost involved. Hydropower has been used for centuries, but recently, it has been used for commercial energy. This is very beneficial to the power plants because there is no pollution, and the only expense is the initial dam, and the costs of the initial generators. There is almost no operating cost involved.



Pros:

- Moderate to high net energy
- High efficiency (80%)
- Low-cost electricity
- Long life span
- No CO_2 emissions during operation
- May provide flood control below dam
- Provides water for year-round irrigation of cropland
- Reservoir is useful for fishing and recreation

Cons:

- High construction costs
- High environmental impact
- Floods natural area
- Converts land to lake habitat
- Danger of collapse
- Decreases fish harvest below dam
- High CO_2 emissions from biomass decay in shallow tropical resevoirs

GLOBAL CHANGE

The earth is rapidly changing, as it has in the past. The question that we are unsure of is are we causing the changes, or are they natural changes of the climates.

STRATOSPHERIC OZONE

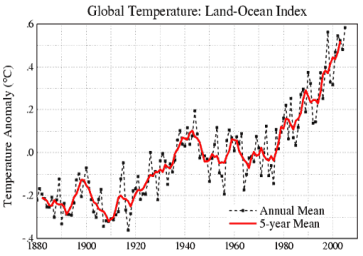
The ozone layer is a layer of O_3 molecules in the Earth's atmosphere. This layer blocks out some UV radiation, and allowing life on earth. When ozone molecules come in contact with certain chemicals, it changes to a less effective form. Most of these chemicals are man-made.

- **Chlorofluorocarbons (CFCs):** are used in coolants such as old refrigerators, and in aerosols.
- **Halons:** are used in fire extinguishers

When these chemicals are released into the atmosphere, the reduce the amount of ozone, and holes start to appear in the ozone. The main position of this hole is over Antarctica. This causes many problems such as human health problems like skin cancer, cataracts, and reduced immune function. Some ecological problems are crop damage and global warming.

GLOBAL WARMING

Global Warming is occurring on Earth today. The temperature has risen 0.5 degrees in the past 100 years. A theory that is widely accepted by many scientists is that because of an increased production of CO_2 by humans, a greenhouse effect is occurring in our atmosphere, and is causing the Earth to warm.



A major fear of global warming is the melting of the polar ice caps, which is predicted to increase sea levels, and ocean will cover much of the current coastal land. This will effect many people because eight of the ten largest cities in the world are located on the coast of a

FREE RESPONSE QUESTION

Question
The city of Mt. Laurel has 5,000 homes. The electricity for these homes is produced by a small coal-powered electrical plant. The average household in Mt. Laurel uses 10,000 kilowatt hours per year. The capacity of the power plant is 13 megawatts.

A.) At the current use of household electricity, how much does Mt. Laurel use each year?

B.) If the power plant runs at full power for one year (8,750 hours) how much energy will be produced?

C.) How many more people could move to Mt. Laurel before needing to upgrade the power plant?

D.) What are two pros and cons to using fossil fuels opposed renewable energy?

Grading

A.)
(2 points)
One point for correct setup
One point for correct answer

5,000 homes * 12,000 kW hours / year = 60,000,000 kWh / year

B.)
(2 points)
One point for correct setup
One point for correct answer

13 MW = 13,000 kW
13,000 kW * 8,750 hrs / year = 113,750,000 kWh / year

C.)
(2 points)
One point for correct setup
One point for correct answer

113,750,000 kWh / year potential - 60,000,000 kWh / year already used = 53,750,000 kWh / year potential leftover
53,750,000 kWh / year / 10,000 kWh / home = 5375 more people could move into Mt. Laurel

D.)
(4 points)
Two points for benefits
Two points for cons

Pros	Cons
-Low cost -Plentiful (Coal) -Compact generators -Most of the plants are designed to handle fossil fuels, not renewable resources	-Not sustainable -Produces a lot of CO_2 -Mining is very destructive -Large quantities of ash -Oil spills and other types of pollution