CARBON: CYCLING, SEQUESTRATION, AND MEASURING IT IN TREES

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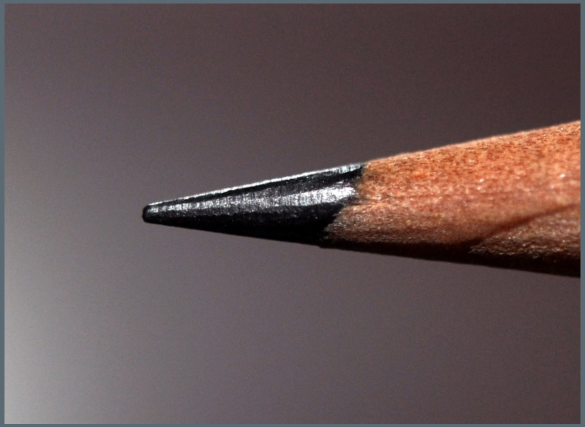
Carbon: Its Everywhere!

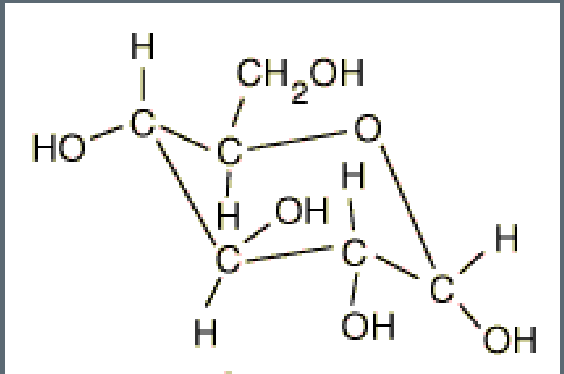
- The forth most abundant element in the universe
- The 15th most abundant element in the earths crust
- Comprises ~0.039% of the atmosphere
- Prevalent as dissolved inorganic carbon in the oceans
- The second most common element in the human body


Carbon: The element of life

Carbon is found in every living organism on earth

- Proteins
- Nucleic Acids
- Carbohydrates
- Lipids



Glucose




Carbon on the Move

- Carbon Cycle PLT activity (section 3 activity 6)
  - Students will explain why the carbon cycle is important to all living organisms.
  - Students will describe and diagram the components of the carbon cycle, including carbon pools and carbon fluxes.

