42 SPRING SCIENCE EXPERIMENTS

HOME SCIENCE TOOLS®
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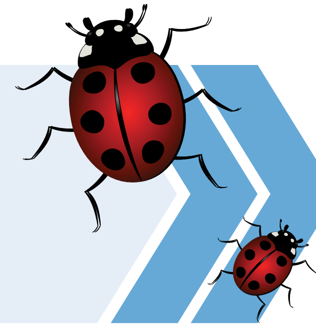
A LADYBUG INVESTIGATION



WHAT YOU NEED:

- ☐ a clean jar or clear container with a lid
- ☐ a hammer
- ☐ a small nail
- ☐ a wet cotton ball
- ☐ a paper cup
- ☐ a magnifying glass
- ☐ a notebook
- ☐ a pencil

The best way to learn about something is to watch it. Scientists do a lot of watching, or observing, to learn about things, especially insects like ladybugs. In this project, you will get to look for ladybugs and then watch them to learn about them, just like a real scientist! Make sure you get permission from an adult before you start this project.

WHAT YOU DO:

1. Get your jar ready to hold ladybugs: ask an adult to help you use the hammer and nail to make small air holes in the lid. Put a wet cotton ball in the bottom of the jar so the ladybugs will have water to drink. Now you're ready to start your ladybug search.

2. Go outside in your backyard or to a park that has a lot of trees and plants.

3. Start walking slowly and looking very carefully around trees, bushes, flowers, and in the grass for ladybugs. If you spot one, write down where you found it (examples: on a flower stem or in the grass), what color it is (bright red? orange? dark red?), and how many spots it has.

4. If you want to, catch the ladybug in your jar. See if you can get the ladybug to crawl onto your hand and then into the jar. Put a few leaves or parts of the plants the ladybug was on into the jar with it.

5. Look very closely at the plants the ladybug was near. Do you see any smaller bugs that the ladybug might have been eating? They will probably blend in with the leaves very well, so look closely!

6. Keep searching for more ladybugs by looking under leaves, rocks, in tall grass, and on the bark of trees.

7. When you find one, watch it for as long as you can. Stay a few feet away so you won't scare it. When you're done watching it, use your paper cup to scoop the ladybug up and put it in your jar.

8. Write notes or draw pictures for each ladybug that you find. This is called gathering data. This is like collecting clues to learn more about ladybugs and will help you answer the questions at the end.

9. When you have a couple ladybugs in your jar, take a closer look at them with your magnifying glass. Draw pictures of what they look like from different angles (underneath, from above, or from the side) and write down things that you think might be helpful "clues" for learning more about the life of a ladybug.

10. If you don't find any ladybugs, pick a different area to explore (try to find a rosebush or a field with lots of tall grasses). You can also observe other bugs you find. Once you're finished observing, answer the questions below to see what you have learned!

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QUESTIONS:

Where did you find the most ladybugs? Were they on leaves, on tree bark, in the grass, on flowers, or somewhere else?

Were they in groups or by themselves?

Based on where you found your ladybugs, what kind of home do you think a ladybug would like? Describe it or draw a picture of it.

Did you see any ladybugs eating? What were they eating?

What can ladybugs do to protect themselves? Do they have places to hide?

Do ladybugs have wings? Can they fly? How far do you think they can fly?

Do all of your ladybugs have the same number of spots? What do you think their spots are for?

What color are your ladybugs? Why is that a good color for them?

How many legs do they have? Do you notice anything special about their legs?

What do their heads look like? Do they have eyes? Do they have antennae?

If you want to keep your ladybugs for a couple days to watch them some more, you will need to give them something to eat. Soak two raisins in water for 15 minutes. Cut the raisins in half, then put them in the bottom of the ladybug jar. Even though your ladybugs have food and water now, they will still be happier in their natural home. After observing them for 2 or 3 days, make sure you let them go in the place where you found them so they can get back to their normal life of hunting aphids and laying eggs to make more ladybugs!

HONEY BEE MEMORY

WHAT YOU NEED:

- ☐ 5 index cards
- ☐ 5 small dishes
- ☐ 5 ziplock bags
- ☐ 1/4 cup sugar
- ☐ A black marker
- ☐ 3/4 cup water

Have you ever wondered how bees and butterflies know where to find good feeding spots? These insects don't have sharp vision, but they see polarized light (which tells them direction based on where the sun is) and patterns of ultraviolet light on bright-colored flowers with lots of nectar. Bees also recognize man-made patterns; sometimes beekeepers put a symbol on a new hive so their bees can remember which is the right one. Do this experiment to test how well bees recognize patterns – and see if you can fool them! You'll need about a week to do this project, with time to check your homemade bee feeder every day.

WHAT YOU DO:

1. On each of the index cards, draw a simple shape with the marker. (You might draw a star, circle, cross, triangle, and square.) Make the shape big enough to cover most of the card and fill in the shape so that it's solid black. When you're done, stick each card inside a ziplock. This will protect it from being ruined outside.

2. Set the bags outside in a flat, sunny spot where they won't be disturbed. Make sure the shapes are facing up. Each one should be placed a couple feet away from the others. If you live in a windy area, use rocks or a stake to hold down the bags!

3. Mix up some sugar water, the "nectar" that will attract bees and other insects. (Real nectar, from flowers, is a similar sugary liquid.) Heat the water until it's about to boil (the easiest way is to microwave it for 60-90 seconds). Then stir in the sugar until it's dissolved. Pour the sugar water into one of the small dishes; fill the other four with plain water. Set a dish outside by each of the ziplocks. Make sure you remember which dish has the sugar water!

4. During the next few days, keep track of what kinds of insects visit the dishes. How many days does it take before bees find the one with sugar water? A few days after you've seen bees at the sugar water dish, switch cards so that the shape that was next to the sugar water is now by a dish of plain water. What happens in the next two days? Do the bees come right to the sugar water, or do they land on the dish with the card that used to be next to the sugar water? Now leave the cards where they are, but switch the sugar water dish with another dish of plain water. How do the bees respond?

SMELLING BEE ACTIVITY

WHAT YOU NEED:

- ☐ A variety of foods with various types of scents. A few easily recognizable options include: pickles, mustard, peanut butter, coffee beans, mint candy, banana, and vinegar.
- ☐ Cotton balls
- ☐ Handkerchief or other blindfold
- ☐ Film canisters or other small, opaque containers with lids, like empty single-serve yogurt containers.

Despite having compound eyes, bees and ants don't use their eyes the same way we do; in fact, some ants are blind! So instead of their sight, bees and ants often will rely on their sense of smell. Special scents called pheromones help them recognize each other and their homes. In this game, you'll be the bee (or ant) and see if you can tell different scents apart.

WHAT YOU DO:

VARIATION 1:

Put a cotton ball soaked in the food (or a small portion of the food) in each container. Have the blindfolded children smell the container and see if they can guess the scent.

VARIATION 2:

If playing the game with several children, divide each scent-soaked cotton ball into two containers. Pass them out to the children and have them take turns sniffing each others' containers and try to find their "pheromone friend," the person with the matching scent.

VARIATION 3:

Make a smelling scavenger hunt. Hide a honey pot or honey bear and tell the children they must sniff their way back to the beehive. Make a trail of scent-filled containers that leads to the "hive." Devise a "path" they must sniff out to in order to find their way back to the "hive." Give the children directions to the hive using different scents to mark the trail. (Use pictures for younger children.)

LIFE CYCLE OF A BUTTERFLY PROJECT

WHAT YOU NEED:

- ☐ Clear plastic container or jar
- ☐ rubber band that fits around the opening of the container
- ☐ scissors
- ☐ magnifying glass
- ☐ piece of cheesecloth

In Search of Caterpillars: For this project, you will need to find a caterpillar. It may not be as hard as you think. That's because butterflies lay their eggs on the plants that their caterpillars like to eat, which are called host plants. Some common host plants for butterfly and moth caterpillars are alfalfa, aster, broccoli, cabbage, clover, dill, milkweed, parsley, snapdragon, and sunflower.

Trees that are hosts to caterpillars include birch, chokecherry and cherry, cottonwood, elm, oak, and willow. Ask an adult to help you figure out which of those plants you have in your yard or someplace near your home where you could go to look for caterpillars.

WHAT YOU DO:

1. Get an adult's permission to go outside and search for caterpillars.
2. To search a plant, gently turn the leaves over one at a time by holding the stem and turning it slightly so you can see the back of the leaf. Look for holes in the leaves. If it looks like something has been eating it, there are probably caterpillars nearby! Keep looking through the plants, and on the ground around the plants.
3. If you find a caterpillar, carefully cut the leaf or part of the plant that it is on and put it into your container; don't pick the caterpillar up or take try to take it off the plant because it can hold on tightly and you may hurt it. Cover the container with cheesecloth and put a rubber band around it so your caterpillar can breathe but can't escape.
4. If you find any very tiny caterpillars, they may have hatched recently! Use your magnifying glass to look more closely at the backs of leaves to see if there are any butterfly eggs that have not hatched into caterpillars yet. If you find any, don't touch them, just look.

NOW WHAT?

Put a few small twigs and blades of grass in the container to give your caterpillar more interesting places to explore. The caterpillar will not need any water, but it will be very hungry, so make sure you remember what plant it was eating when you found it so that you can get fresh leaves from the same kind of plant. Feed your caterpillar once a day, or more often if it eats all the fresh leaves sooner. Take the old leaves out before putting new ones in. Let the caterpillar go after a couple days.

Note: Instead of finding your own caterpillars, you can order some. You will not need to feed these caterpillars anything because the containers that they come in have all the food they will need, but you can watch them eat and turn into butterflies!

MAKE A BUTTERFLY FEEDER

The Plate Method

WHAT YOU NEED:

- ☐ A plate or plastic lid from a 1-gallon ice cream container.
- ☐ String
- ☐ Orange juice
- ☐ Overripe, spoiling fruit. (See if your grocery store will let you have what they are throwing out for free if you don't have any at home.)

Create this butterfly feeder quickly and easily!
Plus, use up old fruit that usually gets thrown away.

WHAT YOU DO:

1. Use the string to make a hanger for your plate. If you're using an old ice cream lid you can punch holes in the side and tie the string to it. If it's a plate that you can't punch holes in, use tape. You can decorate the strings with artificial flowers to make it more attractive to butterflies.

2. Hang your plate from a tree branch before you fill it to make the process less messy! It will probably attract other bugs besides butterflies, so you may want to hang it in a far corner of your yard.

3. Put overripe fruit on the plate; try slices of watermelon, oranges, or bananas. You can also add some orange juice to keep the fruit from drying out as fast. Bananas will be mushier and more appealing to butterflies if you freeze them first and then thaw them and cut them in slices.

4. Watch and see what kinds of butterflies come to eat. Do different species prefer different kinds of fruit? How many butterflies can you see feeding on your plate at once?

5. When the fruit gets too dry, throw it out and put more on the plate.

RAISE YOUR OWN BUTTERFLIES

WHAT YOU NEED:

- ☐ A small aquarium or one gallon jar
- ☐ cheesecloth and a large rubber band to cover the jar
- ☐ caterpillars you collect
- ☐ leaves from the plant on which you found the caterpillars
- ☐ sugar water or oranges

***Butterfly Garden kit also available from HST*

WHAT YOU DO:

1. Collect some caterpillars. You can find these on common host plants like milkweed (monarch butterflies) and parsley (black swallowtail) or trees like cottonwoods and quaking aspens (tiger swallowtail). Check a field guide to find out what butterflies you have in your area and what their larvae eat. Place the caterpillars in the aquarium or jar along with fresh leaves from the plant you found them on.

2. You will need to provide lots of fresh food for the caterpillars during the larval stage. They are very picky eaters; some caterpillars will only eat one type of plant.

3. As the caterpillars get larger, you can prop some sticks in the jar a few inches off the bottom. The sticks will give the caterpillars a place to hang from when they transform into chrysalides.

4. After your butterflies emerge from the chrysalides, they will hang still for quite some time until their wings are fully expanded. They will most likely secrete a colored liquid (usually red or orange) that is leftover pigment from the formation of their wings.

5. You can feed the butterflies with sugar water sprinkled on carnations, or with fresh orange slices. They will drink by unfurling their proboscis, which they use for sucking up the liquid, like a straw. After observing them for awhile, release them near where you found the caterpillars.

