

The Relationship Between the Atmosphere and the Oceans

Information for students¹

- Essential Question: How is the ocean like sparkling water and why is that a problem?
- Since the beginning of the industrial revolution, scientists have been keeping track of the following two things:
 - Increases in the average atmospheric temperature
 - Increases in the acidity of the oceans
- Review or research the following ideas:
 - Composition of air
 - Greenhouse gases
 - Carbonated water
 - pH
- Conduct the experiment described in Appendix A.
- Using the information in Appendix B, reflect on the impact of carbon dioxide.



Materials required

- Paper, writing and drawing materials
- Bowl of water
- Candle
- Transparent glass (or graduated measuring cup to measure amounts of water)
- Matches or lighter (be careful with fire!)
- For the experiment, you may replace the candle and matches with steel wool and vinegar.
- Device with Internet access (optional)

¹ Vancouver Bites! Pic of sparkling water taken at Brix restaurant in Vancouver, 2010, JPEG, 1.63MB, Vancouver, Canada, [https://commons.wikimedia.org/wiki/File:Sparkling_Water_\(4675945072\).jpg](https://commons.wikimedia.org/wiki/File:Sparkling_Water_(4675945072).jpg)

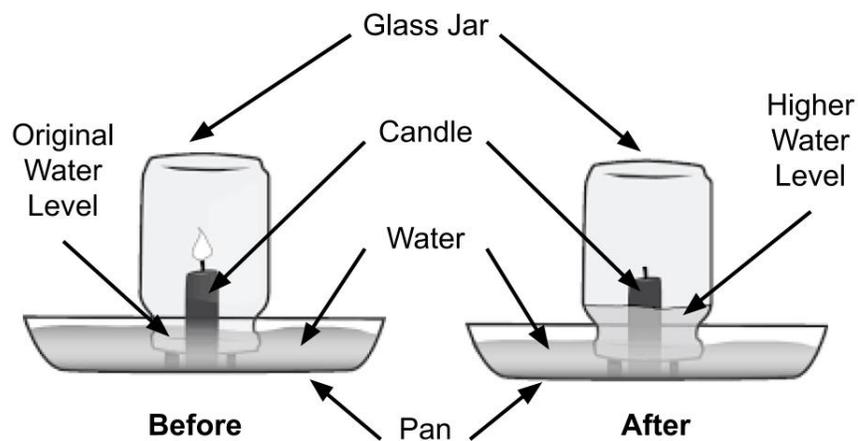
Information for parents

- Help your child find the link to the video, if necessary.
- Read the instructions to your child, if necessary.
- Discuss the questions together.
- Brief video explanation: <https://www.youtube.com/watch?v=fgBozLCGUHY> (optional)

Appendix A: Experiment

Percentage of Oxygen in Water

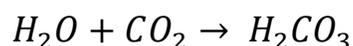
- Objective: Calculate the percentage of oxygen in the air by burning a candle standing in a bowl of water and observing the amount of water displaced into an inverted glass placed over the candle (see image below).



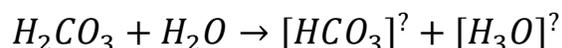
- What do you notice? Why is this happening?
- Sketch and explain what was in the glass before and then after the experiment. Why is this calculation of the percentage of oxygen in the air not perfectly accurate? Share your thinking with the hashtag #ScienceAtHomeQC-grade10
- You may do a similar experiment that does not require burning a candle by replacing it with a piece of steel wool and letting it rust (this also consumes oxygen but takes a few hours - see this link: <https://www.youtube.com/watch?v=xQNI2EdteDE>). (Optional)

Appendix B: Impact of Carbon Dioxide

- Carbon can be dissolved in water. This can be done artificially, by pumping carbon dioxide gas into a solution, as is done to make carbonated drinks (e.g. soft drinks or sparkling water). However, carbon can also be dissolved in a solution naturally, as is the case in the exchange of carbon between the atmosphere and the hydrosphere. The following chemical equation shows how carbon dioxide interacts with water:



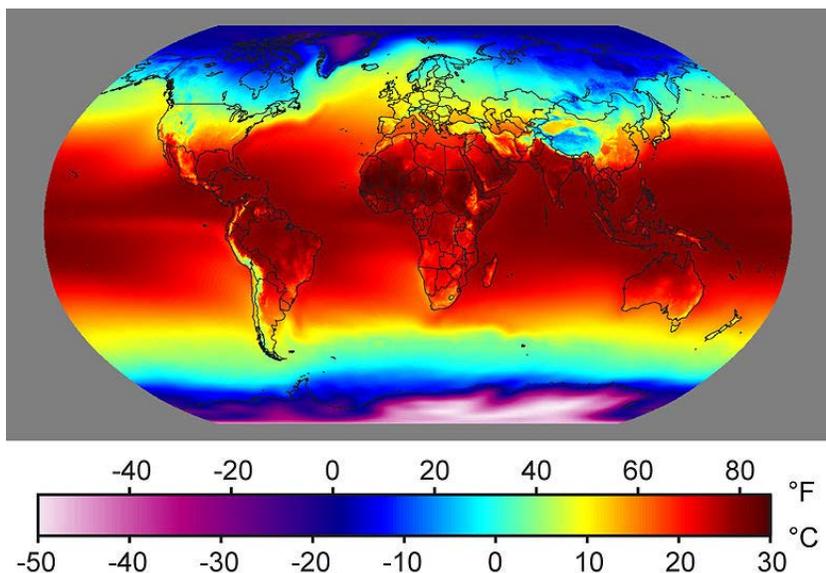
- The product of this reaction is called Carbonic Acid. It dissociates in water to form the following ions:



What are the missing charges on top of each ion on the right-hand side? What is the name of each ion?

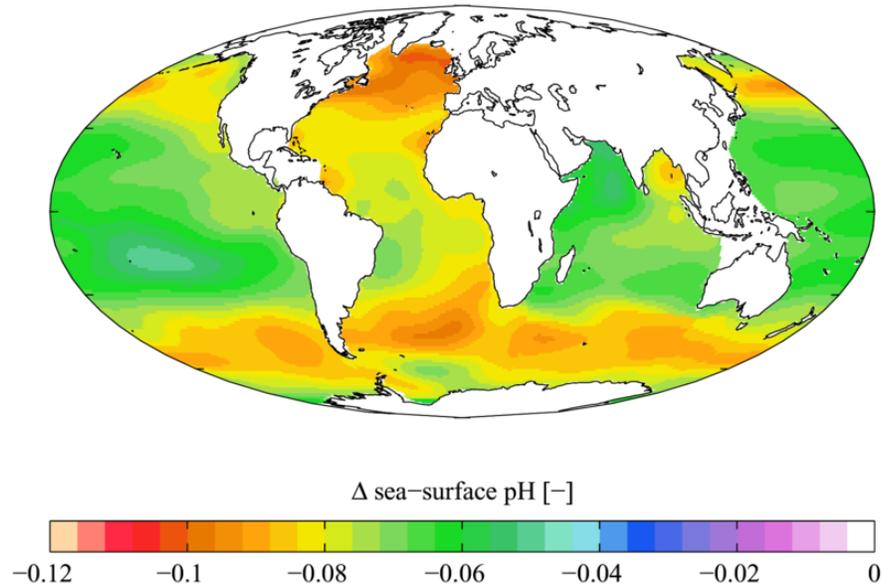
- Interpret the following two charts:

Chart 1: Global Annual Temperature²



² Rohde, R.A., Annual Average Temperature Map, 2008, JPEG, 385 KB, https://commons.wikimedia.org/wiki/File:Annual_Average_Temperature_Map.jpg

Chart 2: Change in Acidity³



- What parts of the planet are the warmest? Why do you think this is the case?
- What parts of the ocean are becoming more acidic? Why do you think this is the case?
- Based on these two charts, infer how temperature might affect the solubility of carbon dioxide in water. Explain your thinking.
- If greenhouse gases like carbon dioxide warm the average temperature of the planet, what effect will that have on the oceans' ability to absorb carbon dioxide from the air? Explain your thinking.
- How does a more acidic ocean affect aquatic life? Give as many examples as you can.

³ Plumbago, WOA05 GLODAP del pH AYool, 2009, PNG, 234 KB,
https://commons.wikimedia.org/wiki/File:WOA05_GLODAP_del_pH_AYool.png