UNIVERSE

THE POCKET BOOK OF Backyard Experiments

DISCOVER THE LABORATORY IN YOUR GARDEN AND AROUND YOUR HOME

DR. HELEN PILCHER

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BIG BIRD COUNT

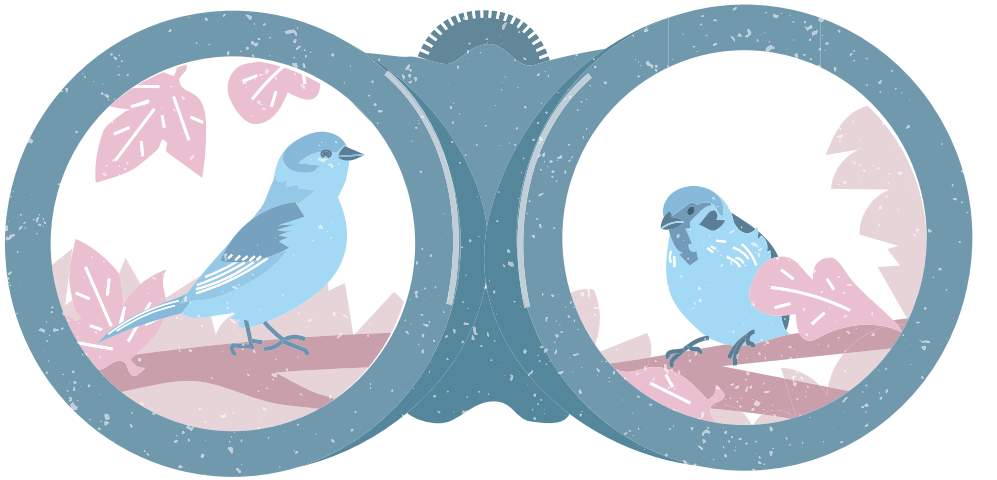
Scientists think that more than one in ten bird species are in danger of going extinct. Even common species are becoming rarer. Keep a record of the birds in your neighborhood by counting them to see how they are doing.

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.

YOU WILL NEED

- **Binoculars (if you have a pair)**
- **Bird guide**
- **Pen and paper**
- **A drink and a snack**

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.



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.

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.

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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.

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

YOU WILL NEED

FEEDER 1

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

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.

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

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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.

YOU WILL NEED

- Leaves and flowers
- Plain cotton fabric
- Wooden cutting board
- Hammer

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.

Once 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!

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.

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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.

YOU WILL NEED

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.

- 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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COLOR-CHANGING FLOWERS

Plants absorb water from the soil, then transport it from their roots all the way to their flowers, leaves, and shoots. This is called transpiration, and you can demonstrate it by keeping a cut white flower in food coloring. Watch what happens to the petals.

YOU WILL NEED

- A selection of small vases or glass jars
- Water
- Food coloring
- Cut white flowers
- Sharp knife

Fill the vases with fresh water. If your cut flowers come with plant food, mix up a jug of water with plant food and then fill the vases with the mixture.

Add a few drops of food coloring to each vase so the water changes color. Gel food colorings tend to work better than natural food colorings, and darker colors, such as red and green, tend to work better than lighter colors, such as yellow and orange. Make the water in each vase a different color.

Experiment with different flowers. You could even try to make a lettuce leaf or a celery stick change color. It's also fun to split a flower stem down the middle, then put the two halves in two vases with different colored water. What do you think will happen?

Trim about ½ in (1 cm) off the stem of each flower before putting a single flower into each vase. You can use any cut white flower, but roses, chrysanthemums, and carnations (shown here) all work well.

Place the vases on a table or shelf and watch what happens. Cut flowers have no roots, so the water is instead drawn into the plants' stems. The stems are full of tiny tubes that are made from a plant tissue called xylem. The water flows through the tubes all the way to the flowers.

You can see when the colored water reaches the flower because the flower starts to change color. This can happen quite quickly. Chrysanthemums start to change color in just half an hour. They look stripy. This is the food coloring inside the xylem tubes in the flower.

