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Overview

This Delta Science Module begins an investigation of measurement and the metric system by introducing students to uniform, nonuniform, and international standard units of measure for length and capacity.

In Activity 1, students operationally define *length* by comparing sticks, which are color-coded by length, and seriating them from shortest to longest.

In Activity 2, students compare two-dimensional shapes in order to operationally define *width.* They compare the dimensions of cardstock rectangles and seriate the rectangles by width.

Students compare the sizes of blocks in Activity 3 and learn about a third dimension—height. They then compare and seriate the blocks according to height.

Students use color-coded sticks of different lengths to measure the dimensions of their desks in Activity 4. When they find that measurements made with nonuniform units are not comparable, students recognize the value of uniform units of length.

In Activity 5, students are introduced to the meter, the basic international standard unit of measure of length in the metric system. They use metersticks to measure various distances in the classroom.

In Activity 6, students learn that the centimeter is $\frac{1}{100}$ of a meter and is a more convenient unit for measuring lengths shorter than a meter. Students use a metric ruler to measure the lengths, widths, and heights of various objects in centimeters.

Students are encouraged to first estimate and then measure both distances and dimensions in Activity 7. They then check the accuracy of their estimates by measuring distances in the classroom with metersticks and by measuring the lengths, widths, and heights of boxes with metric rulers.

In Activity 8, students are introduced to the concept of capacity as a measure of the amount of material a container can hold. They seriate different-sized containers according to their relative capacities.

Students estimate and then measure the capacities of various containers, using first sand and then water, and learn that the capacity of a container remains the same no matter what type of material is used to fill it.

In Activity 9, students use nonuniform units—cups of different sizes—to measure the capacities of various containers. After reviewing class data, they conclude that only the measurements made with uniform units of capacity—cups of the same size—are comparable.

Students are introduced to the liter, the basic international standard unit of measure for capacity, in Activity 10. They estimate, measure, and record the capacities of various containers to the nearest liter.

In Activity 11, students learn that there are 1,000 milliliters in a liter, making the milliliter a more convenient unit for measuring capacities smaller than a liter. Following their estimations, students use a graduated beaker to measure the capacities of various cups to the nearest 5 milliliters.

Activity 12 challenges students to estimate the capacities of a variety of containers to the nearest liter or nearest 5 milliliters. Students then test their estimates by using a 1-L cup to measure capacities to the nearest liter and a graduated beaker to measure capacities to the nearest milliliter.

Materials List

Qty		Description
8		beakers, graduated, 250-mL
8		blocks, 2 cm × 2 cm × 1 cm
8		blocks, 12.5 cm × 7.5 cm × 2.5 cm
8		blocks, 7.5 cm × 5 cm × 5 cm
8		blocks, 20 cm × 5 cm × 2 cm
8		blocks, 2.5 cm × 2.5 cm × 2.5 cm
8		†bottles, plastic, 1-L
1		box, shoe
1	c	chart, Comparing Capacities
1	c	chart, Estimating and Measuring Distances
1	c	chart, Measuring Length in Meters
2	c	charts, Estimating and Measuring Dimensions
8		cones, capacity
8		containers, plastic, 1-L
8		containers, plastic, 2-L
8		containers, plastic, 4-L
8		cubes, capacity
8		cups, plastic, 30-mL
8		cups, plastic, 90-mL
8		cups, plastic, 120-mL
8		cups, plastic, 250-mL
8		cups, plastic, 1-L
8		cylinders, capacity
1	c	food coloring, red, 1 oz
8		funnels
1	c	graph, Desk Height
1	c	graph, Desk Length
1	c	graph, Desk Width
8		†metersticks, blank

Qty		Description
8		†pails
1		popcorn kernels, 1 lb
8		pyramids, capacity
1		rectangle sheets, p/5
16		rulers, metric
6		†sand, 2 lb
8		sponges
8		sticks, color-coded, p/5
1	c	tape, masking
8		tongue depressors
8		†trays, cardboard
1		teacher's guide

Teacher provided items

1		book
1		bottle cap
1		box, medium
8		boxes, large
8		boxes, small
32		containers, assorted
–		crayons
1		cup, paper
8		cups, plastic, 50–200-mL
–		markers, assorted
–	c	newspaper
–	c	paper towels
2		pitchers
1		scissors
1		teaspoon, measuring
–		water, tap

† = in separate box
c = consumable item

Activity 3
Comparing Heights

Objectives

In this activity, students compare the dimensions of different-sized wooden blocks and discover that some objects have a third dimension—height.

