



14. Limestone (calcium carbonate or CaCO_3)

Limestone is a common sedimentary rock. Water may dissolve lots of holes in it. The caverns of West Texas were created by water dissolving large open areas below the surface of the Earth. If there is not enough support for the land surface above a cavern, it can collapse to create a sinkhole.



Limestone is one of the most important economic materials obtained by quarrying in the US. The limestone rock is ground to powder and used in the production of cement, which is an essential ingredient of concrete. Concrete is widely used in buildings, for the foundation, and for roadbeds, driveways, and airport runways. Many quarries are dug for limestone rock

to use only in cement manufacture. Limestone is also used to make the “lime” used in the mortar that holds building materials such as brick and stone together and for manufacturing paper, plastics, steel, glass, and paint. It can be quarried for road gravel and as a dimension stone—many important buildings have facings of limestone, including the Empire State Building.

Limestone consists of calcium carbonate (CaCO_3) with various impurities. The mineral name for CaCO_3 is calcite. One variety of calcite is called Iceland Spar, which looks like clear blocks of ice. It is used for prisms in some microscopes. The element calcium (Ca) in calcite and limestone is the fifth most abundant metal in the Earth’s crust, but it does not occur as pure deposits in nature, only in combination. In our bodies, calcium is mainly stored in our bones and teeth, but your body does not make its own calcium. If you do not get enough calcium in your diet or from nutritional supplements, your bones and teeth will not grow properly and weaken. Calcite has many uses as a neutralizer for acids. Crushed limestone is applied to soil to neutralize acid. High-purity calcite is used as an acid neutralizer in the chemical industry and in over-the-counter antacids such as Tums. It reacts with acid in your stomach to neutralizes some of it, which produces carbon dioxide (CO_2) as a byproduct.

Activities:

K-5: Get some vinegar and baking soda. Take 1 teaspoon of baking soda and put it into a bowl. Pour 1 teaspoon of vinegar on top of the baking soda. Draw or write what happened:

The bubbles that form when you add vinegar (acetic acid or CH_3COOH diluted in water) to baking soda (sodium bicarbonate or NaHCO_3) is carbon dioxide (CO_2), the same gas that is used in soda pop to give it fizz. You can also use a crushed Tums tablet, which is made from calcite, instead of baking soda.



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K-5: Get a small amount of vinegar, about 1 teaspoon. Find some concrete in a non-conspicuous location. Place a few drops of the vinegar on the concrete and observe the results. Did small bubbles come up from the concrete where you dropped the acid? Circle your answer: Yes No

This is a similar chemical reaction as in the previous activity, liberating carbon dioxide from the carbonate ion (CO_3^{2-}) in both the baking soda and the calcite in the concrete.

9+: Read through the two previous activities (you are welcome to conduct them also!) Write the chemical reaction that occurred for each one:

3-8: Calcium carbonate is commonly used as an abrasive in toothpaste to help remove debris, plaque, and surface stains from teeth in combination with the scrubbing motion of brushing. Collect the following ingredients to make your own toothpaste:

- Calcium carbonate antacid tablets, such as Tums
- Baking soda (sodium bicarbonate or NaCO_2)
- Artificial sweetener of your choice
- Liquid food colorings
- Liquid food flavorings, such as peppermint

Combine $\frac{1}{2}$ teaspoon calcium carbonate and $\frac{1}{4}$ teaspoon sodium bicarbonate in a small bowl or cup. Add just enough water (ideally, use an eye dropper to add about a dozen drops of water) to make a paste. Then add about $\frac{1}{8}$ teaspoon of powdered artificial sweetener or 1–2 drops of liquid sweetener.

Taste test your toothpaste by putting a small amount on a spoon tip. Then, experiment with mixing in different amounts of sweetener and/or small amounts of coloring and flavoring (again, use a dropper if available) to make two or more varieties. Record the different ingredients added to the basic paste in each toothpaste variety. Have other family members or classmates taste test your different toothpastes. Make a bar or pie chart displaying how many people picked each toothpaste as their favorite:

Variety 1 added ingredients: _____

Variety 2 added ingredients: _____

Variety 3 added ingredients: _____

(list more as necessary)

Draw your chart here:



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5-8: Calcite crystallizes in the hexagonal crystal system, usually forming large masses of small crystals, but sometimes it forms clear blocks that look like ice. It breaks on smooth surfaces called cleavage surfaces, with rhombohedron shape for the resulting crystals. Unlike a cube, which has rectangular faces, the six sides are parallelograms, with each pair of opposite sides parallel to each other. Draw this 3D crystal shape:

6+: Acid rain can form from mixing moisture in the air with carbon dioxide emitted from the burning of fossil fuels. Review the first two activities for limestone. What effect would acid in the rain have on buildings and roads that are made from concrete or limestone: _____

What do you think the effects on your teeth would be from drinking a lot of acidic beverages, such as most soda pops, or prolonged sucking on highly sour candies (note that "sour" candies decrease the pH in your mouth to form an acidic environment): _____
