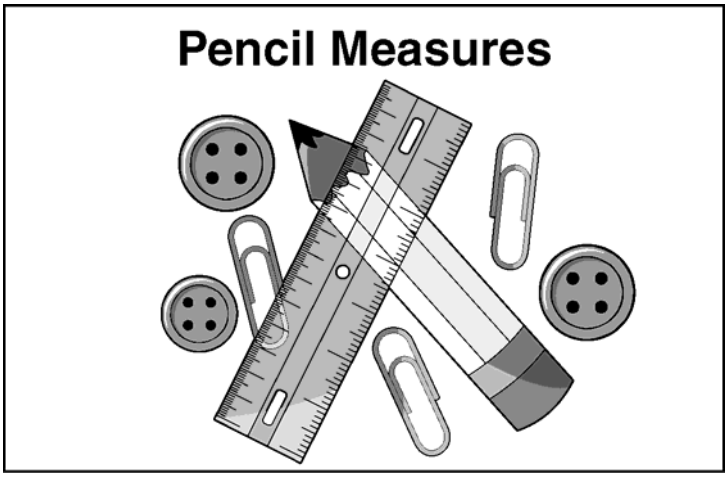
SITES-M Mathematics Challenge



Level: Grade One

Standard: Geometry and Measurement

Learning Target: Focus on Measurement

Grade Level Expectations

GLE 0106.4.3 Use non-standard units in linear measurement.

Checks for Understanding

0106.4.6 Recognize the essential role of units in measurement, and understand the difference between standard and non-standard units.

SITES-M Mathematics Challenge

Grade 1–Focus on Measurement
Pencil Measures

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. Each Challenge includes a set of tasks that require higher-order thinking skills. Because these types of tasks may be new for students and they will have varying levels of understanding, the student responses will vary. The Challenges and guiding questions were designed to help teachers plan their implementation and elicit, analyze, and act on evidence of student understanding.

You will be able to choose which Mathematics Challenge Packet to implement each month, according to the learning needs of your students and your teaching context. Each packet contains all the materials necessary to implement the Mathematics Challenge including a grade-appropriate Challenge, the Mathematics Challenge Meeting Protocol, and the Guiding Questions for Analyzing Student Responses to Mathematics Challenges.

For each Challenge, you will complete a six step process of planning, implementation, and analysis and reflection.

The Mathematics Challenge Process

Stage	Step	Task
Planning	Step 1.	Review the Mathematics Challenge Meeting Protocol
	Step 2.	Review and solve the Mathematics Challenge prior to your Professional Learning Community (PLC) meeting. Think about your responses to the guiding questions on the Meeting Protocol
	Step 3.	Hold your PLC meeting and discuss your responses to the Guiding Questions on the Meeting Protocol
Implementation	Step 4.	Implement the Mathematics Challenge with your class
Analysis and Reflection	Step 5.	For your own planning and documentation, respond to the Guiding Questions on the Analyzing Student Responses Protocol
	Step 6.	To help us improve the Challenges and to provide recommendations for teachers implementing them in future years, complete the Mathematics Challenge Feedback Log and provide copies of all student work to the Assessment Coordinator

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement
Pencil Measures
Mathematics Challenge Meeting Protocol

Each month, your Professional Learning Community will meet to discuss the implementation of one Mathematics Challenge. In preparation for your monthly meeting, please print and review this month's Mathematics Challenge, solve all tasks within the Challenge, and think about the guiding questions below. These questions will be used to facilitate a group discussion regarding the implementation of the upcoming Mathematics Challenge.

Guiding Questions for Implementing the Mathematics Challenges

1. What is the title of the Challenge that you will use this month?
2. What skills or standards is this Challenge measuring?
3. Where does this Challenge fit within your curriculum? Within which unit?
4. At what point during the unit will you administer this Challenge (e.g., At the beginning of a unit to determine what students do or do not know, at the end of a unit to assess what students have or have not learned, in the middle of a unit to determine where to go next instructionally)?
5. How will your students complete this Challenge (e.g., individually, one-on-one, in small groups, as a class)? Why?
6. Are there any prerequisite skills, common misunderstandings, or vocabulary needs that you will have to address? What are they?
7. What difficulties do you anticipate your students will have with the Challenge? How will you address them?
8. Are these skills and difficulties different for special needs students, ELL students, etc.? How? Will you do anything different for these students? What?
9. How will you evaluate student responses (e.g., grade responses with the provided rubric, scan responses to identify common mistakes/misconceptions, have students evaluate one another's responses, have students evaluate their own response)?
10. What will student responses to this Challenge tell you about student understanding?
11. How might you use this evidence of student understanding to adapt your teaching and learning?
12. What other materials, resources, or support might you need? Where can you get them?
13. How can your colleagues assist you in the analysis of student understanding?
14. What other questions or concerns do you have about this Mathematics Challenge?

