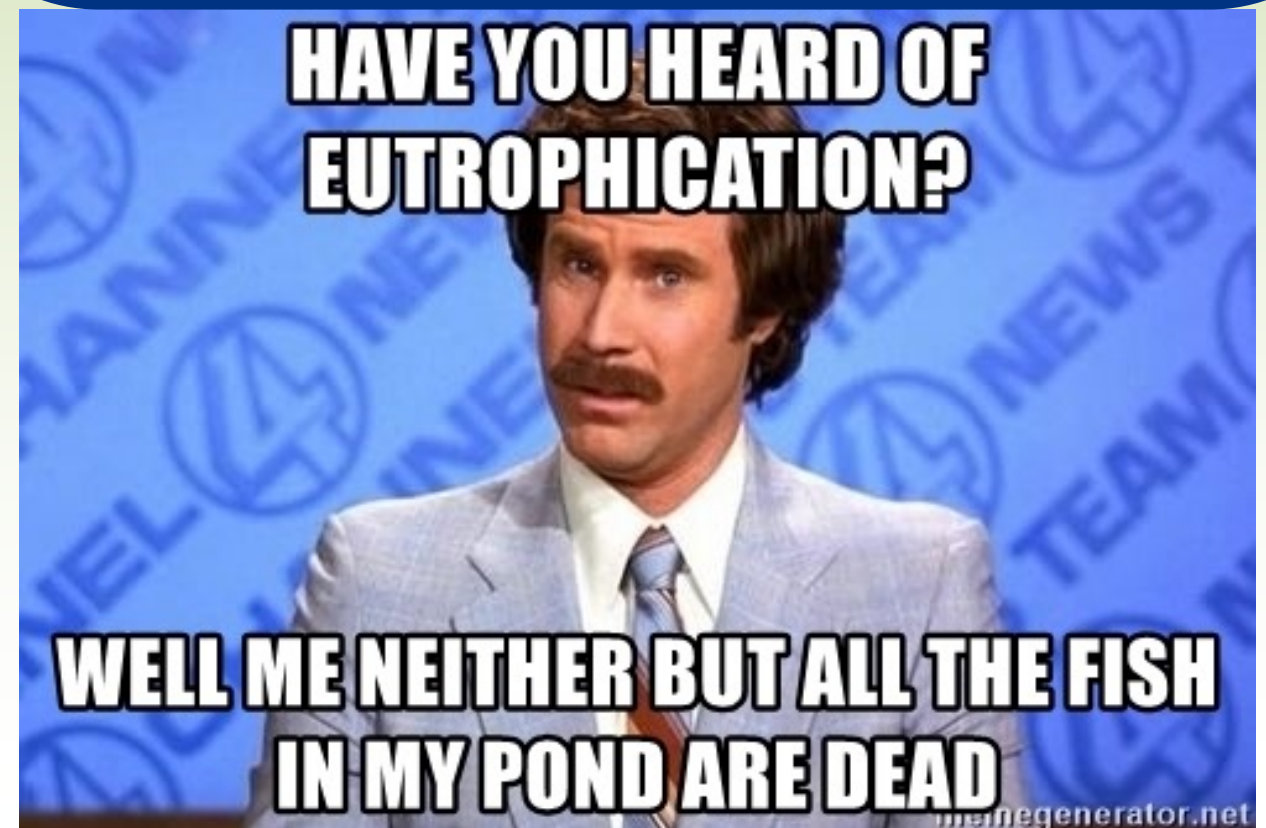
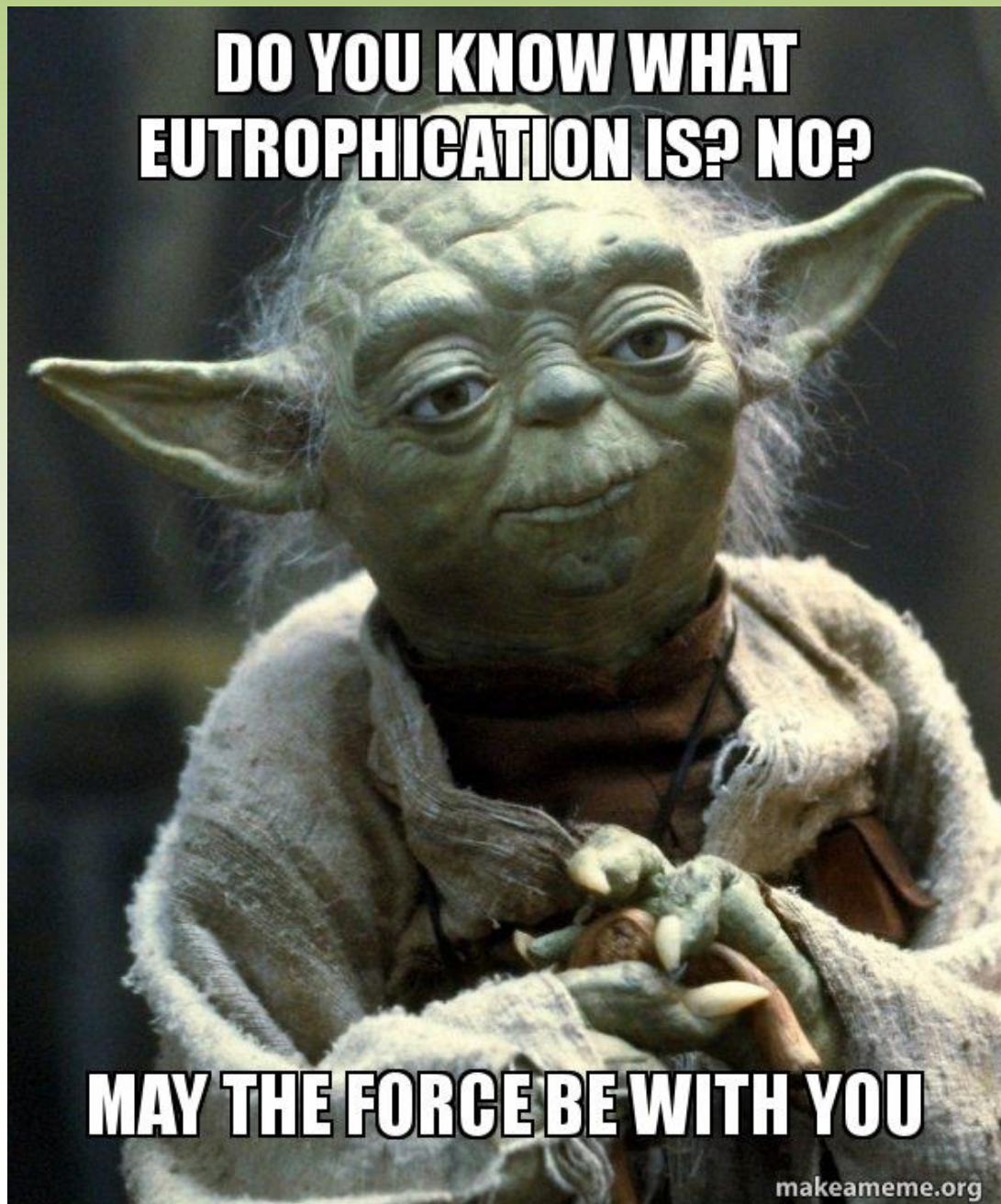


