Discover, Experiment, Learn:
7 Hands-On Science Projects

HOME SCIENCE TOOLS®

Bird-Watching Science Projects

Bird watching, or birding, is a fun and interesting way to connect with nature! You can learn a lot about birds just by watching them fly, eat, drink, and bathe. You don't need special equipment to watch birds—just a comfy spot to sit or a window that overlooks a place where birds often visit. A deck may be a good place to start, too. Bird watching near trees or shrubs in your yard is also a good place to watch. Here are some tips (and a few questions) to get you started:

Sit very still when birds land near you. Quick movements might startle them.

Try some of our bird feeder ideas below to attract more birds to your yard.

Some birds like to eat from the ground, so be sure to observe the ground and surrounding trees.

See if you can guess where the birds you spot might live. Do you spot any nests in nearby trees?

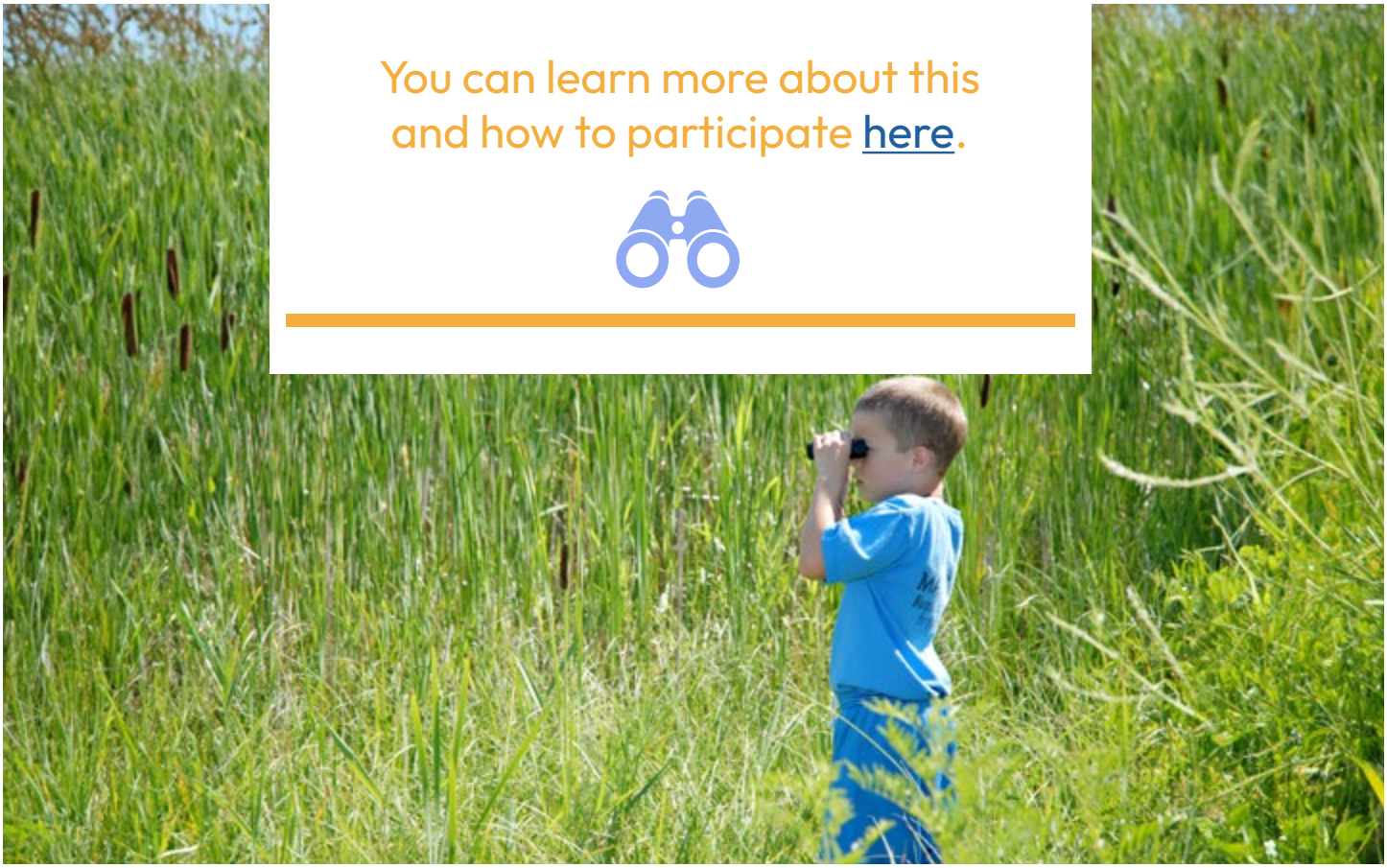
Do different kinds of birds land and eat near one another?

After a few bird watching sessions, you may want to gather some tools to help you discover even more:

- Binoculars –Use a pair to get a better look at birds that are farther away or high up in trees.
- Notebook and colored pencils or crayons – Draw pictures of the birds you see and write a few notes about what you notice them doing.
- Identification guide – Your notes will help you remember what the birds were like so that you can look in an identification guide to learn more about them later.
  This online guide is helpful.

You might be interested in participating in the Great Backyard Bird Count, which begins in February.

You can learn more about this and how to participate here.



Bird Science Projects

Make a Bird Feeder

The easiest way to attract birds to your yard is by supplying them with food. This is especially true during the winter, particularly when snow is on the ground. Different birds enjoy different foods, so try placing several types of feeders in your yard to see which ones attract which birds.

We recommend using black-oil sunflower seeds or millet (which sticks to peanut butter). Note: Purchase these seeds from a pet supply store, as they're different from the black-and-white striped seeds found in grocery stores. This page covers various bird seed types and which ones birds prefer.

Like all animals, birds need food and water to survive. Sometimes, water can be hard to find when it's cold outside. In addition to your bird feeder, you could set out a tray of water. A disposable aluminum pie plate filled with about one inch of fresh water works well. Set the plate outside near your feeder. Placing this plate on a post or ledge of a deck works well, too. You should refill the plate every day, possibly more often, if the temperature is below freezing. Adding small rocks or a twig for the birds to stand on helps the birds keep their feet from getting wet while they drink. Birds will drink the water, of course, but you may also observe them bathing to wash away dirt and parasites. Afterward, they typically preen, grooming their feathers and coating them with protective oil from the preen gland near their tail.

