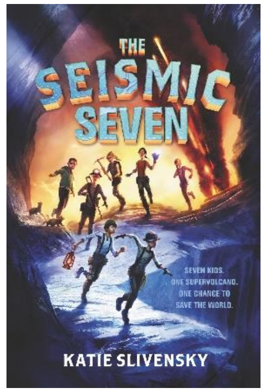
Volcano Experiments!



"If we control the release, we can let out a small amount of gas and magma from the chamber," Dr. Grier explains. "This would reduce the risk of a major pressure release later on that would evacuate the upper rhyolitic magma and reach the basaltic partial melt below, creating a sustained explosion."

I guess we don't immediately respond the way she thinks we should, so in a much slower tone, she adds:

"That would be bad. That would be the supervolcanic part."

- The Seismic Seven *by Katie Slivensky*

Why do volcanoes erupt? It's actually not because of the magma itself. It's because of the gases trapped *in* that magma.

As a general rule, whenever gas is built up and under enough pressure, with no easy way out, it will explode its own way out. If this pressurized gas is inside magma, that magma explodes out with it.

It's not always a huge explosion, though. With magma that is thinner and runnier, the gas leaves it much easier. That's why some eruptions aren't so dramatic. However, if it's thick and sludge-y, the magma traps the gas in, making it hard for it to escape until *so much* is built up and… KABOOM.

In these three experiments, we'll examine how gas can be so explosive!

A couple geology notes:

- *Runny magma is typically "basaltic" while thicker magma is "rhyolitic".*
- *Magma isn't called lava until after it erupts out of the ground.*

Experiment 1 - Gas Expands!

If you've ever shaken a soda bottle and opened it, you know firsthand how explosive gas can be. But why does it do that? Why won't it just stay in the bottle? After all, it fit in there before opening, didn't it?

Well, when you shake that soda bottle, the carbon dioxide that had been dissolved in the liquid gets enough energy to break free and form bubbles. Then, when you open the bottle, those carbon dioxide bubbles push outward and pop rapidly as the carbon dioxide escapes into the air in a big rush!

This happens because gas expands to take the size of the container it is in. If that container has an opening, gas will rush out to take the size of the next larger container it finds itself in (in this case, the room in which you opened the soda bottle*).

**Though if you want to try this at home, definitely go outside to make less of an indoor mess!*

Let's try to create carbon dioxide gas bubbles through a different method. Baking soda and vinegar!

Materials:

- Measuring cup
- Tablespoon
- Stirring spoon
- Empty Bottle – either 8oz or 16oz works great!
- Balloon
- ½ cup White Vinegar
- 2 Tablespoons Baking Soda
- Funnel (optional)

Important: ASK AN ADULT before attempting this experiment.

Also, be sure to do this in an area you can easily clean up! Outdoors is ideal, but indoors can work if you have a tray or large pan to set up on.

Directions

Step 1:

Set up on an easily cleanable surface, such as a large tray or pan. Measure ½ cup of vinegar and pour into an empty bottle.

Step 2:

Put two tablespoons of baking soda into a balloon. A funnel can help, but you can do it without if you don't have one! It may just take a bit longer.

Step 3:

Attach the balloon all the way around the bottle's rim. Keep it titled to the side and *be careful* to not dump the baking soda out of the balloon and into the bottle while doing this. Make sure it's on tight when you're done!

Step 4:

Lift the balloon upright, tipping *all* the baking soda into the bottle, and observe what happens!

Step 5:

Your balloon should now inflate! This is because when vinegar and baking soda react chemically, carbon dioxide molecules get freed from the baking soda. As they expand to fill their container, you will see the balloon expand.

Try experimenting!

- How big can you get your balloon? Try changing the quantities of baking soda or vinegar and repeat the test. Important: only change one variable (piece of the experiment) at a time! In this case, that means only change the amount of vinegar *or* the amount of baking soda. Not both at once!
- Does the size of your bottle impact the size of the balloon? Try different size bottles if you have them available!

Volcano connection:

This balloon demo is not how a volcano erupts, but it does show how rapidly gas can expand when given the chance. Imagine bubbles of gases trying to expand inside a magma pit. What could happen if they found (or exploded) an escape route?

Experiment 2 – Bubbles on the Move

Alright, so we've seen that gas expands to fill its container and will find ways to get out into the open air. Which begs the question—as gas bubbles collect inside magma, why doesn't the gas just escape out of the top of the magma and release into the air, like it did in the balloon experiment? Or, if you didn't do the experiment above, perhaps you're thinking about a different scenario—like boiling water on a stove-top, where gas bubbles form, rise, and pop from a pot, without exploding water all over your kitchen. No big deal. Definitely not destroying huge areas of land.

There are many examples we could think of where gas bubbles release without exploding liquid or solid material everywhere. So why—and how—does gas in a volcano push all that dangerous liquid rock out with it? Isn't rock heavy?

Well, it turns out gas *can* push material around. Quite easily actually. Let's try it out.

