Welcome to Science C!

In this program, your students will build model landforms, observe microwave patterns, explore how much animals survive and adapt, provide nutrients to plants, and so much more.

The 36 experiments in this program will introduce your students to Matter, Ecosystems, Earth Systems, and Engineering Design. They are designed to teach your students to think like scientists and use real scientific skills and practices.

What do Students Need to Know?

In the past, science instruction focused on teaching students what we already knew about science. However, as technological growth and development exploded in recent years, we realized that simply teaching students what we know now isn't sufficient—it doesn't adequately prepare them for the future. The technology and scientific developments our students will use when they are adults haven't been invented yet. So how do we prepare them for what they will need to know when it is still unknown to us?

Instead of teaching facts and knowledge, our instructional focus needs to shift. In addition to exposure to familiar science topics, such as Physical Science, Life Science, and Earth and Space Science, today's students also need skills, and scientific practices, that will help them find out what they need to know on their own. They need to become innovators and developers and not just passive consumers of scientific knowledge. By the time your students are ready for further education or to enter the workforce, they need to know how to investigate purposefully, build models, ask useful questions, and be able to report their findings so they can share what they learn with others. They should also be able to develop creative solutions to problems, and build and test their designs to determine how well they work. Once tested, they should be able to improve their designs so they can develop an even better solution. The lessons required to arrive at this destination will need to be hands-on, interactive, and student-driven. They may be a little noisy, and hopefully not too messy, but certainly an adventure like no other.

Introduction

How This Program Works

Through this program, your students will use the Scientific Method to explore their world, not just memorize the steps. Your students will brainstorm solutions to problems, and have space to come up with ways to test them with you. Together, we will begin to prepare them to think for themselves, weigh the claims they encounter around them, and innovate on their own. We will also incorporate key Scientific and Engineering Practices to explore ideas that connect across all subjects, like cause and effect, patterns, structure and function, systems, stability and change, cycles, and more.

In addition to practicing the Scientific Method, you will also begin to teach the process of Engineering Design, in which students investigate a problem they can be solve through design. Some lessons will present a challenge or problem which will require your students to design (and build!) a solution, and then they will test their solution's effectiveness in solving the problem. From there, they may also apply what they learned from their tests toward designing an improved solution.

Science C will serve as your roadmap for this year's experiment instruction. We have chosen easy experiments that will fascinate your students and help them begin to develop key scientific skills through exploration. Before you start teaching, take a few minutes to familiarize yourself with this book and the structure of each experiment.

Each lesson begins with an overview of the **Key Concepts**, intended to give you, the instructor, a big-picture view of the goals of the lesson. By the end of the experiment and discussion, your students should have a solid understanding of the lesson's Takeaways (which mirror the Key Concepts), so you know they have mastered the important information. And since each lesson is truly an exploration, your students will often delve into elements of several different scientific disciplines in a single day.

Introduction

Let's Get Started

To help you teach with confidence, we recommend you read through each experiment the night before. You may also use this time to gather the supplies noted on the **Materials List** from around your house, the Science Supplies Kit, or the Paper Packet. A few of the experiments require some early preparation, which we'll warn you about in a **Before You Begin** note at the start of the experiment. Be sure to check the next experiment for this note when you wrap up an experiment so you will be fully prepared to teach the next lesson when you intend to.

When you have gathered the supplies and are ready to teach, head to the experiment's **Introduction** and simply start reading to your students. Our provided instruction helps you pique your students' curiosity about each day's topic, and will challenge them to **Make a Prediction** about what they will experience in the experiment. The **Investigate** section offers step-by-step procedures that walk you through the experiment itself, and includes discussion information to help you explain what's happening along the way. Use the questions under **Draw Conclusions** to bring the concepts and observations together, and close with the thoughts under **Takeaway**.

As you have time, enjoy the information under **See the Bigger Picture** which illustrates how the scientific principles discussed in the lesson apply to the world at large. Also, be sure to check out the **Make Connections** section as you work to add more depth and extend conversation about the experiment's topic. We also include **Tips** to help you know what to expect and complete the investigations with as few bumps as possible. If your students still want more, try out the suggestions under **Go Further** for related activities that will help you extend the exploration.