As the weather warms up, you may notice more birds stopping by your feeders. Some of them are likely on their way home after migrating somewhere warmer for the winter. Spring is a great time to watch birds because many begin building nests, laying eggs, and preparing to have babies. You might even get the chance to see baby birds learning to fly for the first time!

Peanut Butter Bird Feeders

The fat and protein in peanut butter provide birds with the extra energy they need during winter, when food is harder to find.

Pinecone Bird Treat

Tie string or yarn to the top of a pinecone to create a hanging loop. Use a knife or spoon to spread peanut butter

all over the pinecone, ensuring it's thick enough to cover the surface and fill in the gaps, but not so thick that it starts to fall off. Once the pinecone is covered, roll it in birdseed, making sure to coat all the peanut butter. Finally, hang your pinecone bird feeder from a tree branch outside.

Bagel Bird Snack

A slightly stale bagel (a couple of days old) works best for this project. Start by threading a string through the hole in the center and tying the ends together to create a loop. Spread peanut butter on one side of the bagel. Then, dip it into birdseed. Carefully flip the bagel and repeat on the other side, ensuring the bagel is fully covered in peanut butter and birdseed. Finally, hang the bagel from a tree branch outside.

Garlands

Ask an adult for help, as you'll need to use a needle. Thread a piece of yarn or string through the eye of a large needle and tie a knot at the opposite end. Carefully string plain popcorn (no butter or salt), fresh cranberries, or Cheerio-type cereal—and feel free to mix them together—onto the string to make a garland. Once your garland is long enough, tie a knot at the end (it might help to tie it around the last piece you strung). Drape the garland over a small tree or shrub or tie the ends together to hang it from a tree branch.

Soda Bottle Feeders

This handy plastic adapter can easily turn an empty soda bottle into a great reusable bird feeder! If you would rather make your own, we recommend trying this project.

Carton Bird Feeder

This feeder is a wonderful way to recycle empty juice or milk containers.

EXPERIMENT 1:
Bird Feeder

Carton Bird Feeder

This feeder is a wonderful way to recycle empty juice or milk containers.

What You Need:

- ☐ An empty paper carton (from milk, a non-dairy beverage, or juice)
- ☐ Scissors
- ☐ A wooden dowel or unsharpened pencil
- ☐ Wire for hanging
- ☐ Cutting patterns
- ☐ Non-toxic acrylic paints
- ☐ Paintbrush

What You Do:

1. Rinse the carton very well. Allow the carton to dry before you start.
2. Use a pen to draw a door shape on opposite sides of the carton, about halfway from the bottom. The door could be any shape you want, such as a circle or oval, or use one of these patterns.
3. Ask an adult to help you cut out the shapes. You should have an identical opening on two opposite sides of the carton.
4. Then, ask an adult to poke two small holes at the top of the carton, big enough for the wire to fit through. Thread the wire through the holes and twist the ends together to make a hanging loop.
5. Mark an "x" at the center about 1/2" below the opening on each side.
6. Ask an adult to cut slits with a sharp knife on each "x." Push the dowel or pencil through one hole and out the other side to make a perch for the birds to sit on.
7. If you would like to paint your bird feeder, take the dowel out first. If the paint doesn't stick very well, you can rub the whole carton with sandpaper to help it stick or wrap it in masking tape before painting. Keep in mind that birds might not want to attract much attention while they are eating (so that squirrels, cats, and other predators won't notice them). So, choose neutral, tree-colored paints.
8. When your bird feeder is dry, push the dowel back through the holes and fill it with birdseed (fill it up to the openings).
9. Find a good spot in your yard and hang the feeder. Note: We suggest at least ten to 15 feet away from windows or any areas with heavy foot traffic, so the birds don't fly away.

Learn More:

If you're interested in learning more about birds, click here to explore bird anatomy, how birds fly, and flightless birds.

Explore air density by creating a simple hot air balloon in this fun science project!

A hot air balloon is made up of three main parts:
1. The envelope (the balloon itself)
2. The basket
3. The fuel source

In this project, we'll show you how to build the envelope using a lightweight trash can liner and fuel your balloon with birthday candles.

EXPERIMENT 2:

Make a Mini Hot Air Balloon

What You Need:

- ☐ Aluminum foil (for the basket)
- ☐ Birthday candles (for the fuel)
- ☐ Scissors
- ☐ Ultra-thin garbage bag (like those lining office trash cans and those that dry cleaners use*)
- ☐ Plastic straws (for the frame)
- ☐ Clear tape
- ☐ Lighter
- ☐ Adult supervision and common sense
- ☐ Plenty of indoor space
- ☐ String (if flying your balloon in a space where it can travel beyond your reach)

*If you're using a dry cleaner's bag, you will need to seal the hole at the top where the hanger goes through.

What You Do:

1. Cut a 4 x 4" square of aluminum foil. This will be your "basket."

2. Use the lighter to melt wax from the bottom end of the candle so it forms a pool about 1" in from the corner of the aluminum foil.

3. Before the wax hardens, press the end of the candle into the melted wax and hold it in place until the candle stands upright on its own. This step may take a few tries.

4. Repeat with the remaining candles, placing them about 1" in from the other three corners. Be gentle with the baskets, as too much movement may cause the candles to come loose. If that happens, simply melt more wax to reattach the candles.

5. Fold the edge of the aluminum foil in 1/4 to 1/2", forming a wall to contain the wax as it burns, so it won't drip outside the basket.

6. Measure the width of your bag's opening and determine how long your straw frame should be. We simply estimated and used trial and error until our frame fit snugly inside the bag's opening.

7. If you're using flexible straws, cut off the bendable part so only the straight section remains.

8. You will need to fasten the straws into two pieces of identical length for the frame. Each of ours had three straws connected together.

Fire Safety: While this project involves birthday candles, always exercise caution when working with open flames. Ensure there are no flammable liquids nearby and have a fire extinguisher or smothering method on hand. Never experiment with fire without adult supervision, especially around young children.

CAUTION

CAUTION

9. To connect the straws, cut a small slit (about 1/4") at the bottom of one straw. Then, insert another straw into the cut end of the first. The slit will make the connection stronger, but secure it with tape for added rigidity, using as little tape as possible.

