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# **FRQ Practice 1.1**

## SUGGESTED SKILL

 *Concept Explanation*

**1.A**

Describe environmental concepts and processes.

**Identify** two organisms that compete for a shared food resource. **Describe** how resource partitioning could reduce the competition between the two organisms you identified.

**Identify (must be correct to earn the describe point)**

- Ringed seal and arctic cod compete for krill
- Orca/polar bear/ringed seal compete for cod
- Orca and polar bear compete for ringed seal

**Describe (1 pt.)**

- If the two organisms identified hunt for the shared food source at different times of day or in different locations (such as near ice or in open water) it would reduce their direct competition for the food resource

# FRQ Practice 1.2

## SUGGESTED SKILL

 *Concept Explanation*

**1.B**

Explain environmental concepts and processes.

**Identify** one characteristic of a biome and **explain** how that characteristic determines the community of organisms found in the biome. (1 pt.)

Characteristic	Explanation
Precipitation	<ul style="list-style-type: none"><li data-bbox="459 440 1818 511">• Average annual precipitation in a biome determines the variety of plant species that can be supported in that biome, since water is a limiting resource for plant growth</li><li data-bbox="459 516 1843 623">• Precipitation patterns determine the composition of the plant community in a biome, which in turn determines the animal species that can be supported since animals use plants as shelter/food sources</li></ul>
Temperature	<ul style="list-style-type: none"><li data-bbox="459 672 1850 820">• Monthly temperature/temperature range in biomes determines the growing season for plants, as it must be above freezing for liquid water to support plant growth. The length of growing season determines the primary productivity/plant biomass/plant species diversity that can be supported in the biome</li></ul>
Latitude	<ul style="list-style-type: none"><li data-bbox="459 865 1850 972">• Latitude determines both temperature and precipitation. Biomes closer to the equator receive more sunlight and rainfall than biomes further from the equator. Rainfall and sunlight determine the plant community in a biome.</li></ul>

# FRQ Practice 1.3

## SUGGESTED SKILL

 Concept Explanation

**1.B**


Explain environmental concepts and processes.

**Identify** an organism found in an aquatic biome and **explain** how that organism is uniquely adapted to live in that biome. (1 pt.)

Organism	Explanation
Intertidal crustaceans (barnacles, crabs)	<ul style="list-style-type: none"><li>• Tough shells/exoskeletons/outer skin to prevent desiccation/drying out during periods of low tide/exposure to sun</li></ul>
Intertidal plants (seaweed)	<ul style="list-style-type: none"><li>• Thick outer layer/mucus to prevent drying out during periods of low tide/exposure to sun</li><li>• Ability to curl inward and conserve water during periods of low tide/exposure to sun</li></ul>
Coral/algae (must specify algae living in coral reef)	<ul style="list-style-type: none"><li>• Coral and algae in the reef produced by the coral have a symbiotic relationship in which the coral provides nutrients/detritus/<math>\text{CO}_2</math> to the algae, while the algae provide sugar/glucose to the coral through photosynthesis</li></ul>
Mangrove trees	<ul style="list-style-type: none"><li>• Mangrove trees have tall, stilt-like roots that are adapted to tolerate brackish/salty water found in estuaries</li></ul>

# **FRQ Practice 1.4**

## SUGGESTED SKILL

 *Visual Representations*

### 2.B

Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

- In theoretical contexts
- In applied contexts

**Identify** one process in the diagram that happens quickly and one process that happens slowly.

**Explain** how the rate at which fossil fuels are transferred into the atmosphere, as shown in the diagram, has altered the carbon cycle during the past 250 years.

**Identify (1 pt. - must identify both correctly)**

- **Quickly: combustion, photosynthesis, respiration, decomposition, burning**
- **Slowly: sedimentation, burial, formation of fossil fuels**


**Explain (1 pt.)**

- **Because extraction and combustion of fossil fuels occurs at a faster rate than carbon is sequestered by fossil fuel formation, the concentration of carbon dioxide in the atmosphere is increasing**

# FRQ Practice 1.5

**Describe** one chemical transformation that occurs in the natural nitrogen cycle and **explain** the importance of that transformation to an ecosystem.

