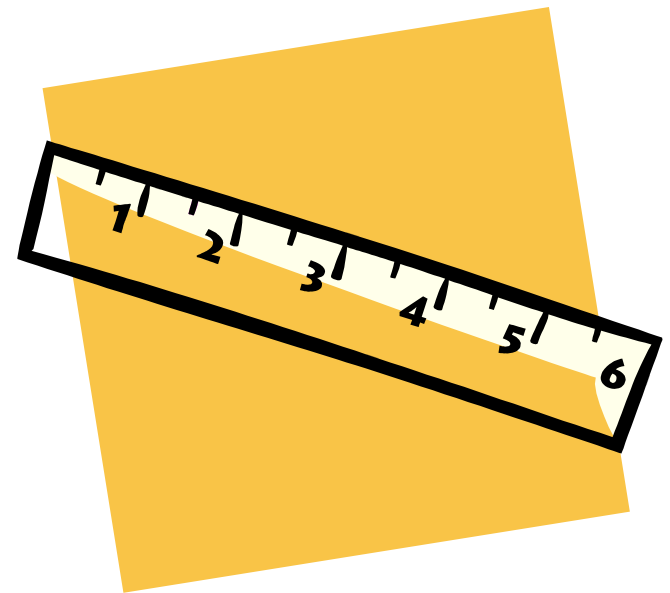


# Building Measurement Tools to Build Understanding

CMC-South

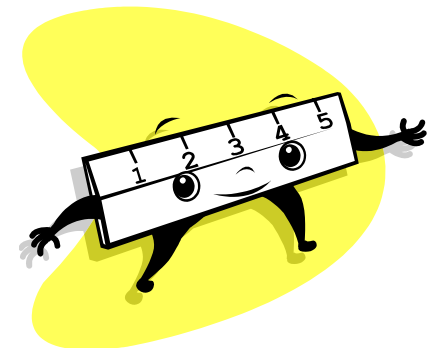
By Julie Joseph

October 25, 2014

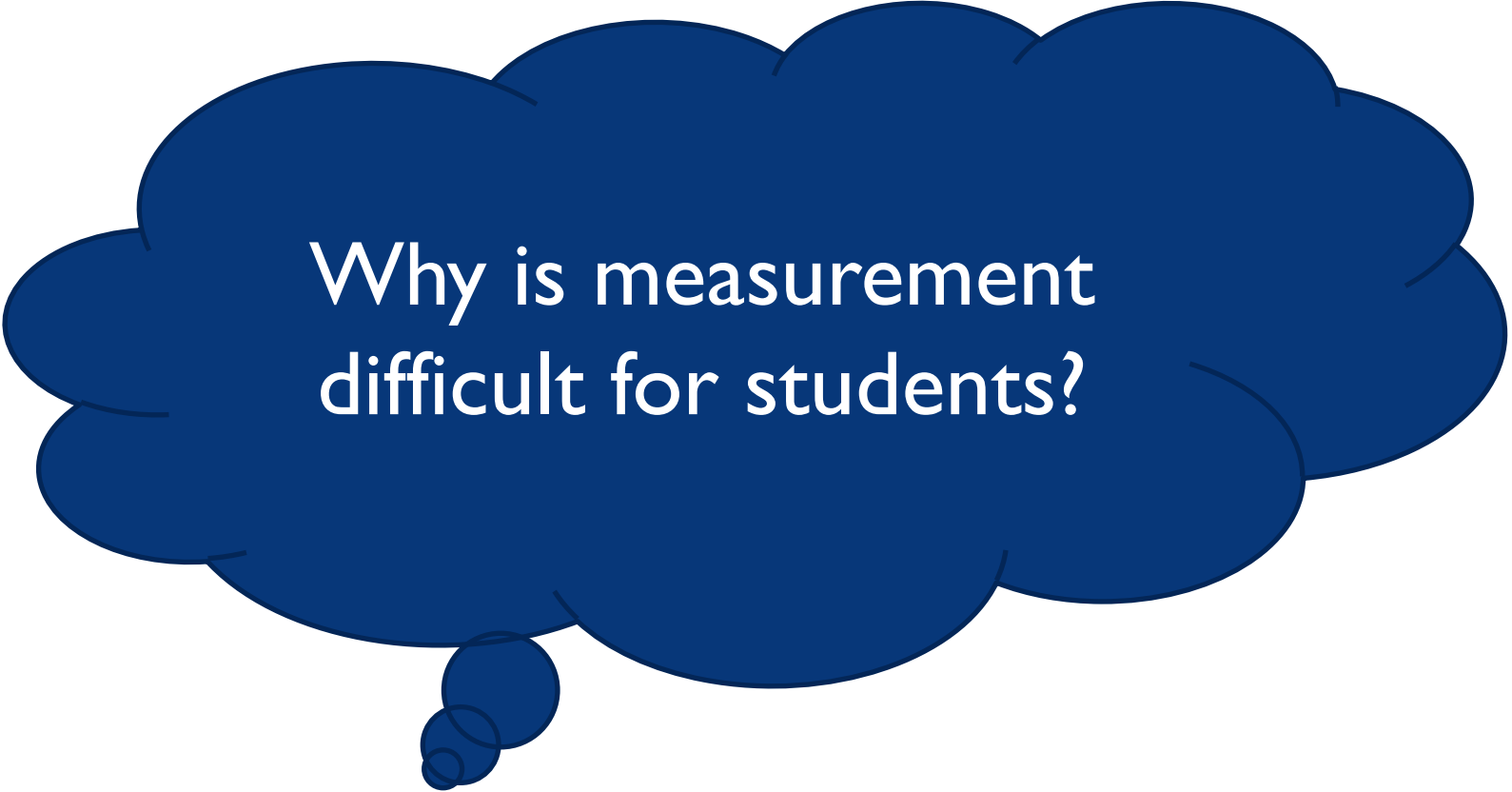


# Goals

- Build understanding of **measurement standards** and **progression**.
- Utilize **hands-on** tools and the **mathematical practices** to develop understanding and solve problems.



# Discuss



Why is measurement  
difficult for students?


# Keeping Focus and Coherence – Grade 1

## MAJOR, SUPPORTING, AND ADDITIONAL CLUSTERS FOR GRADE 1

Emphases are given at the cluster level. Refer to the Common Core State Standards for Mathematics for the specific standards that fall within each cluster.

Key: ■ Major Clusters    □ Supporting Clusters    ○ Additional Clusters

Page 1

- 1.OA.A ■ Represent and solve problems involving addition and subtraction.
  - 1.OA.B ■ Understand and apply properties of operations and the relationship between addition and subtraction.
  - 1.OA.C ■ Add and subtract within 20.
  - 1.OA.D ■ Work with addition and subtraction equations.
  - 1.NBT.A ■ Extending the counting sequence.
  - 1.NBT.B ■ Understand place value.
  - 1.NBT.C ■ Use place value understanding and properties of operations to add and subtract.
  - 1.MD.A ■ Measure lengths indirectly and by iterating length units.
  - 1.MD.B ○ Tell and write time.
  - 1.MD.C □ Represent and interpret data.