10. Repeat for the second half of your frame.

11. Find the middle of your straws and tape them together in an "x," using as little tape as possible.

12. Place the "x" frame snugly inside the bag's opening. Secure it in place using as little tape as possible.

13. Staggering the straw frame and the candles (so the candles are not directly above the straws), tape the basket onto the frame with the candle wicks pointing up into the envelope.

14. If you're flying your balloon in an area where it can travel beyond your reach, tie string to the basket, so you can harness it during its flight.

15. Take your hot air balloon to an open, mostly empty room to fly it. While you can try it outside, even on calm days, the breeze may be too much for the balloon to stay afloat. We flew ours in our office lobby.

16. Ask an adult to help you launch the balloon. One person should hold the closed end of the bag up and away from the basket while the other lights the candles. A lighter with a long stem, like an Aim 'n Flame, works best. Continue holding the bag until it fills with air and stands on its own.

17. After a minute or so, it should lift off the ground.

What Happened:

One important property of gas is that it expands when heated and contracts when cooled. This means that when gas is heated, the molecules move faster and spread further apart. As a result, the gas becomes less dense because the molecules are more spread out.

This expanding property of gas is what allows hot air balloons to inflate and fly. The hot air inside the balloon has a lower density due to its molecules being farther apart, making the balloon lighter than the cooler, denser air outside. The denser surrounding air lifts the balloon, allowing it to float. On the other hand, cooling the air inside the balloon causes the molecules to move closer together, making it denser and causing the balloon to descend. That's why cold, damp clouds or fog can be dangerous for hot air balloon pilots.

Although air might seem weightless, it is formed by gases and has mass like any other matter. Usually, air is made of 78% nitrogen, 21% oxygen, and 1% carbon dioxide and noble gases. The density of air is about 0.075 lb/ft^3 (or approximately 1.204 kg/m^3) at 70 °F and one atmosphere of pressure. That's why using lightweight materials was so vital in building this hot air balloon. The weight of the balloon and the air inside of it must be less than the weight of the displaced ambient air for it to fly.

Note: Atmospheric conditions can significantly affect this. Make sure the temperature is around 65°F with calm, still air. Also, choose a day with high pressure and low humidity (30-40%).

Tips & Tricks:

- If your balloon fills but won't lift off, it may be too heavy. Try cutting the birthday candles in half. Carefully strip some wax off one end to expose the wick. You can do this by partially cutting through the candle, then using scissors to scrape away the wax and reveal the wick.
- Or use the thinnest candles you can find instead of traditional birthday candles.
- Painter's plastic is the right thickness for your balloon, but you'll need to figure out how to fasten it into an envelope.

What are crystals and how do they form?

In these crystal-growing science experiments, you will grow your own crystals and discover more about these fascinating and beautiful wonders!

A crystal is a solid material with atoms and molecules arranged in a consistent, repeating pattern, forming one of seven crystal systems that create several different shapes! Crystals can be expensive and beautiful, like amethysts or diamonds, but they can also be found right in your kitchen in the form of sugar and salt. You can easily grow crystals by adding a crystal-forming chemical to water and waiting for the water to cool or evaporate.

Here you will find five different methods to grow crystals.

Science experiments with instructions are provided for each.

How does the chemical affect the crystals growth?

Which crystal growing science project is your favorite?

EXPERIMENT 3:

Crystal-Growing Science - Rock Candy Sticks

Get ready to watch some cool crystals grow! And when you're finished, you can eat them or give them away as gifts. Click here to download a rock candy crystals printable.

What You Need:

- ☐ 1 1/2 cups white sugar
- ☐ 1 cup water
- ☐ Small plate
- ☐ A spoon
- ☐ A glass
- ☐ Wax paper
- ☐ Saucepan
- ☐ Stove
- ☐ Several 250 ml beakers or small clean jars
- ☐ Cake pop sticks or wooden skewers
- ☐ An adult to help you
- ☐ Food coloring pack (optional)

Note: You can make **rock candy** without sticks. Use a piece of clean cotton string or thread. Follow steps 2-7 below. Then, dip the string into the solution so that half of the string is coated. Take the string out and let it dry. Once the string is dry, tie the clean end around a pencil and put the dipped end back into the glass of sugar water solution, balancing the pencil across the rim of the glass. Make sure the string does not touch the bottom or sides of the glass, or the crystals will not form correctly. Once your rock candy has reached a desired size (usually about one week), carefully remove it from the glass, let it dry, and enjoy!

What You Do:

1. Fill a glass with water, pour some sugar onto a small plate, and lay out a sheet of wax paper. Dip one end of each stick (cut off the pointed ends if using skewers) into the water, then roll it in the sugar, tapping gently to remove any excess. Set each stick to dry on wax paper.

2. Pour the cup of water into the saucepan and add 1/2 cup sugar. Stir well until and continue to add more sugar, 1/2 cup at a time, until you can't get any more to dissolve, even after stirring for several minutes. You should end up with about 1 1/2 cups sugar dissolved in the saucepan. It's okay if there is some undissolved sugar at the bottom of the pan. (You now have a saturated sugar solution). Use a clean toothpick and repeat for each color.

3. Ask an adult to help you heat the sugar mixture on the stove until it boils, stirring without ceasing. Turn the heat to medium-low and keep stirring until all the sugar dissolves. (Now you've made a supersaturated solution!)

4. Continue cooking and stirring the liquid until it becomes clear, but not for more than 5 minutes. If you cook it too long, it will get too hot and turn into hard candy. Turn off the stove as soon as it starts to look clear.

5. Move the pan off the heat and allow it to cool until the pan is no longer hot (the sugar solution will still be slightly warm).

6. Ask an adult to slowly pour the thick sugar solution into the jars. Fill each jar about 2/3 full or enough so that the sugar solution will cover several inches of your sugar-coated sticks.

7. Add 5-6 drops of food coloring to each jar and stir. (Optional: Only add food coloring if you want to make different colors of rock candy.)

8. Once the solution is cool and the sugar-coated sticks are completely dry, place several sticks into each jar.

9. Carefully move the jars to a place where they will not be disturbed. Check them every other day and gently stir the sticks in the sugar solution to break up large crystals forming on the surface.

