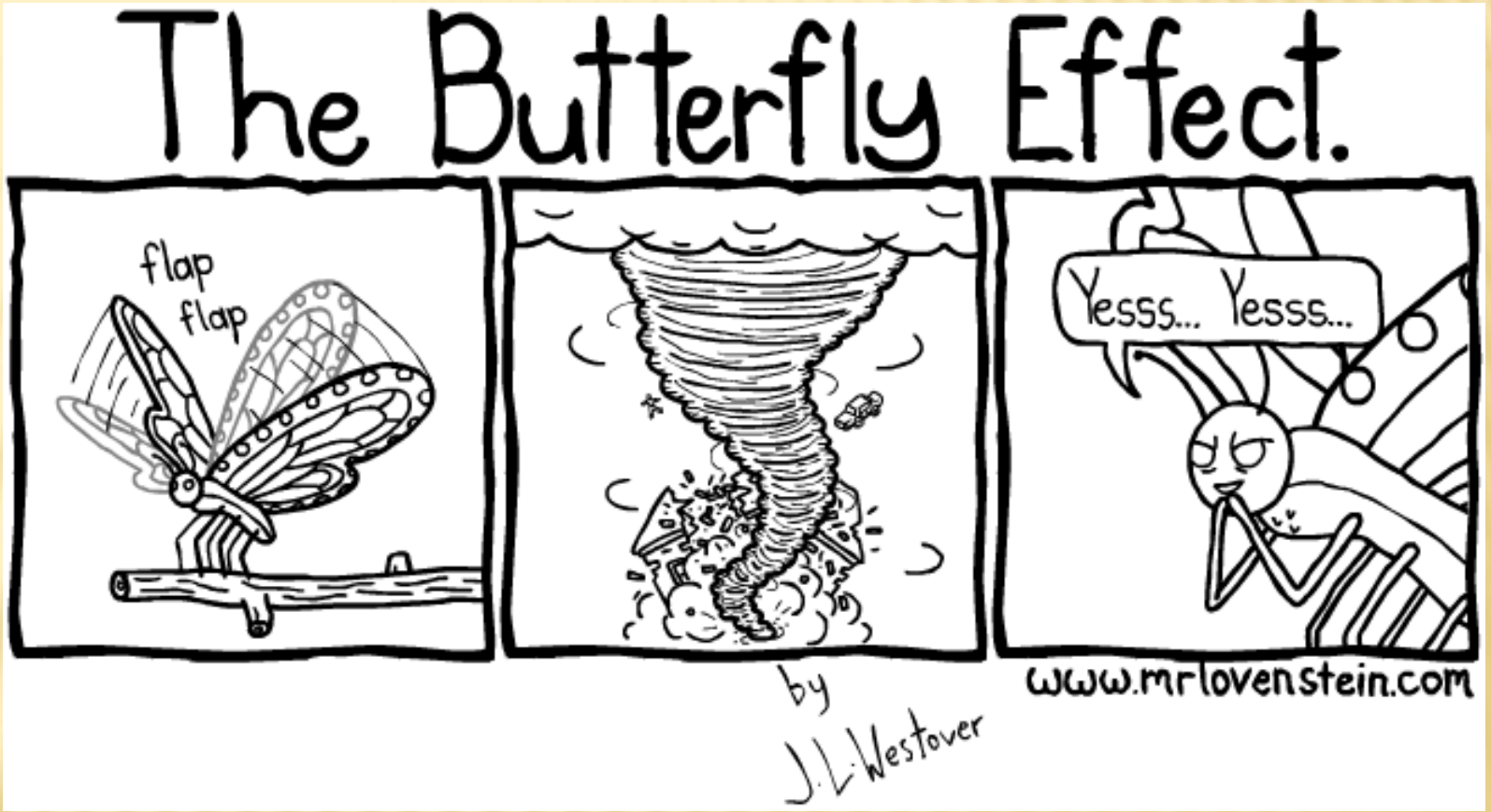
Interacting With The Biosphere

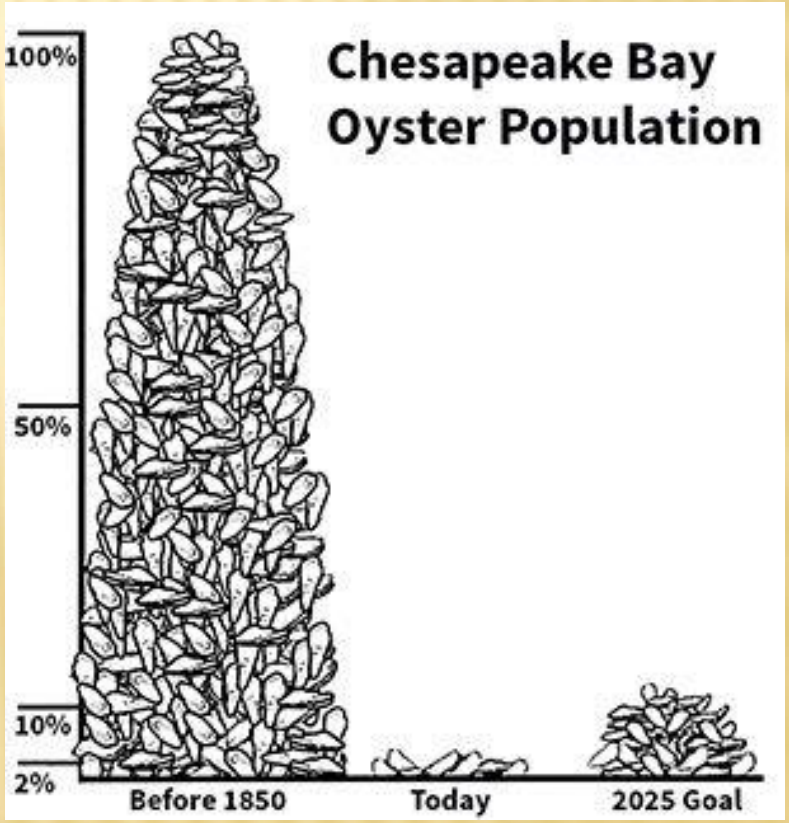
CHAPTER 4

THE BUTTERFLY EFFECT

- Small changes in a system result in large changes in how the system behaves.
- Small changes in the environment add up.



OYSTERS AND THE BUTTERFLY EFFECT



SUSTAINABILITY

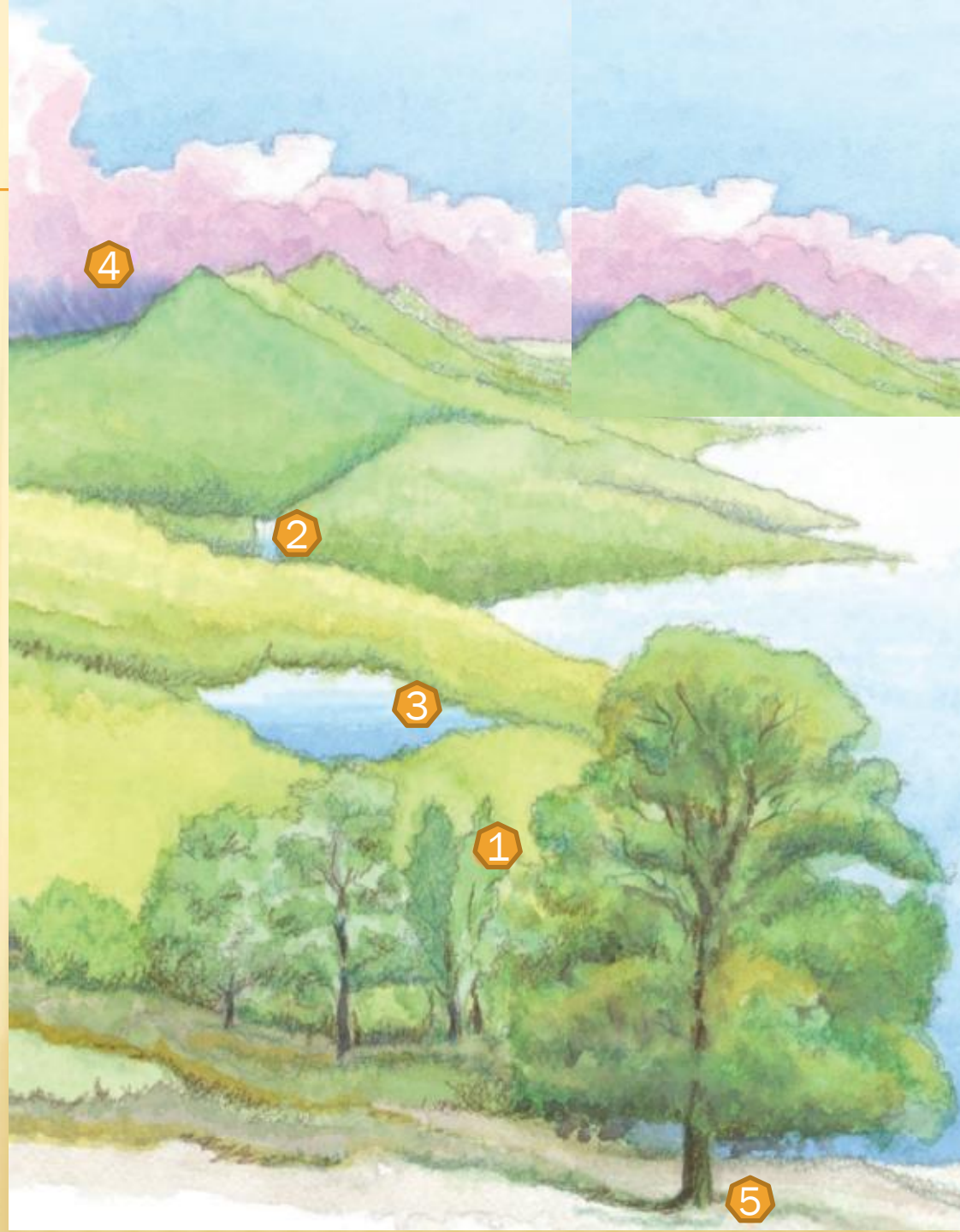
- The ability of the biosphere to maintain its balance indefinitely, keeping lifeforms in check.
- Maintains the planet's productivity and diversity.

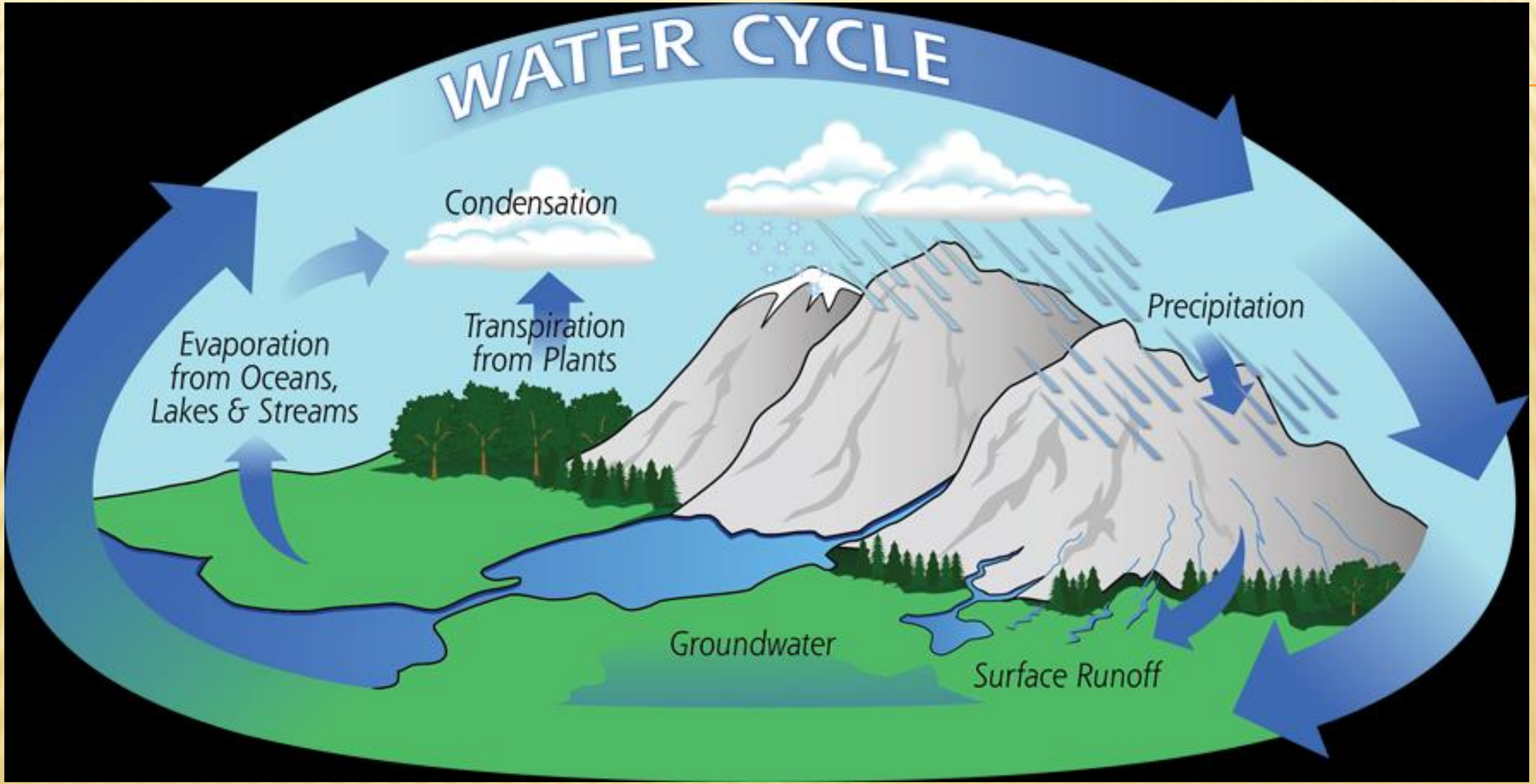
SUSTAINABILITY- THE CYCLING OF MATTER

- Biogeochemical cycles trace the flow of matter through the earth's crust and atmosphere.
- Four major cycles:
  - water
  - oxygen
  - carbon
  - nitrogen

