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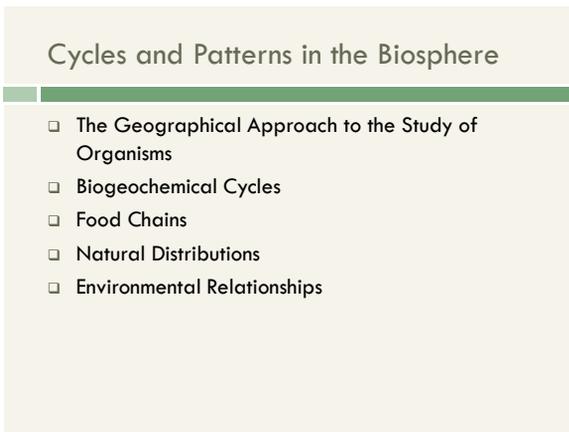
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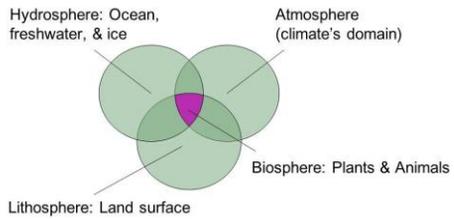
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## Cycles and Patterns in the Biosphere

- Of the 4 components of our physical environment, the biosphere is the most difficult to “pin down” (because you find it in all spheres).



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## The Geographical Approach to the Study of Organisms

- Geographical Viewpoint
  - ▣ Seeks to explain distributions of phenomena and how their spatial patterns change over time
- Biogeography
  - ▣ So then, this is the study of plant and animal distributions and how their spatial patterns change over time
  - ▣ Also, “Biota” means plant & animal life
  - ▣ Flora (plants)
  - ▣ Fauna (animals)

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## Biogeochemical Cycles

- These are the pathways of flow of the various cycles that keep things alive in our planet (see list below).
- They flow through biological, geographical and chemical pathways.
  - ▣ The Flow of Energy
  - ▣ The Hydrologic Cycle
  - ▣ The Carbon Cycle
  - ▣ The Oxygen Cycle
  - ▣ The Nitrogen Cycle

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## Biogeochemical Cycles

- The Flow of Energy:
  - The sun is the primary energy source for all living organisms, except for those animals that depend on geothermal vents in ocean depths (e.g. tube-like creatures).
  - The sun starts the process/ flow of energy by photosynthesis.
  - Photosynthesis is the production of organic matter by chlorophyll-containing plants, bacteria, algae.
  - Only 0.1% of the solar energy entering the earth is used in photosynthesis!

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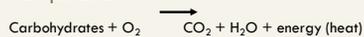
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## Photosynthesis and Respiration

- Photosynthesis



- Respiration




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## Net Primary Productivity

- Net primary productivity is the net photosynthesis of a plant community over a period of one year.
- Net photosynthesis is the difference between photosynthesis and respiration.
- In other words, net photosynthesis is the difference between the amount of carbohydrates produced in photosynthesis and the amt lost in plant respiration (i.e. gain/loss kg carbon-yr).

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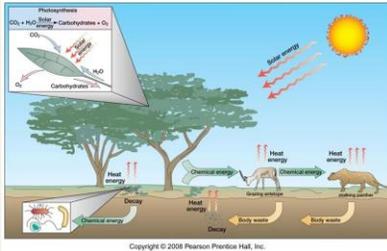
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## Net Primary Productivity

- How that energy is recycled
- Compare oceans to deserts




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## Hydrologic Cycle

- H<sub>2</sub>O is the most abundant substance of biosphere
- Two locations of water
  - In residence in plant and animal tissues
  - And in transit in the Hydrologic Cycle

TABLE 10-1 Water Content in Some Plants and Animals

Organism	Percentage Water In Body Mass
Human	65
Elephant	70
Earthworm	80
Ear of corn	70
Tomato	95

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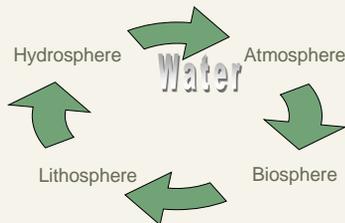
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## Hydrologic Cycle

- Two locations (continued)
  - In transit from one sphere to another, i.e., in the hydrologic cycle.