Plan for your students to take an active role in setting up the experiment and completing the steps (with your help, of course). Give them room to be curious and ask questions. If we don't address something that comes up as you work by the end of the experiment, make a note to help them find the answer later. The more you can support their curiosity and inquisitiveness, the better you will teach them to think like a scientist. And don't forget—they can help you clean up, too!

Introduction

Materials

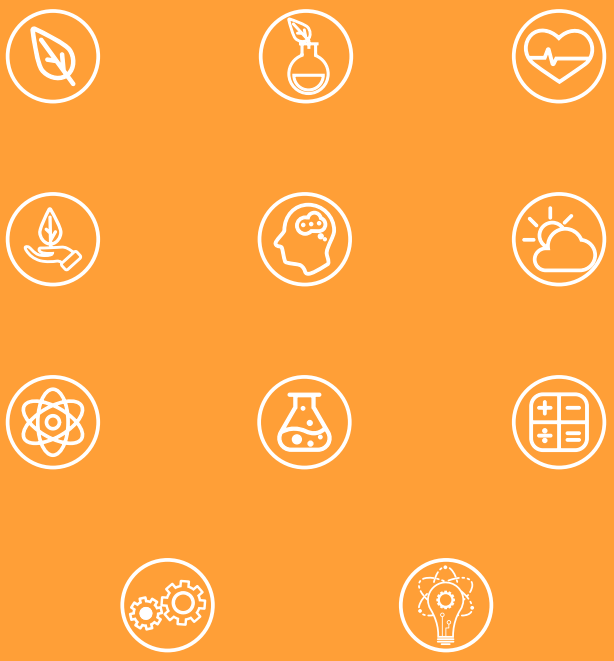
While you will find some experiment supplies around your home, we have collected a number of materials for your convenience in our **Science Supplies Kit**, listed with a K in the Materials List. The data charts and templates, listed with a P, follow each experiment and are also included in the **Paper Packet**.

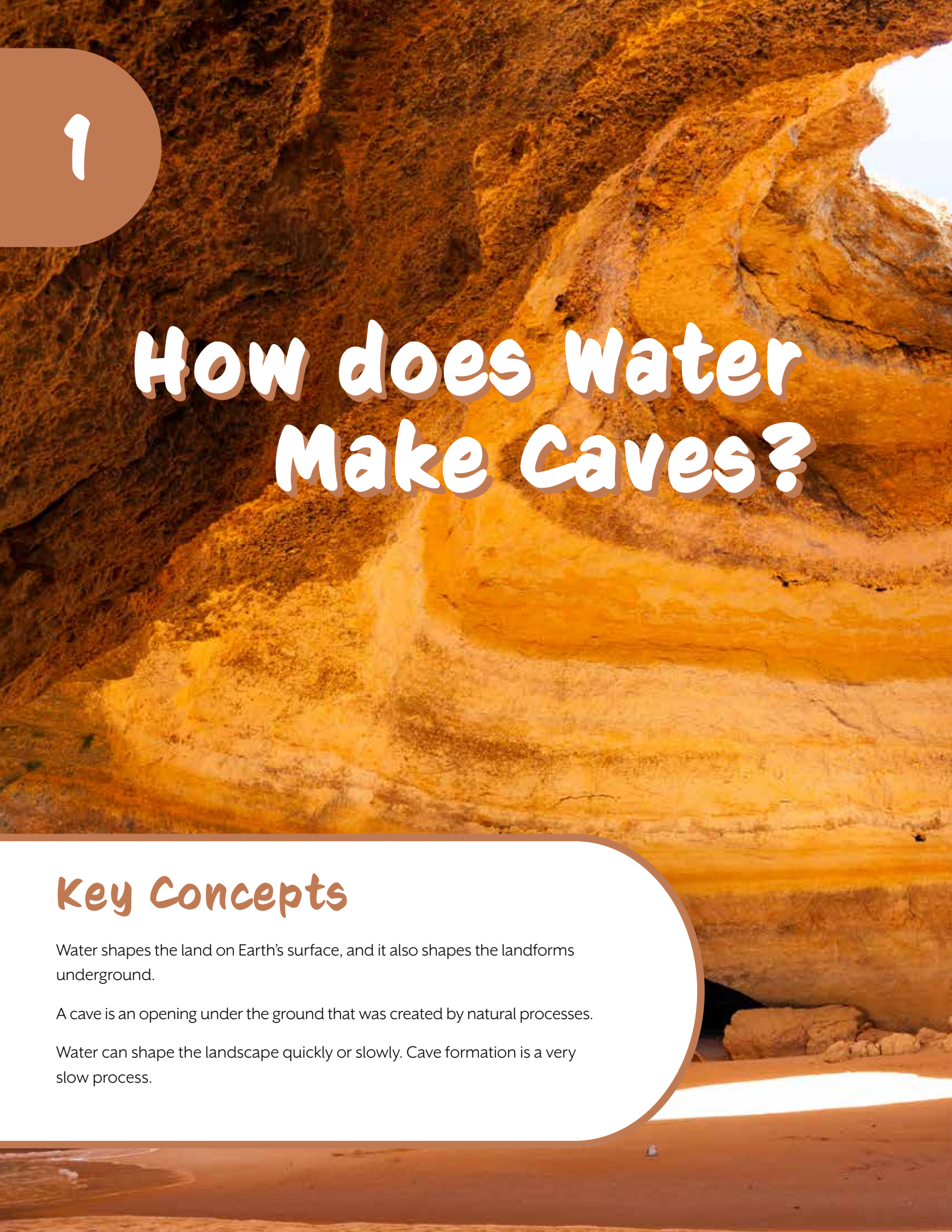
The **Appendix** of this book includes a list of items in the Science Supplies Kit, a list of charts and templates in the Paper Packet, as well as a complete list of the supplies you will need to provide yourself. Start collecting those items now so they will be ready when you need them.