THE WATER CYCLE

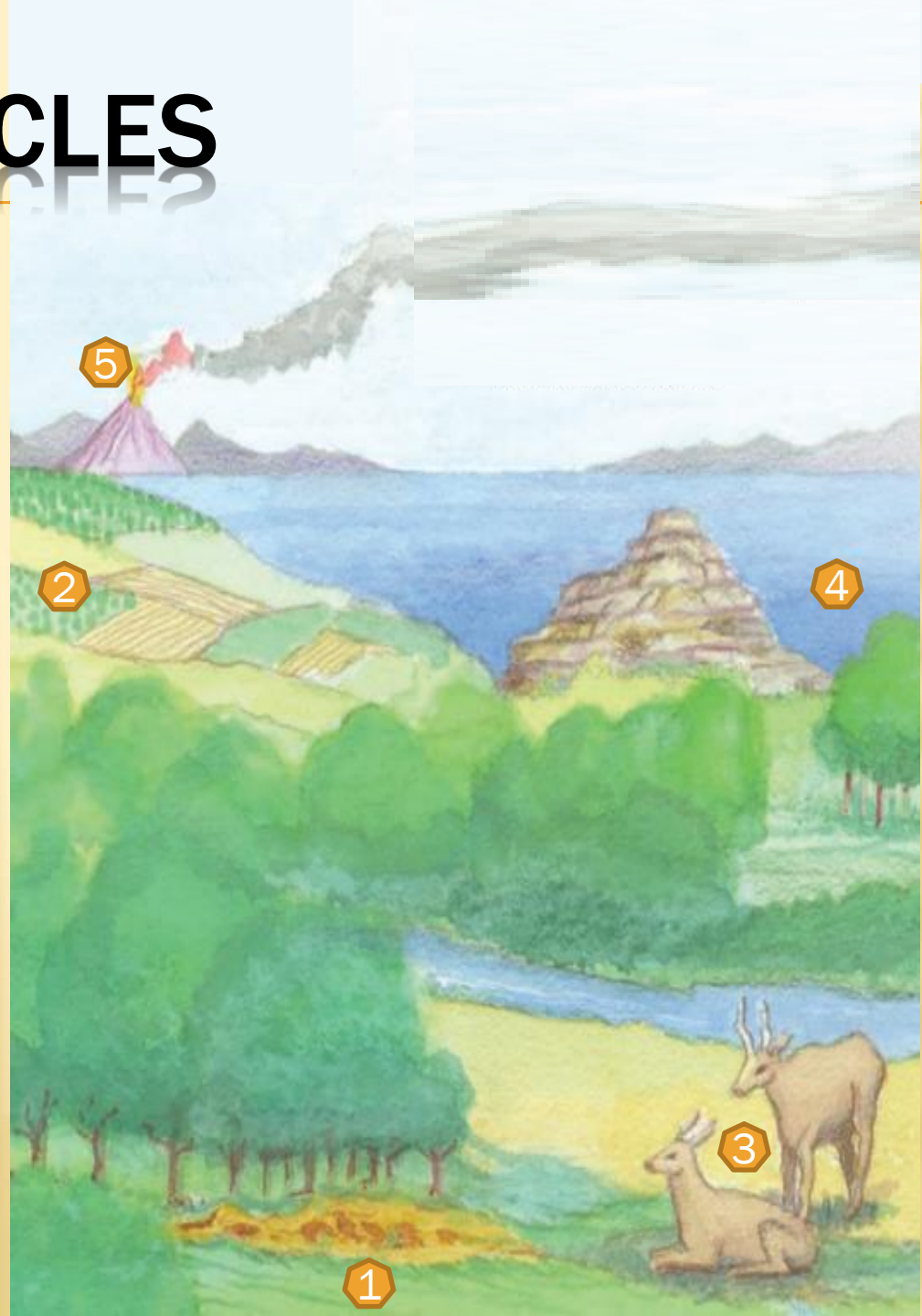
1. Water exits the leaves of plants during transpiration.
2. Water also enters the atmosphere through evaporation.
3. Water from the water table, an underground reservoir, seeps into springs, lakes, and oceans.
4. Cooled water vapor falls to the earth as precipitation.
5. Some becomes runoff water that percolates into the water table.

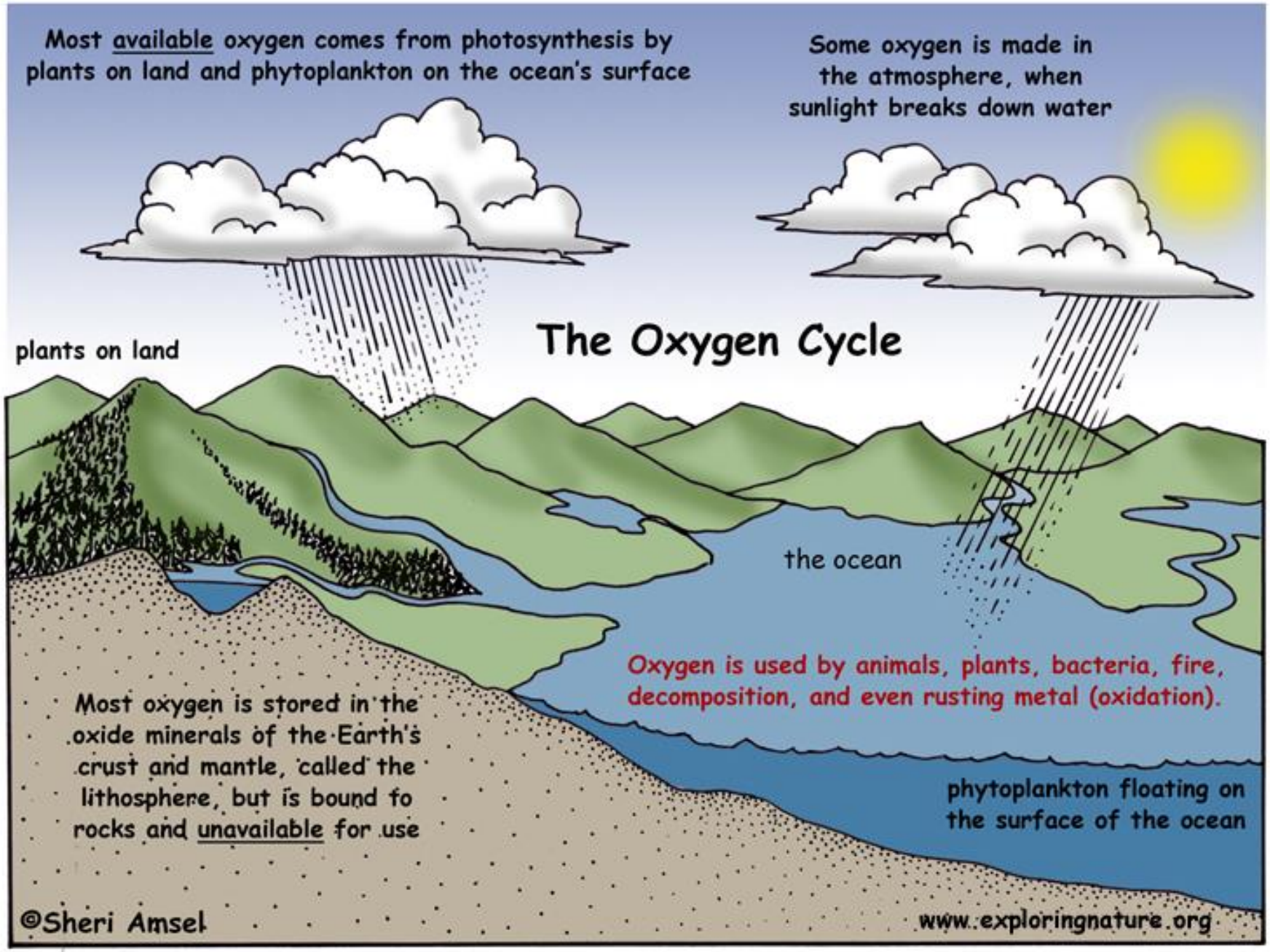



WATER CYCLE
Condensation
Transpiration
from Plants
Evaporation
from Oceans,
Lakes & Streams
Precipitation
Groundwater
Surface Runoff

THE OXYGEN AND CARBON CYCLES

1. Most of the earth's oxygen is trapped in minerals in the earth.
2. Most free oxygen (O_2) is produced by photosynthesis in plants and algae.
3. Bacteria, animals and people take in oxygen and expel carbon dioxide (CO_2). Plants also produce CO_2.
4. Most of the earth's carbon is trapped in the ocean or underground. The largest reserve of usable carbon is CO_2 in the atmosphere.
5. Volcanic eruptions and the combustion of fossil fuels contribute to the carbon in the atmosphere.




Most available oxygen comes from photosynthesis by plants on land and phytoplankton on the ocean's surface
Some oxygen is made in the atmosphere, when sunlight breaks down water
The Oxygen Cycle
plants on land
the ocean
Oxygen is used by animals, plants, bacteria, fire, decomposition, and even rusting metal (oxidation).
Most oxygen is stored in the oxide minerals of the Earth's crust and mantle, called the lithosphere, but is bound to rocks and unavailable for use
phytoplankton floating on the surface of the ocean
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OXIDES