Let the experiment run for a week or more. Change the water every few days. Every time you do this, cut another ½ in (1 cm) off the stem of each flower. This helps to keep the liquid flowing through the plant. Take a photo of the results. How bright are your flowers?

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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.

YOU WILL NEED

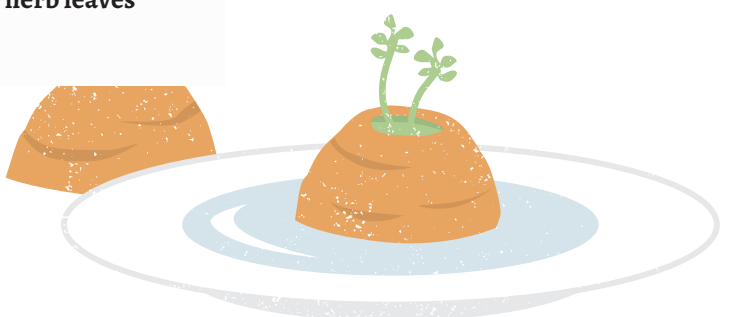
Glass jars

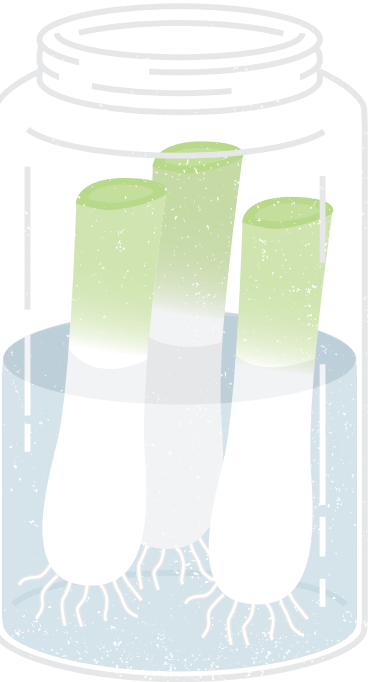
Plates or saucers

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.





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.

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.

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.

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MAKE AN ECOSYSTEM IN A JAR

Plants use the carbon dioxide we exhale to help make the oxygen that we breathe. Demonstrate some of the ecological cycles that keep us alive by creating an ecosystem in a jar. See how long you can make the ecosystem last.

YOU WILL NEED

- Large glass jar
- Pebbles and charcoal
- Soil and potting compost
- Plants
- Spoon
- Water

Ecosystems are communities of living things and a place where they live. For example, your garden is an ecosystem because it contains living things such as birds, insects, bacteria, and plants, and physical structures such as fences, stones, and water.

To build an ecosystem in a jar, first put a layer of pebbles in the base of the jar. This will give any excess water somewhere to collect, so the plants don't drown!

Sprinkle a thin layer of charcoal over the pebbles. You can buy charcoal from a store or collect it from the ashes of a disused barbecue or bonfire. The charcoal is important because it acts as a filter, helping to collect impurities and keep the ecosystem healthy.

Prepare a mixture that is half soil and half potting compost, and add a thick layer to the jar. Potting compost is good because it contains plenty of nutrients to help the plants grow, and the soil is important because it's packed with bacteria. Together, the three layers should fill about a third of the jar.

Add some small plants. Anything will do, but choose plants that require a similar amount of water. So, for example, a cactus and a daisy will not go well together. The plants should easily fit in the jar with room for growth. Dig a small hole in the soil with a spoon and add the plants. Cover the roots with soil.

As a finishing touch, you could add a bigger pebble in among the plants. There's no real reason for this. It just looks professional! Now put the lid on the jar and place it somewhere that is well lit.

The idea is that the ecosystem will look after itself, so there's no need to water it or add in air, but for the first couple of days it may need some assistance. If the soil looks dry, add a little water. If the inside of the jar is always covered in condensation, then open the lid to let it breathe for a while.

Take a photo of your ecosystem and stick it in your journal. Record how long the ecosystem lasts before the plants start to die.

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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!

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.

