Topic D
Measuring and Estimating Length Using Customary and Metric Units

2.MD.1, 2.MD.2, 2.MD.3, 2.MD.4

Focus Standards:

2.MD.1 Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
2.MD.2 Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen.
2.MD.3 Estimate lengths using units of inches, feet, centimeters, and meters.
2.MD.4 Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.

Instructional Days: 4

Coherence
- Links from:
  G1–M3 Ordering and Comparing Length Measurements as Numbers
  G2–M2 Addition and Subtraction of Length Units
- Links to:
  G3–M2 Place Value and Problem Solving with Units of Measure

Topic D builds upon the work students completed in Module 2 with centimeter measures, as students now explore measurement using both customary and metric units. In Lesson 16, students rotate through various centers and measure a variety of objects with inch rulers and yardsticks, strategically choosing the appropriate measurement tool and units for measuring a given object (2.MD.1). In doing so, they develop mental images of customary benchmark lengths.

Next, in Lesson 17, students deepen their measurement sense by applying their experiences in Lesson 16 to estimating the lengths of different objects and then checking their estimates by measuring (2.MD.3). For example, a student might estimate that a desk is three feet tall and then measure to discover that it is actually three feet, six inches tall.

Then, in Lesson 18, students measure the same objects twice, using both metric and customary units. In this way, they learn that centimeters are smaller than inches, but meters are larger than both feet and yards. This reinforces the understanding that when measuring with a smaller unit, more iterations of that unit are needed to measure the same object than when measuring with a larger unit (2.MD.2).

Finally, students compare different lengths using addition and subtraction in Lesson 19. They determine how much longer one object is than another, subtracting the smaller length from the larger one. Problems are
solved in a variety of ways using the relationship between addition and subtraction (e.g., \(25\text{ in} - 18\text{ in} = \_\_\_\_\_\_\text{ in}\), or \(18\text{ in} + \_\_\_\_\_\_\_\_\_\text{ in} = 25\text{ in}\)), and the differences are expressed using standard length units (e.g., 7 in) (2.MD.4).

The work with measurement tools and various length units in Topic D lays the groundwork for problem solving in Topic E, as students use the more abstract tape diagrams to relate addition and subtraction to length.

### A Teaching Sequence Towards Mastery of Measuring and Estimating Length Using Customary and Metric Units

<table>
<thead>
<tr>
<th>Objective 1:</th>
<th>Measure various objects using inch rulers and yardsticks. (Lesson 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 2:</td>
<td>Develop estimation strategies by applying prior knowledge of length and using mental benchmarks. (Lesson 17)</td>
</tr>
<tr>
<td>Objective 3:</td>
<td>Measure an object twice using different length units and compare; relate measurement to unit size. (Lesson 18)</td>
</tr>
<tr>
<td>Objective 4:</td>
<td>Measure to compare the differences in lengths using inches, feet, and yards. (Lesson 19)</td>
</tr>
</tbody>
</table>
Lesson 16

Objective: Measure various objects using inch rulers and yardsticks.

Suggested Lesson Structure

- Fluency Practice (11 minutes)
- Concept Development (39 minutes)
- Student Debrief (10 minutes)
- Total Time (60 minutes)

**Fluency Practice (11 minutes)**

- Sprint: Adding and Subtracting by 3 \(2.OA.2\) (9 minutes)
- Subtraction Fact Flash Cards \(2.OA.2\) (2 minutes)

**Sprint: Adding and Subtracting by 3 (9 minutes)**

Materials: (S) Adding and Subtracting by 3 Sprint

Note: Students practice adding and subtracting by 3 in order to gain mastery of the sums and differences within 20.

**Subtraction Fact Flash Cards (2 minutes)**

Materials: (T) Flash Cards Set 1

Note: This is a teacher-directed, whole-class activity. By practicing subtraction facts, students will gain mastery of differences within 20.

**Concept Development (39 minutes)**

Materials: (S) 12-inch ruler, yardstick, Recording Sheet set

Note: In this lesson, the Recording Sheet will serve as the Problem Set.

This Concept Development is designed for students to work in centers, rotating approximately every six minutes. Each group should have roughly five students. To prepare for the lesson, make one copy of the Recording Sheet set per student. Print the Recording Sheets single-sided so that students can work on the back if necessary. Post the directions at each center.
Lesson 16: Measure various objects using inch rulers and yardsticks.

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Note that the Application Problem has been omitted from this lesson, and instead, four out of five centers include a word problem related to the measurement task. Students may not have time to solve the word problem at every center, but they should complete at least two out of the four.

Center 1: Measure and Compare Shin Lengths

Materials: (S) 12-inch rulers, yardsticks, Center 1 Recording Sheet

Students measure the length of group members’ shins and record on a table. Observe how students go about this task. Do they use the most efficient measuring tool? Do they consistently measure from the same points on each person (top of foot to bottom of knee)?

Center 2: Compare Lengths to a Yardstick

Materials: (S) Book, yardstick, Center 2 Recording Sheet

Note: This center would best be located near a desk and classroom door, since students will be measuring these objects.

Students first estimate how three classroom objects compare to a yardstick and then use a yardstick to measure the objects. The yardstick can be used to measure in different units: inches, feet, or yards. Keep a watchful eye to support students as they navigate the choice of units.