After you have implemented the challenge with your class, be sure to respond to the Guiding Questions on the Analyzing Student Responses Protocol.

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement

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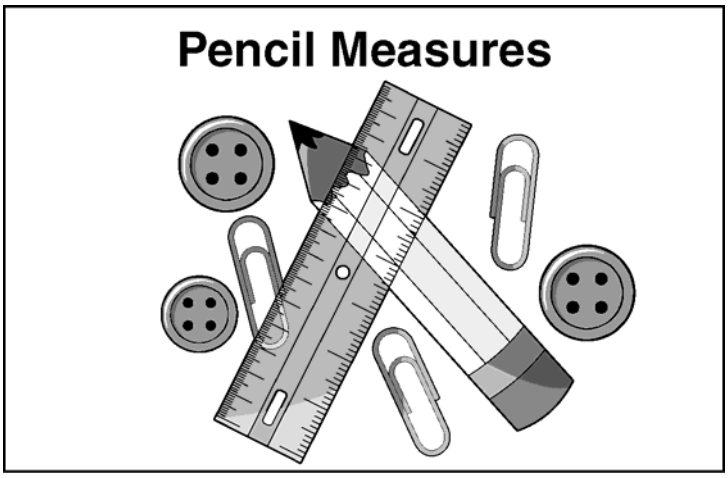
SITES-M Mathematics Challenge

Grade 1–Focus on Measurement



Standard: Geometry and Measurement

Learning Target: Focus on Measurement

Claims:
Students should understand and be able to explain or demonstrate how to:

- ✓ Use non-standard units in linear measurement;
- ✓ Recognize the essential role of units in measurement, and understand the difference between standard and non-standard units.

Task Preparation:
Each student will need copies of the Student Response Sheet, the Paper Clip Rulers, the Button Rulers, a pencil, a pair of scissors, glue, and crayons (optional).

If a student is unable to respond in writing, a scribe may be appointed or verbal answers may be accepted, but these responses will need to be documented for scoring.

Stimulus Cards (Drawing or Word Description):
Paper Clip Rulers and Button Rulers

Manipulatives/Supplies:
Pencils
Scissors
Glue
Crayons (optional)

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement

Cues/Directions:

Distribute student response sheets and a copy of the sheet with the paper clip and button rulers. If a student is unable to respond in writing, a scribe may be appointed or verbal answers may be accepted, but these responses will need to be documented for scoring. Students should be directed to look carefully at each figure. Allow students time to answer.

1. Instruct students to follow along as you read aloud and say: **Mr. Joya keeps a box of pencils on his desk for students to use. The pencils have different lengths. Look at Pencil 1 and Pencil 2 below. Which pencil is longer? (TEACHER NOTE:** Have students check the correct box. **) How can you tell? (TEACHER NOTE:** Students should write their explanation in the box.**)**

2. **Cut out a paper clip ruler and a button ruler. Then look at pencil 3 below. (TEACHER NOTE:** Distribute scissors and allow enough time for this activity. You could cut these rulers out prior to the implementing the challenge to save time.**) Measure the length of Pencil 3 using the paper clip ruler. About how many paper clips long is Pencil 3 ? (TEACHER NOTE:** Students should write their correct answer in the box.**) Measure the length of Pencil 3 again using the button ruler. About how many buttons long is Pencil 3 ? (TEACHER NOTE:** Students should write their correct answer in the box.**) Is your measurement with the buttons the same or different from your measurement with the paper clips? (TEACHER NOTE:** Have students check the correct box. **) Explain why your measurements were the same or different. (TEACHER NOTE:** Students should write their explanation in the box.**) Look at the arrow shape above. If you measure Pencil 3 using a ruler made with this arrow shape, will the number of arrows long be more than, less than, or equal to the number of buttons long? (TEACHER NOTE:** Have students check the correct box. **) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**)**