10. Within a few days, you should see crystals growing on the sticks. After about one week, you will probably have a lot of crystals. When your rock candy crystals are as big as you want them to be, take them out of the jars and set each color of candy in a clean glass to dry.

11. Once dry, wrap them in cellophane and tie with ribbon for a sweet gift!

What Happened:

In step 2, you made a saturated solution—there was so much sugar in the water that it could not dissolve any more sugar, and some was left in the bottom of the pan. Once the saturated solution started to heat up, the water dissolved even more sugar, and a supersaturated solution was formed in step 3. Then, as the solution cooled, the sugar molecules in it started to join with the sugar molecules on the sticks. The sugar on the sticks is called "seed" crystals, and the sugar molecules in the solution attach to these seed crystals as they form.

Meanwhile, the water in the solution began to evaporate, leaving only sugar molecules behind. Gradually, more sugar molecules attached to those already on the stick, forming larger crystals. Because all the solute molecules are the same (they are all sugar), they all form the same shape of crystals and stick together, making a big chunk of sugar crystals that are pretty to look at and tasty to eat!

Note: This is a special science project that is safe to eat because you used clean kitchen dishes and food products, not chemicals. Remember, never eat any experiment unless it's made entirely from food, and always use clean dishes for preparation!

EXPERIMENT 4:

How to Make Quicksand

Quicksand forms when the right type of sand becomes saturated with water. This typically happens when sand is deposited in a sinkhole or hollow in the ground, where the surrounding material (like clay) prevents the water from draining away.

The sand and water make a soupy mixture that may appear solid on top, but when disturbed (like when stepped on), it turns into a liquid. Quicksand is most commonly found along beaches, lakes, rivers, marshes, and swamps, where water is abundant. However, quicksand can also form near underground springs or from runoff water after heavy rains.

Making real quicksand can be tricky. The sand grains need to be round and the same size. Ordinary playground sand (the type you can buy in a store) rarely meets this standard. If you find sand in the wet environments listed above (lakes, marshes, swamps, etc.), it is likely to be the right grain type for quicksand. A much easier and more dependable way to make quicksand is to use cornstarch instead of sand.

What You Need:

- ☐ Spoon
- ☐ Cornstarch
- ☐ Water
- ☐ Plastic mixing bowl

What You Do:

1. In a plastic mixing bowl, combine small amounts of water and cornstarch to form a mixture that looks like heavy whipping cream and has the consistency of honey. The approximate ratio of the cornstarch-water mixture is 1 1/4 cups of cornstarch to 1 cup of water. So, if you use a regular sized box of cornstarch (about 16 oz), you will use about 1 1/2 to 2 cups of water.

2. After making your mixture, gently lay your hand on its surface. You should notice that your hand sinks in the mixture. Move your hand through the mixture slowly. Then, try to move it quickly. Was it easier to move your hand slowly or quickly through it?

3. If your mixture is deep enough to submerge your hand, try grabbing a handful of the mixture and pulling your hand out quickly. Then, try again, this time relaxing your hand and pulling it out slowly. Did you notice the difference?

4. Try punching the cornstarch-water mixture. (Be careful not to hurt

yourself on the bowl.) Make sure to hit the substance hard and pull your fist back quickly. Did the substance splatter everywhere or did it stay put in the bowl? (If it splattered, add more cornstarch.)

What Happened:

When you gently and slowly moved your hand through the cornstarch-water mixture, it behaved like a liquid. But when you tried to move your hand through it quickly or hit the substance hard, it behaved like a solid.

Weird, right?

Well, this cornstarch-water mixture behaves like quicksand.