Carbon on the Move: Pools vs. Fluxes

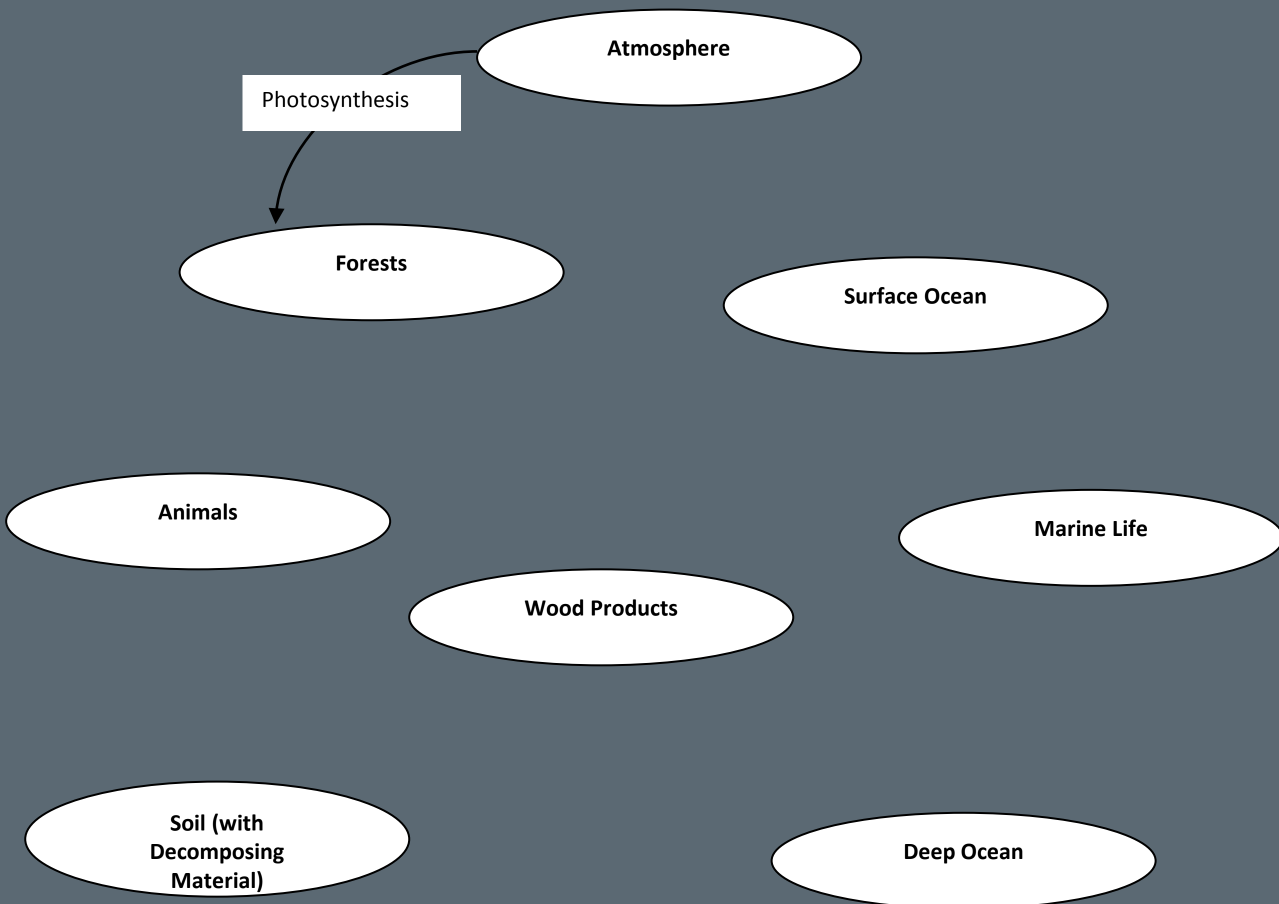
- **Carbon Pools**: The amount of carbon stored within one particular component of an ecosystem. An amount.
  - Examples: Ocean Water, The atmosphere, Trees in a forest

- **Carbon Fluxes**: The transfer of carbon from one pool to another. A rate.
  - Examples: Photosynthesis, Respiration, Combustion

Carbon on the Move: Pools vs. Fluxes

Atmosphere (Pool) Photosynthesis (Flux) Tree (Pool)

Carbon on the Move



Common Carbon Fluxes

Breaks Down
Burns (Combustion)
Dissolves
Eaten (Consumption)
Leaves Solution
Ocean Mixing/Circulation
Photosynthesis
Respiration (Plant, Soil, Animal)
Sequestration

Video

Carbon on the Move

- At each station (Pool) there is a card with 6 possible fluxes that will move the group to a new station (Pool)
- At Each station students roll a die to determine which station they move to in the next round

