Measuring Our World

First Grade Measurement Formative Re-Engaging Lesson

In this Formative Re-Engaging Lesson (FRL), which is a series of performance assessments and activities, first grade students are given the opportunity to experiment with non-standard measurement tools in a variety of ways, including both non-iterative and iterative measurement. Beginning with a pre-assessment, students show what they know and can do as they explore non-standard measurement. Next, though a series of activities, students experiment with measurement of familiar objects using non-standard items as measurement tools, including footsteps and unifix cubes. Any other available measurement items (paper clips, strip of paper, hand lengths, etc.) can be used as non-standard measurement tools. Finally, students will show the knowledge they gained during their experience with the FRL in a post-assessment.

The following performance assessments and exploration activities are included in this FRL:

- Pre-Assessment: Footsteps on the Rug
- Activity 1: Footsteps on Tape
- Activity 2: Comparing Footsteps
- Activity 3: Free Exploration Measurement Activity
- Activity 4: Measuring Objects with Cubes
- Performance Task: Problem of the Month Measuring Mammals Primary Level A
- Post- Assessment: Rug Designs

Introduction to Measurement for Beginning Learners

The purpose of measurement is to make indirect comparisons. Researchers claim that children must use two kinds of reasoning to measure objects: transitive reasoning and unit iteration. Transitive reasoning involves comparing a whole quantity to another whole quantity. In other words, a student who has transitive reasoning might take a non-regular measuring instrument and compare it to a first object and then a second object to find which object is bigger. Unit iteration requires the ability to think about each whole as consisting of equal parts. A student who can measure with a number line or ruler has unit iteration reasoning. Students must first develop transitive reasoning before understanding unit iteration.

Conservation, the idea that an object remains the same shape and size regardless of how it is positioned or divided, is a first developmental step to understanding measurement. One must be sure that a measurement tool's length will stay the same, in the process of moving it, to measure something.



Transitivity, the idea that you can compare the length of two objects by comparing them both to the length of a third object, is the next developmental step to understanding measurement. For example, to decide who is taller, Tara or Chase, you can measure them both with the same object. If you use the length of a pencil to measure Tara's height and the length of the same pencil to measure Chase's height, then you can compare the number of pencil lengths for each to determine if Tara or Chase is taller. Developmentally, conservation must be understood for transitivity to be believed and understood by a young learner.

Unit Iteration, the idea that you can repeatedly use a single measurement unit to measure the length of an object, is the next step to understanding measurement. If a young learner has a bin full of cubes, it is relatively easy to line up the cubes to measure the length of an object, then to count the cubes and know the object's length. It is much more difficult to have just one cube and to measure the object by iterating (repeatedly moving) the cube. Inherent in this iteration process is starting at the beginning, keeping track of where the cube ends so that, when the cube is picked up and repositioned, there are no gaps in measurement, and keeping track of how many cube lengths it took to get from the beginning to the end without the visual aid of counting a train of cubes.

Tools as Units, the idea that an object can be chosen as a tool of measurement, and that this object is then a single chosen unit of length, can be reinforced by labeling all measurements in terms of that object. For example, "David's foot is 14 *cubes* long.", or "Zippy, the classroom lizard, is 7 *large paper clips* long."

Remainder, the leftover portion of the object being measured, that is a fraction of the measurement unit in length, is a complex idea for young learners. That last bit of leftover length is dealt with by young learners in a variety of ways. Some learners feel that, since the remainder is not an entire unit long, it should be disregarded, and make a conscious decision to do so. Other learners feel that they must make sure all of the object's length has been covered by units and so add an extra unit that goes slightly past the end of the object. Some simply ignore the fractional remainder. Since young learners think in whole numbers, it is not yet appropriate to measure the fractional length. It is, however, appropriate to discuss that there is leftover length and how different learners have chosen to reason about it. Encouraging students to justify their decision, regardless of which decision they make, is the goal for young learners.

Administering Assessments

The assessments in this Formative Re-Engaging Lesson, both the pre-assessment (*Footsteps on the Rug*) and the post-assessment (*Rug Designs*), can be administered in a variety of ways, depending on how much time you have and how detailed you wish for your understanding of an individual student's performance to be. Regardless of your chosen assessment method, you will

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read each item to the student(s). If students are unable to write their thinking in detail, you may dictate their responses as spoken.