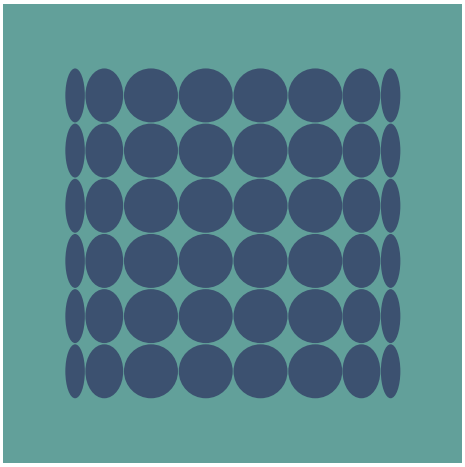
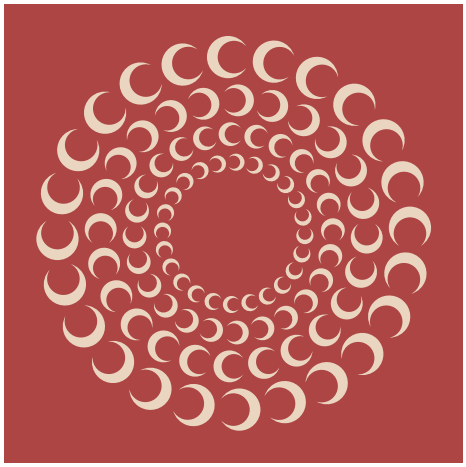
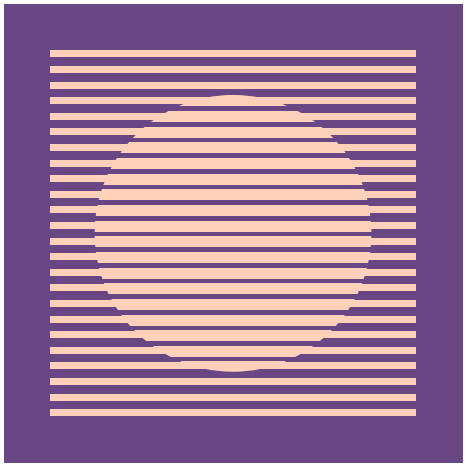
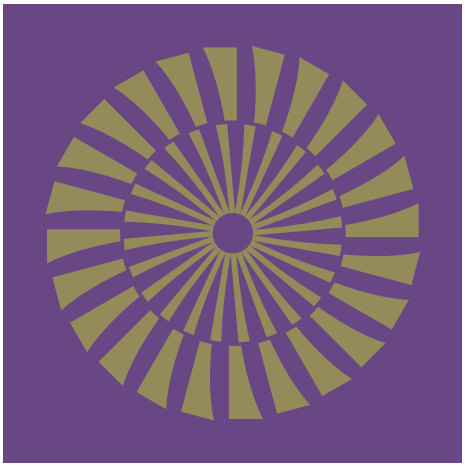
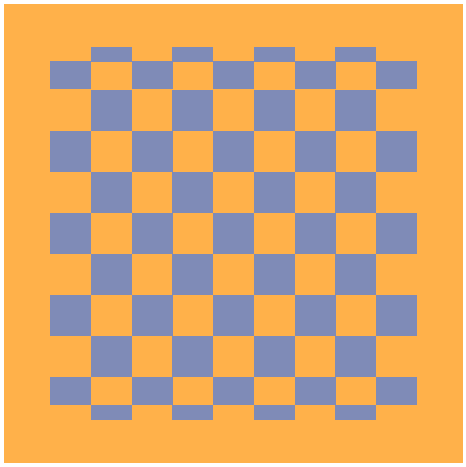
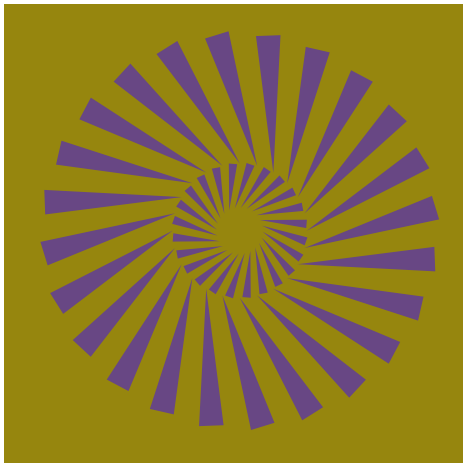
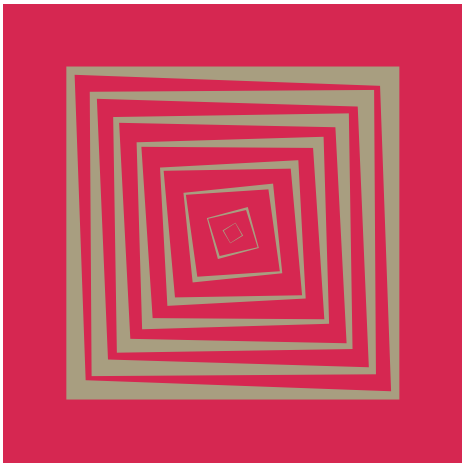
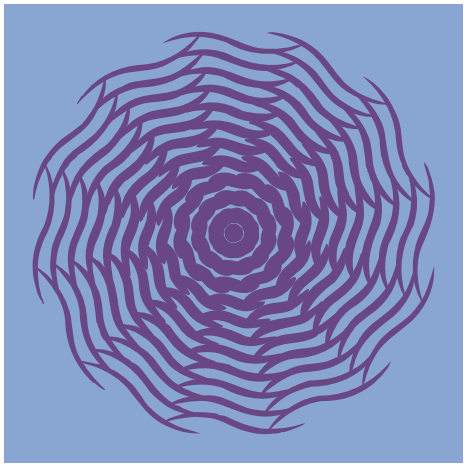
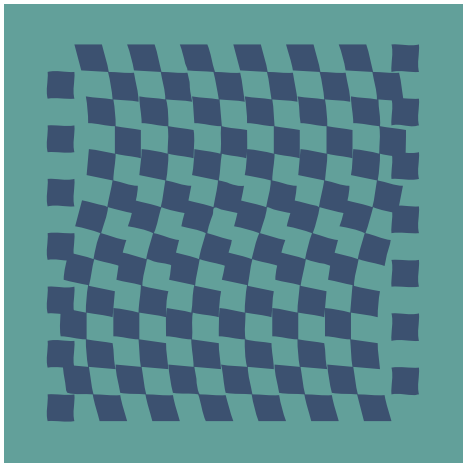
The way a liquid flows or moves is affected by its viscosity. Quicksand and the cornstarch-water mixture are both non-Newtonian fluids, meaning their viscosity changes with the type of force applied to it. Unlike quicksand, the viscosity of Newtonian fluids (such as water and honey) depends only on the temperature and pressure, not on the force applied to the fluid. For instance, warm honey flows more freely (less viscous) than cold honey (more viscous).

Since the ability of a non-Newtonian fluid to move depends on the force or stress applied to it, these fluids do not act like ones we are more familiar with (e.g., water). Light pressure, such as pouring or gently pressing the cornstarch-water mixture, allows it to move like a liquid. But high pressure, such as a firm punch, causes the cornstarch-water mixture to act as a solid. This principle applies to quicksand. When it is lightly stepped on by the unaware adventurer, the quicksand liquefies, and the foot of the adventurer starts to sink. Panicking, the adventurer tries to quickly pull their foot out, only to find that the quicksand acts like a solid, encasing the foot firmly in this unpredictable substance.

But don't worry about getting sucked into quicksand like you see in the movies. Although humans initially sink when they first enter quicksand, they cannot sink all the way (usually only about chest deep). This is because humans are less dense than quicksand. One way to get out of quicksand is to lay back and float, much like you would in water. If your foot gets stuck in quicksand, gently move it back and forth, adding water along the side of your leg. This will help the quicksand behave more like a liquid and release your foot.

One easy (and fun) way to play with and learn about non-Newtonian substances is with Thinking Putty from Home Science Tools! It can act like a liquid and a solid and exhibits thermochromic properties, meaning its color changes with temperature changes.

Optical Illusions

What is an Optical Illusion?

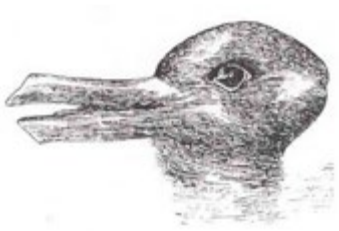
In order to see, your eye must focus light onto the retina, convert it into electrical impulses, and send those impulses to your brain for interpretation. When the electrical impulses arrive in the visual cortex of the brain, the brain "reads" them and interprets them into an image of color and light. Then, it flips the image (the light was projected on your retina upside down and reversed left to right) and fills in for the blind spot if necessary. All this happens almost instantaneously, allowing you to read a book or enjoy a beautiful sunset. Generally, the process works flawlessly, but sometimes, the color, light, or pattern of an object can "trick" the brain into interpreting the image incorrectly, so you think you see something differently from how it really is. This is an optical illusion.

