

LESSON 11:

CITRUS VOLCANOES

Students will experiment with chemical reactions in citrus fruits to create their own volcano.


OBJECTIVES

- What happens when citrus fruits and baking soda mix?
- What is the product of the chemical reaction?
- How does dish soap affect the reaction?
- How is this experiment similar to how real volcanoes erupt?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 3 lemons
- 3 limes
- 3 oranges
- 2 boxes of baking soda
- 1 knife and cutting board
- Food coloring (optional)
- 6 popsicle sticks
- 6 spoons
- 6 large bowls or plates
- 12 pencils and 12 pieces of paper (optional)
- For Extension activity (optional) - one bottle of dish soap

HOOK

 5-10 min


Ask students what they know about volcanoes. What happens when they erupt?

Explain that: In a volcano, there is hot liquid rock called magma. Over time, the pressure in the magma builds up. The pressure builds from gas that forms inside the volcano. Eventually, so much gas builds up inside the volcano that there is no space left and the volcano erupts to release the gas. Magma is forced up through the opening in the volcano and when the magma is on the surface of the volcano, it is known as lava.

Have you ever played "The Floor Is Lava"? Why can't you touch the floor? (Because lava is hot!) Lava can be up to 2,200 degrees!

Today we will be creating our own volcano using a chemical reaction.

HYPOTHESIS

 3-5 min

Discuss with students:

- What do you know about lemons, limes, and oranges? How might they create a chemical reaction?
- How might this look like a volcano?

Then, have students draw out the 'Scientist's Worksheet' and make the following predictions:

- Which fruit will produce the biggest reaction when mixed with baking soda?
- Which fruit will produce the smallest reaction when mixed with baking soda?

Alternatively, you can write these predictions on the board or discuss them orally.



CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)


SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Carbon dioxide
- Acid
- Base
- Magma
- Citric acid
- Hydrogen ion
- Hydroxide ion


EXPERIMENT

 20-25 min

1. To begin, roll the lemons, limes, and oranges to release the juices.
2. Then, half the lemons, limes, and oranges.
3. Give each pair of students half of a lemon on a plate/in a bowl.
4. Using the popsicle stick, poke holes in the lemon flesh to loosen the juices.
5. Add a few drops of the food coloring of their choice (optional).
6. Then, add a large spoonful of baking soda to the top of the lemon. Observe what happens.
7. Then, repeat this experiment with the lime and the orange, recording what happens each time.

Tip: To speed up the reaction, use the popsicle stick to poke the baking soda down into the lemon, lime, or orange.

OBSERVATION

 5-10 min

Ask students to discuss:

- What happened when the baking soda was added to each fruit?
- Which fruit produced the biggest reaction?
- Which fruit produced the smallest reaction?

Students should report that when the baking soda was added, the fruits began to bubble, and liquid flowed out of them. The lemon produced the biggest reaction while the orange took longer to react and may have just fizzed at the surface rather than overflowed like a volcano.



CONCLUSION

🕒 3-5 min

Ask students to share their findings.

- How do you know a chemical reaction occurred?
- How do you think this is similar to a volcano erupting?
- Why do you think this chemical reaction occurred?

Students should note that a chemical reaction occurred because bubbles were apparent. This was evidence of a gas forming. This experiment was similar to a volcano erupting because the liquid flowed out of the lemon, like lava/magma flows out of a volcano. Some students may be able to specify that the build up of gas in the fruit is similar to the build up of gas in the volcano, causing pressure which eventually results in an eruption.

Students should note that the baking soda and citric acid in the fruit juice reacted to cause this chemical reaction. Some students may note that the fruit is acidic, and the baking soda is a base, thus causing a chemical reaction when they mixed.

EXPLANATION

🕒 5-10 min

Lemons, limes, and oranges are acidic and contain citric acid. Citric acid consists of many hydrogen ions. Baking soda is a base and contains many hydroxide ions. When acids and bases mix, they create a neutral substance, because the hydrogen and hydroxide ions combine to balance each other out.

When the baking soda was added to the fruit and met the citric acid in the juice, a chemical reaction began as the ions neutralized. A byproduct of this reaction was carbon dioxide gas. The gas was in the liquid mixture and began to try and escape. As the pressure of carbon dioxide built up in the fruit, it began to overflow (like how magma builds up in pressure and overflows in a volcano). The bubbling foam was the carbon dioxide releasing into the air. The reaction stops when the juice and baking soda mix completely and neutralize each other, meaning no more carbon dioxide gas is being created.

Lemon juice had the biggest reaction because it has the highest level of citric acid. Oranges has the smallest reaction because oranges have the lowest level of citric acid. The higher the level of citric acid, the more hydrogen ions available to react with the hydroxide ions in the baking soda, producing more carbon dioxide.

A chemical reaction occurred here because gas was creating when the acid (citrus juice) and base (baking soda) mixed to neutralize each other. The formation of the carbon dioxide gas was evident in the bubbles the volcano created. This was a big clue that a chemical reaction had occurred!



SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - What will happen?	Hypothesis - Which reaction will be the biggest?	Observation - What did happen?	Observation - Which reaction was the biggest?
Lemon				
Lime				
Orange				
Fruit and dish soap (optional)				

EXTENSION



5-10 min

If students have time to expand on this experiment, try repeating this experiment with one of the fruits (you can use one of the volcanoes already created) but adding dish soap before adding the spoonful of baking soda.

Ask students:

- Does adding dish soap produce a similar reaction?
- Why do you think this happens?

Students should notice that the bubbles and foam are bigger because the dish soap traps some of the carbon dioxide and the gas creates large bubbles and foam with the dish soap.

CLEAN UP & DISMISSAL



3-5 min

Students must then clean their workspace. Materials can be disposed of safely. Make sure to leave the classroom the way you found it.

