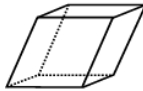


# Mineral Calcite & Vinegar Activity



## Background:

Calcite is the most common mineral in the Missouri Ozarks. This mineral is made of calcium carbonate ( $\text{CaCO}_3$ ). It belongs to the carbonate group of minerals. This mineral makes up the sedimentary rocks limestone and dolostone (also called dolomite) in the Ozarks. The calcite in these rocks was precipitated out of warm shallow seas that once covered Missouri nearly 500 million years ago (Paleozoic Era). This mineral can be easily found in limestone and dolostone quarries in beds (layers) of the karst rocks. The mineral can usually be found on the quarry floor in piles of rock rubble. The mineral is generally white, tan or yellowish.

Calcite crystals are identified by their hardness, crystal shape and reaction to acid. They can be scratched by a copper penny (hardness of 3), they have a rhombohedra crystal shape (see diagram above) and they bubble or fizz when in contact with hydrochloric acid. When the fizz or bubble escapes, carbon dioxide molecules are leaving the molecule of  $\text{CaCO}_3$ .

Hydrochloric (5% acid solution) is not easily available to elementary teachers, but cider and white vinegar are available. The same acid fizz reaction can be demonstrated if the mineral is scratched with a construction nail and powder of the mineral is made available. This process increases the surface area of the mineral. When this happens, the powder will react to vinegar which is a much weaker acid. Groundwater is essentially an even weaker acid that over time dissolves the calcite in the limestone and dolostone, which eventually forms the common karst features of the Ozarks such as caves and sinkholes. Groundwater becomes acidic by picking up carbon dioxide from decomposing leaf litter and other organic matter on the ground as it infiltrates into the ground. With the following demonstration and background information above, the students can see the process that forms the Ozark's karst features in fast motion.

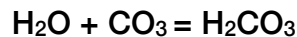
## Materials:

- Before the activity get the calcite. It can be purchased through a geology supply catalog or collected at a limestone or dolomite quarry. (See background above for how to find calcite minerals in a quarry. Get permission from quarry.)
- Vinegar (White or Apple Cider): put a small amount in small Dixie size cups
- Droppers or straws
- Construction nail (one per mineral)
- Paper towels per mineral
- Hand lens (magnifying glasses)

## Steps:

1. Provide students with a calcite mineral, paper towel, construction nail, vinegar, hand lens, and straw or dropper.
2. Instruct students to lay mineral on a folded paper towel and then take the construction nail and scrape the mineral until they get a small pile of the mineral in powder form on the mineral.
3. Instruct students to place a few drops of vinegar on the powder and observe with the hands lenses. Explain that the bubbles they are observing are carbon dioxide escaping from the mineral. They will see what appears to be white smoke, but it is carbon dioxide which is the same gas put in soda pop. Explain that a chemical change is occurring. During a chemical change the atoms rearrange (in this case CO<sub>2</sub> is being released from a CaCO<sub>3</sub> molecule).
4. Explain that this demonstration is similar to the same process that forms caves and sinkholes in the Ozarks. Explain that when water infiltrates into the ground it picks up CO<sub>2</sub> (carbon dioxide) from decaying organic matter. The carbonation of the water makes it a weak acid, which slowly over time dissolves the calcite minerals that make up most Ozarks rocks. As a result, caves and sinkholes form.

### Chemical Formula for how rainwater becomes carbonic acid:



*For additional information and formulas about how calcite comes out of solution and gets deposited to make speleothems, see the link below.*

[Speleothems \(Cave Formations\) - Great Basin National Park \(U.S. National Park Service\) \(nps.gov\)](https://www.nps.gov/greatbasin/learn/management/cave-formations.htm)