Agenda:

- Collect N cycle HW
- QUIZ!!!
- Continue notes
- Class time for HW

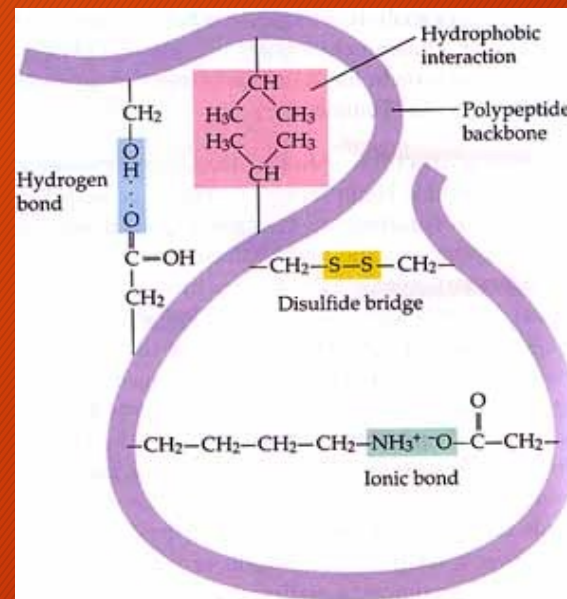
Bell Work:



