

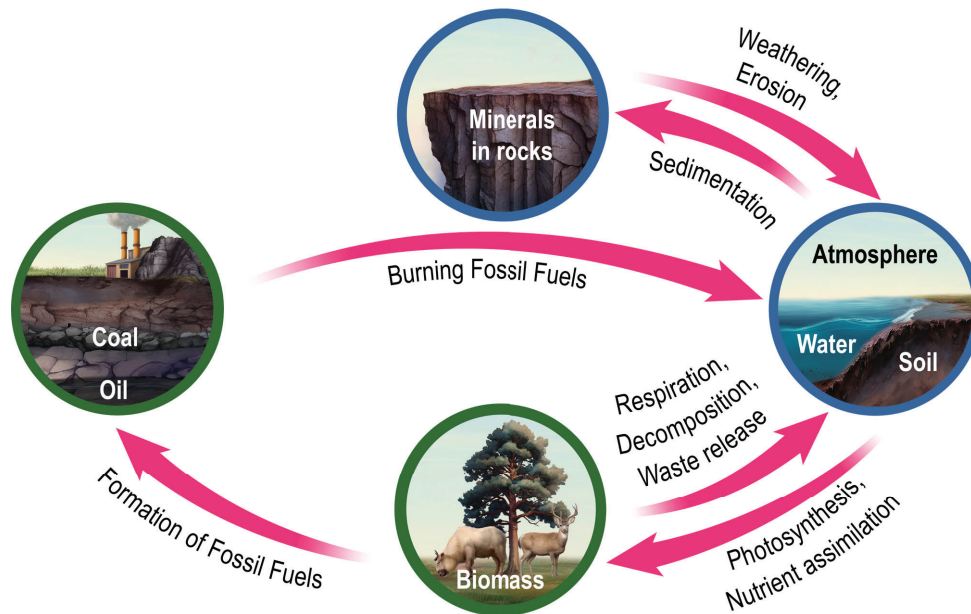


Study Prep

Available on Pearson+

TOPIC: BIOGEOCHEMICAL CYCLES**Introduction to Biogeochemical Cycles**

- ◆ **Biogeochemical Cycles:** processes recycling nutrients/elements between biotic & abiotic parts of an ecosystem.
- Includes cycling of water, carbon, nitrogen, & phosphorus.
 - Biological/geological processes move nutrients between different _____ (“storage spaces”).