3. **Here is one more pencil from the pencil box. Use the inches side of your ruler to measure the length of pencil 4. How many inches long is Pencil 4 ? (TEACHER NOTE:** Students should write their correct answer in the box.**) If you measure the length of Pencil 4 using the inches side of a <u>different</u> ruler, do you think your answer will the same or different? (TEACHER NOTE:** Have students check the correct box. **) Why do you think that? (TEACHER NOTE:** Students should write their explanation in the box.**)**

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4. **Look below at the last two pencils in the box. Which is longer – Pencil 5 or Pencil 6 ? (TEACHER NOTE:** Have students check the correct box. **) Use one of the measuring tools to measure both pencils. Then fill in the table below. (TEACHER NOTE:** Have students correctly fill in the table using whichever measuring device they choose. **)**

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement

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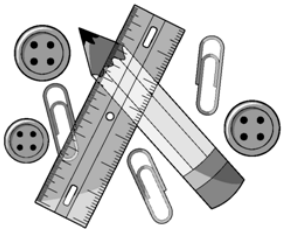
SITES-M Mathematics Challenge

Grade 1–Focus on Measurement

Student Response Sheet

Pencil Measures



Name: _____ **Date:** _____

Mr. Joya keeps a box of pencils on his desk for students to use. The pencils have different lengths.

1. **Look at Pencil 1 and Pencil 2 below.**

Which pencil is longer?

Check one: ☐ **Pencil 1** ☐ **Pencil 2**

How can you tell?

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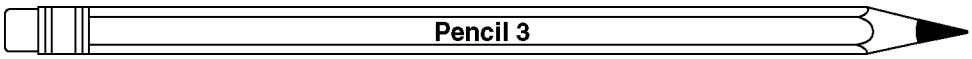
2. Cut out a paper clip ruler and a button ruler. Then look at pencil 3 below.



a. Measure the length of Pencil 3 using the paper clip ruler. About how many paper clips long is Pencil 3 ?

b. Measure the length of Pencil 3 again using the button ruler. About how many buttons long is Pencil 3 ?

c. Is your measurement with the buttons the same or different from your measurement with the paper clips?

Check one: ☐ **Same** ☐ **Different**

Explain why your measurements were the same or different.

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d. Look at the arrow shape above. If you measure Pencil 3 using a ruler made with this arrow shape, will the number of arrows long be more than, less than, or equal to the number of buttons long?

Check one:

- ☐ **More than**
- ☐ **Less than**
- ☐ **Equal to**

How do you know?

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3. Here is one more pencil from the pencil box.

a. Use the inches side of your ruler to measure the length of pencil 4. How many inches long is Pencil 4 ?

b. If you measure the length of Pencil 4 using the inches side of a <u>different</u> ruler, do you think your answer will the same or different?

Check one: ☐ **Same** ☐ **Different**

Why do you think that?

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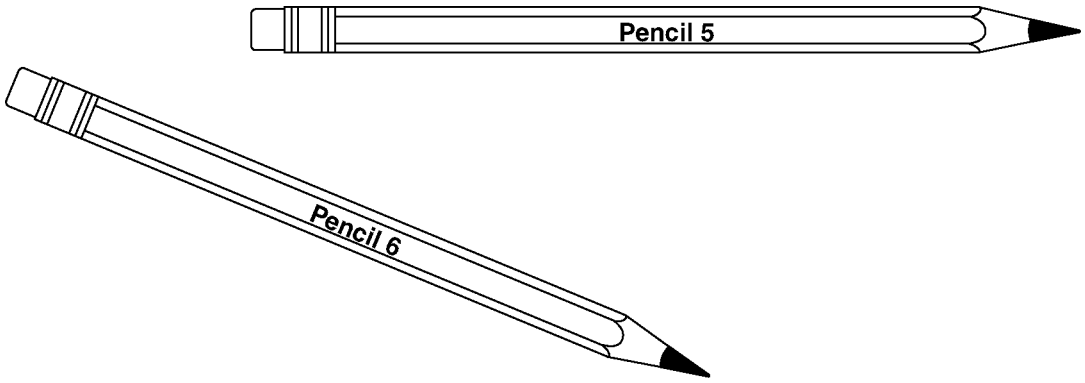
4. Look below at the last two pencils in the box. Which is longer – Pencil 5 or Pencil 6 ?

