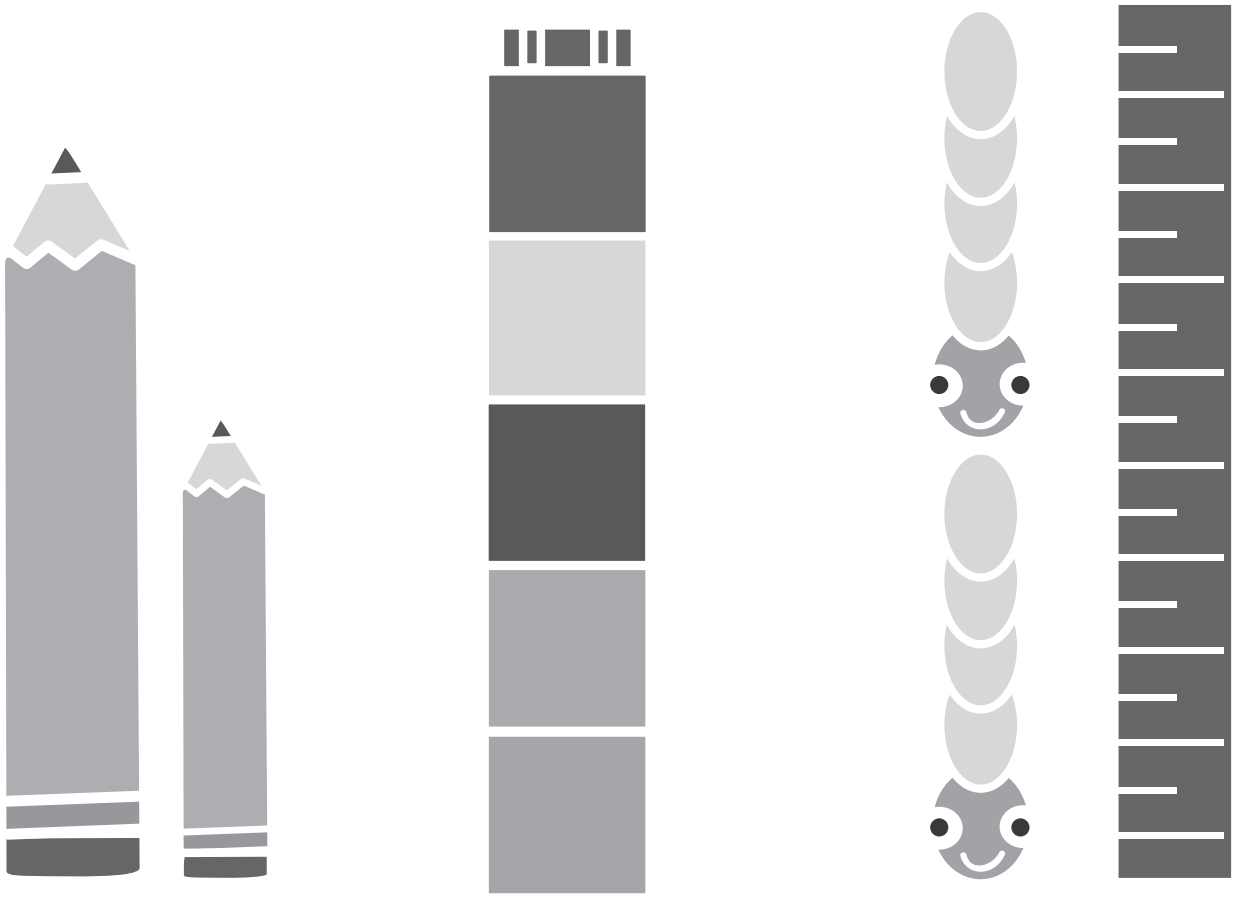
Exploring Measurement Concepts



Real-World Activities to Deepen Understanding

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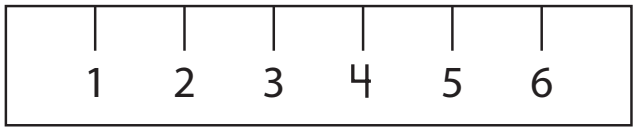
Contents

