CHAPTER 53.

Energy Flow- the flow of energy; it's a one-way flow. It starts with the sun, which provides all of the sun that we use on Earth. Autotrophs (organisms that make their own energy through photosynthesis and the like) capture the energy from the sun. Heterotrophs (creatures that get energy from other organisms) then eat the autotrophs and collect their energy from the autotrophs.

Food Chain- Producer: grabs energy from the sun
Primary Consumer: Eats producers to get energy
Secondary Consumer: Eats primary consumers to get energy
Tertiary Consumer: Eats secondary consumers to get energy
Saprotrophs: Decomposers such as mushrooms
(These are known as Trophic Levels)

With each step in the chain, approximately 90% of the energy is lost. If the producer has 1,000 units of energy, the primary consumer will get approximately 100 of that 1,000 (the rest was spent by the producer to perform its daily functions); the secondary consumer would then get 10 units and the tertiary only 1 unit. As a consequence, the higher levels of the food chain have a harder time getting energy than the lower levels.

Food Web- an actual representation of the way that things eat one another in nature. Many consumers are not only primary or secondary consumers. They eat animals from many trophic levels, and indeed, in some cases the chain can be reversed (such as with centipedes who can be eaten by large birds but can also eat small birds.)

Ecological Pyramids- charts used to show the food chains as they relate to energy flow.

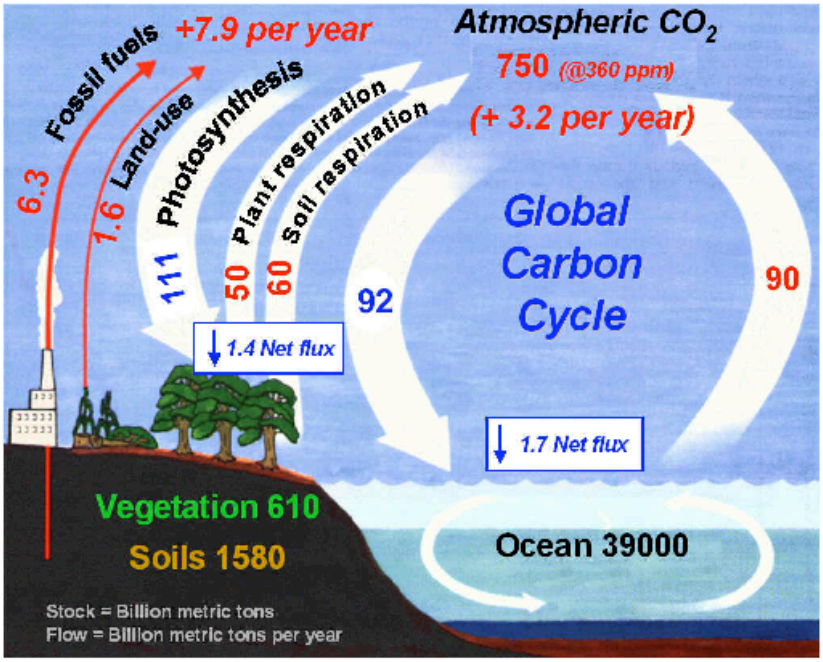
A Pyramid of Numbers just shows the number of organisms in each trophic level for a given area; it's not all that useful.

Pyramid of Biomass shows the amount of biomass there are in each trophic level. Generally speaking, more biomass = more energy needed. As a result, the different in biomass from one level to another is *about* the 90% loss that was explained earlier. Now, the graph on 1186 shows that's not *always* the case- there's 40,000 kg of producers and only 4 kg of primary consumers there, but that's also in Panama's rain forest where there's far more vegetation than anything else.
The pyramid can be inverted, sometimes. If you have something like an algae bed, where the producers reproduce incredibly rapidly, the primary consumers can outnumber the producers and eat more than should be capable of regrowth, but because of the high reproductive rate, it grows back and the system balances out.

Pyramid of Energy is literally the pyramid of energy flow, and it follows the 90% reduction from one level to the next.