## SUGGESTED SKILL

 *Visual Representations*

## 2.B

Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:


- In theoretical contexts
- In applied contexts

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Chemical Transformation (1 point)	Discussion (1 point)
<p>Nitrogen is converted to ammonia, ammonium, or nitrate</p> <p><u>OR</u></p> <p><math>N_2 \rightarrow NH_3 \text{ or } NH_4^+ \text{ or } NO_3^-</math></p>	<ul style="list-style-type: none"> <li>• Converts atmospheric nitrogen into terrestrial nitrogen</li> <li>• Converts nitrogen to a biologically usable form</li> <li>• Provides plants with biologically available (fixed) nitrogen</li> </ul>
<p>Ammonia or ammonium is converted to nitrite, which is converted to nitrate (a description of only one of the steps is acceptable)</p> <p><u>OR</u></p> <p><math>NH_3 \text{ or } NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-</math>  <math>NH_3 \text{ or } NH_4^+ \rightarrow NO_2^-</math>  <math>NO_2^- \rightarrow NO_3^-</math>                      (a description of only one of the steps is acceptable)</p>	<ul style="list-style-type: none"> <li>• Provides plants with nitrates that can be taken up and used</li> <li>• Nitrates, along with ammonia and ammonium, are the most useful forms of nitrogen to plants</li> </ul>
<p>Nitrate, ammonia, or ammonium is converted to nitrogen-containing molecules (e.g., proteins, nucleic acids)</p> <p><u>OR</u></p> <p><math>NH_3 \text{ or } NH_4^+ \text{ or } NO_3^- \rightarrow \text{proteins or nucleic acids}</math></p>	<ul style="list-style-type: none"> <li>• Converts nitrogen to proteins, nucleic acids, and other molecules essential to life</li> </ul>
<p>Nitrate is converted to nitrogen gas</p> <p><u>OR</u></p> <p><math>NO_3^- \rightarrow N_2</math></p>	<ul style="list-style-type: none"> <li>• Converts terrestrial nitrogen into atmospheric nitrogen to continue the cycle</li> </ul>
<p>Nitrogen-containing molecules (e.g., nitrates, urea, uric acid, proteins, nucleic acids) are converted to ammonia or ammonium</p> <p><u>OR</u></p> <p><math>NO_3^-, \text{ urea, uric acid, proteins or nucleic acids} \rightarrow NH_3 \text{ or } NH_4^+</math></p>	<ul style="list-style-type: none"> <li>• Converts the nitrogen in nitrogen-containing wastes and dead organisms back into biologically useful forms</li> <li>• Provides plants with nitrogen in a biologically usable form</li> </ul>

# FRQ Practice 1.6

## SUGGESTED SKILL

 Visual Representations

### 2.B

Explain relationships between different characteristics of environmental concepts, processes, or models represented visually:

- In theoretical contexts
- In applied contexts

Choose 2 reservoirs depicted in the diagram above and **describe** how phosphorus moves from one to the other. (1 pt.)

Reservoirs	Describe
Plants & Soil	<ul style="list-style-type: none"><li>• Plants take in phosphate from the soil via roots and assimilate/incorporate it as biomass</li><li>• Soil microbes break down dead plant biomass and return phosphorus to the soil</li></ul>
Soil & Oceans	<ul style="list-style-type: none"><li>• Soil containing phosphorus is eroded/carried into oceans by wind/runoff</li></ul>
Sediments & rocks	<ul style="list-style-type: none"><li>• Sediments containing phosphorus are turned into rocks/mountains through geologic uplift</li></ul>
Rocks & soil	<ul style="list-style-type: none"><li>• Rocks containing phosphorus are broken down by weathering to create soil</li></ul>

# FRQ Practice 1.7

Chose a processes from the diagram. **Identify** the process and **describe** how water is moving from one reservoir to another.