The Sulfur Cycle



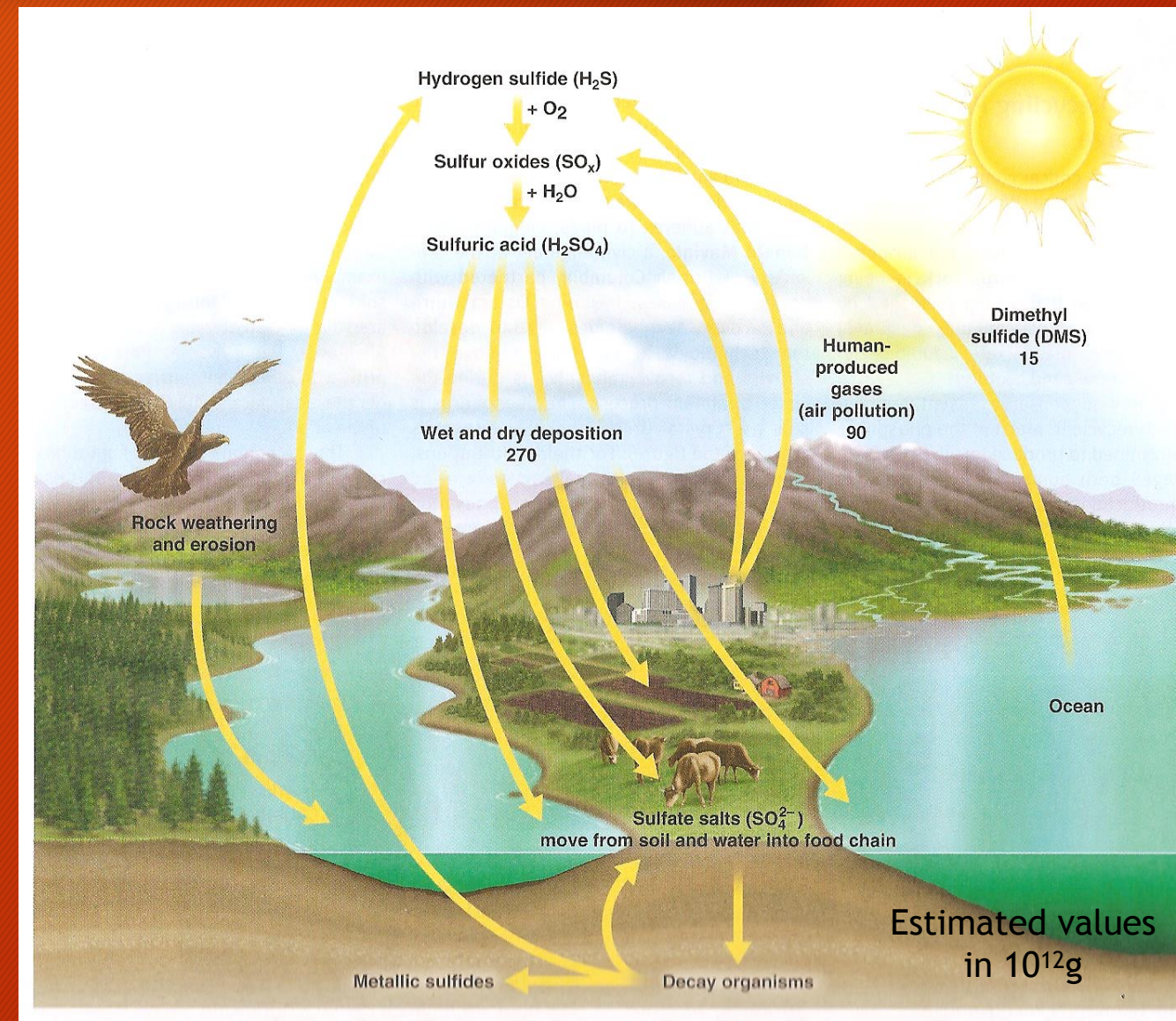
- Why is sulfur important?
 - important part of proteins since it can be found in the some amino acids
- Dimethyl sulfide (DMS) helps condense water into droplets in clouds
- Mostly located in sedimentary rocks and minerals



The Sulfur Cycle

Scientists are still piecing together how the global sulfur cycle works! But here's what we know so far:

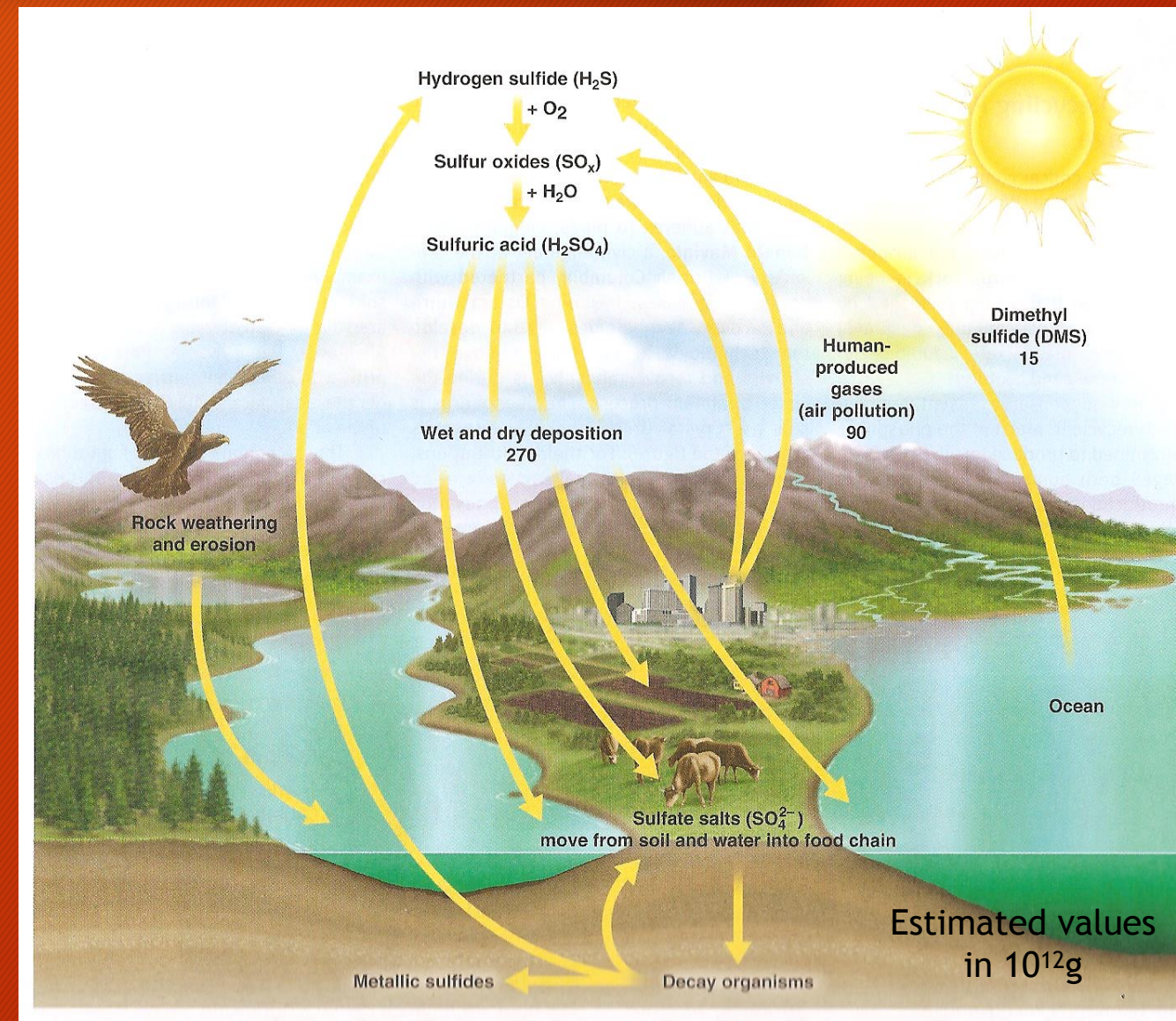
- Most of the global sulfur is in sedimentary rocks which erode over time to release sulfur-containing compounds into the ocean
- Sulfur is released into the atmosphere by sea spray, forest fires, dust storms, and volcanoes
- Very little sulfur present in the atmosphere but the movement of sulfur to and from the atmosphere is substantial
- Plants absorb sulfur from the soil and incorporate it into proteins and animals absorb sulfur from their food