Check one:

- ☐ **Pencil 5**
- ☐ **Pencil 6**
- ☐ **I'm not sure**



Use one of the measuring tools to measure both pencils. Then fill in the table below.

	Number	Units (paper clips, buttons, or inches)
Length of pencil 5		
Length of pencil 6		

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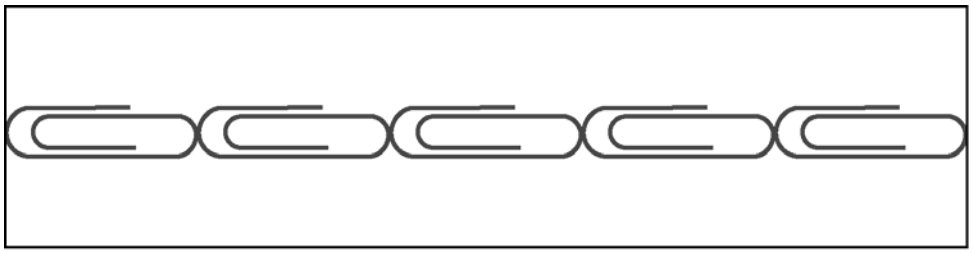
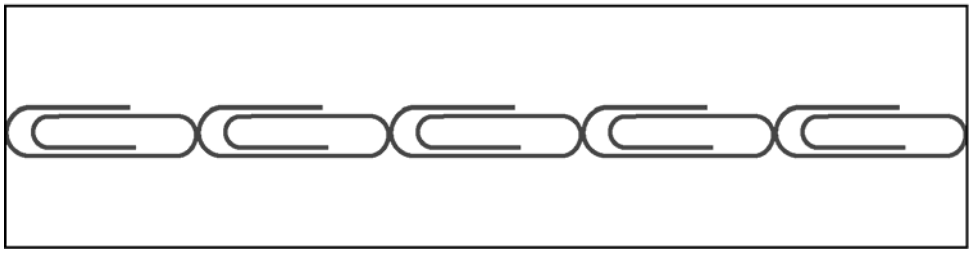
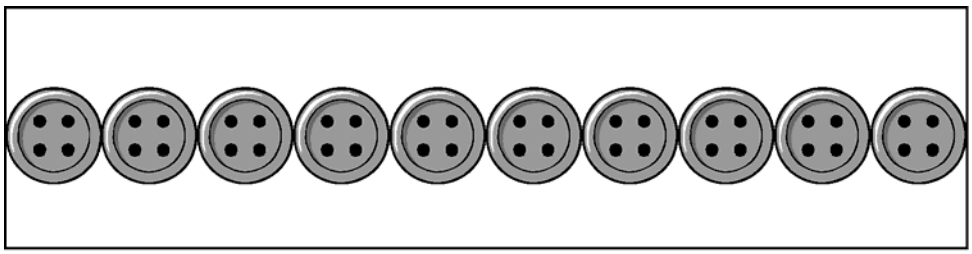
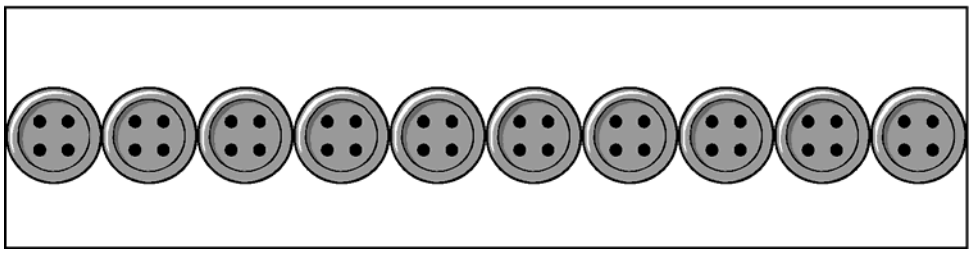
Paper Clip Rulers





Button Rulers





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Learning and Teaching Considerations

Task 1:

A) Be sure that students understand that measurement is a number that indicates a comparison between the attribute of the object (or situation or event) being measured and the same attribute of a given unit of measure. In this Challenge lengths are compared to units of length.