YOU WILL NEED

8.5 × 11 in (21.5 × 28 cm) cardstock

Black marker

Scissors

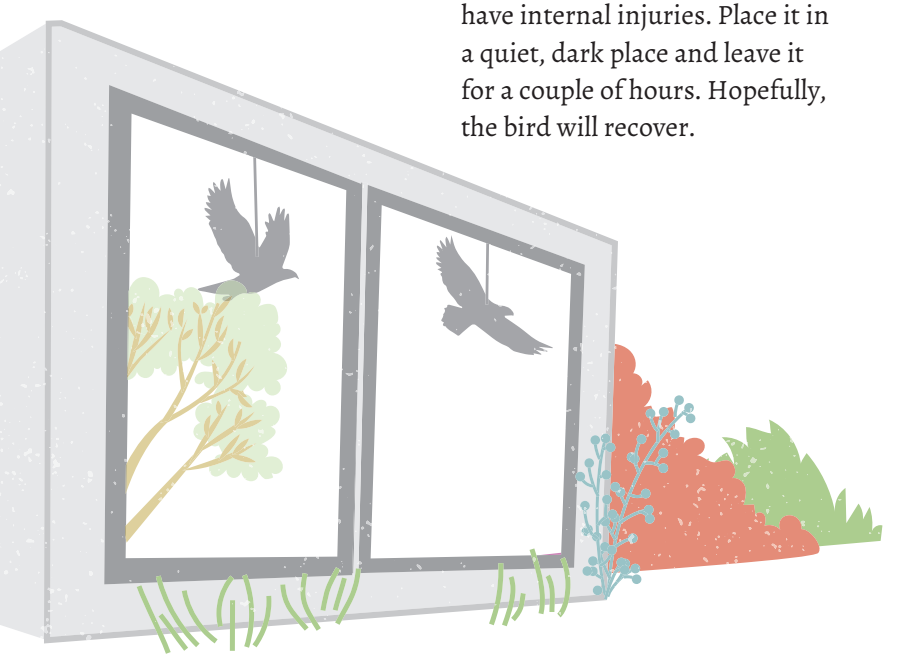
Cotton thread

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?



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.

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.

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AMAZING MOLD EXPERIMENT

The world is full of living things so small they can't be seen with the naked eye. When they grow in vast numbers, they become visible. Watch microscopic mold grow into something big on a slice of bread and learn about the conditions needed to make it grow.

YOU WILL NEED

- Three slices of white bread
- Three pieces of paper towel
- Water
- Three clear plastic bags
- Masking tape

If you've ever opened the bread bin and found that the loaf is covered in colorful fuzz, that's mold. Mold is a type of fungus. It grows from spores that blow around in the air, and can be found just about everywhere, including on your skin, in the soil, and on work surfaces. Some molds can make people ill, but most are totally harmless.

Prepare your mold-growing bags. Fold the pieces of paper towel into quarters and sprinkle them with water so they are damp but not soaking. Now put one piece of paper towel into each of the plastic bags.

Press your hand firmly into each slice of bread so it leaves a handprint in the middle. Some of the spores on your skin will be transferred to the bread. Put one piece of bread into each of the bags so it sits on top of the paper towel. Now seal the bags tightly shut using the masking tape.

Label the bags 1, 2, 3. Put the first bag in the fridge. Put the second bag onto a warm, brightly lit windowsill. Put the third bag into a dark kitchen cupboard. Now leave your mold to grow.

Check on the experiment every day. You should see mold beginning to form after a couple of days. After seven to ten days the experiment will be done. Do not open the bag. You can study the mold from the outside.

DID YOU KNOW? Some molds can kill bacteria. Penicillin is a common antibiotic that was originally discovered in mold.

Do all of the bags contain moldy bread? Which contains the most mold? Has it grown in the shape of a hand? What conditions does mold need to grow? Take photos and describe your results in your science journal. When you are finished, ask an adult to dispose of the experiment in an outside trash can.

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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.

YOU WILL NEED

- Mixing bowl and spoon
- 3½ oz (100 g) plain flour
- 3½ oz (100 g) table salt
- 6 fl oz (175 ml) water
- Rolling pin
- Cookie cutters or a glass
- Items from outdoors, 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.

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.

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.

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.

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?

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!