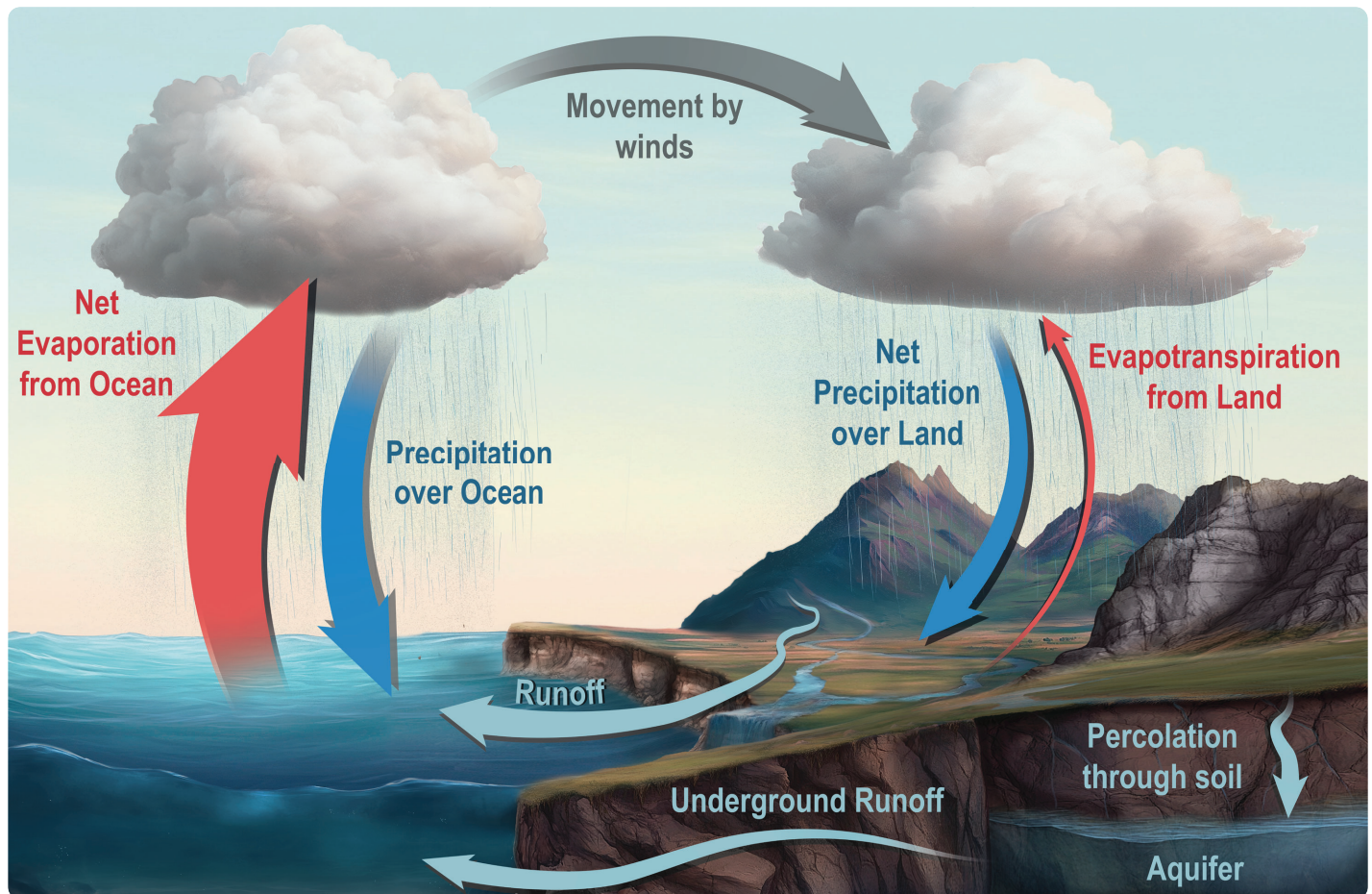
**EXAMPLE**

Which of the following is considered a geological process?

- a) Photosynthesis.
- b) Cellular Respiration.
- c) Excretion.
- d) Decomposition.
- e) Weathering.

TOPIC: BIOGEOCHEMICAL CYCLES**Water Cycle**