The Sulfur Cycle

Scientists are still piecing together how the global sulfur cycle works! But here's what we know so far:

- Marine algae release large amounts of a compound that bacteria convert to dimethyl sulfide (DMS) which helps condense water into droplets in clouds
- In the atmosphere DMS is converted to sulfate, most of which is deposited in the ocean



Why do you think we know so little about the sulfur cycle?



- Case in Point: Lechuguilla Cave
 - Eddy Country, New Mexico
 - 480m (1604ft) below sea level
 - Consists of lemon-yellow sulfur deposits and gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) chandeliers
 - Took 2 years to acquire permission from local authorities for BBC's Planet Earth to film the caves and its unlikely a film crew will ever be allowed in the caves again



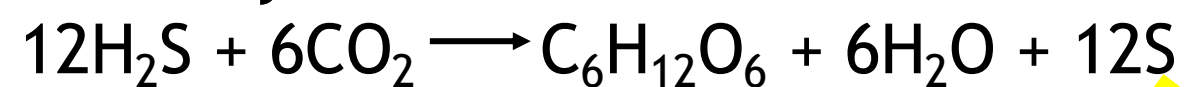
Cave of Crystals AKA Giant Crystal Cave

- Chihuahua, Mexico
- 300m (980ft) below sea level
- 58°C (136°F) and 90 - 99% humidity
 - Humans can only endure 10min. Of exposure in these conditions without proper equipment
- Consists of giant gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) crystals (up to 55 tons!)
- Discovered in 2000 by miners - mining operations kept the caves clear of water and accessible
- The crystals have stopped growing due to the removal of water and exposure to cool air
- Further exploration requires destroying the crystals



What's that ancient form of photosynthesis in which organisms use hydrogen sulfide?

Chemosynthesis:

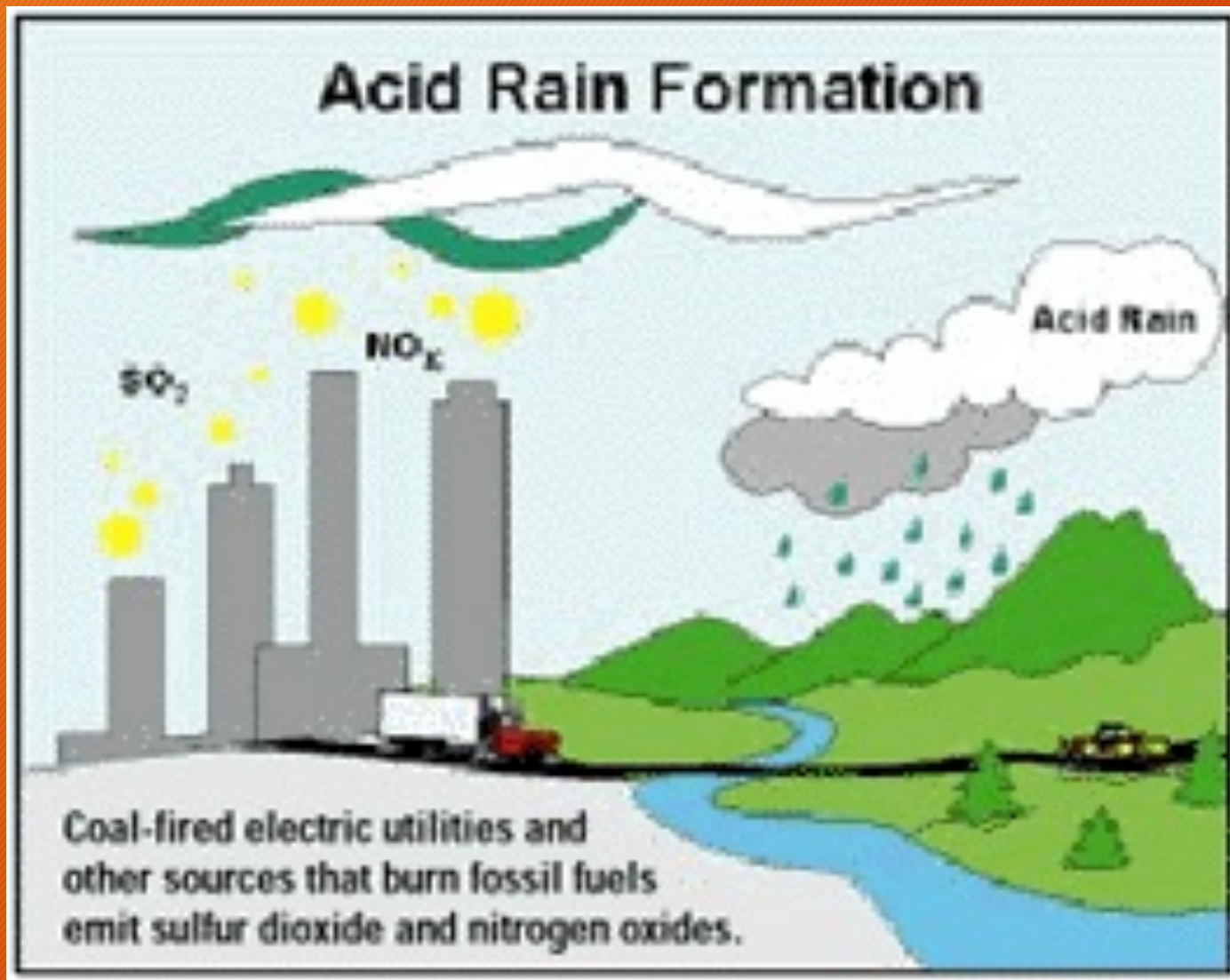


What organisms perform chemosynthesis?



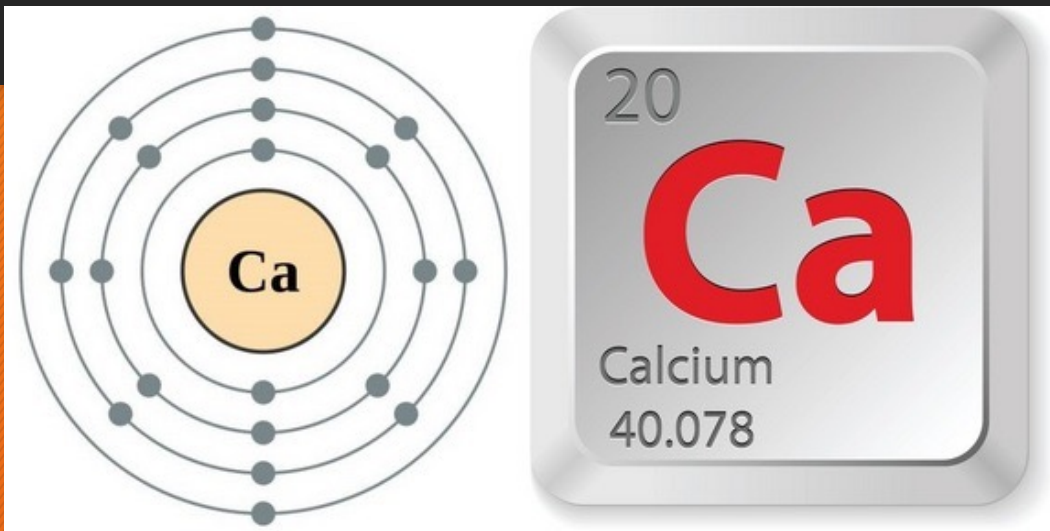
- Theorized that life may have originated here:
 - It has been proposed that amino-acid synthesis could have occurred deep in the Earth's crust and that these amino-acids were subsequently shot up along with hydrothermal fluids into cooler waters, where lower temperatures and the presence of clay minerals would have fostered the formation of peptides.. The building blocks of life!!!

How are Humans affecting the sulfur cycle?