  - 1.G.A ○ Reason with shapes and their attributes.
- 


# Keeping Focus and Coherence – Grade 2

## MAJOR, SUPPORTING, AND ADDITIONAL CLUSTERS FOR GRADE 2

Emphases are given at the cluster level. Refer to the Common Core State Standards for Mathematics for the specific standards that fall within each cluster.

Key: ■ Major Clusters    □ Supporting Clusters    ● Additional Clusters

Page 2

- 2.OA.A ■ Represent and solve problems involving addition and subtraction.
- 2.OA.B ■ Add and subtract within 20.
- 2.OA.C □ Work with equal groups of objects to gain foundations for multiplication.
- 2.NBT.A ■ Understand place value.
- 2.NBT.B ■ Use place value understanding and properties of operations to add and subtract.
- 2.MD.A ■ Measure and estimate lengths in standard units. 
- 2.MD.B ■ Relate addition and subtraction to length.
- 2.MD.C □ Work with time and money.
- 2.MD.D □ Represent and interpret data.
- 2.G.A ● Reason with shapes and their attributes.

# GEOMETRIC MEASUREMENT

## K-5, Geometric Measurement

### Overview

Geometric measurement connects the two most critical domains of early mathematics, geometry and number, with each providing crucial support to the other. Measurement is central to mathematics, foundational for arithmetic with fractions, to other scientific domains, especially science, and to activities in everyday life. For these reasons, measurement is a core component of the mathematics curriculum.

