# The Pocket Book of BACKYARD EXPERIMENTS

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Discover the Laboratory in Your Garden

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# INTRODUCTION

f you've ever asked a question or wondered why something is the way it is, then you are a scientist. Scientists are interested in how the world works. They are inquisitive. They ask lots of questions. They make predictions, or "hypotheses," and then design experiments to test if their hypotheses are true. As new results come in, scientists are constantly revising what they think about the world. This book is designed to bring out your inner scientist. It will help you to appreciate the natural world and the wonders that live in it. It's packed full of experiments and activities that will stretch your imagination and foster your natural curiosity.

All of the activities are centered around the backyard or garden. They can either be done in these





spaces or use items that come from them. If you don't have a backyard, don't worry. Head to a local park or a wild green space instead. Some of the activities can be done in small spaces, such as a balcony, window box, or plant pot, and some can be done indoors. All of them derive their inspiration from the natural world and the fascinating things that live in it.

Many of the experiments can safely be done without adult help. Where adult assistance is recommended, it is clearly marked at the start of the experiment. The activities in this book are designed for young people aged eleven or older, but younger kids will also enjoy them—they may just need a little more help.

The book is split into four different sections: wonderful wildlife, soil science, fascinating flora, and kitchen sink science. You can work through them in order, or dip in and out of the different sections when something catches your eye.

The ingredients for each activity are clearly listed. Most of these are simple items that can be readily found in the garden and the home. The instructions are clear and concise, and there are fun facts



scattered through the book. Did you know, for example, that butterflies taste with their feet?

So, what are you waiting for? Get digging, planting, growing, making, spotting, designing, decorating, and experimenting. But most of all, get in your backyard and have some fun!





### MAKE A SCIENCE JOURNAL

Scientists always write up their experiments so they have a permanent record of what they have learned. Create your own science journal so you can keep notes of all the activities you try from this book.



Notebook

Pen

**Old magazines** 

Glue

To make a science journal, find an unused notebook. One with a hard back is good because it's easier to write in when you're outside. If you don't have a notebook, you can staple some blank pieces of paper together. Write your name on the front cover and label the notebook "Science Journal." Decorate it with doodles or cut out pictures from magazines and stick them on. Plants, animals, and landscapes would all look good, but this is your journal. Decorate it however you like.

Record every experiment and activity that you do. Start each one on a new page. Scientists always write up their experiments in a particular way, so this a good model to follow:

First, write the date and the title at the top of the page, and then a brief description of what you are going to do. This will be the Introduction section. For example:



MARK AND RECAPTURE SNAILS An experiment to determine how many snails are living in a corner of the yard.

List all the items you are going to use, then write step-by-step instructions describing how you are going to do it. That way, if you ever need to repeat the experiment (good scientists do this a lot), you'll know exactly what to do. This is the Methods section.

When you've finished your experiment or activity, write up the results. If you've made observations or collected data, write it down. If you've built something, draw a diagram of it or take a photo and stick it in. This is the Results section.

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Write up each experiment or activity in four sections with four different headings: Introduction, Methods, Results, and Discussion.

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Now write down what you have learned. How successful was the activity? Did the thing you were building work as you'd hoped? How could it be improved? What can you learn from the results of your experiment? Look at the information that you've gathered, and draw a conclusion. This is the Discussion section.







### **BIG BIRD COUNT**

Scientists think that more than one in ten bird species are in danger of going extinct. Even common species are becoming rarer. Keep a record of the birds in your neighborhood by counting them to see how they are doing.

Find somewhere comfy to watch the birds. If you have an outdoor area where birds visit, you could choose to watch them through a window. Alternatively, find a chair



to take outside and then settle down in a good spot. If you don't have an outdoor area, head to a park or a wild green space. Many birds live in cities, so if you find yourself surrounded by buildings, that's fine, too. Just have a look and see what you can spot.

Sit quietly and don't make any sudden movements. Relax, have a drink and a snack, and watch the birds for an hour. Using your bird guide, make a note of all the different species that you see. Use obvious features, such as the bird's size, shape, and coloring, to help identify what it is.





