

CHAPTER 1

KINDERGARTEN: ATTRIBUTES TO MEASURE



Big measurement ideas identified in CCSSM: This chapter focuses on students' noticing and identifying attributes of objects and sets of objects. We want to help students understand what an attribute is and help them use attributes to sort and order objects. We also want to help them expand their vocabulary of comparison words while we enable them to distinguish between measurable and nonmeasurable attributes.

Learning trajectory levels in this grade: Two levels of measurement understanding are relevant to this grade with regard to length, area, and volume. During the kindergarten year, students are likely to recognize attributes including length, area, and volume. Kindergartners tend to demonstrate understanding that fits the Pre-Length Quantity Recognizer or Length Quantity Recognizer level for length measurement. Similarly, these students tend to fit the descriptions that Barrett, Clements, and Sarama (2017) provide for the Area Quantity Recognizer and Volume Quantity Recognizer levels. As students progress beyond identifying attributes, they compare directly and indirectly in ways that are consistent with the Length Direct Comparer level. These ideas are echoed in the measurement standards from the CCSSM for kindergarten: K.MD.A.1, K.MD.A.2, and K.MD.B.3.

Table 1.1 provides an overview of the activities in this chapter. Each activity is linked to the relevant CCSSM standard and levels from a learning trajectory on measurement. The activities are divided into three groups. Activities 1–4 focus on describing and sorting objects by attributes, activities 5–9 focus on comparing objects by length, and activities 10–14 focus on comparing objects by attributes.

Table 1.1. Kindergarten activities matched with Common Core State Standards and learning trajectory levels

General CCSSM	Learning activities	Activity-specific standards	Learning trajectory levels
Describing and sorting by attribute K.MD.A.1: Describe measurable attributes of objects K.MD.A.2: Directly compare objects with a measurable attribute K.MD.B.3: Classify objects into categories; count and sort	Activity 1: Right on the Button! Key idea: Describing and sorting by attributes	K.MD.A.1 K.MD.A.2 K.MD.B.3	Length Quantity Recognizer Area Quantity Recognizer
	Activity 2: What's Bugging You? Key idea: Ordering three objects by size	K.MD.A.1 K.MD.A.2 K.MD.B.3 1.MD.A.1	Length Comparer (Direct, Indirect)
	Activity 3: Goats, Trolls, and Bridges Key idea: Identifying and comparing by attributes	K.MD.A.1 K.MD.A.2 1.MD.A.1	Length Quantity Recognizer Length Comparer (Direct)
	Activity 4: Big, Small, Short, Tall? Key idea: Comparing to order objects	K.MD.A.1 K.MD.A.2 1.MD.A.1 2.MD.A.1 2.MD.A.2 2.MD.A.4	Length Quantity Recognizer Length Comparer (Direct) Length Unit Relater and Repeater Area Quantity Recognizer
Comparing by length K.MD.A.2: Directly compare objects with a measurable attribute	Activity 5: Which Is the Shortest of All Your Toes? Key idea: Comparing by length	K.MD.A.2	Length Comparer (Direct)
	Activity 6: Faster, Slower, Higher, Lower! Key idea: Expand students' vocabulary for comparing objects	K.MD.A.1 K.MD.A.2	Length Comparer (Direct)
	Activity 7: Reach for the Stars! Key idea: Relating age, height, and reach	K.MD.A.1 K.MD.A.2	Length Comparer (Direct) (Exploring, Conversion) Length Unit Relater and Repeater
	Activity 8: On the Other Hand . . . Key idea: Counting up units of length using a hand as a unit	K.MD.A.1 K.MD.A.2 1.MD.A.2	End-to-End Length Measurer (Exploring) Length Unit Relater and Repeater
	Activity 9: Watch Out for the Big Guy! Key idea: Comparing things to parts of our bodies	K.MD.A.1 K.MD.A.2	Length Quantity Recognizer Length Comparer (Direct, Indirect)

General CCSSM	Learning activities	Activity-specific standards	Learning trajectory levels
Comparing by attributes K.MD.A.2: Directly compare objects with a measurable attribute	Activity 10: She Swallowed a What? Key idea: Comparing volume and length	K.MD.A.1 K.MD.A.2 1.MD.A.1	Length Quantity Recognizer Length Comparer (Direct) Volume Quantity Recognizer
	Activity 11: “Just Right!” Key idea: Comparing three objects by size and order	K.MD.A.1 K.MD.A.2 1.MD.A.1	Length Quantity Recognizer Length Comparer (Direct) Area Quantity Recognizer Volume Quantity Recognizer
	Activity 12: Inch by Inch Key idea: Measuring length by repeating inch units	K.MD.A.1 K.MD.A.2 1.MD.A.2 2.MD.A.1	Length Quantity Recognizer Length Comparer (Direct) End-to-End Length Measurer Length Unit Relater and Repeater
	Activity 13: Which One Fits? Key idea: Capacity with envelopes and cards	K.MD.A.1 K.MD.A.2 1.MD.A.1 K.G.B.4	Length Quantity Recognizer Length Comparer (Direct) Area Quantity Recognizer
	Activity 14: Fill It to the Top! Key idea: Noticing volume as a measurable attribute	K.MD.A.1 K.MD.A.2 2.MD.A.2	Length Quantity Recognizer Length Comparer (Direct, Indirect) Area Quantity Recognizer Volume Quantity Recognizer Volume Filler Volume Quantifier

Activity 1: Right on the Button!