Bauxite

Brucite

Cassiterite

Chromite

Chrysoberyl

Columbite

Corundum

Diaspore

Cuprite

Learn More

Franklinite

Goethite

Hematite

Ilmenite

Magnetite

Manganite

Psilomelane

Pyrolusite

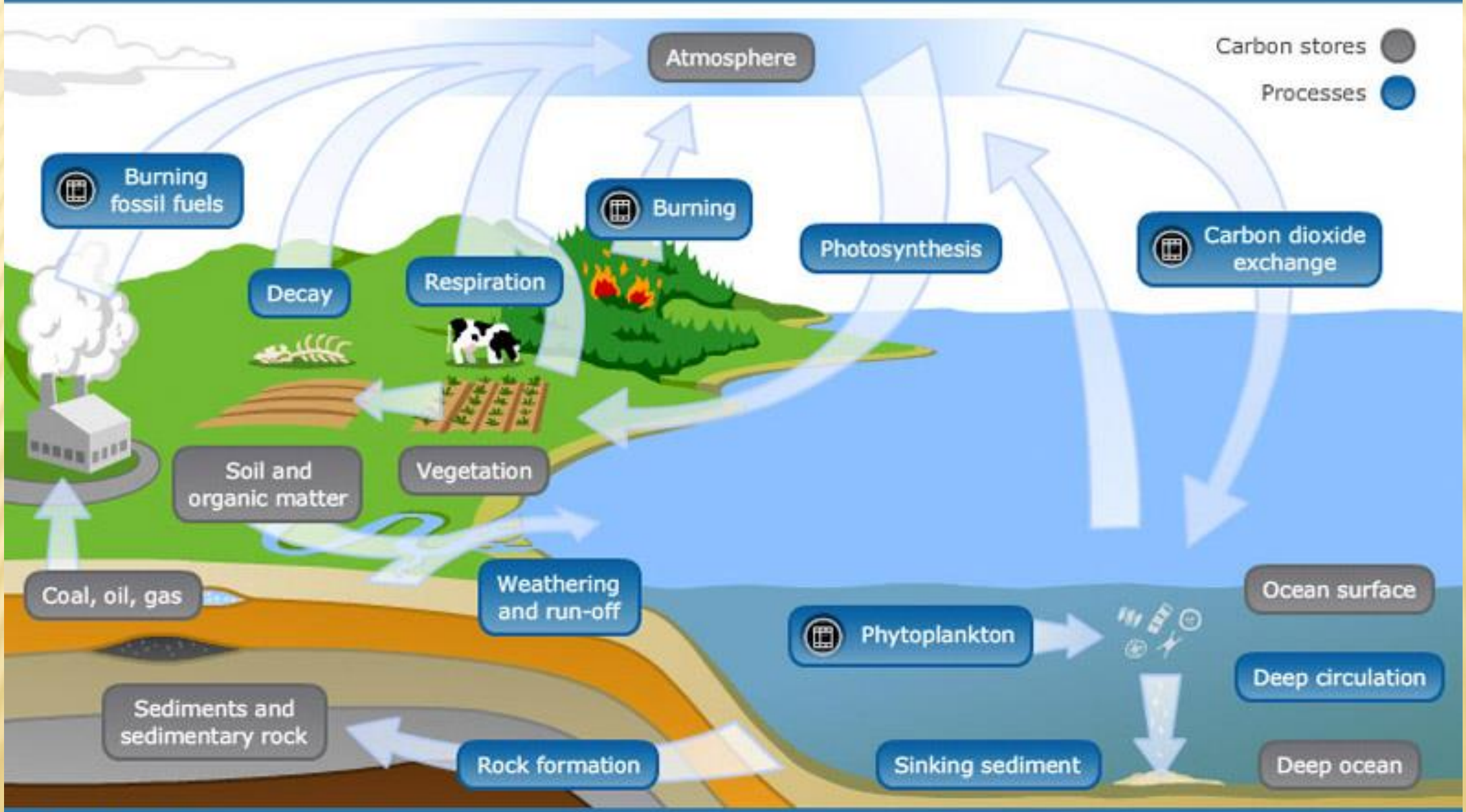
Rutile

Spinel

Uranite

Zincite

CARBON CYCLE



THE NITROGEN CYCLE

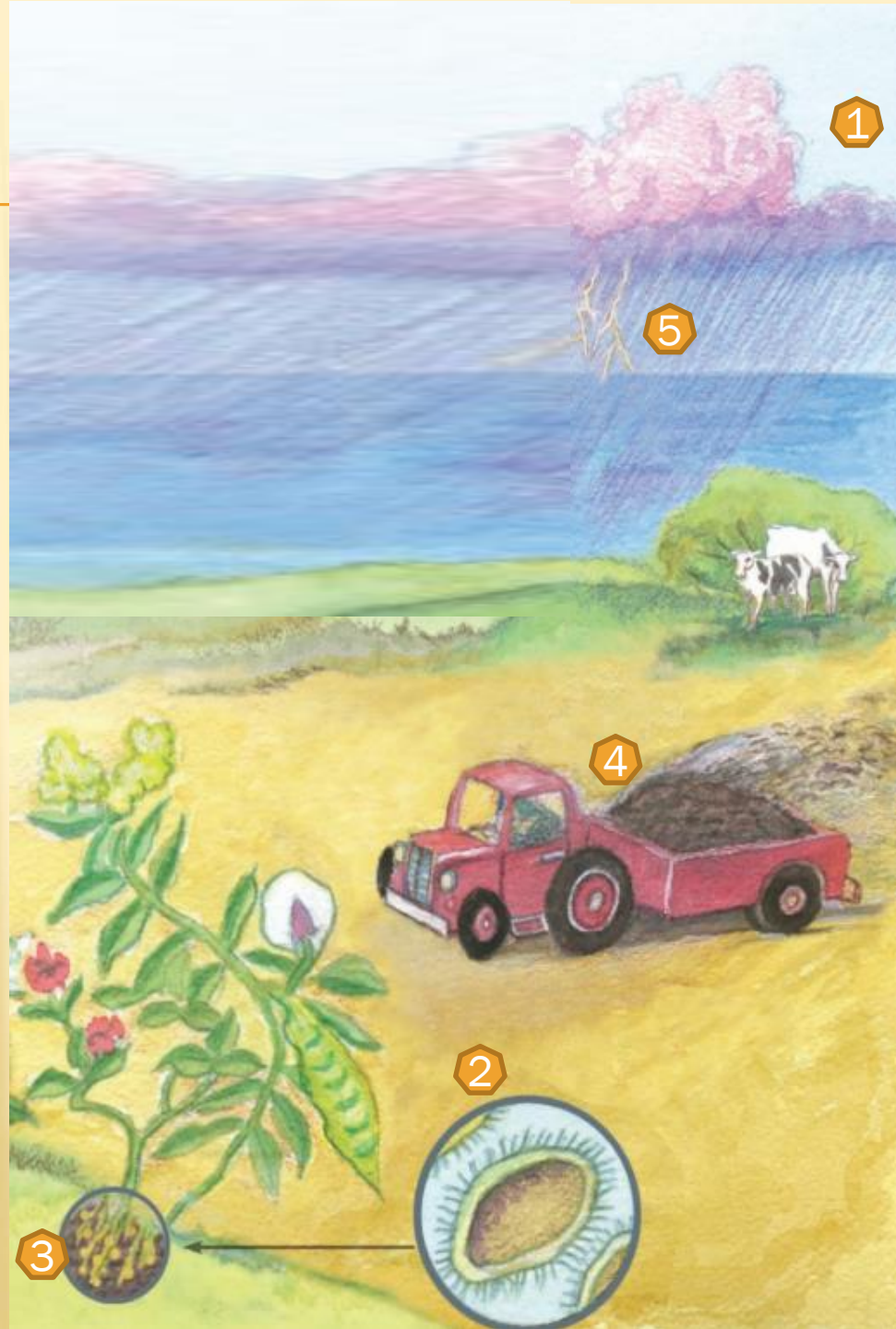
1. Most nitrogen is found in the atmosphere. Animals and people get their nitrogen by eating plants or plant-eating animals.

2. Through nitrogen fixation, bacteria living in the roots of legumes can absorb nitrogen from the air and convert it into ammonia (NH_3).

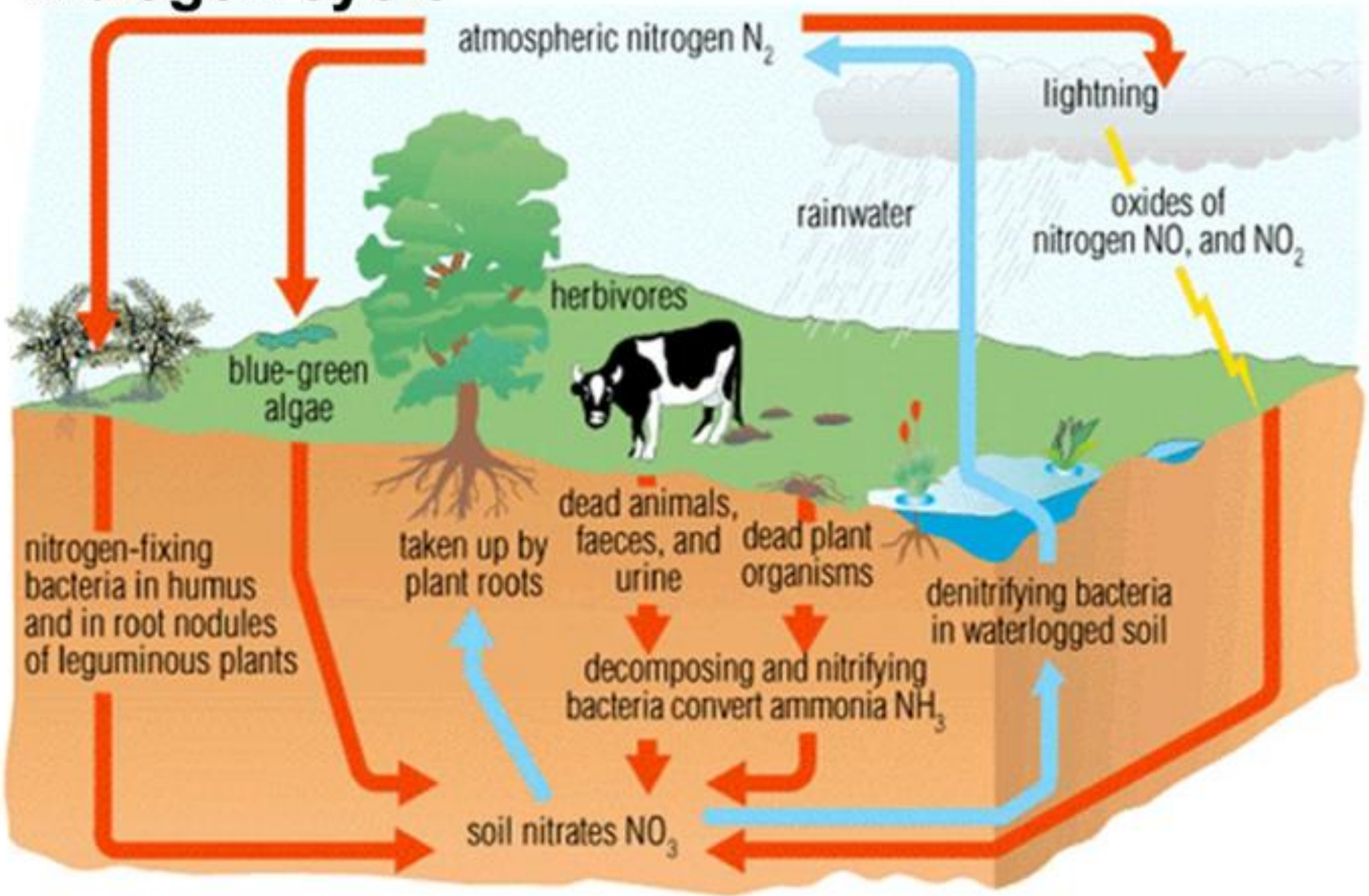
3. Ammonia is broken down by water in the soil and absorbed by plant roots to make nitrogen-containing products that plants need to grow.

4. Nitrogen fixation also occurs with bacteria in the soil.

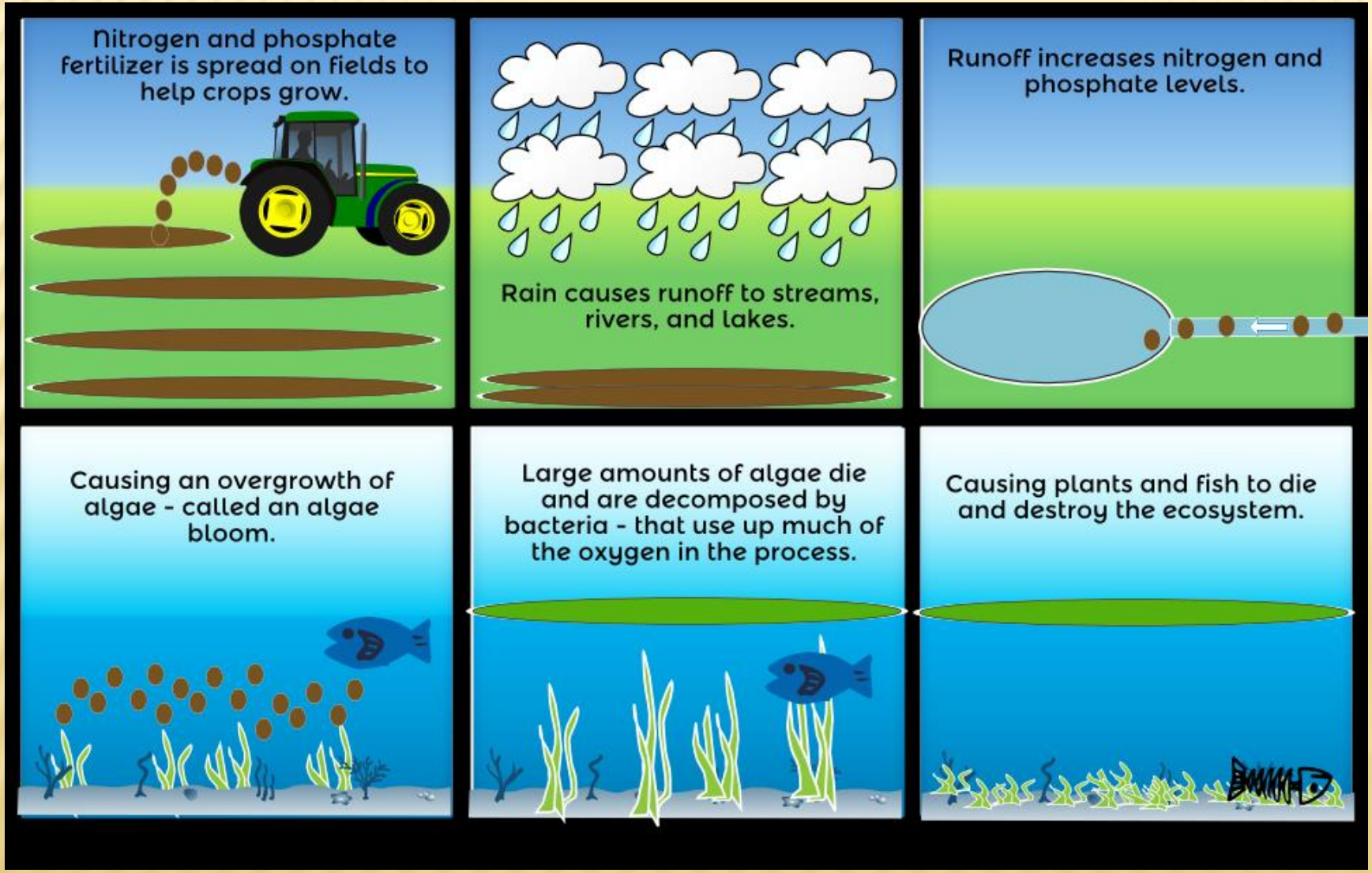
5. Lightning strikes also fix atmospheric nitrogen.