Materials:

- Measuring cup
- Tablespoon
- Stirring spoon
- Dry corn kernels (like you would use to make popcorn!)
- 1/3-1/2 cup White Vinegar
- 2-3 Tablespoons Baking Soda
- 2-3 cups of water
- Large clear container, like an 18 or 24 oz mason jar, a glass vase, or a large clear soda bottle with the top cut off.

Important: ASK AN ADULT before attempting this experiment.

This one can also be messy. Try doing it outdoors or indoors with a tray underneath.

Directions

Step 1:

Set up on an easy to clean surface, like a tray or pan. Then pour 2-3 cups into the clear container you want to try this out in.

Step 2:

Add 2 tablespoons baking soda if you used 2 cups of water. Add 3 tablespoons if you used 3 cups of water. Mix thoroughly until baking soda is dissolved.

Step 3:

Add corn kernels. The amount can vary, but make sure there are at least enough to cover the bottom of your container.

Step 4:

Measure out 1/3 cup of vinegar if you used 2 cups of water. Measure out ½ cup vinegar if you used 3 cups of water.

Step 5:

Pour in the vinegar! Watch what happens!

Tips – It may take a few moments to really get going. Try stirring up the kernels if you don't see much action. Also, feel free to add additional baking soda and vinegar. More of these both together will mean more bubbles!

Try experimenting!

- What combination of baking soda and vinegar gets the most kernels moving? How many kernels can you get going at once?
- What other objects can the gas bubbles lift? Try with peas, rice, or any small object of your choosing. Does the shape of the object matter? Does the weight?

Volcano connection:

This corn kernel test demonstrates that gas can move material other than itself. This is a gentle exploration of that concept—but imagine if there was more energy behind this test. If the bubbles burst up with more energy, they might fling those corn kernels right out into your room! In a real volcanic situation, there would be a *lot* more energy.

Experiment 3 – Volcano Simulation

Perhaps the moment you've been waiting for—it's time to make a volcano! Now that we understand the power of gas, let's visualize it through a classic demonstration.

In this demo, we won't use liquid rock with our bubbles. Our liquid will be made with dish soap. Why dish soap? Because dish soap is great at forming bubbles! As the reaction between our vinegar and baking soda occurs, the gas released will be trapped inside soap bubbles, rather than invisibly released into the air. This soapy solution will be our model lava.

As an important note, this volcano simulation will be more similar to a basaltic volcano, with a thinner, runnier type of magma. Rhyolitic magma (like in *The Seismic Seven*) would be thicker and produce more of an explosion. For safety purposes, even at a small scale, it is better to avoid explosions. Hence why the mixture used will based on liquid soap—nice and runny!

Materials:

- Pan or tray with high sides
- Measuring cup
- Tablespoon
- Stirring spoon
- Empty Bottle – either 8oz or 16oz works great!
- Modeling clay or playdough
- 1/3 Cup White Vinegar
- 2 Tablespoons Baking Soda
- 1/2 Tablespoon liquid dish soap
- Funnel (optional)
- Ketchup (optional)

Important: ASK AN ADULT before attempting this experiment.

This one is DEFINITELY messy! Be sure to do outdoors if possible, or if you need to do it indoors, do it on top of a tray or pan with high sides.

Directions

Step 1:

Place empty bottle in pan. (Note: I used a pan on top of a tray, for double protection in case the mess got out of hand.)

Add 2 tablespoons baking soda to the bottle. You can use a funnel if you have one, or you can just pour carefully!

Step 2:

Measure out approximately half a tablespoon of dish soap. Add to the baking soda inside the bottle.

Step 3:

Time to get artistic! Use modeling clay or playdough to build a volcano cone around your bottle.

This can look as detailed or simple as you would like. This is also a chance to mold your lava-to-be's landscape. Do you want it to flow a certain way? Try building channels or pathways on your cone! Want to see the lava split as it runs down? Try building obstacles for it!

Step 4:

Measure 1/3 cup vinegar and add it to your volcano. Get ready! Eruption is now imminent!

Observe and enjoy!

Try experimenting!

- Want lava that looks redder? Try mixing a batch of ketchup and vinegar together. Ketchup is already vinegar-based, so this will do well when encountering the baking soda. Make sure the mixture is nice and runny, then add it to your volcano!

- How many times can you set off the volcano with just the initial 2 tablespoons of baking soda in the bottle? Count your trials and see which one seems to finally require more baking soda added.
- Did the lava flow the way you predicted? Remodel your clay and challenge yourself to direct the flow to one side of your pan or tray.

Volcano connection:

This only simulates the lava once it exits the volcano. The internal events of what leads up to a volcanic eruption rely on trapped gases and magma, which are too dangerous to experiment with in a home environment. That is why it is helpful to think about the first two experiments in this set to get a more complete picture.

For more about volcanoes, check out your local library! Or reach out to Katie at www.KatieSlivensky.com with any questions.