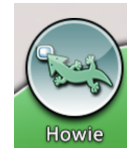


## 6.3 Geological History of Oxygen

**EQ:** How have life and Earth's system's coevolved? How has this affected life? The atmosphere? The geosphere?



|                                                                                                                                                                                                                                    |                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Table of Contents:</b><br><a href="#">Part 1: Procedure</a><br><a href="#">Part 2: Data Table</a><br><a href="#">Part 3: Example</a><br><a href="#">Part 4: Stronger and Clearer</a><br><a href="#">Student Self-Assessment</a> | <b>Links to Resources:</b><br><a href="#">Link to Rubric</a><br><a href="#">Link to Slides</a><br>Video <a href="#">History of the World in 2 hrs.</a> (20 mins) |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Part 1: Procedure

1. Navigate to the [Geological History of Oxygen](#) interactive
2. Click "Launch Interactive"
3. Click on the lizard ("Howie") to understand what the graph shows throughout the interactive.

Orient to the Graph:

| Part of Graph                                                                                           | What does it tell you? |
|---------------------------------------------------------------------------------------------------------|------------------------|
| x-axis                                                                                                  |                        |
| y-axis                                                                                                  |                        |
| The numbers at the top of the graph (Stages)                                                            |                        |
| Why are there two different lines on the graph? (What do the light blue and dark blue lines represent?) |                        |

4. Click on "Home" on the bottom left to start the interactive.



5. Click on the Stage 1 section of the graph. Notice that there are 2 tabs on the right side.

6. Click on the Environment tab to determine what the environment/atmosphere was like. How do we know? Hint: Click on Howie to find evidence.
7. Click on the Life tab to determine what life on Earth was like. How do we know? Hint: Click on Howie to find evidence.
8. Your group will be in charge of one of the time periods. Become an expert on that time period and fill out the organizer together.
9. Create a whiteboard with your section of the graph and answers to questions asked.

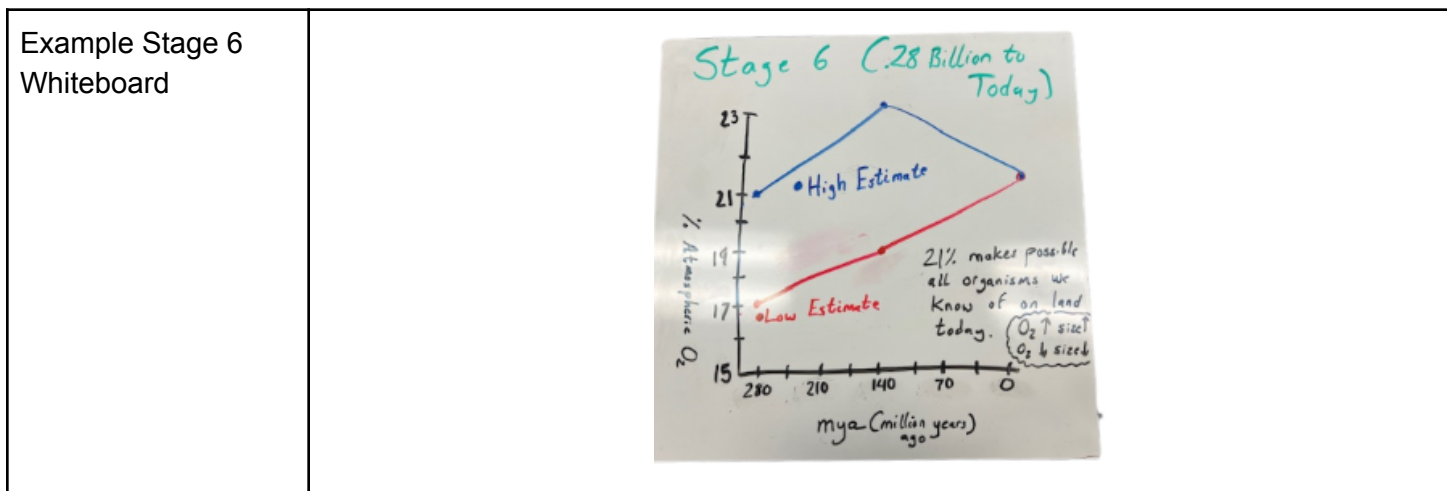
## Part 2: Data Table

| Stage 1: Earth Without O <sub>2</sub> - Example               |                                                                                                                                                                                                            |                                                                                                                  |
|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Archean Period<br>Years:<br>3.8 - 2.4 billion years ago       | Environment: Range of O <sub>2</sub> %:<br>Starting: less than ____%<br>Ending: less than ____%<br>(light and dark blue lines overlap)<br><br>Why did the percent oxygen stay the same during this period? | Life<br>What new life forms?<br><br>Explanation:                                                                 |
| Stage 2: The Great Oxygenation Event                          |                                                                                                                                                                                                            |                                                                                                                  |
| Proterozoic Period<br>Years:<br>2.4 - 1.8 billion years ago   | Environment: Range of O <sub>2</sub> %:<br>Starting: between __ and __ %<br>Ending: between __ and __ %<br><br>Why did the percent oxygen change?                                                          | Life<br>What new life forms?<br><br>How did different organisms adapt to the change in oxygen?                   |
| Stage 3: The “Boring Billion”                                 |                                                                                                                                                                                                            |                                                                                                                  |
| Proterozoic Period<br>Years:<br>1.8 - 0.85 billion years ago  | Environment: Range of O <sub>2</sub> %:<br>Starting: between __ and __ %<br>Ending: between __ and __ %<br><br>Why did the percent O <sub>2</sub> stay the same during this period?                        | Life<br>What new life forms? What new organelle appears in these? (and how did they show up?)<br><br>Big events: |
| Stage 4: Increase in Atmospheric O <sub>2</sub>               |                                                                                                                                                                                                            |                                                                                                                  |
| Proterozoic Period<br>Years:<br>0.85 - 0.54 billion years ago | Environment: Range of O <sub>2</sub> %:<br>Starting: between __ and __ %<br>Ending: between __ and __ %<br><br>Why did the percent O <sub>2</sub> change?                                                  | Life<br>What new kingdom of life emerges?<br><br>What enabled this kingdom to evolve?                            |