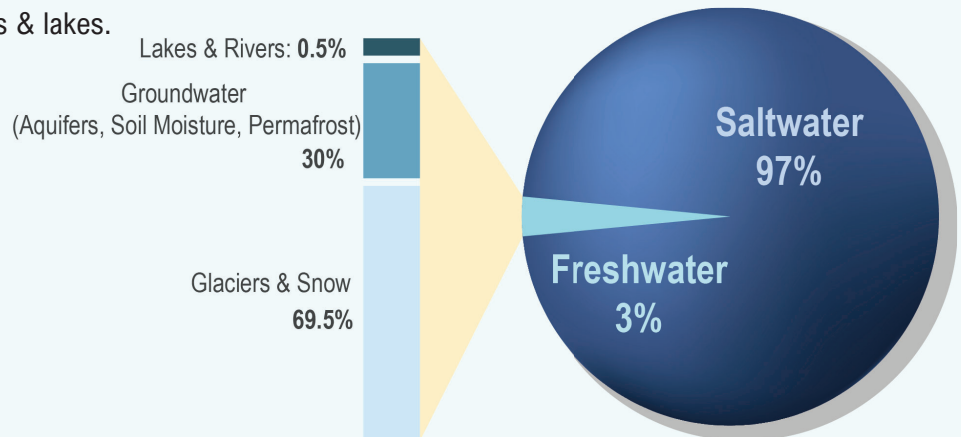
- ◆ Over oceans, evaporation rate EXCEEDS precipitation rate, forming rain clouds.
 - Wind moves rain clouds from oceans → land.
- ◆ Water precipitates on land and eventually returns to oceans via surface water & groundwater.



