Introduction

Welcome to BookShark's Science A!

Throughout this book, you will dig ant tunnels, move like snakes, try to catch the wind, build boats, find out what makes things move, and so much more.

The 36 experiments in this program will introduce your students to Ecosystems, Meteorology, Physics 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.

And yes, get ready: we will start this fantastic journey together in Science A.

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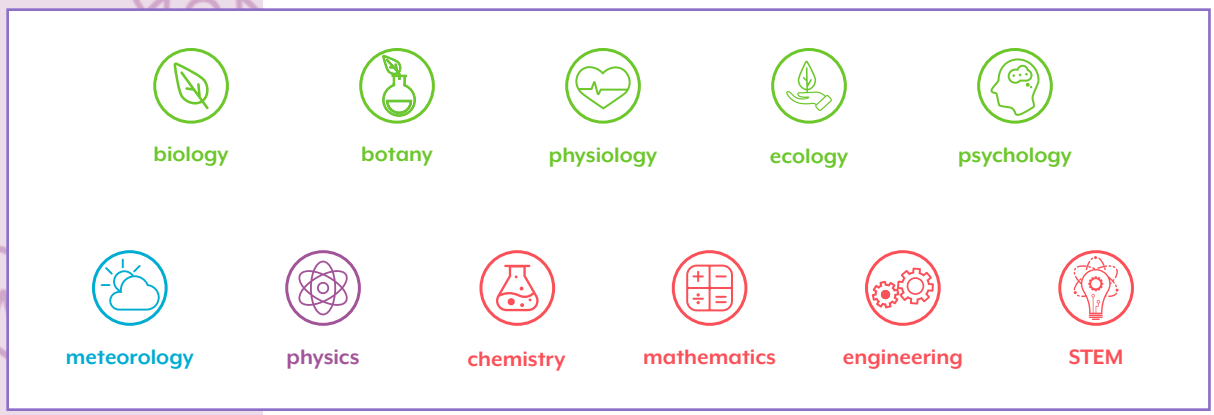
How This Program Works

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.

This book 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. You can quickly see which topics you will cover in the icons provided on the Introduction page for each experiment:



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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. While you will find some experiment supplies around your home, we have collected a number of materials for your convenience in our Supplies Kit (listed with a K on the Materials List). You can also find a sample of some printed components (like data charts or templates) immediately after each experiment, listed with a P. You can also find a copy in the **Paper Packet**.

We include a complete list of the supplies you will need to provide yourself in the **Appendix**, so you can start collecting those items now so they will be ready when you need them.

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 **Did You Know?** and **Make Connections** comments in the sidebars 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

Supplies Kit

The Discover & Do: Science A Supplies Kit can be purchased online at bookshark.com.

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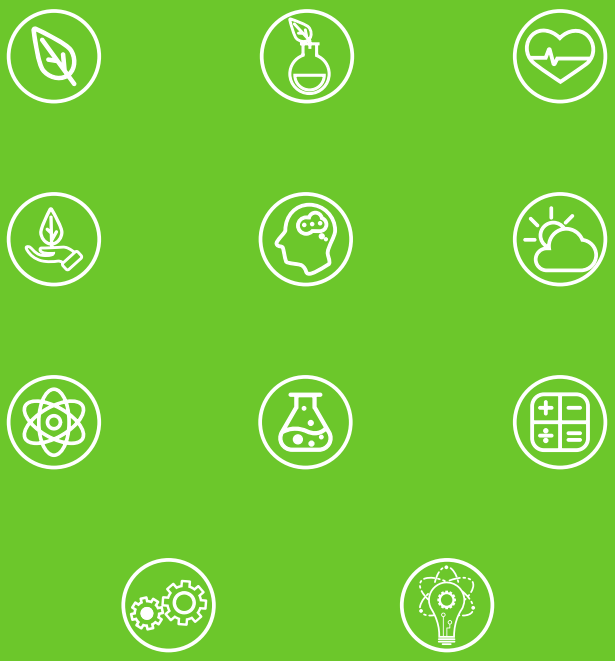
comes up as you work by the end of the experiment, make a note to help them find the answer later. The more you can support their curiosity and inquisitiveness, the better you will teach them to think like a scientist. And don't forget—they can help you clean up, too!

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



1 Why do Ants Build Tunnels?

Key Concepts

Ants, like many animals, need shelter to survive. Shelter provides protection and gives them a safe place to raise their young.

Most ants build nests underground for shelter. They dig tunnels between rooms in their nests to meet their needs: store food, raise young, provide shelter, etc.

To build a tunnel, ants move sand. The sand needs to be damp enough to stick together, otherwise the tunnel will collapse.

Before You Begin

Follow the recipe to make Kinetic Sand located in the **Appendix.**
You can also make it with your children during the experiment.

