



Pre-lab answer key

1. How do organisms make their shells? What are shells made of? Write out both the chemical formula and the material.

Shells are made when the organism takes in chemicals it needs from the water surrounding it, alters the chemistry internally, then secretes the hard shell. Shells can be made of calcium carbonate (CaCO_3).

2. What do you expect to happen to the shell in an acidic solution such as vinegar?

Answers may vary here, but many students may put melt or dissolve.

3. What are sources of carbon dioxide and which of these sources are most likely to affect ocean pH?

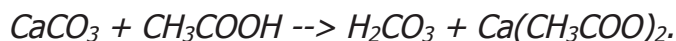
Sources of carbon dioxide include volcanoes, methane breaking down into CO_2 (from cows, tundra, etc.), human emissions of greenhouse gases, exhaling by plants and animals, exchange with the ocean, and the breakdown of plant matter, among others. Likely sources to affect pH need to be in great enough concentrations to alter the water. On a local scale, volcanoes are the most likely. On a global scale, there must be a process which is not naturally balanced to reduce the pH, which includes human emissions of greenhouse gases.

Post-lab answer key

1. When you immersed the shells in vinegar, how did you know that a reaction was happening?

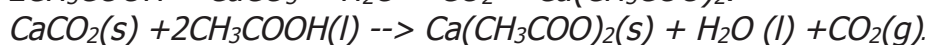
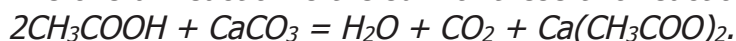
Bubbles formed on the outside of the shell and were visible in the water. The pH of the water began to change to a more basic pH.

2. Write down the chemical reaction you just observed. The chemical formula for acetic acid (vinegar) is CH_3COOH .



Step two of this equation involves the breakdown of carbonic acid into CO_2 and water: $\text{H}_2\text{CO}_3 = \text{H}_2\text{O} + \text{CO}_2$.

The overall reaction is the sum of these two reactions:



3. What type of gas is being produced by this reaction and what does it do to pH?

Carbon dioxide CO₂ and it lowers the pH of the water.

4. How is this reaction similar/different from the reaction during the bubbles protocol?

This is the reverse of the bubbles reaction in which CO₂ and water mix to create carbonic acid. Through this reaction CO₂ is released, lowering the pH.

5. How did observing the shells in vinegar relate to how animals are affected by a lower pH of ocean water?

Animals in a lower pH ocean are exposed to that pH for longer periods of time, we are testing what a shorter period of time does to an animal. The vinegar was far more acidic than the ocean will be, so this is not a direct observation of what would happen in the ocean. However, this does demonstrate the process by which shells are dissolved.

6. How would shelled organisms be affected by a lower pH of ocean water?

Shelled organisms would not be able to build their shells as quickly, and their shells would be dissolved. This could leave them open to predation, kill their food, or kill them outright by becoming too acidic to live in.

7. What are the primary functions of shells for these animals?

Shells provide a hard body for the organism, protecting it from predation. Shells can also act as a signal to a potential mate, protect an organism from the sun or dessication, and anchor and organism to a substrate.

8. Does it cost the animal energy to rebuild or repair their shell?

Yes. To survive, an organism needs to be able to maintain its shell, and doing so uses energy. The organism must bring in the proper materials to make its shell, convert those to a useable form, and then recrete this material as a shell.