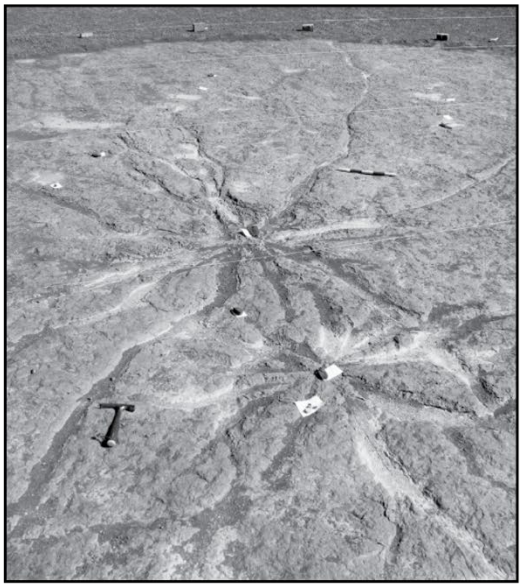
Base your answers to questions 1 through 5 on the information below and on your knowledge of biology.

Old Forest, New Discovery

In 2009, fossilized root networks of the oldest known forest in the world were found in Cairo, New York. This forest dates to the Devonian period, 383 million years ago. Scientists claim that this ancient forest is very important for understanding Earth's climate and biological history and may provide valuable insight to changes that are taking place on Earth today. One such group of plants, *Archaeopteris*, is represented by the figures below.

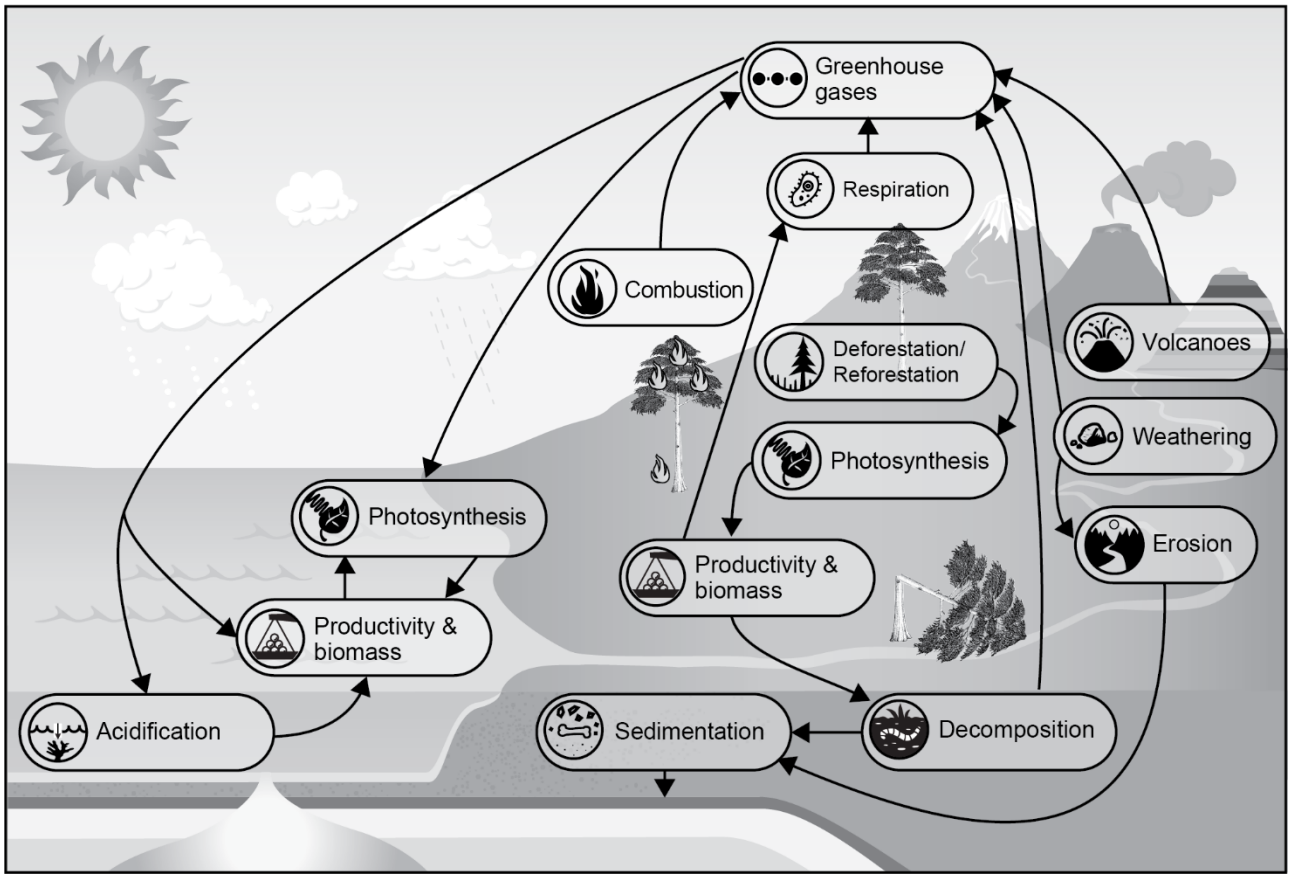
Photograph of Fossilized Root System



Artist Reconstruction of Archaeopteris

The model below shows interactions between spheres of the Earth during the Devonian period.

