

Kelp Forest Coevolution: Lesson 3 Teacher Guide & Student Materials

Explain

Objective(s):

- Students will be able to analyze graphs to determine how the Earth's atmospheric composition has changed over time

Teacher Guide:

[5 minutes] Bellringer Question: Which came first, plants or animals?

Students answer Bellringer question in pairs or in a notebook.

Teacher can ask for volunteers or cold-call to share answers. Listen for reasoning: Can students say that animals have to eat plants to survive? Students may know terms like autotroph/heterotroph, producer/consumer, photosynthesis.

[40 minutes] HHMI Interactive

Students use the simulation to answer questions.

- Link for students: <https://www.biointeractive.org/classroom-resources/geological-history-oxygen>

Teacher circulates to monitor for completion & accuracy (misconceptions).

[10] Optional Extend: Extend learning with an additional graph of Earth's historic atmosphere.

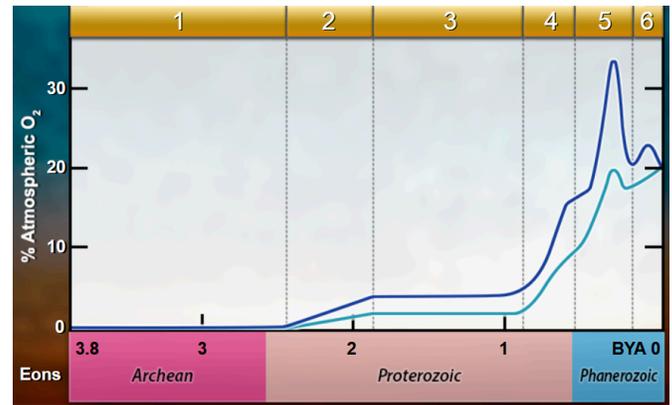
Photosynthesis & the Atmosphere

Name: _____

Date: _____ Period: _____

1. Open the [link](#) posted by your teacher.
2. Click "Start Interactive"

You should see a graph like this →



3. The x-axis has numbers going in reverse order and is labeled in different sections. These sections are geologic time periods, and the numbers represent billions of years ago, abbreviated _____
4. Click in Section 1 of the graph. What 2 types of life exist? _____ and _____

Cyanobacteria are the first organisms to do photosynthesis.

5. Click on Howie (lower right corner) then click the animation on the right. As you click through, make sure to READ then answer:
 - a. Fe+2 atoms from _____ (broken rocks) and hydrothermal vents (volcanoes) were able to _____ the oceans
 - b. Some Fe+2 got turned in Fe+3, which precipitated (settled) onto _____, giving rise to iron formations with bands (stripes).
 - c. Once there was oxygen in the air, it reacts with the iron and causes the iron to precipitate before _____, so there are no more banded iron formations.
 - d. Iron formations disappeared after _____ billion years ago.
6. Click the X in the upper left corner to return to the graph. Now click Section 2. The increasing oxygen caused our banded iron rock formations to stop forming. At the same time, what new type of organism evolved? _____
 - a. Click the "Life" tab on the right side. SUMMARIZE the 2 changes that happened for life on Earth: (note: *anaerobic* means without oxygen; *aerobic* means with oxygen)
 - i. _____
 - ii. _____

7. Click into Section 3 of the graph. The "Environment" tab on the right hand side calls this "The Boring Billion." Look at the graph and explain this name, in your own words: _____
8. Click on the "Life" tab. What important evolutionary event happened during this time, and when? _____

This event is what allowed organisms besides bacteria to do photosynthesis - the forerunner for plants, algae, and our favorite - kelp!

9. On to Section 4. What do you immediately notice about the levels of O₂? _____

10. Click Howie, then click the animation. Normally the organisms doing photosynthesis _____ O_2 and organisms doing cellular respiration _____ O_2 in equal amounts, so carbon goes back and forth.
11. Click "Next." What is happening to the molecules with C (big gray atoms)? _____
12. Click "Next." Look at the summary sentence at the bottom, and rewrite it in your own words: _____

13. Click the X and return to the graph. What new type of organism appears around this time? _____
14. Why do you think this type of organism evolved now, and not earlier? Explain: _____

15. Click on Section 5 of the graph. What was the maximum oxygen level, with units? _____
16. Click Howie. In your own words, what 2 factors made oxygen levels get this high? _____

17. Exit, then click "Life" and click Howie again. This section says there was *diversification* of animals and plants (more types!) and *giant* animals and plants. What is their example? _____
60 cm is about equal to 2 feet!
18. The second bullet point mentions this time period was called the *Carboniferous* because it created extensive _____. Coal and other fossil fuels, like gasoline and natural gas, are what we burn for electricity, even today, and all of it was created 360 - 300 million years ago. Did you know the gas you put in your cars is older than the dinosaurs (which lived 245-230 mya)? _____
19. Click on Section 6. How much oxygen is in our current atmosphere? _____

Extend

The graph to the right shows data about Earth's atmosphere, but 4 different gases and on a different scale.

20. Fill in the 2 empty boxes with the major events that changed O_2 concentrations in the atmosphere
21. Look at the N_2 line. What do you notice? _____

22. What about the CO_2 line?

What do you think might have caused this change in CO_2

concentration over time? *Hint! Think about your answers for #20.* _____