You are Ready to Begin!

We can't wait for you to start this grand adventure with your students, helping them to explore their world while learning to think like scientists and design like engineers. Through this journey, you will prepare them to be an active part of a future that we can't even imagine today.

Experiments





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How does Water Make Caves?

Key Concepts

Water shapes the land on Earth's surface, and it also shapes the landforms underground.

A cave is an opening under the ground that was created by natural processes.

Water can shape the landscape quickly or slowly. Cave formation is a very slow process.

Materials

- 1 cup clay (any color) K
- 2 sugar cubes K
- 1 toothpick K
- small plastic container about 2" high
- dinner plate or aluminum pie tin
- water (warm, not hot)
- pitcher, glass, or measuring cup with spout
- towels
- plastic knife or butter knife
- flashlight
- How does Water Make Caves? Observation Sheet P

Introduction

Most caves are formed when a type of rock, called limestone, dissolves underground. Limestone is a soft rock found underground. Water flows over small cracks in the limestone. It dissolves some of the limestone and makes the cracks bigger. Over a long period of time, the cracks become large enough for people to go inside and are called caves.

Caves form in other ways, too. Ocean waves sometimes form sea caves when they wear away the rock over a long period of time. Volcanoes and earthquakes can form caves quickly. Not all caves are made of rock. Glaciers can form ice caves. As water melts on the top of the glacier, the water flows into cracks and then carves out caves under the ice.

In this activity, you will model the formation of a solution cave. Whenever solid particles dissolve into a liquid, the liquid is called a **solution**. For example if you mix salt into water, the salt particles dissolve into the water and become part of the liquid. The same thing can happen with types of rocks and rain water or ocean water. Solution caves are common in locations where limestone is buried beneath the soil. When it rains, water seeps through the soil. The rainwater absorbs carbon dioxide in the ground and forms a weak acid. The acid in the water dissolves the limestone very slowly over time. You will use sugar cubes to represent limestone in this activity.

Make a Prediction

How does acidic water change limestone to form a cave?

