

A person is shown from the back, wearing a dark shirt and light-colored pants, kneeling in a field of green plants and dry leaves. They are using a quadrat, a square frame made of blue and purple poles, to study the ground. The quadrat is divided into four smaller squares by a white crossbar. The person's hands are visible, holding the poles. The background is a dense field of green plants and dry leaves.

DIY

LAKE SCIENCE

COUNTING WITH QUADRATS

HOW DO SCIENTISTS MEASURE HOW MANY ORGANISMS LIVE IN A HABITAT?

ACTIVITY DESCRIPTION

Millions of organisms can live in and around a body of water. If you tried to count them all, you'd probably be counting forever! What are some ways that scientists can estimate the number of organisms in an ecosystem without counting each one?

Age: 10 and up

Preparation: 5 minutes

Activity: 45 minutes

Cleanup: 10 minutes

ACTIVITY MATERIALS

- 4-8 bendable straws
- 1-2 meters of thin string
- Scissors
- Waterproof shoes or boots (optional)
- Glue (optional)



SAFETY I

Exploring watersheds is fun! But it's important to be safe and respectful when doing science in or near a body of water.

- If necessary, go with an adult.
- Only enter a body of water if it is safe and legal to do so.
- Rinse off equipment with clean water after using it.
- Wear appropriate footwear and clothing when working in or near a body of water.
- Follow the “leave no trace” and “pack it in, pack it out” principles.
- Check to see if the water and/or the creatures in it are protected by environmental regulations. Some sensitive ecosystems need to be left alone in order to recover from damage or overuse.

STEP 1

Take one straw and make a small (1-2 cm) cut at the tip of its long end. Squeeze this cut end (by overlapping the cut edges) and insert it into the short, bendy end of a second straw.

If you want a sturdier quadrat, you can add a drop of glue on the clipped end of the straw before inserting.

Repeat this step with another pair of straws. You should have two pairs of connected straws when you are done.



STEP 2

Clip both ends of one of your connected pairs. Then put the two pairs together by inserting the cut ends of one set into the uncut ends of the other set, as shown in the picture. You should now have a square!

Tip: If you want to make a bigger quadrat, use two straws for each side of your square.



STEP 3

Cut a piece of string about 10 cm longer than a side of your square. Carefully tie one end of the string to one side of the square. Then tie the other end of the string to the opposite side. Make the string as tight as possible without bending the straws.



STEP 4

Tie on another string like the first (repeating Step 3 on the same sides of the square). Then slide the two strings so they are evenly spaced along the straw edges.



STEP 5

Repeat Steps 3 and 4, this time tying two strings across the other two sides of the square.



STEP 6

Clip off any excess string, leaving at least 1 cm so your knots don't come loose. Now your quadrat is ready for sampling!



STEP 7

Visit a nearby body of water (lake, stream, river, pond or ocean), wearing your waterproof shoes if necessary.

Look around your aquatic ecosystem and decide what you want to observe. Can you see many plants? Is there one type of plant you are interested in? Are there macroinvertebrates (small animals) like crayfish, worms, or beetles living near the shore? You can also observe all the living things in the area. Once you've decided what to observe, select one location with your species of interest and lay the quadrat down at that spot.



STEP 8

You will use your quadrat to measure biodiversity—how many different kinds of living things are in a region. Count how many of each type of plant or animal are found inside your quadrat. Take notes using your recording device or draw a picture of your quadrat sample. Make any other notes about the location you're observing, such as whether it's in or out of water, shady or sunny.



STEP 9

Move your quadrat to different locations and count the number of organisms you find at each. The more times and places you do a quadrat count, the better you can estimate how many of each organism live in the whole ecosystem.

The number of organisms changes with the seasons and year to year. Depending on your local habitat, you may not see a lot of organisms. You may need to take more quadrat samples, or come back at a different time of day or season.

What might cause your samples to change over time and at different locations?



STEP 10

OPTIONAL

Scientists measure biodiversity in many ways. You can use your quadrat to calculate one measure of biodiversity called abundance (how many of a particular plant or animal are found in an area).

The following four steps will guide you through this process of calculating abundance. Using a calculator is useful for this type of calculation.



STEP 11

OPTIONAL

First calculate the area of your quadrat in square centimeters. To find the total area you studied, multiply the quadrat area by the number of times you used your quadrat.

Add up the total number of individuals (one type of organism) you found in all your quadrat observations.

Finally, find your ecosystem's abundance by dividing the total number of individuals by the total area (total individuals/total area in square centimeters).



STEP 12

OPTIONAL

The picture shows a 1 m² area of Kentucky bluegrass. Counting all the blades of grass would be hard! Instead, we can take samples to estimate how many blades are in the larger area.

Let's say the area of the quadrat is 20 cm × 20 cm = 400 cm² = 0.04 m². The quadrat was used to count blades of grass in five locations. The total area studied is 5 × 0.04 m² = 0.2 m². The total number of blades counted in the five locations was 0 + 37 + 13 + 18 + 9 = 77.



STEP 13

OPTIONAL

The abundance of Kentucky bluegrass in the study area is $77 / 0.2 \text{ m}^2 = 385$ individual blades of grass per square meter. That's a lot of life!

You could also use this calculation to estimate the abundance of Kentucky bluegrass in an entire field. If the area of a soccer field is approximately 7,000 square meters, then based on the abundance calculated from the samples, the entire field abundance is approximately 2,700,000 blades of grass!



WHAT'S GOING ON?

Even in small areas, there can be so many creatures it's impossible for scientists to count them all. Using quadrats, scientists can count the organisms in a small area to get a sample of the things living there. The sample helps scientists estimate how many and what kind of species live in the entire ecosystem.

The size of quadrat used should be big enough to count the organism being sampled. If you were counting trees or elephants, you'd need a much bigger quadrat! To get a sample of organisms that move around, instead of a quadrat you can use a dip net. Make your own mobile sampler with the Dip Dip Hooray activity!



Scientists use quadrats to measure and study living things in an ecosystem.

WHY MEASURE LIFE?

Biodiversity, or the variety of life, is extremely important for the health of ecosystems—and humans. The wider the variety of plants and animals, the easier it is for an ecosystem to recover from disturbances like fires and floods. For example, having a variety of pollinators (like bees, birds, and bats) means we will still have the ability to grow plants (including food!) even if one kind of pollinator is harmed by problems like disease or climate change.



By using tools like quadrats to measure biodiversity, scientists can get an idea of how healthy an ecosystem is, and whether it needs extra protection to prevent biodiversity loss.

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CREDITS |

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This activity from the DIY Lake Science app allows families to investigate and learn about lakes and bodies of water at home or on the go! The app features twelve hands-on investigations, as well as videos and a lake simulation.

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