CHALK IT UP TO OCEAN ACIDIFICATION

BACKGROUND

What is pH? pH is a measurable property of a liquid or solution that indicates whether the liquid is acidic, basic, or neutral. The pH scale ranges from 0 to 14, with solutions that are acidic having a low pH value, and solutions that are basic (or alkaline) having a high pH value. Solutions that are neither acidic or basic, like pure water, are a neutral pH of 7.

Increasing acidity

Neutral

Increasing alkalinity

pH	Examples of solutions
0	Battery acid, strong hydrofluoric acid
1	Hydrochloric acid secreted by stomach lining
2	Lemon juice, gastric acid, vinegar
3	Grapefruit juice, orange juice, soda
4	Tomato juice, acid rain
5	Soft drinking water, black coffee
6	Urine, saliva
7	"Pure" water
8	Sea water
9	Baking soda
10	Great Salt Lake, milk of magnesia
11	Ammonia solution
12	Soapy water
13	Bleach, oven cleaner
14	Liquid drain cleaner

Pure water has a pH of 7, and ocean water has a pH around 8. This is because pure water is simply water molecules while ocean water or seawater is a solution of materials that dissolve in the water from erosion and other processes, so seawater's chemistry and pH is variable. The ocean is more alkaline or basic. Because the ocean is more alkaline, some oceanic organisms produce a compound called calcium carbonate to build a variety of protections like shells.

CHALK IT UP TO OCEAN ACIDIFICATION

BACKGROUND, cont.

One of the most critical jobs the oceans has is to absorb and store carbon. An increase in carbon dioxide leads seawater to become more acidic, a process called **ocean acidification**. When carbon dioxide (from sources such as the burning of fossil fuels) is added to the ocean, the change in chemistry reduces the amount of calcium carbonate available. Just as humans need calcium to build their bones, sea creatures need calcium carbonate to build strong skeletons and shells. We can see the effect of ocean acidification on sea creatures' skeletons and shells as they become thinner or more brittle. Ocean acidification disrupts the food chain, undermining the stability of the ocean's ecosystems.

MATERIALS

- 2-6 clear glasses or jars
- Tap water
- Vinegar, white-distilled
- Uncolored chalk, like simple blackboard chalk
- Antacid, such as Tums®
- EarthEcho Water Challenge test kit or pH strips (optional)
- Seashells (optional)
- Raw Egg (optional)

Note: *This demonstration is for illustrative purposes only, as vinegar is far more acidic than ocean water. The chalk simulates marine bicarbonate skeletal material like shells or corals. This demonstrates the long-term impact of increased ocean acidity on shell building animals.*

CHALK IT UP TO OCEAN ACIDIFICATION

PROCEDURE

1. Fill one glass ¼ full of tap water, and another ¼ full of vinegar.
2. Optional step: use pH paper or an EarthEcho Water Challenge test kit to measure the pH of the water and the vinegar.
3. Break off 2 pieces of chalk about 1-2 inches long.
4. Drop one piece of chalk in the glass with water, and another in the vinegar. Make observations.You should see some small bubbles coming from the chalk in vinegar.
5. Get 2 new glasses and fill them as you did in Step #1.
6. Now drop one antacid tablet into each cup to see how they react. Make observations.
   Optional extension: repeat this process, but with a seashell in each cup. Leave overnight and then make observations. See photos below.

Seashells before demonstration

Left: Shell soaked in tap water
Right: Shell soaked in vinegar

Optional extension: repeat this process, but with a raw egg (in the shell) in glass of vinegar. Leave the egg in solution for at 2-5 days total, emptying the old vinegar daily, rinsing the glass and egg with water then refilling with fresh vinegar.

CHALK IT UP TO OCEAN ACIDIFICATION

CONCLUSION

What does this mean? If you take a look at the back of the antacid package, you will see that the main active ingredient is calcium carbonate. Remember, $CaCO_3$ is a chemical compound that is found in materials like chalk and antacid. It is also found in a lot of ocean animals, especially those that build their own shells. Some examples of animals that build their own shells are mollusks, such as snails, and bivalves like clams. Crabs, lobster, and even some plankton build their own shells!

Did you know that the hard corals that make a coral reef even build their own shells? Hard corals reefs are communities of coral animals that build their own limestone, or calcium carbonate, skeleton. These hard corals are the base of coral reef communities, which are important to the health of our ocean. About 25% of all known species in the ocean depend on a coral reef at one point in their lifetime.

Unfortunately, scientists are discovering that animals in the ocean are building weaker shells due to ocean acidification. We can protect these animals, plus those that build coral reefs, by reducing the amount of carbon dioxide that enters our atmosphere and oceans through the burning of fossil fuels. Look for ways to reduce your individual carbon footprint such as turning off lights and devices when you aren't using them, and walking or biking short distances instead of driving.