The students

- identify the three dimensions of a box
- seriate wooden blocks according to height
- operationally define *height* and *three-dimensional*

Schedule

About 40 minutes

Vocabulary

height
three-dimensional

Materials

For each student

1	Activity Sheet 3

For each team of four

1	block, wooden, 2 cm × 2 cm × 1 cm
1	block, wooden, 12.5 cm × 7.5 cm × 2.5 cm
1	block, wooden, 7.5 cm × 5 cm × 5 cm
1	block, wooden, 20 cm × 5 cm × 2 cm
1	block, wooden, 2.5 cm × 2.5 cm × 2.5 cm

For the class

1	*book
1	box, shoe
1	*marker, black, fine-tip
1 roll	tape, masking

*provided by the teacher

Preparation

1. Make a copy of Activity Sheet 3 for each student.

2. Use pieces of masking tape and your marker to label the blocks as indicated below. Lay them so that the smallest dimension is the height and affix the tape label on the top of each block, not on the end or the side.

Label number	Block dimension
1	2 cm × 2 cm × 1 cm
2	12.5 cm × 7.5 cm × 2.5 cm
3	7.5 cm × 5 cm × 5 cm
4	20 cm × 5 cm × 2 cm
5	2.5 cm × 2.5 cm × 2.5 cm

3. Each team of four will need a set of five blocks. You will need a shoe box and a book for demonstration purposes.

Background Information

In order to measure the size of a solid object, such as a cylinder or a block, it is necessary to take a third linear measurement. Besides its length and width, a solid, or *three-dimensional*, object has the dimension of *height*.

In this activity, students examine and compare three-dimensional objects. First, they are challenged to identify the three dimensions of a shoe box. Then they compare a set of five wooden blocks to one another and distinguish them based on differences in their lengths, widths, and heights.

So that students compare their blocks uniformly, height is defined as the smallest dimension of a block. This is certainly not true for all objects, as demonstrated by sky scrapers and trees. For objects whose positions are fixed, height is simply always the measurement of the object from bottom to top. For objects whose positions are changeable, height depends on which surface of the object acts as the base.

Name _____ Activity Sheet 3

Comparing Heights

1. Arrange Blocks 1–5 according to increasing length. Write their numbers in order from the shortest to the longest block on the lines below.

1 5 3 2 4

2. Arrange Blocks 1–5 according to increasing width. Write their numbers in order from the narrowest to the widest block on the lines below.

1 5 3 (or 4) 4 (or 3) 2

3. Arrange Blocks 1–5 according to increasing height. Write their numbers in order from the least tall to the tallest block on the lines below.

1 4 5 (or 2) 2 (or 5) 3

What is the number of your block? Answers will vary.

4. Find three objects in the classroom: one that is not as tall as your block, one that is taller, and one that is about the same height. Draw a picture or write the name of each object in the chart below.

Not as Tall	About the Same Height	Taller
	Answers will vary.	

Teaching Suggestions

Place a shoe box right side up on a table at the front of the classroom (see Figure 3-1).