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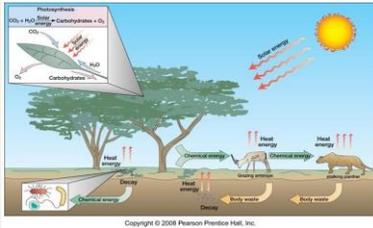
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## Carbon Cycle

- Photosynthesis “pulls” atmospheric carbon into the biosphere; that’s why scientists encourage the planting of trees.
- All living things contain carbon; it’s a basic building block. Including a lot of inanimate objects – e.g. plastics, etc.




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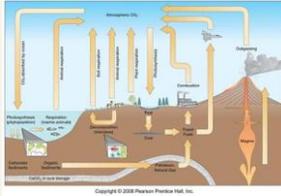
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## Carbon Cycle

- Carbon moves constantly from the living system to organic reservoirs and back.
- The carbon cycle in the terrestrial realm is the same as in the oceans -- plankton use CO<sub>2</sub> and marine animals (e.g. fish) release it during respiration.




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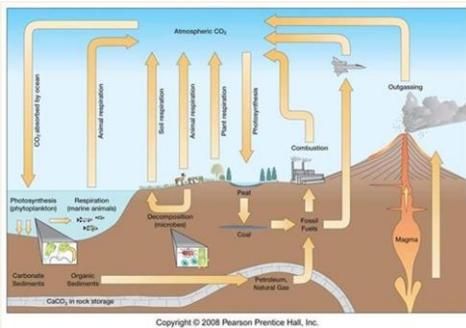
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## Carbon Cycle




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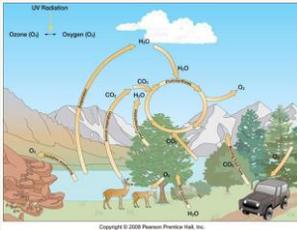
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## Oxygen Cycle

- The atmosphere contains 21% Oxygen.
- $O_2$  is mainly a byproduct of photosynthesis: remember formula of photosynthesis.
- Other sources...e.g. ozone, etc



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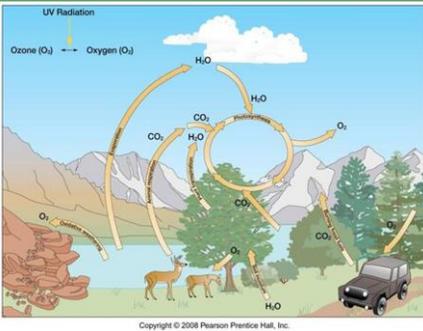
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## Oxygen Cycle



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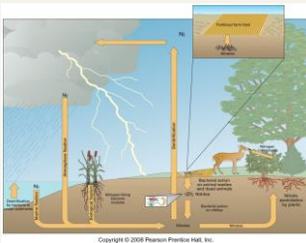
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## Nitrogen Cycle

- Nitrogen Cycle
  - $N_2$  – Atmospheric nitrogen (78% of air);
- Other Mineral Cycles
  - These include other impact trace minerals (e.g., phosphorous, sulfur, and calcium)



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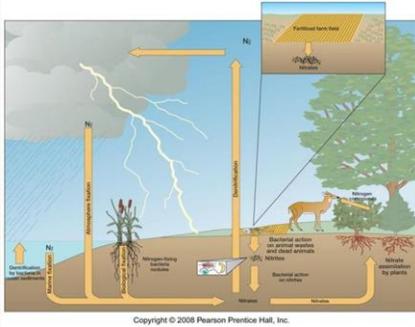
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## Nitrogen Cycle



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## Nitrogen Cycle

- Nitrogen fixation. This is when plants/organisms (e.g. bacteria, soybeans) convert  $N_2$  into a form that plants can use (i.e. nitrates).
- Denitrification on the other hand, is the opposite. This is when nitrates are converted back into atmospheric  $N_2$  (mainly by certain bacteria in the soil).

