Domain: Measurement
Metric Comparisons and Conversions
Grade 5
Formative Assessment Lesson

Designed and revised by the Kentucky Department of Education
Field-tested by Kentucky Mathematics Leadership Network Teachers

If you encounter errors or other issues with this file, please contact the KDE math team at:
kdemath@education.ky.gov

(Revised 2019)

This Formative Assessment Lesson is designed to be part of an instructional unit. This task should be implemented approximately two-thirds of the way through the instructional unit. The results of this task should be used to inform the instruction that will take place for the remainder of your unit.

Mathematical goals

This lesson is intended to help you assess how well students are able to:

- Recognize the relationship among metric units.
- Convert like measurement units within the metric system.
- Explain the relationship between the metric system and powers of 10

Kentucky Academic Standards

This lesson involves mathematical content and practices standards from across the grade, with emphasis on:

KY.5.NBT.1 Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1 10 of what it represents in the place to its left. **MP.2, MP.7**

KY.5.NBT.2 Multiply and divide by powers of 10.
● Explain patterns in the number of zeros of the product when multiplying a number by powers of 10.
● Explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10.
● Use whole-number exponents to denote powers of 10. **MP.3, MP.8**

KY.5.MD.1 Convert among different size measurement units (mass, weight, liquid volume, length, time) within one system of units (metric system, U.S. standard system and time). **MP.3, MP.8**

This lesson involves a range of Standards for Mathematical Practice, with emphasis on:

2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Introduction

This lesson is structured in the following way:

- Before the lesson, students work individually on an assessment task that is designed to reveal their current understandings and difficulties. You then review/analyze their responses and create questions for students to consider/answer in order to improve their solutions.
- After a whole class introduction, students work collaboratively on a card activity.
- Students work with a partner on the collaborative discussion tasks. Throughout their work, students justify and explain their decisions to their peers.
- Toward the end of the lesson there is a whole class discussion.
- Students return to their original assessment tasks and try to improve their own responses.

Materials required

Each student will need:

- A copy of the Metric Conversion: Assessment
- Whiteboard
- Marker

- Eraser

Each partner will need:

- Copies of card sets: A, B, and C (all cards should be copied and cut before the lesson)
- Meter Stick
- Card Template (one copy for each pair or can be displayed on board)
- Each pair will need a copy of the extension activity
- Poster and Glue

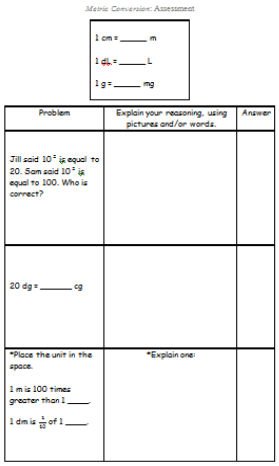
Time needed

Approximately 15 minutes before the lesson for the individual assessment task, one 60 minute lesson and 10 minutes for a follow-up lesson for students to revisit their individual assessment task. Times given are approximated. All students need not complete all sets of cards activities. Exact timings will depend on the needs of the class.

Before the Lesson

Assessment task: Metric Conversions (15 minutes)

Have students do this task individually in class a day or more before the formative assessment lesson. This will give you an opportunity to assess the work, and to find out the kinds of difficulties students have with it. This will allow you to target your help more effectively in the next lesson.


Metric Conversion: Assessment

1 cm = _____ m

1 dL = _____ L

1 g = _____ mg

Problem	Explain your reasoning, using pictures and/or words.	Answer
Jill said 10^2 is equal to 20. Sam said 10^2 is equal to 100. Who is correct?		
20 dg = _____ cg		
*Place the unit in the space. 1 m is 100 times greater than 1 ____. 1 dm is $\frac{1}{10}$ of 1 ____.	*Explain one:	

Do not write on the assessment, as this given back to the student at the end of the lesson to make revisions. However, comments or questions are acceptable.

Give each student a copy of the assessment task Metric Conversion Pre Assessment. Read through the questions and try to answer them as carefully as you can.

It is important that students are allowed to answer the questions without your assistance, as far as possible.

Students should not worry too much if they do not understand nor do everything because in the next lesson they will work on a similar task, which should help them. Explain to students that by the end of the next lesson, they should be able to answer questions such as these confidently. This is their goal.

Framing the pre-assessment: (10-15 minutes)

Give each student a copy of the Metric Conversion.

Before the lesson assessment, teacher says: *Today we are going to work on a task to identify how well you understand metric conversions. This task is to help me see ways that I can help you if you are having any problems with the metric measurement system. If you are not sure about all of your answers, it is okay. You will have 15 minutes to work independently on the task "Measurement Conversion." After 15 minutes I will collect your papers to see how you explained and solved your problems.*

It is important that the students are allowed to answer the questions without your assistance, as far as possible. If students struggle to get started, ask questions that help them understand what they are being asked to do, but do not do the problem for them. See the Common Issues table.

Students should not worry too much if they do not understand or cannot do everything, because in the next lesson they will engage in a similar task, which should help them. Explain to students that by the end of the next lesson, they should expect to answer questions such as these confidently.

Assessing students' responses

- Collect students' responses to the task. Make notes about what their work reveals about their current levels of understanding and their different problem solving approaches. Partner students with others who displayed similar errors/misconceptions on the pre-assessment task.

- We suggest that you do not score student's work. The research shows that this will be counterproductive, as it will encourage students to compare their scores, and will distract their attention from what they can do to improve their mathematics.

- Instead, help students to make further progress by summarizing their difficulties as a series of questions. Some questions in the Common Issues table may serve as examples. These questions have been drawn from commonly identified student misconceptions.