Process	Description
a) Precipitation/rain	<ul style="list-style-type: none"> <li>Water vapor in the atmosphere condenses into liquid/forms water droplets and falls to earth as rain/precipitation, entering surface bodies/groundwater/soil/biosphere</li> </ul>
b) Evaporation	<ul style="list-style-type: none"> <li>Liquid water vaporizes/turns into a gas and enters the atmosphere</li> </ul>
c) Infiltration/recharge	<ul style="list-style-type: none"> <li>Runoff/precipitation infiltrates/seeps into/sinks into the ground/soil entering groundwater/aquifers</li> <li>Groundwater recharges aquifers/surface waters (rivers, streams, lakes, ocean)</li> </ul>
d) Runoff	<ul style="list-style-type: none"> <li>Precipitation falling from the atmosphere to earth lands on the ground and flows down slope into a surface body of water/soil</li> </ul>

# **FRQ Practice 1.8**

## SUGGESTED SKILL

 *Concept Explanation*

**1.A**

Describe environmental concepts and processes.

**Describe** the process of net primary productivity (NPP).

**Describe** the relationship between primary productivity and biodiversity.

**Describe (1 pt.)**

- **Net primary productivity is the rate of energy storage by the plants/producers/autotrophs, through photosynthesis in a given area, after subtracting the energy used/lost by/to respiration**
- **When plants/producers in an area perform photosynthesis, they use some of the energy for respiration and store some of the energy as biomass. Net primary productivity is the rate at which these producers/plants store energy as biomass.**

**Describe (1 pt.)**

- **As primary productivity increases, the biodiversity of an ecosystem increases. This is because a higher primary productivity produces more plant biomass, which supports a wider variety of animal species that rely on these plants for food/shelter**

# FRQ Practice 1.9 & 1.10


## SUGGESTED SKILL

 Concept Explanation

1.B

Explain environmental concepts and processes.

## SUGGESTED SKILL

 Mathematical Routines

6.C

Calculate an accurate numeric answer with appropriate units.

**Explain** why a relatively large forest can only support a small number of wolves (eagles in the scoring guide b/c it's a released FRQ.)

**Calculate** the amount of energy available to a tertiary consumer in the following ecosystem. (100,000 J of energy produced by plants after respiration)

**Explain (1 pt.)**

- To support a pair of eagles, there must be a large amount of biomass at lower trophic levels.
- Less energy is available at each successive trophic level, because as energy moves up the food chain, much of it is:
  - lost as heat (10 percent rule) or lost as metabolic work; or,
  - transformed into a less usable form/becomes less organized (second law of thermodynamics).
- Some biomass is not digestible at the next trophic level (e.g., cellulose, chitin). *Note:* Students may use a trophic pyramid diagram, but it must be accompanied by an explanation in order to earn credit.

**Calculate (1 pt. for correct setup with units, 1 pt. for the correct answer, with units)**

$$100,000 \text{ J} * .10 \text{ (10\% of energy moves on to primary consumers)} = 10,000 \text{ J}$$

$$10,000 \text{ J} * .10 \text{ (10\% of energy moves on to secondary consumers)} = 1,000 \text{ J}$$


$$1,000 \text{ J} * .10 \text{ (10\% of energy moves on to tertiary consumers)} = 100 \text{ J (final answer)}$$

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# **FRQ Practice 1.11**

## SUGGESTED SKILL

 *Visual Representations*

### 2.A

Describe characteristics of an environmental concept, process, or model represented visually.

**Describe** one direct effect that a decline in the frog population would have on the food web.

**Identify** an organism that is both a secondary and tertiary consumer

**Describe (1 pt.)**

- **An increase in the dragonfly/grasshopper/butterfly population as there are fewer frogs to prey on/eat these organisms**
- **A decrease in snake population as there are fewer frogs for them to prey on/eat**

**Identify (1 pt.)**

- **Buzzard**