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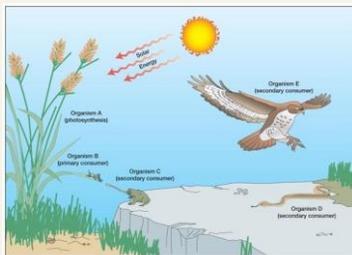
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## Food Chains

- Pathways of energy, water, and nutrients on which organisms depend for their survival.



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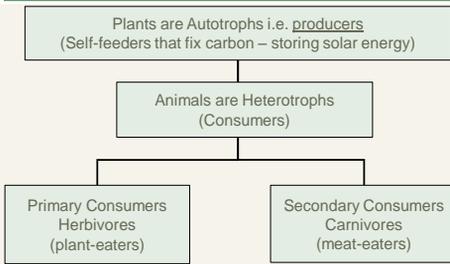
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## Fundamental Units of a Food Chain



- What are Vegans, Vegetarians and Omnivores?

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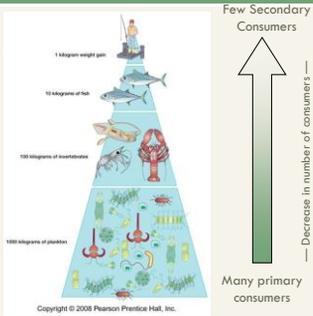
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## Food Pyramid

- Each step in the food chain / pyramid is called a "trophic level"
- It's more efficient to feed people with grain, than with animals fed with grain
- In other words, vegetarians are more efficient than carnivores.




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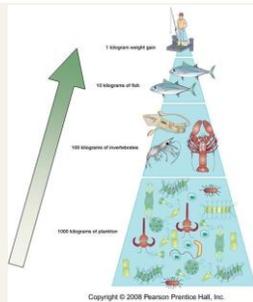
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## Pollutants in the Food Chain

- Biological amplification, also called Biomagnification.
- E.g. persistent chemicals like DDT stay in the fatty tissues of animals and never break down. And actually INCREASE in amount & toxicity UP the food chain.




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## Natural Distributions

- 4 determinants:
  - Evolutionary development
  - Migration/dispersal
  - Reproductive success
  - Extinction

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## Natural Distributions

- Evolutionary Development
  - Darwinian theory of natural selection
  - Influence of Plate Tectonics
    - Acacia species – widespread distribution before the Pangaea break-up



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## Natural Distributions

- Eucalyptus – Did not exist on Pangaea.



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According to scientists, Eucalyptus species developed in geographical isolation in Australia, after the Pangaea break-up. So did Kangaroos and Koalas.

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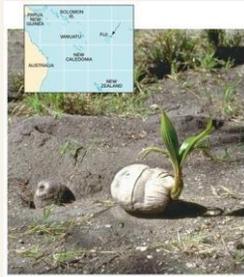
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## Natural Distributions

### Migration/Dispersal

Plants disperse seeds via wind, water, and animals (including human transport).

- Example: Coconuts
- Part of the reason why the Immigration Service does not allow LIVE plants/ seeds / animals into the U.S. (especially undeclared and strange species)



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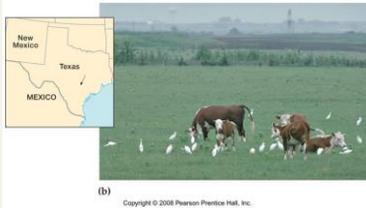
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## Natural Distributions

Animals migrate via legs, wings, fins, etc.