Paper clips measuring object

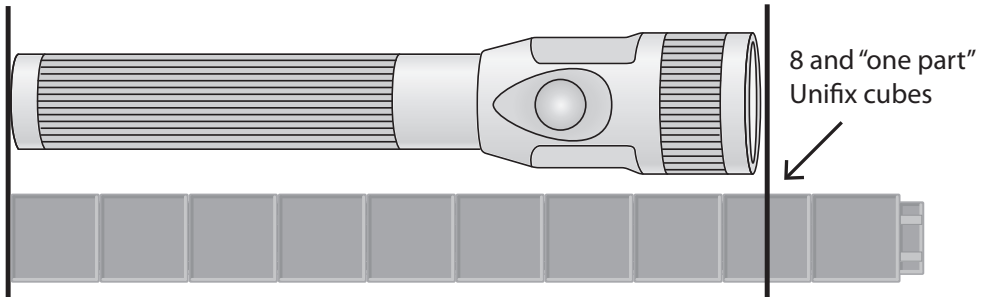


Ruler with nonstandard units

Standards Units Students need to develop an understanding of when the use of standard units is appropriate (grades 2–3), but this should occur after they have had the opportunity to develop a conceptual understanding of units through the use of nonstandard units (grades K–1). As students move into upper grades (4–5 to middle school), they should develop the notion of precision with standard units and be able to estimate measurements in standard units.

Partitioning

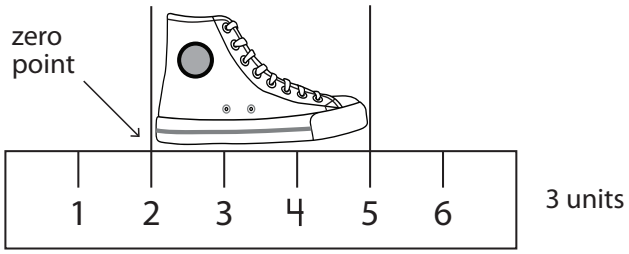
Students need to understand that sometimes the total measurement may not be in whole units and that a "part of" a unit should be used for a more accurate measurement. Initially, this can be stated as just "part of" a unit (grades K–1), but as children begin to develop their knowledge of fractions, they can identify the actual fraction of the unit (grades 2–5), such as the "The book is 5 and a half inches long."



Object being measured where total is partitioned

Zero Point

When measuring, it's important for children to understand that you begin from the point of origin (or "zero point") to the end point, and that any point can serve as the zero point on the scale. To determine the "unit" means to begin from zero point (point of origin) and proceeds to the end of the unit, continuing with the process of iteration to the end of the object being measured.



Object "in middle" of measuring tool

References

Dacey, L., Cavanaugh, M., Sheffield, L., Small, M., Findell, C., & Greenes, C. (2003). Navigating through measurement in prekindergarten–grade 2. *Navigation Series, Principles and Standards for School Mathematics.* Reston, VA: National Council of Teachers of Mathematics.

Jaslow, L. & Vik, T. (2006). Using children's understandings of linear measurement to inform instruction. *Teachers Engaged in Research: Inquiry into Mathematics Classrooms,* Grades PreK–2, 109–134.

Lehrer, R., Jaslow, L., & Curtis, C. (2003). Developing an understanding of measurement in the elementary grades. *Learning and Teaching Measurement,* 1, 100–121.

Grades K–1 Measurement Assessments

This assessment is designed to provide an opportunity for teachers to assess the developmental level of students' conceptual understanding of the big ideas in measurement. The entire assessment should be administered individually, with the child providing verbal responses. The assessment should be given as a pre-assessment initially in order to determine the level of conceptual development and then administered again as a post-assessment after the students have engaged in some of the activities suggested in this book.

