WELCOME TO THE STEAM STATION!

THE UNITED THANK OFFERING PRESENTS:

GRATITUDE ROCKS!

A Vacation Bible Camp Curriculum Focused on Gratitude, Geology, & Fun

WELCOME TO STEAM!

Thanks for signing up to run the STEAM station! You don't need to be a scientist or a geologist to run this station, just someone who is curious about the world around you and wants to encourage campers to be curious too. If rocks (or science) is something you're passionate about, we hope you'll bring your own ideas and creativity. Each day you'll walk students through an experiment or activity that helps them engage with a concept from geology. We'll help you connect that concept to the theme of the day in your teaching section.

HERE'S A QUICK LOOK AT YOUR WEEK AHEAD:

Day One: The Rock Cycle

Activity: Create the Rock Cycle using Starburst candies or chocolate

Day Two: Metamorphic Rocks & Pressure

Activity: Inflate balloons on water bottles with different solutions to create pressure

Day Three: Igneous Rocks & Volcanos

Activity: make volcanos and watch them erupt

Day Four: Sedimentary Rocks & Weathering

Activity: use Skittles to learn about the power of water and weathering

Day Five: Minerals & Gemstones

Activity: Create egg geodes

NOTE: You can start the egg geodes on day four so you can see the crystals on day five, or they can be sent home to finish on day five. There are notes to show how to do both options.

We've also given you information on how to expand the activity for different age groups or fill time if a group gets done quickly. You'll have a handout for each day of the week to guide you through the process.

WHY STEAM AT VBS?

You might be wondering why you are teaching science at church...well, it's because science is fun (and important) and many schools cannot afford a science program that give kids hands-on experiences. This station teaches critical thinking, problem solving, and exposes them to the scientific method while also connecting to the theme for the day.

The experiments are intended for children to do them unless specified. This is sometimes a hard thing for preteens/counselors because they want to do the experiment themselves, so if you've got older students helping at this station, we recommend that you meet with them to do the expansion experiments and/or the activity for the day so they are less likely to take over the experiment from the campers.

SETTING UP YOUR STEAM STATION:

CREATE THE MOOD

We recommend setting up your station like a lab. This helps remind campers that they need to be careful and aware of their surroundings. You might want to have goggles for everyone to borrow or lab coats, or some special item they borrow when in the space to remind them they are scientists.

TOOLS YOU'LL NEED

1. Microwave
2. Tables for doing experiments on
3. Trays (or pie tins) for each student to contain their experiments
4. Decorations - you can put up the posters on the next few pages on the scientific method and the rock cycle.

SENSORY NOTES

This is a place where it is easy to get excited, and when we get excited, we sometimes get loud. It is important to remind campers that they are scientists at your station. If you have a camper with sensory issues, be sure to give them a space to work where they have some space if they need it.

GRATITUDE ROCKS: THE SCIENTIFIC METHOD

Make an observation:
What do you see?

Ask a question:
I wonder...

Develop a hypothesis or prediction:
What do you think is going to happen?

Try the Experiment!

Analyze:
What Happened?

Did you guess what happened correctly?

What did we learn?

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DAY ONE: THE ROCK CYCLE

Today we're going to talk about the rock cycle!

To help you get started, we've made a poster that explains it on the next page. You can print this out for each camper or you can get it made into a poster to decorate your space. The biggest thing to know about the rock cycle is that it is a continuous cycle where rocks are transformed by heat, pressure, or erosion.

Then, we're going to re-create the rock cycle using chocolate or Starbursts. Either process works and we'll give some things to consider why you might want to chose one over the other or you can do both!

DAY ONE: THE ROCK CYCLE

SUPPLIES

You will need (per camper):

- one handout
- wipes for cleaning hands
- toothpicks for stirring igneous rock
- baggies

Option One: Starbursts (get a variety of colors)

- mini starbursts (6-10 per camper)
- regular starbursts (3 per camper)
- microwave
- parchment paper

Option Two: Chocolate

- chocolate bar, white chocolate bar, dark chocolate bar (1 of each for every 3 campers)
- Foil
- Boiling water/electric water kettle
- small bowls for each group reach hot water
- ice (optional)
- Turn ⅔ of the chocolate into shavings, but keep separate

Which should I choose?

Each process has pros and cons so here are some things to consider. Chocolate is messy when melted, so consider your space. Starbursts are less messy but are harder to manipulate.

EXPANSION

To add a challenge, print out the rock sorting sheet for older students and give them samples of each kind of rock to sort on their paper. You can find kits at your local rock shop or online. This is also a great activity to have for kids who finish quickly. If your location happens to have rocks lying around (from landscaping or nature) you can also have the kids go on a hunt to look at rocks and try to identify them. Note: the "types of rocks" handout has sorting spaces for these activities.

We recommend one kit for every 3-4 campers. Make sure to get a kit that features rocks and not just minerals and gemstones so they can see metamorphic, igneous, and sedimentary rocks. This kit is also just fun to have for camp and can be shared between rock formations.

SCAFFOLD

For younger campers, this activity is easier if you focus on one part of the rock cycle. We recommend talking about rock layers. Rock layers are formed over time when different kids of sediment (mud, soil, sand) are laid down and solidify. When we look at a a cross section of rock, you can see the different layers. The layers at the bottom are the oldest and the ones at the top are the newest. This is easy to do by stacking Starbursts or chocolate squares.

TEACHING ABOUT THE ROCK CYCLE

Handouts: for teaching use the "Rock Cycle" and "Rocks, Minerals, Fossils" both of which can also work as posters. For scaffolding or just extra information, use the "Types of Rocks" page. For the experiment, chose the correct handout for the materials you're choosing to use.

Note: Microwaves vary, so please try out melting the Starbursts in the microwave before the campers do it so you know how long it takes. For metamorphic rocks, it only takes a second or two, because you want it soft but not melted.

Welcome to the STEAM Station! You might be wondering how the STEAM station and the Geology Station are different, so before we get started I wanted to share with you a bit about the things we'll be doing in this station during camp and how it is different but connected to the Geology Station. Here in the STEAM station, we're going to look at the science around rocks. This means that sometimes we'll work with rocks and sometimes we won't. Today, we are going to spend time thinking about a really big concept called the rock cycle. The rock cycle is just a fancy way that scientists talk about how all rocks are related and how one rock can become a different kind of rock. I've got this great poster (or handout) so you can see what the rock cycle is. There are three main types of rocks: igneous, sedimentary, and metamorphic. Each of these rocks can become another kind of rock. That seems crazy right, to think about one rock becoming another rock, so let me show you. I think you all know how dirt becomes mud, right? So water gets added to dirt and it clumps up and forms mud. Have you ever noticed that when mud driest it sometimes stays more solid then the dirt was that it came from? This is how sedimentary rocks begin to form. Today we are going to do an activity that helps us see how each rock becomes a different kind of rock.

Step One: Making Sedimentary Rocks

The first thing we are going to do today is make sedimentary rocks. These rocks are when tiny bits of dirt or other rocks get smashed together, sometimes with some water, to make a rock. Before we start, I want everyone to clean their hands using these wipes. Please do not eat the Starbursts, if everyone follows directions, you will get to have some at the end.

Option One: Starbursts

In front of you are a bunch of mini Starbursts and regular Starbursts. I want you to pick up three or four of them and smash them together to form a rock of Starbursts. You don't need to do this well, just get them all to stick together without anything falling off. You've made a Sedimentary rock! Please make two! One will go on your handout and the other we need for the next step.