One-to-One Assessment: If you have the luxury of time, you will gain the most understanding of individual student thinking by administering the assessments one-to-one in an interview format. Students will be able to explain and show to you their thinking in detail.

Small Group Assessment: The next best way to gain detailed understanding of individual student thinking is to assess a small group of students at one time. You can read each item to the group and they can respond individually on their own paper.

Whole Group Assessment at Tables/Desks: Although you won't be able to monitor each student in detail while you are administering the assessment, by giving each student their own paper assessment sheet and reading each item to the entire class, then giving them time to respond in writing, you will still be able to collect their papers and examine student work for individual understanding.

Whole Group on the Rug: You can administer the assessment in a poster-style whole group discussion and collect anecdotal information on what the group knows.

First Grade Measurement Unit Standards

Measure lengths indirectly and by iterating length units.

CCSS.MATH.CONTENT.1.MD.A.1

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

CCSS.MATH.CONTENT.1.MD.A.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*.

Setting the Stage with Measurement – Mathematical Vocabulary

Before beginning measurement activities with your students, it will be helpful to establish some mathematical vocabulary with which to communicate ideas about measurement. A group discussion about the meaning of the words *Measurement, Long, Short, Tall, Longer, Shorter, Taller, and Height* will be helpful. At some point in the lesson, the word *accurate*, or *accuracy,* may be useful.



Pre-Assessment Footsteps on the Rug

(Note that, although this assessment is labeled as a 2nd grade assessment, it is currently aligned with 1st grade standards)

Footsteps On The Rug

Look at the footsteps on the rug. Dad measures the rug by counting his steps. Aaron measures the rug by counting his steps.

1. Who has to take more steps to walk across the whole rug?_____

2. If Dad walks across the whole rug, how many steps will he take in all?

Show how you figured it out.

3. If Aaron walks across the whole rug, how many steps will he take in all?

Show how you figured it out.

4. If Aaron and his dad each took 6 steps, who would walk farther?

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Aaron

Second Grade Exam

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Dad



Common Issues Table for Footsteps on the Rug		
Common Issue	Questions/Prompts to Address the Issue	
Student attempts to use an indirect or direct measurement tool that does not have a relationship to the context of the problem. For example, they may ignore the footsteps that are already placed on the rug and use fingers or cubes or some other measurement tool.	 How are Dad and Aaron measuring the rug? What are Dad and Aaron using to measure the rug? 	
Student does not count the length of Dad's or Aaron's footsteps in spaces, or counts the length in lines instead of spaces.	 How long is Dad's/Aaron's shoe and how do you know? 	
	 Can you show me how you found the length of Dad's/Aaron's shoe? 	
	 Should we count the lines or the spaces when we are trying to figure out how long something is? Why? 	
Student does not utilize the model to work toward a solution.	 How can you use the model of the rug and Dad's/Aaron's footsteps to help you find a solution? Can you draw more footsteps on the 	
	rug?	
Student does not make a connection between Dad's and Aaron's footstep lengths.	• Where is the first place that Dad's and Aaron's toes are on the same line?	
	 How many of Dad's/Aaron's footsteps did it take to get there? 	
	 If Dad and Aaron both measure the length of the rug in their footsteps, will they get the same answer? 	
Did not understand that skip counting could be a useful strategy.	• How can you use skip counting to help you understand this problem?	





Activity 1 Footsteps on Tape

Lesson Goals

- Understand how we can use objects to measure the length of things.
- Understand why, if we use objects of different sizes to measure the same thing, we will get different measurements.

Materials

- Roll of blue tape
- Markers at each tape station for students to record footsteps
- Chart for each tape onto which students can record their footsteps

Set-Up

For this activity, place several lines of tape of various lengths on the floor, spread out in various parts of the room (blue painters tape is best for not leaving marks). Lengths should vary from between 4 and 8 Feet long. Place a chart and markers near each line of tape for recording. Establish labels for each station using letters and mark each piece of tape and each chart with that station letter (A, B, C, etc.)

The Lesson Introduction

After introducing Measurement vocabulary to your students, introduce the Footsteps on Tape lesson. Point out the various tape stations to students and the location of charts and markers. Model the activity for student by asking for a student helper to be your partner. You walk off your own footsteps on the tape while your student partner counts. You then model writing your name on the chart and the number of your footsteps it took to get from the beginning to the end of the tape. Now switch and you count off your student partner's footsteps then they use the marker to record their name and number of footsteps.