Pre-Task

With young children, it is important to first assess their ability to count, with a foundation of one-to-one correspondence and understanding of discrete counting. You may still proceed with the measurement assessment despite the outcome of this task, but it provides you with a baseline of their basic number sense.

Place 8 to 10 objects in front of the child and ask them to tell you how many are there. Observe their counting to determine how they arrive at the total. It is expected that they would either count objects by pointing to each one as they say the number out loud or subitize the total by simply looking and stating the total.

Task 1 The Concept of Units (page 4)

Provide the child with several paper clips, both small ones and larger ones. Ask the child to measure a picture of a hair brush using the paper clips and state to you how long the object is. In this task, you are looking for the child to use the same-size paper clips and place them from end to end across the paper and state the measurement in whole units. (*The brush is 6 paper clips long.*) This will help you determine the child's understanding of identical units and the process of iteration.

Task 2 The Concept of Units (page 5)

Show the child the picture and ask, **"How tall is each ice cream cone? Write how many cubes tall on the blank provided."**

In this task, you are looking for the child to count the number of cubes as identical units and to proceed from the point of origin to the end point.

Task 3 The Concept of Units (page 5)

In the illustration, the rulers are showing unspecified units of measurement. Ask the child to determine how long each pencil is in the units shown on the ruler. Then ask him or her to write the number on the blank provided.

In this task, you are assessing for both zero point and partitioning. As you can see, the pencils are placed strategically at different origin and ending points and a couple of them are "part of" a unit in length.

Task 4 **Identical Units** (page 7)

Pose this situation to the child: **"Susan says that the pen in the picture is 6 paper clips long, but her friend Julio says that it is 4 paper clips long.**

"What would you say? How long is the pen? How do you know?"

In this task, you are assessing the identification of identical units.

Task 5 **Partitioning** (page 8)

Ask the child to examine the pictures and tell you, **"How tall is each tree?"**

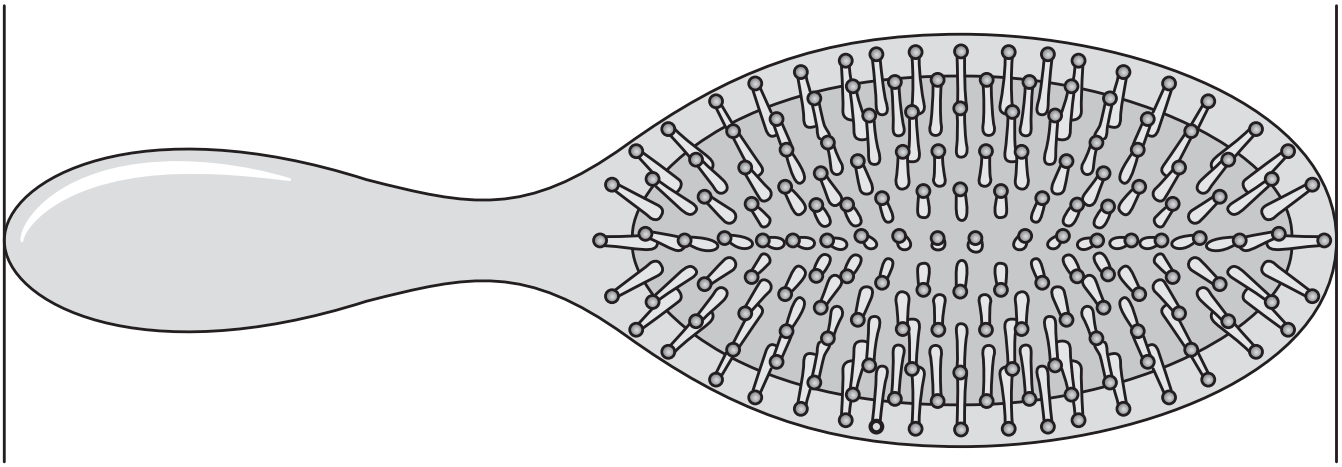
In this task, we are specifically assessing the concept of partitioning.

