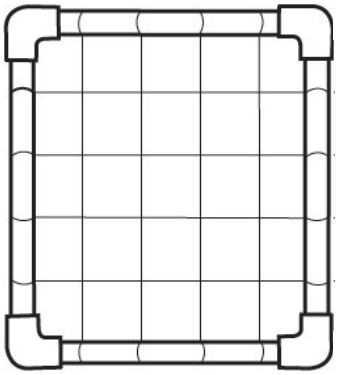
Schoolyard Quadrat Investigations



Topics
Biodiversity, Measurement

Grades
K-2

Sites
Schoolyard, Classroom

Duration
15-30 minutes each month throughout the school year

Materials
- Quadrats (see Teacher Preparation, page 2)
- Thermometer
- Tape measure
- Magnifying glass
- Clear tape
- Data Sheets (see page 7)

Vocabulary
biodiversity, quadrat, temperature

Next Generation Science Standards

Practices

Analyzing and interpreting data

Core Ideas

ESS2.D Weather and climate

LS2.A Interdependent relationships in ecosystems

LS4.D Biodiversity and humans

Crosscutting Concept

Patterns

Performance Expectations

See page 5

Focus Question

How does our schoolyard change over time?

Overview

Young children can use observation and measurement to find out more about an environment with simple tools that extend human senses and make the data collected more precise. In this activity, students use a quadrat and thermometer to investigate a plot of land over time in their schoolyard.

Objectives

Students will:

- Investigate an area of their schoolyard over time.
- Measure temperature and describe the change in temperature over the year.
- Differentiate living from nonliving things.
- Record observations of plants and animals to compare the diversity of life at different times of the year.

Background

The schoolyard is a great place to get students outdoors and engage them in authentic science without the expense of buses and logistics of offsite locations. **Quadrats** are a simple tool students can use to investigate their environment. Scientists use quadrats to take **biodiversity** measurements to uncover patterns that may provide information about the health and interactions of an ecosystem. Data collected may include the numbers of individual organisms and species or the percent cover of different species (e.g., 75% of the plot is covered by nonnative grass) and can be used to monitor change over time and among locations. When data are collected from the same site repeatedly over time (e.g., across seasons or before and after rainfall) or from two or more different sites, they can be used to make comparisons and perhaps conclusions about factors that may affect biodiversity.

In this activity, over a period of nine months, students collect surface **temperature** data monthly and make a variety of qualitative and quantitative observations about the area within their half meter quadrat.

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VOCABULARY

Biodiversity: variety of species in a given area

Quadrat: a square, rectangular or circular frame of a particular size made of PVC pipe, wood or metal and laid on the ground or ocean floor

Temperature: degree of hotness or coldness measured with a thermometer

TEACHER TIP

Leave quadrats unglued so you can place them around taller plants and trees by detaching and reattaching one side.

However, if you will be using the quadrats in a more dynamic environment (e.g., rocky intertidal) where there is the risk of losing a piece if the quadrat comes apart too easily, you may want to glue them.

Surface temperature is the radiating temperature of ground surfaces like pavement, bark, different soil types, grass and buildings. Surface and air temperature are different but each influences the other. An area with direct sunlight will have higher temperatures than those that are shaded. How much of the sun's energy is retained or reflected back into the atmosphere will depend upon time of day (increasing over the course of the morning and peaking an hour or two after local solar noon) as well as amount of vegetation and moisture.

Measuring surface temperature requires simple tools and students can observe change throughout the year or between locations. In addition, investigation of surface temperature can lead to decisions about longer term projects. For example, students may determine the location of a school garden and what they should plant; comparisons can be made to determine the best places to stay warm or cool during recess as well as seasonal patterns. Students might also ask how the surface temperature of black top compares to that of the grassy field or the natural area behind the school. The temperature of an area can also affect which organisms are found there.

Simple investigations like these provide good opportunities to introduce elements of the science process including the concept of a fair test, in which one factor or variable is changed while the others are kept the same. In this investigation, the variable that changes is the time of year. While the location of students' quadrats stays the same. Collecting data monthly and using consistent tools (thermometer) in the same way (temperature is taken in the center of the quadrat) also helps ensure a fair test. Another technique scientists use to ensure a fair test is randomization. Students don't choose the location of their quadrat but randomly toss the quadrat behind their backs. This reduces bias.

See page 6 for suggested monthly activities. Students could also more accurately measure biodiversity by only counting the number of species and individuals within their quadrats each month.

Teacher Preparation

1. Build half-meter quadrats using the instructions below. You will want a minimum of one quadrat per 3-4 students. All supplies can be purchased at a local hardware store.