B) Be sure that students understand that to measure means that the attribute being measured is filled or covered or matched with a unit of measure with the same attribute. In this Challenge the attribute is length.

C) If a student says or writes, "I just know," prompt him or her by saying something like "I'm glad you know, but it's important in math to be able to explain your answers so other people can understand what you're thinking."

D) If a student says or writes, "I don't know," say something positive like "Let's start with what you do know about this problem." Students often know more than they think or say, and encouraging them to vocalize or write about that knowledge is all they need.

Task 2:

A) Be sure that students have opportunities to become familiar with the unit of measure for the task in a hands-on way. Meaningful measurement and estimation of measurements depend on a personal familiarity with the unit of measure being used.

B) Students should be encouraged to perform the task both procedurally and with conceptual understanding. They should be given opportunities to discuss the concept of measuring as a process of comparing attributes as well as opportunities to use measuring units and measuring instruments.

C) Students may notice that one button is half the length of one paper clip; therefore the length in buttons will be double the length in paper clips.

D) Students may notice that the arrow unit is longer than the button unit and that less arrows are needed to measure the pencil.

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Task 3:

A) Be sure that students understand that inches are standard units.

B) Teachers should encourage students to explore different rulers and discuss why inches are the same everywhere. Students may explain that the length of an inch on every ruler they explored is the same. Students may explain that people have agreed how long an inch is.

C) Students may have the misconception that it is not necessary to line up the end of the ruler with the end of the object being measured.

D) Students may have the misconception that they count the first line at the end of the inch ruler in the total number of inches (which would give them an answer of one extra inch). They may not realize that each inch is the distance from one point to another point.

Task 4:

A) To help increase familiarity with units, prevent errors, and to aid in the meaningful use of measurement, be sure that students become familiar with the development of benchmarks for frequently used units of measure.

B) Be sure that students understand which units of measure are appropriate for the particular attribute in question and how those units are used to produce a measurement.

C) Students may have the misconception that they can compare the lengths of the two pencils by measuring the lengths with different tools, such as measuring pencil 5 with buttons and pencil 6 with paper clips.

D) Be sure students become familiar with the use of approximate language for estimating, such as about, a little less than, and a little more than. The use of approximate language is very useful because many measurements do not result in whole numbers.

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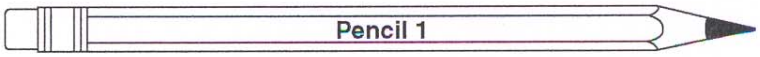
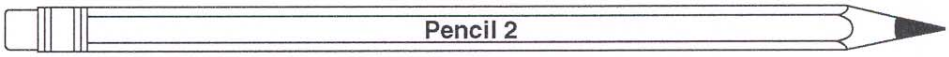
Name: ANSWER KEY Date: _____

Mr. Joya keeps a box of pencils on his desk for students to use. The pencils have different lengths.

1. **Look at Pencil 1 and Pencil 2 below.**





Which pencil is longer?

Check one: ☐ **Pencil 1** ☒ **Pencil 2**

How can you tell?

BOTH PENCILS ARE LINED-UP ON THE LEFT, BUT PENCIL 2 GOES OUT FURTHER ON THE RIGHT.

A HIGH-LEVEL RESPONSE WILL MENTION THE LEFT-ALIGNMENT. STUDENT MAY SAY THAT PENCIL 1 WILL "FIT" IN THE SPACE TAKEN BY PENCIL 2, WITH ROOM LEFT.

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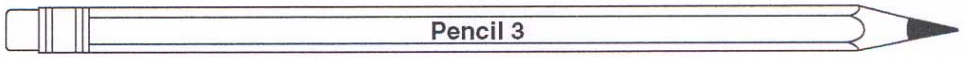
2. Cut out a paper clip ruler and a button ruler. Then look at pencil 3 below.



a. Measure the length of Pencil 3 using the paper clip ruler. About how many paper clips long is Pencil 3 ?

5

b. Measure the length of Pencil 3 again using the button ruler. About how many buttons long is Pencil 3 ?

10

c. Is your measurement with the buttons the same or different from your measurement with the paper clips?

Check one: ☐ **Same** ☒ **Different**

Explain why your measurements were the same or different.