- Emissions from these, along with nitrogen emissions, react with chemicals in the atmosphere
→ SULFATE SALTS → ACID RAIN
- Damage the natural environment (affects both plants and animals) as well as man-made environments (weathering/corrosion of buildings)

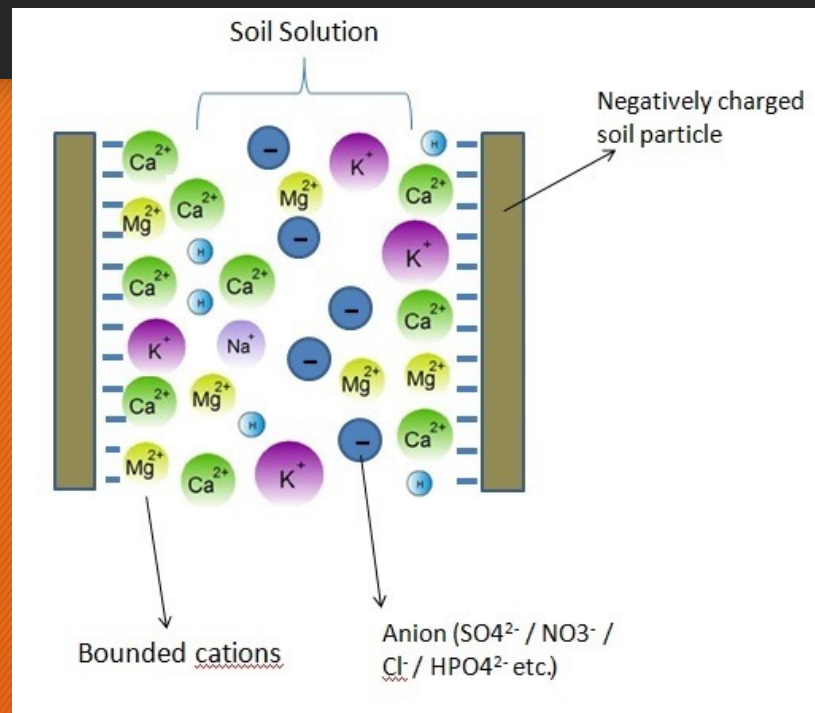
Calcium, Magnesium, and Potassium



- Macronutrients derived primarily from rocks and decomposed vegetation
- None present in gaseous phase but can be deposited from the air in small amounts as dust
- All 3 can be dissolved in water as positively charged ions:
 - Ca^{2+}
 - Mg^{2+}
 - K^{+}



Calcium, Magnesium, and Potassium



- Because of + charge they are attracted to - charges present on the surface of most soils
- Calcium and magnesium occur in high concentrations in limestone and marbles as well as the soils overlaying these rock types
- Potassium is only weakly attracted to soil particles and thus can be leached away by water
 - Leaching potassium can constraint the growth of plants and animals

Ecosystems respond to disturbance

Disturbance- An event caused by physical, chemical or biological agents that results in changes in population size or community composition.

- Natural: hurricanes, ice storms, tornados, etc.
- Anthropogenic: human settlements, agriculture, air pollution, etc.



(a)



(b)

(a) Photo of Chandeleur Islands prior to Hurricane Katrina

(b) Photo of islands after Hurricane Katrina showing massive erosion and loss of sand dunes and vegetation

Watershed Studies

- **Watershed**- All of the land in a given landscape that drains into a particular stream, river, lake or wetland.



Resistance versus Resilience

- **Resistance-** A measure of how much a disturbance can affect its flows of energy and matter.
- **High resistance example:** Disturbance influences populations and communities but has no effect on energy and matter flow
- **Resilience-** The rate at which an ecosystem returns to its original state after a disturbance.
- **High resilience example:** After a disturbance ecosystem returns to the original flows of energy and matter rapidly