Option Two: Chocolate

(Have chocolate shavings ready in bowls with spoons - you can do milk, dark, and white. You'll also want to have some squares of chocolate.) I want you to get some of the small chocolate shavings from in front of you and put them on your foil. Close the foil and press down where the chocolate is until the small pieces form one big piece, you've just made sedimentary rock, please make two! One will go on your handout and the other we need for the next step.

Step Two: Metamorphic Rock

To make metamorphic rocks we have to had heat and pressure to our sedimentary rock. (Can show them on the diagram.)

Option One: Starbursts

Take one of your sedimentary rocks and put it between your parchment paper. I want you to add pressure to your sedimentary rock. You can press with the heel of your hand, but really smoosh it down. Once you have it smooshed, we'll pop it into the microwave for 10 seconds to just add a little heat, then you should be able to smoosh it some more. Notice that you can still see the layers, but it is really one rock that you couldn't pull a part. This might look like your countertops at home, they are often made of metamorphic rocks. Put this one on your handout.

Option Two: Chocolate

Now you are going to take one of your sedimentary rocks and we're going to add a little bit of heat. I'm going to bring a bowl of hot water to your table in just a moment, do not touch the water. While you are waiting, I want you to take some foil and make a little boat or cup out of it to put one of your sedimentary rocks into it. When I bring the water, you're going to float your boat on the water for just a few seconds and then remove it. You've just made a metamorphic rock! You can still see the parts that were in the sediment, but now you couldn't take it apart. This might look like your countertops at home, they are often made of metamorphic rocks. Put this one on your handout.

TEACHING ABOUT THE ROCK CYCLE

Step Three: Igneous Rocks

Now to get serious about heating and cooling! When metamorphic rocks get deep inside of the Earth, they can melt completely. Does anyone know what we call a melted rock? That's right, magma! So, we are going to melt our candy and then cool it so it can form an igneous rock.

Option One: Starbursts

We're going back to our Starbursts, pick up 4-5 of the minis or 2-3 big, or a combination of the two. You are going to smash these together again, but it doesn't have to be perfect. Put these on a piece of parchment paper and this time, we are going to microwave them for about 20 seconds. When your rock comes out, you are going to stir it with the toothpick until it is all combined. As it cools, you can smoosh it together into a rock using your hands and then add it to the handout. You've made an igneous rock! Add it to your handout.

Option Two: Chocolate

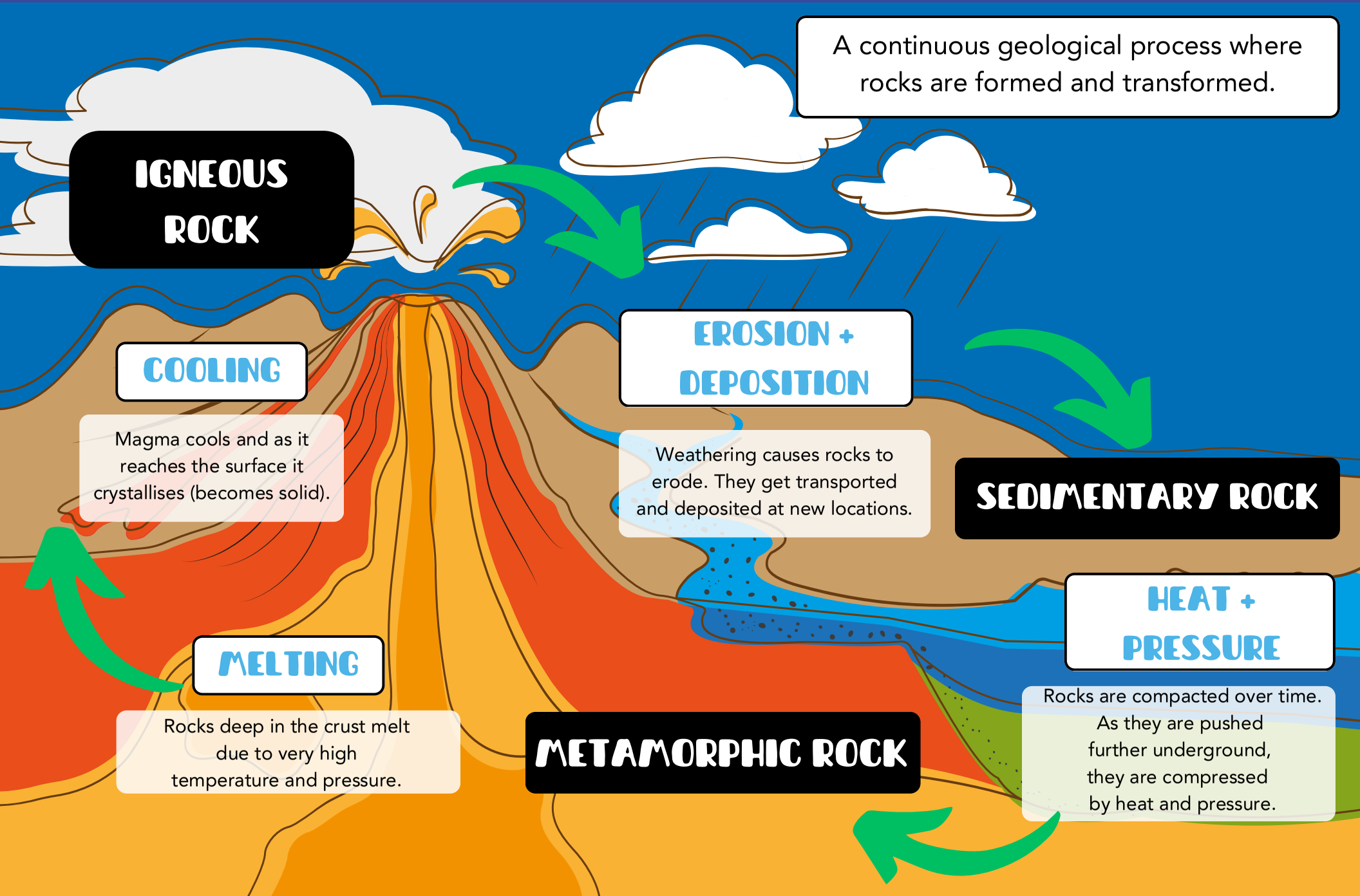
We're going to start again, this time you'll pick some squares and some shavings and put in onto the foil boat again. This time we'll float it on the water and then give it a stir using a toothpick once we pull it off of the water. You've made an igneous rock! Add it to your handout.

Wrap Up

Now that we've made all the forms of rocks, you can see how even rocks are always growing and changing, just like us. In our Bible story today we learned that God is always making things new. Sometimes it is hard to see how things are changing in ourselves or the world around us but they are, and that is a really good thing because it means if we make a mistake, we get to learn from it and try again, or that things we can't do now we will be able to do someday, like rock climb or jump off the high dive.

Thanks for spending time with me today learning about the rock cycle. I'll see you tomorrow!

GRATITUDE ROCKS: THE ROCK CYCLE



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ROCKS, MINERALS, FOSSILS

WHAT ARE ROCKS?

Rocks are made up of minerals and other materials.They are found all around us, from mountains to beaches. Rocks can be grouped into three main types: igneous, sedimentary, and metamorphic.

IGNEOUS:
BALSALT

SEDIMENTARY:
SANDSTONE

METAMORPHIC:
GNEISS

WHAT ARE MINERALS?