OBSERVING AN ANT

The Plate Method

DO YOU KNOW WHERE TO FIND ANTS?

The sidewalk or driveway are good places to look. You might even find some inside your house! It's hard to see ants in the grass since they are so tiny, but you can usually find them living under rocks or logs. Just be careful, because there may be other insects living there, too. Now that you know where to look, go outside and find some ants! When you find one, use a magnifying glass to get a closer look. Follow it around and watch what it does for as long as you can. If you have a bug jar, you can catch one or two ants to get an even better look at them.

DO YOU KNOW THE PARTS OF AN ANT?

Look at the ant you found and answer these questions:
How many legs does it have?
How many segments or sections does its body have?
Do you know what the sections are called?
How many feelers does it have? Feelers are called antennae. Can you tell what the ant uses its feelers for?

WHAT TEMPERATURE DO ANTS LIKE BEST?

Do you get tired of running around and playing outside more quickly when it is very hot out? What if it is very cold out? Do you think temperature affects how fast ants move, too? If you have an ant farm, do this experiment and find out! (Or, if you don't have an ant farm, you can put a few ants in a jar with small holes in the lid instead.)
Look at the ants in your ant farm and notice how fast or slow they are moving.
Put your ant farm in the refrigerator. Make sure it does not tip over!
After 10 minutes, take the ant farm out and look at the ants again. How fast are they moving now? Are they moving faster or slower than they were before you put them in the fridge?

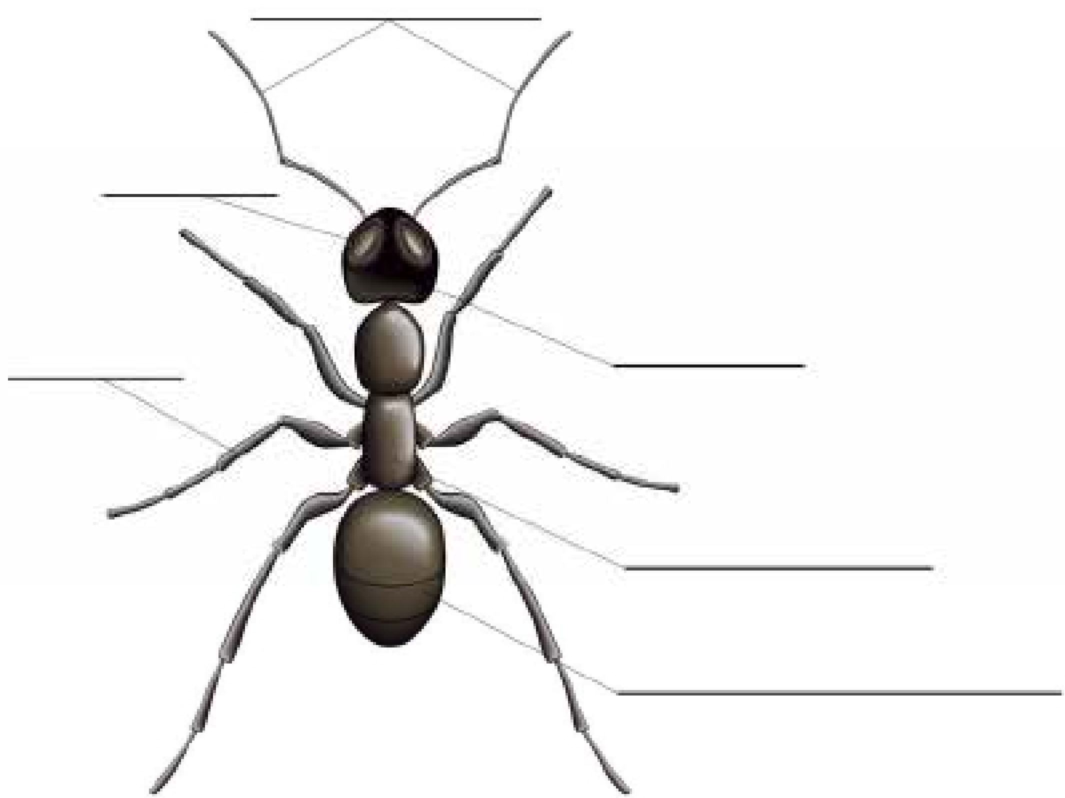
Why do you think that happened to the ants? Ants are cold-blooded just like all other insects and some other animals, like reptiles. Humans, as well as other animals, are warm-blooded. What's the difference? Well, cold-blooded animals are not able to control the temperature of their own bodies, but the bodies of warm-blooded animals try to stay at a certain temperature even if they are in a place that is very cold or very hot.

This means that when an ant is in someplace cold, its body gets cold very quickly. It is harder for ants to move around when they are cold! They are more active and can move much faster when they are warm. Not all types of ants like the same temperature though. For example, ants that live in the deserts of Africa like hotter temperatures better than ants that live close to the mountains in Colorado!

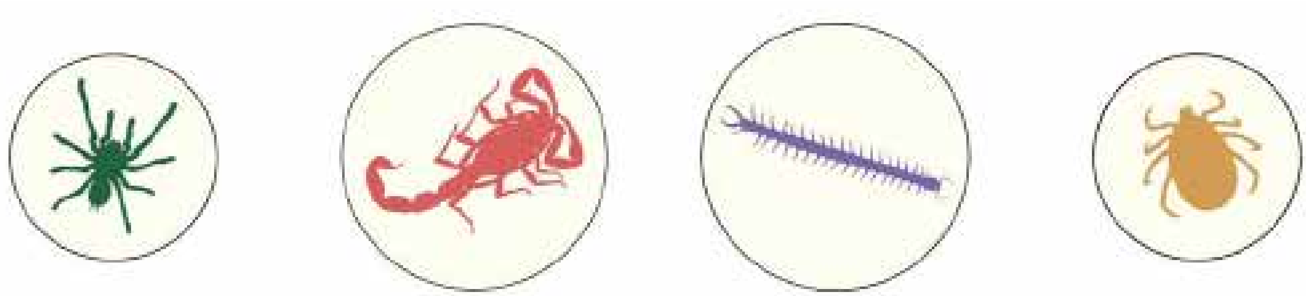
INSECTS VS. BUGS

Label the ant with the body parts listed below it.
These are the parts that make an ant an insect!
Some insects also have wings, but this ant does not.

head	eyes (2)	abdomen
thorax	legs (6)	antennae (2)



Circle the parts of the bugs below that show you they are not insects:



MAKE A MEALWORM HABITAT

WHAT YOU NEED:

- ☐ A glass jar or other clear container
- ☐ Tin foil
- ☐ Rubber band
- ☐ Ruler (with centimeter markings)
- ☐ Wheat bran (plain bran cereal may be used)
- ☐ Oatmeal
- ☐ Carrots
- ☐ Mealworms
- ☐ Notebook
- ☐ Pencil
- ☐ Toothpick

Often, the best way to learn about something is to watch it. Scientists do a lot of watching, or observing, to learn about things like insects. In this project, you'll observe a mealworm's life cycle. Mealworms are a perfect insect to observe since they are easy to take care of and have a short life cycle. If you do not have time to order mealworms, look for beetles outside. Ladybugs (also called ladybird beetles) like to hang out around rose bushes or tall grass. If you find a beetle outside it is better to observe it for a short time and then let it go.

WHAT YOU DO:

1. Prepare a habitat for your mealworm. Put the tin foil over the top of your container and keep it in place with a rubber band. Poke a few air holes for your insect into the foil using a toothpick (have an adult help you with this). You could also have an adult use a hammer and nail to poke holes into the lid for you instead of using foil.
2. Take the foil lid off and put a few handfuls of bran into the bottom of the container.
3. Your mealworm has food – now it needs water! Have an adult cut a small piece of carrot or put a spoonful of oatmeal into the container. Both oatmeal and carrots have enough moisture in them for the mealworm to get water from.
4. Put one mealworm into the jar and observe it for several weeks. How many legs does it have? How many body segments does it seem to have? Where is its face?
5. Take notes about your mealworm. Write the date for each entry, and talk about what you observe your mealworm doing.
6. Measure your mealworm each day to see if it grows! Use a centimeter ruler to measure the length of your mealworm.

WHAT HAPPENED:

Within a few weeks from when you got it, the mealworm changed forms. It started out looking a lot like a worm. A mealworm is actually a larvaof the darkling beetle. The larva has six legs and three body parts – just like the adult beetle. After some time, the larva will change into a pupa. The pupa stage of a butterfly is when a caterpillar becomes a chrysalis. The pupa stage for the darkling beetle looks similar to the larva, but the body gets wider, and the whole insect turns white. The white casing is actually what protects the larva while it turns into a beetle. If you wait long enough, you will see a young beetle hatch out of the larva casing. The young beetle eats a lot (bran flakes and carrots) and will eventually become an adult beetle. To learn more about the beetle life cycle we highly recommend the Beetle Life Cycle Kit.

BUILD A WORMERY

WHAT YOU NEED:

- ☐ Clear plastic 2-liter soda bottle
- ☐ Scissors
- ☐ Sand, soft soil, garden soil, compost (as many different types of soil as you can find)
- ☐ Water
- ☐ Earthworms (about 5)
- ☐ Leaves
- ☐ Piece of construction paper or cardboard
- ☐ An adult to help

Want to learn about worms? We think the best way is to watch them! Here's how you can collect some worms and watch what they do.

WHAT YOU DO:

1. The first thing you need to do is prepare a place for worms to live – called a wormery.
2. Clean the soda bottle and remove the label the best you can. Have an adult help you cut off the top of the bottle where it starts to get smaller to form the neck of the bottle.
3. Fill it with alternating layers of soil and sand. Use at least two different types of soil, but the more you have, the better.Add water to the soil to get it damp, but not too wet or goopy. Place some leaves on top of the soil.
4. Once your wormery is ready, you'll need to get some worms. The easiest way is to buy some from a local bait shop or pet supply store. However, it's not hard to find them out in your yard! If you have a bare patch of earth, try watering the area and then placing a piece of cardboard, carpet, or wood over it. Leave it for a day and then lift the cardboard off the dirt to find the worms hidden underneath. You can also just start digging in the dirt to find worms. (Just make sure you get permission from an adult before you start.)

As you find worms, carefully put them into the wormery. You can use a twig or a plastic cup to gently scoop them up and move them. Try to find 4-6 worms.

Once your worms are in, cover the top of the bottle with construction paper or cardboard to make it dark for your worms.

Over the next few days and weeks, watch them tunnel through the soil and leaves and see how long it takes for the layers of soil to become mixed together. You may even see the worms tunnel along the side of the bottle.

Worms need their soil to be moist so that they can breathe and not dry out. Check on the soil every day. If it looks like it is starting to dry out, add a little water to keep it damp.

When you are done watching the worms, simply dump the entire contents (worms, too!) back in your garden or a patch of dirt in your yard.

BUILD A WORMERY: PAGE 2

WHAT HAPPENED:

Worms can move an amazing amount of soil for their small size. An earthworm can eat its own weight in soil and other matter every day! As you saw in this project, worms help till or turn up the soil as they tunnel through it. Worms make a natural fertilizer. If you place compost (plant material like fruit or vegetable peels) on your garden you can be sure some friendly earthworms will help get it down to the roots of your plants and provide your soil with lots of important and rich nutrients, which in turn will help your plants grow.

NOTES AND OBSERVATIONS:

WATCH ROOTS GROW

WHAT YOU NEED:

- ☐ Plastic zip-top sandwich bag
- ☐ Paper towel
- ☐ Dropper
- ☐ Seeds (sunflower or radish seeds work well)
- ☐ Tape

You may know that plants grow roots, but usually we just see the part of the plant above the ground. Here's an easy way to watch seeds sprout and roots start to grow.

WHAT YOU DO:

1. Fold the paper towel in half and then in half again into a square.
2. Get the paper towel square wet and then gently squeeze it out. It should be wet but not dripping. Place the wet paper towel into the plastic bag.
3. With the bag laying flat, place 3 or 4 seeds between the plastic bag and the paper towel. They should be in a row near the center of the bag.
4. Use a dropper to add a couple drops of water to the paper towel just above your row of seeds.
5. Close the top of the bag keeping a space in the middle unzipped.
6. Tape the two closed sides of the top of your bag so a window that gets a lot of sunlight. Make sure the seeds face outside (towards the sun).
7. Carefully lift the bottom of the bag up to peek at your seeds each day. Depending on what kind of seeds you planted, they should sprout within a few days or a week. (Our sunflower seeds began to show roots after just three days!)