Key idea: Describing and sorting by attributes

Learning trajectory level: Length Quantity Recognizer; Area Quantity Recognizer

Essentials

Collect at least 20 buttons of different sizes, shapes, and colors for each table or group of students.

Engage

Read *The Button Box* by Margarette S. Reid (Dutton 1989). Colorful illustrations and simple text invite the reader to sort, classify, sequence, and count buttons.

Explore

Discuss some of the sorting methods used in the book. After students have had time to play with the buttons at their table, have them sort the buttons by color and then by shape or size. Have them shift to another collection of buttons for more practice if needed.

Expect

- It is OK if a set contains only one button.
- Students may mix buttons together, using more than one strategy without applying the same strategy to all the buttons. For example, they might sort some buttons into two stacks of red and not-red buttons but then sort the rest of the buttons into stacks of large and small buttons so some red buttons show up in those stacks.
- Are students able to support their sorting strategy by using appropriate descriptive words?
- Can students sort their buttons into sets based on an attribute (such as number of holes, shank or no shank, shiny or not) and have you guess their strategy?

Extend

- Read “A Lost Button” from *Frog and Toad Are Friends* by Arnold Lobel (Scholastic 1970). Toad and Frog set out on a walk that is spoiled by the loss of Toad’s button. The button is found after a search that includes help

from their friends. Have students describe the buttons in the text and match them to buttons in their collection.

- Use the collection of buttons that students have sorted to build patterns. Begin by sharing a pattern, say A, B, A, B. . . . Next, have students make and share a pattern with others, such as small button, large button, small button, large button. . . .
- Have students sort collections of objects such as keys, coins, pebbles, bolts, or jar lids. Ask students about the sorting work of their classmates: “Can you guess which attribute was used to sort these?”
- Students can also use these objects to form patterns in artistic designs. You can begin a classroom discussion about their artwork to emphasize the attributes and the grouping of similar objects.

Enrich

Read *Sorting* by Henry Pluckrose (Children’s Press 1995). Objects are sorted in various real-life situations.

Other possibilities include *Play with Sorting!* by Joyce Markovics (Rourke Educational Media 2013), which presents sorting situations using a range of attributes, and *Comparing with Cats* by Tracey Steffora (Heinemann Library 2014), which distinguishes between defining attributes and nondefining attributes (like color or orientation in space).

Activity 2: What's Bugging You?



Key idea: Ordering three objects by size

Learning trajectory level: Length Comparer (Direct, Indirect)

Essentials

Gather scrap materials like pipe cleaners, packing peanuts, tape, beads, lids, ribbon, wire, cans, juice boxes, or buttons.

Engage

Read *The Best Bug Parade* by Stuart J. Murphy (HarperCollins 1996). In this imaginative story, a variety of different bugs talk among themselves to compare their relative sizes while marching in a parade.

Explore

Have each student construct a “bug” from scrap materials. Students are likely to create a variety of bugs, some small and some large. Select from the small bugs a set of three and have their creators sort those bugs into small, smaller, and smallest. Then select from the big bugs a set of three and have students sort them into big, bigger, and biggest. Reconfigure the groups of bugs and repeat the activity at least two more times. (Ideally, no bug will fall into the same spot in the ordering each time.)

Expect

- Students naturally will want to order any set of three objects by size by identifying the small one, the big one, and then the middle-sized one. This activity is meant to develop vocabulary that is more definitive, introducing the comparison words *smaller* and *smallest* (and likewise *bigger* and *biggest*). When you ask students to sort a set of small bugs, you might suggest that they begin by finding the smallest one. Similarly, it may be easiest for them to find the biggest of the three big bugs. To challenge students, ask them to find the bigger bug in a set of three bugs before identifying the biggest bug. Two bugs will be bigger, and then, of those two, one will be the biggest.
- Watch and listen to learn which dimensions students use to determine size. Was it necessary to establish length or height as the criterion?

- Discuss why a student's bug might have been the big one in one group, while in another group it was the bigger one and in yet another the biggest (see fig. 1.1). Could the same scenario have happened with small, smaller, smallest?