Measurement is the process of assigning a number to a magnitude of some attribute shared by some class of objects, such as length, relative to a unit. Length is a continuous attribute—a length can always be subdivided in smaller lengths. In contrast, we can count 4 apples exactly—cardinality is a discrete attribute. We can add 4 apples to 5 other apples and know that the result is 9 apples. However, the weight of those apples is a continuous attribute, and scientific measurement with tools gives only an approximate measurement—to the nearest 1/100<sup>th</sup> of a pound (or, better, kilogram).

Before learning to measure attributes, children need to approximate them, distinguishing them from other attributes. That is, the attribute to be measured has to “stand out” for the student and be discriminated from the undifferentiated sense of amount that children often have, labeling greater lengths, areas, volumes, and so forth, as “big” or “bigger.”

Students then can become increasingly competent at *direct comparison*—comparing the amount of an attribute in two objects without measurement. For example, two students may stand back to back to directly compare their heights. In many circumstances, such direct comparison is impossible or unwieldy. Sometimes, a third object can be used as an intermediary, allowing *indirect comparison*. For example, if we know that Alisha is taller than Barbara and that

This progression concerns Measurement and Data standards related to geometric measurement. The remaining Measurement and Data standards are discussed in the K-5 Categorical Data and Grades 3-5 Measurement Data Progressions.

• The Standards do not differentiate between weight and mass. Technically, mass is the amount of matter in an object. Weight is the force exerted on the body by gravity. On the earth's surface, the distinction is not important (on the moon, an object would have the same mass, would weigh less due to the lower gravity).

# Measurement

Think-Write-Round Robin

Page 3

What does measurement mean?



# Measurement

- “For most of the attributes that are measured in schools, we can say that *to measure* means that the attribute being measured is “filled” or “covered” or “matched” with a unit of measure with the same attribute. This concept of filling or covering is a good way to talk with children about measurement. It is appropriate with this understanding, then, to say that the measure of an attribute is a count of how many units are needed to fill, cover, or match the attribute of the object being measured.”



# Teaching Measurement

- Perhaps the biggest error in measurement instruction is the failure to recognize and separate two types of objectives:
  1. Understanding the meaning and technique of measuring a particular attribute
  2. Learning about the standard units commonly used to measure that attribute.

# Standards for Measuring Length – Grade 1

Continuum

**Measure lengths indirectly and by iterating length units.**

- 1.MD.1. Order three objects by length; compare the lengths of two objects indirectly by using a third object.
- 1.MD.2. Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps.*

# Standards for Measuring Length – Grade 2

Continuum

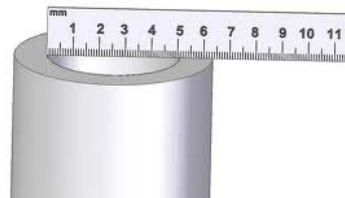
## **Measure and estimate lengths in standard units.**

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.



# Progression Information

## Standard vs. Nonstandard Units

Emphasizing nonstandard units too early may defeat the purpose it is intended to achieve. Early use of many nonstandard units may actually interfere with students' development of basic measurement concepts required to understand the need for standard units. In contrast, using manipulative standard units, or even standard rulers, is less demanding and appears to be a more interesting and meaningful real-world activity for young students.

# A Sample Instructional Progression Measuring with Units

1. Direct comparisons
2. Connect number to length using manipulative units (i.e. centimeter cubes, 1-inch squares)
3. Compare results of direct measurements to direct comparisons



[http://highlandheritage.blogspot.com/2013\\_11\\_01\\_archive.html](http://highlandheritage.blogspot.com/2013_11_01_archive.html)

# Direct Comparison

- Choose three objects on your table.
- Compare them by placing them next to each other and lining up the ends.
- Which one is longest? Shortest?

# Measuring Objects

- Use your inch straws to measure the lengths of 3 different objects.
- Record your measurements on page 7.

Object	Length in inches
Pencil	

# Using Standard Units

- The jump from using units to using rulers to measure is not trivial.
- It is essential that the measurement with actual unit models be compared with the measurement using an instrument.
  - Have students measure with both tools and compare their measurements.



# Creating a String Ruler

- Cut straws into unit of your choice.
- Link straw units together with a long string.

The string of straws is an excellent bridge to a ruler or measuring tape.

# Measuring Objects

- Use your inch straws to measure the lengths of 3 different objects.
- Record them in your table.

Object	Length in inches
Pencil	

Measure 3 more objects with your string ruler and add them to your list.

# Create a ruler

One of the best methods of helping students understand rulers is to have them make their own rulers out of actual units.

