

UNIT 9 - ECOLOGY

Topic 1 – Ecology Basics

Topic 2 – Population Ecology

Topic 3 – Community Ecology

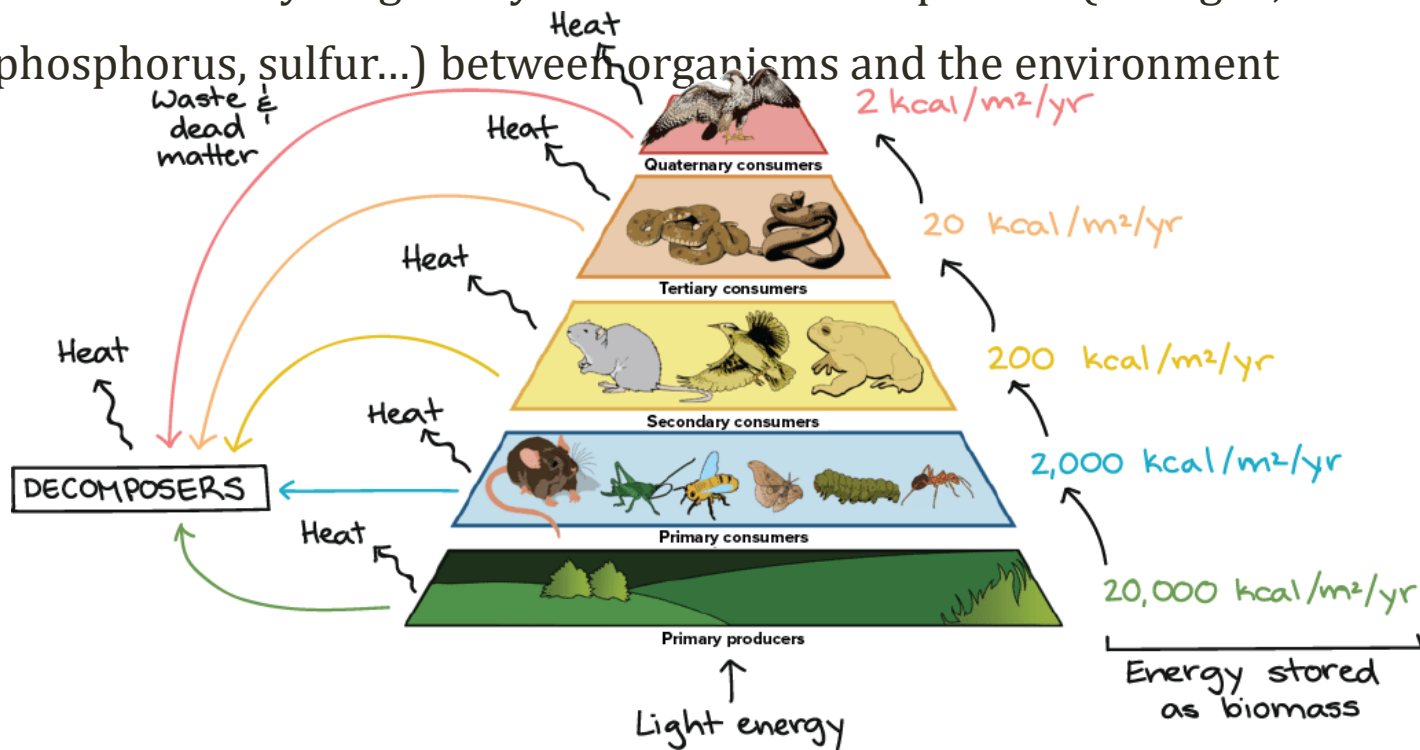
Topic 4 – Energy Transfer and Nutrient Cycles



TOPIC 4: NUTRIENT CYCLES AND FOOD WEBS

By the end of this topic, you should be able to...

- Describe energy (E) transfers (food chains, food webs) that occur within an ecosystem
- Describe the cycling of key elements and compounds (nitrogen, carbon, water, phosphorus, sulfur...) between organisms and the environment



The ultimate source of all energy on earth is the **sun**

Role of Organisms in Energy Transfer:

1) **Producers**: capture energy from the sun and use it to make simple energy-rich molecules (ex: glucose).