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Record your data because you never know when it will be useful. Some universities and wildlife charities run citizen science projects where they encourage members of the public to record their bird sightings and send them in. This is a great idea because it helps scientists to understand how bird populations are changing and how we can all help to save endangered birds.

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As well as making a note of the species, record the number of individual birds that you see. Make a note of the maximum number of each species that you see at any one time. So, if you see a group of two sparrows together, and then later on a cluster of four sparrows, the number to write down is four. This means you are less likely to double-count the same birds. Keep going back to your spot and see how the bird life changes over time. Some species, for example, are more numerous in the spring and summer because that is when they breed. Sometimes new species of birds appear and then disappear. These could be migratory species that have traveled vast distances. Their numbers may change across the day. Some species, for instance, are more active during the day and others are more active at night.





## A BIRDBATH FOR ALL SEASONS

As their natural habitat disappears to make way for towns, cities, and agricultural land, birds are becoming increasingly reliant on gardens. Help them by making them a birdbath, then record all the visitors that use it.

Shallow tray (a metallic trash can lid is ideal)

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**Three bricks** 

### Water

A big stone and some gravel

Tea light candles and matches Choose your dish. The birdbath will be out in the garden all year round, so it needs to be made of something, such as metal or ceramic, that won't shatter when it freezes. A large, metal trash can lid makes an excellent birdbath because it has shallow, sloping sides and is nice and wide. Plastic alternatives won't work because in the winter the birdbath will be heated, and the tray could melt.

Find somewhere flat to put the birdbath. It should be easily visible, and ideally, in a big open space with trees and bushes nearby. This will help the birds keep an eye out for predators while they visit the birdbath. If cats come to your



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Birds need fresh water all year round for drinking and bathing. This is especially important in the winter, when water freezes, and in the summer, when it evaporates more easily.

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garden, prune back any trees or bushes that are within pouncing distance. This will make it harder for the cats to ambush the birds.

Lay out three bricks on the ground in a triangular shape, with a space in the middle. Balance the tray on the bricks, making sure it is stable. Add a large stone to the middle of the tray, surrounded by a sprinkling of small stones or gravel. The stones provide a perch for birds to sit on, and a lifeline for any beetles or bugs that fall in—they'll be able to crawl onto the stones, dry themselves, and then fly away.

Fill the birdbath with water. It should be no more than 4 in (10 cm) deep. In the winter, when the temperature drops, place a lit tea light candle in the middle of the bricks underneath the birdbath. This will help to prevent the water from freezing. Check the birdbath every day and fill up the water as needed.

In your journal, record the different birds that use the bath. Note the date when they visited and what the weather conditions were like. Do the birds use the bath more at certain times of year?







### MAKE A BIRD FEEDER

Food shortages can occur at any time of year, so give our feathered friends a helping hand by hanging up some homemade bird feeders. Test different designs to see which is more popular.

Different birds like different foods, so some bird feeders may be more popular than others. We're going to make two different types of feeders and then test them in the backyard.

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Which of your bird feeders is more popular? Do certain types of bird prefer one to the other? What times of day do the birds visit? Keep a note of your observations in your science journal.



For the first feeder, add the dry ingredients into a bowl. Garden birds will happily eat birdseed, but they'll also eat human food, such as bacon rinds, raisins, bread crumbs, and grated cheese. Mix the ingredients together.

Soften the solid cooking fat by leaving it on a windowsill or a heating vent. Add the cooking fat into the bowl and use a wooden spoon to mush all the ingredients together. The cooking fat will bind the ingredients together.

Take a long piece of string and tie one end around the handle of the mug. Fill up the mug with the bird food mixture and push the garden twig into the hole, so it is half in,



### FEEDER 1

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Dry ingredients such as birdseed, grated cheese, and bread crumbs

Hard cooking fat such as lard

Wooden spoon, string, and twig

Bowl and old mug

### **FEEDER 2**

Apple, and sunflower seeds

Two sticks about 6 in (15 cm) long

String and scissors

half out. Now put the mug in the fridge so the fat becomes hard and sets around the twig.