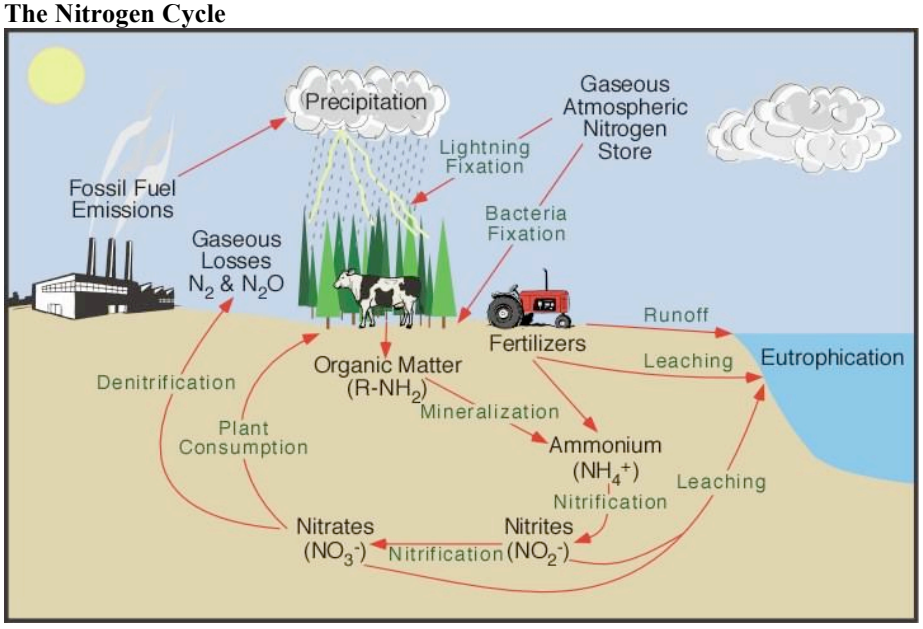
Gross Primary Productivity (GPP) is the total amount of energy created by plants.
Net Primary Productivity (NPP) is what you're left with when you take the GPP and subtract all of the energy the plants already used for respiration.

The Carbon Cycle



That basically sums it up- there's not much more that you need to know than where the carbon is and how it's getting from one place to another. Just know that respiration is primarily animal and soil microorganisms rather than plants. There's also erosion into the water where the CO_2 in the soil dissolves into the water.

The Nitrogen Cycle



This process is somewhat more complicated. There are several steps to the nitrogen cycle

1) Nitrogen fixation. Nitrogen (N_2) becomes fixed to hydrogen to become ammonia (NH_3). As a consequence, it's now a more usable chemical combination. This is done through the microorganisms in the soil. They use an enzyme called *nitrogenase* to accomplish this task. This happens deep in the soil in an oxygen-free environment.

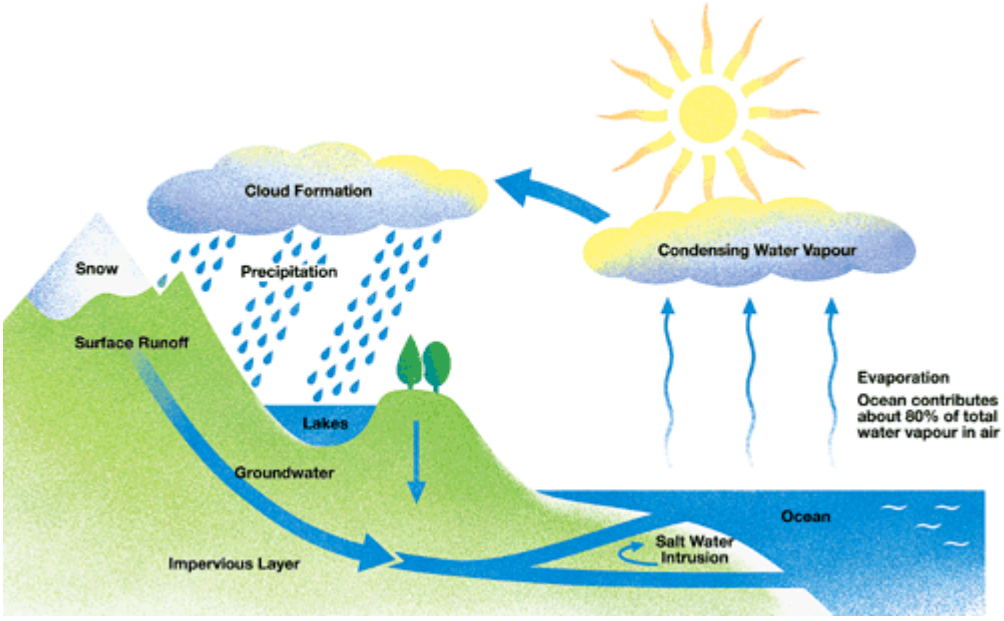
2) Nitrification. Ammonia or Ammonium (NH_4) becomes converted into nitrate (NO_3). First, bacteria in the soil turns the ammonia into nitrite (NO_2) and then other bacteria oxidize the nitrite into nitrate. This is a process that the bacteria do to gain energy.

3) Assimilation. Roots in plants absorb ammonia, ammonium and nitrate and use it in their proteins and in their chlorophyll. Primary consumers eat the plants and add the nitrogen to their system. Animals farther up eat those consumers and also get nitrogen in their system.