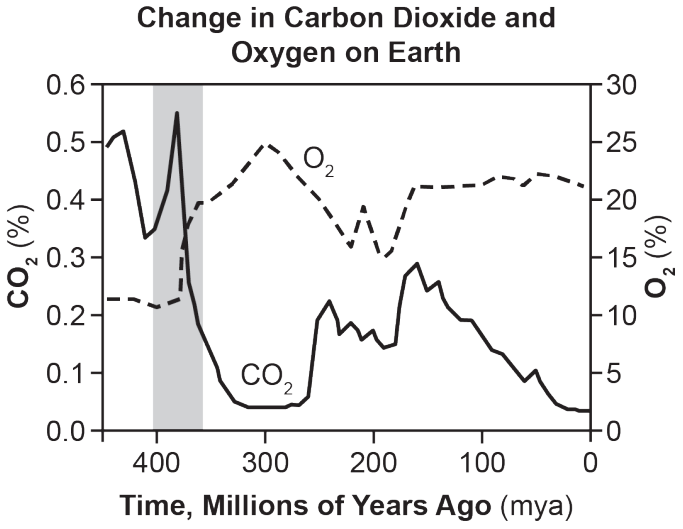
Carbon Cycle During the Devonian Period

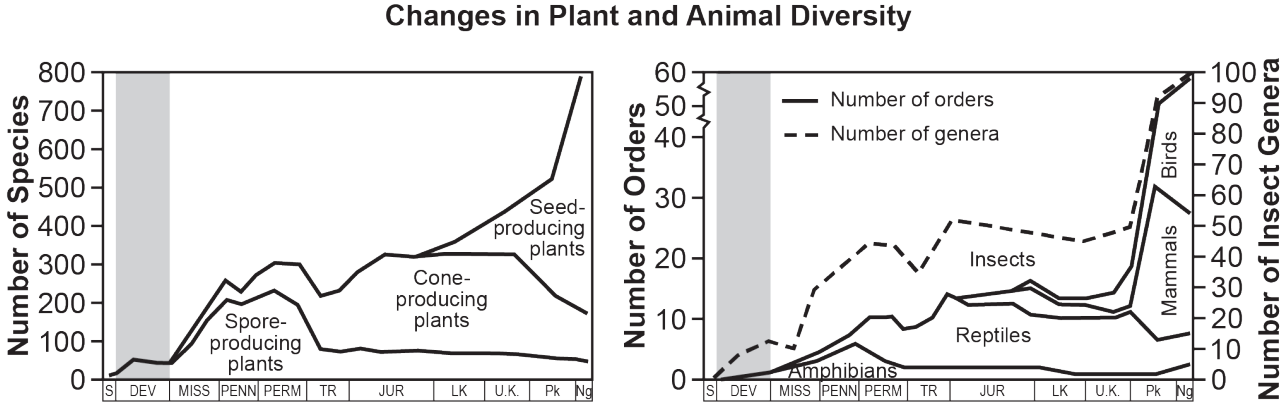


1 Which statement correctly describes the role of *one* process involved in the cycling of carbon between *two* of Earth's systems illustrated in the model?

(1) During combustion, *Archaeopteris* burns, cycling carbon from the geosphere to the biosphere as carbon dioxide is absorbed.
(2) During respiration, *Archaeopteris* cycles carbon from the atmosphere to the biosphere as carbon dioxide is absorbed.
(3) During decomposition, *Archaeopteris* decays, cycling carbon from the biosphere to the atmosphere as carbon dioxide is released.
(4) During photosynthesis, *Archaeopteris* cycles carbon from the biosphere to the hydrosphere as carbon dioxide is released.

The data below summarize some of the changes that occurred in biotic and abiotic factors present on Earth from before the Devonian period to the present day. The shaded areas on each graph identify the Devonian period.





2 Which evidence based claim supports the presence of an environmental condition during the early Devonian period that contributed to the rapid spread and increase of plants on land?

(1) High levels of CO_2 provided the carbon necessary to support an increase in the number of plants.
(2) Low levels of O_2 during the early Devonian promoted the growth of larger plants.
(3) High levels of O_2 provided the energy needed to support an increase in the number of plants.
(4) Low levels of CO_2 during the early Devonian promoted the increase in the number of plants.