While it is setting, prepare the second bird feeder. Ask an adult to core an apple by cutting a hole through the middle of the apple to remove the core. Take a handful of sunflower seeds and push them into the fleshy part of the apple so the seeds are half sticking out.

Take two short sticks and cross them so they form an X shape. Take a long piece of string and tie the crossed-over sticks together. Thread the long end of the string up through the apple core. The sticks make perches for the birds to stand on while they are eating the apple and the seeds.

K Hang both feeders in the backyard and wait for the birds to appear.





# SOIL TEXTURE EXPERIMENT

Some gardens have light, sandy soil. Others have heavy, clay soil. There are many different types of soil. Find out which type of soil is in your garden using this simple texture test.

Fill the glass jar three-quarters of the way with soil from the garden. Make sure there are no pebbles or



large stones in the soil. If there are any big clumps of soil, break them apart with your fingers first and crumble the soil into the jar.

Add a tablespoon of laundry detergent and a tablespoon of salt to the soil. Fill up the jar with water. Stir the mixture using the spoon, then screw the lid on tightly. The ingredients need to be really well mixed, so shake the jar for five minutes.

Yeut the jar on a windowsill and leave it for a few days. Don't pick it up or disturb the jar during this time. After a couple of days, the soil will settle into different layers.



Soil is made from different types of particles. Sand particles are the heaviest, so they will sink to the bottom. Clay particles are the lightest, so they will settle on the top. Silt is a grainy material. Silt particles are medium-sized, so if there is silt in your soil, it will form a layer in the middle, between the sand and the clay.

You can estimate how much of each different type of particle is in your soil by measuring the thickness of the different layers. If the sand layer at the bottom is really thick, for example, then you have sandy soil.

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Grow plants that are suited to your soil type. For example, lavender plants like sandy soil, while roses like clay soil.

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Sandy soils are easy to dig in but they dry out easily and are low in nutrients. This means they need regular watering and filling up with fertilizers. Clay soils are heavy and can be difficult to dig in. They are rich in nutrients and retain water well, but can become waterlogged, making it harder for plants to grow. Silt soils are somewhere in the middle.







### PHOTOTROPISM BOX

Plants need light to help them grow, so they always grow toward it. This is called phototropism. Perform an experiment to demonstrate phototropism using a cardboard box, a potato, and some sunshine.



Stand the shoebox on its shortest side so it stands upright, long and tall. Using scissors, make a hole in the middle of the "roof" of the shoebox. The hole should be about 1 in × 1 in (3 cm × 3 cm).

Make two cardboard shelves to fit inside the shoebox. Mark out the shelves on the cardboard by drawing around the base of the shoebox when it is standing upright. Cut them out. The shelves now need to be trimmed. Cut 1<sup>1</sup>/<sub>2</sub> in (4 cm) off the end of each rectangle.

Fit the shelves inside the shoebox using tape. The two shelves should split the box into three equal parts. The bottom shelf should be fixed to one wall of the box, and the top shelf should be fixed to the opposite wall. The shelves will prevent the light from falling directly onto the potato plants and create obstacles that the shoot needs to grow around.

Prepare your plant. You need an old potato that has started to sprout eyes. The eyes are the beginnings of new shoots that are starting to grow. Fill the plant pot with soil. If the soil is dry, water it a little, but take care the soil doesn't become waterlogged. Cut the potato in half and press the freshly cut side down onto the soil.

Place the plant pot into the bottom of the shoebox. Close the shoebox and secure the lid by putting tape around it. Put the shoebox on a warm windowsill and leave it for a couple of weeks. Once a week, open the box up and check to see if the plant needs watering. Then seal it back up again.

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DID YOU KNOW? Photo means light. Plants contain special hormones that help them to grow toward the light.