TOPIC: BIOGEOCHEMICAL CYCLES**EXAMPLE**

Given the information from this graphic & the previous lesson, which of the following processes moves the smallest volume of water?

- a) Evaporation from freshwater rivers & lakes.
- b) Evaporation from oceans.
- c) Evapotranspiration over land.
- d) Precipitation over oceans.

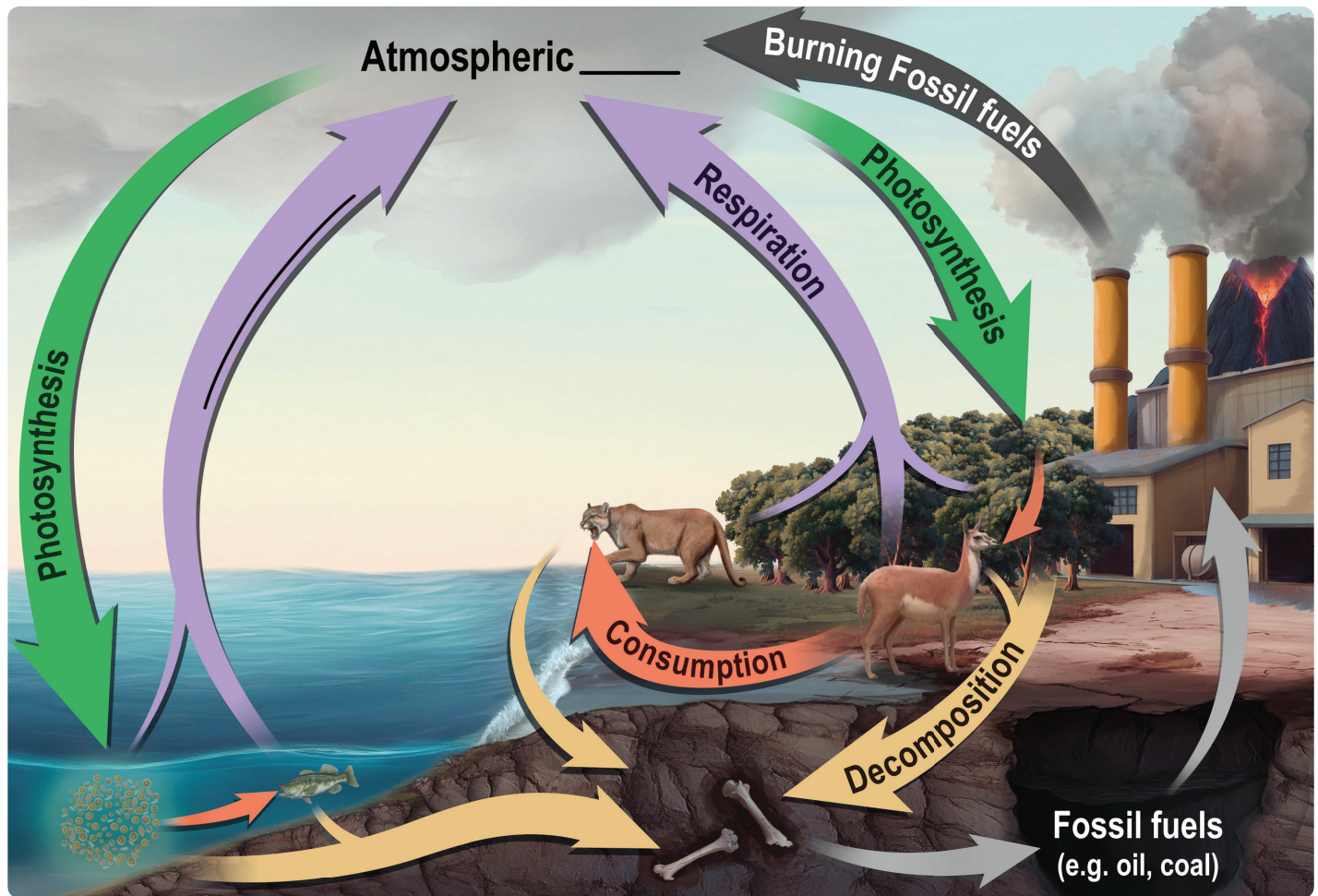
**PRACTICE**

Imagine you're tracking a water molecule frozen in snow on land. Which of the following is a possible path it could take to eventually end up as part of the ocean?

- a) Melting into a stream, ingested by an animal, percolate into the ocean.
- b) Melting into a stream, evaporating into the atmosphere, then runoff into the ocean.
- c) Melting into soil, taken up by a plant, evapotranspiration into the ocean.
- d) Melting into soil, percolating into an aquifer, underground runoff into the ocean.

TOPIC: BIOGEOCHEMICAL CYCLES**Carbon Cycle**

- ◆ Carbon in atmospheric CO_2 enters ecosystems via **photosynthesis**.
 - Carbon reservoirs include oceans, biomass, soil, sedimentary rocks, fossil fuels, & the atmosphere.
- ◆ Carbon can be returned to the atmosphere via **respiration** or burning of fossil fuels.



**TOPIC: BIOGEOCHEMICAL CYCLES****EXAMPLE**

While a change in local conditions (e.g. heavy rainfall, drought etc.) may limit the amount of nitrogen, phosphorus, or water in an ecosystem, this is rarely the case with carbon. Why?

- a) Plants can produce their own carbon via photosynthesis.
- b) Decomposers can produce their own carbon when they break organic material down.
- c) CO₂ in the air is a constant source of carbon for plants.
- d) Plants can take up carbon from the soil more efficiently than nitrogen, phosphorus, or water.