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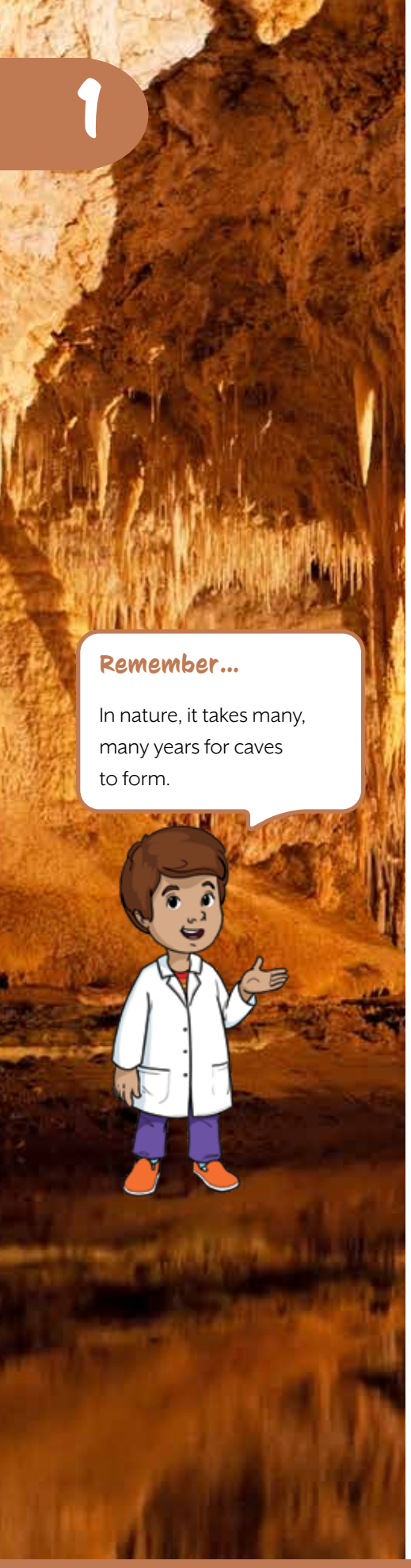
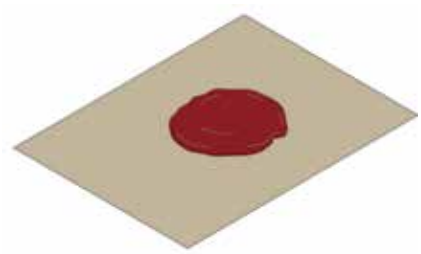


Remember...

In nature, it takes many, many years for caves to form.

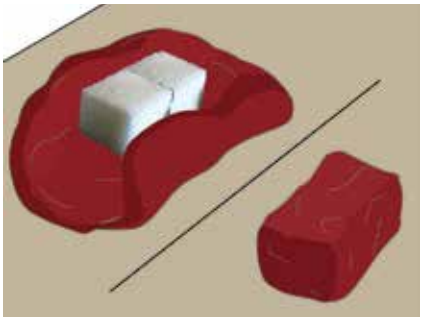
Investigate

1. Press the clay in a flat, oblong or rectangular shape approximately 4"x3" in size.



2. Place two sugar cubes end-to-end in the center of the clay. Make sure the sugar cubes touch each other.

3. Wrap the edges of the clay around the sugar cubes, forming a box shape.



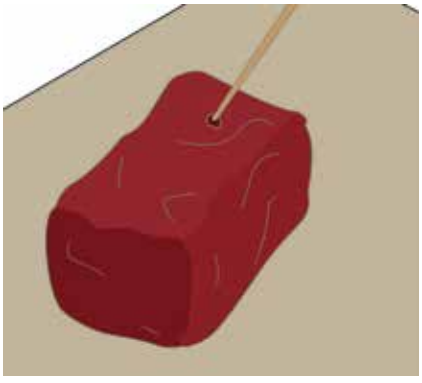
4. Pinch and smooth the edges of the clay together so that the sugar cubes are completely sealed inside the clay.

The sugar cubes represent limestone buried underground. The clay is the rock that surrounds the limestone.

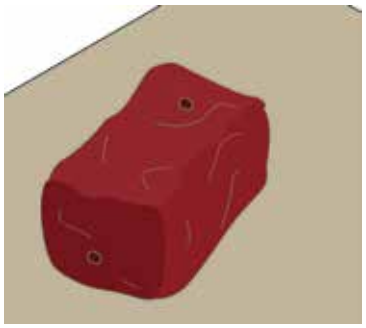
Next, cracks start to form in the ground.

5. Use a toothpick to make a hole in the top of the clay box, above the sugar cubes. Carefully push the toothpick in until you can feel the sugar cubes.

6. Pivot your toothpick around to make the hole about 2-3 millimeters wide.

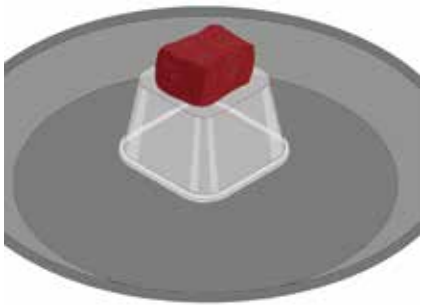


7. Use the toothpick to make a second hold on one side of the clay box. Carefully push in until you can feel the sugar cubes. Make the hole about 2-3 millimeters wide.