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After three weeks, you should see a green shoot poking out of the hole at the top of the box. The experiment is now complete. Draw a diagram to show how the plant grew. Did the shoot grow around the shelves to get to the light?







### HAPA ZOME

Hapa Zome is the Japanese art of beating leaves and flowers with a hammer in order to make natural prints on fabric. Give it a go! It's easy and effective, and the results are beautiful.



Go outside and choose some leaves and flowers. They should be as varied as possible, in different shapes and sizes. Choose a variety of colors. White flowers won't make a mark on white fabric, so pick blooms with bright or dark-colored petals. The leaves and flowers should be freshly picked. Ones that are full of moisture work the best, so make sure you collect fresh, healthy specimens.

Prepare your fabric. Plain white fabric works, but you could go for any light-colored cloth. Thin cotton fabrics work well, so you could cut up an old pillowcase or bedsheet (but make sure you check with an adult first). Cut a piece of fabric that is the size of the image you want to make. Now cut a second identical piece.

Lay the first piece of fabric on a wooden cutting board or other flat surface. Position the leaves and flowers on the fabric, arranging them into the design that you would like to see printed. Now lay the second piece of fabric over the top.



Here's where the fun starts. Gently tap the fabric with the hammer. If you don't have a hammer, or aren't allowed to use one, a rolling pin or smooth rock works just as well. Be gentle. Don't batter the fabric. Tap at it lightly. What do you see? The pattern of the plants should begin to appear. Conce you have flattened all of the plants, peel away the top layer of fabric. Remove the leaves and flowers. The dye from the plants will have transferred onto the two pieces of cotton. Hang them up to dry, then enjoy!



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What will you do with your Hapa Zome prints? If you want to make decorative flags, you can cut them into triangles and thread them onto a piece of string. Alternatively, the prints make great wall hangings, and if you stick them onto cardboard, they make stunning greeting cards.





### MAKE A PLANT PRESS

You can keep a record of the plants that grow in your garden by pressing and drying them. Pressed flowers and plants are also really great for using in arts and crafts projects. It's easy to make a simple press out of recycled materials.

Newspaper (small sheets are easier)

**Corrugated cardboard** 

Two flat pieces of wood, of equal size

Two belts, luggage straps or bungee cords, or string

Freshly picked garden plants

Fold the newspaper sheets down the middle, where the fold normally is. These newspaper sheets will be your "blotters," soaking up the moisture from the plants. Assemble them into sets of three, so that you can open and close each set together, like a mini newspaper.

Cut rectangles of cardboard so that they're the same size as your folded newspaper sheets. The tunnels in the corrugated cardboard will allow air to flow through your press.

Start by putting a sheet of cardboard on top of the wood base, then a set of three





newspaper sheets. Open up the sheets and place a plant in the center, then close them so the plant has three sheets of paper on either side.

Add another piece of cardboard to the stack, and then another set of newspaper sheets, and another plant. Keep going until you've put all your plants into the stack.

K Finish the stack with a last layer of cardboard and then place the second piece of wood on top.

Now you need to put the straps around the press to hold it tightly closed. You can tie the press together with string, like a parcel, if you don't have straps.

Leave the plants in the press for twenty-four hours, and then you can check on them if you want to. You'll find that they take a few days to dry completely, and then you can reuse your press to flatten more plants—remember to use fresh newspaper.

**Botanists press** specimens of plants they find on their travels around the world, and these are kept in special libraries called herbaria. A herbarium can tell us a lot about where different plants grow.

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FASCINATING FLORA



### ROOT-GROWTH VIEWER

Plant roots always grow in the direction of gravity. This is called gravitropism (or geotropism). Watch gravitropism in action by building a root-growth viewer from an old CD case.



Find an unwanted CD case that is made entirely of transparent plastic. Open up the CD case and remove the plastic tray that usually holds the CD. This can be recycled.

Place a large handful of soil in a bowl. Crumble the soil with your fingers to get rid of any big lumps. Mix the soil with a little water so that it is moist but not too soggy.