Center 3: Choose the Units to Measure Objects

Materials: (S) 12-inch ruler, yardstick, Center 3 Recording Sheet

At this center, students select the most appropriate unit to measure an object. Encourage students to choose objects with significantly different lengths so that they can gain experience measuring in inches, feet, and yards. Observe how students measure. Are they using a measuring tool that fits with their chosen object? Is it the most efficient measuring unit for the object?

Center 4: Find Benchmarks

Materials: (S) 12-inch ruler, yardstick, Center 4 Recording Sheet

Students identify objects for each of three benchmark lengths: inch, foot, and yard. Through a trial and error process, students develop a more precise understanding of the benchmark length.

Center 5: Choose a Tool to Measure

Materials: (S) 12-inch ruler, yardstick, Center 5 Recording Sheet, math book, pencil, pink eraser

NOTES ON MULTIPLE MEANS OF REPRESENTATION:

Introduce English language learners to all the centers that have been created so that they know what is expected of them at each center. Clarify what they are being asked to measure, e.g., shin, and clarify the measuring units they will be using at each center, e.g., inches, feet, and yards.

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Challenge above grade level students by asking them to help write measurement word problems to exchange with other students and solve. This will extend their learning of the content and also assess their content learning.
Note: This center would best be located near a rug and chalkboard or white board.

Students practice selecting the most efficient measuring tool for a given object. Help students remember that every length of the yardstick measures 3 feet when they calculate the length of the rug and chalkboard. (A common misconception is to count each iteration of the yardstick as 1 unit when measuring in feet.)

**Student Debrief (10 minutes)**

**Lesson Objective:** Measure various objects using inch rulers and yardsticks.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

You may choose to use any combination of the questions below to lead the discussion.

- When you used the 12-inch ruler, how did you label your measurement? (1 foot, 3 inches.) When you used the yardstick, did you have to use two unit labels? Explain why or why not.
- Choose one of the word problems you completed during centers. Explain your solution path to your partner.
- At Center 4, were the objects you chose close to the benchmark lengths? Were the things you chose for a foot, 12 inches long? For the yard, 3 feet long?
- If you didn’t have a 12-inch ruler or a yardstick, could you think of a way to measure an object? Would you know about how many inches or feet that object was? Talk to your partner.
- How do you decide which unit to use when measuring?

**Exit Ticket (3 minutes)**

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Add or subtract.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 + 3 =</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>3 + 3 =</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>6 + 3 =</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>9 + 3 =</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>12 + 3 =</td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td>15 + 3 =</td>
<td>28</td>
</tr>
<tr>
<td>7</td>
<td>18 + 3 =</td>
<td>29</td>
</tr>
<tr>
<td>8</td>
<td>21 + 3 =</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>24 + 3 =</td>
<td>31</td>
</tr>
<tr>
<td>10</td>
<td>27 + 3 =</td>
<td>32</td>
</tr>
<tr>
<td>11</td>
<td>30 - 3 =</td>
<td>33</td>
</tr>
<tr>
<td>12</td>
<td>27 - 3 =</td>
<td>34</td>
</tr>
<tr>
<td>13</td>
<td>24 - 3 =</td>
<td>35</td>
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<tr>
<td>14</td>
<td>21 - 3 =</td>
<td>36</td>
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<tr>
<td>15</td>
<td>18 - 3 =</td>
<td>37</td>
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<tr>
<td>16</td>
<td>15 - 3 =</td>
<td>38</td>
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<tr>
<td>17</td>
<td>12 - 3 =</td>
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<tr>
<td>18</td>
<td>9 - 3 =</td>
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<tr>
<td>19</td>
<td>6 - 3 =</td>
<td>41</td>
</tr>
<tr>
<td>20</td>
<td>3 - 3 =</td>
<td>42</td>
</tr>
<tr>
<td>21</td>
<td>3 + 0 =</td>
<td>43</td>
</tr>
<tr>
<td>22</td>
<td>3 + 3 =</td>
<td>44</td>
</tr>
</tbody>
</table>
### Lesson 16: Measure various objects using inch rulers and yardsticks.