1. Precut narrow strips of construction paper into lengths.
2. Use two different colors of paper.
3. Discuss how the strips could be used to measure by laying them end to end.
4. Provide long strips of tagboard about 5 cm wide. Students paste the strips end to end along the edge of the tagboard, alternating colors.
5. Students should not be encouraged to use the end of the ruler as a starting point; many real rulers are not made that way.
6. Students should eventually put numbers on their homemade rulers.

# Numbering a ruler

- For young children, numbers can be written in the center of each unit to make it clear that the numbers are a way of recounting the units.
- When numbers are written in the standard way, at the ends of the units, the ruler becomes a number line. This format is more sophisticated and should be carefully discussed with children.

## Gummy Worm Stretch!



**Materials:** rulers, gummy worms

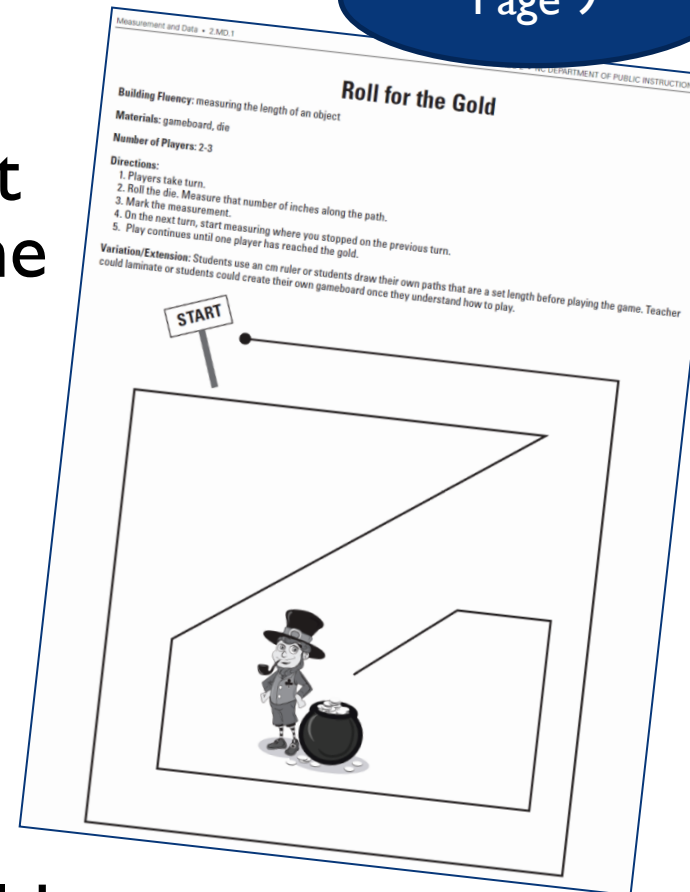
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1. Measure the length of a gummy worm using your ruler.
2. Stretch your gummy worm as far as you can without it breaking.
3. Measure the stretched gummy worm.
4. What is the difference in length between the original and stretched gummy worm?
5. Record your findings.

# Roll for Gold

Page 9

- Players take turns.
- Roll the die. Measure that number of inches along the path.
- Mark the measurement.
- One the next turn, start measuring where you stopped on the previous turn.
- Play continues until one player has reached the gold.