THE LENGTH OF A BUTTON IS LESS THAN THE LENGTH OF A PAPER CLIP. SO IT TAKES MORE BUTTONS TO COVER THE LENGTH OF THE PENCIL THAN PAPER CLIPS.

STUDENT MAY SAY THAT 2 BUTTONS EQUAL 1 PAPER CLIP IN LENGTH.

OR, THE PAPER CLIP UNIT IS LARGER THAN THE BUTTON UNIT.

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d. Look at the arrow shape above. If you measure Pencil 3 using a ruler made with this arrow shape, will the number of arrows long be more than, less than, or equal to the number of buttons long?

Check one:

- ☐ More than
- ☒ Less than
- ☐ Equal to

How do you know?

THE LENGTH OF THE ARROW IS LONGER THAN THE LENGTH (DIAMETER) OF A BUTTON. SO IT WILL TAKE LESS ARROWS TO COVER THE LENGTH OF THE PENCIL.

STUDENT MAY MEASURE THE ARROW IN BUTTONS. THE ARROW IS ABOUT 3 BUTTONS LONG. THE ARROW AS A UNIT IS A LARGER SIZE THAN THE BUTTON AS A UNIT.

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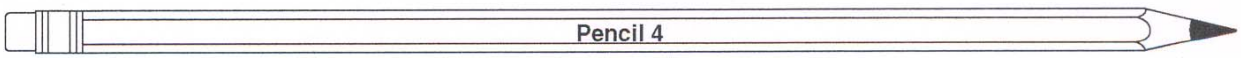
3. Here is one more pencil from the pencil box.



a. Use the inches side of your ruler to measure the length of pencil 4. How many inches long is Pencil 4 ?

7

b. If you measure the length of Pencil 4 using the inches side of a <u>different</u> ruler, do you think your answer will the same or different?

Check one: [X] Same [ ] Different

Why do you think that?

INCHES ARE THE SAME NO MATTER WHAT RULER THEY ARE ON.

THE INCH IS A STANDARD UNIT OF MEASURE. THIS MEANS THAT AN INCH IS THE SAME LENGTH EVERYWHERE.

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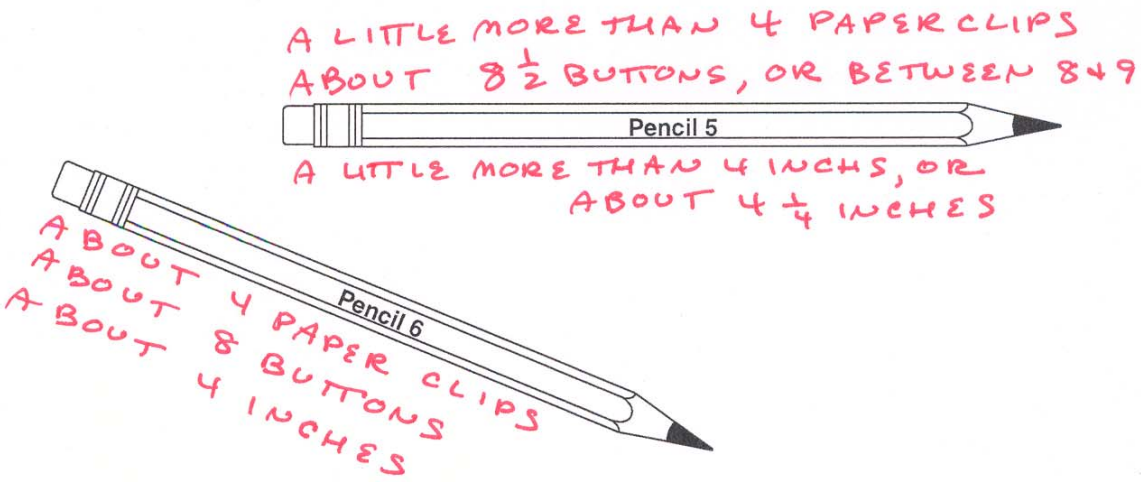
4. **Look below at the last two pencils in the box. Which is longer – Pencil 5 or Pencil 6 ?**

PENCIL 5 IS A BIT LONGER, BUT STUDENT CAN CHECK ANY BOX.

Check one:

- ☐ Pencil 5
- ☐ Pencil 6
- ☐ I'm not sure



Use one of the measuring tools to measure both pencils. Then fill in the table below.