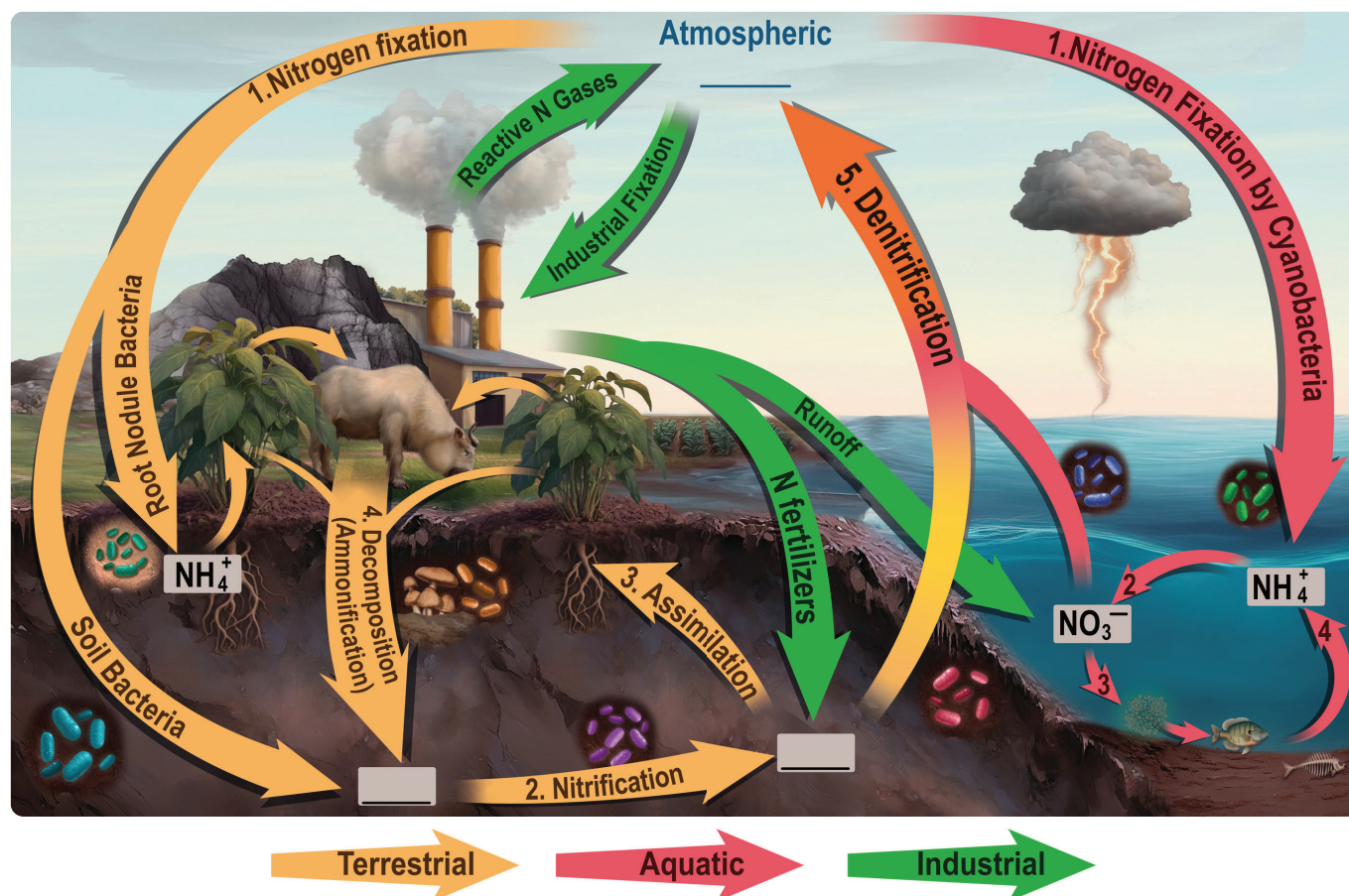
PRACTICE

Which of the following statements is false?

- a) Biomass is one of the largest carbon reservoirs in the biosphere.
- b) Burning plants increases the amount of atmospheric CO₂.
- c) The carbon cycle has maintained a constant atmospheric CO₂ concentration over the last million years.
- d) Carbon can be stored in soil, rocks, and ocean water.

TOPIC: BIOGEOCHEMICAL CYCLES**Nitrogen Cycle**

- ◆ The atmosphere is ~78% N_2 gas; however, N_2 is biologically _____ to most organisms.
 - Nitrogen typically enters ecosystems via *nitrogen-fixing* _____ in soil & plant roots.
 - Nitrates (NO_3^-) & ammonium (NH_4^+) are the primary forms of nitrogen that plants can absorb/use.



1. Nitrogen Fixation	$N_2 \rightarrow NH_3 \rightarrow NH_4^+$	Nitrogen-fixing bacteria in soil/plant root nodules bring atmospheric nitrogen (N_2) into ecosystems.
2. Nitrification	NH_3 or $NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$	Nitrifying bacteria convert ammonia or ammonium to nitrate, which plants readily absorb.
3. Assimilation	NO_3^- and NH_4^+ absorbed	Plants primarily absorb/use nitrate & ammonium.
4. Ammonification	Organic Nitrogen $\rightarrow NH_3$ or NH_4^+	Decomposition process where organic nitrogen from dead organisms & wastes is converted into ammonia or ammonium.
5. Denitrification	NO_2^- & $NO_3^- \rightarrow N_2$	Denitrifying bacteria allow nitrogen gas to return to the atmosphere.