WHAT HAPPENED:

Seeds need certain conditions in order to start growing. Until it is in the right conditions, the seed is dormant – it's kind of like it is asleep. When the seed has everything that it needs to start growing (warmth, oxygen, and water), it will "wake up" and sprout, or germinate. Once the seed germinates, it will begin growing roots going downwards and a stem going up. As the plant continues to grow, it needs sunlight, oxygen (from the air), water, and nutrients from soil.

Check on your seeds each day and notice how quickly the roots grow once they appear. At first they might just grow as one root that keeps getting longer, but after a few days, it will likely start to have other little roots growing in different directions. Those additional roots help the plant reach more soil to find water and nutrients and also help keep the plant stable, so it won't easily fall over or be pulled out of the ground. Even though your seeds aren't in soil, the roots know they need to grow that way. After about a week, you can carefully take the tiny plants out of the bag and plant their roots in the ground outside or in a pot with potting soil if you want to continue watching the plants grow.

DRINKING PLANTS

WHAT YOU NEED:

- ☐ Carrot
- ☐ Glass of water
- ☐ Blue food coloring
- ☐ A sharp knife & a cutting board
- ☐ An adult to help

You can watch a root (a carrot) "drink" up water with this easy experiment.

WHAT YOU DO:

1. Mix a few drops of the food coloring into the glass of water.
2. Place the carrot in the water.
3. After a few hours, pull the carrot out and have an adult cut off a small section near the tip.
4. Look at both the carrot and the piece that was cut off. You should see blue dots on the inside of those two pieces.

WHAT HAPPENED:

The blue dots show where the water is being carried through the root. A plant's roots bring water and nutrients up to its stem and leaves through hollow tubes. A carrot is a root vegetable. Since you added coloring to the water you put your root (the carrot) in, the tubes showed up as blue dots when you cut the carrot's tip. All plants need water and nutrients in order to grow. Cut off another piece of the carrot, looking for the same blue dots again. Keep cutting sections off the carrot. How far did the water travel up the carrot? If the carrot you used had a green top still connected to it, the water probably traveled all the way up to the top part, which is the stem of the carrot plant.

In order for a carrot to grow when it's in the ground, the green plant part above the ground needs to be healthy. It stays healthy by getting water and nutrients from the root, which eventually grows into a thick orange root that's good to eat!

WATCH SEEDS SPROUT

WHAT YOU NEED:

- ☐ A clear plastic cup
- ☐ Potting soil
- ☐ Bean seeds
- ☐ Water
- ☐ Sunny windowsill

WHAT YOU DO:

1. Fill the cup about 3/4 full with potting soil.

2. Push a seed along the side of the cup into soil. Cover the hole with soil. You should be able to see the seed from the outside of the cup, but not the top. Repeat all around the cup, leaving a little room to grow in between each seed.

3. Water the soil. It should be moist, but the water should soak in and not stay on top of the soil.

4. Set your cup in a windowsill or another warm, sunny spot. Turn the cup every few days to make sure all of the seeds get sunlight.

5. Look at your seeds every day and water them whenever the soil looks dry.

WHAT HAPPENED:

When you gave the seeds the right conditions, you saw how flowers grow within only a few days! What conditions did you provide for your seeds? You gave them soil, water, sunlight, and warmth. A plant needs all of those conditions in order to grow.

You can probably see tiny roots growing from your seeds down into the soil. Plants use roots to get water and nutrients from the soil. You should also be able to see a small green stem sprouting up above the soil. This stem will continue to grow from the nutrients and water it gets from the roots. The plant will eventually grow leaves. Leaves use sunlight to make and store more food for the plant to use as it keeps growing. Soon your little plants will be too big for the plastic cup. Ask an adult to help you find a place outside or in a large pot where you can plant them and continue to watch them grow.

After awhile, the plants will grow little buds that will bloom into flowers. The flowers will eventually turn into a fruit; in this case, they will grow into bean pods! Inside of these fruits is where more seeds are formed for the next batch of plants to grow from. If the flowers of a plant don't grow into a fruit, the seeds are formed inside the flower instead.

MINI FLOWER GARDEN

Experiment

WHAT YOU NEED:

- ☐ An empty cardboard egg carton (not Styrofoam or plastic!)
- ☐ Acissors
- ☐ Plastic wrap
- ☐ Potting soil
- ☐ Water
- ☐ A marker
- ☐ Flower seeds (look for seeds that grow quickly)
- ☐ Sunny windowsill or other warm place
- ☐ 3 sheets of black construction paper
- ☐ Masking tape (or any tape that isn't clear)
- ☐ Worksheet chart

This project has TWO PARTS: In the first part you'll plant flower seeds in an egg carton and watch them sprout into plants. In the second part, you will experiment to see what happens if your plants don't get enough water or sunlight. Ask an adult to help you do this project!

WHAT YOU DO–PART 1:

1. Open the egg carton and carefully cut the top and bottom halves apart. Line the lid with a piece of plastic wrap to make a tray. Set the bottom half (the part with the 12 little sections) of the carton into the tray you just made.

2. Fill each section about 3/4 of the way full of potting soil.

3. Have an adult help you read the back of the package of your flower seeds to find out how deep to plant them. Poke three or four little holes in the soil in one section using your pinky finger. Make the holes as deep as the package says to plant the seeds. Put one seed into each hole, then cover the seeds with a little more soil.

4. Repeat step four in each section of your garden so that each one has 3-4 seeds planted.

5. Sprinkle some water into each section to water the seeds. Don't add too much – just make sure the soil looks a little bit wet.

6. Carefully move your whole garden to a warm place that gets a lot of sunlight, like a windowsill.

7. Look at the soil in each section every day. Do you see any signs that your seeds are growing? If the soil looks dry, add some water. If it still feels moist, check it again tomorrow.

8. Once all of the plants have grown at least 2 inches tall, you can begin Part 2 of the experiment.

WHAT YOU DO–PART 2:

1. Start this part of the experiment in the morning so that you can check on your plants after a whole day of sunlight. Use the worksheet to keep track of your garden during your experiments!

2. Draw a line down the middle of the carton (the short way) so that there are six sections on each side of the line. Draw a star on one side of the carton. The six sections between the star and the line are the ones you will experiment with. Let's call this the test half. The other half of the garden will be called the control half, because you will not change anything about how you take care of the plants in that half.

3. Draw a star on the worksheet in the same place as the one on your garden. This is a chart to help you keep track of the test half.

4. Choose three sections in the test half of your garden for a sunlight test. These plants will still get the same amount of water as the control plants, but they will not get any light!

5. Make a cone to cover the plants: roll up a sheet of black paper into a narrow cone shape and tape the edge. Put a piece of tape over the top to block more light. Make three cones and put them over the sections you chose to test. Make sure the cones completely cover the plants.

6. Mark the circles on your chart to show which sections will not get any light (cross out the sunlight and circle the water).

7. The other three sections of plants in the test half are for a water test. These plants will still get the same amount of sunlight as the control plants, but they will not get any water!

8. Mark the circles on your chart to show which sections you are not going to water.

9. Look at your chart and water all of the sections in the garden with an equal amount of water, except for the three from step 6 that do not get water.

10. Put your garden in a sunny spot and leave it there all day. After the sun sets, check on your plants. Carefully lift up the cones to check the sunless plants. If you see any changes, you can draw pictures on the worksheet. If nothing has changed, put the cones back on. In the morning, water them again, and leave them for another day. Continue to check and water them until you can see a difference between the plants. It might take several days, depending on how much sunlight they are getting and the type of flowers you are growing.

11. When you are finished with the experiment, make sure you take the cones off. The plants in the test half may need some extra-special care to get back to health!

12. When your plants outgrow the egg carton cups, ask an adult to help you cut the cups apart with scissors and plant each one in a pot or outside in a real garden, if you have one. Dig a hole just big enough to set the egg carton cup in. You can plant the whole cardboard cup in the soil right along with the plant; it will break down in the soil over time. Push dirt around the plant to hold it up and cover the hole. Make sure you continue to water your plants!

WHAT HAPPENED:

Part 1: For the first few days, you probably didn't see much going on in your flower garden. After about a week, some little green stems should have begun to sprout up out of the soil in some of the cups. This is the first sign that your flower plants are growing, even though they had already been growing for some time below the soil, like you saw in the last experiment. Keep watering your young plants and you will be amazed at how quickly they will grow! Soon little leaves should start to appear on the stems.

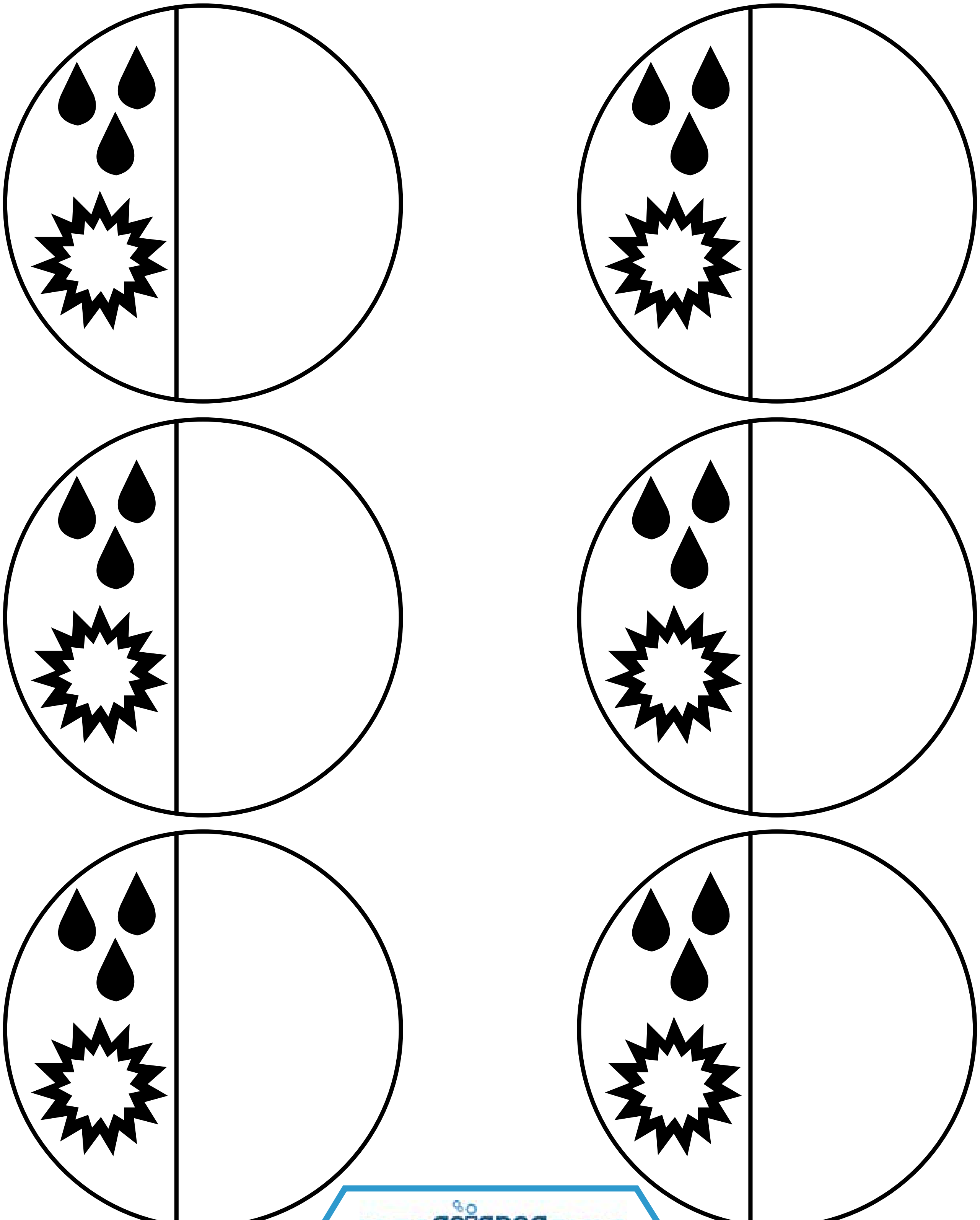
Part 2: What did you notice about the plants that didn't get any sunlight? Their stems and leaves probably started to look a little more yellow than the other plants. They might have wilted some or not grown as tall as the control plants. Even though these plants were getting the same amount of water as the other plants, they weren't getting any sunlight! Water isn't enough to keep a plant healthy. Why not? Well, plants use sunlight to create food. When they don't get any sunlight, they can't create food! Plants need water and food to survive!