Types of Optical Illusions

Some optical illusions happen naturally. Have you ever noticed that the moon looks much bigger when it's close to the horizon than when it is high in the sky? Or have you seen what looks like water on the highway when driving in the sunshine? These are both optical illusions—the moon doesn't really change size, and the road may be dry as a bone!

Other illusions happen because of a certain combination of colors and shapes, changes in background, or because our eyes get tired. Here are just a few types of illusions. Look at our Illusions Example Sheet to see pictures of each.

Ambiguous Illusions



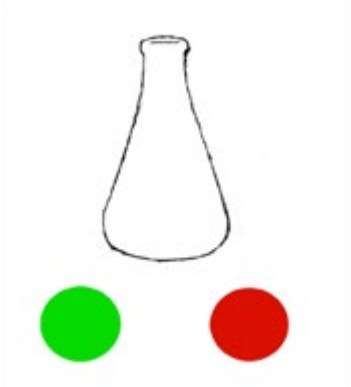
Is this a rabbit or a duck? (Rabbit faces right, duck faces left.)

These illusions contain two pictures, and which one you see depends on how you look at them. You've probably seen the classic example where the image looks like a vase or two people facing each other. In other types, shadows and contrast can make an image appear as a cube or an empty room. Check out the illusions sheet for more examples. Try drawing your own ambiguous illusion!

Illusory Motion

Sometimes, things look like they're moving, but they really aren't! This is a complex illusion that depends on color, contrast, and pattern. One famous example is the Rotating Snakes image. It is not animated! Try printing it out on a color printer, and it will still work. Focus hard in the middle of the image and the motion will stop. The image to the right is another example called "Sea Sickness." But **be careful**! Looking at illusory motion might make you seasick. Look at the larger version in the Illusions Example Sheet to see it move.

Afterimages

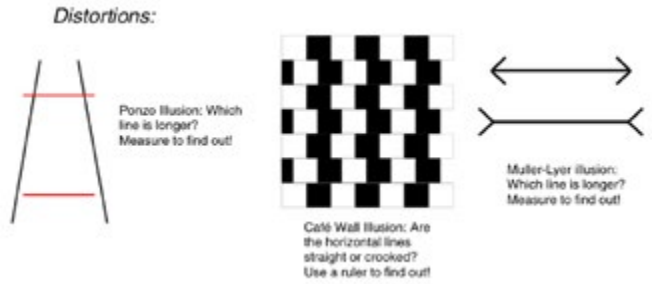


Have you ever seen something even after you stopped looking at it? This is called an afterimage. Look at the example on the illusions sheet. Stare hard at the red ball for about 20 seconds. Then, look at the empty flask, letting your eyes unfocus a bit. You will see the ball inside the flask, but it changed colors!

How does that work?

As you stare at the red ball, the red receptor cells (called cones) in your eye become tired and stop sending signals to your brain. When you look at the interior of the flask, you would normally see a white background, which is a mix of signals from red, blue, and green cones. Instead, you saw a bluish-green ball inside the flask, because the red cones were still too tired from looking at the red ball to transmit information. Try staring at the green ball now. What color is the afterimage?