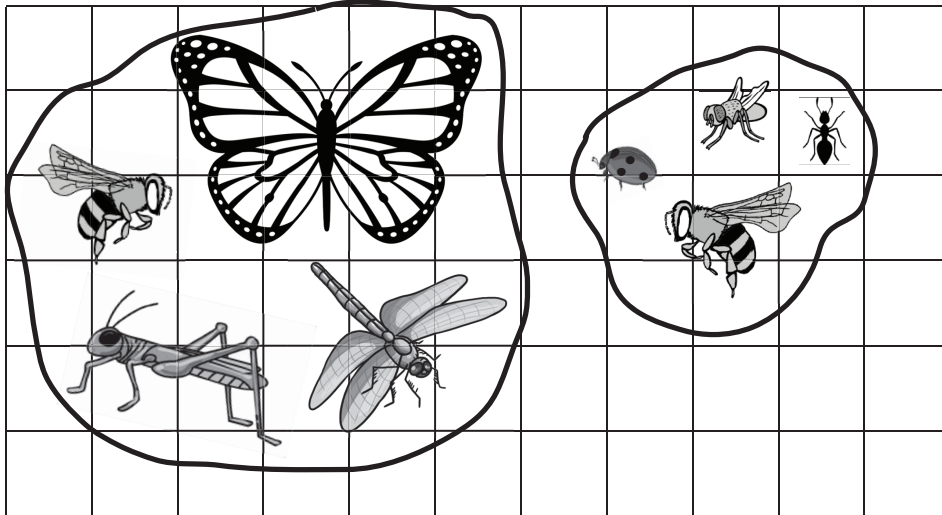


Fig. 1.1. A bumblebee is smallest in the group of insects on the left, although it is the largest insect in the other grouping.

Extend

Have students order all the bugs for one big bug parade. It may be worthwhile and less confusing to build the parade one bug at a time. Identify the smallest and the largest bugs first, allowing plenty of space between those two bugs for other bugs to join the parade. Each placement of a new bug promotes students' comparison skills.

Enrich

Read *A Garden Full of Sizes* by Simone T. Ribke (Children's Press 2004). A garden offers many size comparison opportunities. For example, pumpkin seeds are small, while radish seeds are tiny. Apples grow on thin branches; the trunk of the apple tree is thick.

Activity 3: Goats, Trolls, and Bridges



Key idea: Identifying and comparing by attributes

Learning trajectory levels: Length Quantity Recognizer; Length Comparer (Direct)

Essentials

Provide a space for students to act out the story.

Engage

Read *The Three Billy Goats Gruff*, illustrated by Stephen Carpenter (Scholastic 1998). Three different-sized billy goats have to deal with a mean, ugly troll who lives under the bridge that they need to cross to get to greener pastures on the other side. The different sizes of the goats also reflect their different ages.

Explore

Choose four students to act out the parts of the goats and the troll. The remaining students can make the sounds of the bridge crossings at increasing levels of loudness to indicate older, heavier, and larger goats. Voice volume should indicate increasing age and size of the goats. Ask the “goats” to switch roles (e.g., the smallest, youngest goat now plays the largest, oldest goat), and have them repeat the play. Have each “goat” explain how his or her part was different for the second performance.

Expect

- Students may think of size in different ways. Some students may need encouragement to use words other than *big* and *little*. Others may use words like *taller*, *heavier*, *shorter*, and *wider* to describe the goats.
- You can use this story to help students connect five ideas: (1) the ordinal words, (2) the goats’ ages, (3) height or width, (4) weight, and (5) the volume of their voices. For example, the first goat is the youngest, the smallest, the lightest in weight, and has the smallest voice. The other two goats’ attributes differ accordingly.
- Ask students to name ways in which the last goat to cross the bridge is different from the first goat.
- Do students mention more than one attribute when explaining how one goat differed from the next? Look for specific attributes of size such as height, length, width, horn thickness, or beard length.

Extend

- Point out that the size of the printed words in the book describing the sounds—TRIP, TRAP, TRIP, TRAP, TRIP, TRAP!—get bigger with each goat shown to indicate loudness and to correspond to the increasing size of the goats.
- Have students illustrate the events of the story in sequential order. Encourage students to use their illustrations to retell the story to a friend or family member.

Enrich

Read *Big, Bigger, Biggest* by Marilyn Deen (Capstone Press 2012), and check out the world's big, bigger, and biggest animals.

Activity 4: Big, Small, Short, Tall?



Key idea: Comparing to order objects

Learning trajectory levels: Length Quantity Recognizer; Length Comparer (Direct);

Length Unit Relater and Repeater; Area Quantity Recognizer

Essentials

Gather an amaryllis bulb or a Wisconsin Fast Plant, dirt, a planting pot, and Unifix cubes. Scout out the school's neighborhood to find appropriate trees and buildings for an extended walking activity.