What did you notice about the plants that received the same amount of sunlight as the control plants, but no water? Did the plants start to wilt without water, or do they just not grow as much as the others? At first you might not have noticed any difference at all, but once the soil dried out, the plants' roots started to run out of water and the plants probably started to wilt and maybe even wither or shrivel up a little bit. Even though these plants were still getting plenty of sunlight, they still couldn't make food, because water is one of the things required for plants to be able to make food!

FLOWER GARDEN WORKSHEET

1. Circle or cross out the water and sunlight pictures or show what you did to each section of your garden.

2. Draw a picture of what your plants looked like at the end of the experiment. You can print out a differend page for each oday of tyour experiment if you want ot show how the plants changed with time.



DISSECTING A FLOWER

Experiment

WHAT YOU NEED:

- ☐ Lilies, irises, or any flower with large parts work well for this project.
- ☐ scalpel or sharp knife
- ☐ magnifying glass
- ☐ Adult supervision recommended

A good way to learn about the reproductive parts of a plant is by dissecting a flower.

WHAT YOU DO:

1. Start by identifying each main outside part of the flower. Beneath the petals, there should be smooth, leaf-like projections called sepals. The male part of the flower is called the stamen; there are usually multiple stamens on each flower. The long stalk of the stamen is called the filament. At the top of the filament is the anther, which holds pollen. The female part of the flower is called the pistil. At the top of the pistil is the stigma, which collects pollen and carries it down though its hollow body, called the style, to the ovary, where the pollen fertilizes the flower's eggs. Some flowers have all male or all female parts (melons and pumpkins for example), and are called imperfect. Most flowers are perfect: they have both male and female flowers.

2. The first step in this dissection is to remove the sepals and petals, by pulling them down toward the stem. If you have a microscope, look at the tip of the petal on a low magnification. If you don't have a microscope, use your magnifying glass to examine the petal. What is the petal's texture like?

3. Next, remove the flower's stamens; break or cut them off of the stem. Examine the pollen with your magnifying glass or microscope. Can you see what shape each pollen grain is? Make a drawing of the pollen.

4. As you dissect the flower, you should be able to identify the plant as either a monocot or a dicot. Almost all grasses are monocots, as are irises, lilies, and some other flowering plants. Monocots have petals in multiples of three and usually have parallel veins in their leaves. Most woody and common flowering plants are dicots. They have petals in multiples of four or five and have branched veins in their leaves.

5. After you have finished with the pollen, remove all parts except the pistil so that it remains alone on the stem. Carefully cut the pistil in half lengthwise, making sure that your fingers are out of the way. Use your magnifying glass to look at the inside of it. You should be able to see that the style is a long, hollow tube that carries pollen from the stigma to the ovary. You might be able to see tiny eggs, or ovules, in the pistil's ovary.

6. If there are any buds or half-opened flowers that were on the same stalk as your flower, pull them open and identify any of the parts that you can find. Do any look different than on the opened flower?

7. Please note that sometimes a part of the flower, such as the anther on top of the stamen, will be broken off, so you might not be able to observe all parts. If this happens, try using another flower.

HOW TO MAKE A TERRARIUM

WHAT YOU NEED:

- ☐ Large glass or plastic jar (or small aquarium or clear container with a lid
- ☐ Small selection of plants

A terrarium is a collection of live plants, usually in a glass or plastic container, with a balance of light and air that allows them to grow without needing the usual care house plants need. Small shade and water-loving plants are the best kind for terrariums; check with a garden shop or an online gardening site if you need help finding some. Some specific plants that grow well in this environment are Venus fly traps, ferns, moss, ivy, chamomile, begonias, Cyclamen, African violets, and orchids.

WHAT YOU DO:

1. To make your own terrarium, you will need a large glass or plastic jar or a small aquarium or other clear container that has a lid. The lid keeps water vapor from escaping so that the terrarium stays moist. You'll need a vent, though, (poke small holes, if your lid does not have one) to allow some air into the terrarium.

2. Cover the bottom of the jar with 2-3 inches of dirt. You might also want to add some pebbles to the bottom for better soil drainage.

3. When you put the plants in the soil, be sure not to crowd your terrarium with too many plants—if you want more than a few varieties, use multiple containers. You can use a spoon and fork to dig holes and set the plants in place if the mouth of the jar is too small for your hand to fit through easily.

4. Keep your terrarium where it will receive partial sunlight rather than hot, direct light. After the first time, you will only need to water your plants very occasionally if at all. (Over-watering will cause rot!) The water vapor from the plants will stay in the terrarium and be continually 'recycled,' so there should be condensed water vapor clouding the sides of the container.

5. The terrarium has a moist, rainforest-like environment. You might want to talk with your children about other common climates (such as desert, tropical, polar, and temperate) and the kinds of plant life found in each.

TRAVELING NUTRIENTS

Experiment

WHAT YOU NEED:

- ☐ 1/2 cup dry soil
- ☐ 1/2 teaspoon blue powdered tempera paint
- ☐ Funnel
- ☐ Water
- ☐ Wide-mouthed jar (that the funnel can rest in)
- ☐ Coffee filter
- ☐ Cups or containers
- ☐ Measuring cup

Water is often called the Universal Solvent because it can dissolve more substances than any other liquid, often carrying these dissolved particles with it. When water travels through soil, nutrients (food) and dissolved particles travel with the water to be deposited somewhere else. Here is an experiment to visually demonstrate how this process happens.

WHAT YOU DO:

1. Mix the dry soil and tempera paint thoroughly. Place the funnel in the jar and place the coffee filter in the funnel. Pour the soil mixture into the funnel.

2. Slowly pour 1/2 cup water into the funnel, watching as the water runs out of the funnel into the jar. Notice the color of the water.

3. Remove the funnel from the jar and pour the water into a cup or container. Replace the funnel over the jar, with the coffee filter full of sand still in place.

4. Repeat steps 2 and 3 with a fresh 1/2 cup of water several times, saving the water in a new cup after each pouring.

WHAT HAPPENED:

When the first half cup of water went through the soil, the water that came out was very dark blue in color. However, each subsequent cup that went through the soil mixture came out lighter and lighter. Eventually, the water traveling through the soil came out clear in the jar. How many half cups of water did it take for the water to run clear?

The tempura paint in this experiment represents the nutrients and dissolved particles found in the soil. Water is a very efficient transporter of particles as evidenced by the color of water as it was poured through the soil. The soil started with a relatively high amount of nutrients and particles in it — the tempura paint. The water flowing through the soil was able to pick up a large proportion of the 'nutrients' and carry them with it through the funnel. Each subsequent pouring of water picked up more nutrients. With each pouring, the remaining nutrients became less and less until the water ran clear and there were no more nutrients left to travel with the water.

RECYCLED SEED STARTER PROJECT

Experiment

WHAT YOU NEED:

- ☐ Empty cardboard egg carton
- ☐ Potting soil or dirt
- ☐ Seeds (carrots, green beans, radishes, and herbs grow well)
- ☐ Aluminum foil
- ☐ Scissors
- ☐ A large nail
- ☐ An adult to help

WHAT YOU DO:

1. Cut the lid and front flap of the egg carton off neatly. Set the front flap into the lid to cover up the holes.
2. Line the inside of the lid with one or two sheets of aluminum foil. Be sure to cover all of the cardboard to keep it from getting wet. You will use this later as a tray to catch extra water.
3. Turn the bottom half of the carton over (If there are tall portions that stick up between the egg cups, you can cut those off, too). With an adult's help, carefully use a large nail to poke 2-3 holes in the bottom of each egg cup. These holes will allow extra water to drain out.
4. Set the bottom half of the egg carton right side up into the foil-lined tray.
5. Fill each cup with soil and press it down lightly.
6. Plant seeds by making a small hole and sprinkling 5-6 seeds into it. Repeat in each cup and cover the seeds lightly with soil.
7. Sprinkle water carefully over the soil in each cup.

Set the egg carton on a sunny windowsill. Water the seeds every day or as often as the edges of the soil begin to look dry. Because the cardboard from the egg carton will soak up some water, be careful not to water the seeds too much, or the carton will become soggy. You can also lift the carton out of the tray and pour out excess water if needed.

WHAT HAPPENED:

What do seeds need in order to sprout and grow? They need water, sunlight, and nutrients from soil. Learn more about germination (when seeds sprout) and how plants grow.

Once your seeds have sprouted and grown into healthy seedlings, you can plant them outdoors. Even if you don't have a garden, your seedlings should do just fine planted in larger pots or various recycled containers (poke holes in the bottom of containers so extra water can drain out, then fill with soil). When you're ready to plant your seedlings, carefully cut the egg cups apart. You can plant each egg cup (carton and all!) directly into the ground or a container by digging a hole large enough for the cup to fit in and then carefully packing dirt around it. A cardboard egg carton is biodegradable, which means it will break down and become part of the soil over time. The roots of your plants will help break the egg carton apart, too. In nature, organic matter – such as leaves that fall from trees in Autumn – breaks down into the ground over time. Leaves and other organic materials (natural things that were once living) enrich the soil, giving plants growing nearby nutrients they need to be healthier. The cardboard from your egg carton pots won't enrich the soil, but it will still break down and become a part of the soil.

Note: It is important to make sure freezing nighttime temperatures have passed where you live before planting seedlings outside. Even one night of frost could damage or destroy small plants.

COLOR CHANGING FLOWERS

WHAT YOU NEED:

- ☐ Fresh white carnations, mums, or other all-white flowers
- ☐ Green food coloring
- ☐ Jar or vase of water

Have you ever seen bright green flowers around Saint Patrick's Day? In this project, you'll get to dye some yourself and also learn a little about how flowers live in the process.

WHAT YOU DO:

1. Add at least 15-20 drops of food coloring to the container of water and mix it well. The more coloring you add to your water, the more the color will show up in your flowers, so make sure you use plenty!transpiration to dye flowers
2. Cut about a half inch off the end of each flower's stem at an angle. Making a fresh cut at an angle will allow the flowers to absorb more water.transpiration to dye flowers
3. Place the flower stems into the colored water and observe how the petals look. They are pure white, right?
4. After about an hour, check on the flowers. Have the petals changed at all?
5. Leave the flowers alone for several more hours and check on them periodically. After a full 24 hours, the petals should have quite a bit of green on them.transpiration to dye flowers

WHAT HAPPENED:

You probably know that plants "drink" water from soil through their roots, and it in turn travels up the plant's stem or trunk (in the case of a tree) and to its leaves, flowers, or fruit. This process is called transpiration and it helps plants cool off. When a flower's stem is cut off of the plant it grew on, the stem is still able to suck water up to keep the flower alive for a little longer, even though it no longer has roots attached to it.

How does that happen? Well, it works sort of like sucking on a straw to get a drink from your glass to your mouth. When water in the flower's petals and leaves evaporates, it pulls more water up the stem to replace the water that evaporated. How does the evaporating water pull more water up with it? Water has a special property, called cohesion, that causes it to stick to itself. Water moves through tiny tubes in the stem called xylem (say ZYE-lum). Because of cohesion, each drop of water pulls another drop along behind it, effectively moving water up the stem and into the flower.

Adding green dye to the water allowed us to see how water travels from the flower's roots, up its stem, and then transpires (or evaporates) at its petals. As a bonus, you get pretty green flowers you can use as decoration for St. Patrick's Day!

When you're done enjoying your colored flowers, ask an adult to slice upwards through the stem of one to see the tiny tubes full of green dye and how the colored water traveled up the stem to change the color of the flower's petals.