Caution! In your introductory demonstration, DO NOT address ideas such as making sure there are no gaps between footsteps, making sure to start at the beginning of the tape, or establishing a rule to deal with remainders. These are ideas that will naturally surface for students in their exploration and it will be useful for you to observe to see how different students are dealing with these issues. Students are likely to discuss these issues organically as the exploration progresses and it is more useful for their development of understanding for you to let them grapple with these issues as they build understanding for themselves. You can observe closely as they explore to see how they think about these issues, then these ideas can be addressed in the Lesson Debrief, as part of the debrief discussion, through a series of questions. Even if your demonstration student leaves gaps, does not start at the beginning, or does not go all the way to ©SILICON VALLEY MATHEMATICS INITIATIVE 2017



the end, when you and your student are modeling the activity for the other students, leave it be for now.

Establish the direction of rotation for partners to cycle through the stations. Establish an amount of time for the entire exploration (about 10 minutes is recommended). Assign some partner pairs to each station and start the exploration.

The Lesson Exploration

Students work in pairs. One partner paces off the length of a line of tape with footsteps while the other partner counts the number of footsteps. Partners then go to the chart and record that student's name and the number of footsteps it took for them to reach the end of the line of tape. Partners then switch. Partners rotate through the various stations with the tape lines of various lengths. If students finish the rotation before time is up, allow them to repeat stations. In the case that a single student gets a different measurement each time for the same length of tape, you can incorporate questions about why the same person might have gotten different measurements for the same length of tape into the debrief discussion.

While Students Are Exploring...

This is your chance to be a detective and look to see what is happening as you prepare to bring up certain points of discussion in your lesson debrief. Look for interesting things to discuss that come up as a direct result of the students' exploration. For example, if you notice that a student recorded a very small number of footsteps, compared to the other students, that may be an indication that there were gaps, or that they didn't start at the beginning of the tape, or didn't walk to the end of the tape. You may even have the privilege of directly observing this if you are in the right place at the right time! If you are lucky enough to be there for direct observation, again, resist the urge to bring up these kinds of things during the exploration. Just tuck these observations into your back pocket and save them for the debrief. As you know, we can't possibly predict every interesting thing that students might do during an exploration. Keep your eyes open and be on the lookout for gems to discuss later!

The Lesson Debrief

Bring all of the charts to the front of the room to use during the discussion. The heart of the debrief discussion will center on why different students have different numbers of footsteps for the same length of tape. You will, of course, need to facilitate a deliberate set of questions, in sequence, to get to the understanding, while not giving away the answers right away. The answer to this question is somewhat counterintuitive since the smaller the foot the more footsteps it will take. Students are used to equating larger with more with more and smaller with less so this idea may create some dissonance.

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Sample Charts to bring to the front of the room to use as anchors to focus the debrief discussion:



It is a goal to facilitate the chance for as many students as possible to talk about the lesson for as much time as possible during the debrief. Discourse Strategies to increase student discourse time during the debrief are as follows:

Discourse Strategies

Turn and Talk:

- "Turn to your partner and discuss <u>question or comment here."</u>
- Repeating Another Student's Thinking:
 - *"Turn to your partner and discuss what <u>name of student here</u> just said."*
 - "Is there someone who can repeat to the class <u>name of student here</u>'s thinking?"
 - "Who can repeat what <u>name of student here</u> just said?"

Discussing a Dilemma:

- *"Jesus just said <u>what Jesus said</u> but Riley just said <u>what Riley said</u>. Turn to your partner and discuss who you agree with and why.*
- "Now that you've had a chance to talk with your partner, would someone be willing to share who you agree with and why?"

Ideas to tease out during debrief and sample questions/comments to do so:

Many items can be measurement tools for length.

• "What are some things that we could use the measure the length of something?"



The length of a foot can be a measurement tool.

• "How could we use the length of a foot to measure something?"

Since our feet are all different sizes, it will take us different numbers of footsteps to walk the tape.

- "If we all walked the same tape length, why did we get different numbers of footsteps?"
- "Tanya got 12 steps but Dylan got for 8 steps for walking the same length of tape. How could that happen?"

Gaps will affect the number of footsteps; to be *accurate*, we try to eliminate gaps.