#### Date: 1/24/14

<table>
<thead>
<tr>
<th>B</th>
<th>Improvement</th>
<th># Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (3 + 0 =)</td>
<td>23 (6 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>2 (3 + 3 =)</td>
<td>24 (9 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>3 (3 + 6 =)</td>
<td>25 (12 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>4 (3 + 9 =)</td>
<td>26 (15 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>5 (3 + 12 =)</td>
<td>27 (18 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>6 (3 + 15 =)</td>
<td>28 (21 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>7 (3 + 18 =)</td>
<td>29 (24 + 3 =)</td>
<td></td>
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<tr>
<td>8 (3 + 21 =)</td>
<td>30 (27 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>9 (3 + 24 =)</td>
<td>31 (0 + 33 =)</td>
<td></td>
</tr>
<tr>
<td>10 (3 + 27 =)</td>
<td>32 (33 + 33 =)</td>
<td></td>
</tr>
<tr>
<td>11 (30 - 3 =)</td>
<td>33 (33 + 66 =)</td>
<td></td>
</tr>
<tr>
<td>12 (27 - 3 =)</td>
<td>34 (66 + 33 =)</td>
<td></td>
</tr>
<tr>
<td>13 (24 - 3 =)</td>
<td>35 (99 - 33 =)</td>
<td></td>
</tr>
<tr>
<td>14 (21 - 3 =)</td>
<td>36 (66 - 33 =)</td>
<td></td>
</tr>
<tr>
<td>15 (18 - 3 =)</td>
<td>37 (999 - 333 =)</td>
<td></td>
</tr>
<tr>
<td>16 (15 - 3 =)</td>
<td>38 (33 - 33 =)</td>
<td></td>
</tr>
<tr>
<td>17 (12 - 3 =)</td>
<td>39 (33 + 0 =)</td>
<td></td>
</tr>
<tr>
<td>18 (9 - 3 =)</td>
<td>40 (30 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>19 (6 - 3 =)</td>
<td>41 (33 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>20 (3 - 3 =)</td>
<td>42 (36 + 3 =)</td>
<td></td>
</tr>
<tr>
<td>21 (0 + 3 =)</td>
<td>43 (36 + 33 =)</td>
<td></td>
</tr>
<tr>
<td>22 (3 + 3 =)</td>
<td>44 (36 + 63 =)</td>
<td></td>
</tr>
</tbody>
</table>
Center 1: Measure and Compare Shin Lengths

Choose a measuring unit to measure the shins of everyone in your group. Measure from the top of the foot to the bottom of the knee. I chose to measure using _________________. Record the results in the table below. Include the units.

<table>
<thead>
<tr>
<th>Name</th>
<th>Length of Shin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the difference in length between the longest and shortest shins? Write a number sentence and statement to show the difference between the two lengths.

Center 2: Compare Lengths to a Yardstick

Fill in your estimate for each object using the words more than, less than, or about the same length as. Then, measure each object with a yardstick and record the measurement on the chart.

1. The length of a book is ________________ the yardstick.
2. The height of the door is ________________ the yardstick.
3. The length of a student desk is ________________ the yardstick.

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of book</td>
<td></td>
</tr>
<tr>
<td>Height of door</td>
<td></td>
</tr>
<tr>
<td>Length of student desk</td>
<td></td>
</tr>
</tbody>
</table>

What is the length of 4 student desks pushed together with no gaps in between? Use the RDW process to solve on the back of this paper.
Center 3: Choose the Units to Measure Objects

Name 4 things in the classroom. Circle which unit you would use to measure that item, and record the measurement in the chart.

<table>
<thead>
<tr>
<th>Object</th>
<th>Length of the Object</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>inches/feet/yards</td>
</tr>
<tr>
<td></td>
<td>inches/feet/yards</td>
</tr>
<tr>
<td></td>
<td>inches/feet/yards</td>
</tr>
<tr>
<td></td>
<td>inches/feet/yards</td>
</tr>
</tbody>
</table>

Billy measures his pencil. He tells his teacher it is 7 feet long. Use the back of this paper to explain how you know that Billy is incorrect and how he can change his answer to be correct.

Center 4: Find Benchmarks

Look around the room to find 2 or 3 objects for each benchmark length. Write each object in the chart and record the exact length.

<table>
<thead>
<tr>
<th>Things that are about an inch.</th>
<th>Things that are about a foot.</th>
<th>Things that are about a yard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. _____ inches</td>
<td>1. _____ inches</td>
<td>1. _____ inches</td>
</tr>
<tr>
<td>2. _____ inches</td>
<td>2. _____ inches</td>
<td>2. _____ inches</td>
</tr>
<tr>
<td>3. _____ inches</td>
<td>3. _____ inches</td>
<td>3. _____ inches</td>
</tr>
</tbody>
</table>
Center 5: Choose a Tool to Measure

Circle what you chose to measure each item. Then measure and record the length in the chart. Circle the unit.

<table>
<thead>
<tr>
<th>Object</th>
<th>Measurement Tool</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of the rug</td>
<td>12-inch ruler / yardstick</td>
<td>_______ inches/feet</td>
</tr>
<tr>
<td>Math book</td>
<td>12-inch ruler / yardstick</td>
<td>_______ inches/feet</td>
</tr>
<tr>
<td>Pencil</td>
<td>12-inch ruler / yardstick</td>
<td>_______ inches/feet</td>
</tr>
<tr>
<td>Length of the chalkboard</td>
<td>12-inch ruler / yardstick</td>
<td>_______ inches/feet</td>
</tr>
<tr>
<td>Pink eraser</td>
<td>12-inch ruler / yardstick</td>
<td>_______ inches/feet</td>
</tr>
</tbody>
</table>

Sera’s jump rope is the length of 6 math books. On the back of this paper, make a tape diagram to show the length of Sera’s jump rope. Then write a repeated addition sentence using the math book measurement from the chart to find the length of Sera’s jump rope.
1. Circle the unit you would use to measure each item.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marker</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Height of a car</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Birthday card</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Soccer field</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Length of a computer screen</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Height of a bunk bed</td>
<td>inch / foot / yard</td>
</tr>
</tbody>
</table>
1. Circle the unit you would use to measure each item.