Minerals are natural substances found in rocks. They have specific chemical compositions and crystal structures. There are over 4,000 known minerals on Earth, each with its own unique properties.

QUARTZ

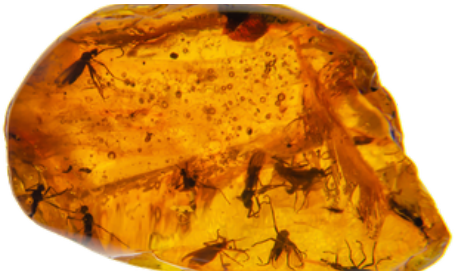
FELDSPAR

MICA

WHAT ARE FOSSILS?

Fossils are the preserved remains or traces of ancient life, (ex. bones, leaf print), which offer insights into past ecosystems and the history of life on earth. There are seven main types of fossils, six are below with the seventh being molecular fossils.

BODY FOSSILS



PRESERVED REMAINS FOSSILS

TRACE FOSSILS

PETRIFIED FOSSILS

MOLD & CAST FOSSILS

CARBON FOSSILS

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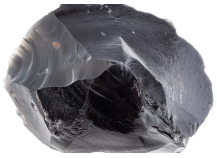
TYPES OF ROCKS

IGNEOUS ROCKS

are formed when magma or lava cools and solidifies.

BASALT



OBSIDIAN

PUMICE

Igneous Rocks are characterized by their crystalline or glassy texture, lack of fossils, and varying compositions based on the rolling rate and magma composition.

SEDIMENTARY ROCKS

are formed when sand, silt and various organic materials accumulated over time

SHALE

SANDSTONE

LIMESTONE

Sedimentary rocks are characterized by their composition, texture, and the process of accumulation.

METAMORPHIC ROCKS

are formed by the transformation of existing rocks due to extreme heat and pressure.

SCHIST

formed from shale or mudstone, often contains mica.

MARBLE

formed from limestone or dolomite.

GNEISS

forms from a variety of rocks, including granite, and is characterized by it's banded or layered appearance.

Metamorphic rocks are characterized by their foliated or banded texture, and the presence of minerals like quartz and mica.

SORT ROCKS HERE!

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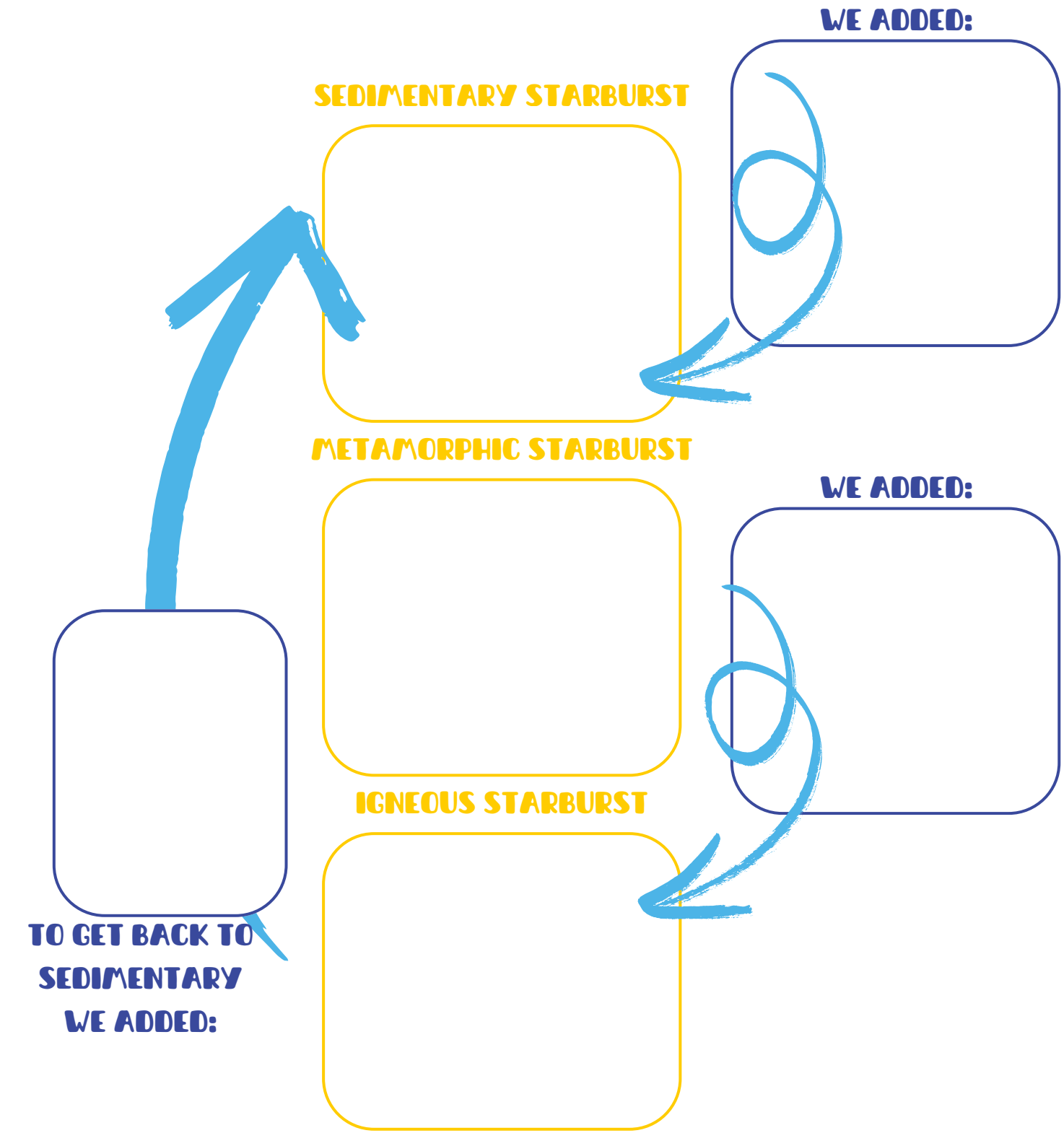

ROCK CYCLE WITH STARBURSTS!