MAKE A RAINBOW

WHAT YOU NEED:

- ☐ A clear square or rectangular baking dish
- ☐ A handheld mirror
- ☐ Water
- ☐ A flashlight (with a normal bulb rather than an LED)
- ☐ A white wall or sheet of paper
- ☐ Sticky-tack or modeling clay

WHAT YOU DO:

1. Fill the baking dish about two-thirds full with water.
2. Carefully set the mirror in the bottom at an angle. You may find it helpful to use a small piece of modeling clay or sticky tack to hold it in place.
3. Position the pan and mirror so that the mirror reflects toward a white wall. (Or ask a helper to hold a sheet of white paper about six inches from the mirror.)
4. Turn off the lights in the room. Turn on your flashlight and shine it through the water directly at the mirror.refraction rainbow
5. Can you find the rainbow on the wall or sheet of paper? You may need to adjust the angle of your flashlight or the mirror to get it to appear brightly.refraction rainbow

WHAT HAPPENED:

How did the pan of water with a mirror in it make a rainbow on your wall? The water in the dish caused the beam of light from your flashlight to bend. This is called refraction. When white light (like the kind from a flashlight's bulb) refracts, all of the colors it is made up of become visible! You couldn't see the different colors until they hit the mirror and were reflected back out of the water as a rainbow! Note that the rainbow may not have had a bow shape like ones you would see in the sky. That's because a natural rainbow in the sky is actually a full circle, but unless you are above the rainbow, you can only see half of it.

Something similar sometimes happens after a thunderstorm; but instead of the water being in a dish and a flashlight making the light, the water is in the form of droplets in the air (often in clouds) and the light comes from the sun! Beams of sunlight hit drops of water in the sky and are refracted (separated into their colors) and reflected back out, allowing us to see a rainbow if we're at the right angle.

EGG RACE

WHAT YOU NEED:

- ☐ Plastic eggs
- ☐ Cardboard box
- ☐ Sharp scissors or knife
- ☐ An adult to help
- ☐ Packing tape
- ☐ Stopwatch

This egg race project teaches about physics concepts like force, friction, and gravity. Customize your egg and/or your ramp and see how it changes your results.

WHAT YOU DO:

1. Ask an adult to carefully cut the flaps off of your box with sharp scissors or a knife. Make a long ramp by taping the short ends of the flaps together using packing tape. It should measure at least two feet long for best results.

2. Fold each long side of the ramp up 1-2" to help keep your moving egg from rolling off the edge! Find a spot to try your ramp—prop one end up on the edge of a chair or sofa with the other end on the floor.

3. Get your stopwatch ready and start it as you set the egg on its side at the very top of the ramp. Stop the stopwatch as soon as the egg reaches the bottom. You may have to try it several times to get an accurate time (or ask someone to help you watch the egg while you time it).

4. Now find another spot to prop the ramp—try something that is lower to the ground than your first spot and time the egg again. Compare the time it took at the first height and when you placed the ramp lower (at less of an incline).Egg ready to race down ramp

5. Repeat with another location that is even higher than your first test and compare the times from all three heights.
Variation: Instead of using a stopwatch, you could make two ramps of the same length and race plastic eggs down them with a sibling or friend. Try putting both ramps at the same level of incline, then changing only one ramp, and then try putting different objects inside your eggs to see if the speed at which they travel down the ramp changes!

WHAT HAPPENED:

You created a ramp out of the cardboard flaps. A ramp is a type of simple machine called an inclined plane. Using an inclined plane reduces the amount of work (force) needed to move an object upwards. However, we used the ramp in this example in the opposite way—to move objects downwards! When a ramp is placed at different heights, the time it takes for an object to move down the ramp changes. At what angle did the egg move the quickest down the ramp? When the ramp's angle was steep, the egg made it to the bottom faster than when the ramp's angle was lower to the ground, right? Do you know why?

There are a few forces that affect the egg's motion down the ramp. The first is gravity. Gravity is pulling down on the egg and is what allows it to move so quickly to the bottom. The second force is friction. Friction is actually acting against the egg. When the ramp had a lower angle, the negative effect of friction was stronger causing the egg to slow down a bit more than when the ramp was at a higher angle. Because the egg and the ramp both have a smooth outer surface, there was not much friction acting on the egg in this situation. Do you think it would be different if your ramp had been covered in something with a rough surface, such as sandpaper? What if the egg had been a square block rather than a round shape? You can test those theories out if you like by trying different materials and objects on your ramp.

GREEN EGGS AND HAM

WHAT YOU NEED:

- ☐ Frying pan and stove
- ☐ Egg
- ☐ Red cabbage
  (it's called red, but it looks purple!)

When you were little, you probably read the Dr. Seuss book Green Eggs & Ham. Do this easy pH trick to make green eggs just like in the book.

WHAT YOU DO:

1. Chop a 1/2 cup of cabbage, cover it with boiling water, and let it sit for 10 minutes until the water is dark purple. Strain out the cabbage.
2. Crack an egg and separate the egg white from the yolk by carefully pouring the egg from one half of the shell to the other over a bowl. (Or you can pour the egg into a slotted spoon over a bowl instead.) Set the yolk aside.
3. Mix a little cabbage juice in with the egg white. What happens?
4. Grease the pan and let it heat up a little, then pour the egg white in.
5. Set the yolk in the middle of the egg white and finish cooking!

WHAT HAPPENED:

Red cabbage contains pigments called anthocyanins, which change colors when they come in contact with acids (low pH) or bases (high pH), making them a natural pH indicator. When the cabbage juice comes in contact with an acid (like vinegar) it will turn red, but when it is mixed with a base it will turn bluish-green. What does this project tell us about egg whites, then? Egg whites are basic (also called alkaline) and so they turn the red cabbage juice green.

EGG FLOAT

WHAT YOU NEED:

- ☐ Two raw eggs
- ☐ Two glasses or jars (similar size and shape)
- ☐ Water
- ☐ Salt
- ☐ Tablespoon

Make a regular egg float in a 250 ml beaker!

WHAT YOU DO:

1. Fill each glass half full of tap water.

2. Using a spoon, gently set one egg into each glass of water.

3. Add 3 tablespoons of salt to one glass and stir it being careful of the egg. There should still be some salt at the bottom of the glass that won't dissolve. If not, add another tablespoon of salt. As the salt mixes with the water, the egg should rise higher in the water until part of the egg is above the surface of the salty water! If this doesn't happen, add more salt a tablespoonful at a time and stir until the egg begins to float.egg density

WHAT HAPPENED:

A normal egg sinks in plain water because the egg is more dense than the water. Density is a measure of how solid something is. All things are made up of tiny particles called molecules. If the molecules inside an object are very close together, the item is solid, or dense. If the molecules are farther away from each other, the object is less dense, or less solid. (An example of a very dense item is a penny. A cork is less dense.) When enough salt is added to water, the density of the water changes and becomes more dense than the egg, causing it to float up towards the surface of the water!

To take this experiment a step further, you can remove the egg from the first glass and use a dropper or a spoon for slowly add the plain water from the first glass on top of the saltwater in the second glass. The key is to add the plain, less dense water slowly enough that it will stay above the saltwater instead of mixing with it. Watch what happens to the egg. Does it float to the top? It should stay right between the two layers of salty and not salty water. Can you explain why? It's because the egg is less dense than the saltwater, but more dense than the plain water, so it floats between the two!

EGG IN A BOTTLE

WHAT YOU NEED:

- ☐ Eggs
- ☐ Saucepan and stove
- ☐ Vegetable oil
- ☐ Matches
- ☐ Strips of paper folded a couple times length-wise
- ☐ Wide-mouth glass drink bottle
(slightly shorter than the bottle- such as a Starbucks Frappuccino bottle – the mouth needs to be a little smaller than the egg. We used a large egg wih the Starbucks bottle, but with other bottles you might need smaller eggs.)

Learn about the relation of temperature and pressure as you watch an egg get sucked into a bottle. This project requires adult supervision.

WHAT YOU DO:

1. Place the eggs in a saucepan and add enough water so that the eggs are covered by about an inch. Let the water boil for 5 minutes, then remove the pan from the heat and cover it. Let it sit for 25 minutes, then remove the eggs and dip them in cold water.

2. Use a paper towel to coat the inside edge of the bottle mouth with a little bit of vegetable oil for lubrication.

3. Peel one of the eggs, then dip it in water and set it with the small end down in the mouth of the glass bottle. It should be slightly larger than the mouth of the bottle, so it doesn't fit inside.

4. Use a match to light the end of a strip of paper on fire. Lift the egg off the bottle, drop the paper inside with the flame down, and quickly replace the egg. Watch the egg wiggle a little in the bottle mouth, and then get sucked inside!

WHAT HAPPENED:

First, the science behind a hard-boiled egg: Egg whites are made of water and proteins. Proteins are made of long chains of amino acids, but in an egg the chains are clumped tightly together in individual spheres. (These are called "globular proteins.") When the egg is heated, the proteins and water molecules begin to move faster. As they move and collide with each other, the individual protein chains start to "unravel," eventually bonding loosely with other protein chains, forming a network of protein with water trapped inside. The consistency has changed from runny egg white to a soft solid!

So how does this squishy-but-solid egg get mysteriously pushed inside the bottle? The answer is all about air pressure. When you first set the egg on the bottle, the air pressure inside the bottle matched the air pressure outside, so nothing happened. When you dropped the burning paper into the bottle, it caused the air inside to heat up and expand rapidly. That expanding air pushed the egg aside and escaped from the bottle; that's why you saw the egg vibrating. When the fire consumed all the oxygen inside the bottle, the flame went out and the remaining air in the bottle cooled down. Cool air takes up less space, exerting less pressure inside the bottle. (The egg acted as a seal to prevent outside air from getting in to fill the extra space.) The result was an unbalanced force—the force of the air pushing on the egg from outside the bottle was greater than the force of the air pushing up on it from inside the bottle. Voila – the egg was pushed into the bottle!

How do you get the egg out again? You need to increase the pressure inside the bottle. Turn the bottle upside down and tilt it until the small end of the egg is sitting in the mouth. Now put your mouth close to the bottle and blow, forcing more air into the bottle and raising the pressure inside. When you take your mouth away, the egg should pop out – just be careful it doesn't hit you in the face!

EGG CRYSTAL GEODES

WHAT YOU NEED:

- ☐ Raw eggs
- ☐ water
- ☐ food coloring
- ☐ 250 ml beakers
- ☐ Funnel (optional)
- ☐ Plastic cups
- ☐ Epsom salt (magnesium sulfate),
- ☐ alum (aluminum potassium sulfate) or other solids commonly used to grow crystals, like Borax (sodium tetraborate), copper sulfate, etc.)
- ☐ White school glue and paint brush (for alum crystal geodes only)

Make sparkly crystal "geodes" inside real eggshells. First you'll need to make a supersaturated solution. For our geodes, we used magnesium sulfate and aluminum potassium sulfate. Can you think of other solids you can use to grow crystals? For this project, plan ahead and reserve the eggshells the next time you use eggs in a recipe.

WHAT YOU DO:

1. Crack the eggs close to the top of the narrow end. Remove yolk and white.
2. Carefully place eggshell under warm running water and peel the membrane from the shell. Be very gentle! This part is tricky and requires much delicacy to avoid breaking the fragile eggshells. Once the membrane is removed and the eggshells are rinsed, invert them on a paper towel to dry.
3. For alum crystal geodes, paint the inside of the shell with white glue. Then sprinkle with alum powder, and let dry.
4. To make supersaturated solution, use your microwave to heat 100 ml of water in a 200 ml beaker just until boiling. Remove the beaker using hot pads or heat-resistant leather gloves.
5. Stir in your solid (Epsom salt, alum, etc.), one spoonful at a time. Your solution should be clear. Heat it up more if all the solid won't dissolve.
6. Add food coloring, and let cool for about 10 minutes.
7. Carefully submerge the eggshell. Or set it in a clean empty cup and use the funnel to fill it with the supersaturated solution.
8. Leave the eggshell and supersaturated solution undisturbed for several days or longer.
9. After a few days, you should start to see crystals forming inside your eggshell. Use a spoon to remove it from the solution, or carefully pour the supersaturated solution out of the eggshell.