3 Identify numerical evidence from the graphs that supports an argument that oxygen levels affected animal evolution during the Devonian period as a part of a feedback between the atmosphere and biosphere. [1]

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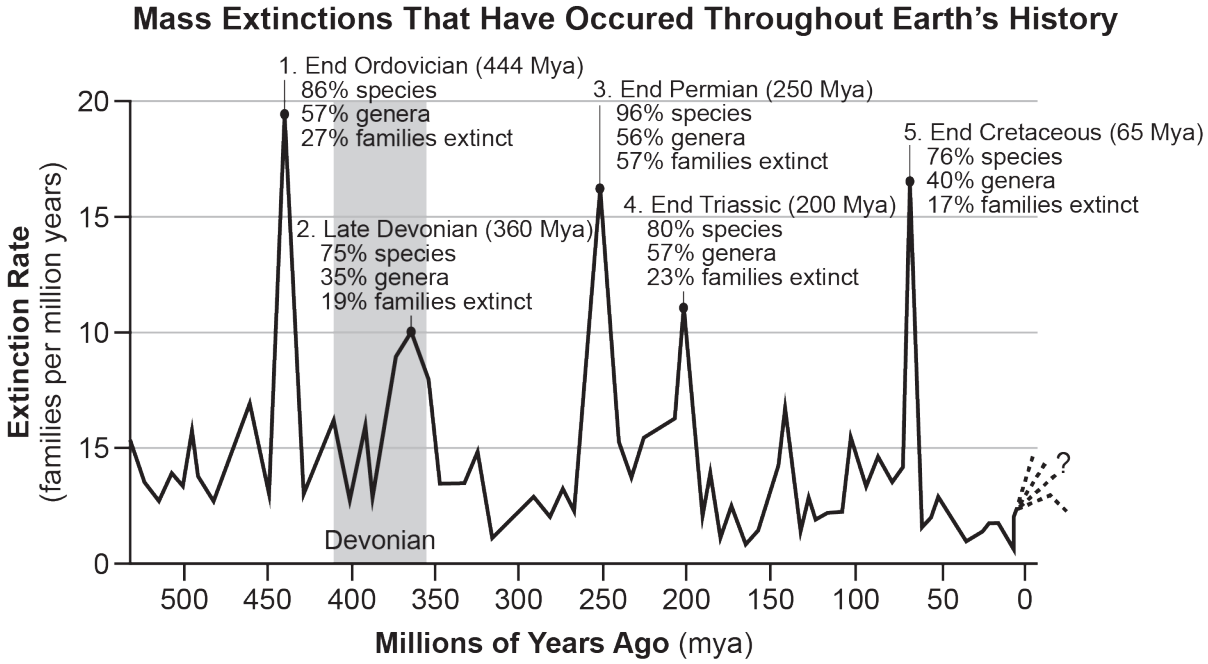
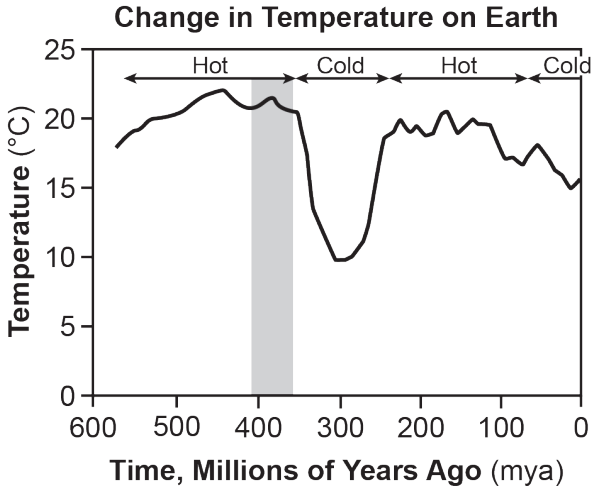
The Devonian period ended with a major extinction event. Many of the organisms that went extinct were a part of marine communities. The graphs below illustrate the mass extinctions that have occurred throughout Earth's history and temperatures over a similar period.





4 A claim is made by a student that temperature changes alone directly caused the Late Devonian extinction. Evaluate the evidence provided to determine the merit of this claim. [1]

Compared to the late Devonian period, extinction rates have dramatically decreased. However, human activity and the rising carbon levels in our atmosphere are global challenges considered to be factors affecting extinction. One proposed solution is using geological carbon sequestration to capture carbon directly from fossil fuel burning power plants and store it in depleted oil and gas reservoirs, saline formations, or deep coal beds approximately 800 meters below Earth's surface.

5 Describe a constraint that would need to be considered to minimize the effect on ecosystems and biodiversity when designing a system to geologically sequester carbon.

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