	Number	Units (paper clips, buttons, or inches)
Length of pencil 5	SEE	
Length of pencil 6	ABOVE	

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement
Rubric

CATEGORY	4	3	2	1
Mathematical concepts	**Response shows complete understanding of the mathematical concepts used to solve the problem(s).**	**Response shows substantial understanding of the mathematical concepts used to solve the problem(s).**	**Response shows some understanding of the mathematical concepts needed to solve the problem(s).**	**Response shows very limited understanding of the underlying concepts needed to solve the problem(s), OR the response is not written.**
	Response shows evidence in ALL of the following tasks. **Task 1**. Student identifies pencil 2 as being longer than pencil 1 and explains why. **Task 2**. Student answers 5, 10, and different, as shown on the answer sheet. Student is able to explain that the button is a shorter unit of measure than the paper clip. The shorter the unit, the more units are needed to measure the pencil. Student answers less than in part (d) and explains that the arrow is a longer unit of measure than the button. **Task 3**. Student answers 7 and same, as shown on answer sheet. Student is able to explain that the inch is a standard unit of measure. **Task 4**. Student checks one box and is able to measure both pencils using at least one type of unit.	Response shows evidence in only 3 of the tasks described in category 4.	Response shows evidence in only 2 of the tasks described in category 4.	Response shows evidence in only 1 or none of the tasks described in category 4.

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement
Rubric

CATEGORY	4	3	2	1
Strategy and procedures	**Student typically uses an efficient and effective strategy to solve the problem(s).**	**Student typically uses an effective strategy to solve the problem(s).**	**Student sometimes uses an effective strategy to solve the problem(s), but not consistently.**	**Student rarely uses an effective strategy to solve the problem(s).**
	Response shows evidence in ALL of the following tasks. **Task 1**. Student may indicate drawing a vertical line along the left side of each ruler to show alignment (or starting point). Student may also indicate measurement with pencil marks on the drawings. **Task 2**. Teacher should indicate on response sheet if student is using the paper clip and button rulers correctly. Student may make pencil marks on the ruler itself. If so, teacher should note it. Student also may use the button ruler to measure the arrow in part (d). **Task 3**. Teacher should indicate on response sheet if student is using ruler correctly. **Task 4**. Teacher should indicate on response sheet if student is using at least one of the three rulers correctly.	Response shows evidence in only 3 of the tasks described in category 4.	Response shows evidence in only 2 of the tasks described in category 4.	Response shows evidence in 1 or none of the tasks described in category 4.

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement Rubric

CATEGORY	4	3	2	1
Explanation and communication	**Explanation is detailed and clear; uses appropriate terminology and/or notation.**	**Explanation is clear; uses some appropriate terminology and/or notation.**	**Explanation is a little difficult to understand, but includes critical components; shows little use of appropriate terminology and/or notation.**	**Explanation is difficult to understand, is missing several components, and does not use or include appropriate terminology and/or notation.**
	Response shows evidence in ALL of the following tasks. **Task 1**. A good explanation will mention the fact that the two pencils are lined up at the eraser end. **Task 2**. In part (c) student explains that the button unit is shorter than the paper clip unit, (or that the paper clip unit is longer than the button unit). Student may indicate that one button is half the length of one paper clip. The longer unit needs less units to measure the length. In part (d) student explains that the arrow unit is longer than the button unit and less arrows are needed to measure the pencil. **Task 3**. Student explains that inches are standard units. Student may say that inches are the same everywhere or on every ruler that has inches. Student may say that people have agreed how long an inch is. **Task 4**. Student puts the correct unit with the measurement.	Response shows evidence in only 3 explanations described in category 4.	Response shows evidence in only 2 explanations described in category 4.	Response shows evidence in only 1 or none of the explanations described in category 4.

