Ocean Acidification Experiment

Science Film Festival — Knowledge Through Entertainment

The oceans absorb from one quarter to up to one third of the atmospheric CO2, according to estimates; this is the reason why they are often mentioned as a key component to prevent the raise of this specific greenhouse gas. Unfortunately the cost of this absorption is a significant reduction of the sea pH. In fact, we are registering an ocean acidification.

The historical pH change of surface waters, which is reconstructed with different techniques including the analysis of protozoa's shells, managed to identify the mass extinctions of several marine organisms in times of maximum acidification. But the current process has never been experimented in such a short time in the planet history (the current rate is estimated to be 100 times faster than it has been in the last 55 million years).

This phenomenon, associated with the increase of the average temperature and the reduction of the oxygen dissolved in the sea (due to eutrophication, which is caused by an excess of nutrients coming from dryland, for ex. nitrates and phosphates used in agriculture, or nitric oxides originated by transport and energy production),could drastically reduce the sea animal and vegetation biodiversity within few decades, with serious consequences on the functioning of the global marine ecosystem, on whom we depend.

TIME REQUIRED

60 min.

QUESTIONS

- What does "acidic" mean?
- What do you know is acidic?
- How increased amounts of CO2 in the air is affecting our oceans?

MATERIALS AND EQUIPMENT

- Science notebooks and pencils
- 4 large jars with lids
- 2 clear cups for each student group
- Additional cups for pouring vinegar and water
- Vinegar
- Water
- pH strips and color guide (2 per group + 2 more)
- Permanent markers (1 per group)
- Lobster shell cut in half (cooked, no meat in shell)
- Seaweed (the type bought for aquariums at a pet store)
- Seashells (2-4 per group) Pebbles to cover the bottom of 2 large jars
- Paper towels
- Masking tape
- Measuring cups/Graduated cylinders for students to measure and pour vinegar and water
- Goggles
- Salt (Optional for shell experiments. Don't use for seaweed if the plants purchased is for freshwater.)
- Small trays (Optional. Set up with equipment needed for seashell experiment.)
- Related article: What is Ocean Acidification? https://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F

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PROCEDURE

Introduction: All supplies are set up on science table

1. You've been learning about the massive amounts of carbon dioxide that are going into the air. It stays in the air a long time (~10 years). Some of it sinks down, falling into the ocean. I've been reading that this increased CO_2 in the ocean is making it more acidic.

2. Turn-and-talk: What does "acidic" mean? What do you know is acidic? Acidic means acid-like. There are weak acids, as in lemons or any fruit that tastes sour. There are very strong acids, as in the acid that's put in car batteries, or in a swimming pool to kill the germs. If you touch that strong acid, full strength, it will burn your skin. Weak acids, like lemon juice or vinegar, don't hurt your skin, but they will sting if put on a cut or splashed in your eyes.

3. So "ocean acidification" is ....

4. Plant and animal life are being harmed by ocean acidification. How could we create an experiment to see if that's true? Wouldn't it help us understand the scientists' concerns if we could actually see evidence?

5. Turn-and-talk: How could we create an experiment? Listen to a few ideas. Remind children that all variables need to be held constant, except that one container of water will be more acidic. The other container will have tap water.

Lesson: Class stands around the science table

1. Show them the equipment, and again get ideas for setting up a "fair test" to see the evidence of acidic water on sea life.

2. Explain that vinegar is a weak acid. Explain that pH strips are chemically treated to change color depending on the acidity level of the liquid. Show them the color guide. Have a volunteer dip the end of a strip into the tap water and match the color to the guide and note the number. Repeat with the vinegar. As a liquid becomes more acid the pH number goes down and the strip turns red. Compare the numbers and colors. Discuss what this evidence tells us.

3. Ask volunteers to set up the seaweed experiment, emphasizing the importance of holding variables constant: same types of containers; same type and amount of pebbles in the bottom of each container; same type, age, and health of seaweed in each container (anchoring it the same way in the pebbles in each jar). With masking tape and marker, label one jar "Control: Water". Label the other, "Experiment: Water and _____ mL of acid (vinegar)". (Put about 1/4 the amount of acid as water). Add water and acid, making sure that both jars have the same amount of total liquid in each container. Write the date.

4. Turn-and-talk: What's your hypothesis? Will the seaweed be different in each container if we check it in 1 week? 2 weeks? 3 weeks? How?

5. Repeat procedure with lobster shell.

6. Turn-and-talk: What's your hypothesis? Will the lobster shell be different in each container if we check it in 1 week? 2 weeks? 3 weeks? How?

7. Now you'll return to your table groups and discuss how you can set up another experiment to test how the seashells will respond to acidic water. But first tell me where seashells come from. How are they made? If they react to the acidic water what does that tell us?

8. When the group can tell the teacher how they will set up the experiment, holding the variables constant (except for the acid), they can get a tray with shells, graduated cylinder, cup of water, cup of vinegar, 2 empty clear cups, paper towel, permanent marker, masking tape.

9. Students set up experiment, making sure to label containers with "Control" and "Experiment," and how much acid was added to the experimental cup. It will be interesting to compare the differences over time, with groups that have added less acid with those who have added a larger quantity. Groups should also put their names on their experiment (or on the tray), and the date. Make sure the cups are put in the same location, so they are exposed to the same amount of light and heat.

Formative Assessment: Teacher circulates, questioning student reasoning, and assessing who needs extra guidance

1. Half-Way Teaching Point: Are you holding your variables constant? How? Why is it important to do so? What's your hypothesis? Do you think the seashells will respond the same way as the lobster shell and seaweed?

2. Once experiments are set up, students record the scientific procedure used (hypothesis, materials, procedure), filling in the results and conclusions at a later time.

and/or

Students draw a model showing power plants/factories/cars polluting the air □CO_2 in the air and descending into the ocean □Ocean becoming more acidic □ ? (students draw what they think will happen to the seashells/lobster shell/ seaweed. They will revisit this page later and change their model if necessary, so they should not color it in at this point.) Students should be sure to label everything, drawing arrows to show the path of the carbon dioxide, and writing a descriptive title for their model.

3. Now, or later when analyzing the results of the experiments, show Hermie the Hermit Crab video if 5th grade or younger/Science Today video if 5th grade or older. Also, you may want to have older students read a nonfiction article about ocean acidification, such as those listed in the Materials section above.

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Closure & Student Self-Assessment: Turn-and-talk

1. Why do scientists do experiments? Why have you set up experiments today? How often should we check our experiments? If we see a change in the sea life, what will we know? What should we do about it?

2. Teacher hands out an index card to each student. Write your name. Write down what's causing the ocean to become more acidic, and why that might be a problem. What else are you wondering about? Students complete Exit Tickets and turn in to teacher.

Authors/Source
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