Fill the CD case halfway with the damp soil, leaving the half closest to the hinge empty. This will give your bean room to grow.

Place the bean in the middle of the soil, then sprinkle it with water. Green beans and fava (broad) beans work well. Close the CD case and



stand it upright so the hinge is at the top. Tape around the sides of the case, but do not tape up the gap in the hinge. This will provide the plant with air and an escape route for the shoot when it becomes too big for the case.

Prop up the CD case on a sunny windowsill. Water the bean daily using an eyedropper or syringe by adding a few drops of water through the gap in the hinge.

Look at your seed every day. As the seed starts to grow, mark its growth on the CD case using a permanent marker. Label the seed coat, roots, shoots, and leaves. What happens to the seed coat as the plant gets bigger? It should begin to shrivel as all the food reserves that are inside become used up by the growing plant.

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DID YOU KNOW? In space, there is very little gravity, but plants can still grow. Scientists have grown cress onboard the International Space Station.



The roots will be growing down. When the roots are around 2 in (5 cm) long, turn the CD case 90 degrees and prop it back up on the windowsill. The roots will now be pointing in the wrong direction, but watch what happens to the roots over the next few days. They will reorient and start growing in the direction of gravity. Draw a picture of your results in your science journal.





### GROW PLANTS FROM FOOD SCRAPS

Plants have such a strong urge to grow, that some plants we eat will keep on growing from the parts that we throw away. Some of them will even grow into completely new plants you can eat! See which ones you can grow on the windowsill.



Glass jars

**Plates or saucers** 

**Fresh water** 

Food scraps: carrot tops, onion bases, celery or lettuce bases, and leafy herb leaves For root vegetables such as carrots and beets, you want to keep the tops of the root (where the leaves attach to the vegetables) and a little bit of the root itself. To get them to grow, put them onto a saucer of water. Check every day and add more water to the saucer as it dries out. In a few days you should see fresh green leaves growing. You can eat them.





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Beet leaves have a mild flavor and make a nice salad. Carrot leaves can be a bit bitter, so you may not like them.

For onions, you want the bases of the bulbs (where the roots stick out). You can use the bottoms of spring (green) onions, or bulb onions; it doesn't matter. Pop them into the bottom of a glass jar with some water. Check on them every day and replace the old water with fresh water. Very soon you will see new roots growing from the onion bases, and you may start to see fresh leaves as well. The leaves are edible, just like chives.

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Plants are very different from animals, because they can often regrow after being cut in half. They need air, water and sunlight to regrow, but they will eventually run out of nutrients unless they're planted in soil.

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You can regrow the leafy greens that grow from a solid section (called a "heart"), such as cabbage and lettuce. We often throw that part away because it's tough, but if you put it onto a saucer of water and keep checking on it every day, you should find that it starts to grow new roots and fresh, edible leaves.

You can also try growing the leaves themselves. Leafy greens and leafy herbs such as parsley, cilantro, and watercress—will often grow roots in a jar of water. If you want to, you can then pot them up into soil, and they will continue to grow into larger plants.





# DYE IT WITH AVOCADO

Kitchens and gardens are full of plants containing natural chemicals that can be used to dye fabrics. Make a dye from avocado pits, then see if you can make different-colored dyes from different plants.



Four avocado pits

Plastic bag

Wooden cutting board

Hammer

Old saucepan and water

Sieve and wooden spoon

Old blouse or T-shirt, pillowcase or sheet

Put the avocado pits inside the plastic bag and place it on the wooden cutting board. Take the hammer and give the pits a gentle whack. The idea is to break the pits in half and then smash them into smaller pieces. The bag is there for protection as it stops bits of avocado pits from flying all over the place.

✓ Put the small, freshly crushed avocado pieces into an old saucepan and add 1.8 pints (1 liter) of water. Heat the mixture until it begins to boil, then reduce the heat and let it simmer gently for an hour. Ask an adult for help. This will help to draw the dye out of the avocado pit and concentrate the dye. Make sure

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the pan doesn't boil dry. Top it off with a little water if needed. Strain the mixture through a sieve and return the liquid to the saucepan.