TOPIC: BIOGEOCHEMICAL CYCLES**PRACTICE**

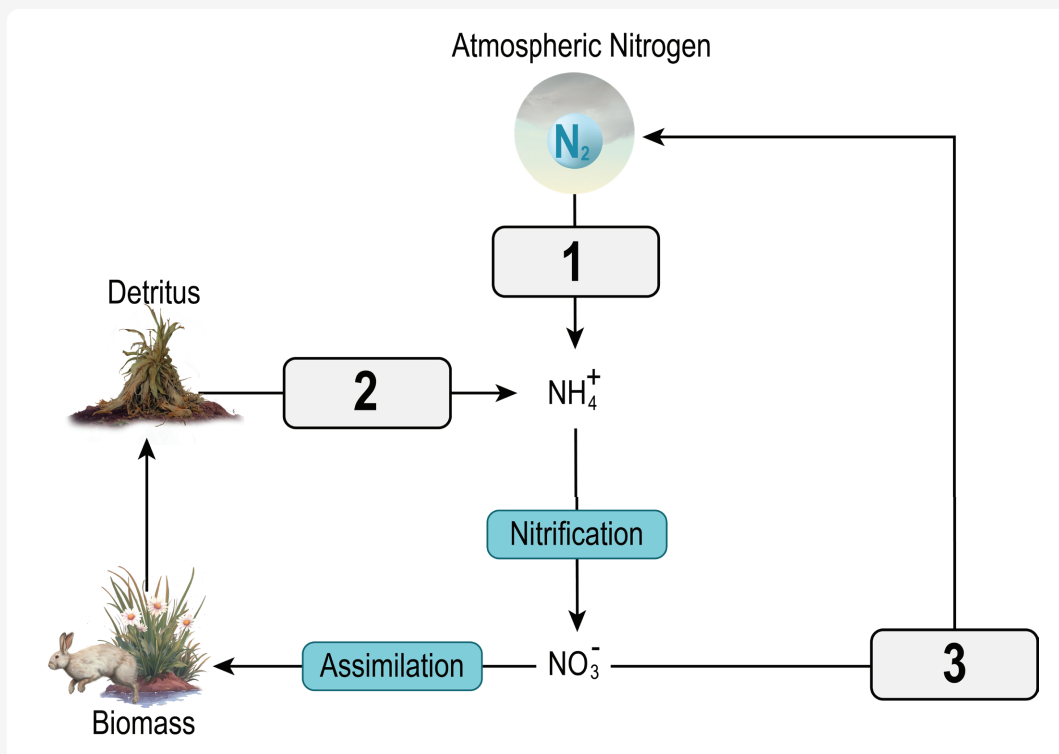
You are tasked with restoring a degraded ecosystem that has experienced a shortage of nitrogen. Which of the following steps could you take?

- a) Introduce nitrogen-fixing bacteria, which convert nitrogen gas to nitrogen-containing compounds.
- b) Introduce denitrifying bacteria, which convert nitrate to nitrogen gas.
- c) Introduce nitrifying bacteria, which convert nitrate to ammonium.
- d) All of the above.