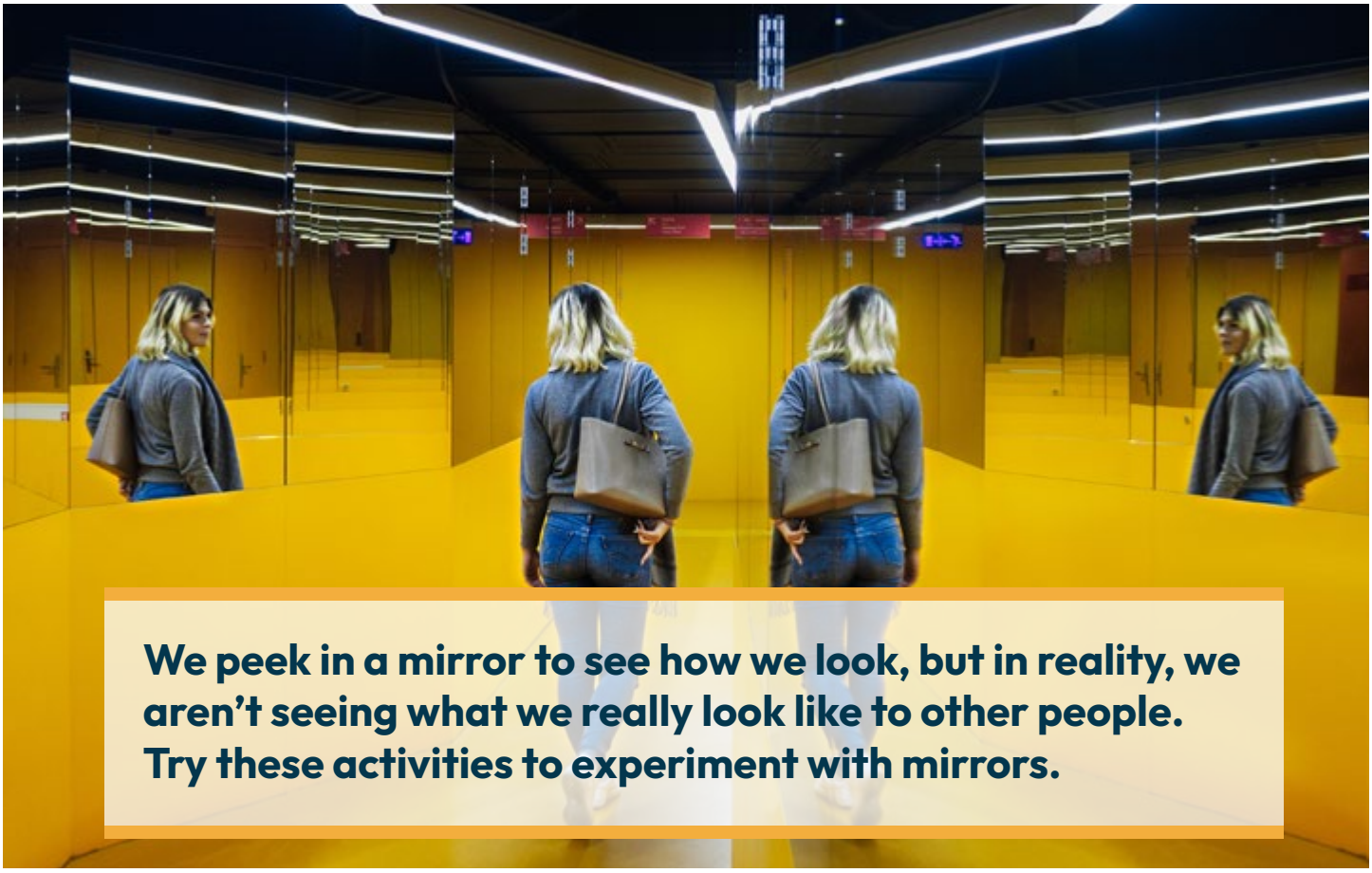
Distortions



In these illusions, objects look like they change shape or size. Distortion illusions happen because our brains process objects in relation to what is around them. For example, we expect things in the distance to look smaller than things up close. Distortion illusions play with those expectations to trick us into thinking we're seeing something different than what's there. Check out several distortion illusions on the Illusions Example Sheet.

Impossible Objects

It may look fine on paper, but the minute you consider whether it can exist in real life, you'll be scratching your head! Impossible objects look reasonable but really defy your brain's expectations—outside edges become inside edges, staircases lead up and down in a continuous loop, and more.



We peek in a mirror to see how we look, but in reality, we aren't seeing what we really look like to other people. Try these activities to experiment with mirrors.

EXPERIMENT 5:

Mirror Illusions

What You Need:

- ☐ Paper
- ☐ Bathroom mirror
- ☐ A picture of yourself
- ☐ Handheld mirror
- ☐ Soup spoon

Note: You can make rock candy without sticks. Use a piece of clean cotton string or thread. Follow steps 2-7 below. Then, dip the string into the solution so that half of the string is coated. Take the string out and let it dry. Once the string is dry, tie the clean end around a pencil and put the dipped end back into the glass of sugar water solution, balancing the pencil across the rim of the glass. Make sure the string does not touch the bottom or sides of the glass, or the crystals will not form correctly. Once your rock candy has reached a desired size (usually about one week), carefully remove it from the glass, let it dry, and enjoy!

Activity 1

What to Do:

1. Look at yourself in the bathroom mirror. Is the image you see the same as what other people see when they look at you? What side is your hair parted on? Do you have any freckles or dimples on one side of your face?

2. Now hold up a picture of yourself and look at it. Compare the picture to your reflection. Is your hair parted on the same side in the picture? Are your freckles or dimples in the same place? Turn the picture around and look at its reflection in the mirror. What does it look like now

Mirrors work by reflecting light that bounces off your face back into your eyes, creating a reversed or backward image. When you look at yourself in the mirror, you see everything on the opposite side of how someone else would see you. A camera captures an unreversed image of your face, but if you look at a reflection of that picture in the mirror, it will be reversed once more.

Activity 2

What to Do:

1. Write out the alphabet in capital letters on a piece of paper and hold it up in front of a mirror. Since the image is reversed, most of the letters will appear backward, but not all! See if you can find and circle the 11 letters that look normal. These letters are vertically symmetrical, meaning that if you sliced them in half, each half would be the exact opposite ("mirror image") of the other. Try making words with these letters and reading them in the mirror—but be careful! Just because the letters appear correctly does not mean they will be in the right order. Can you write a message that is readable in the mirror? Try to figure it out!

Mirror Illusions

2. Take the handheld mirror and set it up vertically on the piece of paper just above the alphabet. Most of the letters will appear upside down in the mirror, but there are nine that will look normal. These letters are horizontally symmetrical (if you cut the letter in half from side to side, the top and bottom would be mirror images of each other). Try making words with these letters and reading them in the mirror.

A mirror code would be hard to write in if you only had nine or 11 letters to work with. Of course, you could always learn how to write your alphabet backwards and use that instead!

Activity 3

What to Do:

Stand in front of a bathroom mirror. Then, hold up a handheld mirror so it faces the bathroom mirror. How many of you do you see? You probably see too many of you to count! This happens because the handheld mirror reflects the image in the bathroom mirror, which reflects the handheld mirror's image... and so on!

Activity 4

What to Do:

Even though a bathroom mirror reverses your image, it still gives you a fairly accurate representation of what you look like. Not all mirrors work this way, though. If you have ever been to a funhouse at the fair, you've seen how mirrors can make you look very strange. Funhouse mirrors are typically curved. If the mirror curves toward you, it's a convex mirror and will make you look short and round. If it curves away from you, it's a concave mirror and will make you look tall and thin. You probably don't have carnival mirrors at home, but try looking at your reflection in a large soup spoon. Does your reflection look different on the back of the spoon compared to the front?

Discover the hidden colors behind your favorite candies with the Candy Chromatography Science Project! First, you'll learn what chromatography is, then use a fun experiment to test two types of candy. Find out if there are more colors hiding beneath the ones you see!

Chromatography Concepts

The word chromatography comes from the Greek words for color and writing. It's a simple technique used to separate a mixture into its individual components. In chemistry, a mixture is a combination of substances that can be separated because they aren't chemically bonded. In contrast, a compound consists of elements that are chemically bonded and can't be separated."

In this paper chromatography project, you will dissolve a mixture and then watch as it pulls across a piece of paper. The mixture separates and its components travel across the paper at different rates. The result is known as a chromatogram, or the pattern of separated substances revealed through chromatography.

EXPERIMENT 6:

Candy Chromatography Science Project

The three primary colors for mixing dyes or paints are red, yellow, and blue. Other colors are often a mixture of these three colors. Do you think M&Ms and Skittles will have the same chromatograms? Find out with this easy and fun seven-step candy chromatography science project!

What You Need:

- ☐ M&Ms and Skittles or other candy with colored coating
- ☐ Petri dish or a clean plate
- ☐ Pipet or dropper
- ☐ Toothpick
- ☐ Filter paper (or coffee filters cut into strips)
- ☐ Water
- ☐ Salt
- ☐ Ruler or pencil
- ☐ Clips or tape
- ☐ Beaker

What to Do:

1. Prepare a saltwater solution by mixing 1/8 teaspoon of salt into 3 cups of water, shaking or stirring until completely dissolved. This will be your chromatography solvent. Pour about 100 ml of salt water into the beaker.