4) Ammonification. Animals excrete nitrogen rich urea or uric acid. Animals that die also have nitrogen in their systems. These are then assimilated back into the environment as ammonia. It's then reused in nitrification and assimilation. However, during nitrification, there's one last thing that can happen.

5) Denitrification. Nitrates are reduced to their basic Nitrogen form (N_2). This Nitrogen then returns to the air to start all over again.

The Aquatic Cycle



Surely you know this one… Know the words precipitation, evaporation, condensation, percolation (water going into the ground to become groundwater), and runoff; you'll be fine.

Chapter 55
Pgs 1232-1242.
Extinction: death of a species, occurs when the last individual member of a species dies.
Example: Dusky Seaside sparrow.

- Found in Florida, became extinct in 1987 due to human destruction of its habitat.

Biological Diversity: variety of living organisms, from genes to the ecosystems in which they live.

- Species richness- number of different species
- The genetic variety within a species
- Ecosystem diversity- variety of interactions among ecosystems.

Biggest Mass extinction ever-

- Different in several aspects
  - Cause directly attributed to human activities.
  - Occurring in compressed period of time

- More plant species are becoming extinct today than in previous mass extinctions.

Endangered species- numbers are so severely reduced that it is in imminent danger of extinction throughout all or significant part of its range.

Threatened Species- extinction is less imminent but the population of particular species is quite small.

Species become extinct for many reasons:
1. Destruction or modification of habitats
2. Production of pollution
3. Upset delicate balance of organisms in an given area, introducing new species
4. Illegal hunting
5. Commercial harvesting.

Habitat Fragmentation- breakup of large areas of habitat into small, isolated patches, are supported by extensive scientific evidence.
Exp: Humans leave small isolated patches of natural land cut off by roads and such. Species then from the surrounding 'developed' landscape might intrude the isolated habitat, or species that prefer isolated habitat may occur in greatly reduced numbers.

Biotic pollution: introduction of a foreign, or nonindigenous species into an area where it is not native.
- Upsets the balance among organisms living in that area.
- Causes greater negative change than common predators.

Ex: Mussels

Humans affect Biodiversity:
Commercial harvest- removes live organism from the wild.
Ex: rare parakeets thrive on black market for money and thus are thereatened species currently.

Grates biological diversity declining: Cali, Florida, Hawaii.
Rain forests are fastest declining ecosystem.

Conservation biology: scientific study of how humans impact organisms and of the development of ways to protect biological diversity.

In situ- establishment of parks and reserves, concentrates on preserving biological diversity in nature.
- Can't guarantee preservation of all types of biological diversity.
- Best way to preserve biological diversity.
- Natural ecosystems offer best strategy for long-term protection.

Protected areas for in situ conservation are not always effective because the biological diversities are greatest in developing countries but little money or expertise is used to manage them.

Ex Situ Conservation: Involves conserving biological diversity in human-controlled settings.
Exp: Zoos
Restoration ecology- principles of ecology are used to help return a degraded environment as close as possible to its former state.

Ex situ- used in an attempt to save species on the brink of extinction
Techniques used-

Artificial insemination: sperm is collected from a suitable male of a rare species and is used to impregnate a female.
Embryo Transfer: a female of rare species is treated with fertility drugs, which cause her to produce multiple eggs. Some of these eggs are collected, fertilized with sperm and then surgically implanted into females of a related but less rare species who later give birth to offspring of the rare species.

Ex: African Wildcat to a common house cat.

Endangered Species Act- 1973, authorized to protect threatened species of US and aboard.

International organizations:
WWF- studying the effects of fragmentation on the Amazonian rain forest.

CITES- 146 countries participate in it.

- Originally drawn up to protect endangered animals and plants considered valuable in the highly lucrative international wildlife trade.
- Bans hunting, capturing or selling endangered animals.
- Controversies surround CITES on who actually owns wildlife and whether global conservation concerns take precedence over competing local interests.
- EX: African Elephant- was listed as endangered in 1989 to halt slaughter of elephants driven by ivory trade, and then the species seemed to recover too large for their habitat and started knocking over trees and habitat necessary for other animals. Organizations in US started to develop birth control pills to reduce elephant births, however African people wanted to cull the herd periodically in order for profit.
    - CITES in 1997 transferred these populations to a less restrictive potential threatened listing to allow trade of stockpiled ivory to Japan.

National Conservation Strategy- a detailed plan for managing and preserving the biological diversity of that specific country.

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

Outline the use of the Simpson diversity index.
D = diversity index
N = total number of organisms of all species found
n = number of individuals of a particular species
The Simpson diversity index is a measure of species richness. A high value of D suggests a stable and ancient site and a low D value could suggest pollution, recent colonization or agricultural management. The index is normally used in studies of vegetation but can also be applied to Comparisons of animal (or even all species) diversity.