Post-Task

Record your notes based on what you observed using the form provided on page 9.

Name _____

1 How Many Paper Clips?



_____

paper clips long

Place the paper clips below the hairbrush.

How many paper clips long is the hairbrush?

Kindergarten Activities

1 My Teddy Bear

Number of Students

Whole class or small groups

Materials

- Each student should bring a teddy bear or stuffed animal to class, or the teacher can bring one large stuffed animal.

Overview

In this activity, students explore the measurable attributes of an object to begin thinking about measurement.

Presenting the Activity

1. Invite students to describe their teddy bears or stuffed animals. Students will describe the toys in a variety of ways, including nonmeasurable attributes (such as texture or color). Have students use as many descriptions as possible.
2. Based on their responses, lead the students to discuss and focus on more of the measurable attributes of the stuffed animal, such as height, length of arms and legs, possible weight (even if they say something like, "mine is fatter than others").
3. Once they have identified some measurable attributes, lead them in a brief discussion about how they might find out "how long" an arm or leg is or "how tall" the stuffed animal is, or "how much it weighs." Guide the students to begin thinking about using tools to measure objects.

Tip!

Students may suggest the use of standard tools such as rulers, measuring tapes, or scales, but you can suggest to them that there are all kinds of tools for measuring and that in subsequent activities, we will actually use these tools.

Focus of Development Concept of units and some experience with zero point

MATH STANDARDS: Describe several measurable attributes (such as length or weight) of a single object.

Assessing Student Responses

This activity is designed as a short, discussion-based session to allow students to explore measurable attributes. The intent is to build a foundation for measurement concepts.

- During whole-group or small-group discussion, did students identify any measurable attributes?
- Did they use any formal language such as "long, short, tall, heavy, or light," or did they use more informal language such as "fat, skinny, frumpy, floppy, or sits high"? All descriptive language is acceptable, but it will be important to begin to guide students to use more formal language as they begin to actually measure objects.
- Did the students begin to compare their stuffed animal with others? Or compare the one large stuffed animal with other objects in the room? This may be a natural inclination and should be encouraged to promote comparison as a way to identify measurements.

Extending the Activity

- **As an extension, if the students all brought their own stuffed animals, have the class arrange them from shortest to tallest. It is best to focus on one attribute and height is the easiest to start with.**

Grade 1 Activities

1 Long, Longer, Longest

Number of Students

Small group of 2–4

Overview

In this activity, students order three objects by length using a reference length (such as longest) to compare two other lengths (shorter and shortest).

Materials

- Unifix® Cubes or other connecting cubes for each student
- A variety of different-sized objects such as books, stuffed animals, pencils, etc., placed in paper bags (one bag per student)
- "The Teacher Says" Game Cards (page 113)