Nitrogen cycle



EUTROPHICATION



4-2 Sometimes the only way that fish can get oxygen in a green pond is through the air bubbles produced when birds kick their feet in the water.

eutrophos- well nourished.

The condition of a nutrient-rich body of water leading to the uncontrolled growth of algae.

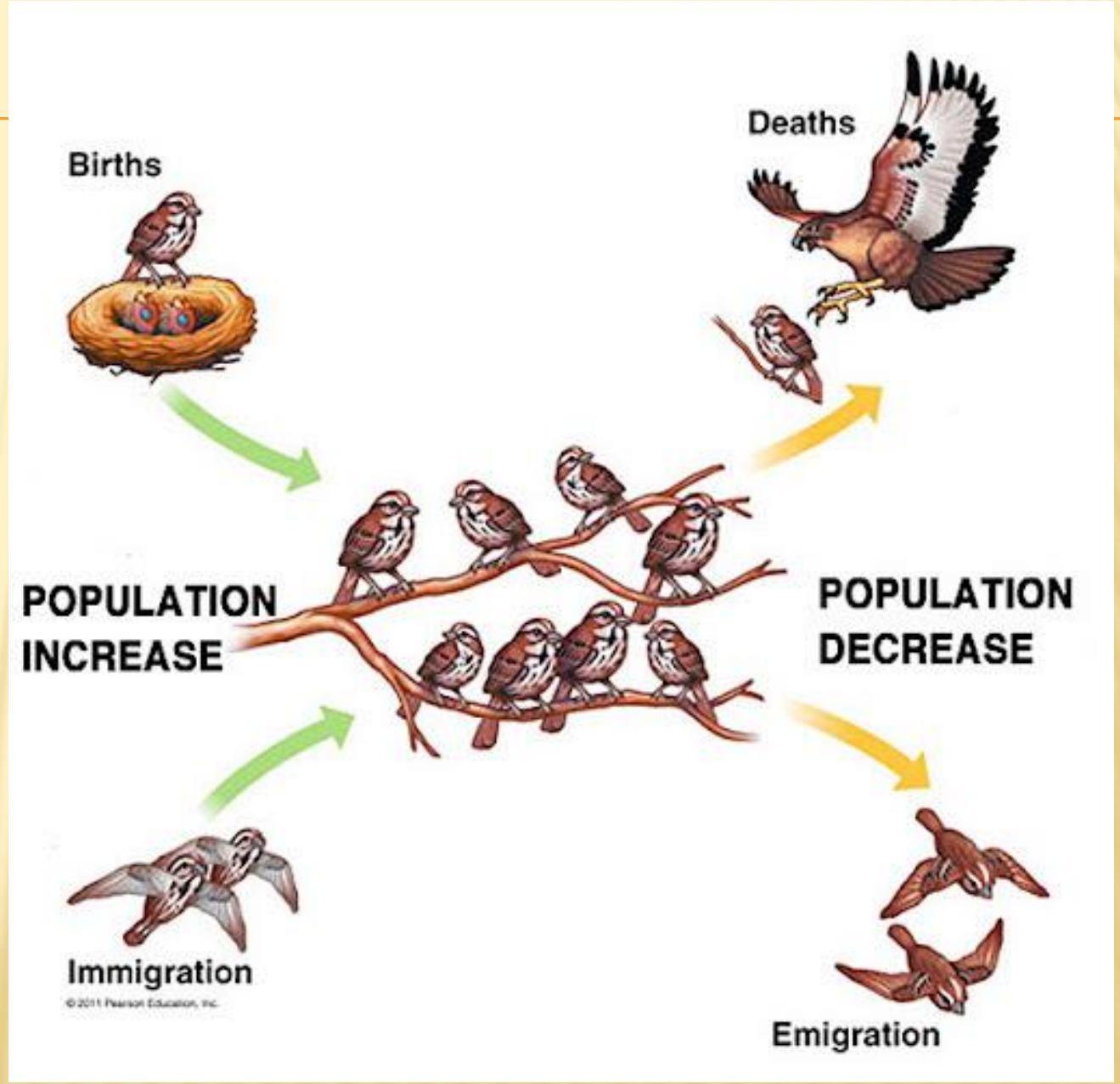
POPULATION GROWTH

- Population density- the number of individuals per unit of area.
- Limiting factors- factors that limit the growth of a population.
  - Examples: excess carbon dioxide, lack of oxygen, buildup of wastes, food availability

POPULATION GROWTH

Populations change size in two ways:

1. Ratio of birthrate to death rate.
   - When birthrate > death rate: population increases
   - When death rate > birthrate: population decreases
2. Outside individuals joining the population (immigration) or members leaving (emigration).

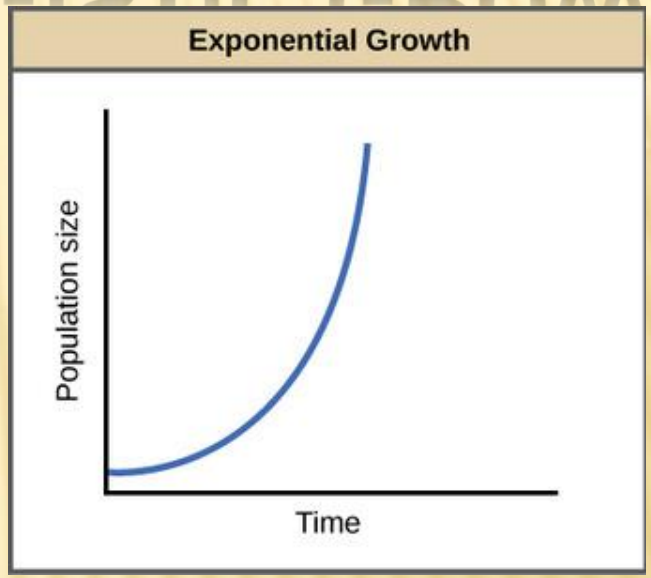


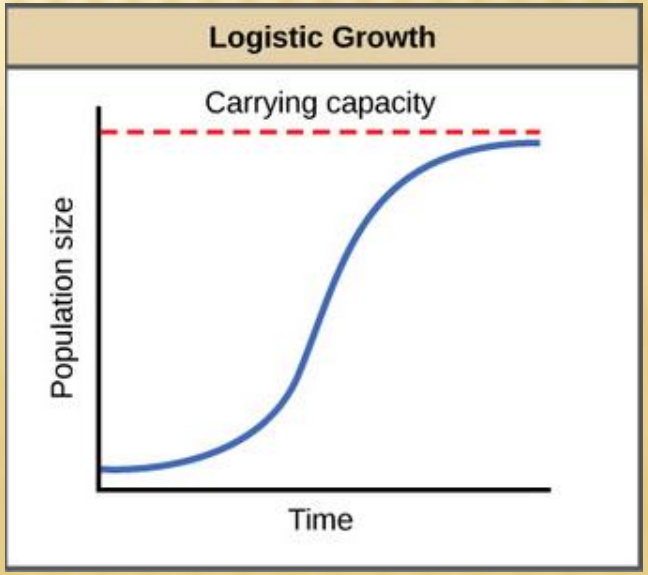
BIODIVERSITY

- The amount of variation (genetic variation or number of species) in an ecosystem.
- A change in biodiversity can be natural, or it can result from four major human factors:
  1. habitat loss
  2. overuse of resources
  3. introduction of a species to a new area
  4. overuse of chemicals such as fertilizer

EXPONENTIAL GROWTH VS. LOGISTIC GROWTH

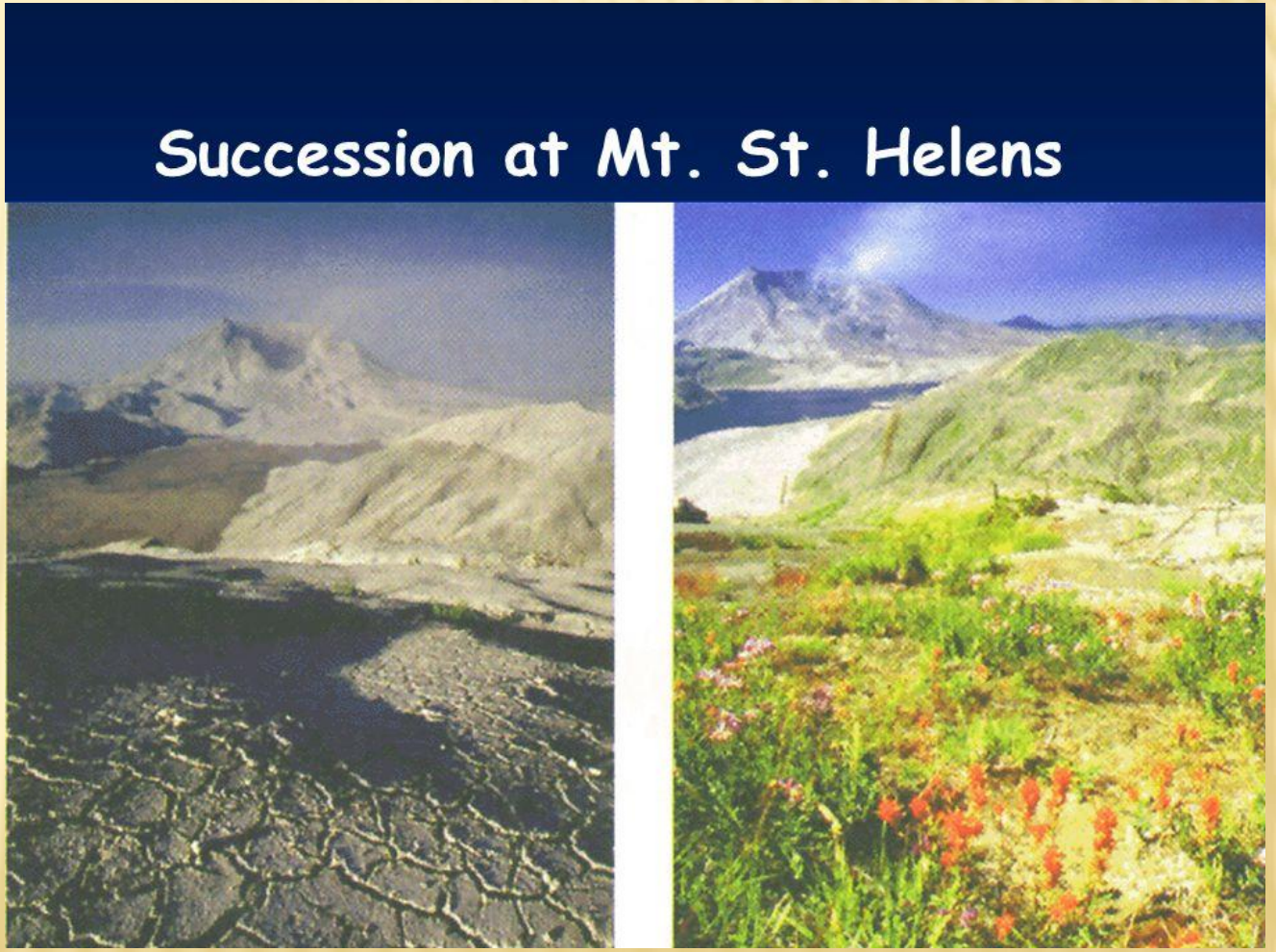
- Exponential growth- rapid growth that can occur in a population when resources are abundant.
- Carrying capacity- the maximum number in a population that an area can sustain.
- Logistic growth- a slower and more realistic rate of growth that accounts for the limiting factors and carrying capacity of a population.