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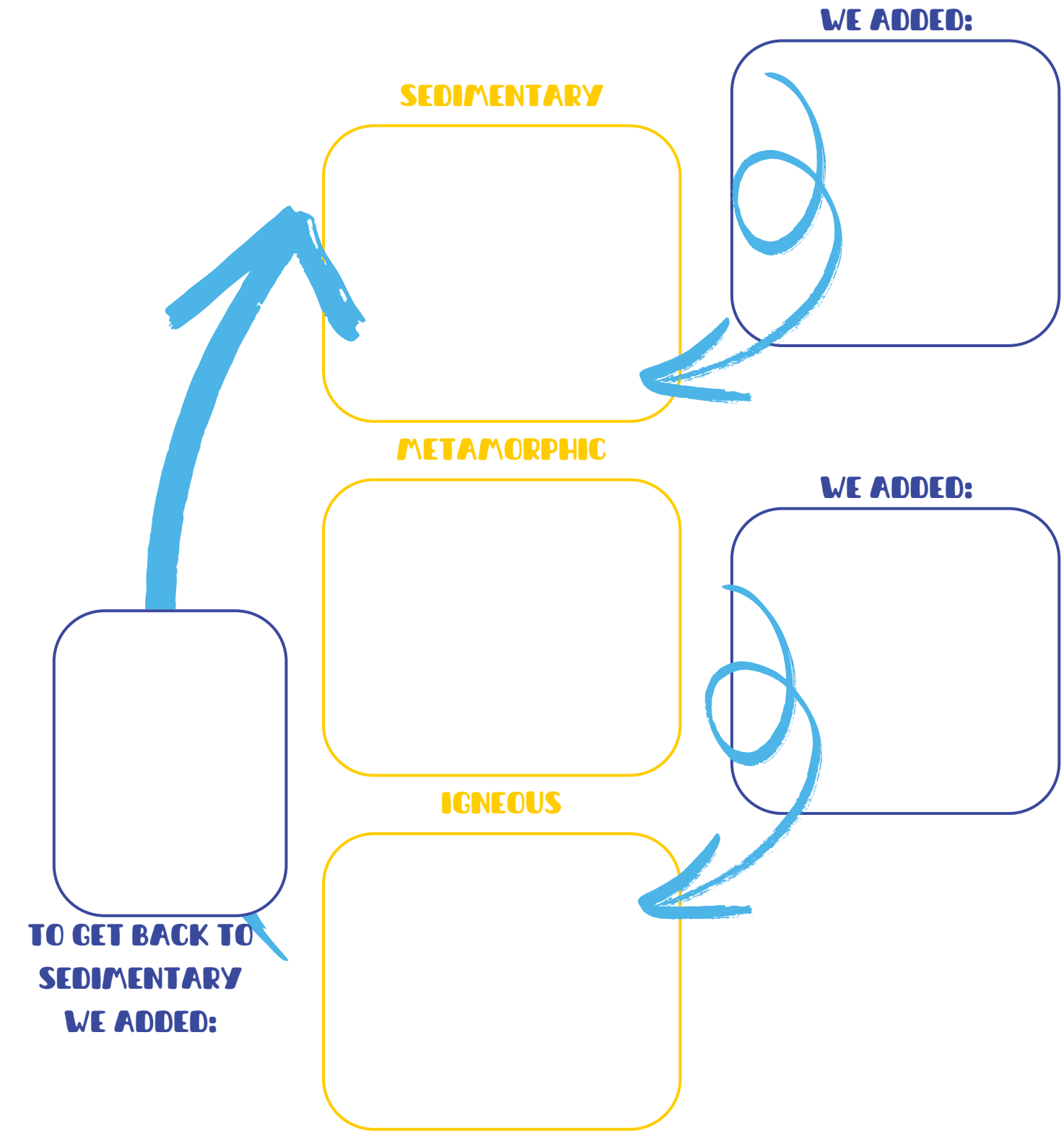

ROCK CYCLE WITH CHOCOLATE!

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DAY TWO: AIR PRESSURE

Today we're going to talk about metamorphic rocks and what sets them apart in geology - pressure! We will learn about pressure and how pressure can change things. In this station, campers will see first hand how pressure works by manipulating objects with air pressure.

For a lot of campers, the thought of a rock melting is kind of crazy, so this is a fun day to talk about how sometimes the things we can't see are the things making a big difference. We're going to do activities to explore pressure. We're going to use items to create a chemical reaction to see which one inflates a balloon fastest.

DAY TWO: METAMORPHIC ROCK

SUPPLIES

For the Demonstration:

- disposable pie tin
- candle
- glass vase that fits over the candle but leaves a little room around
- water
- food coloring
- matches

For Expansion:

- peeled, hard boiled eggs (one per camper)
- one glass bottle per camper (mouth needs to be small enough to put an egg on top without falling in)
- matches
- small piece of paper (per camper)
- fire extinguisher

For Activity:

- one small water bottle per camper and one as a control
- 2 Alka-seltzer tablets for half of the campers
- 6 oz vinegar for half of the campers
- 1-2 tbsp baking soda for half of the campers
- one balloon for each bottle of water
- funnels will make it easier to put the powder into the balloons, or you can use straws that have a spoon cut

PRO TIP:

fill the balloons ahead of time to save on mess and struggle. Use one color of balloons for baking soda and one color for the tablets.

EXPANSION

For older kids or to do a demonstration, today we recommend one that many of us grew up with - getting an egg into a bottle. This is a quick experiment where you put a small piece of paper on fire into a glass bottle. Let the paper catch (so small flame) and then put the egg on top. As the pressure increases inside the bottle it will pull the egg down into the bottle and extinguish the flame.

The other way to expand this project is to let the students experiment. Once they've done the experiment with the balloons, let them create a hypothesis to test - changing one variable in the experiment each time. They can use their field guide to take measurements, record what they changed, and know what makes the biggest impact.

SCAFFOLD

For younger campers this activity is really a good match for their skill set. You may need to help them or practice with them getting the balloons onto the bottles as it is a tight fit. If this is the case, you can attach the balloons for them and then they can lift the balloon up to make the reaction happen.

TEACHING ABOUT PRESSURE

Today in STEAM, we're learning about pressure. Unfortunately, it is very hard to re-create the amount of pressure and heat needed to melt a rock, so we're going to focus on changing air pressure instead. To start, I'm going to do a demonstration on how pressure changes things. As you can see, I have a pie plate with water in it, I've added some food coloring so we can see the water more easily. Next, we're going to light this candle that is in the middle of plate. Once the flame is going, we're going to carefully cover the candle with this vase. As the candle burns, it heats up the air and increases the air pressure. The flame is burning because of the oxygen found in the air, as it runs out of oxygen to burn, the candle will go out and it stops heating the air and the pressure will decrease. When the air pressure decreases, it will pull the water into the vase to fill that area of low pressure. (Note: when breaking the seal on the glass, be careful or the water will rush up and flood the candle wick making it hard to light again for the next group.)

We can do more cool things with pressure!

Blowing Up Balloons (See Photo on Previous Page)

Today we are going to do an experiment to see the fastest way to inflate a balloon without using our mouths. Whenever we do an experiment, we want to follow the scientific method, so we need a control, meaning something we're not doing anything to it. This will be bottle #1. into this bottle we'll just add some water and put a balloon over the mouth. It's good to practice your technique with getting the balloon onto the bottle because it can be a bit tricky. Now, with a partner, you are going to test two ways to blow up a balloon without using your mouth. Let me explain what is in bottle #2 and bottle #3.

Bottle 2 is filled ⅔ full with water.
Bottle 3 is filled ⅔ full with white vinegar.

- For the person with bottle 2, you are going to crush up two alka seltzer tablets. Put the small pieces into your balloon.
- For the person with bottle 3, you are going to add 2 teaspoons of baking soda to your balloon.
- Once you have your powder in the balloon, you will put the mouth of the balloon over the mouth of the bottle, but don't tip the balloon up just yet because we want everyone to start at the same time. (Help anyone who needs it to get the balloon onto the bottle.)
- Alright we'll count down - 3-2-1 and tip the contents of the balloon into the bottle!
- Which balloon inflated the fastest?
- Can anyone tell me why this experiment worked? When the powder mixes with the liquid, there is a chemical reaction that takes place which creates carbon dioxide gas. This gas filled the bottle and then the balloon so that it blows up the balloon.

Note: this is easily expanded for the older kiddos by asking them to determine what ways they want to change the experiment - decrease the liquid, increase the liquid, etcetera. Then you can chart the results and see what is the most effective way to inflate a balloon on a bottle.

Egg in a Bottle

Now that we know a little about how pressure works and how we can change pressure to increase it in an experiment, we're going to look at how heat and pressure work together by doing a classic experiment about air pressure - egg in a bottle.