- "I noticed that Christopher got 8 steps the first time he walked the tape but that he got 12 steps the second time he walked the same tape. Why do you think he got a different number of steps the second time?"
- If gaps do not come up naturally, you may want to model gaps by walking the tape again to double check your initial measurement, making some gaps, then asking students why your number was different the second time.
 - "Why did I get a different number of footsteps the second time I walked the tape?"
 - "Do both measurements make sense? Why? Why not?"
 - "What can I do to make sure I get an accurate measurement?"
 - "How can we measure carefully?"

Smaller feet will require more steps, larger feet will require less steps to cover the same distance.

- "We noticed that people have different sizes of footsteps so it will take different amounts of footsteps to walk the same amount of tape."
- "I see that Jordan took 12 steps and Manuel took 9 steps."
- "Whose feet are longer, Jordan's or Manuel's?"
- "If Manuel's feet are longer, wouldn't it take more footsteps steps for him to walk the tape?"
- "If Jordan's feet are smaller, wouldn't it take less footsteps for her to walk the tape?"

Note! Please note that these are just sample questions to give the flavor of the type of discussion you will want to have with your students. How you facilitate your Lesson Debrief will depend on what occurs during the lesson and what opportunities for discussion present themselves. Based on your professional judgement, ask questions that will lead toward understanding of the lesson concepts. Attempt to keep the discussion going mostly by continuing to ask questions, rather than telling answers, and by using discourse strategies.



Activity 2 Comparing Footsteps

Lesson Goals

- Understand that footsteps can be used to measure the length of things.
- Understand that our footsteps are all different lengths
- Understand why, if we use objects of different sizes to measure the same thing, we will get different measurements.

Materials

- One piece of 8 ½ x 11 paper, or construction paper, for each student
- Markers
- Scissors

Set-Up

No Set-up is required for this lesson

The Lesson Introduction

Let your students know that they will be comparing the sizes of footprints in this lesson, as we think about using footprints as a measuring tool. Gather students on rug and choose a partner to help you with demonstration. You put your foot on a piece of paper and ask your partner to trace around your foot with a marker. You cut out your footprint and write your name in the middle.

The Lesson Exploration Part 1 Preparation

Students work in pairs. Give each student a piece of paper and make markers and scissors available. Ask each student to trace their partner's footprint, then ask the students to cut out their footprints and write their names in the middle, just like you did in the demonstration.

The Lesson Exploration Part 2 Investigation

Students meet at the rug and form a circle. Ask three volunteers to come up to the front of the circle with their footprints. Deliberately choose students with noticeably different sizes of footprints. Ask them to order their footprints by size. Facilitate a conversation with the class about how they think the three volunteers decided on the order and why they placed them the way they did. You may wish to ask questions to get at the idea of alignment. Many students will instinctively align the heels with an invisible line but may be at a loss to explain why they did that

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and how it helped them to determine relative lengths in an accurate way. Once the class has had a discussion about the three footprints, invite the rest of the class, one by one, to add their footprints to the line order. Facilitate as the placement proceeds to help process any tough decisions by asking questions about what they are thinking and how they are trying to decide where to place their footprint.

The Lesson Debrief

The heart of the debrief discussion will center on how decisions were made to place footsteps where they did. You will need to facilitate a deliberate set of questions, in sequence, to get to the understanding, while not giving away the answers right away.

It is a goal to facilitate the chance for as many students as possible to talk about the lesson for as much time as possible during the debrief. Discourse Strategies to increase student discourse time during the debrief are as follows:

Discourse Strategies

Turn and Talk:

• "Turn to your partner and discuss <u>question or comment here."</u>

Repeating Another Student's Thinking:

- "Turn to your partner and discuss what <u>name of student here</u> just said."
- "Is there someone who can repeat to the class <u>name of student here</u>'s thinking?"
- "Who can repeat what <u>name of student here</u> just said?"

Discussing a Dilemma:

- *"Jesus just said <u>what Jesus said</u> but Riley just said <u>what Riley said</u>. Turn to your partner and discuss who you agree with and why.*
- "Now that you've had a chance to talk with your partner, would someone be willing to share who you agree with and why?"

Ideas to tease out during debrief and sample questions/comments to do so:

Footsteps are different sizes and we can compare the sizes.

- How can we tell who has the smallest foot? Largest foot?
- How can we tell where <u>name of student here</u>'s footstep goes in relation to the other footsteps?
- How do we know for sure that <u>name of student here</u>'s footstep is smaller/larger than <u>name</u> <u>of student here</u>'s footstep?

A good strategy for comparison is to line up the heels of each footstep against an imagined line then see which footstep goes up the highest. Many students naturally go to that strategy.