Prepare the fabric. White cotton works well, so you could use an old blouse or T-shirt, or cut up an old pillowcase or sheet (check with an adult first). Moisten the fabric by running it under a tap, then add it to the saucepan. Make sure the fabric is completely covered. Swirl it around with a spoon and leave it overnight.

The next day, remove the fabric and wring it out. Leave it to dry on a clothesline or heating vent. When it is dry, ask an adult to iron the fabric on a medium heat. This will help to fix the color so it won't run when the fabric gets wet.

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DID YOU KNOW? You can also make ink from avocado pits. Try using some of the leftover dye to paint a picture.

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Avocado dye stains fabric a light, rosy pink color, but what other colors can you make using the natural ingredients that are around you? Experiment with different items from the garden and the kitchen. Onion skins, carrot tops, coffee grounds, blueberries, nettles, and pomegranate seeds also make excellent dyes. In your journal, record which items work best.



### HELP BIRDS AVOID WINDOWS

Birds sometimes fly into windows and injure or kill themselves. Become a bird hero and help prevent this from happening by making your windows bird-proof. The birds will thank you for it!

K Birds sometimes fly into windows or glass doors because they simply don't see them. The glass acts like a mirror, reflecting images of the trees and the sky, so often the birds don't realize that the glass is actually there.

To prevent birds from flying into windows, the panes need to be made more obvious. This can be achieved simply by hanging objects in front of them.

Small birds are frightened of large predatory birds, such as hawks, and will go to great lengths to avoid them. Sketch a picture of a hawk on a piece of card. Its wings should be outstretched as if in flight.

JOU WILL NEED

8.5 × 11 in (21.5 × 28 cm) cardstock

**Black marker** 

Scissors

**Cotton thread** 

Adhesive putty or tape

It doesn't need to be a masterpiece, but if you find this difficult, you can print out a picture from the Internet and use it as a template.



Color the hawk in using the black marker. The idea is to create a dark silhouette that will be easy for garden birds to spot. Using the scissors, cut the hawk out. Make a small hole in the bird's body and attach a long piece of cotton thread. Hang the bird in your window using adhesive putty or tape.

Repeat the process. If the window is particularly big, add more than one hawk. Try making a silhouette scene, including trees, flowers, clouds, and a sun. Birds are less likely to fly into a window filled with lots of obstacles. Make a note of what happens over time. Is your bird deterrent successful?

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DID YOU KNOW? In some countries, a group of hawks is called a "kettle" of hawks, but in reality, it's rare to see hawks together. Adult hawks tend to be solitary birds that only come together when they breed or migrate.

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This simple measure should greatly reduce the number of collisions that occur, but if you do find a bird that has flown into a window, treat it with care. It may be suffering from concussion or have internal injuries. Place it in a quiet, dark place and leave it for a couple of hours. Hopefully, the bird will recover.





# TORNADO IN A BOTTLE

When they occur naturally, tornadoes can destroy trees, houses, and cars. Make a mini tornado in a bottle. It won't destroy anything (I promise), but it will help to explain how real tornadoes form.



Two equal-sized plastic bottles with caps

Scissors

Food coloring

Duct tape

Remove the cap from one of the bottles. Using the scissors, cut a neat, circular hole in the middle of the cap. The hole should be about 1/2 in (1 cm) across. This is tricky, so you may need an adult's help. Now make an identical hole in the cap of the second bottle. Add a couple of drops of food coloring to one of the empty bottles, then top it up with water. The water should almost reach the top of the bottle. Swirl the bottle around to make sure the food coloring and water mix together. The coloring makes it easier to see the tornado.

Screw the caps back on to both of the bottles as tightly as you can. Place the empty bottle upside down on top of the bottle that contains the water. Tightly wrap lots of duct tape around the lids. In a moment you're going to turn it all upside down and you don't want the water leaking out. This step is also tricky, so you may need to bother an adult again.