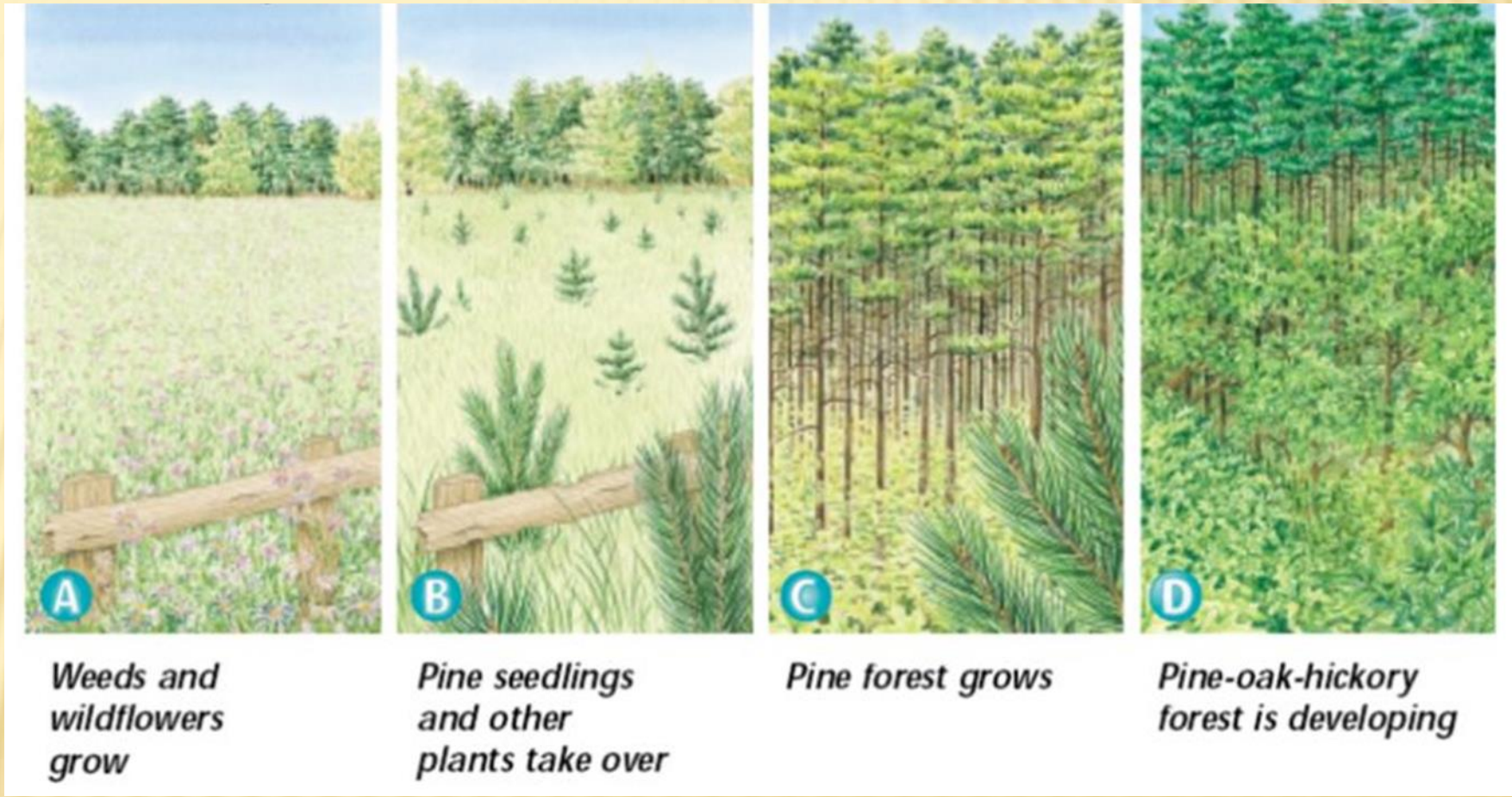
PIONEERING ECOSYSTEMS

- The change of a biotic community over time is known as succession.
- Succession that begins with a barren landscape is primary succession.
- Plants and animals that are the first to return to an area are known as pioneer species.



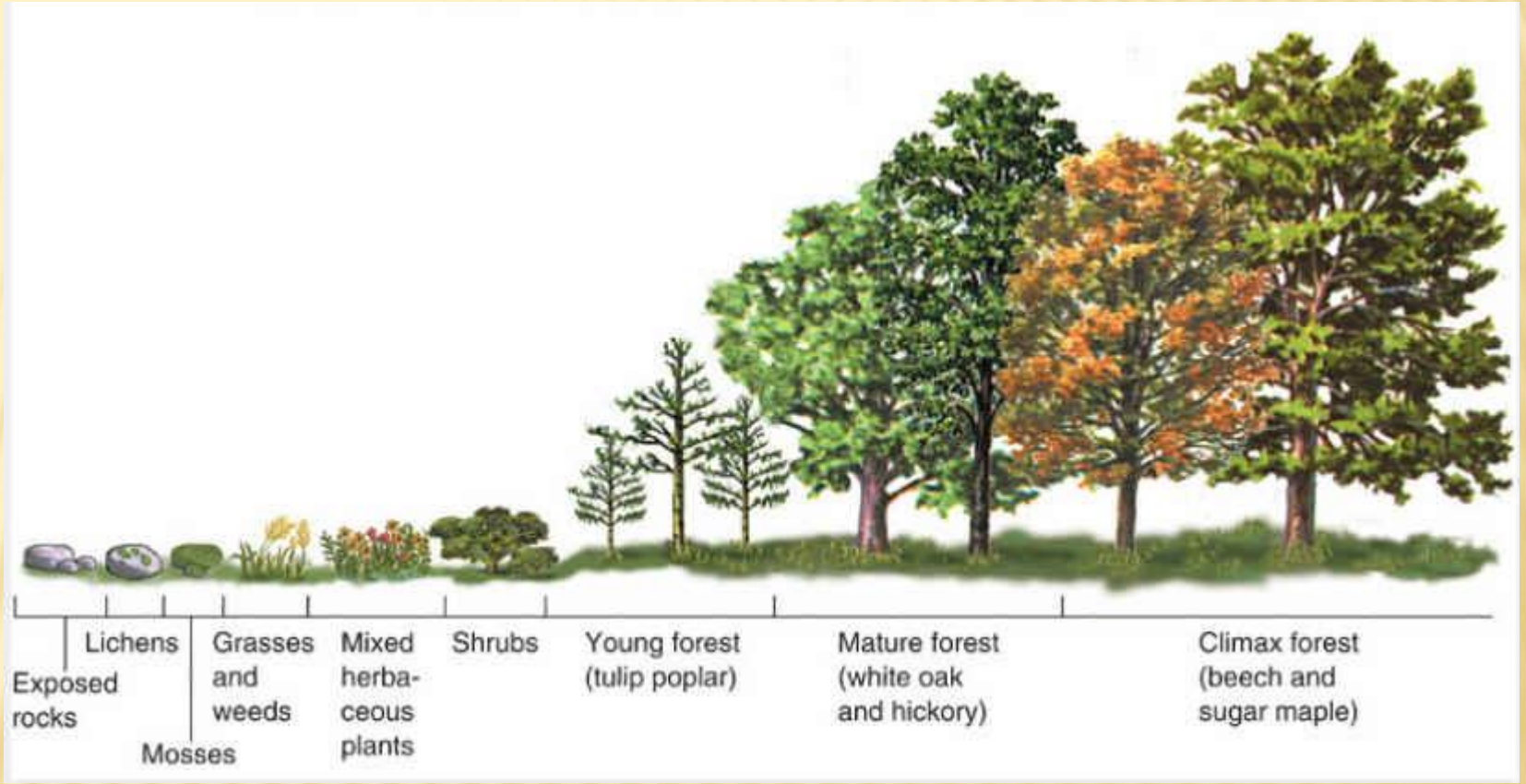
SECONDARY SUCCESSION

- succession in a disturbed landscape that already has <u>soil</u>



CLIMAX SPECIES

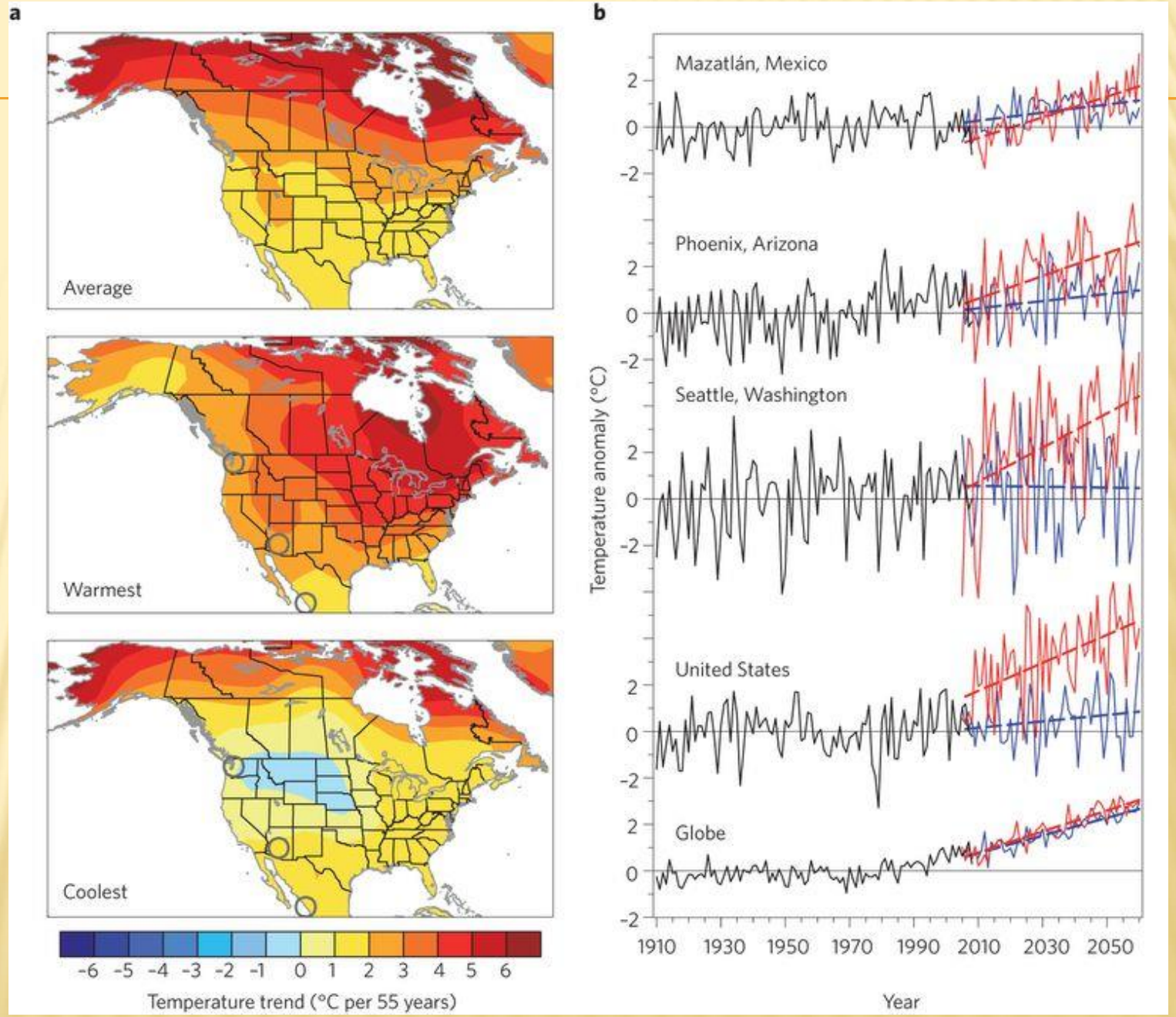
- stable, long-lived species that mark the end of succession.



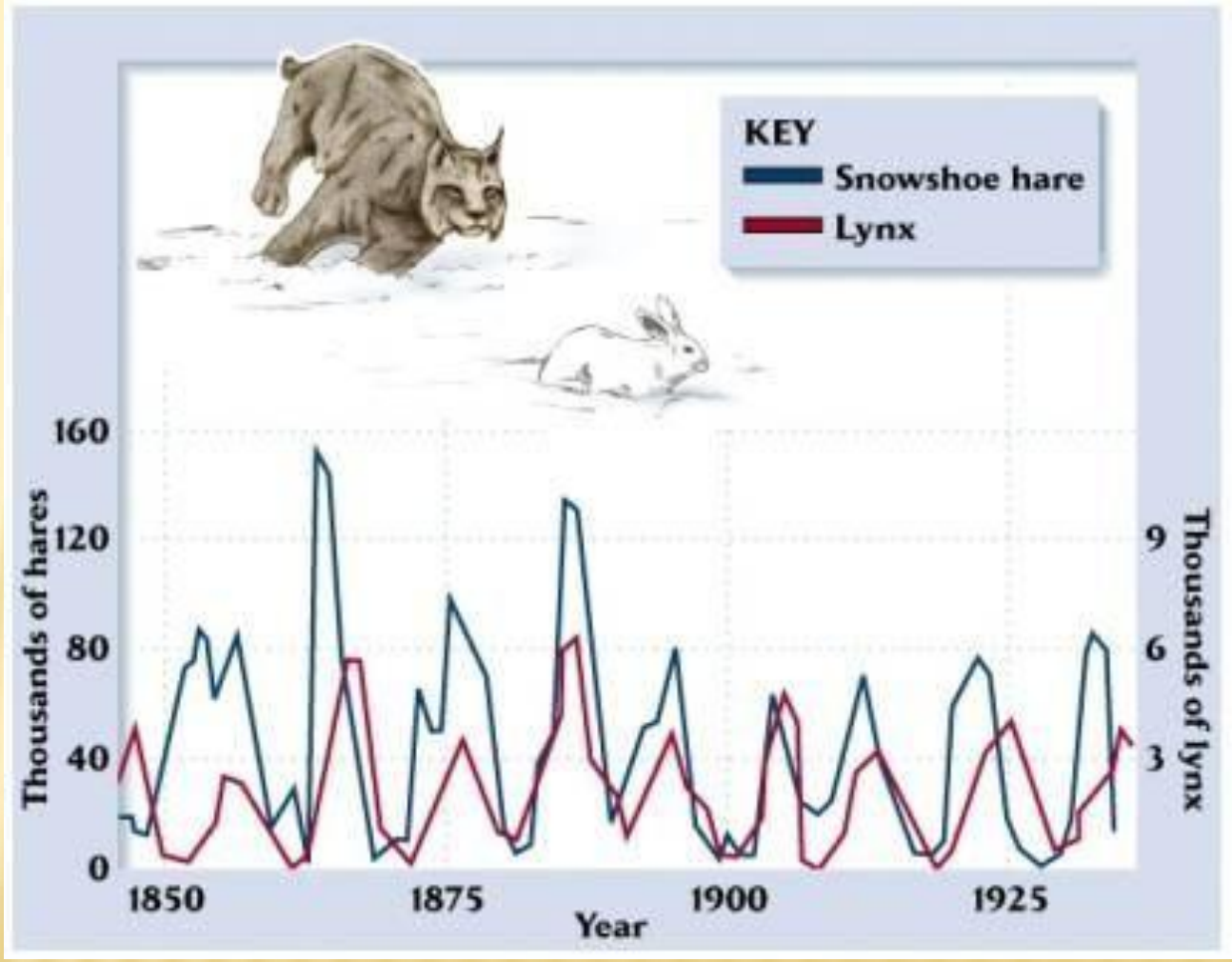
FINDING ORDER IN CHAOS

- Cycling of matter and population growth are very complex systems that can appear chaotic and random at times.
- Evolutionists view the butterfly effect as a random process that allowed life to evolve from nonliving material in the oceans because it shows us that we can't completely model nature.