- "Why did you arrange the footsteps the way you did?"
- "Why did you line up all the heels like you have?"



Some students will not line up the heels but, instead, will place footsteps randomly in relation to each other.

• "How can we find out for sure which footstep is longer? How do we know? How can we prove it?"

The length of the footstep will determine the measurement we get.

• "If we measured <u>name of linear object</u> with <u>name of student with a larger foot here</u>'s footstep, would we get the same measurement if we measured that object with <u>name of student with smaller foot here</u>'s footstep? Why?"

Note! Please note that these are just sample questions to give the flavor of the type of discussion you will want to have with your students. How you facilitate your Lesson Debrief will depend on what occurs during the lesson and what opportunities for discussion present themselves. Based on your professional judgement, ask questions that will lead toward understanding of the lesson concepts. Attempt to keep the discussion going mostly by continuing to ask questions, rather than telling answers, and by using discourse strategies.



The sample student work above illustrates what happened in just one lesson.

The students in Sample A lined up their heels against an invisible line on the bottom and the discussion centered on why they did that and why it was helpful if trying to find out which footstep was longest/shortest/etc...

The Sample B student work above illustrates a case where students did not align their footsteps in a way that would meaningfully help them to compare sizes of footprints and the discussion centered on asking how those students could prove which footstep was longest/shortest.

The Sample C student work above illustrates the end product of a process during the debrief where students were invited one by one to place their footsteps in a line up from longest to shortest. During this part of the debrief, students were invited to articulate why they were placing their footstep in the position that they did and how they knew where it belonged. Use of measurement vocabulary was encouraged during their justification processes.





Activity 3 Free Exploration Measurement Activity

For this activity, students use any non-standard measurement item to explore a space and find objects that are the length of their item. Non-standard measurement items could include cube trains, pencils, or any other linear item available in the classroom. If using cube trains, you could give pairs of students same-length trains and send them off together to explore, but vary the lengths of the trains from pair to pair (ie. Pair 1 has 3-cube trains, Pair 2 has 4-cube trains, Pair 3 has 5-cube trains, etc.).

Activity Extension

If you wish to make the activity more formal, students can create a group list of items and their lengths. You can then facilitate a discussion about the relative lengths of different objects in the classroom.



Activity 4 Measuring Objects with Cubes

Lesson Goals

- Understand how we can use objects to measure the length of things.
- Determine the lengths of objects using self-constructed cube trains.
- Decide which dimension to measure when measuring the length of a multi-dimensional object.
- Make sense of different measurements made of the same object, realizing that dimension measured affects length.
- Make sense of remainders in a measurement of length context using cubes

Materials

- Small tub of unifix cubes for each partner pair containing enough to measure longest object on the table
- Variety of objects, labeled by name, to measure
- Chart for each anticipated cube length. (see examples below)
- Marker for each partner pair

4	5	6	7
cubes long	cubes long	cubes long	cubes long



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Set-Up

For this activity, gather a large number of items that can be measured linearly. Label each item, using white paper and clear tape, with the name that you will want students to record. Place all items on a table for students to retrieve and replace as the exploration progresses. Prepare tubs of unifix cubes for partner pairs.

The Lesson Introduction

Tell students that they will work in pairs to measure a variety of objects. Point out the various objects to choose from on the measurement table. Show them the bin of unifix cubes. Ask for a volunteer to come up and determine the length of one of the objects, using cubes. Once they have made a determination, ask them to write the name of that object on the chart that matches their measurement. Point out where to find the name on the object. Ask partner pairs to measure one object at a time during the exploration, record it, replace it, then take another.

Caution! In your introductory demonstration, DO NOT address ideas such as making sure to start at the beginning of the object or establishing a rule to deal with remainders. These are ideas that will naturally surface for students in their exploration and it will be useful for you to observe to see how different students are dealing with these issues. Students are likely to discuss these issues organically as the exploration progresses and it is more useful for their development of understanding for you to let them grapple with these issues as they build understanding for themselves. These issues can be addressed in the Lesson Debrief, as part of the debrief discussion, through a series of questions. Even if your demonstration student does not measure accurately, leave it be for now.

The Lesson Exploration

Students work in pairs to measure various objects on the table and record their names on the appropriate charts. Set a time for exploration – usually about 10 minutes.

While Students Are Exploring...