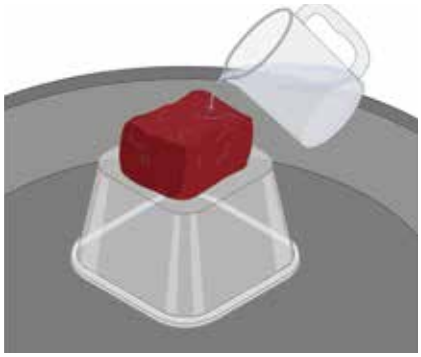
What do the holes in the clay represent? (Cracks in the limestone.)

8. Near a sink, place a plastic container upside down in the center of the dinner plate or aluminum pie pan. Place the clay block on top of the plastic container.



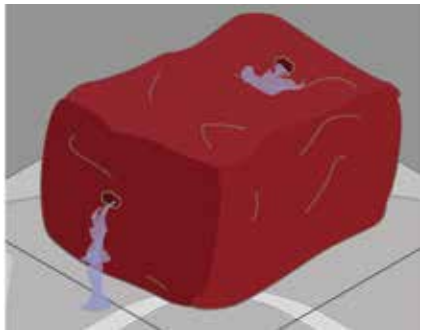
9. Carefully pour warm (not hot) water into the top hole in your limestone.

Tip: It might be easier to use a measuring cup with a pour spout.

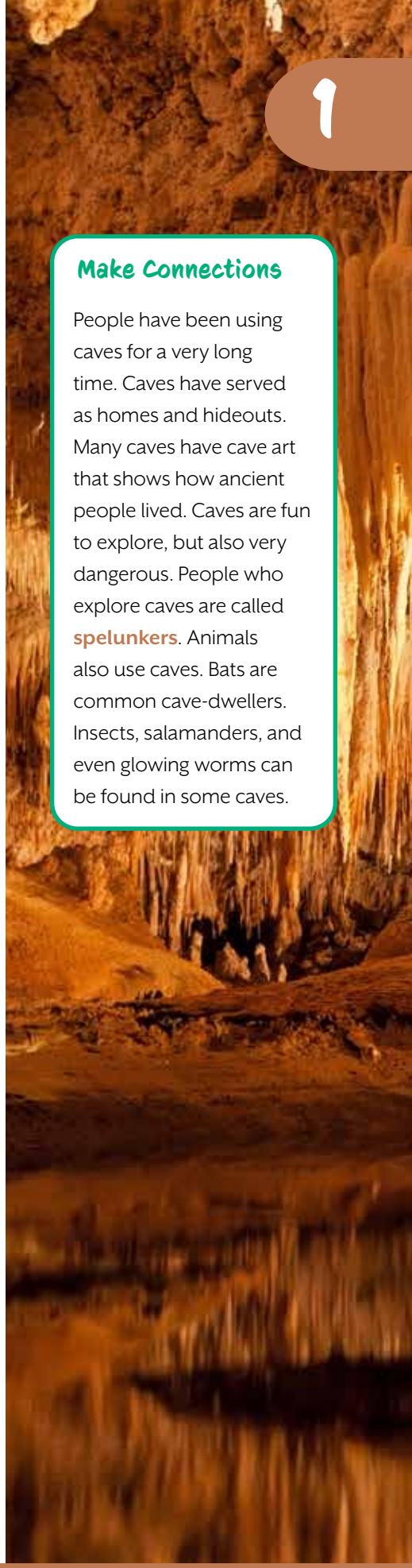


10. Some water will overflow, and some will go into the hole. Be patient, it will take some time for the water to come out the second hole.

Tip: If water does not appear to be flowing out the second hole, use the toothpick to make the holes a little bigger or to break apart the sugar cubes.



11. On the **How does Water Make Caves? Observation Sheet**, draw what you observe.



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Make Connections

People have been using caves for a very long time. Caves have served as homes and hideouts. Many caves have cave art that shows how ancient people lived. Caves are fun to explore, but also very dangerous. People who explore caves are called **spelunkers**. Animals also use caves. Bats are common cave-dwellers. Insects, salamanders, and even glowing worms can be found in some caves.