We will push this hard-boiled egg into a glass bottle by only using air pressure. We're going to light a small piece of paper, and put it into the bottom of the bottle with the egg on top. The heat causes the air in the bottle to expand, and once the fire burns off the oxygen in the bottle, it will extinguish the flame. When the fire goes out, the air, trapped by the egg, cools and contracts, creating a low-pressure area that pushes the egg into the bottle.

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DAY THREE: VOLCANOES!

It's volcano day in the STEAM and Geology Station! Today, we are going build and erupt volcanoes. This is going to be a shared experiment with the geology station. Depending on how your stations are set up - you'll make volcanoes in one station so they can dry, and then explode them in the other station. (Meaning if kids come to geology first, they'll build their volcanos there and then erupt in STEAM or vice-versa.) We've also got a great expansion piece for older students or it can be used as a fun demonstration. Students will learn about lava rocks in the craft station so you will be able to reference what they are learning there depending on when they arrive at your station.

DAY THREE: IGNEOUS ROCK

SUPPLIES

To Build the Volcano You will need:

- one container per camper (you can use the water bottles from yesterday)
- to build the volcano, you will need either salt dough or air dry clay depending on your climate
- paint for decorating the volcano (if clay wasn't colorful)
- paint brushes, etc.

To Erupt the Volcano (per camper):

- baking soda 2-3 tablespoons
- vinegar - 1 Cup
- clear dish soap (a few drops)
- red food coloring (a few drops)
- tray to catch the liquid explosion

For Elephant Toothpaste (per demonstration):

- 300 ml hydrogen peroxide
  - 50% food grade hydrogen peroxide or
  - best "fun" results - 40 volume hydrogen peroxide - this can be found at beauty supply stores (just get the clear not the creme) and can be done by older campers
- 4 teaspoons potassium iodide crystals
- 1500 Erlenmeyer Flask, or similar
- 3 tablespoons clear dish soap
- food coloring
- 100 ml water

EXPANSION

Again, this same lesson is attached to the Geology Station. So work together to decide which part of the lesson is happening when. A way to expand this lesson is to do a demonstration of elephant toothpaste. We've put the instructions on the next page. Hydrogen peroxide can bleach clothes or burn eyes, so safety goggles and gloves are a must with this experiment (or just have folks stand at a safe distance). (Additionally, once the potassium iodide is re-hydrated, it can stain.)

Note on color: when this reaction happens, the iodide shows itself by adding a yellowy-orange hue to your experiment, so if you're wondering why the color is weird, it's the iodide!

SCAFFOLD

This is a great activity for young campers because they love mixing things and getting a reaction. If you want to decrease the amount of mess or even set up, you can also set this up as an outdoor experiment. Have the little ones build a mountain in the dirt or sand then place a small jar in the middle of their mound. This way they can create their volcano in the dirt/sand and see how the magma would flow down the sides like on a real mountain. It also helps contain the mess!

TEACHING ABOUT PRESSURE

Volcano Building

Today in STEAM/Geology, we're learning about how things can look like one thing, but are something completely different. Volcanoes look like mountains, which they are, but there is something much more interesting happening under the surface. We've got this poster (you can also use a video) to help us see what is happening below the surface of a volcano...as you can see, deep below the earth's surface, rocks are met with heat and pressure, which causes them to melt. This forms magma. Magma continues to build and starts to push upwards. This causes cracks inside the mountain. The magma continues to push into these cracks until it ultimately pushes through the surface as an eruption. As the magma hits the air and ground, it cools, turning it back into rock. Sometimes this happens slowly, and sometimes it happens violently. When a volcano erupts, there can also be ash and gas released alongside the magma. We're going to work together with the geology station today, so in our group time, we're going to build your volcano. Then it will dry before you get to your geology station where you'll work on the eruption.

Did you know that there are four types of volcanoes?

- The first is called a shield volcano. This is like Mauna Loa and Mauna Kea in Hawaii. These have non-explosive eruptions because they have large, gentle slopes.
- Another type is called a composite volcano. This is like Mt. Fuji in Japan or Mt. Rainer in Washington. These are steep volcanos formed by layers of lava, ash, and mud and they have very explosive eruptions. They can also erupt from multiple spots.
- Next is a lava dome, this is when a thick, viscous lava pushes up from the vent but doesn't flow very far.
- Finally, there are cinder cones like Paricutin in Mexico. These are small, steep-sided volcanoes that have a single vent at the top.
- Another good term to know is a caldera - this is the depression or hole that is formed when a volcano collapses after an eruption. This is like Crater Lake National Park.

Okay, so given this, you can decide what kind of volcano you want to make - steep sides, long slopes, tall or short. You'll grab one of these flasks and some of our air dry clay and build your volcano.

Note: If using air dry clay, you can premix the colors for the kiddos or let them experiment with the colored clay to come up with the colors they need. You may need to be ready to give ideas on how to create brown if you weren't able to find it. If you are using salt-dough, you can either have it ready for them to use or let them mix it themselves. You can use food coloring to dye the dough the colors they want, just make sure to use gloves so you don't stain your hands. The clay does not need to be fully dry for the explosions to work.

Volcano Eruption

Earlier today you built your volcanos and now we are going to erupt them! In order to make an eruption, we're going to revisit something you did yesterday but change up the ingredients. Does anyone remember what two items you combined to make the bath bombs fizz? (citric acid and baking soda) We're going to use the same base, baking soda, but combine it with a new acid, vinegar. To make it a bit more fun, we're also going to add some clear dish soap and food coloring, because what fun is lava if it isn't red? So our first step is to combine our baking soda, dish soap and food coloring until it looks kind of like wet sand. Then we'll put that in the bottom of our volcano. Once we are ready (and our volcano is safely on a tray) we'll add our vinegar, fast, but not so fast that it doesn't go in the jar and make the reaction.

Did you notice that the volcano didn't explode right away? That's because the pressure (or in the case of our volcano, the bubbles) had to build up before the reached the surface.

How might we change the reaction? (Let them change the ratios and make another reaction!)

Once we've finished our reactions, we're going to dump all of the liquid out of our volcanoes carefully so you can take your volcano home today and do this experiment again.

PRO TiP:

Build the volcanoes on a disposable pie tin so they are easy to transport home at the end of the day. Use a piece of tape to label the tins with the campers names and put near the pick up area so they can be easily retrieved. We also recommend putting a note with them (or by them) so parents know how much baking soda and vinegar to use.

DEMONSTRATION/EXPANSION

Elephant Toothpaste

Today, we're going to have a demonstration that you've probably seen on television called elephants toothpaste. You are going to help me get everything ready, but then I'm going to ask you to step back because the chemicals once combined can cause burns or issues with your eyes. That's why I'm going to wear gloves, an apron, and eye protection, In science, safety is always first.

Please note: the ratios here are based on a 1000 Erlenmeyer Flask. If you are using a bigger or smaller container, please practice, and scale your ingredients.

1. Get a small beaker or measuring cup.
    a. Put 4 teaspoons of potassium iodide crystals in the beaker.
    b. Add 100 ml of water.
    c. Stir to dissolve.
2. Place your flask on a flat surface (we recommend doing this outside for easier clean up).
    a. Pour in 300 ml of hydrogen peroxide.
    b. Add food coloring - if you want to get fancy, you can try using a gel food coloring and have it stick to the sides of the bottle to create stripes during the explosion.
    c. Add 3 tablespoons of clear dish soap into the bottle - swirl it around carefully to combine.
3. Now, stir your potassium iodide one more time, then pour it quickly into your flask and step back!