This is your chance to be a detective and look to see what is happening as you prepare to bring up certain points of discussion in your lesson debrief. Look for interesting things to discuss that come up as a direct result of the students' exploration. For example, if you notice that some students are linking the cubes and others are iterating them, and they are coming up with different measurements, that will be interesting to explore in the debrief. It will also be interesting to see how students deal with lengths that are not exactly the length of a given number of cubes. Do they stop before they move past the length so they don't go over or do they move past the length to make sure the length gets fully covered? You may even have the privilege of directly observing this if you are in the right place at the right time! If you are lucky

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enough to be there for direct observation, again, resist the urge to bring up these kinds of things during the exploration. Just tuck these observations into your back pocket and save them for the debrief. As you know, we can't possibly predict every interesting thing students might do during an exploration. Keep your eyes open and be on the lookout for gems to discuss later!

The Lesson Debrief

Bring the students to the rug and bring the number charts to the front of the room. Ask students if they notice anything interesting about the measurements. They may notice that objects are on more than one chart. If they do not notice this or bring it up, you should. This could happen for different reasons. Inaccurate measurement, differences in how they deal with remainders, and the measurement of different dimensions of the same object could all be reasons why an object appears on more than one number chart. These discrepancies will be the issues for discussion that will be at the heart of the debrief.



It is a goal to facilitate the chance for as many students as possible to talk about the lesson for as much time as possible during the debrief. Discourse Strategies to increase student discourse time during the debrief are as follows:

Discourse Strategies

Turn and Talk:

• "Turn to your partner and discuss <u>question or comment here."</u>

Repeating Another Student's Thinking:

- "Turn to your partner and discuss what <u>name of student here</u> just said."
- "Is there someone who can repeat to the class <u>name of student here</u>'s thinking?"
- "Who can repeat what <u>name of student here</u> just said?"

Discussing a Dilemma:

- *"Jesus just said <u>what Jesus said</u> but Riley just said <u>what Riley said</u>. Turn to your partner and discuss who you agree with and why.*
- "Now that you've had a chance to talk with your partner, would someone be willing to share who you agree with and why?"



Ideas to tease out during debrief and sample questions/comments to do so:

Object with more than one dimension appears on multiple number charts

- *"I notice than the <u>object name</u> is on more than one number chart. Why do you think that is?"*
- *"Who got <u>measurement of object for the object name?</u> What did you measure?"*
- "Who got <u>alternate measurement of same object</u> for the <u>object name</u>? What did you measure?"
- "So, why were there two measurements for the same object? Are both measurements correct? Why or why not?

Objects with one commonly-measured dimension got different measurements

- *"I notice than the <u>object name</u> is on more than one number chart. Why do you think that is?"*
- "Can someone who got <u>number on the chart</u> please come up and show us how you measured this object?"
- "Can someone who got <u>other number on the chart for same object</u> please come up and show us how you measured this object?"
- "Were there differences in how they measured the object? If yes, what were they? Did both groups measure accurately?

Note! This may be a case of dealing with remainders differently. If that is determined, ask a series of questions to get to that understanding.

Note! Please note that these are just sample questions to give the flavor of the type of discussion you will want to have with your students. How you facilitate your Lesson Debrief will depend on what occurs during the lesson and what opportunities for discussion present themselves. Based on your professional judgement, ask questions that will lead toward understanding of the lesson concepts. Attempt to keep the discussion going mostly by continuing to ask questions, rather than telling answers, and by using discourse strategies.





First Grade Formative Re-Engaging Lesson – Measuring Our World Indirect Measurement

<u>Activity 5</u> Problem of the Month

Measuring Mammals Primary Level A



Problem of the Month Measuring Mammals



Lesson Goals

• Use a non-standard unit measure, or other student-selected method, to determine the height of three different giraffes on a diagram.

Materials

- Who Is Taller? Sheet, enlarged to 11 x 17, one for each student
- Unifix cubes
- Scissors
- Pencils

Set-Up

Have ready to pass out to each student, when you get to the lesson Investigation: an 11x17 copy of *Who Is Taller*?, unifix cubes, scissors, and pencils.

The Lesson Introduction

Discussion on the rug: (Teacher shows the giraffes) "What do we call these animals? Who can read the names of these animals? Which animal do you think is taller? How could you find out for sure?"