1

Additional Information

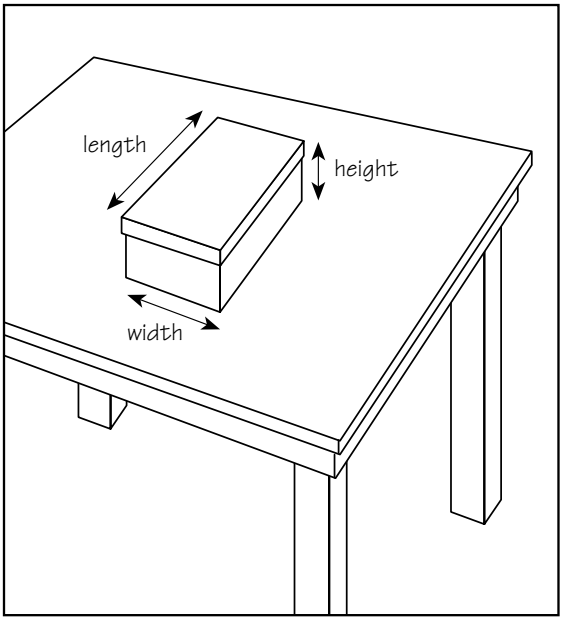

Figure 3-1. A box has three dimensions: length, width, and height.

Review the concepts of length and width by asking, **Which dimension is the length of this box?**

Students should say that the length of the box is the measurement from one end of the box to the other.

Invite a volunteer to show the class the dimension that is the length of the box. Then ask, **Which dimension is the width of the box?**

Students should say that the width of the box is the measurement across the box from side to side.

Invite a volunteer to show the class the dimension that is the width of the box.

Ask, **What else can we say about the box?**

If no one mentions it, suggest the idea of how high the box is. Explain that height is the measurement of an object from bottom to top.

Write the word *height* on the board. Invite a volunteer to show the class the dimension of the box that is its height. Guide students to operationally define *height.*

The wording of students' definitions is not important so long as students understand that height is the measurement of an object from bottom to top.

2

Ask, **How many dimensions does a stick have?**

Students should say one—length.

Ask, **How many dimensions does a cardstock rectangle have?**

Students should say two—length and width.

Ask, **How many dimensions does this box have?**

Students should say that the box has three dimensions—length, width, and height.

Encourage students to identify objects in the classroom that also have height, such as desks, bookcases, and chairs.

Write the term *three-dimensional* on the board. Explain to students that since they can describe the box in terms of length, width, and height, it is said to be *three-dimensional.*

3

Give each student a copy of Activity Sheet 3. Distribute a set of wooden blocks, numbered 1–5, to each team of four. Allow students a few minutes to pick up and examine each block in turn. Tell them that typically when we describe the size of a block by giving its dimensions, we give the longest dimension as its length, its next longest dimension as its width, and finally, its smallest dimension as its height.