| Stage 5: O <sub>2</sub> Levels Above Present Day              |                                                                                                                                                               |                                                                                                                                                                                                                                                |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Phanerozoic Period<br>Years:<br>0.54 - 0.28 billion years ago | Environment: Range of O <sub>2</sub> %:<br>Starting: between ___ and ___ %<br>Ending: between ___ and ___ %<br><br>Why did the percent O <sub>2</sub> change? | Life<br>Are there any new life forms?<br><br>What organisms got large? Why is this?<br><br>What formed as a result of the vegetation from the Carboniferous period?<br><br>Why did these large life forms not last? (Hint: Look at the graph!) |

## Part 3: Example

| Stage 6: Recent O <sub>2</sub> Levels (to save time, this stage has been completed for you) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Proterozoic Period<br>Years:<br>0.28 billion years ago - present                            | Environment: Range of O <sub>2</sub> %:<br>Starting: between 18 and 22 %<br>Ending: around 21%<br>(light and dark blue lines overlap)<br><br>Why did the percent O <sub>2</sub> change?<br><br>Only in the last 600 million years (0.6 BYA) has there been enough O <sub>2</sub> in the atmosphere to sustain large animal life (including humans). At this point in time, we are for the most part O <sub>2</sub> neutral because even though there is more need for O <sub>2</sub> , there is also more O <sub>2</sub> being released by larger photosynthetic organisms. | Life<br>What new life forms? Over this period, more species of all kingdoms of life evolved.<br><br>How does the availability of oxygen affect the diversity of animals?<br><br>The larger an animal is and the more active they are, the more O <sub>2</sub> -requiring cellular respiration they must undergo, extracting energy (ATP) by breaking down sugars. Larger animals therefore need more O <sub>2</sub> to sustain themselves. Only extremely small organisms can survive in low O <sub>2</sub> environments because they do not require the large amounts of ATP from aerobic respiration. So, the diversity of animals is large during this period because a variety of animal species needing low to moderate to high amounts of O <sub>2</sub> are able to exist. |



## Part 4: Stronger and Clearer

### Protocol:

|                                |                                                       |                                                                                                                                                                              |                                                       |                                                                                                                                                                              |                                                       |                      |
|--------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------------|
| Initial answer:<br>On your own | Collect ideas and language from your 1st partner<br>➔ | Your argument becomes <b>stronger</b> (better evidence, examples, explanations) and <b>clearer</b> (topic sentence, precise word choice, logical organization, transitions). | Collect ideas and language from your 2nd partner<br>➔ | Your argument becomes <b>stronger</b> (better evidence, examples, explanations) and <b>clearer</b> (topic sentence, precise word choice, logical organization, transitions). | Collect ideas and language from your 3rd partner<br>➔ | Final written answer |
|--------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------------|

**Prompt:** How did the changes in the composition of the atmosphere lead to changes in the composition of the biosphere (variety of life on Earth)?

### Word Bank:

|                |                                                                                                   |  |  |  |  |  |
|----------------|---------------------------------------------------------------------------------------------------|--|--|--|--|--|
| cyanobacteria  | O <sub>2</sub>                                                                                    |  |  |  |  |  |
| photosynthesis | organisms                                                                                         |  |  |  |  |  |
| geosphere      | coal                                                                                              |  |  |  |  |  |
| My Pre-Write   | Initial ideas / drawings / answer to prompt:                                                      |  |  |  |  |  |
| Partner 1:     | Ideas, evidence, and language from this person that will help my idea to be stronger and clearer: |  |  |  |  |  |
| <div></div>    |                                                                                                   |  |  |  |  |  |

|                                                                                           |                                                                                                          |
|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Partner 2:<br><br><div style="border: 1px solid black; height: 30px; width: 100%;"></div> | <i>Ideas, evidence, and language from this person that will help my idea to be stronger and clearer:</i> |
| Partner 3:<br><br><div style="border: 1px solid black; height: 30px; width: 100%;"></div> | <i>Ideas, evidence, and language from this person that will help my idea to be stronger and clearer:</i> |

**Final Written Idea:** Write your final strongest and clearest idea in a paragraph. You can use your notes from above to write it. Your final paragraph should be **stronger** (more evidence and detail) and **clearer** (better language) than your first try.

**How did the changes in the composition of the atmosphere lead to changes in the composition of the biosphere (variety of life on Earth)?**

## Student Self-Assessment

- ☐ During the activity, my idea became *stronger*.
- ☐ I borrowed and built on ideas from my partners to strengthen my idea (e.g., better or more evidence).

Evidence: Highlight evidence from your partners that you incorporated into your final text.

- ☐ During the activity my idea became *clearer*.
- ☐ I borrowed and used language from my partners (and/or texts) to make my idea *clearer*.

Evidence: In a different color, highlight components of language (words, phrases, but NOT whole sentences) that you gathered from your partners and used in your final text.