<table>
<thead>
<tr>
<th>Height of a door</th>
<th>inch / foot / yard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math book</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Pencil</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Length of a car</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Length of your street</td>
<td>inch / foot / yard</td>
</tr>
<tr>
<td>Paint brush</td>
<td>inch / foot / yard</td>
</tr>
</tbody>
</table>

2. Circle the correct estimate for each object.
   a. The height of a flagpole is more than / less than / about the same as the length of a yardstick.
   b. The width of a door is more than / less than / about the same as the length of a yardstick.
   c. The length of a laptop computer is more than / less than / about the same as the length of a 12-inch ruler.
   d. The length of a cellphone is more than / less than / about the same as the length of a 12-inch ruler.
3. Name 3 things in your classroom. Decide which unit you would use to measure that item. Record it in the chart in a full statement.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>I would use ______________ to measure the length of ______________.</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
</tbody>
</table>

4. Name 3 things in your home. Decide which unit you would use to measure that item. Record it in the chart in a full statement.

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>I would use ______________ to measure the length of ______________.</td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
</tbody>
</table>
Lesson 17

Objective: Develop estimation strategies by applying prior knowledge of length and using mental benchmarks.

Suggested Lesson Structure

- Fluency Practice  (10 minutes)
- Application Problem  (5 minutes)
- Concept Development  (35 minutes)
- Student Debrief  (10 minutes)
- Total Time  (60 minutes)

Fluency Practice (10 minutes)

- Subtraction Fact Flash Cards 2.OA.2 (5 minutes)
- Grade 2 Core Fluency Differentiated Practice Sets 2.OA.2 (5 minutes)

Subtraction Fact Flash Cards (5 minutes)

Materials: (T) Flash Cards Set 1

Note: This is a teacher-directed, whole-class activity. By practicing subtraction facts, students gain mastery of differences within 20 through regular, motivating practice.

Grade 2 Core Fluency Differentiated Practice Sets (5 minutes)

Materials: (S) Core Fluency Practice Sets from G2–M7–Lesson 1

Note: During G2–M7–Topic D and for the remainder of the year, each day’s fluency includes an opportunity for review and mastery of the sums and differences with totals through 20 by means of the Core Fluency Practice Sets or Sprints. The process is detailed and Practice Sets are provided in G2–M7–Lesson 1.

Application Problem (5 minutes)

Benjamin measures his forearm and records the length as 15 inches. Then he measures his upper arm and realizes it’s the same!

a. How long is one of Benjamin’s arms?

b. What is the total length of both Benjamin’s arms together?
Lesson 17: Develop estimation strategies by applying prior knowledge of length and mental benchmarks.

Date: 1/24/14

Concept Development (35 minutes)

Materials: (T) 2 charts (pictured below), new unused pink eraser

The beginning of this Concept Development provides a structure for students to develop a class list of mental benchmarks. Choose a mental benchmark for each length unit that is meaningful for each individual class.

Part 1: Identify mental benchmarks.

T: Look back at your recording sheets from yesterday’s centers. Let’s make a list of things we measured that were about the size of a foot. (Record ideas on the chart as students say them.)

S: My math journal was about a foot. It was just a little bit shorter. → The construction paper was exactly a foot. → The homework sheet was a little less than a foot long.

T: What on our list could remind us about the length of a foot?

S: The paper!

T: The length of the paper or the 12-inch ruler can be a mental benchmark for the length of a foot or 12 inches.

T: How about a mental benchmark for a yard? (Chart as students share.)

S: My arms are a yard when I hold them open like this. → I measured my brother’s bike at home and it was 3 feet, which is a yard! → The width of our classroom door was exactly a yard!

T: Which item on our list should be our class benchmark for the yard?

S: The width of the door!

T: Look at your recording sheet. Did anyone find something that could be our mental benchmark for an inch?

Notes on Multiple Means of Representation:

Explain the idea of a mental benchmark by showing a few examples. For instance, demonstrate that width of paper clip is about a centimeter. Explain that having the mental benchmark helps in estimating the length of objects.
Lesson 17: Develop estimation strategies by applying prior knowledge of length and mental benchmarks.

Date: 1/24/14

NOTES ON MULTIPLE MEANS OF ACTION AND EXPRESSION:

Before this lesson, find some time to practice estimating and measuring different objects with students with disabilities and those who are performing below grade level. This practice will allow them to participate in the lesson in a more meaningful way and perhaps take the lead in group discussions.

S: The middle part of my finger is an inch! → I measured a quarter and it was an inch long.
T: Which one should be our benchmark for an inch?
S: The quarter!
T: Talk to your partner about how it is helpful to understand mental benchmarks when people say things like, “Your new teacher is about 6 feet tall,” “Draw a line about 6 inches long,” or “The room is about 10 yards long.”
S: Then you will know better who might be your new teacher. → Then you will know about how long to draw the line. → Then you can understand the size of the room. → If you understand benchmarks, you can see what people are talking about better.

Part 2: Use mental benchmarks to estimate lengths and check estimations with measurement tools.

T: The width of a quarter is a benchmark for...?
S: An inch.
T: The length of a paper is a benchmark for...?
S: A foot.
T: The width of a door is a benchmark for...?
S: A yard!
T: Let’s use mental benchmarks to estimate measurements.