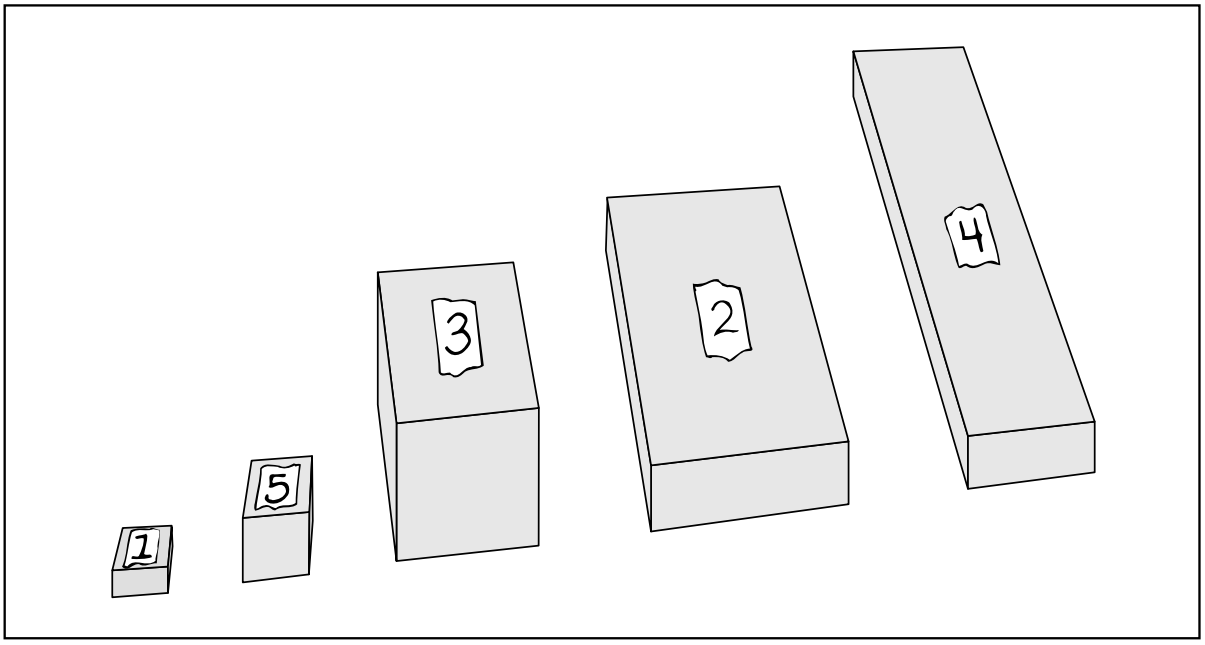

Figure 3-2. Blocks seriated according to increasing length.

Tell students to lay their blocks flat on the desk, numbered sides up, and line them up from shortest to longest (see Figure 3-2).

Remind students to make sure each block's smallest dimension is its height from the desk to the top of the block. Check each team's arrangement to ensure that they are not confusing width or length with height.

Tell students to complete Step 1 on the activity sheet.

Ask, **Which is the longest block? Which is the shortest?**

Students should say that Block 4 is the longest block and Block 1 is the shortest block.

Tell students to rearrange their blocks as needed to order them according to increasing width.

Again, check team's arrangements to be sure they are not confusing length with width.

Have students complete Step 2 on the activity sheet.

Ask, **Which is the widest block? Which is the narrowest block?**

Students should say that Block 2 is the widest block and Block 1 is the narrowest block.

Have two students on each team select one block each from their set of five. Ask each pair of students to bring the two blocks to the front of the classroom. Have them place the blocks flat on the desk, numbered sides up, and indicate which one is taller than the other.

