SHELLS IN ACID

Adapted from NAMEPA's An Educator’s Guide to the Marine Environment: Shells in Acid

PURPOSE
Students will test the strength of normal seashells versus shells that have been soaked in vinegar to simulate the weakening effect of ocean acidification. Students identify the correlation between decreasing oceanic pH (ocean acidification) and the weakening of shells and discuss the effect this could have on the health of shellfish in the world’s oceans.

MATERIALS (PER GROUP OF 4)
- *white vinegar
- *small, thin seashells
- *non-reactive containers (glass beakers, Pyrex, measuring glass)
- *water
- heavy books (several)
- paper towels
For #6:
- shells (1 per student)
- snack size plastic bags (1 per student)
- Small amount of vinegar
- magnifying glass

*Before beginning this activity, shells should be pre-soaked overnight in a 1:1 solution of vinegar and fresh water.

PROCEDURE
1. Engage/Elicit
Ask the students to give examples of different species of shellfish. Answers may include clams, oysters, mussels, scallops, etc. Ask students why and where they have seen these creatures. Students’ knowledge may come from eating seafood, or perhaps from having seen them in an aquarium, a marina or in coastal areas. Ask the students why these animals are important to the marine environment and to human beings.

2. Explore
Lay out an assemblage of the non-soaked shells. Have the students observe the shells. Allow the students to handle the shells and ask them why the development of shells is advantageous to such animals. Explain that shellfish are invertebrates, meaning that instead of having an internal skeleton like humans, invertebrates produce a hard, protective covering. Mention that shellfish make their shells by combining calcium (also a major component of our bones!) with carbonate, two substances found in seawater. The product, calcium carbonate, is the same material that chalk is made out of.

After dividing students into groups of 4, give each group of students a control group (explain the term) of non-soaked shells and an experimental group (explain the term) of vinegar soaked shells that contain the same similar species, so that students can make a visual and direct comparison for each species.

Give each group two sheets of paper towel, labeled “Normal” and “Acid Washed.” Ask students to lay the shells out on the paper towels in two groups according to the treatment. Make sure that the paper towels and arranged shells are close enough to one another so that the books you are using can cover all of them at once, but far enough to keep the groups visually separate. The shells soaked

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in vinegar should look frail, brittle, washed out and feel less “intact” than their non-soaked counterparts.

Create a data table as a group (observations of both types of shells, predictions for how many books will break both types of shells, # of books to crack/break regular shells, and # of books to crack/break “acid washed” shells.

Ask the students to make predictions about which group of shells will withstand a greater amount of pressure (from the weight of the books) before they conduct the experiment. You can also ask them to guess how many books will cause shells from either group to break. Note that the books used for the control and experimental groups should be the same weight. If you do not have books with comparable weights, have students perform the experiment with the non-soaked shells first and then with the soaked shells to compare.

Have students carefully lay books on top of the two groups of shells until you hear or see shells cracking. Notice how much weight (how many books) is necessary to break the shells, and which kind of shell breaks first! See if the students can continue adding weight to the shells to break the (hint!) non-soaked shells – it’s hard to do!

3. Explain
Initiate a discussion and ask students to share the results of their experiments. Have the students refer back to their original predictions – do the results support or refute their predictions?

5. Evaluate/ Wrap-up
Ask the students to brainstorm some possible implications of ocean acidification on shell-forming organisms, and problems that could come from weaker shells. After establishing that shells can become brittle, fragile, and more easily breakable due to acidification, consider the connection between a strong, protective shell and a healthy organism.

Discuss how a shell protects an organism from dangers such as predation, pounding surf, and the hot sun, and have the students think about the challenge of surviving these harsh conditions with a weakened shell.

What does this mean for shellfish populations?

How will this affect marine ecosystems, and/or areas where these organisms are usually plentiful?

6. Provide each student with a snack size baggie with a small amount of vinegar (enough to cover a small shell in the corner), a small shell, and access to a magnifying glass. Have students place their new shell into the vinegar and observe what happens half way through club and at end. They should see bubbles instantly and some deterioration of shells. You can also do this yourself with an example shell the evening before so they can see more holes in the shell.

EXTENSION
Calcium carbonate is also the main ingredient in chalk. For a dramatic demonstration in real time, you can bring in a bottle of seltzer water (contained in a non-reactive glass beaker or Pyrex container) and drop the chalk in. The bubbles in the seltzer water are made of carbon dioxide, which will eat away at the chalk quickly and cause it to dissolve completely in a few minutes. After watching this happen, explain that the same substance, carbon dioxide, is produced by burning fossil fuels and is entering the oceans, causing acidification. In the ocean, however, this process is happening at a much slower rate because ocean water (pH 8.1) is not nearly as acidic as seltzer water (pH 3.5).