Another name for a producer is an **autotroph**

Ex: plants, blue-green bacteria



Cyanobacteria

40 μm



2) **Consumers** = cannot make their own food, must obtain nutrients by eating other organisms. Another name for a consumer is a **heterotroph**

Ex: Animal, amoeba

Three Types: **carnivores** (meat only), **omnivores** (meat and plants), and **herbivores** (plants only)



3) **Decomposers** = cannot make their own food, break down dead organic matter as a food source; help recycle nutrients throughout the ecosystem

Ex: Fungi



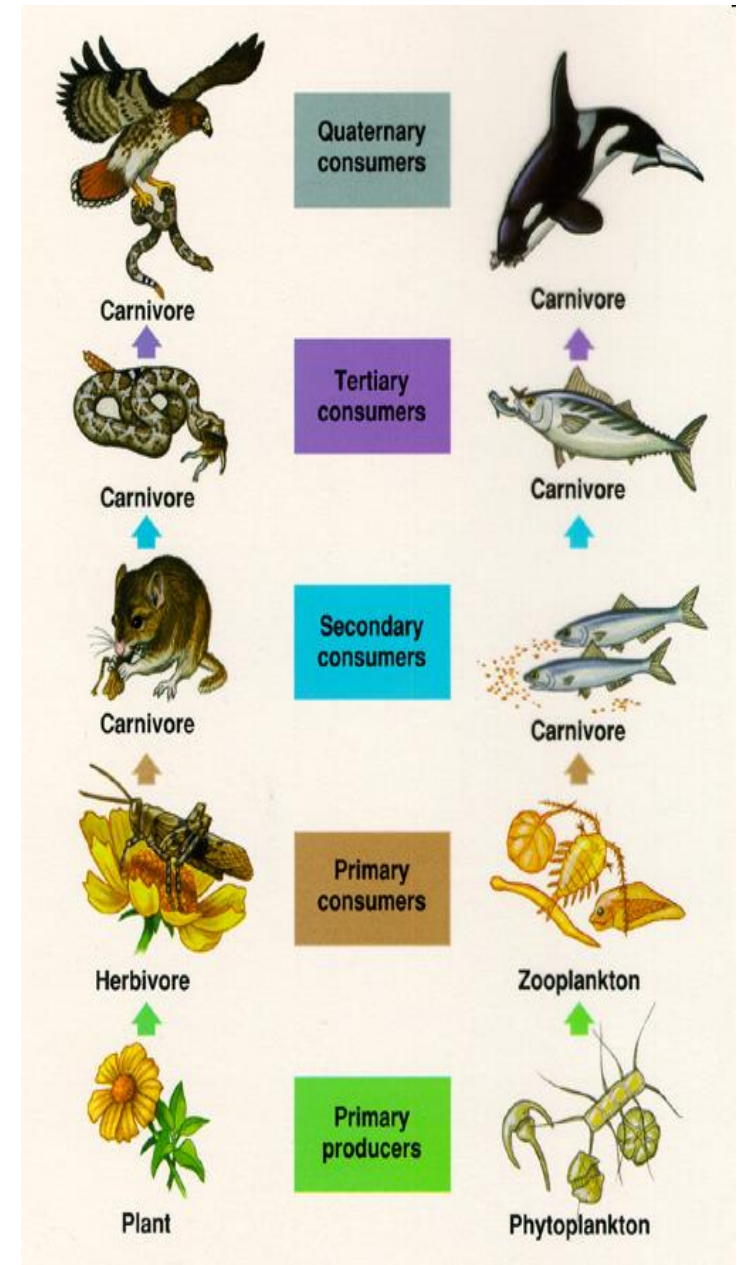
There are different “trophic levels” that represent the different levels of energy transfer.

organism that eats a producer:

primary consumer

organism that eats a primary consumer:

secondary consumer



ALGAE → ZOOPLANKTON → MACKEREL → SQUID → SHARK

Food chains show linear relationships among organisms whereas **food webs** show many different pathways of energy transfer and species' relationships.

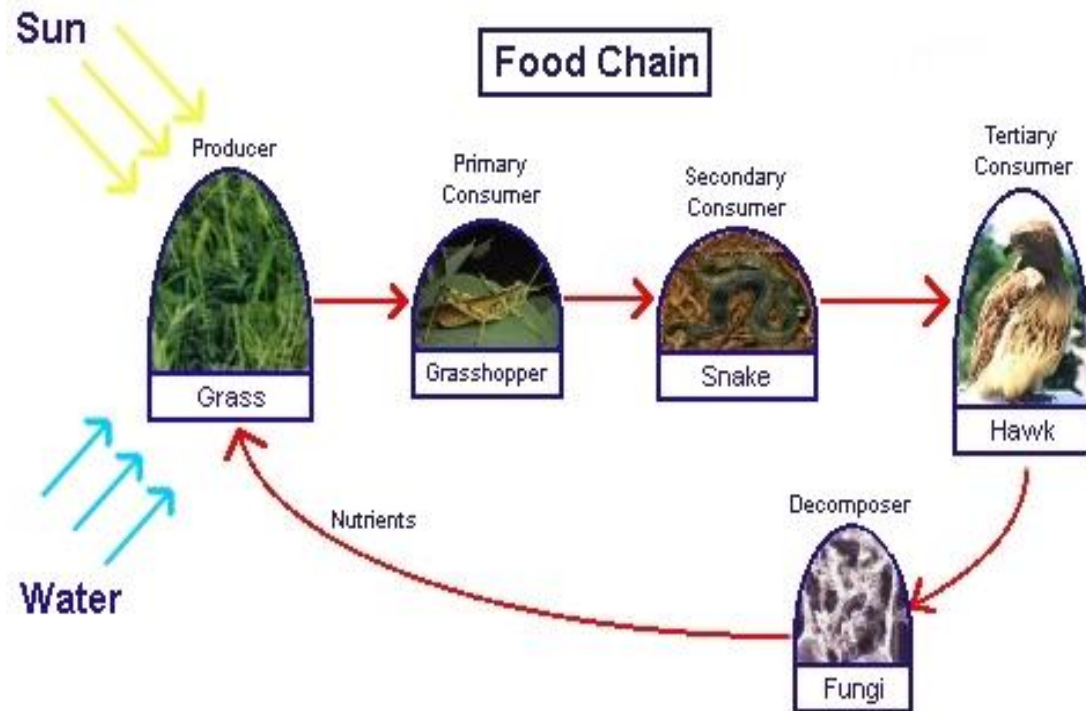
How many trophic levels are in the food chain shown above? _____