Variations:

Option One - Safe and Easy to Find Ingredients:
You can do this same experiment using yeast and hydrogen peroxide that you can get at the store. This is very safe and campers can do it themselves. It will not have as big of a reaction but it is still really fun. You can use this as an opportunity to teach the scientific method. Simply change the type of peroxide you are using and measure the results each time. You can also have them change the amounts of the reactants and dish soap to see if they get different results. Again, if you are having students work with the materials, make sure they have gloves and safety goggles and an apron to protect their clothing.

Option Two - Compare Reactions:
The only thing better about eruptions is having more of them! A great way to show the scientific method is to tell the campers you're going to change one variable in the experiment to see which has the biggest eruption. You can change the flask size, the amount of soap, or you can use three types of hydrogen peroxide: 3% (found at drug stores), 40% (found at beauty supply stories, but be sure to get clear not creme), and 50% (from the supplier found in the directors guide).

One last idea - this is a fun one that is totally safe but very sticky. You can create the same explosion using dark soda and mentos. Simply drop 7 mentos into a room temperature two liter bottle of dark soda and watch it explode! We tested this with a clear soda, orange soda, ginger ale, diet and regular cola to see which had the best reaction. The darker the cola the bigger the reaction. Diet didn't really change the reaction but it did make for a less sticky clean up.

PRO TiP:
We spent an entire morning perfecting our elephant toothpaste until it was Middle Schooler approved. We noticed two things with this ratio: the exothermic reaction was visible - there was steam rising from the foam, so it was easy to see that it got warm. One of our gloved testers moved the foam off of the flask mid-eruption (orange foam) and then it created the cool tubes like toothpaste, and you can see how much foam was on the ground from the first part of the reaction!

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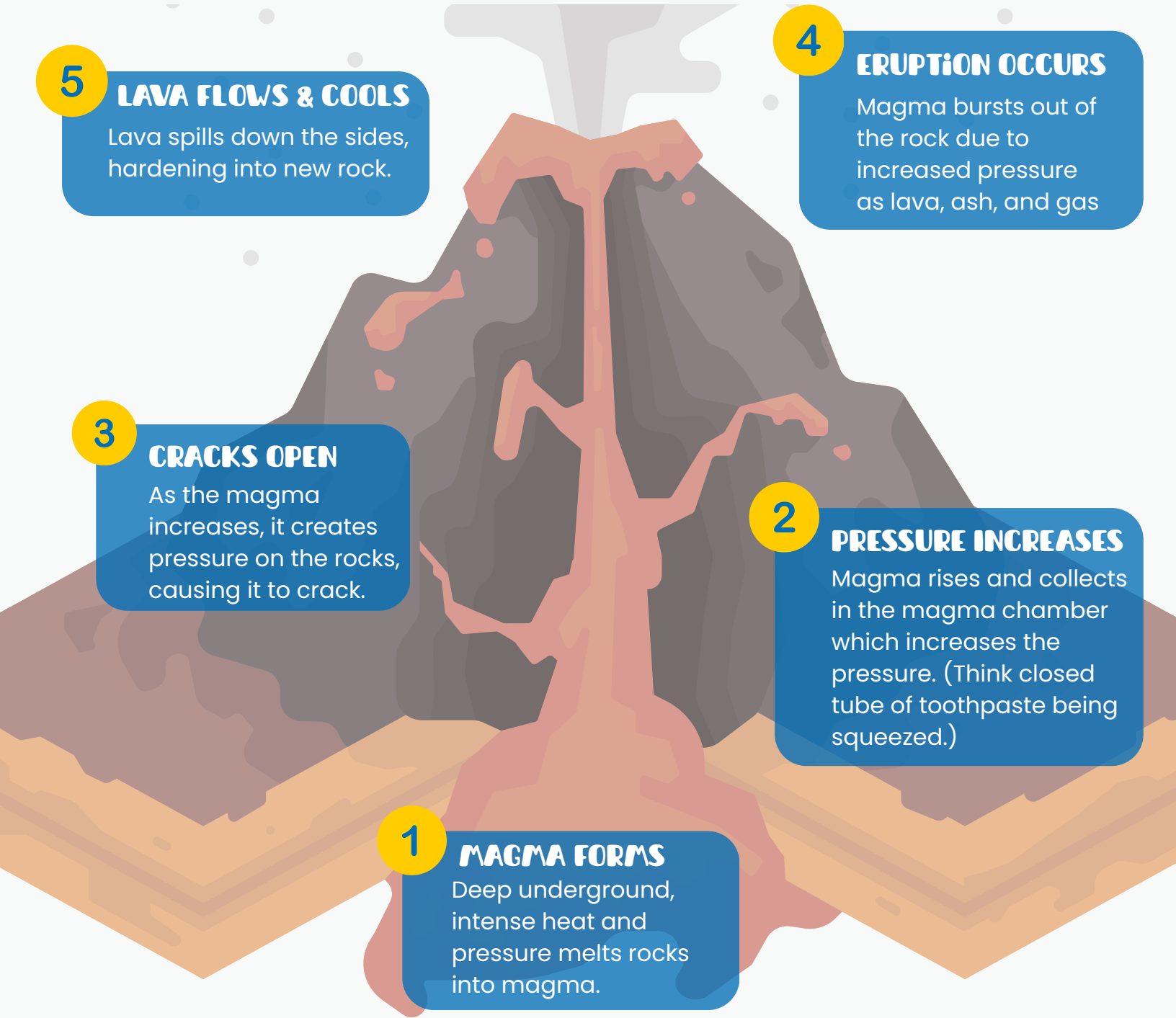
HOW A VOLCANO ERUPTS

NOTE: MAGMA AND LAVA ARE THE SAME THING!
LAVA IS WHEN MAGMA IS ABOVE GROUND, MAGMA IS LIQUID ROCK FOUND BELOW GROUND.



1. **MAGMA FORMS**
   Deep underground, intense heat and pressure melts rocks into magma.
2. **PRESSURE INCREASES**
   Magma rises and collects in the magma chamber which increases the pressure. (Think closed tube of toothpaste being squeezed.)
3. **CRACKS OPEN**
   As the magma increases, it creates pressure on the rocks, causing it to crack.
4. **ERUPTION OCCURS**
   Magma bursts out of the rock due to increased pressure as lava, ash, and gas
5. **LAVA FLOWS & COOLS**
   Lava spills down the sides, hardening into new rock.

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VOLCANO TYPES

1 **SHIELD VOLCANO**

Large, broad volcano with gentle slopes

2 **COMPOSITE VOLCANO**

Steep-sided, Symmetrical cone - can have multiple vents

3 **LAVA DOME**

Formed when lava pushes up but doesn't flow far

4 **CINDER CONE**

Small, steep-sided volcano constructed from loose fragments

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DAY FOUR: EROSION & WEATHERING

Today we are going to talk about weathering. Our overall theme is about how we are changed by being in relationship with one another, so what better way to show that then by looking at how rocks get weathered. We're going to do two experiments - the first takes a little waiting so we've added in a second to fill the time. We're going to create a rainbow using skittles and water. Then while they wait on that experiment to happen, we're going to see how erosion works - in a much speedier way then waiting to see it happen - by using sugar cubes and some small rocks to see what happens to the sugar when it all gets tossed together. If you want to have some examples on hand - sea glass or river rocks make great visual aids.