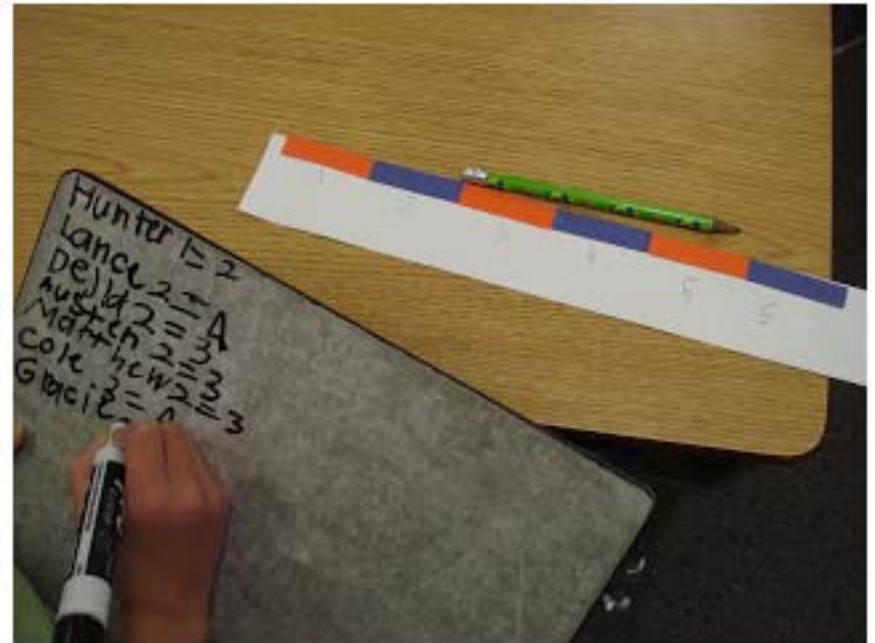


# Ruler Misconceptions

- Research indicates that when students see standard rulers with the numbers on the hash marks, they often believe that the numbers are counting the marks rather than indicating the units or spaces between the marks.
  - Assess understanding by providing students with a ruler with hash marks but no numbers. Have students use the ruler to measure an item that is shorter than the ruler. A correct understanding of rulers is indicated if students count spaces between the hash marks.
  - Another assessment is to have students measure with a “broken” ruler, one with the first two units broken off.
  - You can also assess by having students measure an object that is longer than the ruler.

# Tricky Measuring

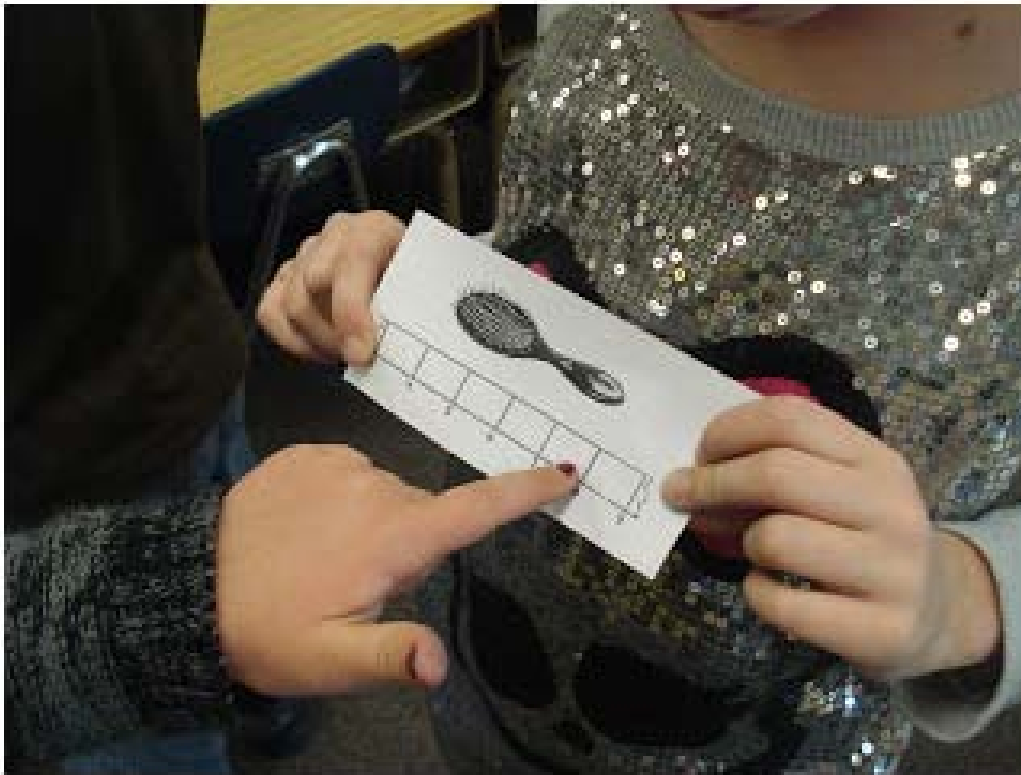
- Each child chooses an object from their desk.
- They line it up with their ruler, but not with zero and leave it on their desk.
- Students go around the room and record as many measurements as they can.





# Broken Ruler Cards

Pages 10-13



# Reflection

How will you use these ideas in your teaching of measurement?

## Goals

- Build understanding of **measurement standards** and **progression**.
- Utilize **hands-on** tools and the **mathematical practices** to develop understanding and solve problems.