T: Step 1: Use a mental benchmark to think how long something is. Look at this dry erase marker. Turn and talk: How long do you think it is?
S: Shorter than the paper. Maybe 7 inches? → It’s longer than a quarter, maybe 5 inches or so.
T: (Record estimates.)
T: Step 2: Let’s measure and see how close our estimates are! Which unit should we use?
S: Inches!
T: (Have a student measure and record the length on the chart.)
S: The actual length of the marker is 8 inches.
T: Were our estimates close to the actual length?
S: Yes! → Mine wasn’t that close. → Some were.
T: What strategies can we use so that our estimates are close to the actual length?
S: Think about which benchmark is closest in length to what we are measuring and compare. Is it a little more or a little less, a lot more or a lot less? → Visualize how many times a benchmark makes the same length as the thing you’re measuring.
Lesson 17: Develop estimation strategies by applying prior knowledge of length and mental benchmarks.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

You may choose to use any combination of the questions below to lead the discussion.

- Look at your Problem Set. With a partner, figure out the difference between your estimate of the height of a desk and the actual measure of the height of a desk. Did you include the unit?
- Look at your Problem Set. Were there some estimates and actual length measures that were exactly the same? Why do you think that you were able to guess the right measurement for some items?
- How do mental benchmarks, objects that are about the same length as standard forms of measure like the 12-inch ruler, help when we are comparing length?
- Talk to your partner about why getting good about estimating length could be helpful?
- Sometimes when we measure things, they are not exactly a foot or a yard long. How do we record things that are a foot and a little bit more or a yard and a foot more?

**Exit Ticket (3 minutes)**

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Estimate the length of each item by using a mental benchmark. Then measure the item using feet, inches, or yards.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mental Benchmark</th>
<th>Estimation</th>
<th>Actual Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Width of the door</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Width of the white board or chalkboard</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>c. Height of a desk</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>d. Length of a desk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Length of a reading book</td>
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</table>
Lesson 17: Develop estimation strategies by applying prior knowledge of length and mental benchmarks.

Date: 1/24/14

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<thead>
<tr>
<th>Item</th>
<th>Mental Benchmark</th>
<th>Estimation</th>
<th>Actual Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Length of a crayon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Length of the room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Length of a pair of scissors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Length of the window</td>
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</tbody>
</table>
Estimate the length of each item by using a mental benchmark. Then measure the item using feet, inches, or yards.

<table>
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<th>Item</th>
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<th>Estimation</th>
<th>Actual Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Length of an eraser</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Width of this paper</td>
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</tbody>
</table>
Estimate the length of each item by using a mental benchmark. Then measure the item using feet, inches, or yards.

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<tr>
<th>Item</th>
<th>Mental Benchmark</th>
<th>Estimation</th>
<th>Actual Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Length of a bed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Width of a bed</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>c. Height of a table</td>
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<tr>
<td>d. Length of a table</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>e. Length of a book</td>
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</table>
Lesson 17: Develop estimation strategies by applying prior knowledge of length and mental benchmarks.

Date: 1/24/14

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<tr>
<th>Item</th>
<th>Mental Benchmark</th>
<th>Estimation</th>
<th>Actual Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Length of your pencil</td>
<td></td>
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<tr>
<td>g. Length of a refrigerator</td>
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<tr>
<td>h. Height of a refrigerator</td>
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<td></td>
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<tr>
<td>i. Length of a sofa</td>
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Lesson 18

Objective: Measure an item twice using different length units and compare; relate measurement to unit size.

Suggested Lesson Structure

- Fluency Practice (10 minutes)
- Application Problem (5 minutes)
- Concept Development (35 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (10 minutes)

- Decomposition Tree 2.OA.2 (5 minutes)
- Grade 2 Core Fluency Differentiated Practice Sets 2.OA.2 (5 minutes)

Decomposition Tree (5 minutes)

Materials: (S) Decomposition Tree Template (from G2–M7–Lesson 6)

Note: Students are given 90 seconds to decompose 20 inches. Students apply knowledge of sums and differences within 20 to length.

T: (Distribute tree template.)

T: You are going to break apart 20 inches on your Deco Tree for 90 seconds. Do as many problems as you can. Go!

S: (Work for 90 seconds.)

T: Now exchange your tree with your partner and check each other’s work. (Allow students 30–45 seconds to check.)

T: Return each other’s papers. Did you see another way to make 20 inches on your partner’s paper? (Allow students to share for another 30 seconds.)

T: Turn your paper over. Let’s break apart 20 inches for another minute.

Grade 2 Core Fluency Differentiated Practice Sets (5 minutes)

Materials: (S) Core Fluency Practice Sets from G2–M7–Lesson 1

Note: During G2–M7–Topic D and for the remainder of the year, each day’s fluency includes an opportunity
for review and mastery of the sums and differences with totals through 20 by means of the Core Fluency Practice Sets or Sprints. The process is detailed and Practice Sets provided in G2–M7–Lesson 1.

**Application Problem (5 minutes)**

Ezra is measuring things in his bedroom. He thinks his bed is about 2 yards. Is this a reasonable estimate? Explain your answer using pictures, words or numbers.

Note: This Application Problem provides practice using benchmarks to estimate measurement. When students finish invite them to share their reasoning either whole group or with partners.