1

Make Connections

After caves form, water continues to drip into the cave. The minerals in the water form deposits that can make large formations. The formations hang from the ceiling of the cave (**stalactites**), like icicles. Formations called **stalagmites** can point up from the floor. Stalagmites usually form under stalactites.

What happens to the water? (It goes in the hole at the top and starts coming out of the hole at the side.)

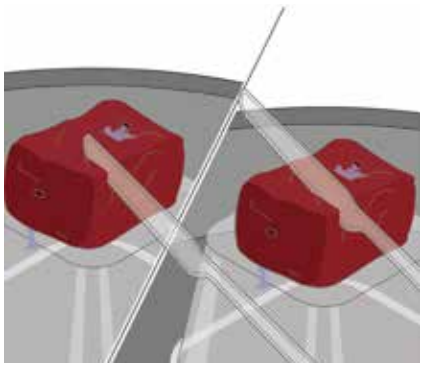
Remember, our cup of water represents acidic water.

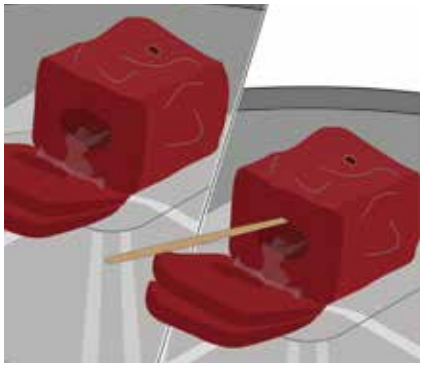
What do you think the water is doing inside the clay? (Possible: It seeps through the sugar; dissolves the sugar.)

12. Slowly pour the water through the clay holes for 1-2 minutes, emptying the dish and refilling your measuring cup as needed.

13. Use a plastic knife or butter knife to cut the end of the clay with the hole. Cut with a sawing motion for best results.

14. If necessary, use the toothpick to gently make the cave bigger and bigger so you can easily see all the way inside.





15. Use the flashlight to peer inside. Draw a picture of what you see on the Observation Sheet to complete your second observation. (Possible: A hole, space or cave. Some left over sugar.)

Draw Conclusions

In your model, the clay represents rocks in the ground and the sugar cubes are limestone. The cup of water represents acid water that seeps into cracks in the rocks.

What happened to the sugar cubes as water entered the clay? (The sugar cubes dissolved.)

What happens to limestone when acidic water seeps into the ground? (The water dissolved the limestone. Over time, caves form.)

Takeaway

In this activity, you made a model of a cave formation. In the model, the clay was used to represent rocks underground. Small cracks form in the rocks. You pretended to form small cracks with the toothpick. The cracks allowed the water to enter the rock and dissolve the "limestone" sugar cubes. Over time, which was just a few minutes in this activity, the sugar cube limestone dissolved, leaving a large opening in the rock. The large opening is the cave.

Go Further

To see what happens to the sugar when the water touches it, put a small amount of sugar in a bowl and pour water onto it. How does the sugar change? Did it disappear altogether? Taste the water to find out! (Remember, the sugar dissolves into the water to make what chemists call a **solution**.)

Use a small piece of limestone (sometimes available from a garden center, hardware store, or a landscaping business). Put the limestone in a cup and pour vinegar on top. Leave the limestone in the vinegar for several days and observe the changes that occur.

Many caves are open to the public for touring. Find a cave near your home or plan a vacation near a cave. Schedule a tour to learn more about the structures inside the cave and to hear the history of how the cave was used.

See the Bigger Picture

Water shapes earth in a process called **weathering**. We can observe clues that weathering has taken place. For example, rocks in streams are smooth from the flow of water over a long period of time. Water also shapes parts of Earth we cannot see. Underground, caves form as water enters cracks in rocks and eventually dissolves soft rocks like limestone. Cave formation through weathering is a very slow process. Scientists believe the Sudwala Caves in South Africa formed 240 million years ago.

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How does Water Make Caves?

Observation Sheet

Observation 1: After you pour water on the clay, draw what happens to the water, or describe to a grown-up what you see so they can write it below.

Observation 2: After you open the block of clay, draw another picture of what you see.

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