Materials

- 1 1/4 cup sand K*
- 1 pipe cleaner K
- 1 straw K
- 1 popsicle stick K
- 3/4 cup flour (or cornstarch)
- 1/4 cup cooking oil (vegetable, canola, olive, etc.)
- flat surface, like a cutting board or cookie sheet
- plastic wrap
- 2 books, somewhat heavy
- 1 pencil

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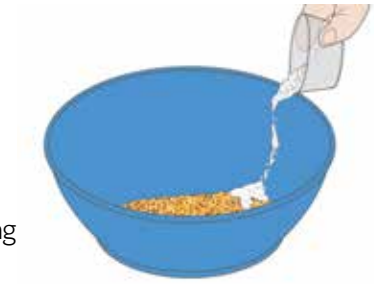
Have you seen an ant hill? The hole at the top is the front door to the ant's underground nest. Ants build nests in the ground for shelter. They dig tunnels to connect the rooms in their nests together. In this experiment we are going to dig and explore the type of tunnel an ant might dig.

What is an Ant Farm?

An ant farm is a special clear-sided box filled with sand. An ant colony can live in it. The box is narrow so you can see the tunnels the ants build down into their nest.

Investigate

Mix Kinetic Sand



1. Add 3/4 cup flour and 1/4 cup cooking oil to 1 1/4 cup sand and mix well.

Build an Ant Farm Window

1. Spread the kinetic sand on a flat surface, like a cutting board or cookie sheet, until it is about 1/8th of an inch thick—about as deep as a ruler lying flat on the table.

* These items can be found in the Discover & Do: Science A Supplies Kit

Did you know?

Ants need semi-damp soil in order to build tunnels so that the sand or earth will stick to itself and the tunnel will stay open. If the soil is completely dry, ants will not tunnel as much.

Tip

For easy clean-up, mix the kinetic sand ingredients in a zipper seal bag, mushing them together with your hands.

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Make Connections

Like a hallway in your house, tunnels in an ant colony connect rooms together too. These hallways are part of the whole ant nest, which works like a system. A **system** is something that has different parts that work together. The tunnels and rooms are two different parts that work together to make an ant home.

Make Connections

The sand needs to move out of the way in order to make a hole for the tunnel. Like your digging tool, ants carry the dirt or sand out of their nests in order to excavate a tunnel.

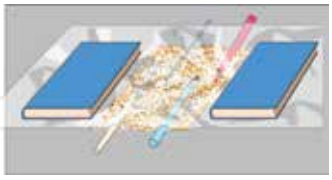
Did you know?

Ants build tunnels that are only slightly wider than their length so if they fall, they can stretch out and catch themselves with their legs and antennae.

2. Lay the plastic wrap on top of the flattened sand with one edge of the sand accessible.

3. On opposite sides of the sand pile, lay the books on top of the plastic wrap to hold it down. If needed, pull the books apart slightly to tighten the wrap against the sand.

4. From the open side, try making tunnels with different digging tools (pencil, pipe cleaner, straw, etc.). Leave the top open so you can see the digging action through the plastic wrap "window."



What did you notice as you were digging your tunnel?
(Possible: Sand fell in the tunnels)

Which was your favorite digging tool? Why? Could you change anything to make it work better?
(Possible: a straw; it collected the sand and allowed for easy removal)

What happened to the sand as you were digging?
(Possible: it needed to be moved out of the way)

Dig a Tunnel in a Mound

The tunnel you've built up to this point is really a channel—which is like a tube without a roof. Real ant tunnels exist underground and have roofs, but are harder to see. We'll build a real tunnel in a moment.

1. Remove the plastic wrap from the sand and reshape the sand into a mound.

2. Dig a tunnel into the mound. Can you make a tunnel that goes all the way through?

3. Try digging a big, wide tunnel in the sand. What happens? How about a tall, narrow tunnel?

Draw Conclusions

Were you able to build a tunnel all the way through the sand?

If your tunnel collapsed, what were you doing when that happened? Why do you think it collapsed?
(Possible: I made it too wide; it lacked support)

Why do tunnels in ant nests help ants survive?
(Possible: they help ants stay safe underground and continue to live and grow)

Takeaway

Why do ants build tunnels? They build nests for shelter. But they need tunnels to move from one part to the next. The tunnels and rooms form a system that makes up the ant hill.

Go Further

Dig a second tunnel to meet a tunnel you already have. Try shining a flashlight into one tunnel and look through the other. Can you see the light? Did you make a system?

Build a network of above-ground tunnels in a kid-sized fort in your house or yard. Can you use large boxes to make tunnels? What rooms would you want in your fort?

Note: When you finish today's experiment, hold on to your bag of kinetic sand. You will use it for another experiment.

See the Bigger Picture

Other animals that dig tunnels in their shelters include rabbits, moles, voles, chipmunks, and rats.

People dig tunnels too. Before they begin to dig, engineers test ground conditions by analyzing soil and rock samples, and drilling test holes. When they're ready, engineers first dig through the ground with a tool like a boring machine.

Then they brace any unstable ground around them while they dig. Finally, crews line the tunnel and add a roadway and lights.

Important: Do not dig bigger tunnels without appropriate bracing. Poorly designed tunnels can collapse!

Did you know?

The sand ants pile above the entrance to their nests helps to get it out of the way, but also helps to soak up the rain before it washes down into their tunnels.