**Concept Development (35 minutes)**

Materials: (T) Chart for recording measurements as pictured below (S) Centimeter ruler, inch ruler; 1 plain sheet of white paper; bag with an unsharpened pencil, a new crayon, a new eraser

Part 1: Compare centimeters and inches.

Assign Partners A and B.

T: Partner A, measure the pencil using the inch ruler. Partner B, measure the pencil using the centimeter ruler.

T: Partner A, how long is the pencil?
S: About 7 inches!
T: (Record answer.) Partner B, how long is the pencil?
S: About 18 centimeters!
T: (Record answer.) Hmm, why do you think the measurements are so different? Turn and talk.
S: We used different units to measure. → He measured with an inch ruler, and I used a centimeter ruler.
T: Are both measurements correct?
S: Yes!
T: Let’s check and see. Partner A, this time measure the pencil with the centimeter ruler. Partner B, measure the pencil with the inch ruler.
S: (Measure.)
T: Are your measurements the same as your partner’s when using the different rulers?
S: Yes!
NOTES ON MULTIPLE MEANS OF ENGAGEMENT:
Support students performing below grade level by repeating the activity with different lengths. Ask them to draw lines that are 6 centimeters long and 6 inches long. Repeat until students are sure that the inch line is longer than the centimeter line and can explain that:
- The same number of units will make a longer line when using inches than centimeters.
- It takes more centimeters than inches to measure different objects.

Part 2: Measure using centimeters and inches.
Give students time to measure both the objects in their bags and the sides of the white paper using both inches and centimeters. They should stop to record the measurements on the plain paper as they go. Encourage students to replicate your chart to organize their work.

T: What pattern do you see in your measurements using the different rulers?
S: The number of inches is always smaller. The number of centimeters is always bigger, because a centimeter unit is smaller than an inch unit and it takes more of them when we are measuring.

T: Does this remind you of the time we measured straws with two different size paper clips?
S: Yes!
T: Turn and talk: What do you know about measurement and unit size?
S: The smaller the unit means it takes more of those units when measuring something. The bigger the unit means you use less of them.

T: Using your rulers, draw two lines on your white paper. Make one line 5 inches and the other 5 centimeters.
T: Before you begin, tell your partner which line will be longer.
S: The 5 inch line!
T: Tell your partner how you know!
S: One inch is longer than 1 centimeter, so 5 inches will be longer than 5 centimeters. Inches are longer, so the line will be longer too.
T: (Allow students time to draw the two lines.)
T: Were we right? Is the 5-inch line longer than the 5-centimeter line?
S: Yes!
T: Look at your lines. How many centimeters do you think it would take to equal 5 inches? Use your centimeter ruler to check your estimate.
Lesson 18: Measure an item twice using different length units and compare; relate measurement to unit size.

Date: 1/24/14

NYS COMMON CORE MATHEMATICS CURRICULUM

Lesson 18

Lesson Objective:

Measure an item twice using different length units and compare; relate measurement to unit size.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.

You may choose to use any combination of the questions below to lead the discussion:

- Look at the lines you measured on your Problem Set. Talk to your partner about why it is important to label the length with your chosen unit. Why is it important to label our numbers in math in general?
- Look at Problem 5 on your Problem Set. Are the lines you drew equal in length? Why might...
somebody think that the lines should be equal?

- Can you think of other times where we have used different units in math?
- When you measured in centimeters and inches, did you ever have to round up or down? How did you do that?
- Talk to your partner about why the unit size matters when we are measuring things.
- Why do we measure using different units? When would you want to measure using a small unit? A large unit?

**Exit Ticket (3 minutes)**

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Name ________________________________ Date ________________

Measure the lines in inches and centimeters. Round the measurements to the nearest inch or centimeter.

1. __________________________________
   ______ cm           ______ in

2. __________________________________
   ______ cm           ______ in

3. __________________________________
   ______ cm           ______ in

4. __________________________________
   ______ cm           ______ in
5. Draw lines with the measurements below.
   a. 3 centimeters long
   b. 3 inches long

6. a. Did you use more inches or more centimeters when measuring the lines above?
   ________________________________

   b. Write a sentence to explain why you used more of that unit.
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________

7. Thomas and Chris both measured the crayon below but came up with different answers. Explain why both answers are correct.

   Thomas: _____8____ cm
   Chris: _____3____ in

   Explanation: ___________________________________________________
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________
Measure the lines in inches and centimeters.

1. ______________________________________
   _____ cm   _____ in

2. ______________________________________
   _____ cm   _____ in
Measure the lines in inches and centimeters. Round the measurements to the nearest inch or centimeter.

1. ____________________________________________
   _____ cm    _____ in

2. ____________________________________________
   _____ cm    _____ in

3. ____________________________________________
   _____ cm    _____ in

4. ____________________________________________
   _____ cm    _____ in
5. a. Draw a line that is 5 centimeters in length.

   b. Draw a line that is 5 inches in length.

6. a. Draw a line that is 7 inches in length.

   b. Draw a line that is 7 centimeters in length.

7. Takeesha drew a line 9 centimeters long. Damani drew a line 4 inches long. Takeesha says her line is longer than Damani’s because 9 is greater than 4. Explain why Takeesha might be wrong.

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

8. Draw a line that is 9 centimeters long and a line that is 4 inches long to prove that Takeesha is wrong.
Lesson 19

Objective: Measure to compare the differences in length using inches, feet, and yards.