Engage

Read *Titch* by Pat Hutchins (Macmillan/McGraw Hill 1971). Titch is the smallest of three students and has the smallest of everything until he plants a seed.

Explore

Discuss the story. Titch wants a kite that flies higher than that of his sister and brother. Where might it fly? Titch also wants a musical instrument bigger than his sister's trumpet and his brother's drum. What could it be?

Have students look at the instruments shown on page 20 of *Titch* and decide which is larger. How do they know? Titch wants a tool bigger than a hammer or saw. Ask students for ideas about bigger tools. Look at the two tools on page 24 and ask students to say which tool is larger. How do they know?

Pete has a big spade, Mary has a fat flowerpot, and Titch has a tiny seed. Ask the students how Titch might feel about this.

Ask students to estimate the height of the plant as shown on pages 30–32. Imagine that Titch is 3 feet tall (see page 32), his sister is 4 feet tall, and his brother is 5 feet tall. How tall must the plant be? You may expect students to say the plant is 7 or 8 feet tall. Ask them to defend their answers, especially ones that vary greatly from 7 or 8 feet.

Expect

- Expect students to say that the drum is bigger than the trumpet, but encourage them to be more specific about attributes of the two instruments: height, width, distance around, area of the drumhead, or even loudness.

- As students consider the plant's growth from page 30 to page 32, they may mention the height or the number of leaves or branches.
- For the discussion of the story of Titch, find out whether students can identify attributes beyond the size words *big* and *small*. For example, tools can be compared by noticing differences in length, area, volume, or weight. Listen for words and phrases like *wider*, *fatter*, *thinner*, *covers more space*, or *takes up more space*.

Extend

- Plant an amaryllis bulb (or a Wisconsin Fast Plant) in a pot. Do not show students any packaging with a picture of the plant. Ask the students to make a series of drawings to show what they expect the plant to look like and how tall they expect it to be after one week, two weeks, or three weeks. How many days will it take to grow to be 6 inches tall, or 12 inches tall? (Once it sprouts, it will grow fast enough to measure the growth daily.)
- Stack up Unifix cubes to show how much the plant has grown. Change the color of the cubes each week to show how much it grew during that week. Eventually, the accumulation of cubes will reflect the plant's growth rate each week.
- Take a walk and look for a tall tree (or building), then a taller tree (or building), and then the tallest tree (or building). Have students fold a sheet of paper in thirds horizontally and mark the folds to indicate the heights of the tall, taller, and tallest trees or buildings they saw on the walk.
- If a neighborhood walk is not an option, read *Jack and the Beanstalk* by Paul Galdone (Clarion 1974). Have students fold a sheet of paper in thirds, as described above, and draw a picture of the beanstalk with Jack climbing it. Ask students to think of a plant that is taller than a dandelion but not as tall as the enormous beanstalk in the story and show this comparison in their drawing (see fig. 1.2 on the following page).

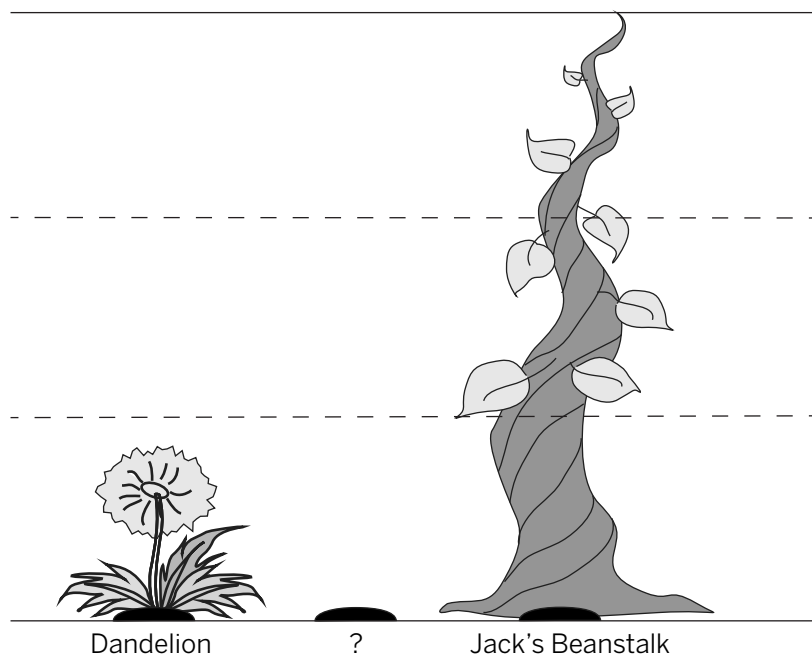


Fig. 1.2. What plant is taller than a dandelion but not as tall as the beanstalk?