WHAT HAPPENED:

A crystal is a hard, solid substance made of molecules that bond together in specific patterns to form a shape with straight edges and flat surfaces. If you made more than one type of egg crystal geode, you saw that not all crystals have the same shape or size. The site where a crystal begins to grow, called its nucleation site, determines its size: fewer nucleation sites mean larger crystals, and many nucleation sites produce smaller crystals. A few molecules of magnesium sulfate or aluminum potassium sulfate (or whatever solid you used) found each other in the solution and joined together in a crystal formation. More molecules joined until enough gathered to form a visible crystalline solid. Chemists refer to this as a crystal 'falling out of'? the solution. If you left these crystals in the solution, they'd continue to grow.

DISAPPEARING EGGSHELL

WHAT YOU NEED:

- ☐ An egg from the grocery store
- ☐ A drinking glass
- ☐ White vinegar

An egg is covered by a hard shell to help protect the chick growing inside. When the chick is ready to hatch, it breaks the shell open. Try this experiment to find out what a shell is made of.

WHAT YOU DO:

1. Set a raw egg in a glass of white vinegar so that it's completely covered in the liquid. Bubbles should start to form on the surface of the egg.

2. Let the egg sit in the vinegar for about 3 days and then take it out and rinse it in water, being careful not to pop it. Does it feel different from when you put it in the vinegar? Does it still have a white shell?

WHAT HAPPENED:

The eggshell disappeared! But there might be some chalky white stuff left on the egg. This is because vinegar is a type of acid that 'ate' away and dissolved the calcium carbonate that the shell is made out of. (Chalk is also made out of calcium carbonate!) When something dissolves, it breaks into very tiny pieces and mixes with a liquid. You can see it happening if you put a sugar cube into a cup of hot water and stir. The sugar cube disappears as the sugar dissolves into the water.

You might be wondering why the egg white and yolk inside the shell stayed in the shape of an egg even though the shell is gone. This is because the egg has another covering underneath the shell; called a membrane. It is very thin and you can see the yellow yolk through it.
The vinegar can't dissolve the egg membrane, but some of it was able to get through the membrane, making the egg swell up.

SHRUNKEN EGG

WHAT YOU NEED:

- ☐ The egg without its shell from the previous project (Dissappearing Eggshell)
- ☐ A drinking glass
- ☐ Corn syrup

Do this project to see if you can get the egg to shrink!

WHAT YOU DO:

1. Carefully place the egg in a glass of corn syrup, so the egg is covered.

2. Let the egg sit in the corn syrup for about 3 days. Then take it out and see what happened!

WHAT HAPPENED:

The egg shrank! This is because the egg membrane let a bunch of water pass out of the egg to try to balance how much water was inside the egg and how much water was outside it in the glass. The very tiny parts that make up corn syrup (called molecules) were still too big to pass through the membrane, so none of the corn syrup got inside the egg. The egg lost a lot of water, but didn't get anything to take the water's place, so it looks a little funny! Do you think it would fill up again if you put it in a glass of water? Try it out!

The fact that the egg membrane can let some things through is very important for a baby chick. Air passes through the membrane, just like water did in this experiment, and that allows the baby chick to breathe while it's inside the egg.

SPIN THE EGGS

WHAT YOU NEED:

☐ 1 hard boiled egg
☐ 1 raw egg

Do this project to see if you can get the egg to shrink!

WHAT YOU DO:

1. Spin the hard-boiled egg on its side.

2. When it's going fast, gently put your fingers on it to stop it. Move your hand off immediately when it stops.

3. Now spin the raw egg.

4. Stop it in the same way you did with the hard-boiled egg. After you let go, what happens?

WHAT HAPPENED:

Newton's First Law of Motion, also known as the Law of Inertia, states that an object's velocity will not change unless it is acted on by an outside force. This means an object at rest will stay at rest until a force causes it to move. Likewise, an object in motion will stay in motion until a force acts on it and causes its velocity to change.

The raw egg should have started to turn again. This is because the motion of the liquid within the egg is still going; the force you exerted was not enough to stop both the inertia of the shell and the inertia of the liquid inside of it. If you held the egg longer, you would exert enough force to stop the egg completely. These results demonstrate the Law of Inertia: an object will continue to remain in one state until sufficient outside force acts upon it, either to put it in motion or to bring it to rest.

FIZZING EASTER EGG DYE

WHAT YOU NEED:

- ☐ Hard-boiled eggs
- ☐ Food coloring
- ☐ Sodium bicarbonate (baking soda)
- ☐ Vinegar
- ☐ Bowls
- ☐ Paintbrushes
- ☐ Tongs
- ☐ Newspaper or paper towels

You've probably had plenty of experience with homemade baking soda and vinegar volcanoes, but have you ever used that basic chemistry concept to dye eggs? This project is fun for all ages!

WHAT YOU DO:

1. Make a paste of baking soda and water and add a few drops of food coloring. Repeat in separate bowls with as many colors as you'd like.baking soda egg dye paste

2. Using a paintbrush, apply the baking soda mixture to a hard-boiled egg (if the mixture is too thick and goopy, add more water, several drops at a time until it has thinned to the right consistency to spread easily). Once your egg is decorated the way you want it, set it in an empty bowl.Pour vinegar on the eggs

3. Pour about ½ cup of vinegar directly over each egg and enjoy the colorful, fizzy reaction!pour vinegar on eggs

4. Once the fizz has died down, use tongs to carefully fish your egg out of the liquid and set it on newspapers or a stack of paper towels to dry.dry off eggs

5. Repeat with as many eggs as you like—you'll find that the baking soda paint makes it easy to make more intricate designs on your egg than ordinary egg dye would!

WHAT HAPPENED:

A basic chemical reaction between the baking soda (which is a base) and the vinegar (an acid) is what caused all the fizzing and bubbling! The baking soda made a type of paint when you mixed it with water and food coloring. After the chemical reaction, the baking soda and vinegar were mostly used up, leaving the dye behind on the eggs.

BAKED ALASKA

WHAT YOU NEED:

- ☐ Cake or brownie mix
- ☐ Ice cream (flavor of your choice)
- ☐ 4 egg whites*
- ☐ 1/4 tsp cream of tartar
- ☐ 1/2 cup sugar

Is it possible to put ice cream in a hot oven without it melting? Oh, yes! Make this delicious dessert to try it out. There are many variations of this dessert—choose the type of cake, ice cream, fillings, and toppings that you like best. You can make one large dessert, or individual ones as we did.

WHAT YOU DO:

1. Choose a bowl (or individual ramekins) for an ice cream mold and line it with aluminum foil. Pack the ice cream in tightly and then freeze for several hours or overnight.

2. Bake the cake or brownie mix as directed on the package. Allow the cake to cool all the way. Cut the cake to form a base for your ice cream mold. (Use a biscuit or cookie cutter for individual servings.) The base should be slightly bigger than the molded ice cream.

3. When the cake is cooled and the ice cream well frozen, make the meringue: Use a mixer to beat the egg whites on high until frothy, then add the cream of tarter and beat until soft peaks form. Continue beating and add the sugar one tablespoon at a time until you have stiff glossy peaks. (Lift the beater out of the bowl – if the peaks stay standing up, your meringue is ready.)

4. Preheat the oven to 450 degrees F.

5. Place the cake on a cookie sheet, then remove the ice cream from the mold and place it on top the cake base.

6. Use a spatula to quickly spread the meringue over the cake and ice cream, covering it completely. Make sure the meringue goes all the way down to meet the cookie sheet. (If you think your ice cream is getting soft quickly, you can put the dessert back in the freezer for 15-20 minutes before putting it in the oven.)

7. Place on the middle rack in the hot oven and watch closely. Remove when meringue is golden brown, about 3-5 minutes.

8. Serve immediately—and enjoy!

*SAFETY TIP

Sometimes the egg whites in the meringue won't be fully cooked. If you're concerned about salmonella, use pasteurized dehydrated egg whites or meringue powder you can buy at the store. You can also use liquid pasteurized egg whites from a carton, although the meringue won't fluff up as much as with fresh eggs.

WHAT HAPPENED:

We know eggs change their form when heated. In this recipe, we see that egg whites also change their form when beaten vigorously! The two changes are caused by the same thing: globular proteins unfolding and forming new bonds with each other. When you beat the eggs, you're adding air bubbles to the mixture of proteins and water in the egg whites. Some of the amino acids in the proteins are attracted to water and some are repelled by it. The proteins begin to unfold so that the water-loving amino acids can move towards the water, and the others can move toward the air pockets. The unfurled proteins bond with each other, creating a network of protein that traps the air bubbles inside, making a nice fluffy, frothy meringue.

Now, the ultimate question—why didn't the ice cream melt completely when you put it into that very hot oven? The answer is that the meringue acted as an insulator, slowing down the transfer of heat. It works kind of like styrofoam (but tastier); the air trapped in small pockets in these materials makes them both good insulators.

HOMEMADE WHIPPED CREAM

WHAT YOU NEED:

- ☐ Whipping cream (very cold)
- ☐ Large metal mixing bowl
- ☐ Wire whisk or electric mixer

Make a regular egg float in a 250 ml beaker!

WHAT YOU DO:

1. Pour a half cup of heavy whipping cream into the mixing bowl

2. Using your wire whisk or electric mixer, whip the cream. After several minutes, it should begin to stiffen.

3. Continue whisking until it's reached the desired consistency.

WHAT HAPPENED:

Whipping cream is a dairy product that contains a lot of milk fat—usually around 30% or more. Cream comes from skimming off the top of fresh milk, where most of the milk fat has risen. The fat from the cream is contained in tiny droplets, like mini balloons too small to see without a microscope. When you whip cream, you're introducing millions of tiny air bubbles into the liquid. First the cream gets foamy, but as you continue whipping, you strip away the protective outer membranes on the fat balloons. This allows the fat to join together and gradually form protective bubbles around the tiny pockets of air. Like butter, it's also an emulsion. In fact, if you whip it long enough, it will turn into butter! Air suspended in liquid and held stable by fat – and is also why you need cream with a relatively high fat content (at least 30%) in order to whip cream. The less fat, the thinner the fat globules are stretched and the harder it is to make a stable emulsion.

ICE CREAM IN A BAG

WHAT YOU NEED:

- ☐ 1/2 cup of milk
- ☐ 1/2 cup of cream
- ☐ 1/4 cup of sugar
- ☐ 1/2 teaspoon of vanilla or other flavoring
- ☐ 2 cups of ice
- ☐ 1/2 cup salt
- ☐ quart-size ziplock bag
- ☐ gallon size ziplock bag

The principles of rocketry apply to more than flying rockets – with this project you can make a 'rocket car' that is powered by pressurized gas (air in a balloon!). Adult supervision recommended.

WHAT YOU DO:

1. Stir milk, cream, sugar, and flavoring together in a bowl, then pour the mixture into a quart-size freezer ziplock bag. Stick this bag inside a gallon-size ziplock, half-filled with ice and rock salt – about 2 cups of ice and 1/2 cup of salt.

2. Use a thermometer to measure the temperature in the outer bag. Next, begin shaking the bag so that the ingredients are whipped together. What do you expect to happen to the cream mixture?

3. After five minutes of shaking, let the bag sit for a few minutes. Now take the temperature inside the gallon bag again. Has it changed? What happens if you don't shake it?

4. When the ice cream is thick, get out a spoon and enjoy!

WHAT HAPPENED:

Salt lowers the freezing point of water, which causes the ice to melt at a lower temperature. The lower freezing point provides the temperature difference needed to transfer heat between the freezing ice cream ingredients and the melting ice. Rock salt doesn't lower the freezing point as much as table salt does (so it results in smoother ice cream, because it freezes more gradually), but for this activity you can try table salt.

Ice cream is a colloid, an emulsion where two substances are just suspended within each other rather than being chemically bonded together. This is why many ice creams also have an emulsifier to prevent the fat molecules from separating from the rest of the ice cream (this makes the texture of the ice cream smoother). Ice cream also uses a stabilizer (like gelatin or guar gum) to help hold air into the ice cream, which gives it its light texture. To be officially called ice cream, the colloid has to be at least 10% milk fat and 6% non-fat milk solids (such as proteins).