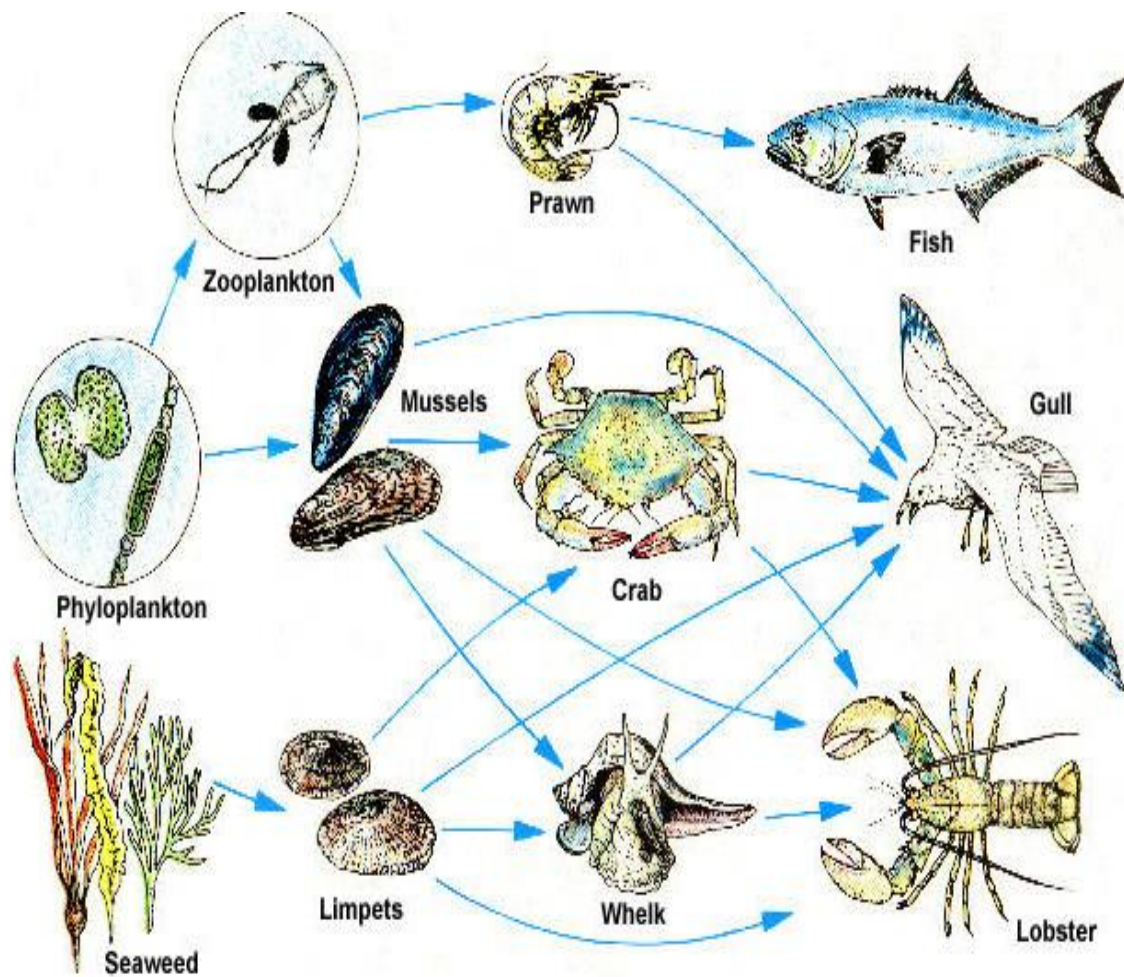
Identify the trophic level of each organism