The Lesson Exploration

Students work individually but are allowed to collaborate with those sitting next to them if they naturally do so. Give each student pair an 11x17 copy of *Who Is Taller*? and make unifix cubes, pencils, and scissors available. Let students know that, in the end, you will want for each of them to show their solution on their own paper.



Prompt student pairs with the following questions:

- Which giraffe is taller and how can you check to know for sure?
- What can you use to find out?

Allow work time

Once progress has been made, add the next set of prompts/questions:

• Gerry is a young giraffe. How much taller is George than Gerry? How do you know? Show how you figured it out.

Near the end of the investigation, ask students to either draw a picture to represent their solution, dictate a response to this summary question, or write their own response, if they are capable of doing so.

While Students Are Exploring...

This is your chance to be a detective and look to see what is happening as you prepare to bring up certain points of discussion in your lesson debrief. Look for interesting things to discuss that come up as a direct result of the students' exploration. For example, you may notice that some students are iterating one cube to measure giraffe heights while other students are lining up multiple cubes to measure the same heights. If they are iterating one cube, pay attention to how they are keeping track. Perhaps students will not use cubes at all but will create their own measurement methods that include drawing number lines or their own drawn cubes, which may or may not be accurately and consistently drawn to be the same size. You may even have the privilege of directly observing some of these methods as they unfold if you are in the right place at the right time! If you are lucky enough to be there for direct observation, again, resist the urge to comment on their process in any kind of leading way during the exploration. Just tuck these observations into your back pocket and save them for the debrief. As you know, we can't possibly predict every interesting thing that students might do during an exploration. Keep your eyes open and be on the lookout for gems to discuss later!

The Lesson Debrief

The heart of the debrief discussion will center on how decisions were made to compare the heights of George, Gerry, and Geoff.

It is a goal to facilitate the chance for as many students as possible to talk about the lesson for as much time as possible during the debrief. Discourse Strategies to increase student discourse time during the debrief are as follows:

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Discourse Strategies

Turn and Talk:

• "Turn to your partner and discuss <u>question or comment here."</u>

Repeating Another Student's Thinking:

- "Turn to your partner and discuss what <u>name of student here</u> just said."
- "Is there someone who can repeat to the class <u>name of student here</u>'s thinking?"
- "Who can repeat what <u>name of student here</u> just said?"

Discussing a Dilemma:

- *"Jesus just said <u>what Jesus said</u> but Riley just said <u>what Riley said</u>. Turn to your partner and discuss who you agree with and why.*
- "Now that you've had a chance to talk with your partner, would someone be willing to share who you agree with and why?"

Ideas to tease out during debrief and sample questions/comments to do so:

Different methods were used to measure the heights of George, Gerry and Geoff:

- How did you find out who was tallest, George, Gerry, or Geoff?
- What did you do to measure the height of George?
- How do we know for sure that <u>name of giraffe here</u> is shorter/taller than <u>name of giraffe</u> <u>here</u>?

Note! Please note that these questions, and the questions below, are just sample questions to give the flavor of the type of discussion you will want to have with your students. How you facilitate your Lesson Debrief will depend on what occurs during your lesson and what opportunities for discussion present themselves, based on your lesson observation and your own students' work. Based on your professional judgement, ask questions that will lead toward understanding of the lesson concepts. Attempt to keep the discussion going mostly by continuing to ask questions about student ideas that surfaced during the lesson, rather than telling answers, and by using discourse strategies.

The three pieces of student work that formed the basis of one discussion are featured below. You may get student work that looks very different, depending on the background knowledge and varied experiences of your own students. The analysis below is intended only to show how one can lead a productive debrief discussion based on actual student work. If core unit ideas do not emerge during your lesson, rather than introducing issues during the lesson debrief that did not surface during the lesson, consider providing additional experiences with non-standard measurement that will allow the ideas to naturally emerge through additional student exploration.