Resistance versus Resilience

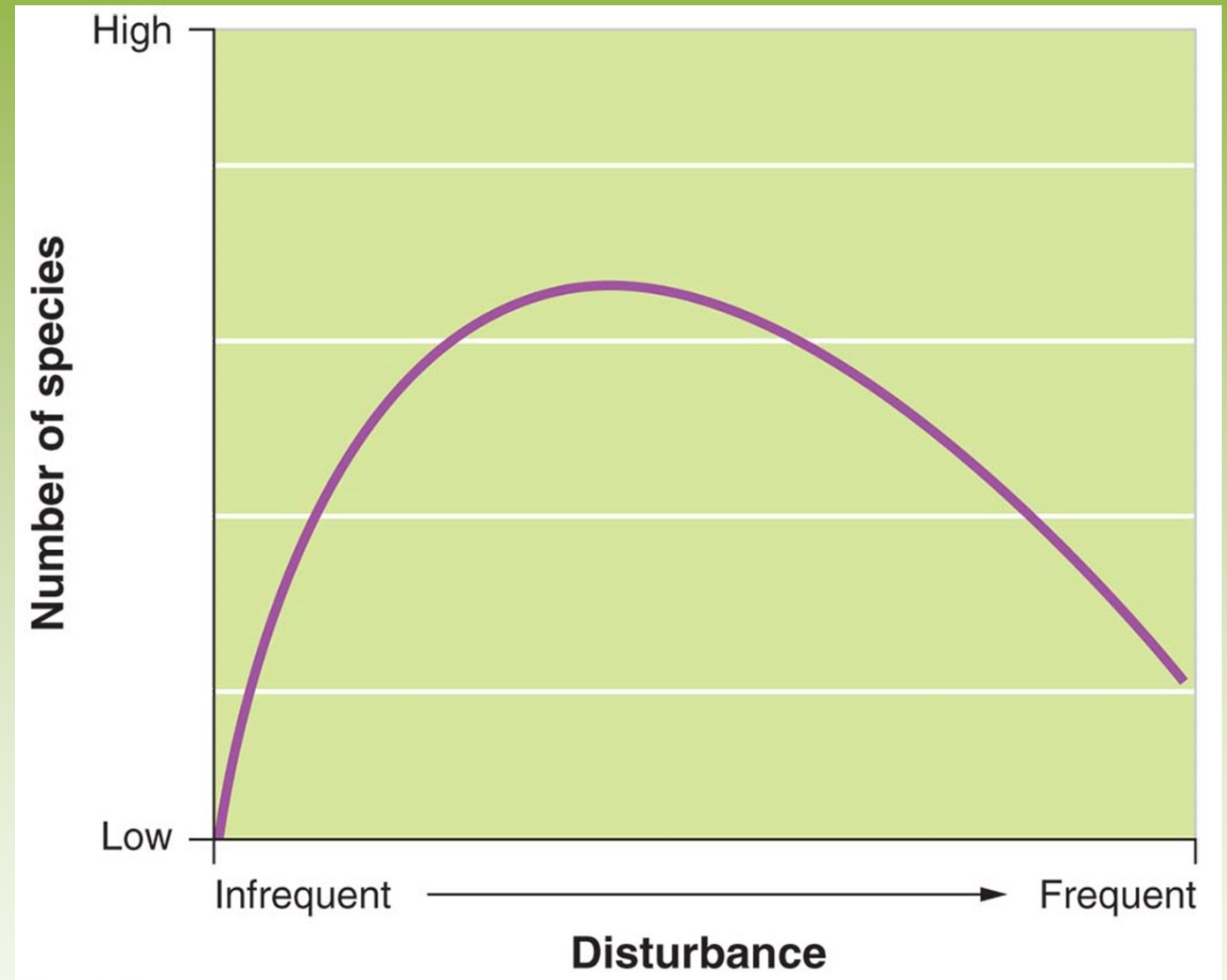
- **Restoration ecology**- A new scientific discipline that is interested in restoring damaged ecosystems.



Draining of wetlands can destroy a wetland ecosystem. Damage can be mitigated by using heavy machinery to build new wetlands that serve the same function.

The Intermediate Disturbance Hypothesis

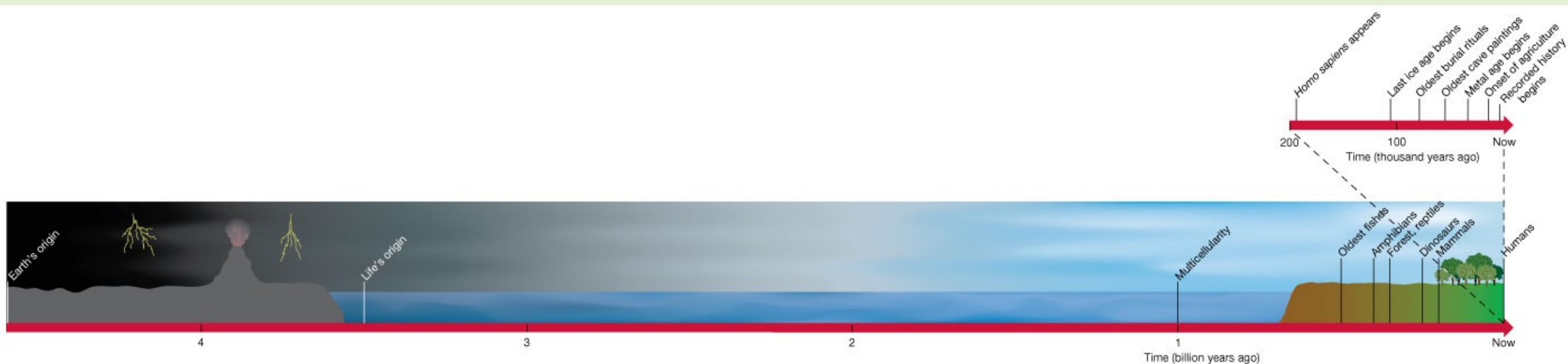
- The intermediate disturbance hypothesis- states that ecosystems experiencing intermediate levels of disturbance are more diverse than those with high or low disturbance levels.



Rare disturbances favor the best competitors which outcompete other species. Frequent disturbances eliminate most species except those that have evolved to live under such conditions. At intermediate levels of disturbance, species from both extremes can persist.

Ecosystems Provide Valuable Services

- **Instrumental value** – it has worth as an instrument or tool that can be used to accomplish a goal
- **Intrinsic value** – it has worth independent of any benefit it may provide to humans
- Relative to the origin of the earth 4.5 billion years ago, how long have humans been here?