Organism	Trophic Level
Algae	
Zooplankton	
Mackerel	
Squid	
Shark	

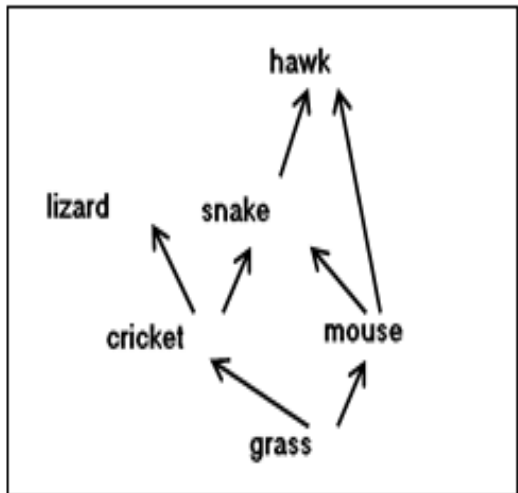
FOOD CHAINS VS. FOOD WEBS

Which is a better method for showing the energy-transfer relationships in an ecosystem and why?





FOOD WEB PRACTICE



- A) Which organism is a producer?
- B) Which organisms are primary consumers?
- C) Which organism is both a secondary and tertiary consumer?
- D) What does the snake eat?
- E) Which organism would be *most* affected by the extinction of the cricket?

EFFICIENCY OF ENERGY TRANSFER

The total mass of organic matter (living stuff) at each trophic level is called the **biomass**

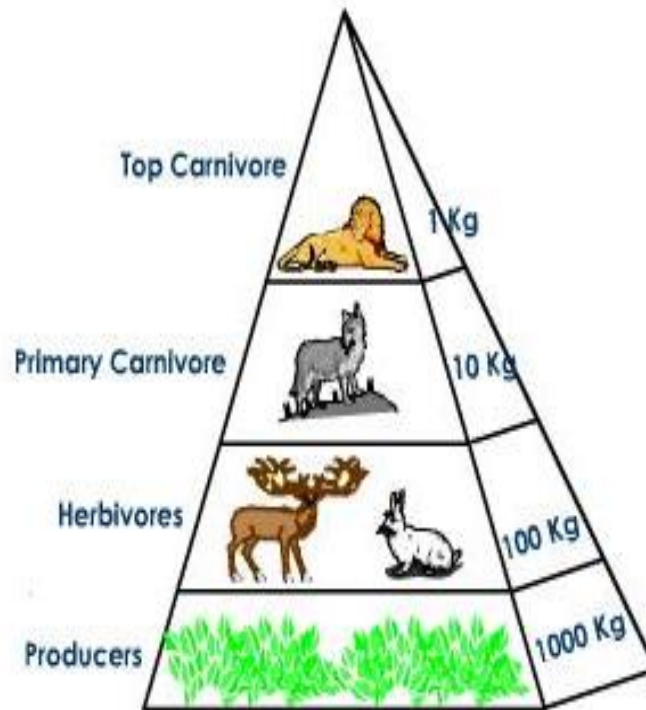
Only **10%** of the energy/biomass from one level can be transferred to the next level.