1. Models of complex systems such as climate tend to have limited reliability because the systems often have thousands of tiny variables.



2. As scientists have improved their models, they have discovered that the world is more orderly and predictable than it might appear. (Ex: boom and bust cycles)

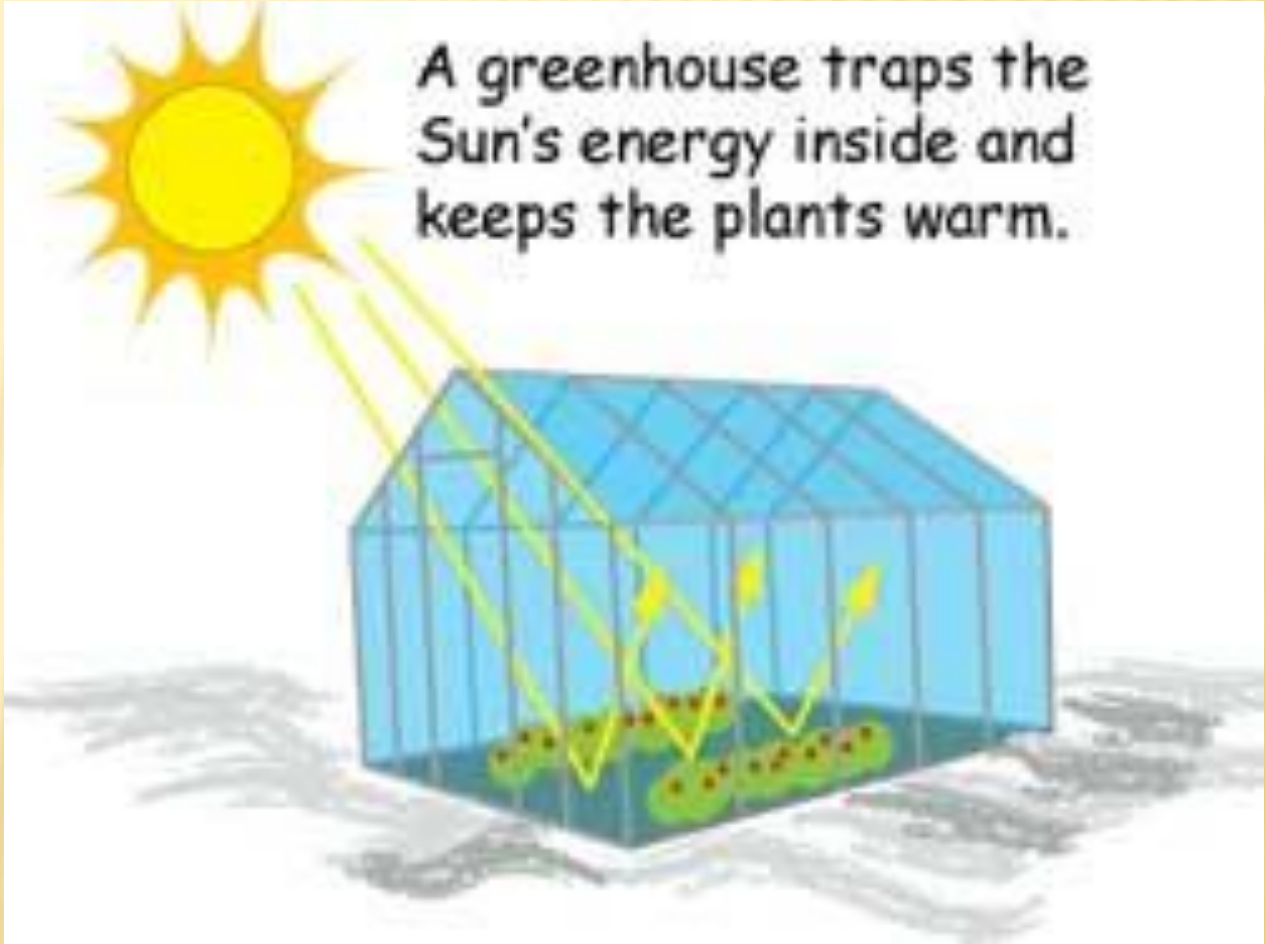


3. A person's view of chaos in nature ultimately reflects his worldview:

- Naturalistic worldview: interprets randomness and chaos as evidences for evolution.
- Biblical worldview: sees results of the Fall. We can still see God's order and design, but it has been broken because of sin.

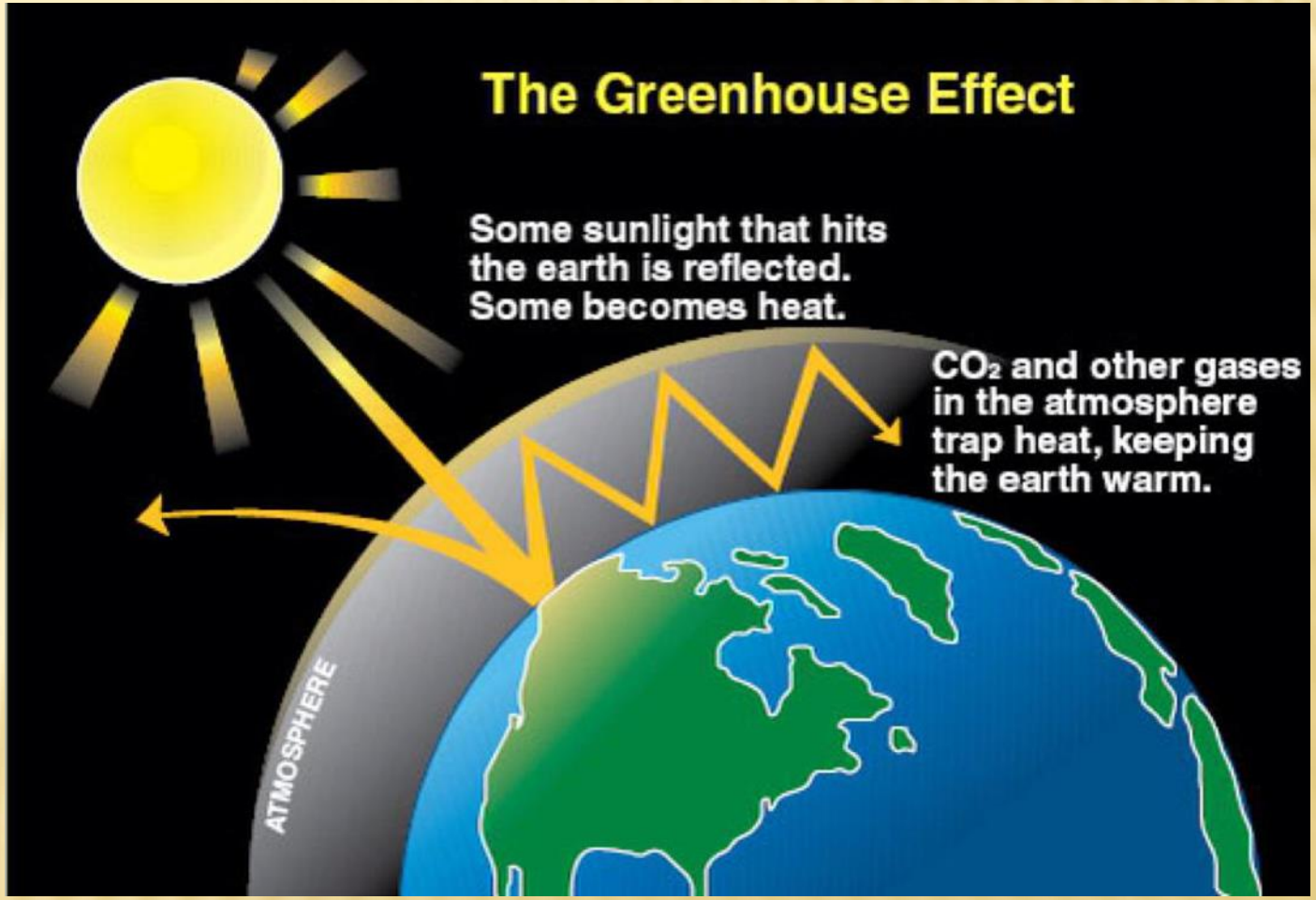
GREENHOUSE GASES

- gases in the atmosphere that trap heat.
- many of the compounds that move through the biogeochemical cycles are greenhouse gases.



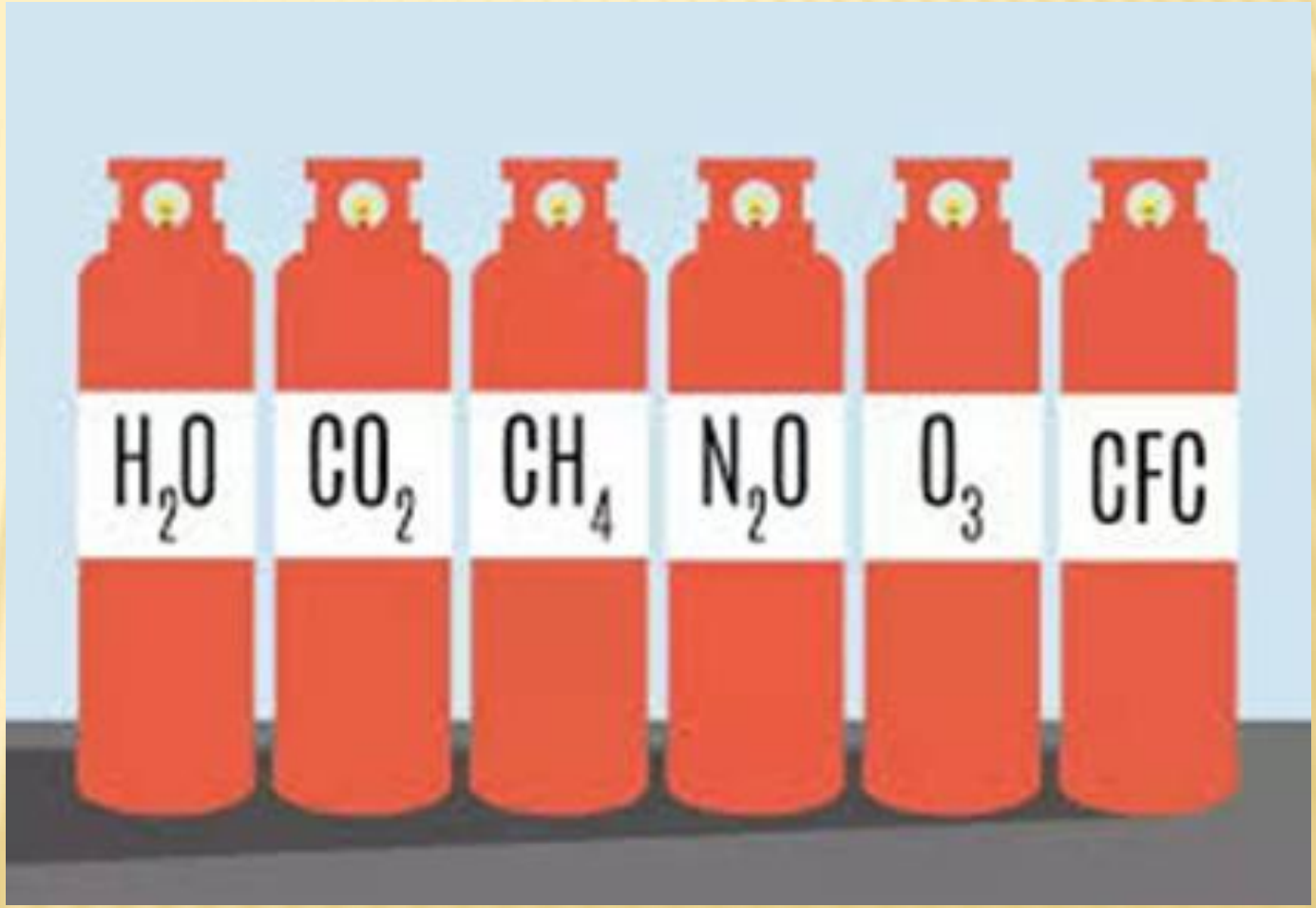
GREENHOUSE GASES

- Necessary for life:
  - keep the earth warm
  - absorb harmful radiation from the sun.