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## Mathematics Speakers

Steve Leinwand & Max Ray



REGISTER

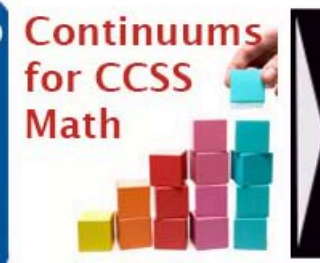
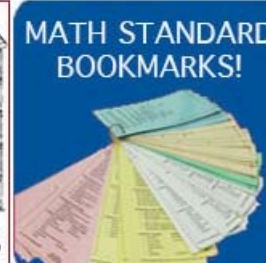
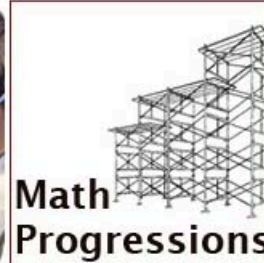
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## CYBERQUEST SCENARIOS RELEASED

Tulare County Office of Education is proud to announce the release of [this year's CyberQuest scenarios](#) featuring *real-world, current events related, grade level Common Core Math performance tasks.*



# Resources

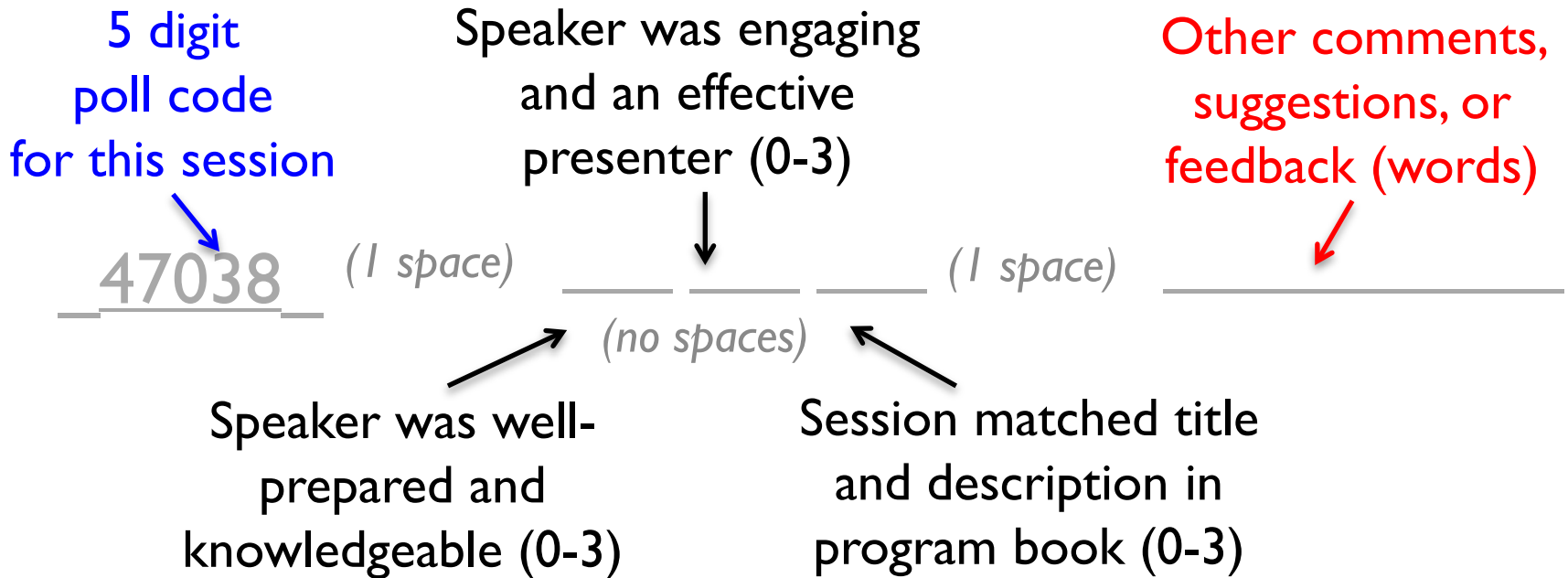
- Common Core Connect
  - <http://commoncore.tcoe.org>

## E-mail

- Julie Joseph
  - [jjoseph@ers.tcoe.org](mailto:jjoseph@ers.tcoe.org)

Strongly Disagree	Disagree	Agree	Strongly Agree
0	1	2	3

Send your text message to this Phone Number: 37607



Example: 47038 323 Great session!

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