Why is this? – not all energy-containing material can be eaten or digested

Ex: bird beaks, cellulose in plants, teeth

BIOMASS VS. ENERGY PYRAMIDS

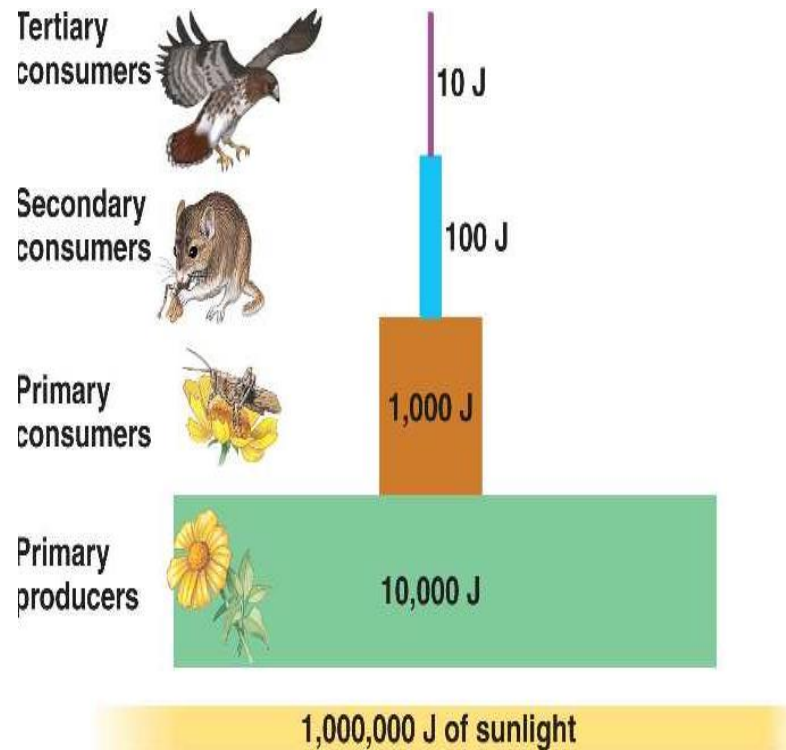
Below is a basic **biomass** pyramid



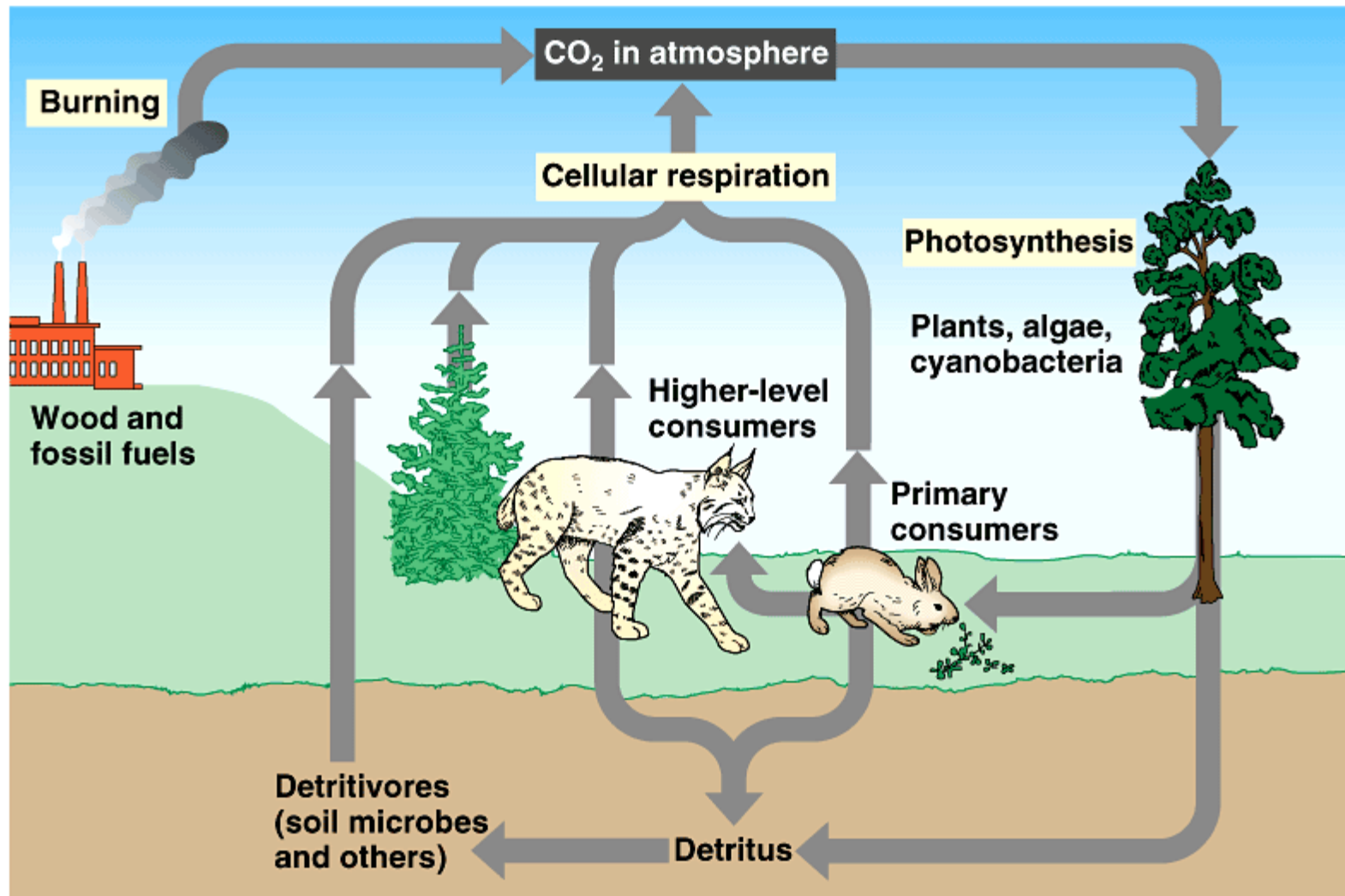
Upright Pyramid of biomass in a Terrestrial Ecosystem