Materials for each quadrat

- 2.2 meters of 3/4" Sch (schedule) 40 PVC
- Four PVC elbows (3/4" 90° angle)
- Meter tape
- Vise
- Hacksaw (or ask the hardware store to cut PVC pipe into 4 ~0.48m pieces) Adding the elbow should bring each side to 0.50m.

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Building Quadrats

- Use your meter tape and pencil to mark off 0.48m sections of PVC pipe.
- Secure the PVC in the vise and very carefully cut the pipe with the hacksaw at the pencil marks.
- Attach an elbow to each of the 4 pieces and assemble your quadrat.

2. Decide how you will group students. Pairs or groups of three per quadrat are ideal. Also consider whether you will assign quadrat locations or allow students to choose their own locations using the behind the back method as described in the procedure.

3. Review the month activity suggestions on page 6 and the student data sheets. Decide if you will make copies of the data sheets (one per student) or create your own activities. If you use the data sheets, you may choose to either hand them out each month or all at once.

TEACHER TIP

Have students tape student sheets into their science notebooks to help them keep track of their data.

Procedure

1. **Introduce the focus question to the class.**
Share the question: *How does our schoolyard change over time?* You may write it on the whiteboard or have students add it to their science notebook. Give students time to write down their initial thoughts or discuss with a partner. Depending on their prior knowledge, you may need to spend some time exploring the characteristics of living (biotic) and nonliving (abiotic) things first.

2. **Explain the purpose and details of the activity to the class.**
Students will adopt a plot of land for the rest of the year and take data from it each month. Explain that this is something scientists do: collect data over time. Ask them to think about why scientists do this and how the data might be used.

3. **Model how to use a quadrat and pass out student data sheets.**
Explain that a quadrat is a tool scientists use to collect data about a small plot of land or microhabitat. This data can then be compiled to help better understand species and habitat interactions. Pass out the student data sheet(s) and explain that this is where they will record their data.

4. **Student groups select their quadrat location and collect data for month one.**
Go outside and allow students to stand in an area that interests them. Have them turn around and gently toss the quadrat behind their back. Where it lands is the plot they'll return to throughout the year. Record the location using GPS or take pictures or measure and carefully record the location of each student's plot. During this first visit, allow ample time for students to investigate the plot and take data. Subsequent data collection sessions may be shorter. (Note: before you begin structured monthly activities, give students unstructured time to explore their plot and/or schoolyard.) Back in the classroom, discuss their observations. See page 6 for suggestions.

5. **Student groups monitor change over time and collect data about their plot.**
Each month, student groups measure surface temperature within their quadrat

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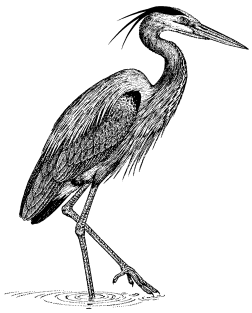
and look at organism biodiversity or ecosystem interactions. You may want to reinforce the monthly concepts with pre- or post-reading or activities. Once students have collected data, you can discuss the nature of science as a group. *Why is it important to take a temperature reading with the same tool and in the same place each month? How will the measurement vary with the time of day? With location and surface type? How might temperature affect the type and number of organisms in each plot?*

6. **STUDENT GROUPS ANALYZE CUMULATIVE DATA AND DISCUSS RESULTS AS A CLASS.**
   Students complete their graph showing how surface temperature changed throughout the year and compare it to their month one prediction. *How did it compare?* Then have groups compare data. *How did the temperature vary with surface and location? Why do they think that is? How does temperature affect living, nonliving and once living things?* You may create a class graph displaying how the temperature and living/nonliving/once living things compare by student quadrat location. Ask students how they could use the data they collected (see **Background** for ideas).

7. **RETURN TO THE FOCUS QUESTION.**
   Now that students have collected data and discussed their results, have them revisit the question: *How does our schoolyard change over time?* Students may think on their own or discuss with a partner. Then, in their science notebook, you may have them draw a line of learning and under it add to their original thoughts about the question.



Extensions

- Have students come up with a testable question and use appropriate tools to collect data in addition to temperature on an ongoing basis.
- Have students compare their data to that of classmates or other classes, particularly across seasons and years to look for patterns.
- Ask students to develop an action plan to encourage the conservation of their plot.

Resources

Monterey Bay Aquarium. www.montereybayaquarium.org

References

Broda, H. W. (2007). *Schoolyard-enhanced learning: Using the outdoors as an instructional tool, K-8*. Stenhouse Publishers.