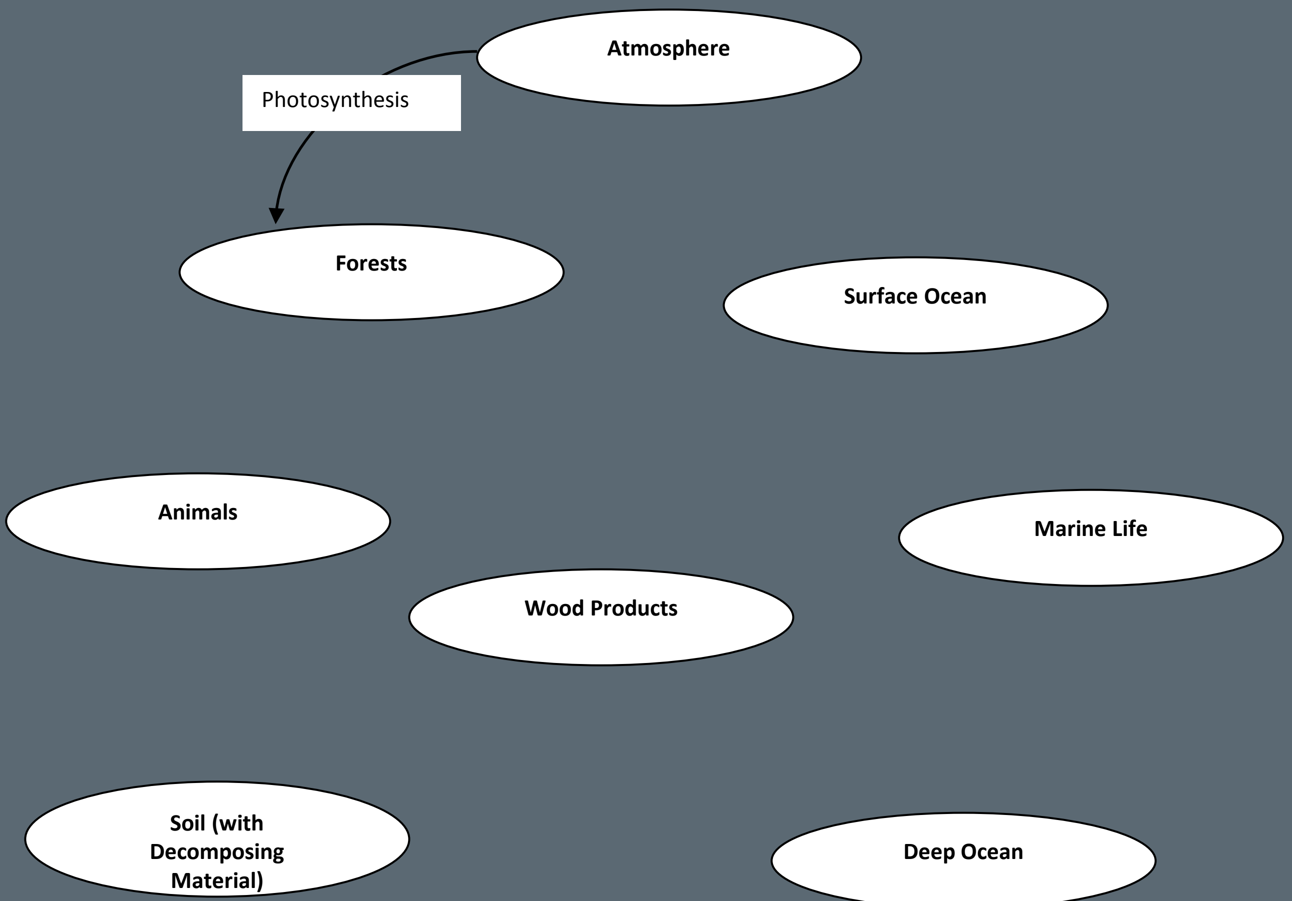
Animals

1. A bird eats you for dinner. **Stay at Animal.**
2. You are stored in animal fat cells. **Stay at Animal.**
3. You get released as carbon dioxide during respiration. **Go to Atmosphere.**
4. You get released as carbon dioxide during respiration. **Go to Atmosphere.**
5. When the animal produces waste, you find yourself on the forest floor in a pile of poop. **Go to Soil.**
6. The animal dies and begins to break down on the forest floor. **Go to Soil.**

Carbon on the Move

Round	Starting Location (Carbon Pool)	What happened? (Carbon Flux)	Ending Location (Carbon Pool)
1	Atmosphere	Photosynthesis	Forest
2	Forest	Sequestered	Wood Products
3	Wood Products	Break down	Soil
4	Soil	Consumed	Animal