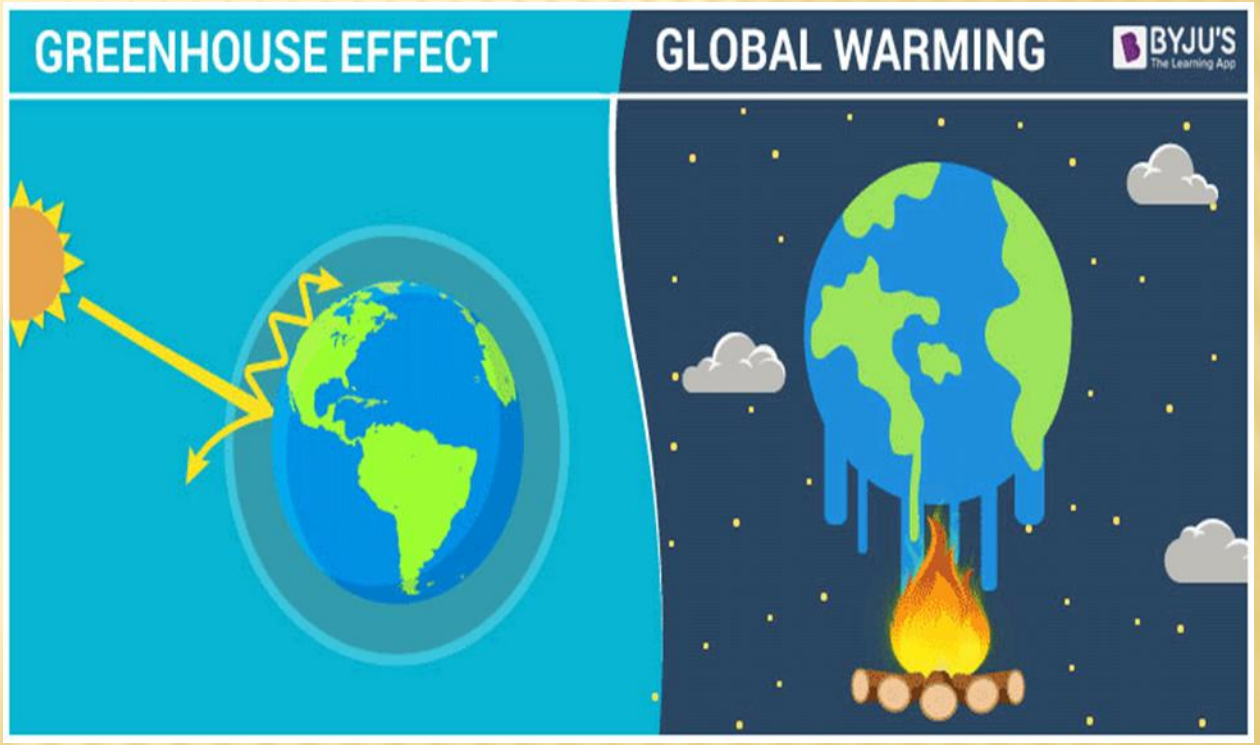
GREENHOUSE GASES

- The most common greenhouse gases are:
  - water vapor (H_2O)
  - carbon dioxide (CO_2)
  - methane (CH_4)
  - nitrous oxide (N_2O)
  - ozone (O_3)
  - chlorofluorocarbons (CFCs).



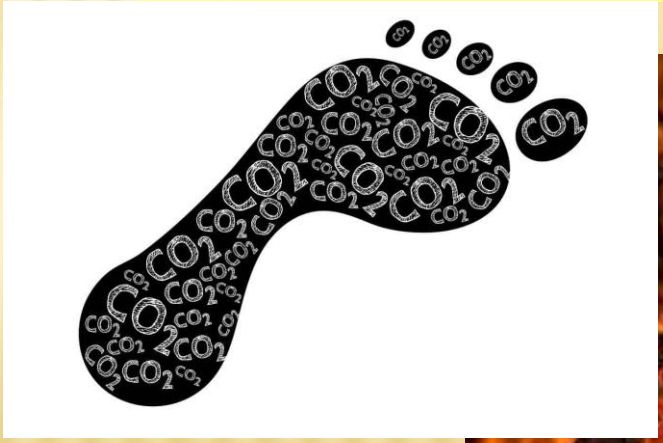
GREENHOUSE GASES

- Many scientists believe that as greenhouse gases build up in the atmosphere and trap heat, they cause the earth to heat up in a process called global warming.



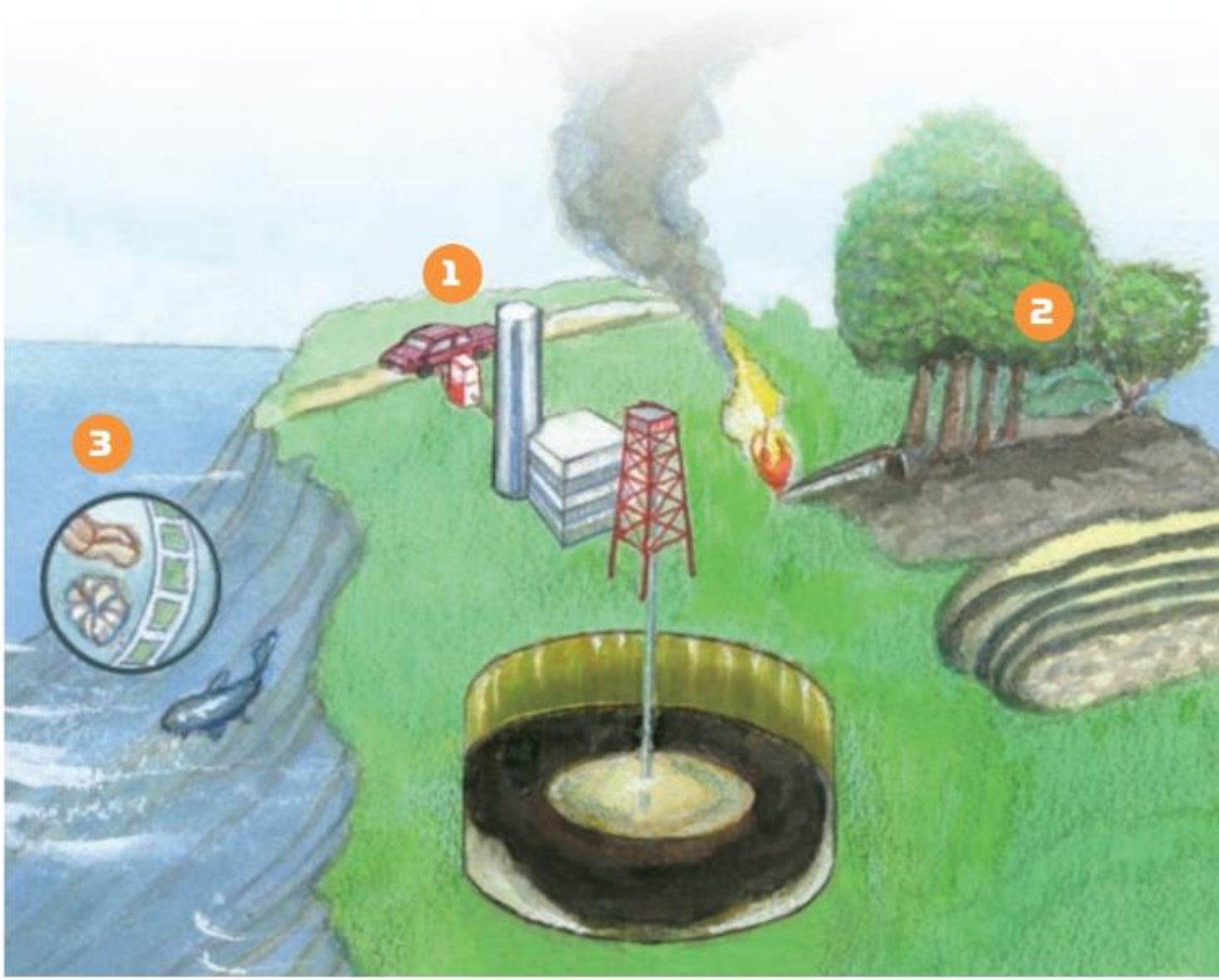
CARBON FOOTPRINT

- The amount of greenhouse gases released when people burn carbon-containing fuels.
- Some scientists claim that human activities, such as burning fossil fuels or wood, increase our carbon footprint.



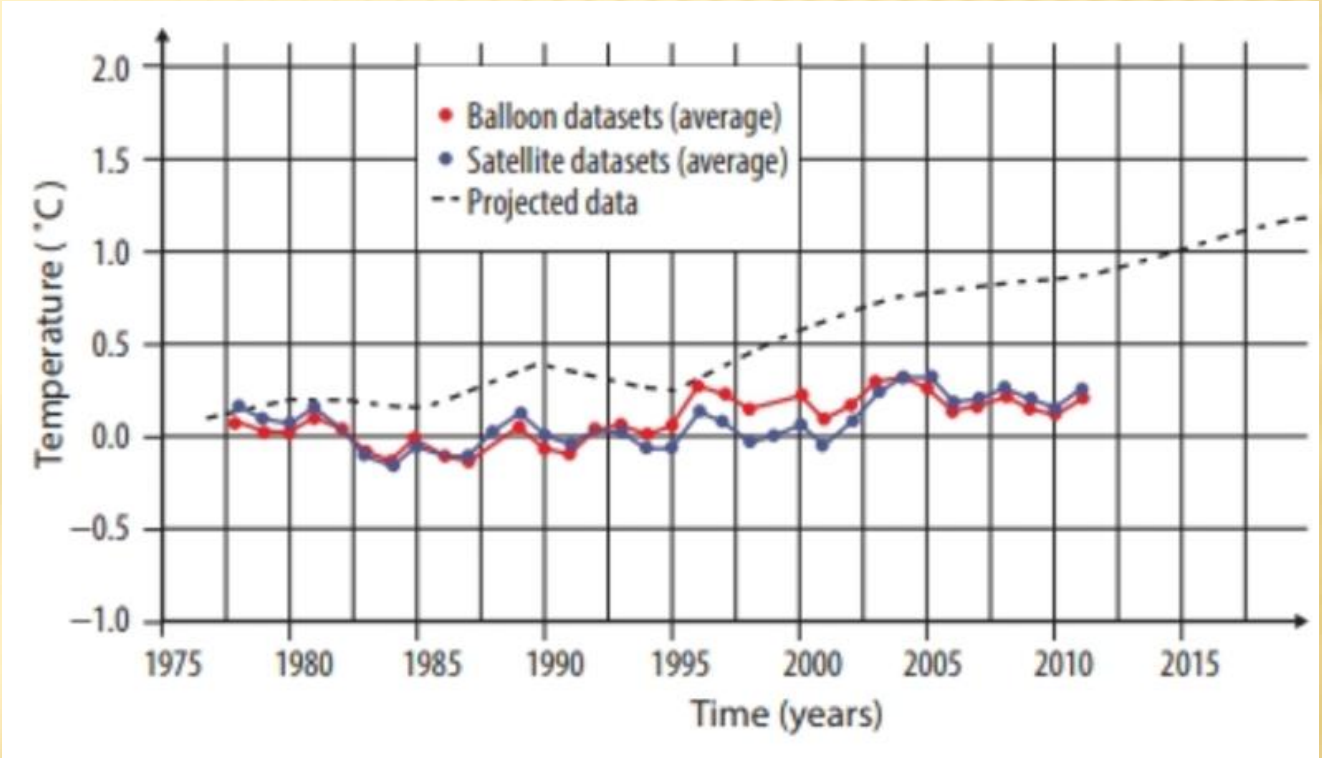
4-10

Burning fossil fuels 1 contributes about 4 gigatons of carbon a year to greenhouse gases. On the other hand, plants 2, decomposers, and the ocean 3 contribute a whopping 210 gigatons a year!