4

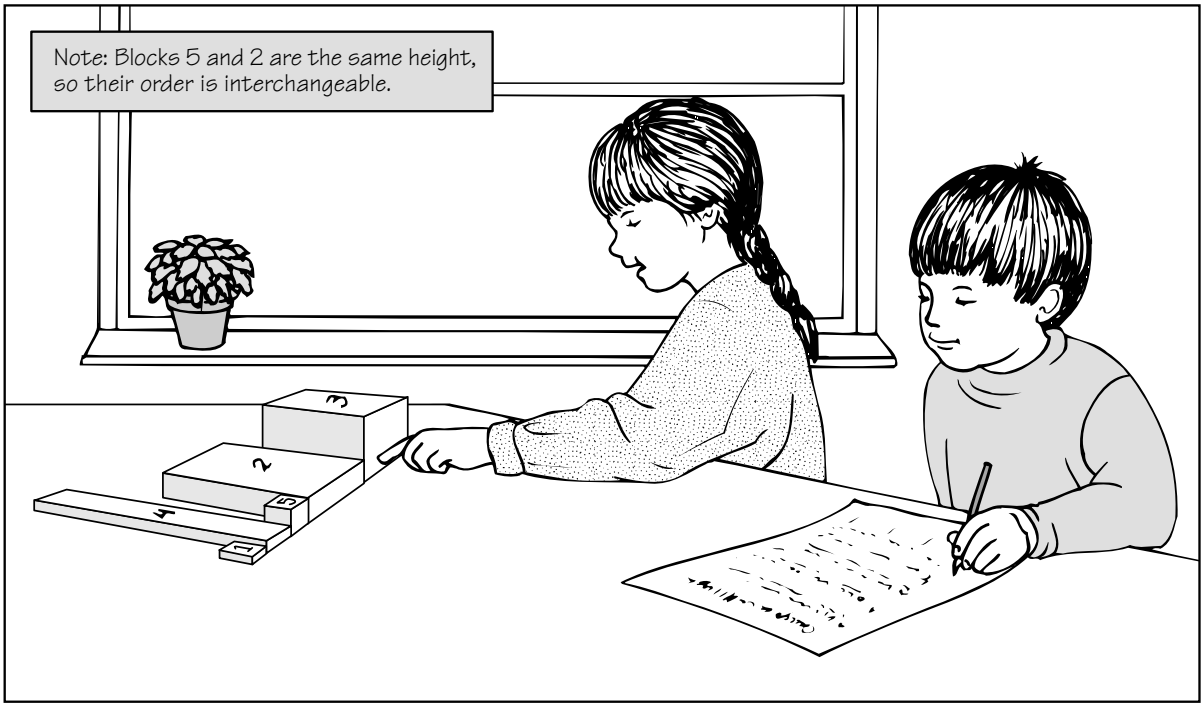

Figure 3-3. Students seriate the blocks according to increasing height.

After each pair of students has had a turn to do this, ask the class, **How can you tell that one block is taller than another?**

Students should say that they can place the blocks side by side flat on a desk and observe which of the blocks is taller than the other.

Have students arrange the blocks in order of increasing height and complete Step 3 on the activity sheet.

Blocks 5 and 2 are the same height, so their order is interchangeable.

Ask, **Which block is taller than Block 2?**

Students should say that Block 3 is taller than Block 2. Make sure students are evaluating the height, not the length or the width, of each block.

Ask, **Which block is not as tall as Block 4?**

Students should say that Block 1 is not as tall as Block 4.

5

Tell each student to select a block and record the number of the block on the activity sheet. Challenge each student to find one object in the room that is not as tall as his or her block, one that is taller, and one that is about the same height.

Make sure students are comparing heights, not lengths or widths.

Have students record the objects they find by writing the name or drawing a picture of each object in the chart in Step 4 on the activity sheet.

Discuss the results as a class. Encourage all the students who chose Block 1 to stand at the front of the class, holding their blocks, and show the class the objects they selected in each category. Repeat this process until students have all had a chance to show the class the objects they selected in each category to compare with their blocks.

Finally, review dimensions with students. Help them realize that not all objects have length, width, and height. Draw a line on the board. Point to the line and ask, **Does this line have the dimension of length?**

6

Students should say yes.

Ask, **Does this line have the dimensions of height or width?**

Students should say no.

Write the term *one-dimensional* on the board and remind students that a line has only one dimension—length.

Draw a rectangle on the board. Point to the rectangle and ask, **How many dimensions does a rectangle have?**

7

Students should say a rectangle has two dimensions—length and width.

Invite a volunteer to come to the board and trace the length and width of the rectangle with a finger. Ask the class, **Does this rectangle have height?**

Students should say no.

Write the term *two-dimensional* on the board and remind students that a rectangle has only two dimensions. It has length and width but not height.

Hold up a book and ask, **How many dimensions does this book have?**

8

Students should say it has three dimensions—length, width, and height.

Invite a volunteer to identify and trace the dimensions of the book. Write the term *three-dimensional* on the board and tell students that most objects that we see around us have three dimensions—length, width, and height. Write *length*, *width*, and *height* on the board.

Reinforcement

Collect a variety of wooden and cardboard boxes and allow students to compare the lengths, widths, and heights of the boxes. Encourage students to arrange the boxes

R

first in order of increasing length, then in order of increasing width, and finally in order of increasing height.

Cleanup

Leave the masking tape number labels on the blocks. Return the numbered blocks,

C

the roll of masking tape, and the shoe box to the kit.

Science at Home

Encourage students to collect six boxes from a cupboard at home—boxes of cereal, rice, pasta, or cake mix, for example—and

arrange the boxes according to increasing height. (Remind students to ask permission before disturbing any boxes.)