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Standards

Next Generation Science Standards www.nextgenscience.org

Performance Expectations

Supports K-ESS2-1: Use and share observations of local weather conditions to describe patterns over time

Supports K-LS1-1: Use observations to describe patterns of what plants and animals (including humans) need to survive

Relates to K-PS3-1: Make observations to determine the effect of sunlight on Earth's surface

Supports 2-LS4-1: Make observations of plants and animals to compare the diversity of life in different habitats

Crosscutting Concepts

Supports Patterns at K-2: Children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Common Core State Standards www.corestandards.org

Mathematics

1.MD.C.4: Organize, represent, and interpret data with up to three categories.

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Monthly Data Collection Plan

Month	Outside	Inside
ONE	1. Take a temperature reading from the center of your plot. 2. Draw a picture of your plot. 3. Make a list of at least 5 things found in your plot. 4. How will you find your plot again?	• Classify your list into living, nonliving, and once living. • Share your temperature data. • Predict: How might the temperature change throughout the year?
TWO	1. Take a temperature reading from the center of your plot. 2. Observe your plot and write questions you have about your plot. What are you curious about?	• Set up a line graph to put your temperature data on. • Optional: Choose one question you can investigate and write a prediction.
THREE	1. Take a temperature reading from the center of your plot. 2. Look inside and outside your plot. Have humans influenced this area? Note any ways you think humans have changed your plot.	• Add to your temperature graph. • Discuss: How have humans influenced this area? (e.g., Was there any trash in your plot?) • Discuss: What can we do to help keep our plot healthy?
FOUR	1. Take a temperature reading from the center of your plot. Then take readings at each corner. 2. Next take an air temperature reading. Hold the thermometer away from your body at chest height for three minutes before taking reading.	• Add the center temperature to your graph. • Discuss how your readings were similar or different in different areas of your plot. • How did the surface temperature compare to the air temperature? Why might that be? • Discuss how your temperature readings have changed since September.
FIVE	1. Take a temperature reading from the center of your plot. 2. Make a list of 5 things found in your plot. 3. Identify things in your plot that provide plants and animals with what they need in order to survive	• Add to the temperature graph. • How did the five things you observed this month compare to those in month one? • Discuss how your plot is a home for plants and animals. Is your plot a good habitat?
SIX	1. Take a temperature reading from the center of your plot. 2. Predict what might happen to your plot if there was a heavy rainstorm. Draw a picture of what it might look like. Do the same if there was an extreme drought.	• Add to the temperature graph. • Share your drawings with a partner. Discuss how this extreme weather might affect the animals and plants that live in or near your plot.
SEVEN	1. Take a temperature reading from the center of your plot. 2. Use your senses to make 5 qualitative observations of your plot.	• Add to the temperature graph. • Use your sense observations to write a paragraph about your plot. Include personal connections and any questions you are curious about.
EIGHT	1. Take a temperature reading from the center of your plot. 2. Draw a picture of your plot. 3. Make a list of at least 5 things you see in your plot.	• Add to the temperature graph. • Compare this picture to the one you drew in month one. Then compare the 5 things to those you observed in months one and five. Discuss any similarities or differences.
NINE	1. Take a temperature reading from the center of your plot. 2. Make a Box and T chart of the similarities and differences in your plot compared to month one.	• Use your Box and T chart to write a paragraph comparing and contrasting your plot. • Finish your temperature line graph. • Write about your graph. What do you notice? What could this mean for your plot? Was your data consistent with your prediction?

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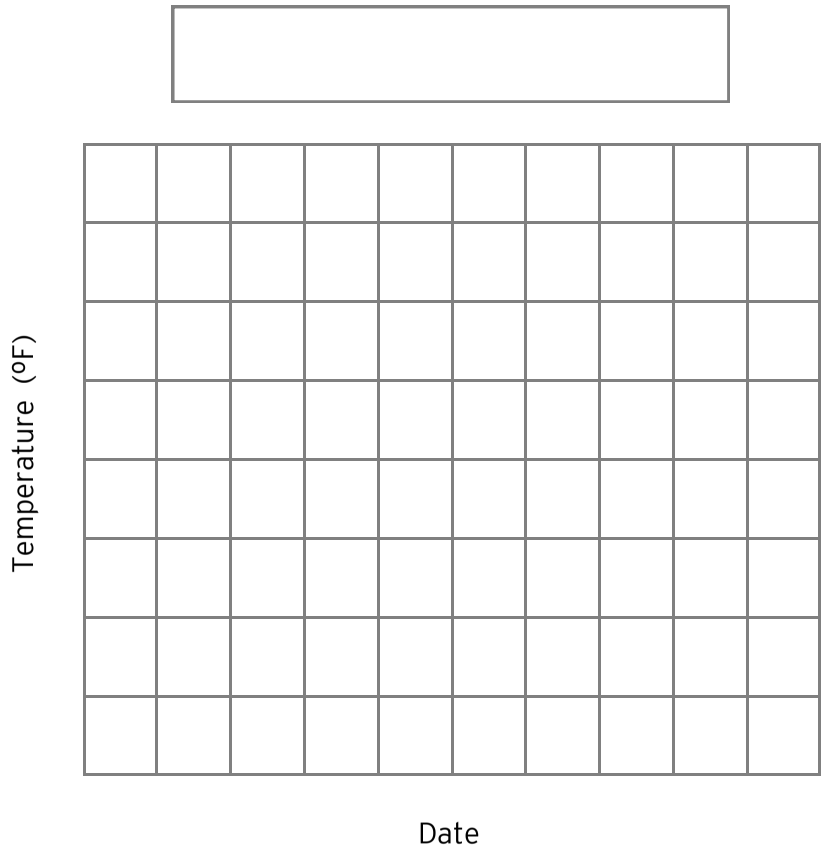
My Quadrat Data Over Time