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SITES-M Mathematics Challenge

Grade 1–Focus on Measurement
Rubric

CATEGORY	4	3	2	1
Mathematical accuracy	**All or almost all of the steps and solutions have no mathematical errors.**	**Most of the steps and solutions have no mathematical errors.**	**Some of the steps and solutions have no mathematical errors.**	**Few of the steps and solutions have no mathematical errors.**
	Student provides correct answers for ALL of the following tasks. **Task 1**. Student answers that pencil 2 is longer. **Task 2**. Student answers that pencil 3 is about 5 paper clips long and about 10 buttons long. Student answers that the measurements are different. Student answers less than in part (d). **Task 3**. Student answers 7 and checks the box for the same, as shown on answer sheet. **Task 4**. Student measures both pencils correctly as shown on answer sheet. All measurements are given with appropriate units–button, paper clips, or inches.	Student provides correct answers for only 3 of the tasks described in category 4.	Student provides correct answers for only 2 of the tasks described in category 4.	Student provides correct answers for 1 or fewer of the tasks described in category 4.

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Scoring notes checklist

Task	Check Yes	Category
Task 1		
Student identifies pencil 2 as being longer than pencil 1 and explains why.		Concept
Student may indicate drawing a vertical line along the left side of each ruler to show alignment (or starting point). Student may also indicate measurement with pencil marks on the drawings.		Strategy
A good explanation will mention the fact that the two pencils are lined up at the eraser end.		Explanation
Student answers that pencil 2 is longer.		Accuracy
Task 2		
Student answers as shown on the answer sheet. Student is able to explain that the button is a shorter unit of measure than the paper clip. The shorter the unit, the more units are needed to measure the pencil. Student answers less than in part (d) and explains that the arrow is a longer unit of measure than the button.		Concept
Teacher should indicate on response sheet if student is using the paper clip and button rulers correctly. Student may make pencil marks on the ruler itself. If so, teacher should note it. Student also may use the button ruler to measure the arrow in part (d).		Strategy
In part (c) student explains that the button unit is shorter than the paper clip unit, (or that the paper clip unit is longer than the button unit). Student may indicate that one button is half the length of one paper clip. The longer unit needs less units to measure the length. In part (d) student explains that the arrow unit is longer than the button unit and less arrows are needed to measure the pencil.		Explanation
Student answers that pencil 3 is about 5 paper clips long and about 10 buttons long. Student answers that the measurements are different. Student answers less than in part (d).		Accuracy
Task 3		
Student answers 7 and same, as shown on answer sheet. Student is able to explain that the inch is a standard unit of measure.		Concept
Teacher should indicate on response sheet if student is using ruler correctly.		Strategy
Student explains that inches are standard units. Student may say that inches are the same everywhere or on every ruler that has inches. Student may say that people have agreed how long an inch is.		Explanation
Student answers 7 and checks the box for the same, as shown on answer sheet.		Accuracy

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Task 4		
Student checks one box and is able to measure both pencils using at least one type of unit.		Concept
Teacher should indicate on response sheet if student is using at least one of the three rulers correctly.		Strategy
Student puts the correct unit with the measurement.		Explanation
Student measures both pencils correctly as shown on answer sheet. All measurements are given with appropriate units–button, paper clips, or inches.		Accuracy

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SITES-M Mathematics Challenge
Grade 1–Focus on Measurement

Analyzing Student Responses Protocol

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. They include extended responses, open-ended tasks, and tasks that require higher-order thinking skills. Because these types of tasks may be novel for students and they will have varying levels of understanding, the student responses will vary.

The guiding questions below were designed to assist you in analyzing your class' response to the Challenge and determining appropriate next steps for your teaching and learning. Responses to these questions are for your reflection and documentation and will not be collected.

Guiding Questions for Analyzing Student Responses to the Mathematics Challenges

1. When completing the Challenge, what did your students do well? How do you know?

2. When completing the Challenge, what did your students struggle with? How do you know?

3. When your students completed the Challenge, did they implement multiple correct solutions strategies? What insightful approaches to problem solving did you observe?

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4. What, if any, patterns (e.g., common errors/misconceptions) did you observe across your student responses?

5. What questions or concerns did your students have when working through this Challenge or a particular task? Are these things you should address for the class as a whole?

6. What, if any, feedback did you provide to your class? How did you provide it?

7. What did you learn about your students' mathematical understanding based on their responses to this Challenge?

Reminders:

1) After you have completed the Challenge with your class and responded to these Guiding Questions for Analyzing Student Responses, please complete the Challenge Feedback Log. A link to this Log is e-mailed to you each month. Responses will be used to improve the Challenges and to provide recommendations for teachers implementing the Challenges in future years.

2) Please provide copies of all student work to the Assessment Coordinator.

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