SUPPLIES

You will need for the first experiment:

- one white plate (needs to be water-resistant but can be disposable) per two student
- Skittles of various colors (about 50 per camper)
- room temperature water

You will need for the second experiment:

- jar (this is a great chance to upcycle jars! This just needs to be a clean jar with a lid - one per camper and then use the jar for the egg geodes tomorrow)
- a handful of small pieces of gravel
- 5 sugar cubes per students

Note: the jar and gravel can be used over and over again, you'll only need new sugar cubes each time.

Other Options?

Depending on where you live, this is a great chance to talk about what erosion looks like where you live. So if you live at the ocean you can talk about waves, if you live in a farming community, you can talk about soil erosion, for example. There are great experiments online to help you demonstrate what erosion looks like where you are and when and why we want to avoid causing it.

Note: No scaffold is offered because this is great for all ages!

EXPANSION

You can set up three "ecosystems" to see how different types of ground cover can help stop soil erosion. Begin by cutting the side off of three water bottles (so it can lay on its' side with the top operating as a spout above the surface). Fill one bottle about halfway with soil. The second bottle should have the same amount of dirt, but put mulch or leaves on top. Finally, the third bottle should have plants growing in it (you can use chia for a fast growing option).

You'll want to have a clear container under the mouth of each bottle to catch water. See above photo for an example.

First, pour water over the soil to recreate a hard rain. What do you see in the water? Do this again with the other two, which one kept the most soil from escaping the bottle?

PRO TIP:

Worried about damp air? You can swap the weathering activity with the egg geodes to give them more time to form crystals, you'll just need extra jars!

TEACHING ABOUT CHANGES, WEATHERING, AND EROSION

Erosion vs. Weathering

Today we are talking about how we can be changed by all sorts of things, especially how our communities change us. You're probably wondering what this has to do with science, but today's theme has a lot to do with how the world works. Communities, in nature, are called ecosystems, and when something new comes to an ecosystem, it changes to adapt to the new presence or to try to get rid of it if it is harmful. We're going to learn about this in terms of erosion. Does anyone know what the word erosion means? Erosion is the geological process where soil, rocks, and sediment are transported by water, wind, or ice. How about weathering? Weathering is the geological process where soil, rocks, and sediment are broken down by water or wind. So weathering and erosion go hand in hand. We're going to look at both of these today because they are strong forces of change in a community or ecosystem.

Skittles Erosion

Our first experiment today is to try to erode the rainbow out of Skittles. You all probably know the line: "Skittles: Taste the Rainbow" right? Well today, we're going to see the rainbow. I want you to work in pairs. I'm going to give you each a plate and some skittles, your job is to line them up with whatever color pattern you like around the outside rim of the plate. Remember, you may not agree, but we can work together to solve the conflict. We'll wait for everyone to finish before moving on so take your time and feel free to trade skittles to get the color you want. You can eat any extras, but first make sure you get all the way around the edge!

Now that everyone has their rainbow ready, we're going to bring you water that you can pour gently into the middle of your plate. You'll pour until the water touches your Skittles but not so much that they float away. Once we've finished that, we're going to work on another activity but keep an eye out on your Skittles and let me know if you see anything happening. Be ready for folks to shout when they see their rainbow forming! Let them know that we'll come back to it shortly but to keep watching!

Okay - back to our Skittles! What do you see? While we waited, the water eroded the color off of the skittles and formed it into a rainbow of water! What can you tell me about it? Why do you think it worked like this? The answer is a bit complicated but it is due to the rate the dye and sugar diffused through the water. The highest concentration is by the candy and the least sugar and dye is in the middle which lets it keep the shape it made! This is showing us that even when we don't see it, water is changing the world around us. From shorelines, to eroding rocks.

How Communities are Formed

As the Skittles errode - their color won't quite make it to the middle. This is a chance to talk to the campers about how communities are formed.

Today we are not only talking about sedimentary rocks, but how communities are formed. Our communities are like this plate of skittles. Everyone brings their gifts and then we share them. The more we share, the more beautiful the community becomes. What happens when new people come to our community? (Add 6-8 skittles to the middle of the plates.) Did these Skittles make it more beautiful or less? More, right? Because the color wasn't going to make it to the middle, the new members of our community helped make sure all of the gifts got to everyone that needed them. Sometimes we can be worried that new people will change our community, but change, like we learned earlier this week, isn't always bad. Our communities are formed when we share our gifts and welcome new people into them.

PRO TiP:

The point of this activity is to have campers work together because they are forming a community. The Skittles on the square tray was a huge tray that four campers did together. This process of deciding how to lay out the Skittles is not without conflict. It is okay and developmentally good for them to have conflict and work it out. Do not jump in and stop the conflict, encourage them to work together and work it out.

TEACHING ABOUT CHANGES, WEATHERING, AND EROSION

Sugar Weathering

While we wait on our Skittles to erode, we're going to weather some "rocks". Each of you has a jar - to that jar, you're going to add a handful of gravel (if they have tiny hands, they might need to add two). Now we're going to add our "rocks" - does anyone know what these are? These are sugar cubes! Sugar cubes are just sugar and a bit of water that helps hold the sugar crystals together in a specific shape. Interestingly, this is how rocks are formed! Water helps hold the sediment together until enough pressure creates the rock. (If you want to really get expansive, you can have the kids make sugar cubes!) We're going to add our sugar cubes into the jar with the gravel and then put the lid on tightly. Just like when rocks roll down the hill, or along the bottom of a stream, we're going to shake our jar and let the "rocks" interact with each other. Let everyone shake for a minute or so.

Stop! Now, we're going to open our jar and see what we find. (Make sure they can see what their sugar cube looked like before.) You probably have gravel, sugar, and a much smaller sugar cube, right? This is exactly what happens when rocks get weathered. The water or pressure from other rocks, knocks off their hard edges making them super smooth. (If you have river rock or sea glass, this is a great time to show those to the students!) We can see the effects of weathering over time. Did you know, that the Great Smoky Mountains in Tennessee formed 200-480 million years ago? That's why they are much softer and covered in trees, because they have been weathering a very long time. But if you've seen the Rocky Mountains in Colorado, they are very tall and sharp, that's because they are much younger mountains, they were formed about 80-70 million years ago and haven't weathered as much.

It is really amazing how water and wind can change things - it is hard to see because it takes a long time, but changes are happening all around us.

Notes: More gravel will make this go faster as will using brown sugar cubes vs. white (see below, the cubes on the right were the before sizes and the left is the after). Campers should immediately see a cloud of sugar forming in their jars, the more they shake or the longer, the more they will change the shape of their cube.

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DAY FIVE: EGG GEODES

Today is our last day of camp and we're going to do one of the most popular experiments - make geodes out of borax crystals and egg shells. Today you will need some pre-planning, mostly to get folks to clean and save egg shells for you, because you will need half of an egg shell for each student. Depending on what time of day the campers come, this may be an experiment that they take home with them to finish. Crystals form in 2-3 hours but can take up to 6 hours depending on humidity. With that said, you can always start it on day 4, and then finish up on day 5. (For example, if you started the geodes yesterday, do the weathering activity today.) Another option is to have campers do it first thing in the morning when they arrive and discuss it before the end of the day.