Carbon on the Move



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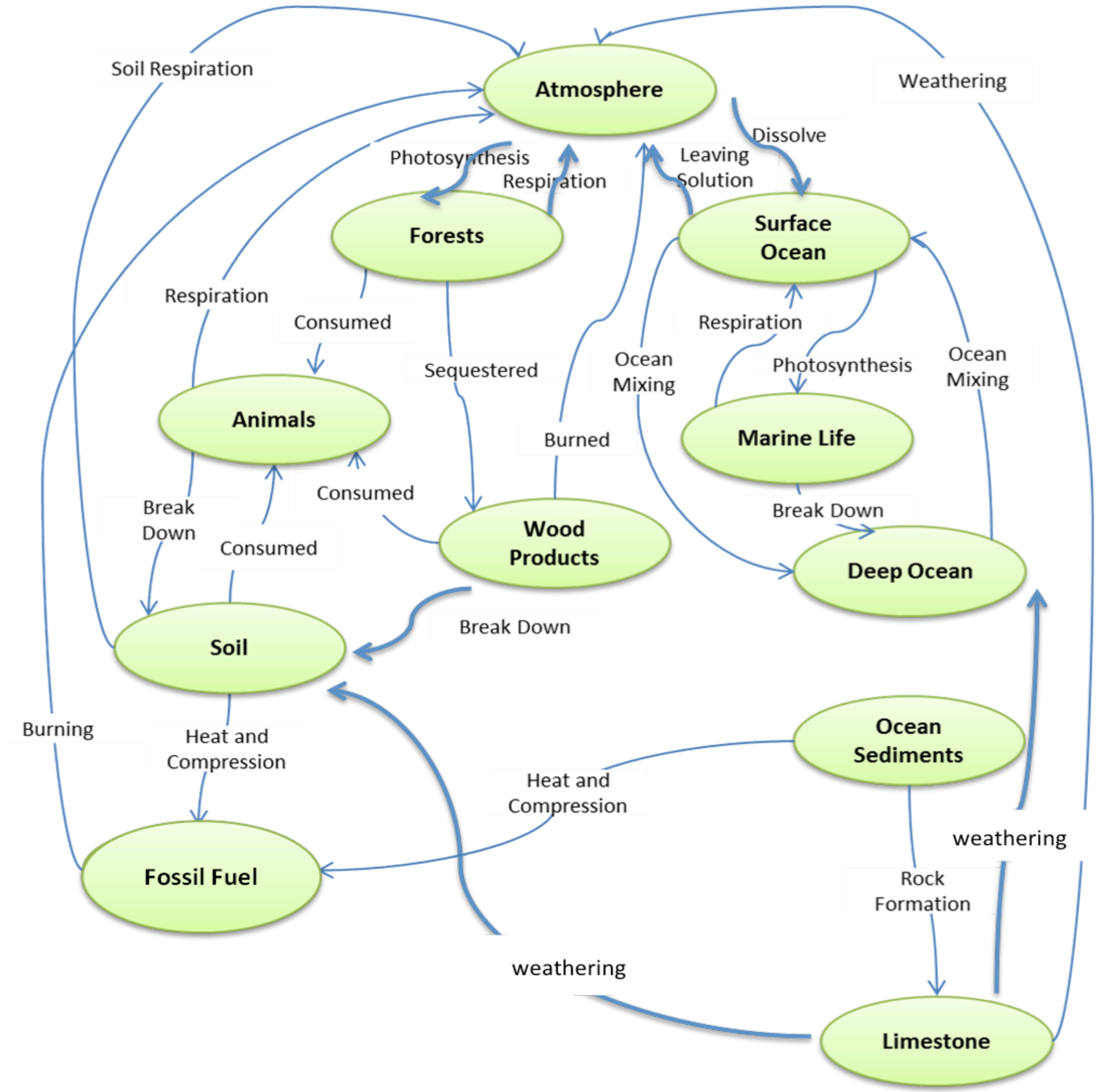
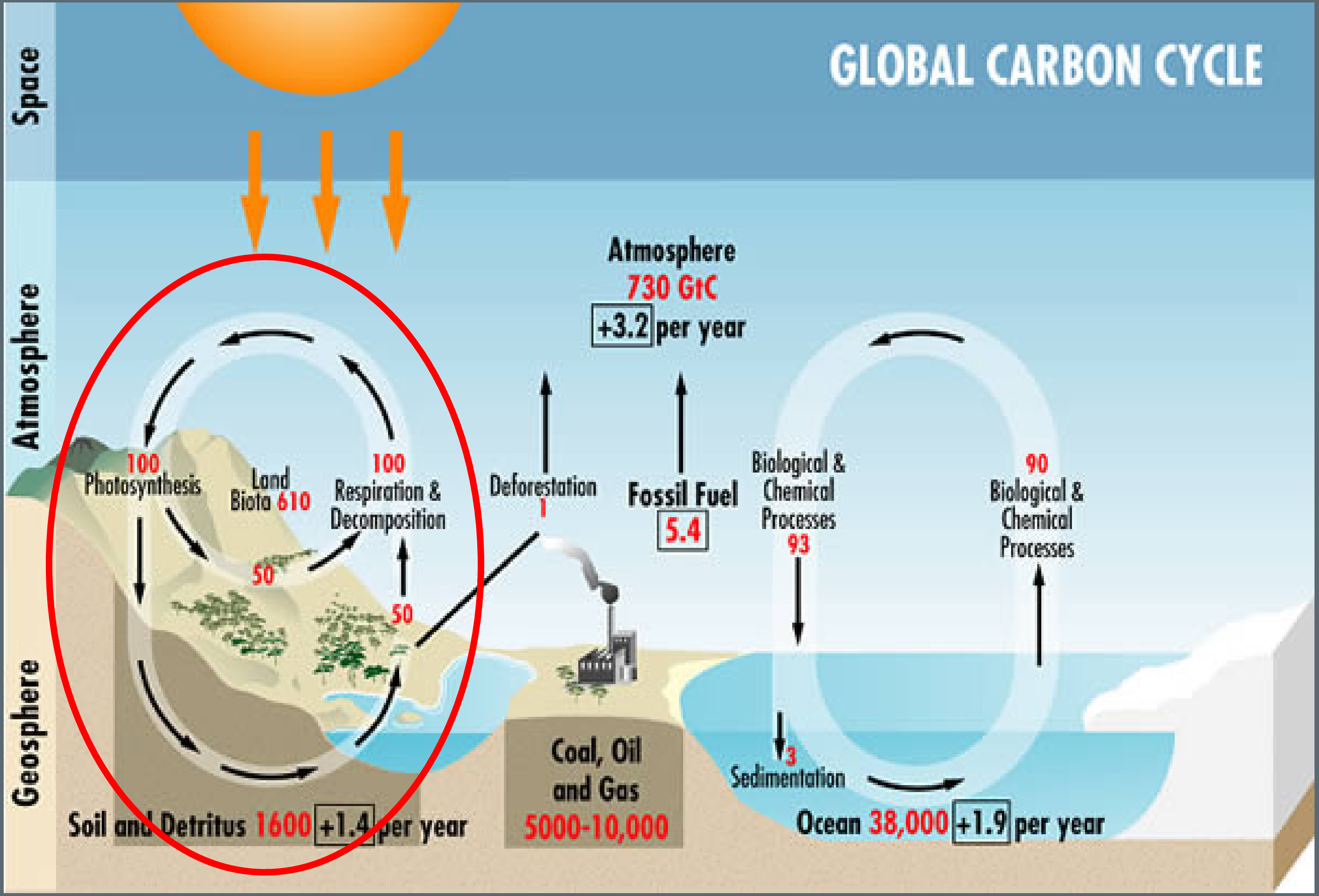