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Real tornadoes form in a similar way. They occur when a downward current of air from a thundercloud sucks in air from its surroundings, creating a rapidly spinning column of air.

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Carefully turn the device upside down and stand it on a table. What happens? The bottom bottle may look empty, but it's actually full of air. The water in the top bottle is pressing down on the air, but the air in the bottom bottle is pushing back against the water. This keeps the water in the top bottle.

Pick up the bottles and swirl them around in a circular motion. Now what happens? The movement allows air to escape upward into the top bottle. This creates a column of spinning water that is wider at the top and narrower at the bottom. This is your tornado. The water will now start to pour through the connection. Time how long the water takes to flow into the bottom bottle.







### MAKE MUSHROOM PRINTS

Mushrooms aren't plants or animals. They are fungi. Try making beautiful mushroom prints with the fungi from your fridge.

Collect some mushrooms. Some wild-grown mushrooms can be poisonous if they are eaten, so it's best to use store-bought mushrooms for this experiment. You're not going to eat them, but it's good to be safe. The mushrooms need to be fresh and juicy, not old and dried out.

The mushrooms that we see in the supermarket are the bit of the fungus that grows above ground. Let's start by learning about the mushroom's structure. Draw a picture of a mushroom in your science journal. Label the stem, which is the bottom part, and the cap, which is the top part. Look underneath the cap. Can you see lots of tiny folds? These are called gills, but they're not like the gills

100 WILL NEED

Mushrooms

Knife

Black and white paper

Large pebbles

Bowl

that fish have. Mushroom gills contain tiny seedlike structures called spores. When the spores are released from the cap of the mushroom, they can germinate and produce new fungi. Label the gills on your diagram.



✗ It's time to make the print. Take two mushrooms that are the same. Cut off their stems and discard them. Place one cap on a piece of white paper, and the other on a piece of black paper. The gills should be facing down. Place a large pebble on each mushroom. The pebble should be big enough to weigh the mushrooms down, but not so big that the mushrooms are squashed.

Cover the mushrooms with a bowl to help prevent them from drying out. Leave the mushrooms overnight. In the morning, carefully remove the bowl, pebble, and mushroom. How do your prints look?

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DID YOU KNOW? Fungi can't eat food like animals, and they can't make their own food like plants. Instead, they absorb nutrients from nearby plant or animal matter.



The prints are made from the thousands of spores that have fallen from the gills. Different mushrooms have different-colored spores. White spores show up best on black paper, and darker spores show up better on white paper. What color are your spores?

Repeat the experiment, this time with a different variety of mushroom. Supermarkets sell many different kinds of mushrooms including oyster, portobello, and the more familiar white mushrooms. What do their spore prints look like? Remember that the prints contain live spores, so don't put them in your journal. Photograph your prints and stick the photos in your journal instead.



# MAKE A CLOUD IN A JAR

The closest that most of us get to clouds is when we fly through them in an airplane. Make a mini cloud in a jar and learn how clouds form.



✗ It is safest to do this experiment in the kitchen sink. Unscrew the lid from the jar and turn it upside down. Place three or four ice cubes inside the upturned lid. Ask an adult to help you fill the glass jar halfway with freshly boiled water, then balance the upturned lid on top of the jar. Watch the jar for five minutes. What happens?

Empty the jar and repeat the experiment. Fill the jar halfway with freshly boiled water, but this time, add a good squirt of hair spray into the jar before placing the cold lid on top. Watch for five minutes. What do you see this time?

Water evaporates from our oceans, lakes, and rivers, and rises up into the air as water vapor. As the water vapor gets higher, the air gets cooler. This makes the water vapor condense into tiny droplets of water. When droplets join together, they become heavier and fall as rain.



K In the first experiment you probably saw tiny drops of water form on the sides of the jar. The warm water vapor rose up inside the glass and condensed into droplets when it touched the cold lid.

