

Ohio Standards Connections

Measurement

Benchmark B

Know that the number of units is inversely related to the size of the unit for any item being measured.

(Grades 3 - 4)

Indicator 1

Relate the number of units to the size of the units used to measure an object; e.g., compare the number of cups to fill a pitcher to the number of quarts to fill the same pitcher.

(Grade 4)

Indicator 5

Make simple unit conversions within a measurement system; e.g., inches to feet, kilograms to grams, quarts to gallons.

(Grade 4)

Mathematical Processes Standard

Benchmark J

Read, interpret, discuss and write about mathematical ideas and concepts using both everyday and mathematical language.

(Grades 3 - 4)

Lesson Summary:

Students will create visual models of measurement units, identify tables of equivalent units and make simple conversions within a measurement system.

Estimated Duration: 90-120 minutes

Pre-Assessment:

The pre-assessment can be embedded within a whole-class or small-group discussion during which students provide examples of referents and comparative terms or descriptions of relative sizes of units. These discussions and/or products provide information about student understanding of relative size of units and readiness to do simple conversions.

Engage students in a discussion by asking them to identify units of measure for length. Record responses on board or chart paper. Suggest students organize the information in a table in which the units are ordered by relative size and describe the relative size and a personal, common referent for each unit. Provide an example to help students understand the task.

Unit	Describe Relative Size	About the size of ...
inch	Smaller than a foot and a yard Used to measure small things There are lots of them in a yard 12 inches is the same as one foot	Width of a quarter Length of a paperclip

Note: Expect and accept a variety of informal and more formal or technical descriptions and referents.

Commentary:

"Measurement sense", including establishing and working with personal benchmarks (referents) and knowing the relative size of common units of measure is a key component of making simple conversions among units of measure.

Scoring Guidelines:

Evaluate student work for accuracy in ordering units, in describing relative size and referent.

Post-Assessment:

Post-assessment can be accomplished through one or both of two strategies.

- Collect and evaluate student work completed during lesson. Solutions to

simple conversion exercises and contextual problems may be used to evaluate students' demonstration of the target indicators.

- Use a set of follow-up questions and tasks that can be assigned as homework or included in an on-demand assessment. Questions should focus on students' emerging measurement sense and simple conversions rather than on performing procedures. Samples for a variety of items that could be included in a follow-up assignment (post-assessment) are included at the end of the lesson materials.

Scoring Guidelines:

A sample, general rubric is provided. This rubric can be customized to match the nature of the tasks in the lesson or those assigned as homework or included in a more formal post-assessment. The completeness and accuracy of solutions, understanding of the relationship among units of measure, and making simple conversions should be the focus of the evaluation of student progress.

2 - Response is accurate and complete. Solutions are correct and include supporting work and/or explanation.

1 - Response shows partial understanding. Solution is correct but no work or explanation is provided to support the solution, or solution includes correct process or reasoning showing understanding but a minor computation error led to an incorrect solution.

0 - Response shows major gaps in understanding or fails to address most components of the task. Response shows an incorrect process or reasoning resulting in an incorrect solution.

Instructional Procedures:

Commentary:

The purpose of this initial activity is to provide visual models of the units as it is often difficult to clearly see the various units on standard measurement tools.

1. Divide the class into small groups or have each student construct models for units of length. Provide each group or each student with materials to construct models

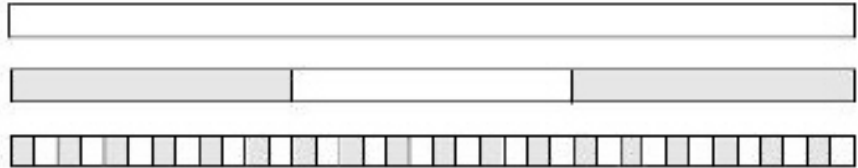
Commentary:

Students who can measure lengths using rulers and measuring tapes often are adept at reading the scales but have little understanding of what the numbers or markings represent. Making and using the models with only full units easily visible will reinforce conceptual understanding of units and what the numbers on the tools represent.

2. Measure two one-yard lengths of tape or string. Mark off one-foot sections on one length of tape or string. Color each section a different color or alternate sections when using paper tape to make the sections easy to see and

Making Simple Conversions — Grade Four

count. Also measure and cut paper tape or string to make a one-foot section. Mark off one-inch sections and color each to make the 12 sections easy to see and count.