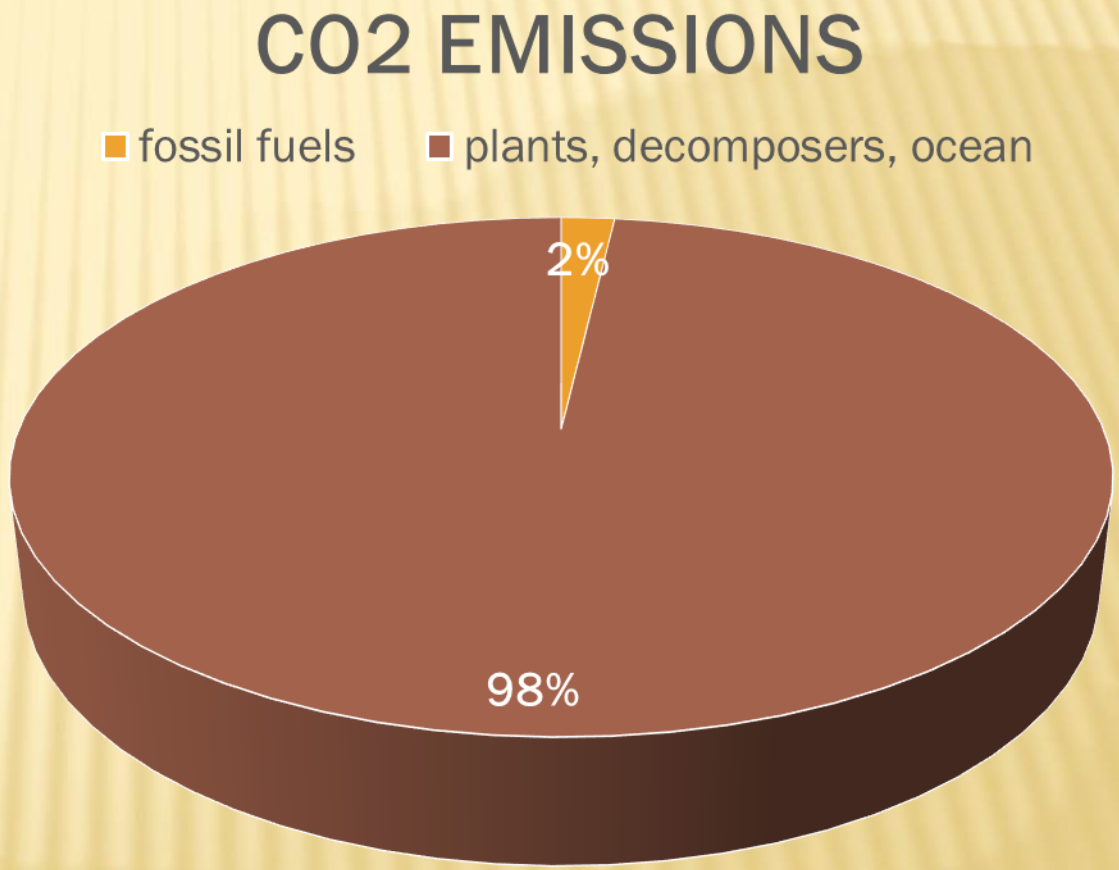
GLOBAL WARMING?

- Scientists predict that the earth's temperature will soon <u>increase</u> as we burn more fuels and cut down more trees.
- Data shows that the earth's temperature has risen about half a degree in the last 50 years.



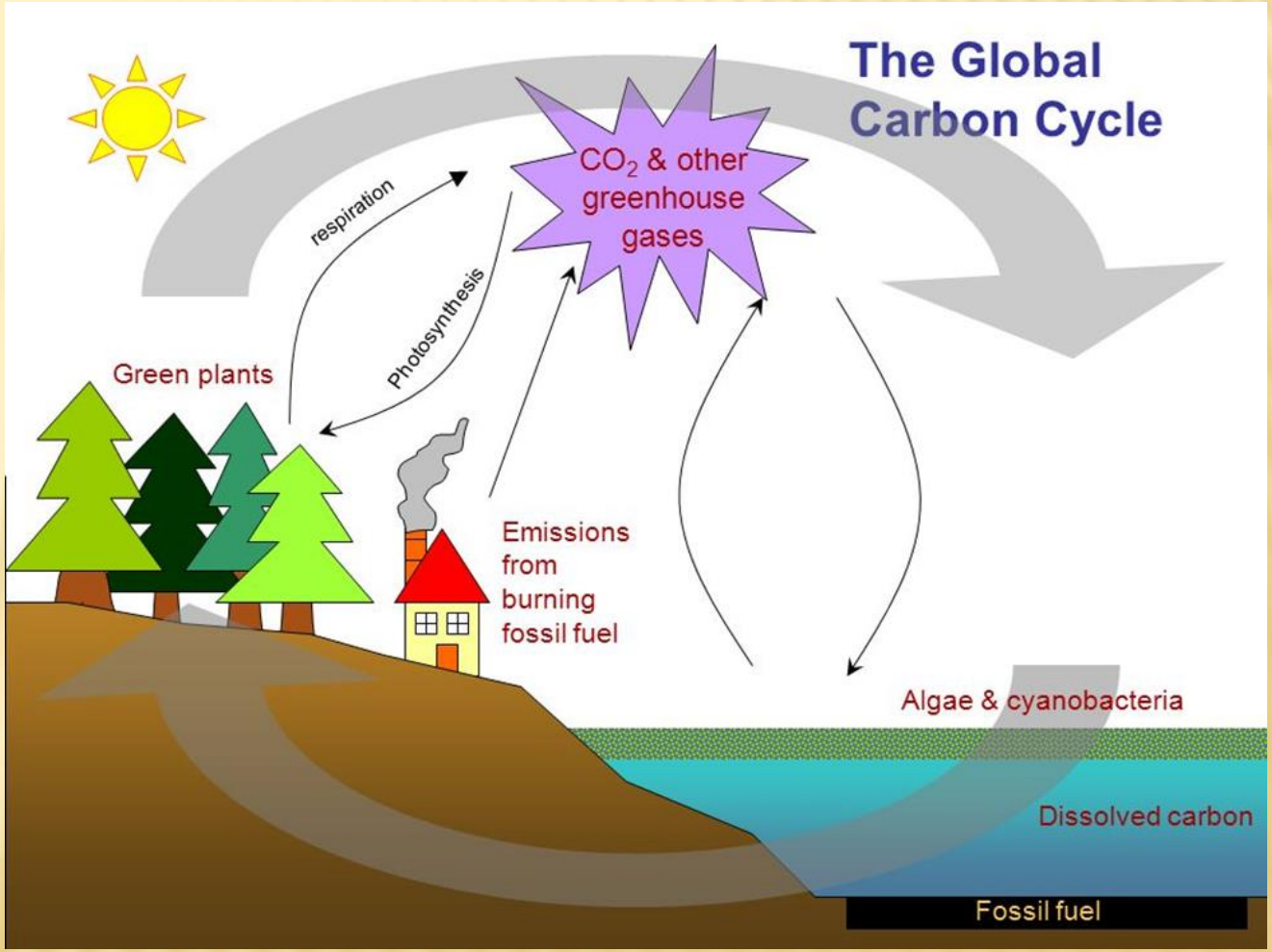
CARBON FOOTPRINT

- Burning fossil fuels does produce greenhouse gases.
- Natural processes are responsible for most of the greenhouse gases released into the atmosphere.



RECYCLING GREENHOUSE GASES

- Bacteria, algae, and plants take in greenhouse gases and <u>remove</u> them from the atmosphere.
- God designed His earth to <u>recycle</u> its byproducts, including greenhouse gases.



- Part of fulfilling the Creation Mandate is to:
  - Monitor the amount of greenhouse gases we produce
  - Improve our technology to produce less of them
  - Use trees wisely

ECOLOGICAL FOOTPRINT

- How humans relate to the carrying capacity of the earth.
- A comparison of how many resources a person uses to how quickly those resources can be replaced.

CLIMATE CHANGE

- Scientists measure global temperatures in an attempt to understand climate change, the difference in Earth's temperature and climate over long periods of time.
- Scientists blame people for climate change.

POSITIVE EFFECTS OF CLIMATE CHANGE

4-13

Melting glaciers have the potential to be helpful to people. The Northwest Passage, an ocean corridor above Canada that links the Atlantic and Pacific Oceans, is typically blocked by ice. Over the past few years, the ice has melted enough to allow a few shipping routes through the Passage, cutting shipping costs and connecting continents in a whole new way.

HOW SERIOUS IS CLIMATE CHANGE?

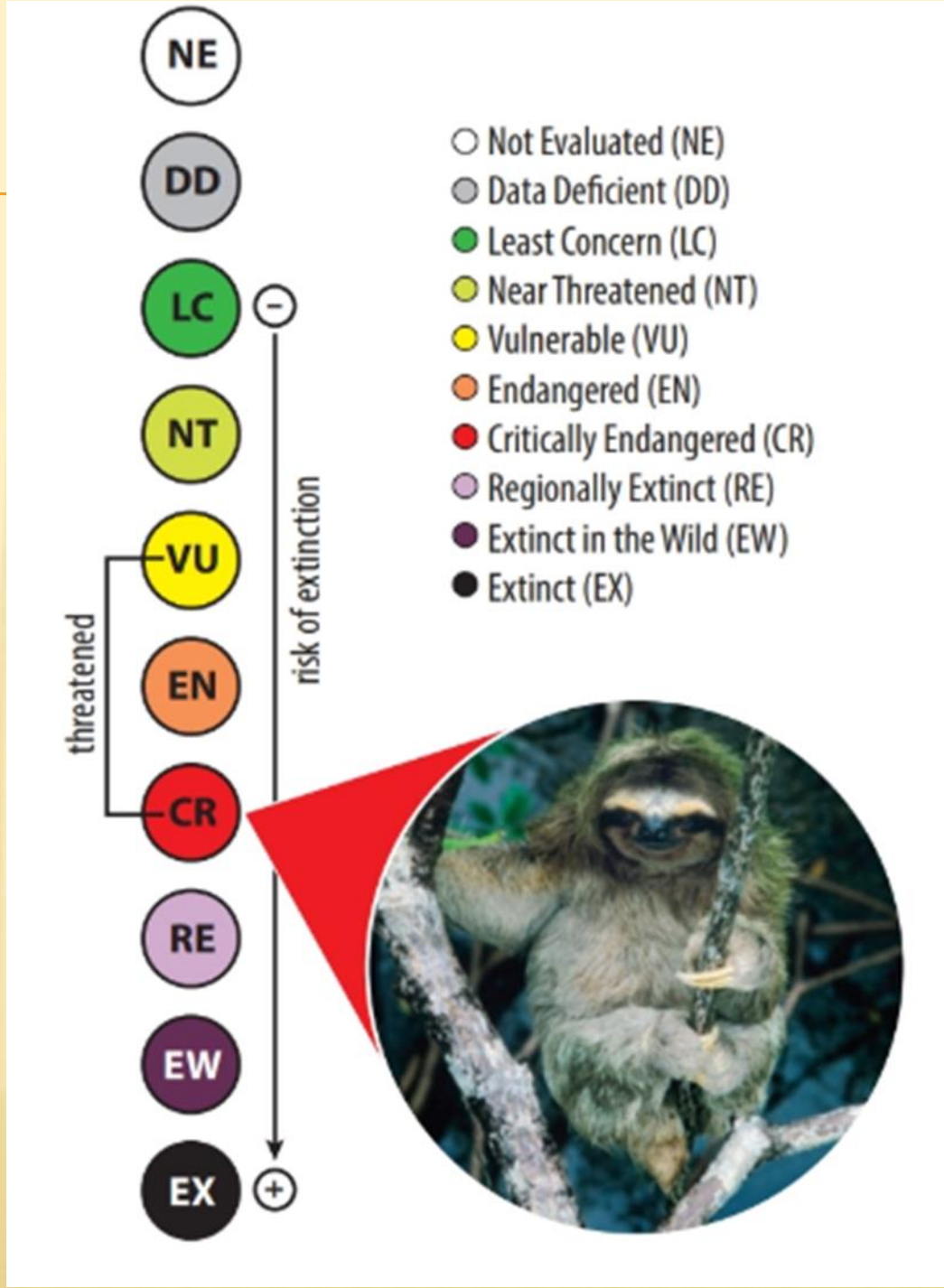
- Most of the fears surrounding climate change are based on melting ice and snow, rising ocean levels, and increased rainfall.
- These changes are observable, and some people see them as the first steps toward the earth's destruction.

- **According to a biblical worldview, the earth has gone through at least one major change in its climate during its 7,000 year history.**
- The Flood, followed by the Ice Age, drastically changed the face of the earth, but the earth has rallied to replenish itself.


while the earth remains seedtime & harvest, cold & heat
GENESIS 8:22
and summer &winter, and day & night shall not cease
Knowing-Jesus.com

EXTINCTION RATES

- Evolutionary biologists believe that the extinction rate for species is <u>increasing</u>.
- People with a biblical worldview say that since the Flood, the extinction rate has been <u>decreasing</u>.



INVASIVE SPECIES

- Organisms that move into a habitat where they are not native and then compete with native species for <u>resources</u>.
- **Examples:** Burmese python, lionfish, and kudzu

lionfish spread

INVASIVE SPECIES

- **Kudzu** (*Pueraria montana*) is a plant that has taken over large tracts of land in the American South.
- Native to **Asia**

BIOREMEDIATION

- a technique that uses <u>organisms</u> to remove or neutralize hazardous materials.