K For clouds to form, something else needs to happen. The tiny droplets of water vapor in the sky need to meet and mix with tiny particles of dust, ice, or sea salt. The droplets and the particles stick together, and this makes a cloud.

There were no dust particles in the first experiment, but in the second experiment, the hair spray acted like dust. Tiny water droplets stuck to particles of hair spray. This made the cloud in the jar.

🔨 Now for the fun part. It's time to set your cloud free. Carefully remove the lid and watch the cloud disappear. If you've ever wanted to touch a cloud, now's your chance!

🔨 See if you can make better clouds by squirting other harmless aerosols into the jar. Can you make clouds with deodorant or air freshener?



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**DID YOU KNOW?** Other planets have clouds, too, but they're not made of water. Jupiter has clouds that contain molecules made of ammonia and sulfur.

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KITCHEN SINK SCIENCE





# WRITE WITH Invisible ink

You don't have to be a spy to write in invisible ink. Learn how to create and decipher secret messages using just lemons and a candle.

Cut the lemon in half and squeeze all of the lemon juice into a bowl. Remove any seeds that fall into the mixture. Add a couple of teaspoons of water and stir it well. The secret ink is ready to use.

DID YOU KNOW? During the Second World War, prisoners of war wrote messages in invisible ink. They didn't have lemons or orange juice, so they wrote their secret messages in urine, which is also weakly acidic. Dip your paintbrush into the ink and write your secret message on a piece of paper. Work quickly because as the ink dries, it becomes impossible to see. If you have an old-fashioned calligraphy pen, you can dip the nib in the ink and write with that. Allow the paper to dry.

Ask an adult to decipher the secret message. Get them to light a candle and hold the paper above the flame. Don't hold it too close or the message will go up in flames! Move the paper around over the heat source. What do you see? The message will be revealed.



The Pocket Book of Backyard Experiments

This invisible ink works because the acidic lemon juice browns more quickly than the rest of the paper. What else could you use to make invisible ink? Try making invisible ink from other acids, such as vinegar, apple juice, and orange juice. Which works the best? Can you think of any other ways to reveal the secret message?

Heat is the key. Alternatively, place the paper on a heating vent or ask an adult to iron the paper for you. Both methods should work. Another way to read the message is to put salt on the drying ink. Leave the salt for one minute, then wipe it away. When you want to display the message, color over it with a wax crayon, and the message will appear.









### DIY FOSSILS

Why wait millions of years for fossils to form when you can make your own fossils today? Follow this recipe and make fossil imprints from the living things you find around you.



such as leaves and pine cones Fossils are the remains of prehistoric life-forms that lived millions of years ago. Sometimes plants and animals become fossilized, but sometimes their footprints or outlines become etched into stone. These are called trace fossils, and they're very important because geologists can learn a lot from them.

To make some modern trace fossils, first prepare the dough. Add the flour and salt to the mixing bowl, and give it a stir with a spoon. Add the water, a little at a time, mixing as you go. The mixture should become doughy. When it's ready, it should come away from the side of the bowl cleanly.



K Sprinkle a little flour on a work surface. Scoop up the dough with your hands and shape it into a ball on the powdered surface. Roll the mixture flat until it forms a layer around 3/4 in (2 cm) thick. Cut out circles using a cookie cutter or an inverted glass.

K Choose an item for your first trace fossil. Flowers and leaves leave beautiful imprints, as do pine cones and empty snail shells. Gently press the item into the dough. It shouldn't disappear completely, but it should sink slightly into the dough. Press down on all of the features to make a good imprint.

K Carefully remove the item from the dough using your fingers. What do you see? There should be a detailed impression of the item left in the dough. Place the dough somewhere warm, where it can dry overnight, near a heating vent or on a windowsill.

K Look up some photos of fossilized plants, seeds, and shells on the Internet, like the picture above. Evolution causes living things to change over time. How similar or different are your fossils to ones from the distant past?



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**DID YOU KNOW?** Trace fossils include footprints left by prehistoric animals, but they also include other items that animals leave behind. These can include nests. burrows, and even dinosaur poop!



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