Suggested Lesson Structure

- Fluency Practice (11 minutes)
- Concept Development (24 minutes)
- Application Problem (15 minutes)
- Student Debrief (10 minutes)

Total Time (60 minutes)

Fluency Practice (11 minutes)

- Subtraction from Tens 2.NBT.5 (2 minutes)
- Sprint: Subtraction Patterns 2.OA.2, 2.NBT.5 (9 minutes)

Subtraction from Tens (2 minutes)

Note: This fluency reviews mental math strategies within 100 and subtraction of 9 or 8 from any number.

T: When I say a basic fact, you add 10 to the whole and continue until I say to stop. So, after 11 – 9, you would solve 21 – 9, then...?

S: 31 – 9, 41 – 9, 51 – 9.

T: Yes, go as high as you can before I give the signal to stop. Let’s begin. 11 – 9.

S: (Work.)

T: (Stop them when you see the slowest student has completed at least two problems.)

Continue with the following possible sequence: 12 – 8, 11 – 8, and 13 – 9.

Sprint: Subtraction Patterns (9 minutes)

Materials: (S) Subtraction Patterns Sprint

Note: Students practice subtraction in order to gain mastery of the sums and differences within 20 and see relationships with higher numbers.
Concept Development (24 minutes)

Materials: (T) Piece of butcher paper (30 inches × 18 inches), 1 student desk (18 inches × 24 inches), 12-inch ruler, yardstick, piece of string (7 feet long) (S) Personal white boards

Note: The dialogue below uses hypothetical measurements. The length of the string should be about 10 to 15 feet shorter than the length of the classroom wall. The Application Problem should be completed before sending students off to work on the Problem Set. (The Problem Set time has been added to the Application Problem.)

T: I want to cover this desk in paper. I need to know if the paper is long enough. I need a few extra inches on each side to tape it down. Let’s figure out if I have enough paper.

T: What do we need to do to see if the paper is the right size?

S: Measure both the desktop and the paper. → Put the paper on the desk to make sure the paper is longer than the table. → Use a ruler or a yardstick to measure both lengths.

T: Good ideas! Let’s measure the desktop and the paper. (Call a student volunteer to measure the paper and another to measure the table.)

T: What measurement tool do you think they should use to measure the paper and the table? Why? Talk to your partner.

S: A yardstick, because I can see that the paper and the table are both longer than a 12-inch ruler. → We won’t have to measure and advance so many times if we use a yardstick. → We can use the yardstick, but use inches to actually measure.

T: If we use the yardstick, why don’t we have to measure in yards? Talk to your partner.

S: We can choose inches, feet, or yards. → We can do what we want. It just depends on what we are measuring. → The yardstick can be used to measure yards, but we only need inches for the table.

S: (Volunteers measure the paper and the table with a yardstick.)

T: How long is the table?

S: 24 inches.

T: (Record measurement.) How long is the paper?

S: 30 inches.

T: (Record measurement.) Which is longer?

S: The paper!

T: Turn and talk. How much longer is the paper, and how do you know?

S: The paper is 6 inches longer because 30 – 24 is 6. → It’s 6 inches
longer because $24 + 6 = 30$.

T: (Record the difference in the two lengths as a number sentence.) Do we have enough paper to cover the table?

S: Yes!

Invite students to measure and compare the lengths of the following objects: journal and pencil, crayon and pink eraser, and marker and scissors. Have them record each length and the difference in lengths as they go. Each time, they should compare the two lengths and describe the difference using a number sentence.

T: Can you help me with one more thing? I would like to use this string to hang our work along the wall. How can we figure out if we have enough string?

S: Measure the string and the wall.

T: Which measurement tool should we use?

S: The yardstick!

T: We know we don’t have to measure in yards. What unit should we use this time?

S: Inches! → Feet! → Yards.

T: First, let’s measure both lengths in feet so we can be more precise than we could be using yards. Inches would be too much! Do you remember what to do if our measurement falls in between the foot hash marks?

S: If it is more than halfway, or 6 inches, to the next foot we will round up, if it is less than halfway we will round down.

T: Good! (Call on a few student volunteers to measure the length of the wall and the length of the string.) While these students are measuring silently, it is everyone’s job to tally the number of feet as they go.

T: (Allow students time to measure the string.) How long is the string?

S: 17 feet!

T: (Record measurement.)

T: (Allow students time to measure the wall.) How long is the wall?

S: 32 feet.

T: (Record measurement.)

T: Uh, oh. We need more string. Turn and talk: How can we figure out how much more string we need?

S: Subtract! → Add on from 17 to get to 32.

T: (Write the number sentences on the board as shown to the right.)

T: Count on from 17 to figure out how much more string we need.

S: Seventeen plus 3 is 20, plus 12 more is 32. We need 15 more feet.

Repeat this activity, this time measuring the string and wall using yards. Students should again compare the two lengths and describe the difference using a number sentence.
T: What was the difference between the length of the string and the length of the wall when we measured in feet?
S: 15 feet.
T: What was the difference between the length of the string and the length of the wall when we measured in yards?
S: 5 yards.
T: Did the length of the string or the wall change? Why are the differences so different?
S: No! Feet and yards are different. We used a different unit each time. Feet are smaller than yards, so we need more of them to cover the same distance.