Sample Student Work from One Lesson and Opportunities for Debrief Discussion Points		
Student A	Student B	Student C
<text></text>	Whe Is Taller? J <	
Method Used by Student A and	Method Used by Student B and	Method Used by Student C and
Implications for Debrief Discussion Student A iterated a cube/pencil combination to determine the height of each giraffe, showing the iteration method at the bottom of their page and notating the result above next to each giraffe. Discussion for this piece of work, using questions to guide a discussion, centers on how the student used the pencil and cube to measure the giraffes, why they used both tools, and how they could make their thinking even clearer than just writing a number above by each giraffe.	Implications for Debrief Discussion Student B iterated a cube to determine the height of each giraffe, showing the iteration method up by each giraffe. As observed during the lesson, student placed a cube at the bottom of each giraffe, drew a line above that cube, moved that cube up so that the bottom of the cube was on top of the line, then continued that process until they got to the top of the giraffe. They then numbered each of their lines from the bottom up to determine the height of each giraffe. Discussion for this piece of work, using questions to guide a discussion, centers on how the student used the cube and recording method. Accuracy can also be discussed here.	Implications for Debrief Discussion Student C created a vertical number line of numbers starting at the bottom of each giraffe and moving to the top. Because the numbers were not all made the same size, the measurements are not accurate. This could be a successful method if more care is taken to space the numbers uniformly, perhaps with the use of an actual vertical number line with tick marks. Conceptually, this method is viable and shows understanding. Practically, it is a difficult method to execute with accuracy. Both of these points can form the basis of a debrief discussion.
Sample Questions to Guide	Sample Questions to Guide	Sample Questions to Guide
Discussion of Student Work A	Discussion of Student Work B	Discussion of Student Work C
How did this student measure the height of each giraffe?	 How did this student measure the height of each giraffe? How did they use a substate 	 How did this student measure the height of each giraffe? How did they use numbers to
a cube to measure the heights?	Where did the lines that are	Does it matter how big each
Did they need to use both tools?	numbered come from?	number is written?





 Are there some good reasons for using both tools? Doos it matter what 	 How do the lines and the numbers help us to understand what this student did2 	 Do George and Geoff look like they are about the same height, or not? 	
 Does it matter what measurement tools we use? How can this student make it clearer to us up by the giraffes how they did their measurement? 	 Was this measurement method accurate? 	 If they are about the same height, why did this student get 18 high for Geoff and 10 high for George? Was this measurement method accurate? 	
 Was this measurement method accurate? 		 If this measurement method was not accurate, how could we use this idea to measure more accurately? 	
Debrief Questions to Compare Student Work and to Generalize About Measurement:			
 Student B shows that George a Who do you think is correct and 	nd Geoff are the same size but Student A why?	and B show that they are different sizes.	

• Which tool or tools did each student use for measurement? Can they all work? Why or why not?

- When is it important for all of us to use the same measurement tool and when is it ok for us to use different measurement tools?
- How can we be accurate when we measure something?



Measuring Mammals Worksheet: Enlarge to 11 x 17 and Duplicate



Who Is Taller?

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Measuring Mammals POM Level A Solutions

Solutions: Level A:

1. Examine the two giraffes named George and Geoff. Determine which giraffe is taller than the other. Explain the difference in the size of the giraffes. How did you determine your answer?





2. This is young Gerry. How much taller is George than Gerry? Explain how you found your answer.



- 1. Geoff and George are the same height. It can be found by taking a third item and comparing the two to the third through a transitive process or measuring with a number line or ruler.
- 2. George is three times larger than Gerry. Students will need to use an iterative process to determine the heights, either through repeating the size of the smaller unit or using measuring tools.

POM Teacher's Notes

Measuring Mammals

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Post Assessment *Rug Designs*



 Performance Task
 Rug Designs Test 1
 P6

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 P6



Common Issues Table for Rug Designs		
Common Issue	Questions/Prompts to Address the Issue	
Student attempts to determine the length of a rug by counting the lines instead of the	• What did you count to measure the length of Ann's design??	
spaces in between the lines.	• Some people counted the lines and other people counted the spaces.	
	• Which spaces did you count to measure Ann's design?	
	• Which lines did you count to measure Ann's design?	
	• How many spaces long is Ann's design?	
	• How many lines long is Ann's design?	
	• Do they both make sense if we want to find length? Why or why not?	
Student misreads the prompt and tries to find out how much LONGER Ann's design is than Bob's design, rather than finding the length of Ann's design.	• What are we asked to find out about Ann's design?	
Student does not have a successful method for finding out how many more units Bob needs to make his design go across the rug from end to end.	• How can we figure out how many more units Bob needs so that his design goes from end to end?	
	 Is there a good way to use the diagram to figure out how many more units Bob needs? 	
	• How could we keep track of how many more units Bob needs so we are sure?	

Additional Literature Resource

<u>How Big is a Foot?</u>, Rolf Myller, Rise and Shine Press, 1991. A king gives a bed to the queen who has everything, but measuring it is a problem when the king uses his foot as the unit of measurement!