Instrumental Values of Ecosystems

- Provisions- Goods that humans can use directly.
- Lumber, food crops, medicinal plants, natural rubber, and furs
- Bark of Pacific Yew contains a chemical with anti-cancer properties



Instrumental Values of Ecosystems

- Regulating services- The service provided by natural systems that helps regulate environmental conditions.
- Tropical rainforests play a major role in regulating the amount of carbon in the atmosphere



Figure 3.21
Environmental Science for AP®
John Pontier/Earth Scenes/Animals Animals

Instrumental Values of Ecosystems

- Support systems- The support services that natural ecosystems provide such as pollination, natural filters and pest control.
- Pollinators such as the honeybee play an essential role in ensuring the pollination of food crops such as cherries

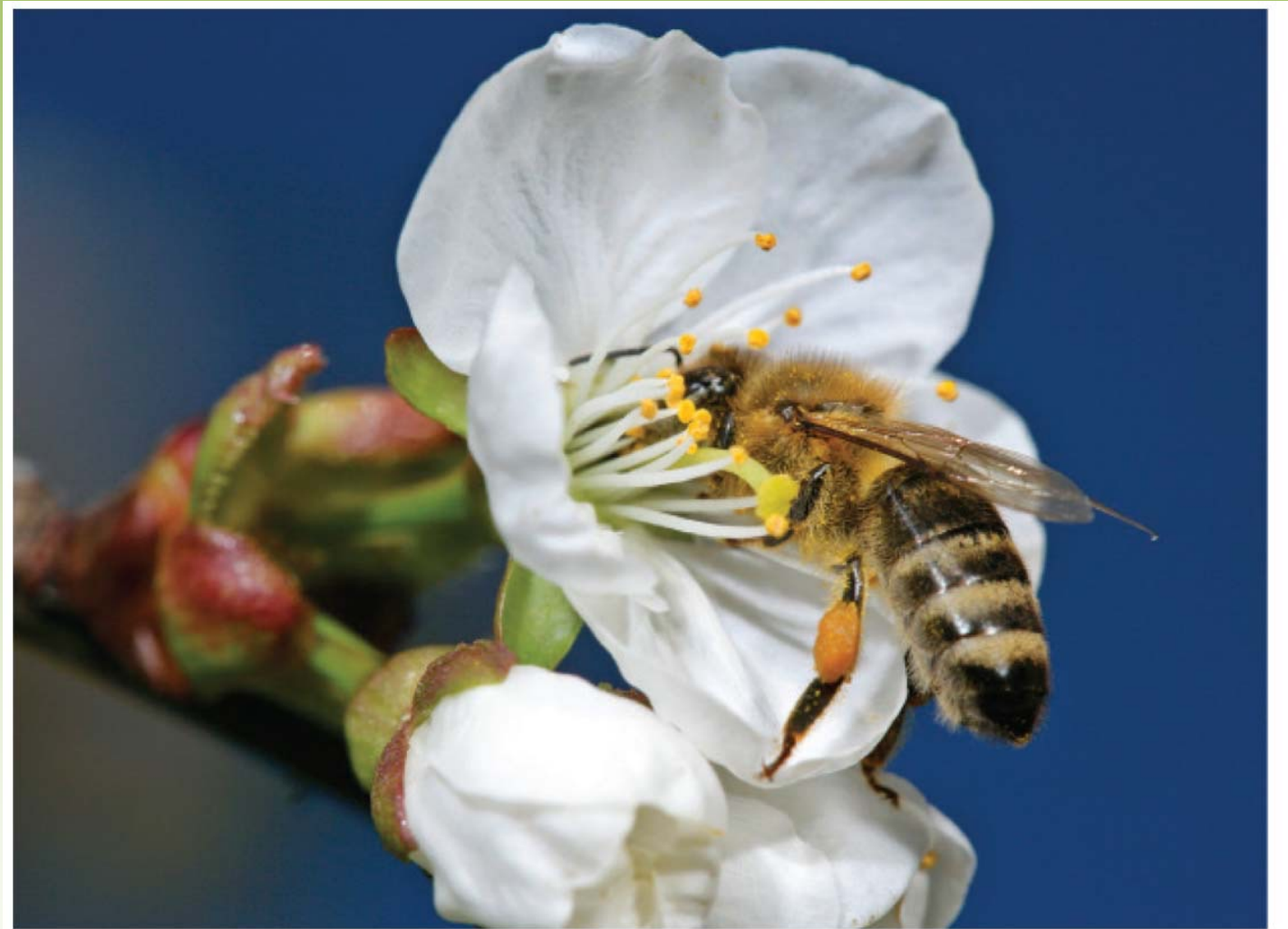


Figure 3.22
Environmental Science for AP®
Steffan and Alexandra Sailer/Ardea/Earth Scenes/Animals Animals

Instrumental Values of Ecosystems

- **Cultural services-**
Ecosystems provide cultural or aesthetic benefits to many people.
- Grand Tetons National Park provides aesthetic beauty valued by humans



Figure 3.24
Environmental Science for AP®
Buddy Mays/Corbis

IT'S DONE

IT'S OVER