PRACTICE

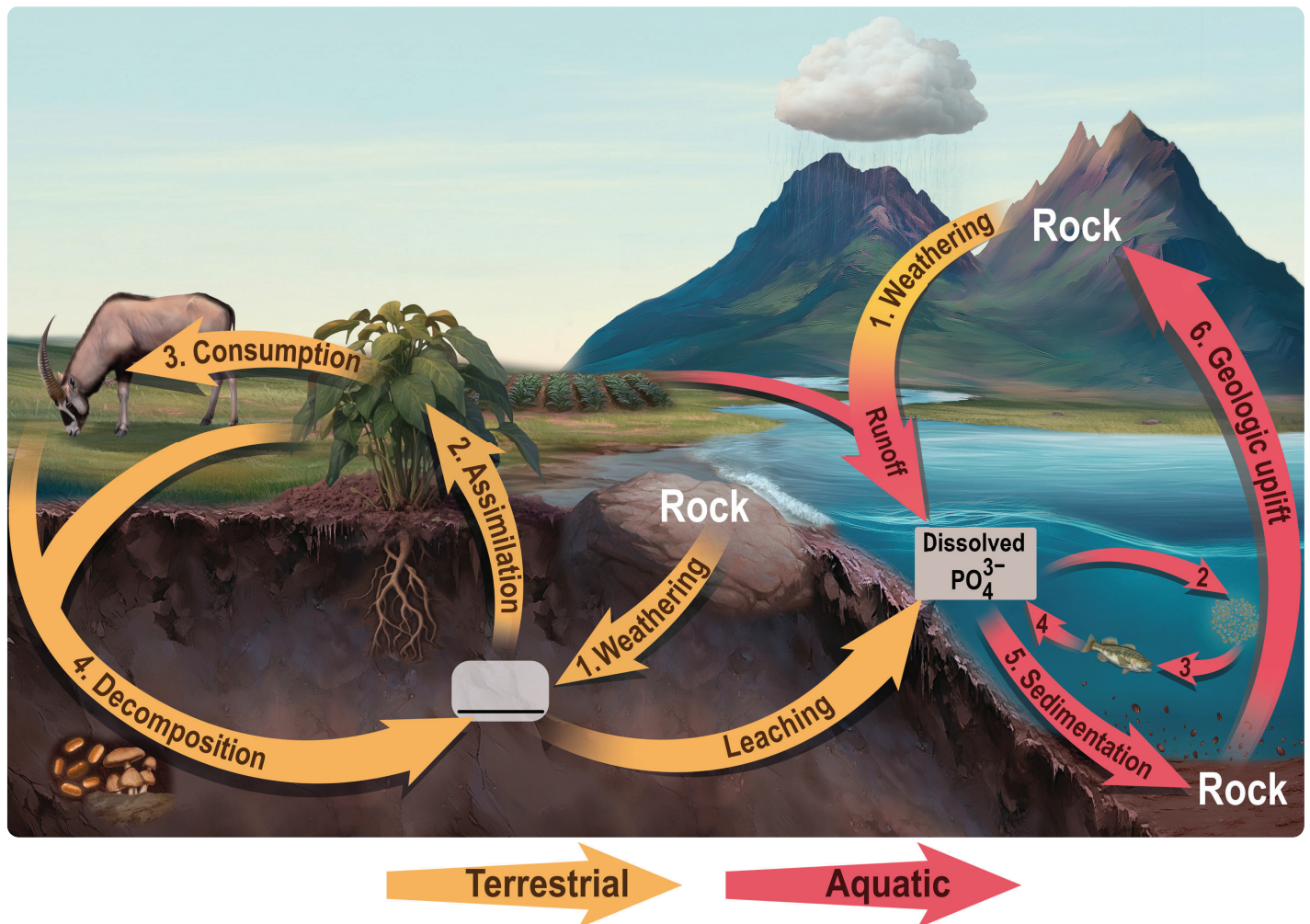
Which of the following answers correctly completes the diagram below?

- a) 1 – nitrification, 2 – ammonification, 3 – nitrogen fixation.
- b) 1 – denitrification, 2 – nitrification, 3 – nitrogen fixation.
- c) 1 – nitrogen fixation, 2 – nitrification, 3 – denitrification.
- d) 1 – nitrogen fixation, 2 – ammonification, 3 – denitrification.