BIOMASS VS. ENERGY PYRAMIDS

Below is a basic **energy** pyramid



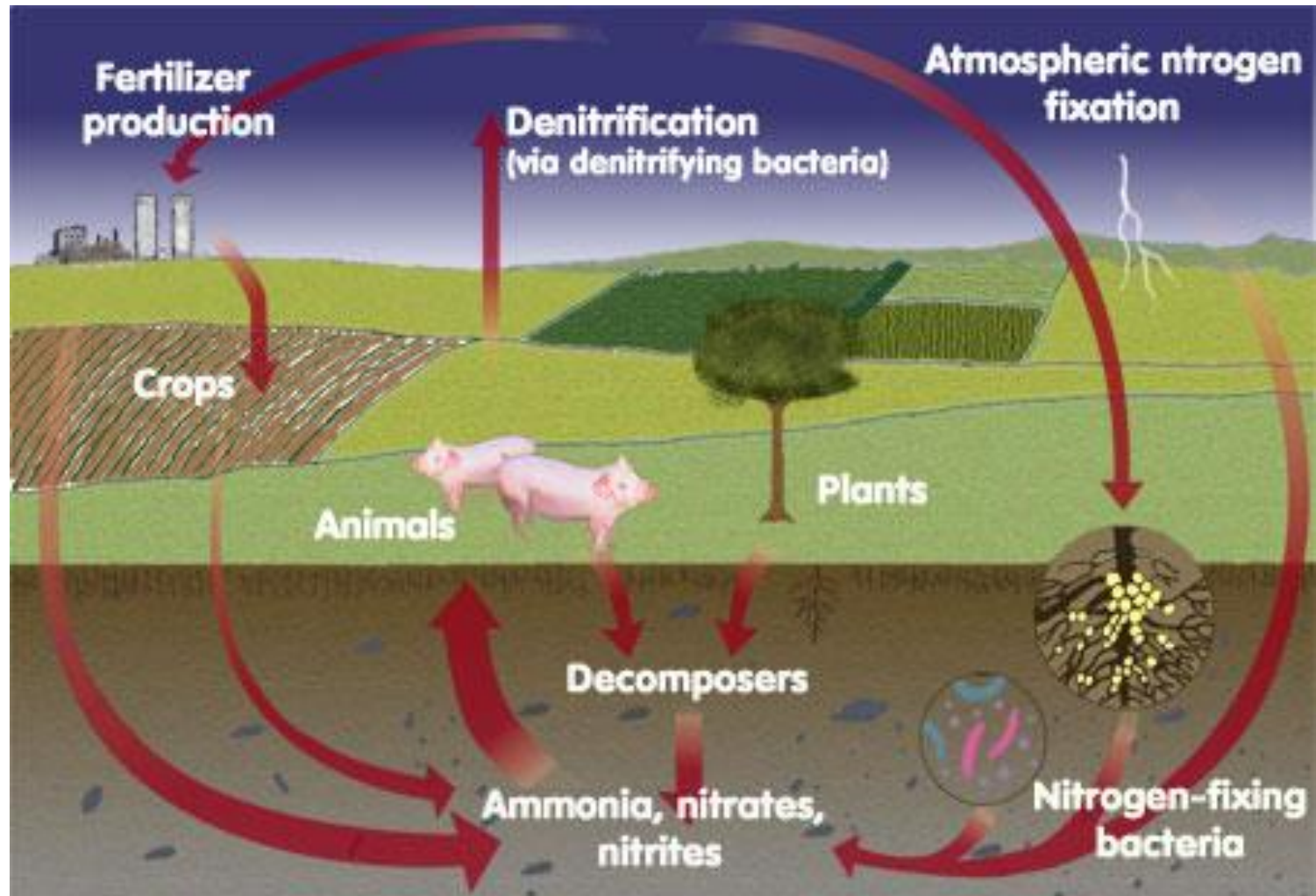
CARBON CYCLE



MAIN PROCESSES

<i>Term</i>	<i>Definition</i>
Photosynthesis	The process by which plants convert carbon dioxide and water into sugars and release oxygen back into the air
Respiration	Organisms recycle carbon dioxide and release it back into the air
Decomposition	Decomposers (ex: fungi) break down dead material and release the carbon stored in these organisms back into the soil
Fossil Fuels	Organic matter that is buried underground which is converted into peat, coal, oil or gas deposits
Combustion	The burning of fossil fuels, adds CO ₂ (carbon dioxide) to the atmosphere