* Note: Three one-foot lengths marked in inches have been taped together to form a model for one yard marked in inches.

Tie knots or use a marker to visibly mark the units when using string or cord.

Teacher Tip:

Working in small groups will reduce the time needed. The task could be posed in a way that allows students to make the models over a period of time prior to the lesson.

- *An alternate strategy is to have each student make a model for each unit (one yard, one foot, 12 inches). These smaller models can be used to model and answer questions in steps 3 and 4; e.g., taped together to form longer "tapes."*
- *Some tapes with inches marked or shaded are available for purchase.*

3. Guide students through a discussion to describe insights about the relative size of units gained through making the models. For example, the yard model could be constructed quickly (tape together three one-foot "inch" models.) Discuss and compare the number of sections in each model ... 36 inches, 3 feet, 1 yard.
4. Ask students to use the models to measure three to six common items (length of table, width of door, height of desk, length of pencil) in the classroom. This task can be organized in a number of ways. For example:
 - Things to be measured can be written on sets of cards. Each small group is provided with a set of cards and the members of the group work together to complete all measures and record on paper or a table provided.
 - Another variation is to give each group different items to measure and the results recorded on a class table or chart. It is important to include items of varying lengths to be measured. Include at least one item with a dimension to be measured that is greater than 36 inches so students will have to think of and apply a strategy for measuring something for which their "tape" is too short.
5. Begin this activity by having students measure an item using a specified unit. For example, ask students to measure the length of a table or width of their

desk in inches. After students have recorded their answer, ask them to predict what the measure will be when a different unit, such as feet or yard, is used. Have students write their prediction and why or how they made their prediction.

Commentary:

Measuring the object first in inches and then in feet or yards is an important part of the activity as it builds and reinforces the inverse relationship between the size of the unit and the number needed to measure the object. This leads to building the concepts about which measurement is best to use with specific objects. For example, measuring small objects, such as a pencil in inches and large objects, such as a room in feet or yards.

6. Ask students to volunteer to share their predictions and reasoning. This informal discussion of students' predictions and reasoning will provide information about students' comfort with and success in relating unit size to number of units needed to measure the same length. After a brief period of sharing, have students measure the item in feet and/or yards using their model.
7. Complete a class table listing the measurement(s) similar to the one below to record results as each item is measured or to summarize the results when each student or group has measured common items:

Item	Measure in inches	Measure in feet	Measure in yards
Length of table	60 inches	5 feet	Almost 2 yards *

* Some students or groups may include a more exact measure using fractions to approximate the length as about 2 and one-half or 2 and two-thirds yards. This will provide an opportunity for discussion and connecting to fractions. However, it is appropriate to use general descriptions in the lesson as the focus is on relative size.

Commentary:

Students will have used rulers, tape measures and other tools in previous measurement experiences. In grade three, students measure lengths accurate to the nearest one-half or one-fourth unit. The focus of this lesson is on the relationships among units and making simple conversations rather than on using a measurement tool to measure to a desired degree of precision. Students need to recognize that measurement is approximate and accept measurements that are close but not exact.

8. Have students make additional measurements using multiple units, such as feet and inches, and record the results on individual charts or tables as well as on a class chart or table.
9. Engage students in a review and discussion of the results of the measurement component of the lesson. Facilitate the discussion to focus on making observations about relationships among measures when different units are used to measure the same object, such as the number of inches is always greater than the number of feet and the number of yards. Use questioning to guide students in making comparisons and generalizations about the relationships between the units and numbers, such as the smaller the unit, the larger the number of units and as the size of the unit increases, the number of units decreases.

Teacher Tip:

Ask students to share their strategies for measuring the item for which the dimension to be measured was greater than 36 inches. Have students (or groups of students) demonstrate their strategies. For example, some strategies may be holding or taping their tapes end-to-end or marking a point and moving the tape or using tapes with different units and making some simple conversions, such as "we put two tapes marked in feet end-to-end and counted three sections plus a little more" or "we used the yard tape and the inch tape and it was one yard plus four inches so we knew it was 40 inches because $36 + 4$ is 40."