- Example: Cattle egrets; see map of extent



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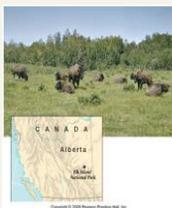
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## Natural Distributions

### Reproductive Success

Reproductive success is influenced by changes in the environment, caused either by nature or by predators.

- Example: when fringes of the Arctic warm up and the range of cod fish expands but polar bears perish from drowning (so the changes are good for one, but not for the other).



American bison in natural environment, without human interference.

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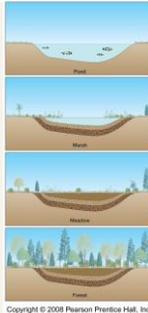
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## Natural Distributions

### Extinction

- ▣ Plant succession. This is when one type of vegetation is replaced by another, naturally. Example: Infilling of a small lake. Here, certain plants are being replaced by other types of plants.
- ▣ But is it not a true form of "extinction", because extinction is permanent. It only becomes extinction if certain species (plants, animals) fail to reappear when the conditions are right again. It's not extinction even if they reappear in another environment/ location.
- ▣ Humans are a great cause of extinction by the destruction of natural habitats e.g. excessive hunting, deforestation, etc. or just sheer killing as in the case of the American Buffalo.



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## Environmental Relationships and Limiting Factors

- ▣ A limiting factor a variable that is the most important in determining the survival of an organism.
- ▣ The Influence of Climate the strongest limiting factor. And under climate we have:
  - ▣ Light
  - ▣ Moisture
  - ▣ Temperature
  - ▣ Wind

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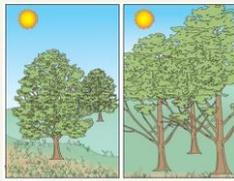
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## The Influence of Climate

### Light

- ▣ Plant shape – in lots of light, trees are broad & short; in inadequate light, trees are tall & narrow. **Why?**
- ▣ Photoperiodism – amt of light received during a 24-hr period. E.g. Fall & Winter. Organisms are sensitive to this; it determines the dropping of leaves and hibernation.



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## The Influence of Climate

- **Moisture**
  - Effect of moisture supply on plant adaptations (in both deserts and rainforests). The leaves are broad in rainforests, and little/tiny in deserts. **Why?**
- **Temperature**
  - In hot climates, some plant leaves are shiny to reflect the sun.
  - Plants are less tolerant to cold than animals (they have no fur, blubber, and can't **move**). You find animals beyond the tree-line. E.g. polar bears, penguins. Plants actually do better in extreme heat (e.g. cacti) than in extreme cold. Also, see pictures of Joshua Trees (Grand Canyon).

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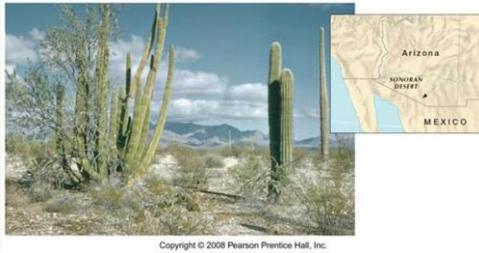
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## The Influence of Climate



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## The Influence of Climate

- **Wind**
  - Animal body heat loss
  - Plants
    - Desiccation (drying)
    - Wind shear



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## Other Influences Besides Climate

- ❑ Edaphic (soil) influences
- ❑ Topographic influences
  - ❑ Steepness of slopes
  - ❑ Orientation of slopes in regards to sunlight
  - ❑ Porosity of soil on slopes
- ❑ Wildfire impacts – not always negative



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## Environmental Correlations: Example of Selva

- ❑ “Selva” means tropical rainforest
- ❑ Climate – Af
- ❑ Flora – Tropical rainforest
- ❑ Fauna – Flyers, crawlers, creepers, and climbers
- ❑ Soil – Laterization



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