Chapter 55 pgs 1242-1251.
Deforestation is occurring at an unprecedented rate

- Deforestation: temporary or permanent clearance of forests for agriculture or other uses
- Earth's forests are declining each year by fifteen million hectares
- Causes:
    - Firest caused by drought
    - Land clearing practices
    - Expansion of agriculture
    - Construction of roads in forests
    - Tree harvests
    - Insects
    - Diseases
- Why deforestation is bad:
    - Results in erosion of soil and that decreases soil fertility, which can cause mud floods. Soil erosion also effects production of hydroelectric power as salt sulds up behind dams. Soil erosion can also form deserts

- Biological diversity is lost. Many tropical species have limited ecological niches within a forest so they're vulnerable to habitat destruction. Mostly migratory species (birds and butterflies) suffer through this
- Less protection for humans and other organisms. Forests on hillsides and mountains provide protection from floods by trapping and absorbing precipitation and if deforestation occurred, water cannot be held
- Regional and global climate changes/hydrological cycle changes. Transpiring trees release moisture in air and rain falls due to that but when the trees are goine, droughts become common and temperatures rise.
- Increase in global temperature due to increased carbon dioxide. Carbon is released when the trees are cut down or burned

Where and why are forests disappearing?

- Deciduous forests in temperate areas are largely cleared up for housing and agriculture
- Tropical ran forests are cleared up for agriculture, logging, and ranching

Three Major Reasons Why Forests are Cleared:

- Subsistence Agriculture
  - Family produces enough food to feet itself
  - 60% of deforestation caused by this
  - Because many farmers don't own their own land in the developing countries, they go to forests.
  - They first cut down the trees and allow them to dry. Then they burn the area, and plant crops immediately
    - Above method is called slash-and-burn method
    - Yields for first crops are high because of high nutrients but productivity declines rapidly after which they pack up and move to another area of the forest
- Commercial Logging
  - Harvested rainforests in southeast Asia for exporting abroad
  - Most tropical countries allow fast rate of commercial logging because it provides money
  - However, it destroys and reduces value of important natural resources
  - 20% of deforestation caused by this
- Cattle Ranching
  - 12% of deforestation caused by this
  - Central America (mainly)
  - Much of the beef is raised on these ranches and forests and then exported to fast food chains in America (That's why you should be a vegetarian…you can save the animals AND the planet!!!!!!!)
  - After forests are cleared, cattle can graze there for up to 20 years, after which the soil fertility is depleted

Global Warming:

- Due to human actions, we see a significant climate changes
- Earth's temperature is taken by these instruments/methods:
  - Meteorological stations
  - Buoys
  - Weather balloons
  - Satellites
  - Ships
- Earth's avg temp increased by 0.6% during 20^{th} century

Greenhouse Gases Cause Global Warming

- Carbon Dioxide, Methane, Surface Ozone, Nitrous oxide, Chlorofluorocarbons
- Burning carbon containing fuel (coal, oil, and natural gas) accounts for seventy-five percent of human made carbon emissions
- Carbon is also released by land conversions like when forests are burned

Why Global Warming Occurs Due to These Gas Emissions:

- Gases absorb infrared radiation (heat) in atmosphere
- Absorption slows the release of heat into space which warms the lower temperature
- Some heat from lower temperature goes to oceans and raises its temperature

- Because these gases trap sun's radiation like glass does in greenhouse, they are called greenhouse gases

Stratosphere Ozone Continues to Decline

- Ozone: form of oxygen that is a human-made pollutant in the lower atmosphere but a naturally produced, essential part of the stratosphere
- Ozone Hole: Thinning of ozone
    - Depletes itself through September-November period because during that time, the wind and ice caps are pushed to Antarctica
    - Renewable layer
    - 67% of ozone is depleted each year
    - Chlorine is the biggest culprit for this thinning
        - CTCs → get into the atmosphere by pesticides and manufacturing of dyes
        - CCL → carbontetrochloride
    - After CCL is released into the atmosphere, UV radiation breaks down CFCs and CCL into free chlorine. Then it reacts with the ozone and breaks into individual oxygen atoms
    - One chlorine particle can break down 1000 molecules of ozone

Why is Global Warming Bad for us/other organisms?

- Causes skin cancer
- DNA mutation
- Decreased immune system capabilities
- Blindness (because cataracts are increased)

How We're Fixing the Problem:

- Montreal Protocol: an international agreement to phase out production of ozone-depleting chemicals…so 150 countries have to reduce CFC's by 50%