10. Pose a question that involves a simple conversion. The question may be selected based upon the time of year or something of interest to students. For example, base the question on something in the news or a class project – a newspaper article states the record snowfall for the area is 54 inches. Ask students about how many feet and how many yards of snow would be the same as 54 inches?
11. Suggest students make a model using their tapes to show how much snow or how deep 54 inches of snow would be if it all fell at once. Give students time to think about the problem individually. Circulate around the room and observe strategies students are using.
12. Have students share the different ways and combinations of units they may have used; e.g., taped together five one-foot lengths marked in inches and counted or found the 54th inch or a combination of different models (one yard + one foot + six inches).

Commentary:

Some students may line up the models made earlier and look across the tools. Another possible strategy is to create a simple conversion table similar to the one in step 13. Other students may perform a computation, such as multiply or divide the number of inches by the number of inches in a foot or some other number.

13. Ask students to share their strategies. Ask students who used their tapes, created earlier in the lesson, to demonstrate how they found their answers. For example, the students may line up their models side-by-side and show where 54 inches would be on the inch model and where that same mark falls on the foot model and yard model.
14. Some students may share or demonstrate that they used a counting strategy. Discuss this strategy with students. Create a table to model a counting strategy as this reinforces the relationships among units. Have a student recreate or get started on a table that could be used to solve the problem.

Sample of table that can be used to make simple conversions:

Number of inches	Number of feet
12	1
24	2
36	3
48	4
60	5
72	6

15. Ask students to describe the pattern or relationship between the number of inches and the number of feet. Write those statements on the board or chart paper. Some examples include "the number of inches is twelve times the number of feet" and "the number of feet goes up one each time the number of inches goes up twelve." Do not edit student responses, but rather, record their language. Ask students to clarify any statements that may be unclear or not completely accurate.
16. Use the table to talk about the solution to the problem posed. For example, the record snow fall would be between four and five feet. Some students will observe that it is about four and one-half feet. Do not require students to provide fractional units, but rather allow a variety of solutions. However, do address the need to appropriately represent and describe answers, such as 4 feet 6 inches or four and one-half feet.

Teacher Tip:

Some students may suggest using division to make the conversion. Probing questions should be posed to make sure the student can describe how he/she decided what number to divide the number of inches by and why division works in this context.

Some students may be frustrated when the conversion is not an easy computation and they must deal with a remainder. Consider starting with a problem situation that is a more straightforward conversion, such as

determining the number of rolls of ribbon, each containing three yards, needed to make six decorated flower pots. Pose the problem by providing information or an illustration that shows each decorated flower pot requires two feet of ribbon. This provides a context for creating a table that relates number of yards to feet, such as:

Number of yards	Number of feet
1	3
2	6

Teacher Tip:

Students should see that examples of tables can be set up different ways ... yards to feet or feet to yards ... when showing relationships among units and solving problems making simple conversions.

17. Provide time for students to solve one or two additional problem(s) independently. Allow students to share answers and solution processes. Facilitate a class discussion about the relationship between the measures and strategies for making simple conversions.

Teacher Tip:

See sample tasks for additional options for tasks that may be used as class work or homework assignments. Include within assignment at least one problem that requires applying strategy to a "new" measure or units such as meters and centimeters.

Differentiated Instructional Support:

Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).

- Permit students to use models constructed to make and verify simple conversions.
- Select carefully the numbers and contexts used for some problem sets so that weak computation skills do not interfere with completing the tasks.
- Ask students to write about their observations and formulate general rules that may be used to decide when and how conversions are made.

Extension:

These are ideas for all students to continue learning on this topic – in the classroom or outside of the classroom.

- Create a similar task(s) with weight or volume units that require the construction of a simple conversion table similar to those in the lesson and writing a summary statement to describe the relationship among those units. Include a problem situation in which students must make decisions, such as dealing with a situation in which the conversion is not exact (there is something left over).

Homework Options and Home Connections:

Have students identify two or three situations in which one might need to make simple conversions in daily life. Students may ask parents to give an example of contexts in which they may need to convert from one unit to another; e.g., when making a purchase, comparing information on packages, etc. Students can either describe the context and the conversion needed or create a task or question using the context for others to solve. (Student must provide solution.)

Materials/Resources Needed:

For the teacher: Chart paper, markers, note cards.

For the students: Measurement tools (ruler, measuring tape, yardstick, meter stick), rolls of cash register or calculator paper tapes or heavy string or cord, crayons or markers.

Key Vocabulary:

- inch
- foot
- yard
- meter
- centimeter

Attachments:

- Sample Tasks to Follow-up Assignment or Assessment for Simple Conversions