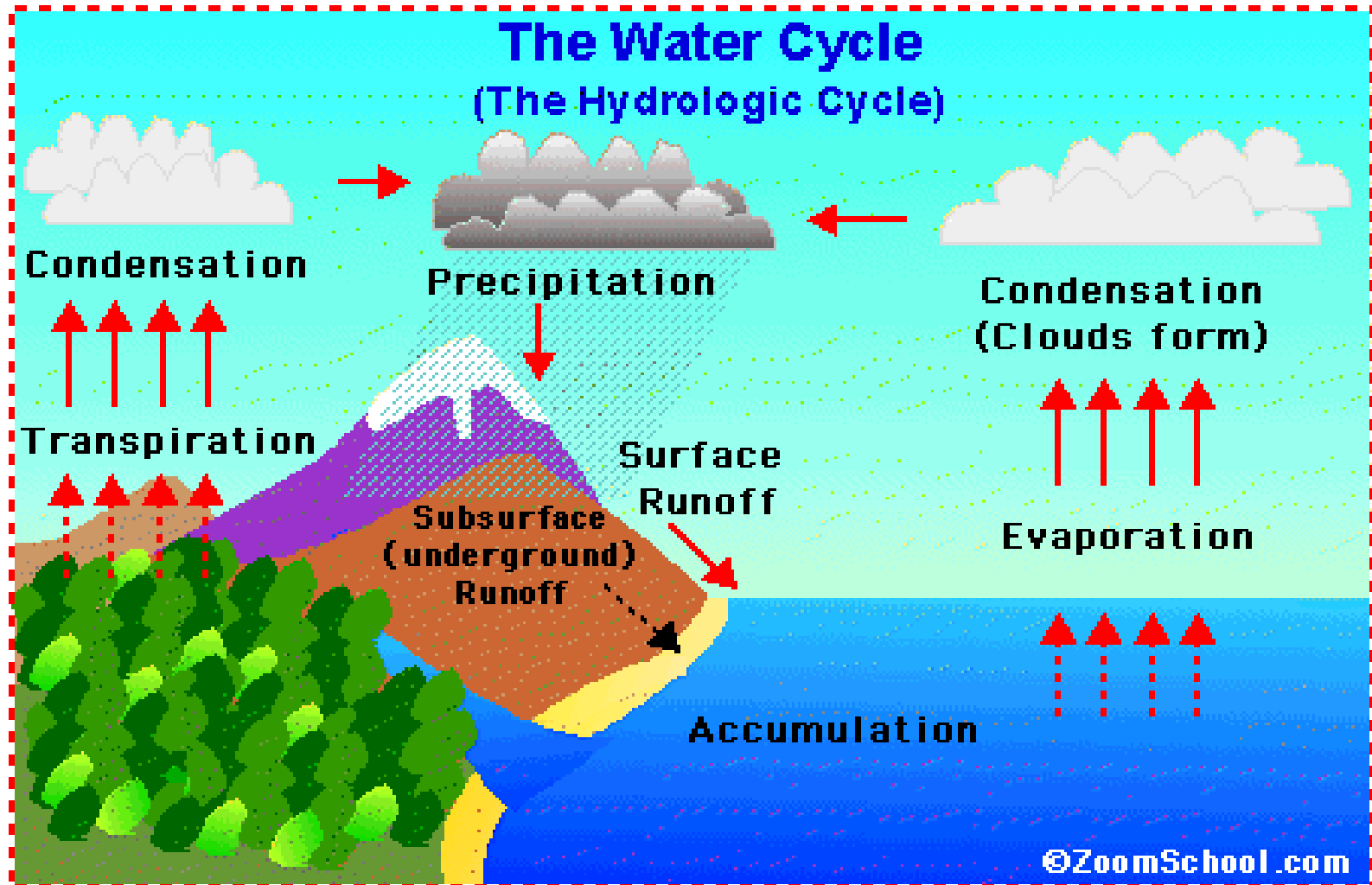
NITROGEN CYCLE



MAIN PROCESSES

<i>Term</i>	<i>Definition</i>
N ₂	Nitrogen gas that is found in the atmosphere; not useable nitrogen for plants and animals
NH ₃	Ammonia; Found in the waste products of living organisms
NO ₃	Nitrate; Humans add this to the nitrogen cycle through plant fertilizers
NO ₂	Nitrite; Found in the waste products of living organisms
Bacterial Nitrogen Fixation	Nitrogen fixing bacteria capture and convert nitrogen gas into ammonia
Legumes	Plants that contain nitrogen-fixing bacteria in their roots
Atmospheric Nitrogen Fixation	Lightning bolts convert nitrogen gas into nitrates
Denitrification	Soil bacteria convert nitrates into nitrogen gas
Decomposers	Convert the nitrogen in dead organisms into ammonia