Soil Respiration
Atmosphere
Weathering
Dissolve
Photosynthesis
Respiration
Leaving Solution
Forests
Surface Ocean
Respiration
Consumed
Respiration
Sequestered
Ocean Mixing
Photosynthesis
Ocean Mixing
Animals
Marine Life
Burned
Break Down
Consumed
Break Down
Consumed
Wood Products
Deep Ocean
Break Down
Soil
Ocean Sediments
Burning
Heat and Compression
Heat and Compression
weathering
Fossil Fuel
Rock Formation
weathering
Limestone

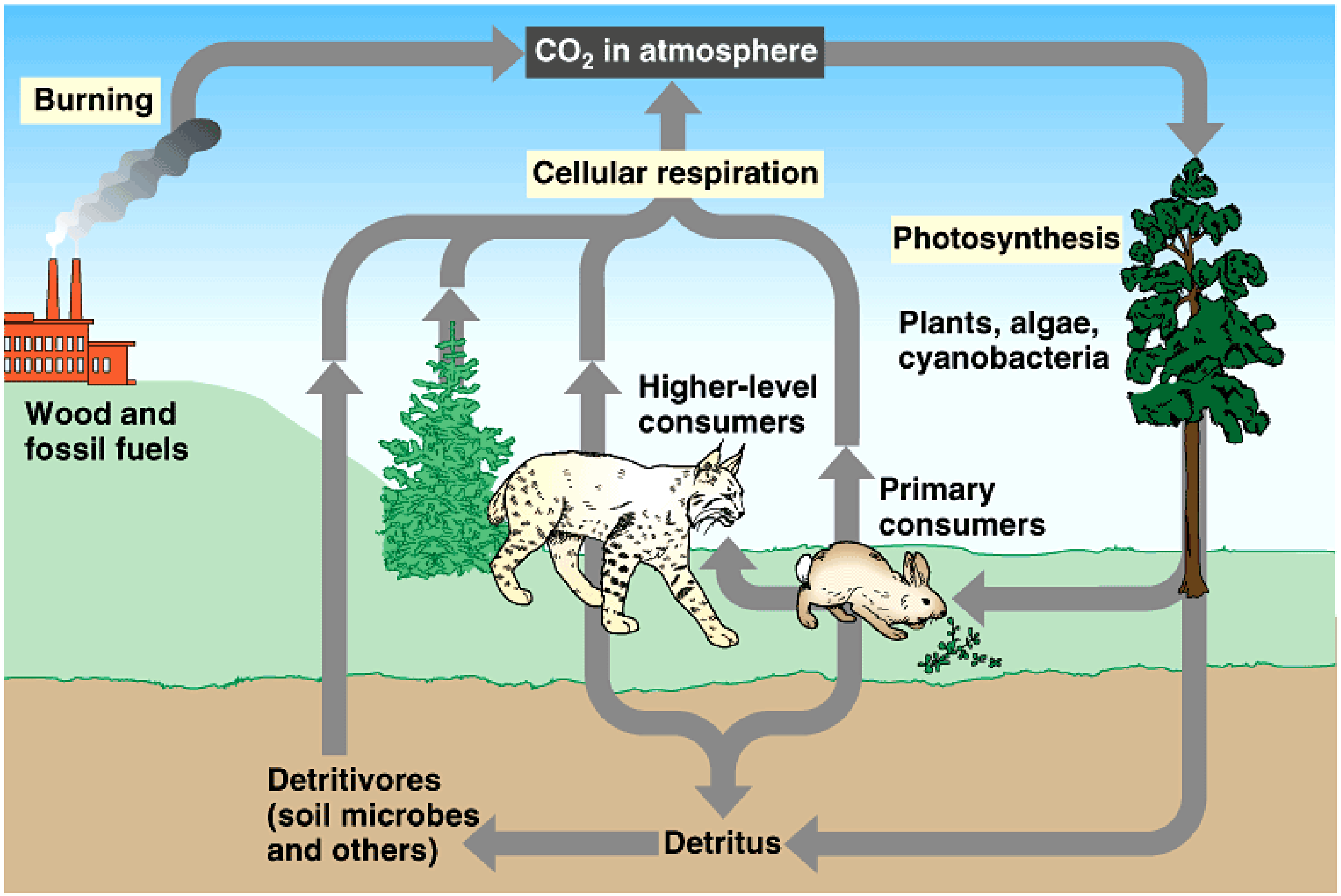
Magnitude of Pools and Fluxes



Counting Carbon

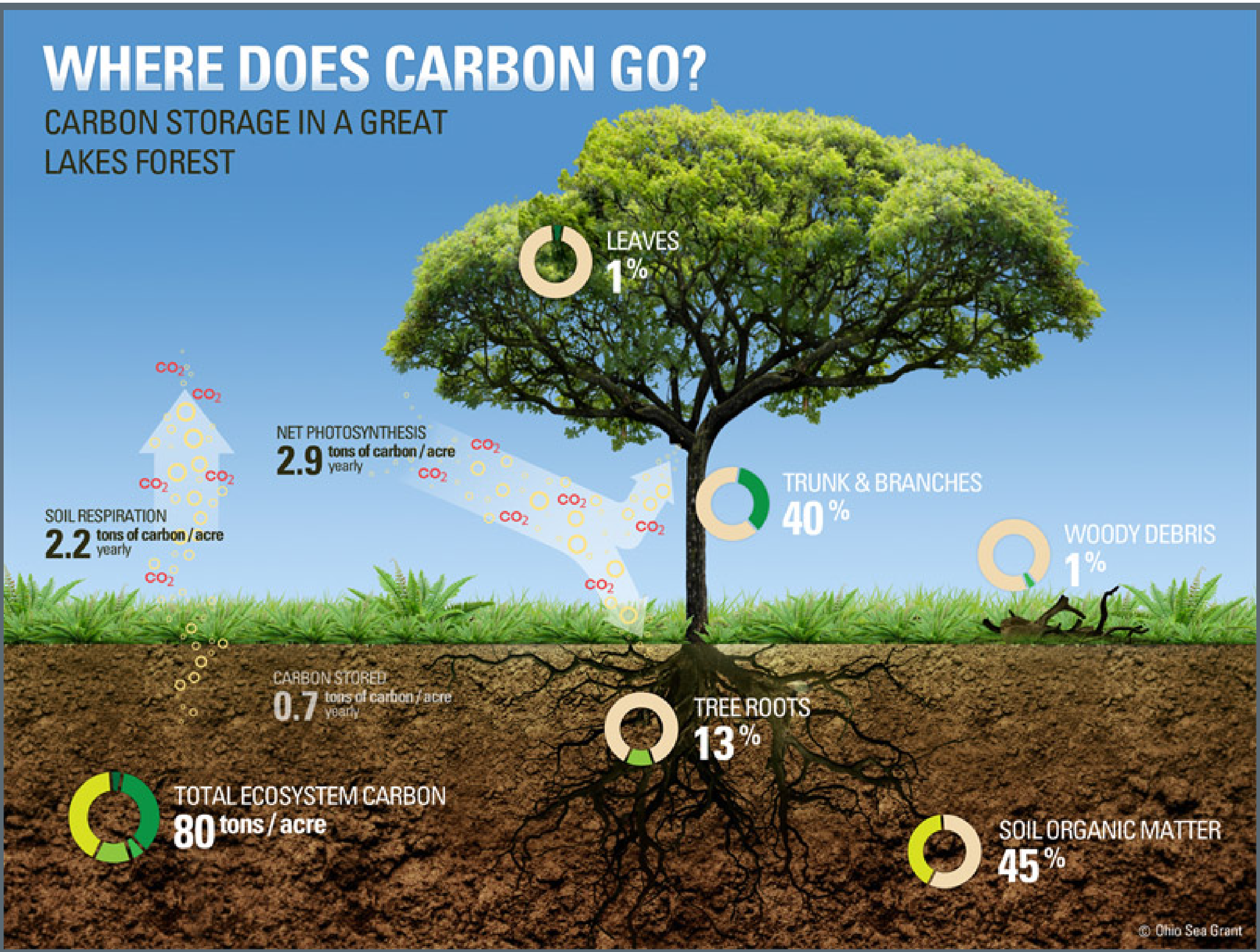
- Carbon Sequestration PLT activity (section 3 activity 7)
  - Estimate the amount of carbon in an individual tree
  - Estimate the amount of carbon in an acre of pine forest
  - Compare forest carbon estimates with state carbon emissions
  - Discuss the potential of forests to sequester anthropogenic carbon emissions

