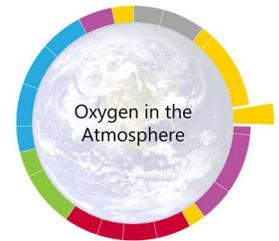


O2 - Oxygen in the Atmosphere (approximately 2 to 3 traditional class days)



The model:

- Oxygen is one of the most abundant elements on Earth, but it didn't occur as a gas in the early atmosphere.
- Some kinds of life release oxygen as a gas as a result of some life processes.
- Oxygen is a highly reactive substance and combines readily with other molecules to form new compounds.
- As life became more abundant on Earth oxygen was released into the atmosphere but most of it quickly reacted with other substances and therefore did not build up in the atmosphere for a long time (as much as a billion years).
- Around 2.5 billion years ago it began accumulating in the atmosphere as evidenced by banded iron formations
- As life continued to become more abundant and moved onto land the atmospheric oxygen increased and stabilized to modern levels of approximately 21%.

LS	Model Move	Est Time (min)	Overview	What did we figure out?	Model Ideas Generated
1	P→Q	10-25	We recognize that Earth has changed over time and focus in on one very specific change: the amount of oxygen in Earth's atmosphere has increased from 0% to 21% over billions of years. We then develop a driving question that asks how and why oxygen levels have changed over time.	We came up with our driving question: Why/how did the atmosphere's oxygen increase over time?	
2	M→P	15	We offer some initial ideas about where the oxygen came from and then revise our phenomenon to look at a more detailed pattern of changes in oxygen in the atmosphere.	We've explored some initial ideas and examined a bit more information on the pattern of change in oxygen in the atmosphere.	We offer a number of the ideas in the model here, but we do explicitly surface the idea about oxygen's abundance.
3	P→M	45	We work as a class to examine two chemical processes that involve oxygen: photosynthesis and oxidation. We then work with more data about both Earth's geology and the history of life on Earth in order to piece together an apparent correlation.	We figured out that oxygen was always on Earth but not as a free gas in the atmosphere. We learn about some processes that cause oxygen to change form. We have more detail about the timeline of events on Earth.	Here we bring out ideas about oxidation and photosynthesis, two processes that are key to the model.
4	M→Q	20	We return to the driving question and answer it.	We put all the pieces together to see how we can explain the pattern of change in the oxygen in the atmosphere over time.	
5	M	10	We have a quick discussion about how the change we see in oxygen in the atmosphere is just one example of how the different spheres of Earth have changed over time. We also recognize a broader idea that the spheres are interconnected.	We realized that our spheres framework allows us to see and think about change over time on Earth and interaction among different systems on the planet.	

A	M	10	Optional. We engage in a conversation in order to evaluate a competing model that oxygen in the atmosphere came from water molecules.	We realized that our spheres framework allows us to see and think about change over time on Earth and interaction among different systems on the planet.	
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