	Month One	Month Two	Month Three	Month Four	Month Five
Surface Temp in Quadrat					

	Month Six	Month Seven	Month Eight	Month Nine
Surface Temp in Quadrat				

Month One: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Draw what you see inside your quadrat.

List 5 things you see.

1._____

2._____

3._____

4._____

5._____

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Month Two: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Write 5 questions you have about your plot.

1._____

_____

2._____

_____

3._____

_____

4._____

_____

5._____

_____

Month Three: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Draw any signs of human influence in or around your plot.

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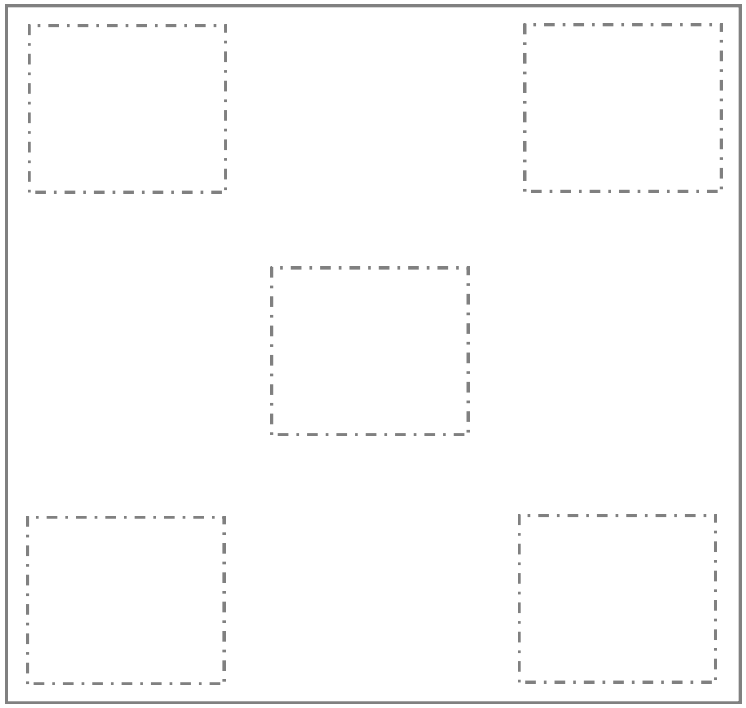
Month Four: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Record your surface temperature data in each box.



Air Temperature (ºF)

Month Five: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

List 5 things you see.

1._____

2._____

3._____

4._____

5._____

What is in your quadrat that helps plants and animals survive?

1._____

2._____

3._____

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Month Six: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Draw a picture of what your plot might look like in heavy rain (flooding) and little or no rain (drought).

Heavy Rain (Flooding)

Little or No Rain (Drought)

Month Seven: My Quadrat

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Use your senses to make observations.

1. I see _____

2. I smell _____

3. I hear _____

4. I feel _____

5. I taste _____

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Month Eight: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Draw what you see inside your quadrat.

List 5 things you see. Circle if it is living, nonliving or once living.

1. _____ Living Nonliving Once Living
2. _____ Living Nonliving Once Living
3. _____ Living Nonliving Once Living
4. _____ Living Nonliving Once Living
5. _____ Living Nonliving Once Living

Month Nine: My Quadrat Data

Date:_____ Time:_____

Weather (circle): Sunny Cloudy

Surface Temperature (ºF)

Look at your data from months one and nine.
Write the **similarities** you see in the box.
Write the **differences** below the box.

In both months one and nine I noticed: _____

DIFFERENCES	In month one I noticed:	In month nine I noticed:

How do you think the surface temperature affects the plants and animals living in and around your plot?

What might that mean for your schoolyard over time?

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