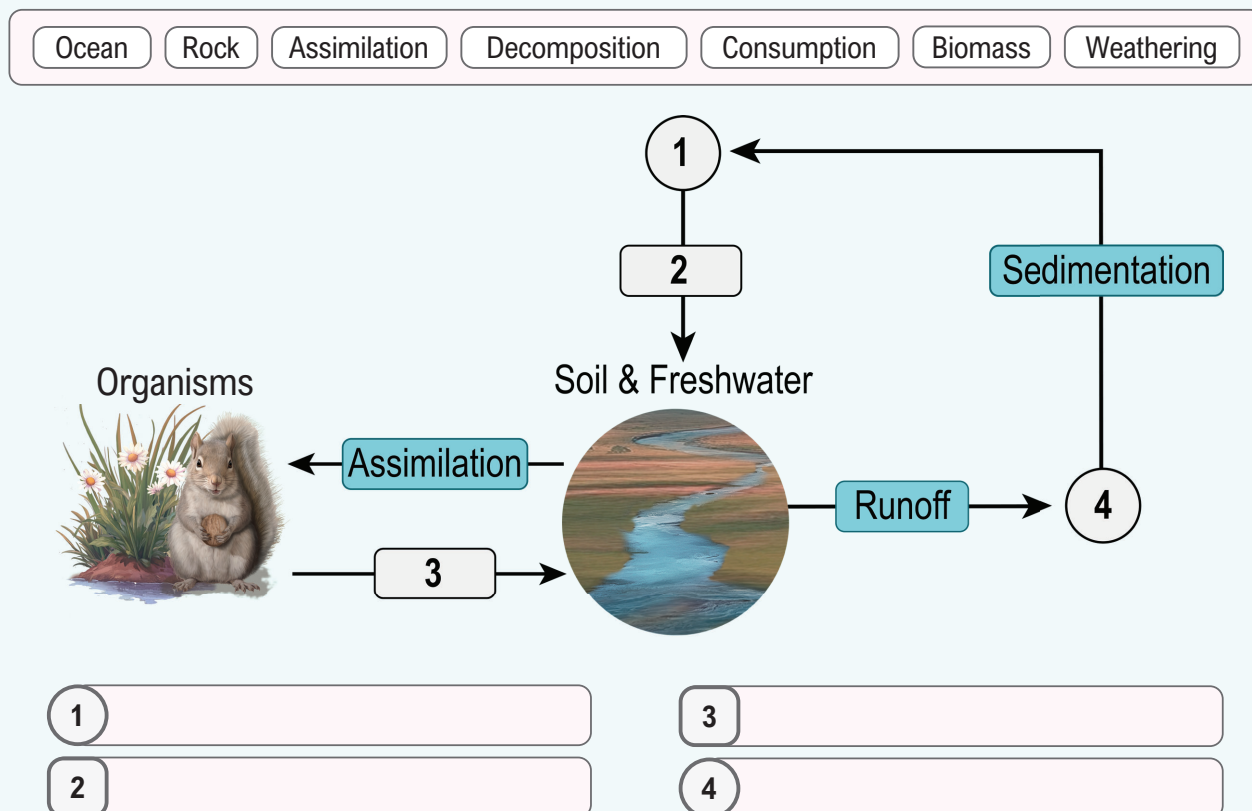
TOPIC: BIOGEOCHEMICAL CYCLES**Phosphorus Cycle**

- ◆ Phosphorous does NOT have an atmospheric component (P cycling is local).
- ◆ The largest reservoir of phosphorus is in sedimentary rock in the form of phosphate (PO_4^{3-}).
 - **Weathering** of rocks causes phosphate to release into soil.
- ◆ Producers uptake phosphorus, then it moves up food chain via consumption; recycled via **decomposition**.
 - Sedimentation of phosphorous incorporates it back into rocks & geologic uplift can re-expose rocks to weather.



TOPIC: BIOGEOCHEMICAL CYCLES**EXAMPLE**

Complete the Phosphorous Cycle diagram below by matching the following terms to the correct number (not all answer options will be used).

**PRACTICE**

Which of the following statements is true?

- a) Unlike nitrogen, carbon, and water, the atmosphere is not a significant reservoir of phosphorus.
- b) Sedimentary rock is one of the largest reservoirs of phosphorus.
- c) Phosphorus is essential to ecosystems as it's a major component of nucleic acids & ATP.
- d) All of the above are true.