NOTES ON MULTIPLE MEANS OF ENGAGEMENT:
Challenge above grade level students by asking them what would happen if Katia is asked to hang two strings of lights on the building wall. How many more yards of lights will she have to buy? Ask students to explain what strategies they used to find the answer.

Application Problem (15 minutes)

Katia is hanging decorative lights. The strand of lights is 46 feet long. The building wall is 84 feet long. How many more feet of lights does Katia need to buy to equal the length of the wall?

Note: This Application Problem provides practice with comparing the difference between measurements without making the measurement. When students finish, invite them to share their reasoning with either the whole group or with partners.

Problem Set (10 minutes)

Students should do their personal best to complete the Problem Set within the allotted 10 minutes. For some classes, it may be appropriate to modify the assignment by specifying which problems they work on first. Some problems do not specify a method for solving. Students solve these problems using the RDW approach used for Application Problems.

Student Debrief (10 minutes)

Lesson Objective: Measure to compare the differences in length using inches, feet, and yards.

The Student Debrief is intended to invite reflection and active processing of the total lesson experience.

Invite students to review their solutions for the Problem Set. They should check work by comparing answers with a partner before going over answers as a class. Look for misconceptions or misunderstandings that can be addressed in the Debrief. Guide students in a conversation to debrief the Problem Set and process the lesson.
You may choose to use any combination of the questions below to lead the discussion.

- When you measured the lines on your Problem Set, did the endpoint fall exactly on an inch hash mark? Talk to your partner about what you did if the endpoints of the lines fell between inch hash marks.

- Look at Problem 4 on your Problem Set. Tell your partner how long Martha’s fence is. Did anyone have a measurement smaller than 54 yards? Without doing any calculations, how do you know that this is incorrect?

- Today in the lesson when we were measuring and comparing lengths, how did you decide which tool to use? Talk to your partner about when and why you would choose a 12-inch ruler instead of a yardstick, or a yardstick instead of a 12-inch ruler.

- Sometimes we choose to measure in yards, other times in feet, yet others in inches or centimeters. Talk to your partner about when you might measure using each of these units. (Yards for a football field, feet for a wall, inches for a book, centimeters for a bean.)

- What strategies did you use to solve the Application Problem? How many more yards of lights does Katia need?

Exit Ticket (3 minutes)

After the Student Debrief, instruct students to complete the Exit Ticket. A review of their work will help you assess the students’ understanding of the concepts that were presented in the lesson today and plan more effectively for future lessons. You may read the questions aloud to the students.
Lesson 19: Measure to compare the differences in length using inches, feet, and yards.

Date: 1/24/14

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Lesson 19: Measure to compare the differences in length using inches, feet, and yards.

Date: 1/24/14

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</tr>
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<td>38</td>
<td>14 - 6 =</td>
</tr>
<tr>
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<td>39</td>
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<td>22 11 - 6 =</td>
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Measure each set of lines in inches, and write the length on the line. Complete the comparison sentence.

1. Line A __________________________________________________________________________
   
   Line B _______________________
   
   Line A measured about ____ inches.   Line B measured about ____ inches.
   
   Line A is about _____ inches longer than Line B.

2. Line C __________________________________________________________________________
   
   Line D __________________________________________________________________________
   
   Line C measured about ____ inches.   Line D measured about ____ inches.
   
   Line C is about _____ inches shorter than Line D.
3. Solve the following problems:
   a. $32 \text{ ft} + \underline{\text{_______}} = 87 \text{ ft}$
   b. $68 \text{ ft} - 29 \text{ ft} = \underline{\text{_______}}$
   c. $\underline{\text{_______}} - 43 \text{ ft} = 18 \text{ ft}$

4. Tammy and Martha both built fences around their properties. Tammy’s fence is 54 yards long. Martha’s fence is 29 yards longer than Tammy’s.

   ![Diagram showing Tammy’s Fence: 54 yards and Martha’s Fence: __________ yards]

   a. How long is Martha’s fence? $\underline{\text{_________}}$ yards
   b. What is the total length of both fences? $\underline{\text{_________}}$ yards
Name _____________________________ Date _______________

Line A ___________________________________

Line B ___________________________________

Line A measured about ____ inches. Line B measured about ____ inches.

Line A is about _____ inches longer/shorter than Line B.
Measure each set of lines in inches, and write the length on the line. Complete the comparison sentence.

1. Line A
   _______________________________
   Line B _________________________
   Line A measured about ____ inches.   Line B measured about _____ inches.
   Line A is about _____ inches longer than Line B.

2. Line C
   _______________________________
   Line D _________________________
   Line C measured about ____ inches.   Line D measured about ____ inches.
   Line C is about _____ inches shorter than Line D.

3. Solve. Check your answers with a related addition or subtraction sentence.
   a. 8 inches - 5 inches = _______ inches
      _______ inches + 5 inches = 8 inches
b. 8 centimeters + _______ centimeters = 19 centimeters

c. 17 centimeters - 8 centimeters = _______ centimeters

d. _______ centimeters + 6 centimeters = 18 centimeters

e. 2 inches + _______ inches = 7 inches

f. 12 inches - _______ = 8 inches