Carbon Cycle of a Forest



http://york.conroeisd.net/Teachers/jlutke/Cycling%20of%20Matter

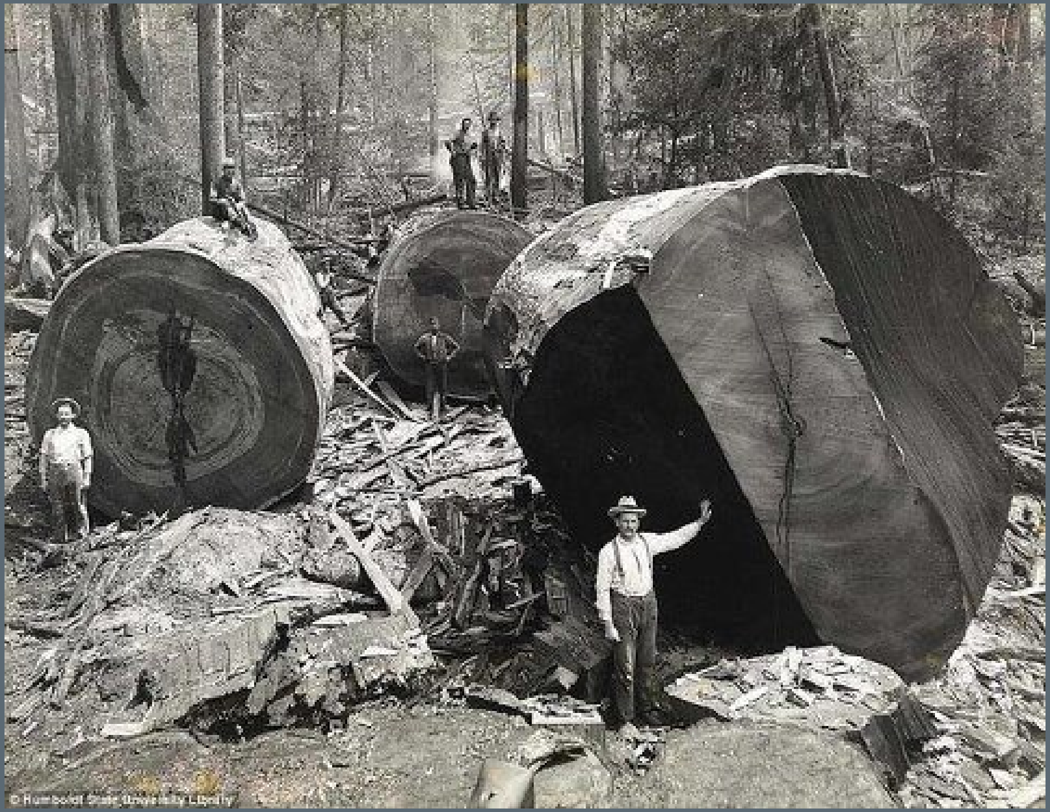
Flow of Carbon in a Forest



http://changingclimate.osu.edu/features/accounting-for-carbon

Trees are Carbon Storehouses

- **Large**
- **Long-lived**
- **Durable (hard to decompose)**
- **Carbon can be stored in wood products**



Measuring Carbon

Land Use Type	Carbon Sequestration Rate (lbs C/acre/year)
Pine Forest (Johnson et al., 2001)	5,442
Mixed Forest (Johnson & Coburn, 2010)	4,220
Grassland (Lal, 2004)	892

Measuring Carbon

- Equations have been developed for many tree species to calculate carbon content from height and diameter

For a tree whose diameter > 11 inches:

$$\text{Green Weight} = 0.15\,(d)^2 \times H$$

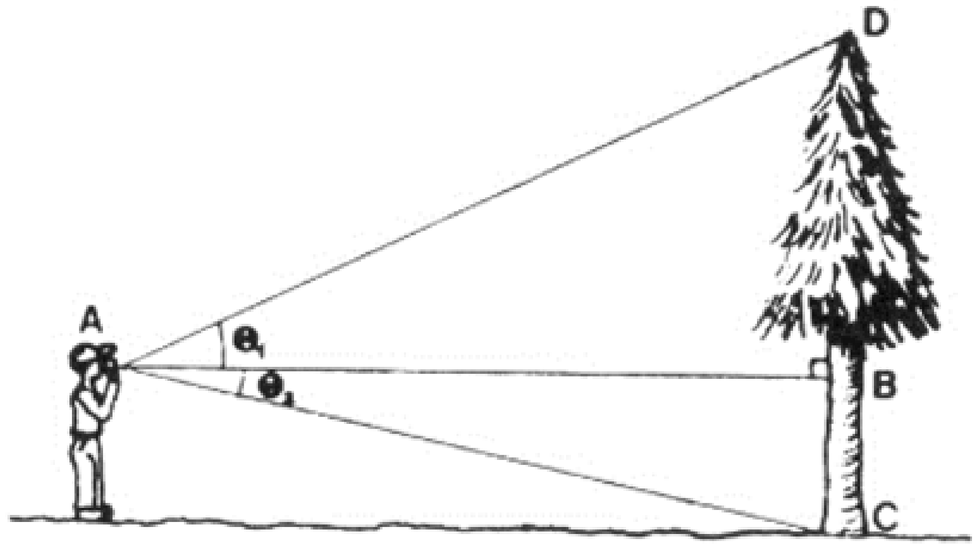
For a tree whose diameter < 11 inches:

$$\text{Green Weight} = 0.25\,(d)^2 \times H$$

Measuring Carbon

$$Diameter = \frac{Circumference}{\pi}$$

Measuring Carbon



$$\tan\theta_1 = \frac{DB}{AB} \qquad DB = AB\tan\theta_1$$

$$\tan\theta_2 = \frac{BC}{AB} \qquad BC = AB\tan\theta_2$$

$$\text{total tree height} = DB + BC = AB(\tan\theta_1 + \tan\theta_2)$$

Measuring Carbon

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For a tree whose diameter < 11 inches:

$$\text{Green Weight} = 0.25\,(d)^2 \times H$$

$$\text{Dry Weight} = \text{Green Weight} \times 0.5$$

$$\text{Carbon} = \text{Dry Weight} \times 0.5$$

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Florida Climate Institute

PINEMAP

University of Florida Center for Precollegiate Education and Training

CENTER FOR PRECOLLEGIATE EDUCATION AND TRAINING

SFRC School of FOREST RESOURCES & CONSERVATION