

Lesson 4: How to Estimate Animal Size and Numbers at a Distance

Teach students about size-distance relationships and making group estimates.

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Nature observation is an inexact science. Unpredictable events that can occur, such as a flutter of butterflies passing overhead or a herd of deer crossing your path, make it difficult to collect perfect data. Therefore, nature researchers often use estimations.

In this lesson, you will teach students how to make good estimations of animal size and numbers. This lesson brings in math and art concepts to help students understand spatial relationships and approximations. Start with size-distance relationships, and end with the grid system.

Estimating Size

Teach students how to estimate size at a distance. This lesson is broken into three parts. The first part introduces techniques for measuring size; the last parts expand on the concept through an outdoor activity and perspective drawing. Be prepared to take digital pictures throughout the lesson.

PART 1: ESTIMATING SIZE AT A DISTANCE

1. Show a close-up picture of a screech owl (without background). Ask students to estimate its size in height and width, prodding them for the reasons behind their estimates.
2. Show a picture of the same owl in a tree, and ask students to estimate its size. Has anything changed? What are students basing their guesses on this time?
3. Practice measuring height at a distance. Ask students to pick an object in the distance (about ten feet away). Then have them close one eye and estimate the object's height by forming a "C" with the thumb and index finger of their left hand (or a backwards "C" with their right hand) around the image.
4. Pick three students who are about the same height, and place them ten feet away from the group. Ask the other students to use the "C" technique from the previous step to measure the three students' heights. Ask students to describe to the class how big the "C" is, from the ends of their fingers (in centimeters or inches).
5. Ask the class to measure two of the students from the previous example at fifty feet and one hundred feet using the same "C" technique as before. Explain the difference in results (i.e., the students' size gets smaller with increasing distance).
6. Take a digital picture of the three students at different locations, which you will use later in the lesson.

LESSON OBJECTIVES AND MATERIALS

OBJECTIVES

- » Use estimation to help determine animal size
- » Learn how to draw using perspective
- » Use a grid system for estimating group size

MATERIALS

- » NM data-collection form
- » Field guides or animal fact sheets
- » Screech owl pictures—one close-up picture without a background and one of an owl in a tree with background
- » Wooden or metal stakes
- » Three pictures of the same owl
- » A digital camera
- » Computer and graphics software (such as Adobe PhotoShop)
- » Pictures of ants
- » Grid paper
- » Field journals (bound scientific notebooks)
- » Pens and pencils

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How to Estimate Animal Size and Numbers at a Distance (continued)

PART 2: PRACTICE OUTDOORS

Pre-Lesson Preparation: Prepare three wooden stakes by attaching to each an identical, life-size picture of an animal. The great horned owl works well.

1. Take your students outside, and place the stakes at different distances—approximately ten, fifty, and one hundred feet. Then ask students to
 - » Make observations and predictions about the size of the three animals
 - » Use the “C” method to make height predictions
2. Take a digital picture of the stakes for later use.
3. Gather the stakes to show the students that the photos are the same size.
4. Ask students to discuss their observations.

PART 3: PRACTICE WITH PERSPECTIVE DRAWING

1. Explain the basic concepts of perspective drawing, describing how one can represent objects at a distance on paper by making objects appear smaller and closer together as they near the vanishing point. Explain the basic meaning of “vanishing point” and the “horizon line,” using pictures and examples for emphasis.
2. Upload to a computer the photos you took previously of the students and stakes. Open each image separately in a program that allows you to edit the image using lines (such as Adobe PhotoShop).
3. Demonstrate how to draw using one-point linear perspective on the computer.
 - » First, draw the horizon line above the image. (Figure A)
 - » Next, create a small circle or square on the horizon line to indicate the vanishing point. (Figure B)
 - » Then, draw lines extending from the image (such as the owl) to the vanishing point. (Figure C)
 - » Ask students whether the image will get smaller or larger the closer it moves to the vanishing point.
 - » Copy and paste the same image at different places on screen, enlarging the image farther from the vanishing point and diminishing it closer to the vanishing point. (Figure D)
4. Ask students to practice perspective drawing in their field journals or on handouts.