DAY FIVE: MINERALS & GEMS

SUPPLIES

You will need:

- one handout per camper
- wipes for cleaning hands
- jars with lids (we used half pint jars) that can go home with each camper (can be the same jars as day 4, this keeps the egg safe going home, especially if the crystals are still growing)
- 100% pure borax - 3 Tablespoons per camper
- boiling water/electric water kettle (about 1 cup per camper)
- food coloring
- one half of an eggshell for each camper - cleaned and prepared (see directors guide for directions)
- white glue (one bottle)
- paint brush (one)
- one spoon per camper for mixing

EXPANSION

This is a fun one to expand because you can use the same principles with different objects. The easiest way is to give the students chenille sticks to bend into letters or shapes, then using a craft stick, suspend it in the jar of the borax solution. The crystals will grow on the fuzz of the chenille stick and make a very fun hanging. The color of the chenille stick will show through the crystal so campers can decide if they want to color the solution or not.

Campers can also find objects in nature to use - we love the look of a pine cone with white borax crystals, for example.

SCAFFOLD

For younger campers, patience is the biggest problem with this activity in addition to being careful with the hot water. With your smallest campers, we suggest having helpers stir the solution until it is clear to prevent burns or not stirring long enough. With some help, they can do this experiment on their own, but it might be good to use the geode coloring sheet for while they are waiting for their solution to be mixed. They can add the food coloring and pour the solution over their shell.

TEACHING ABOUT HIDDEN GLORY

What Makes Geodes So Special?

Today we are finishing up the week talking about all of the ways that each of us is a gift to the world around us, even if we don't see it yet or maybe others don't see it yet. There is a very cool rock that you cracked open earlier in the geology station (or later as the case may be), called a geode. Geodes look like a very basic, boring rock, but when you open it, it has beautiful crystals inside. Just a reminder that geodes are created when pockets of air form inside the rocks. Air pockets can form inside a rock during a volcanic eruption when lava cools around a bubble of air. They can also form when organic material trapped inside of a rock dissolves. Once that pocket forms inside the rock, groundwater, which is filled with different minerals, seep through the rock and the air pocket. As the water escapes, minerals found in the water remain. These minerals (ex. quartz, iron, titanium, nickel, chromium, manganese) over thousands of years form crystals inside the rock. The color of the crystals depends on the mineral that created it. The most common geode contains quartz, which typically has a milky white color.

Making Egg Geodes

Today we are going to make our own geodes using borax crystals. So the first thing we are going to do is make a solution of borax and water. We're going to supersaturate the borax, which means we're going to get as many of the borax crystals into the water as possible, so we're going to heat up the water which let's us do that. I need each of you to carefully measure 3 tablespoons of borax into your mixing cup. An adult will come by and bring you hot water (about 1 cup) from the kettle. Be very careful, this water is hot, so stir carefully. Your job is to mix the borax until the water is completely clear again. This takes some time, so be patient! Once your water is clear, you can raise your hand and we'll bring you food coloring that you can add to make the color of your geode if you want it. When we add the food coloring, mix it again and make sure it is all combined. While you are stirring, we're going to give each of you a jar with your name on it that has an eggshell inside. Be careful because it is very fragile! You'll carefully pour your finished solution over the eggshell and it will be ready for you to pick it up at the end of the day. (Or tomorrow if using two days.)

Handout

You'll each get a handout today because this is an experiment that you'll take home with you. You can remove your geode when you get home and see the crystals, but then you can heat up the jar and liquid in the microwave and give it a good stir, and make crystals on other things so the handout will help you keep experimenting after camp is over!

PRO TiP:

If doing the geodes on day 4, just use the text in the middle of this page "making egg geodes" then you can come back to it on day 5 and add in the Skittles or the weathering activity.

PRO TiP:

Kids aren't great at measuring, that's okay! As long as they get 3 TBSP into the jar they're fine. They can be heaping, they can be a bit less, it doesn't need to be perfect. In the egg shown here, the kiddo accidentally put 4 scoops. It did get stuck to the jar, but it turned out great and in just a few hours.

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EGG GEODES

What did we learn about today?

Today our students participated in an experiment where they grew crystals inside an egg shell to learn the following scientific concepts:

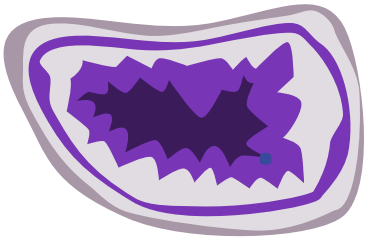
1. **Supersaturation:** students created a solution of borax (3 tbsp) and hot water (1 cup). By heating up the water, we were able to dissolve more minerals then we could have with room temperature water, thus making it supersaturated. As the water cools and evaporates, the mineral (borax) we added to the water needs to go somewhere.
2. **Precipitation:** when the mineral can no longer remain dissolved in the supersaturated liquid, it precipitates! Just like a cloud that is filled with water molecules, minerals will "fall" out of the liquid and form on a host site.
3. **Host:** we learned that our minerals need somewhere to go when the water cools, and this is our "host". In this case, we needed to help make a rough surface so the minerals have something to attach to, so our eggshells were first treated with white glue and a coating of borax.
4. **Minerals:** are a naturally occurring, inorganic solid with a characteristic chemical composition and a defined, ordered internal structure. We talked about how we might see some of these minerals from our drinking water on shower heads and faucets.

The crystals inside the egg shell should not be eaten and we recommend washing hands after touching the crystals.

WHAT IS BORAX?

Borax is a mineral found naturally in dry lake beds. It's typically used for cleaning and should not be eaten. Borax is white, so to make our geodes colorful, we've added food coloring to our experiment.

$NA_2B_4O_7 10H_2O$



WHAT ARE GEODES?

Geodes are rocks filled with crystals. Geodes are created when pockets of air form inside the rocks. How does air get inside a rock? Great question! Air pockets can form inside a rock during a volcanic eruption when lava cools around a bubble of air. They can also form when organic material trapped inside of a rock dissolves. Once that pocket forms inside the rock, groundwater, which is filled with different minerals, seep through the rock and fills that air pocket. As the water escapes, minerals found in the water remain. These minerals (ex. quartz, iron, titanium, nickel, chromium, manganese) over thousands of years form crystals inside the rock. The color of the crystals depends on the mineral that created it. The most common geode contains quartz, which typically has a milky white color.

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DRAW IT!

GEODES ROCK!

What does your geode look like?

KEEP EXPERIMENTING!

Want to try this at home?
Another way to do this is to bend a pipe cleaner into any shape you want as long as it is small enough to fit into your jar and not touch the sides.

Use a piece of string or wire to attach the pipe cleaner to a straw (or stick). You'll use the straw to suspend the pipe cleaner inside a heat-proof jar, so make sure it is long enough to cross the mouth of the jar.

Put 3 tablespoons of borax and 1 cup of boiling water into the jar. Stir until clear. You can add food coloring once it is clear.

Suspend the pipe cleaner in the jar and leave overnight. In the morning, pull out the pipe cleaner and you'll find it's now covered in crystals!

You can also do this with pinecones for a wintery decoration!

WANT TO LEARN MORE?

Want to try more experiments with growing crystals or learn more about geodes? There's a book for that!

Animated Science's *Rocks and Minerals* is a great introduction for elementary aged scientists into the wonderful world of geology.

The Street Beneath my Feet by Charlotte Guillain and Yuval Zommer is a great picture book exploring geology.

This experiment is from the book: *Stay Curious and Keep Exploring: Next Level* by Emily Calandrelli. Where you can find lots of experiments to try at home.