2. Take two pieces of chromatography paper or cut two 4×8 cm rectangles from a coffee filter. Use a pencil to mark a line 1 cm from the bottom of each piece. Label one piece 'Skittles' and the other 'M&Ms'.

3. Sort the candies to find several matching colors. Both packs should contain red, orange, green, etc.

4. Use the pipet to place a single drop of water for each M&M color in the bottom of the petri dish, making sure the drops are evenly spaced. Place an M&M on each water drop and set aside. The water will dissolve the candy coloring. After 1-2 minutes, remove the candy.

5. Repeat step 3 for the Skittles, this time using the lid of the petri dish.

6. Dab the end of a toothpick in one of the colored water droplets and apply the pigment to the filter paper. Apply 2-3 coats, letting the spots dry in between. Use a clean toothpick and repeat for each color.

7. Tape or clip the papers side by side (but not touching), securing them with a pencil or ruler. Place the pencil or ruler across the mouth of the beaker, ensuring the papers barely touch the water. The water will soak up the paper and move upwards. Once the water reaches the top, remove the papers and transfer them to a clean, dry, flat surface to dry.

Examine your results. What colors do you see on your chromatogram? Are the two chromatograms similar? Where do you see differences? Look at the ingredient list on the packaging and see if some of the same dyes are listed. If the dyes overlap, what do you think is the reason for different chromatograms?

What Happened:

The water travels up the paper strip through capillary action.

Capillary action happens because water is attracted to the surface of the paper. As the first water molecules stick to the paper, they pull other molecules along with them. (This is also how water moves up through the roots of plants.)

As the candy coating dissolves in the water, it's also pulled up the paper. In this candy chromatography experiment, you likely discovered that the candy coating is made up of several pigments. Some pigments dissolve in water more easily and travel farther up the paper, while others are more attracted to the paper and move more slowly.

Generally, smaller molecules travel farther than larger molecules.

For further exploration, try experimenting with colored markers, flavored gelatin, powdered drink mix, or food coloring, and see if you can predict the results!

Have you ever wondered how you can provide a habitat for pollinators like honeybees and butterflies in your back yard?

Learn how to make a pollinator hotel with this step-by-step guide and lesson.

Pollinators are animals that help move pollen. Most pollinators are insects, like bees, butterflies, and beetles. Butterflies, beetles, and many species of bees do not build homes. Instead, they use leaves, branches, and other plant materials to shelter themselves.

Pollinator hotels, also referred to as bee hotels, help pollinators survive because they provide them with homes. The pollinators in your area are different from pollinators in another state or country.

Before building your pollinator hotel, you should research local pollinators. You can do this by using the internet or library books. Make sure to find resources that are specific to the state, city, or region you live in. For example, if you live in Texas, you will have different pollinators than someone living in Washington.

Local experts can also be a great resource. You can find experts at state and national parks. If there is a college or university in your area, you may be able to find a professor who is a local expert. Reach out to a local expert by phone call or email.

EXPERIMENT 7:

How to Make a Pollinator Hotel

What You Need:

- ☐ 2-liter bottle
- ☐ Scissors
- ☐ String

Items to fill your hotel

- ☐ Sticks
- ☐ Pinecones
- ☐ Cardboard tubes
- ☐ Leaves
- ☐ Hay
- ☐ Scraps of paper
- ☐ Anything else you think a pollinator may use to stay warm and dry

What You Do:

1. Research pollinators in your area to determine the types of pollinators you will use for your pollinator hotel.

2. Using scissors, cut the neck off the bottle.

3. Roll your scraps of paper to make small tubes. The tubes should be large enough for a bee to fit in. **Hint:** You can use a marker or pencil to help roll the paper.

4. Arrange your paper tubes in the bottle. You can arrange the sticks, pinecones, and other materials you gathered with the paper tubes until you are happy with the hotel.

5. Cut two pieces of string, each 3 feet long.

6. Wrap one piece of string around the top of the bottle. Tie a knot to make a loop.

7. Wrap the other piece of string around the bottom of the bottle. Tie a knot to make a loop the same size as the first loop.

8. Hang your bottle from a tree branch using the string loops.

9. Visit or view your pollinator hotel to see how well it is being used. If there are pollinators in your hotel, allow them to rest peacefully.

What Happened:

The Importance of Pollinators

Pollinators are crucial to the reproduction and survival of many plants. They move pollen from one plant to another, allowing the plant to reproduce and make more of that species of plant. The pollinators don't just do this for the good of the plants. Instead, when they pollinate plants, they eat nectar and some of the pollen. This is known as **symbiosis**, the direct ecological interaction between two different organisms that has developed over time.

The type of symbiosis that pollinators and plants have is called **mutualism**. Mutualism is a symbiotic relationship between two organisms or species where both benefit (or get something) from each other. The plants are able to reproduce and the pollinators access food.

The Right Pollinator for the Job

Not all pollinators pollinate all plants. Instead, each plant has specific characteristics or traits that it uses to attract certain pollinators. These characteristics can include shape, smell, color, and location.

Beetles and hummingbirds are two pollinators that are drawn to bright colors. While both beetles and hummingbirds are drawn to yellow and orange flowers, hummingbirds are also drawn to pink, purple, and red plants.

Bats are pollinators that are drawn to smell rather than color. They typically pollinate fragrant flowers, herbs, and plants. Additionally, most bats are nocturnal. **Nocturnal** animals are active at night. Because bats are nocturnal, they must pollinate plants that bloom at night rather than during the day. Flowers that bloom during the day are not accessible to bats.

Flower size is also a role in attracting the right pollinators. Hummingbirds, moths, and butterflies can access pollen and nectar from thin flowers. Hummingbird beaks are larger than the proboscises of butterflies and moths, which are specifically designed to reach into tiny flowers—flowers too small for a hummingbird's beak to fit

Your pollinator hotel is best suited for insects, not birds or bats—and that's okay! Bats and birds build their own homes, so they won't need a pollinator hotel. However, beetles, bees, butterflies, moths, and other insect pollinators will find it a safe place.

Looking to Dive Deeper?

Try these pollinator and insect kits:
Super Seeds Science Unlocked Kit
Life Cycle of the Honey Bee Kit

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