FIG. A



FIG. B

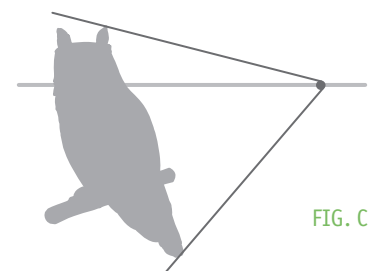


FIG. C

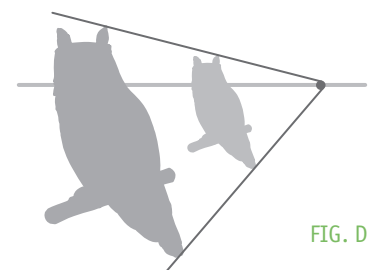


FIG. D

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Practical and Assessment

Practical

Test your students' understanding of making estimates and drawing using perspective. Show younger students different pairs of animal pictures in different sizes and ask them to speculate which one of the two animals in the pair is farther away. Ask older students to draw their nature animals using perspective—creating the horizon line, the vanishing point, and three different sketches of their animals.

Student Assessment

How'd your students do? Here are some ways to assess your students' comprehension of the material, reflective of grade level.

EXCEEDS STANDARD

- » Grades K-2: Student was able to identify that the smaller animal was farther away five out of five times.
- » Grades 3-4: Student was able to draw a picture of the same animal using perspective (in three different sizes).
- » Grades 5 and up: Student was able to use vanishing point lines to draw an animal in three different sizes.

MEETS STANDARD

- » Student was able to meet the above standards with only one error in size-distance relationship interpretation.

BELOW STANDARD

- » Student made more than one mistake in size-distance relationship interpretation.

COMMON TERMS

- » **Vanishing point:** In perspective drawing, the point at which receding axes converge
- » **Perspective:** Any graphic system used to create the illusion of three-dimensional images or spatial relationships on a two-dimensional surface. There are several types of perspective, such as linear, atmospheric, and projection system
- » **Horizon line:** The line in a perspective drawing where the sky meets the ground. A drawing inside a room has an eye-level line
- » **Grid system:** A series of boxes or circles divided into equal areas

KEY POINTS

Keep previous lessons fresh in students' minds. Ask students to elaborate on the characteristics and behavior of the animals you use as examples.

Estimating Group Numbers

PART 1: INTRODUCTION TO GROUP ESTIMATES

Pre-Lesson Preparation: Make copies of a picture of an ant mound. Also, create a large class chart that has at least four columns. Mount the chart on the wall for recording data throughout the lesson.

1. Refer to the NM data-collection form, and introduce the sections that relate to number and estimates. Explain that scientists need good estimates to determine the population of different species across the country.
2. Show a picture of an ant mound and ask
 - » What do you see?
 - » What questions do you have about this picture?
 - » How many ants do you think are in this picture? How do you know?
3. Ask each student or pair of students to mark their estimates on the class chart.
4. Record on the class chart the different methods students come up with for determining the number of ants.
5. Pass out pictures of an ant mound. Ask students to choose a strategy for estimating the number of ants in the picture. Some students might count by ones; some students might count groups of ants.
6. Record each student's or pair of students' estimates in another column of the class chart. Ask students what they notice about the two groups of estimates. The second group of numbers should be more similar than the first estimates.

PART 2: THE GRID SYSTEM

1. Still using the ant-mound example, ask students to speculate how to determine the number of ants without counting them or without a picture (for example, if they encountered an ant mound outdoors).
2. Overlay a grid onto the picture of the ant mound. Ask students how they would use the grid to determine the number of ants.
3. Explain how to use the grid system, which is the method scientists use when estimating large numbers of animals in nature: Count the number of animals in one box and multiply by the total number of boxes.
4. Practice the grid system using other examples, such as pictures of birds in a tree, blood cells, or gum balls. (See example below.)
5. Challenge students to imagine the grid in their heads without looking at it. Explain that scientists use an imaginary grid to recognize the number of animals traveling together in nature.
6. Ask students to practice using the imaginary grid on different objects—such as cookies on a cookie sheet or pens on a desk.
7. Take the lesson outside and practice using the imaginary grid for trees in the park, birds in a flock, plants in a flower bed, and rocks in a pile.



Practical and Assessment

Practical

Test your students' ability to estimate the number of animals in groups. Show different groups of objects to students. Then ask them to guess the number of objects from the picture or diagram.

Student Assessment

How'd your students do? Here are some ways to assess your students' comprehension of the material, reflective of grade level.

EXCEEDS STANDARD

» Student was able to give an estimate within 90 percent of the total number.

» MEETS STANDARD

» Student was able to give an estimate within 75 percent of the total number.

BELOW STANDARD

» Student was able to give an estimate that was less than 75 percent of the total number.

COMMON TERMS

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