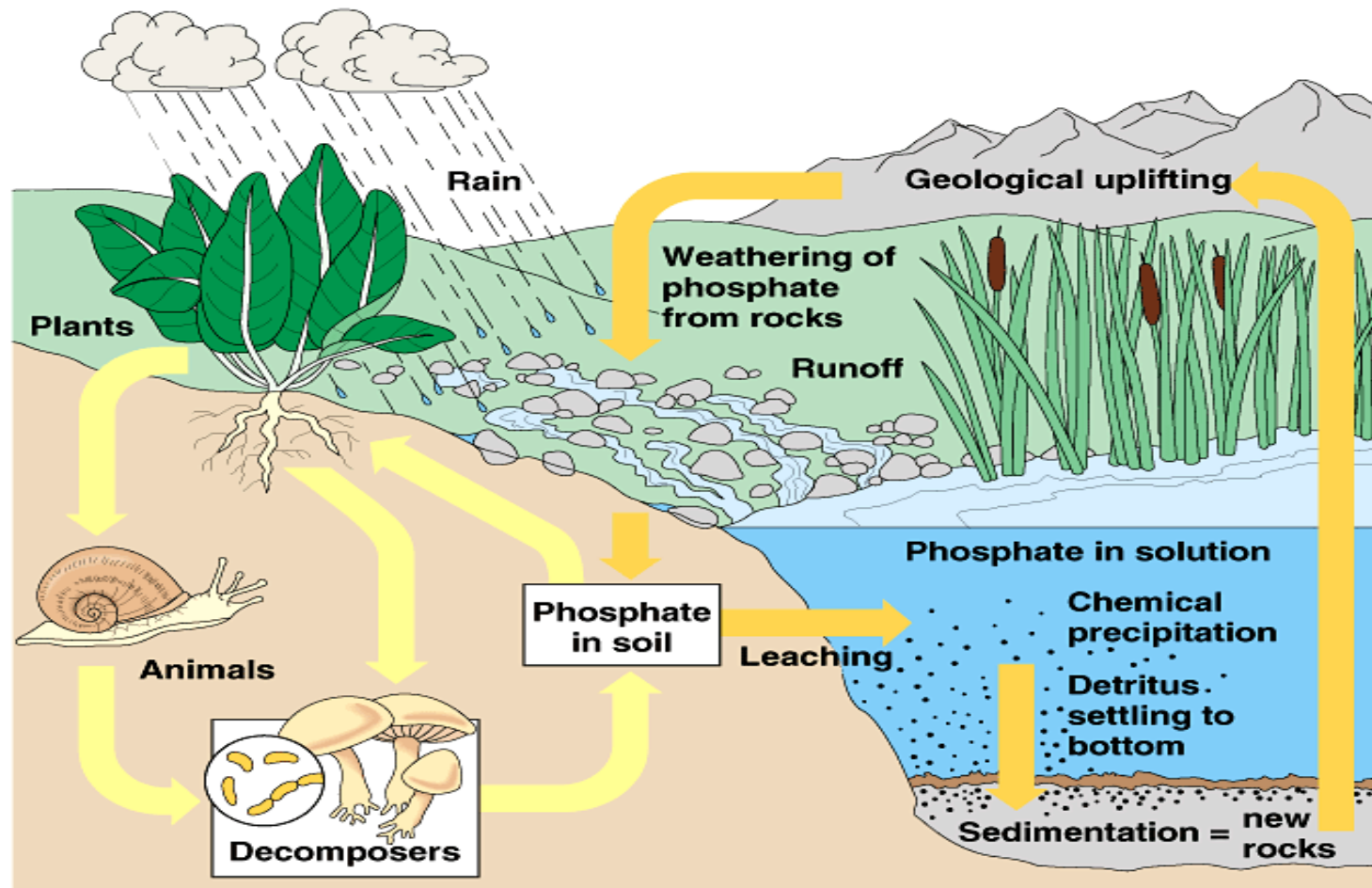
WATER CYCLE



MAIN PROCESSES

<i>Term</i>	<i>Definition</i>
Condensation	Water vapor in the atmosphere changes into liquid water
Precipitation	Condensed water returns to earth in the form of rain, sleet, snow, or hail
Evaporation	Liquid water from lakes, ponds, etc. changes into atmospheric water vapor
Transpiration	Water evaporates from the leaves of a plant
Percolation	Seepage of precipitation into the soil to form groundwater
Groundwater	Water that falls on land and soaks into the ground
Runoff	Leftover precipitation that cannot percolate into the soil and instead drains into a body of water

PHOSPHORUS CYCLE



MAIN PROCESSES

<i>Term</i>	<i>Definition</i>
Soil phosphate	PO ₄ , the form of phosphorus that is present in the soil
Producers	Plants that absorb phosphates from the soil
Consumers	Animals that eat producers and obtain phosphates
Decomposition	When decomposers (ex: fungi) break down dead/decaying organisms and return phosphorus to soil in the form of phosphates
Weathering	When rocks are eroded, which releases phosphate into the soil
Sedimentation	Formation of rocks that contain phosphorus