OBSERVING BABY ANIMALS

Spring is a time when many baby animals are born. It is a great time to visit a zoo and see if you can spot any newborn baby animals. Even if you don't see any brand-new babies, it is fun to see older babies that were born last year. If you get to visit a zoo this spring, take this list along to help you observe the baby animals and their parents. Watch to see how much they depend on their parents and how they are different from adult animals. You can also ask zoo keepers some of your questions if you can't find out just by watching the animals.

Even if you don't live near a zoo or can't visit one, you can watch animals in your yard or at a park. Common animals like squirrels, rabbits, chipmunks, frogs, and birds have babies in the spring, too!

QUESTIONS ABOUT BABY ANIMALS:

Do the babies stay close to their parents? Do they sometimes wander away on their own to play or look for food?

Do the mother or father animals feed their babies and take care of them?
(Most birds and mammals do but reptiles and amphibians usually don't.)

What do the baby animals eat? Do they eat the same food as their parents?

Can the babies walk, run, or swim on their own?

Do the parents carry their babies around?
(Monkeys and koalas do. Even cats and dogs sometimes carry their young!)

Do other adult animals, besides the mother or father, help take care of the baby animals?
(Families of gorillas and elephants usually help with baby animals.)

Can you think of some ways that animal babies are similar to human babies?

What are some ways that animal babies and human babies are different?

BABY ANIMALS

Why are baby animals born in spring? Many animals have their young as the days are getting warmer, and plenty of food is available. Spring is a great time to see kittens, chicks, lambs, or other baby animals! You can learn more about why animals have babies in the spring.

Do you know what the names of different baby animals are? What is a baby cow called? Some of these names may surprise you!

A *baby bear* is called a **cub**.
A *baby cow* is called a **calf**.
A *baby fish* is called a **fry** or **fingerling**.
A *baby goat* is called a *kid*. A *mother goat* is a **nanny**.
A *baby horse* is called a **foal**.
A *baby kangaroo* is called a **joey**.
A *baby sheep* is called a **lamb**. A *mother sheep* is a **ewe**.
A *baby monkey* is called an **infant**.
A *baby pig* is called a **piglet**. A *mother pig* is a **sow**.
A *baby platypus* is called a **puggle**.
A *baby spider* is called a **spiderling**.
A *baby swan* is called a **cygnet**.

What other names of baby animals do you know?

BABY BIRDS

There are lots of different names for baby birds! In general, they are called chicks or hatchlings, but some types of birds have special names. Here are a few:

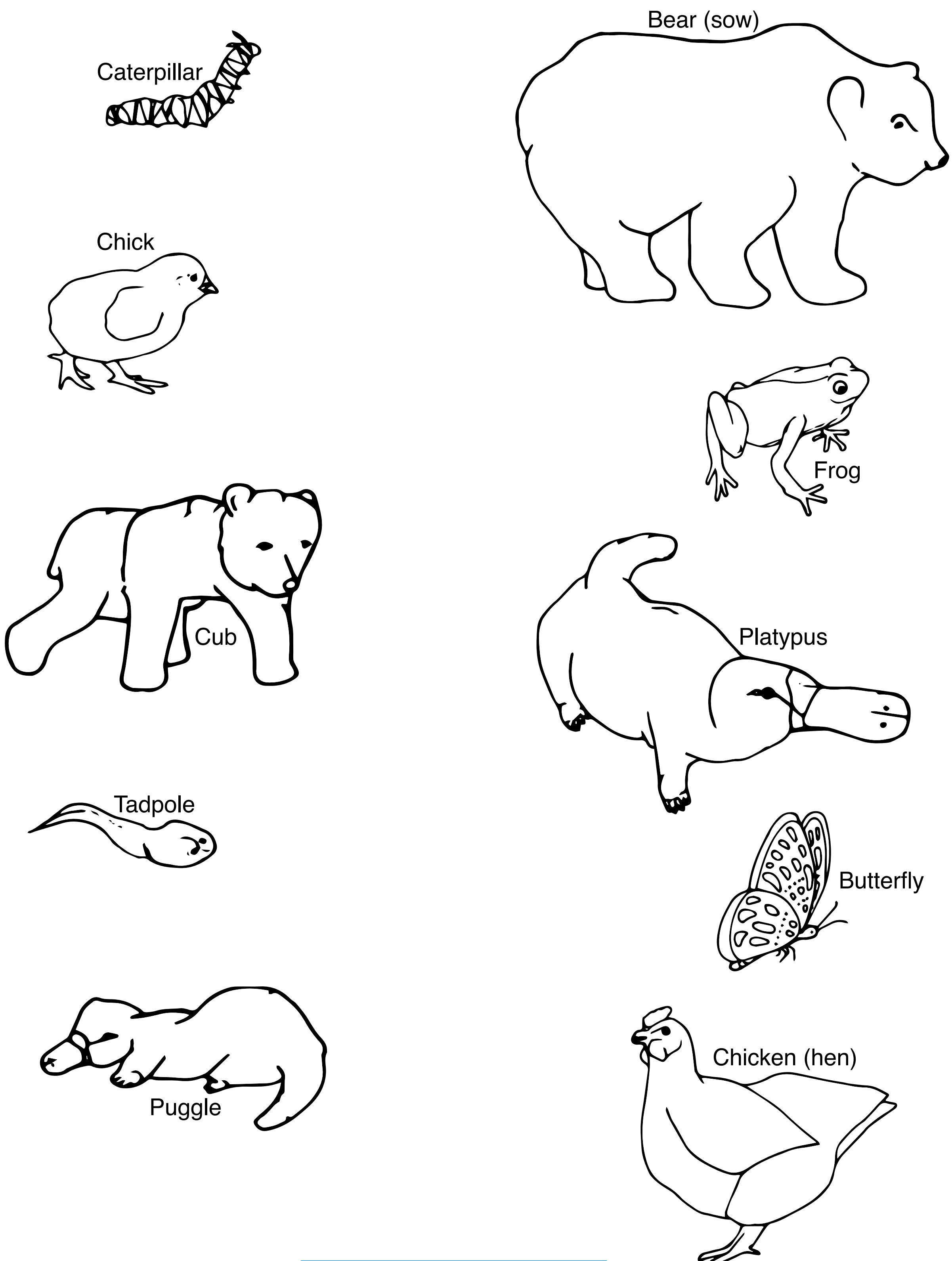
A *baby duck* is called a **duckling**.
A *baby goose* is called a **gosling** (say GOZ-ling)
A *baby eagle* is called a **fledgling** or an eaglet.
A *baby swan* is called a **cygnet** (say SIG-net) or a **flapper**.
A *baby pigeon* is called a **squab** (say SKWAHB).

Groups of hatchlings are sometimes called a brood or a clutch. Groups of grown-up birds can have different names, too. Usually they are a flock, but a group of geese is called a gaggle and a group of ducks is called a brace.
Science Words

Down – tiny, soft, fluffy feathers that keep the chick warm.
Hen – a grown-up, mother (female) chicken.
Yolk – the yellow part of the inside of the egg. This gives the baby chick the food it needs to grow.
Egg Tooth – a bump on the chick's beak that it uses to crack the shell so it can hatch.

BABY ANIMALS

Can you match each baby to its mother?



NIGHT EYES

WHAT YOU NEED:

- ☐ A lamp
- ☐ A small mirror
- ☐ A dark room

Some animals sleep all day and wake up when it gets dark! Raccoons, hedgehogs, owls, some kangaroos, snapping turtles, tigers, foxes, seals, opossums, and lots of other animals are most active at night and are called nocturnal. How well can you see at night? How do nocturnal animals see to hunt and find their way around in the dark? Do these simple experiments to learn more about eyes and seeing in the dark.

WHAT YOU DO – PART 1:

1. Look at your eyes in the mirror. Look at the dark spot, called a pupil, in the center of each eye. Notice its size.

2. Make the room as dark as you can by turning off the lights and closing the shades. It's okay if there is some light, but if it is still very bright, try going in a closet or room with no windows.

3. Plug in the lamp and sit near it but don't look at it. Look at your pupils again in the mirror. Now hold your mirror towards the light and look in it (don't look directly at the light bulb as it may hurt your eyes). Did your pupils get smaller?

4. Now turn so that your back is to the lamp. Look in the mirror again. Did your pupils get larger after you turned away from the brightness of the lamp?

WHAT HAPPENED:

A pupil is the part that allows light into the eye so that another part, called the retina, can create an image of what the eye is looking at. When pupils look largest, they are open the widest. More light goes into the eye and reaches the retina when the pupil is open wide. Less light goes in when the pupil is closed more and looks smaller. The retina is very sensitive to light, so part of the pupil's job is to protect the retina from getting more light than it needs.

When you looked toward the lamp, your pupils got very small because they were exposed to a lot of light. They didn't need that much light in order to help you see clearly in the darkened room, so they got smaller to adjust how much light got to your eyes. When you turned away from the light, not as much light could get into your eyes, making it harder to see clearly. Your pupils reacted by opening wider to let more light come in to help you see better in the darker part of the room!

WHAT YOU DO – PART 2:

1. Go into a very dark room, like a closet or bathroom without windows. It should seem pretty black in there. (You can take a friend, sibling, or parent with you!)

2. Sit for a few minutes and see if you can start to see some of the things in the room.

3. Once you feel like your eyes have adjusted to the darkness, turn on a light. Does it seem brighter than normal?

WHAT HAPPENED:

After being in the dark room for awhile your eyes adjusted to the darkness and you were probably able to find your way around and see the shapes of objects in the room. When you turned the light on, it probably seemed a lot brighter than it would have if you had been in a room with some light. Did the light hurt your eyes or make you squint? Was it harder to focus on things when the light first came on? Your eyes got used to the dark and were more sensitive to light than normal, making it hard to see clearly.

That's exactly what it is like for nocturnal animals all the time during the day when there is lots of light. Their eyes just can't handle the brightness like ours can.

After a few minutes, you probably noticed that you could see just fine in the light. If you went back into the dark room, you would have found that it was again very dark in there and hard to see anything. This is because your eyes work better in the light, even though they can adjust to help you see when it's dark.

Something similar happens in reverse after being outside on a very bright, sunny day. When you come inside, even if all the lights are on, it might seem like it is very dark. That's because it is dark inside compared to outside. Your eyes had gotten used to the extra light while you were in the sun and had to re-adjust to less light when you came back inside.

Nocturnal animals' eyes aren't able to adjust to bright lights the way ours can, and our eyes can't adjust to darkness as well as theirs can. Their eyes are designed for seeing very well when there isn't much light, but they don't work very well for seeing in really bright light! To help protect their eyes from even small amounts of bright light, some nocturnal animals have a special second eyelid that they can close to cover their eyes and completely block out light. This helps them sleep during the day and also helps protect their eyes if they are exposed to bright light by accident.

FEATHERS

WHAT YOU NEED:

- ☐ A large feather (you can try to find one outside, or buy one from a craft store. Feathers you find outside can be very dirty, so make sure you wash your hands when you're done with this project!)
- ☐ Magnifying glass
- ☐ Velcro
- ☐ Water

When baby chicks hatch, they are covered with tiny, soft, fluffy feathers called down. Down helps keep them warm. (It can keep us warm too, which is why quilts and coats are often stuffed with down!) As they grow older, chicks grow bigger feathers called contour feathers. These are colored on the tips and downy at the base (the part closest to the body) to help keep them warm. They also grow long, strong flight feathers on their wings and tail. Look at a feather up close to learn more about it:

WHAT YOU DO:

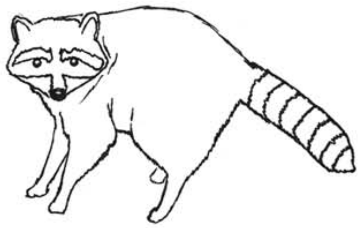
1. Feathers help protect birds from getting drenched in the rain. Instead of soaking through them, water just slides right off! Turn on the water faucet so it is just a tiny trickle. Hold a paper towel underneath the faucet and watch how the water soaks right through. Next, put the feather under the trickle. What happens? The water should just roll off, leaving the feather dry. (If it doesn't, try turning the feather over.) Birds keep their feathers waterproof by putting a layer of oil on them. They get the oil from a place near their tail called a preen gland.