Presenting the Activity

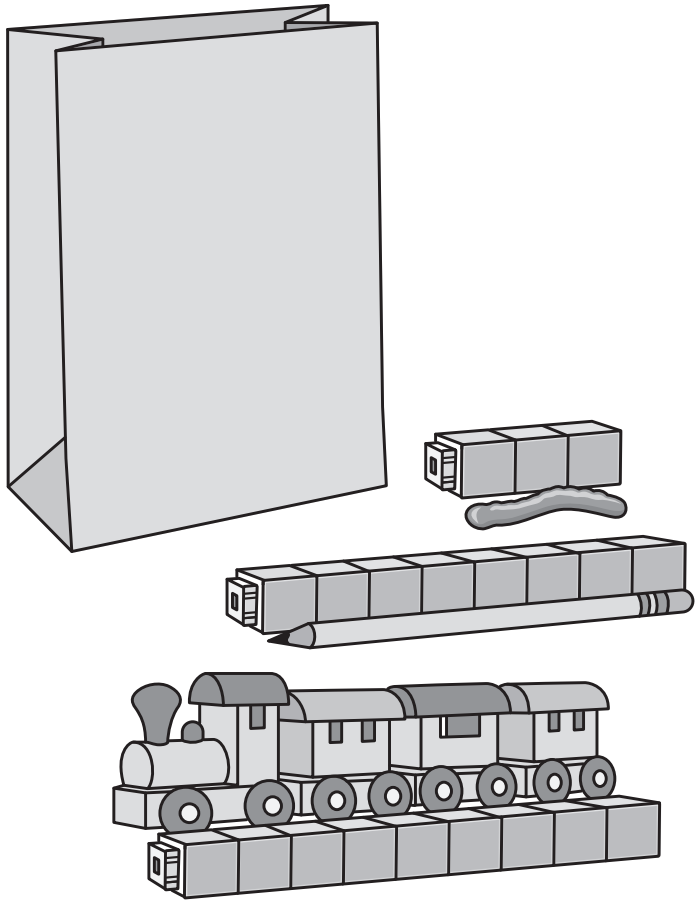
1. Begin with a discussion to compare familiar classroom objects, such as a small book and a large book. Ask questions with an emphasis on vocabulary, such as, "Which book is longer and which book is shorter?
2. To find out, demonstrate measuring the covers of both books with connecting cubes. Place the first cube at the top or bottom edge of the smaller book. Snap the cubes together to find the length of the smaller book. Count the number of cubes used.
3. Next, measure the larger book with the connecting cubes. Compare the lengths of the two books.
4. Distribute connecting cubes and a paper bag with three items to each student. Ask students to measure each items with cubes and then place them in order from shortest to longest.
5. Explain how to play a comparison game called "The Teacher Says" (similar to "Simon Says"). In this game, students stand behind their table or desks. The teacher reads a card from the deck, such as "The teacher says, show me your longest item."
6. Each student holds up their longest item. If correct, the student stays standing. If incorrect, the student sits out for one round. If the card read by the teacher does not start with *The teacher says,* the student must sit down.

Tip!

Although connecting cubes are used to determine length, the true focus of the activity is *not* to find a numerical measurement but to *compare the lengths* of objects.

Focus of Development Comparing lengths of objects

MATH STANDARD: Order three objects by length; compare the lengths of two objects indirectly by using a third object.



Assessing Student Responses

Observe students' participation during the activity. Record your observations anecdotally.

- Do students understand that length is the measurement of an object from one end to another?
- Do students correctly measure with the connecting cubes?
- Do students find an object whose length is between two given lengths?
- Do students use comparison words such as *long, longer, longest* and *short, shorter, shortest*?
- Do students accurately compare three objects?

Extending the Activity

- **Let students choose their own unit and items to measure. The items do not need to be all the same type, but need to be measured with the same nonstandard unit, such as cubes or pencils.**
- **Ask students to explain which item is the longest and which is the shortest.**
- **Ask students to describe the lengths with comparison statements such as, "We measured the lengths of three pencils with Unifix Cubes. The new pencil is the longest, the red pencil is shorter than the yellow pencil, and the green pencil is the shortest of all three pencils."**

"The Teacher Says" Game Cards

Copy and cut the cards apart.

The teacher says, "Hold up your longest object."	Order your objects from longest to shortest.	The teacher says, "Order your objects from longest to shortest."
The teacher says, "Hold up your object that is shorter than the _____."	Order your objects from shortest to longest.	The teacher says, "Hold up your object that is longer than the _____."
Hold up your longest item.	The teacher says, "Hold up your shortest item in your right hand."	The teacher says, "Hold up your shortest item in your left hand."
Hold up your shortest item.	Hold up your object that is shorter than the _____."	The teacher says, "Hold up your shortest item."