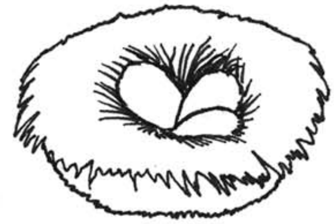
2. Look at a piece of velcro. Do you see how one side has tiny hooks that catch on to the other side? Bird feathers work a little bit like this. Take your feather between two fingers and rub your fingers down from the tip. The long, thin "branches" of the feather (called barbs) will separate into sections. Use a magnifying glass to look at the barbs: they are covered with tiny little hairs called barbules. Now take your fingers and smooth the barbs back together. The barbules catch each other and stick, like velcro. Sometimes you will see a bird rubbing its feathers with its beak. This is called preening and the bird does it to smooth the barbs back together.

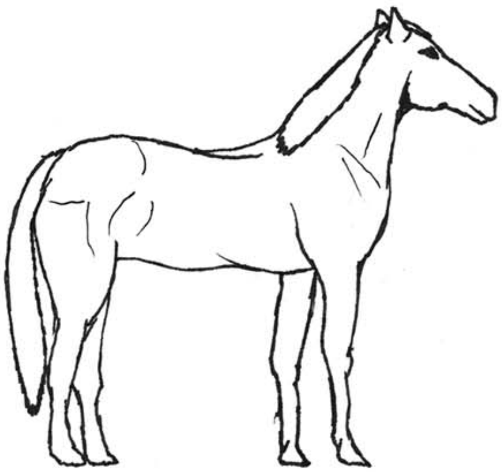
3. What's that running down the middle of your feather? That's the rachis (say RAY-kuhs), and it makes the feather strong. Look at the very end, which is called the quill – does it look a little bit like a drinking straw? That's because it's hollow, to keep the feather from getting too heavy. People used to dip the quill in ink to use as a pen!

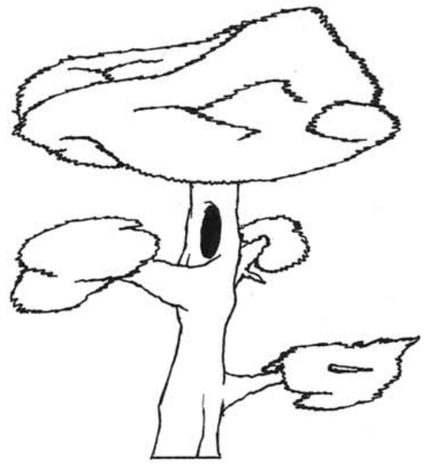
ANIMAL HOMES

Match the animals to their homes, then color the page.









CRACK OPEN A GEODE

Experiment

WHAT YOU NEED*:

- ☐ Geodes
- ☐ Rock pick or hammer
- ☐ Chisel (optional)
- ☐ Safety impact goggles
- ☐ Sock

*You can also purchase the Complete Deluxe Geode Kit with Rock Pick

WHAT YOU DO:

1. Place the geode inside the sock. This will help prevent rock fragments from flying and hurting you.

2. Put the geode on a hard concrete surface, like a sidewalk, patio, or garage floor.

3. Wearing safety goggles, hit the geode gently along the middle with the rock pick until it splits open. If you hit too hard, you may end up with lots of little pieces, so starting with gentle blows is best.

4. Another method uses a chisel to split the geode, making it more likely to end up with two equal halves. Set the geode on the concrete, place the chisel in the middle, and tap it very gently a few times with the hammer. Turn the geode a quarter turn and do this again. Continue scoring along the circumference of the geode until you see a crack form all the way around, then pull the two halves apart. (This method works best with hollow geodes.)

5. Examine the interior using a magnifier. Can you make out individual crystal shapes? How many different types of crystals do you notice?

WHAT HAPPENED:

Geodes are formed when there is a hollow cavity in solid rock. This cavity can form in several ways: by a gas bubble in a lava flow, by limestone being dissolved by an acidic substance, or by a shell not being filled completely with sediment when it is fossilized. When mineral-rich ground water gets into these cavities, the minerals can form crystals, depending on the temperature, pressure, and the amount of water. (Go here to learn more about crystals.)

Each geode is unique. Some will have large colorful crystal formations, others may have solid bands of quartz, and still others will have mineral deposits but no crystals formed yet. Sometimes a geode might be full of silt or sediment. This kind is called a “mud ball.” If you are selecting your own geodes, try to choose ones that seem light for their size; these are more likely to be hollow in the center and have crystal formations.

MAKE A HUMAN SUNDIAL

Experiment

WHAT YOU NEED*:

- ☐ Chalk
- ☐ Magnetic Compass
- ☐ Timer, alarm, or stopwatch to alert you at one-hour intervals
- ☐ A large, open concrete space, such as a driveway, sidewalk or patio where the sun shines all day and you can leave your chalk marks.

The object that casts the shadow is called a gnomon (pronounce it: the g is silent and it rhymes with Roman). Instead of using another object for the gnomon, use yourself!

WHAT YOU DO:

1. Find North. Use a [compass] or map to help you find North.
2. Stand so that you have open concrete to both sides and in front of you.
3. Have someone draw around your feet so you know where to stand and can come back to stand in the same place each hour.
4. Hold one arm up straight above your head, so that your arm is touching your ear.
5. Have the other person make a mark with chalk on the concrete along the line of your arm's shadow. Write the time next to, or underneath the mark.
6. Set your alarm for the next top of the hour (noon, 1:00, 2:00, etc.)
7. When the alarm sounds, go stand in the chalk feet outline and put your arm up straight in the same position as the last time.
8. Have someone make a chalk line along the shadow your arm makes. Make sure to use the same side of the shadow each time.
9. Write the hour next to, or underneath, the mark.
10. Repeat the observation, chalk mark and hour note, each hour. If you started in the afternoon, come back to the sundial the next day in the morning hours to complete the hour marks.

WHAT HAPPENED:

As the day went by, the Earth spun on its axis, so the rays from the sun reached your sundial from different angles, making your arm cast a shadow in different places. By marking the shadow at equal segments of time, and assigning a number to each segment, you've made your first clock!

This sundial is accurate for your location and time of year. When the Earth moves around the sun and the sun's rays reach you differently, the sundial won't be accurate.

BALLOON CAR

WHAT YOU NEED:

- ☐ 16-20 oz. plastic water bottle
- ☐ Drinking straws
- ☐ Wooden shish-kabob skewers
- ☐ 4 plastic bottle caps
- ☐ Balloon
- ☐ Duct tape or masking tape
- ☐ Nail, hammer, knife, scissors

The principles of rocketry apply to more than flying rockets – with this project you can make a 'rocket car' that is powered by pressurized gas (air in a balloon!). Adult supervision recommended.

WHAT YOU DO:

1. The water bottle forms the chassis, or body, of your balloon car. You can start by mounting the wheels on this body.

2. Stretch out a large balloon by blowing it up and then letting the air out of it a few times. Next, make a nozzle. The size of the nozzle is very important. If it is too small, the air can't escape with enough force to propel the car forward. If it is too big, the air will escape too fast and the
3. car won't go very far. Create the nozzle by taping four drinking straws together. Insert the straws into the mouth of the balloon and seal the opening by wrapping a strip of duct tape around it several times.

4. To mount the balloon/nozzle on the car, use a knife to cut two perpendicular slits (to make an X) in the top of the car about 4′ back from the mouth of the bottle, as shown in the illustration. Thread the nozzle through this opening and out through the mouth of the bottle. Leave about an inch of the nozzle sticking out of the mouth.

Find a hard surface, like a long table, linoleum floor, or sidewalk. Blow up the balloon through the straws at the mouth of the bottle. Pinch the base of the balloon to prevent the air from escaping too soon. Set the car down, let go of the balloon, and watch it go!

WHAT HAPPENED:

The air in the balloon is gas under pressure. The air pushes against the balloon, causing it to expand, but the balloon is also pushing back on the air. The pressure of the balloon pushes the air right out through the nozzle, which creates thrust that propels the car forward.

Keep track of how long the car rolls and how far it goes. Try it several times, then try changing the design to see if you can get it to go farther or faster. How will it work if you only use three straws for the nozzle? What if you use a bigger or smaller balloon? Does the car go farther on linoleum or the sidewalk? Why do you think this might be? Will the car go farther if you start it at the top of a ramp?

Decorate your car and have races with siblings or friends. Try to figure out why one car goes faster or farther than another, and keep experimenting to make your design better!

EPSOM SALT CRYSTALS

WHAT YOU NEED:

- ☐ Epsom salt
- ☐ Food coloring
- ☐ Beaker, cup, or small bowl
- ☐ Hot tap water

WHAT YOU DO:

1. In the beaker, stir 1/2 cup of Epsom salts with 1/2 cup of very hot tap water for at least one minute. This creates a saturated solution, meaning no more salt can dissolve in the water. (Some undissolved crystals will be at the bottom of the glass.)

2. Add a couple drops of food coloring if you want your crystals to be colored.

3. Put the beaker in the refrigerator.

4. Check on it in a few hours to see a beaker full of epsom salt crystals! Pour off the remaining solution to examine them.

WHAT HAPPENED:

Epsom salt is another name for the chemical magnesium sulfate.

The temperature of the water determines how much magnesium sulfate it can hold; it will dissolve more when it is hotter.

Cooling the solution rapidly encourages fast crystal growth since there is less room for the dissolved salt in the cooler, denser solution. As the solution cools, the magnesium sulfate atoms run into each other and join together in a crystal structure.

Crystals grown this way will be small, thin, and numerous. Left undisturbed, the crystals should last months or more!

FOAMY FLASK/ELEPHANT TOOTHPASTE

Science Project

WHAT YOU NEED:

- ☐ PPE (personal protective equipment): gloves, apron, and goggles
- ☐ Hydrogen peroxide, 6% or higher (available at beauty supply stores)
- ☐ Baking dish or pie tin
- ☐ 250 ml flask
- ☐ Funnel
- ☐ Graduated cylinder
- ☐ Yeast
- ☐ Food coloring

Make a dramatic demonstration of a chemical reaction with this spin-off of the classic "elephant toothpaste" experiment. This version catalyzes a chemical decomposition using only common household items, making it safer for home labs and younger scientists. While the chemicals used may be ordinary, the results are exceptional!

WHAT YOU DO:

1. Safety first! Before beginning the experiment, put on your PPE.
2. Use the graduated cylinder to measure 50 ml hydrogen peroxide, and pour it into the flask.
3. Add a few drops of food coloring if you like.
4. Place the flask in the middle of a pie tin or baking dish.
5. Measure 10 ml dish washing soap, and add it to the flask.
6. Open the packet of yeast, and pour its contents through the funnel into the flask. Quickly remove the funnel.
7. Feel the outside of the flask, and note its temperature. Wait a few minutes to see foam come streaming out of the flask.
8. Dispose of the remaining mixture by pouring it down the sink and rinsing with hot water.

WHAT HAPPENED:

Hydrogen peroxide's chemical formula is H2O2. H2O is liquid water, and O2 is oxygen gas. In this experiment, we observed the chemical decomposition of hydrogen peroxide. Chemical decomposition is the separation of a chemical compound into elements or simpler compounds. In this case, hydrogen peroxide decomposed into water and oxygen. The chemical expression for what happened is: $2\ H_2O_2 \rightarrow 2\ H_2O + O_2$.

Adding the yeast sped up the process. Enzymes in the yeast called catalase acted as a catalyst—a substance added to a chemical mixture that speeds up the chemical reaction time. The yeast wasn't necessary to make foam — only water, soap, and a whole lot of oxygen gas was necessary. But adding the yeast made the hydrogen peroxide decompose (break down) much more quickly than it would normally, releasing oxygen and water faster. The dish soap made the production of oxygen more noticeable because of the foam. This reaction also created heat, so it's what's known as an exothermic reaction, a reaction that releases heat energy.

Another interesting fact about hydrogen peroxide: it is sometimes used as rocket fuel. When hydrogen peroxide breaks down rapidly, it produces a lot of oxygen gas, which propels the rocket into the air. The hydrogen peroxide HST sells is a solution of water and hydrogen peroxide, as is the kind most of us keep in our medicine cabinets—30% and 3% respectively. Hydrogen peroxide that powers rockets is at least 90% concentration.

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