We recommend you either:

- write one or two questions on each student's work, or
- give each student a printed version of your list of questions and highlight the questions for each individual student or
- display a small list of questions on the board that will be of help to the majority of students

Below is a list of common issues and questions/prompts that may be written on individual tasks, on the board or asked during the collaborative activity to help students clarify and extend their thinking. (Leave a couple of blank spaces for teachers to add their own common issues and suggested questions and prompts.

Common Issues:	**Suggested questions and prompts:**
When converting from a smaller unit to a larger unit, students might multiply rather than divide.	When converting metric units, when might you divide? When might you multiply?
When evaluating an exponent, students might multiply the base by the power or add the base plus itself.	What is the base number? How many times is the base multiplied by itself?
Students will not use reasoning to demonstrate conceptual knowledge.	Will it take more smaller units to make larger units or more larger units to make smaller units? How can you compare and convert metric units?

Suggested lesson outline

Whole Class Introduction (10 minutes)

Give each student a mini-whiteboard, marker, and eraser. Maximize participation in the whole-class introduction by asking all students to show you solutions on their mini-whiteboards.
Display Slide P-1 of the projector resource.

You may use these slides, they are at the end of the FAL.

P-1

Metric is to Measure
What's Missing?

length of a marker : dm :: width of a pencil tip : _____

dg : cg :: dL : _____

mg : g :: mm : _____

dL : mL :: dollar : _____

dollar : penny :: one : _____

Metric is to Measure
What's Missing?

- length of a marker: dm :: width of a pencil tip: mm
- dg : cg :: dL: cL
- mg : g :: mm : m
- dL : mL :: dollar : penny
- dollar : penny :: one : $\frac{1}{100}$

Read the first analogy aloud. Give students think time to analyze the relationship and record what's missing on their whiteboard. Next, have students explain their reasoning. Proceed through all analogies.

If time allows, have students create their own analogies to share related to the metric system.

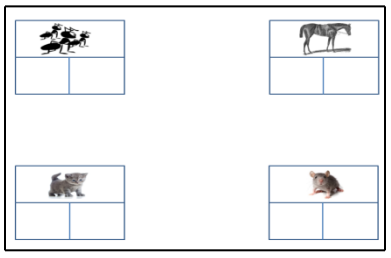
Collaborative Activity: (20 - 30 minutes)

Strategically partner students based on pre-assessment data. Partner students with others who display similar errors/misconceptions on the pre-assessment task. While this may seem counterintuitive, this will allow each student to more confidently share their thinking. This may result in partnering students who were very successful together, those who did fairly well together, and those who did not do very well together.

Explain to students how they are to work collaboratively:

Give each student pair Card Set A.

Display slide P-2 of the projector resource to show students how to place Card Set A. (Cards must be placed in the following corners before beginning task: horse-top right, mouse-bottom right, kitten-bottom left, ant-top left.)



Teacher says: *You are now going to work as a pair to place the eight remaining cards. The cards represent the estimated length of an animal's leg. You and your partner will take turns placing the cards. Each time you place a card, explain your thinking clearly and carefully. If you disagree with the placement of a card, challenge your partner. It is important that you each understand the math and reasoning for all the card placements.*

Make a note of student approaches to the task
Listen and watch students carefully. In particular, notice any common mistakes.
You can use this information to focus a whole-class discussion at the end of the lesson.

Support student problem solving
Try not to make suggestions that move students towards a particular approach to this task. Instead, ask questions to help students clarify their thinking. Encourage students to use each other as a resource for learning.

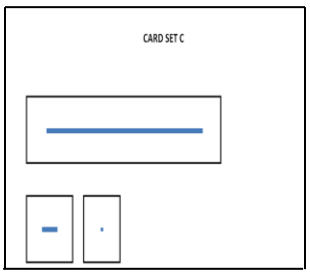
Questions for students struggling with Card Set A:

- Which animal has the longest leg? Of the units on the cards, which one represents the longest length? Repeat the strategy with the shortest leg.

- How can you figure out the difference between the ant's leg and the horse's leg?

- Think about the measurements we have learned. How big is 1 millimeter? [About the size of a pencil tip lead] Which picture would reasonably support the length of 1 millimeter?

If students continue to struggle with Card Set A, an option would be to show students a meter stick, along with card set C. This would aide students in making a reasonable estimate for the length of each animal's leg. Card Set C contains a visual representation of the length of one decimeter, one centimeter, and one millimeter. The meter stick will be used for the one meter representation.



When one student has placed a particular card, challenge their partner to provide an explanation.

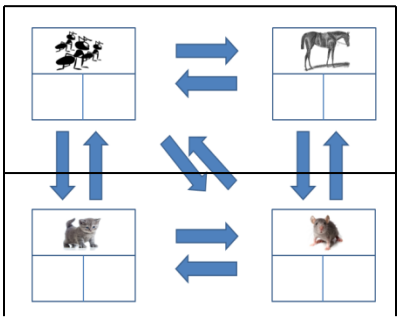
John placed this card here. Michael, why has John placed it here?

If you find students have difficulty articulating their decisions, you may want to use the questions from the Common issues table to support your questioning.

If the whole-class is struggling on the same issue, you may want to write a couple of questions on the board and organize a whole-class discussion.

Placing Card Set B

As students finish placing Card Set A, hand out Card Set B and display slide P-3 of the projector resources. **Do not collect Card Set A – Students will add Card Set B to Card Set A.**
Teacher says: *Here is your next set of cards. You will need to look at the image on the projector (P-3). The image on the projector will help you place the arrow cards. Using the value arrow cards, compare the metric units of measure. You will only use 10 cards. There is a blank card for you to fill in if you do not see the value needed. Each time you place a card, explain your thinking clearly and carefully. If you disagree with the placement of a card, challenge your partner. It is important that you both understand the math and reasoning for all the card placements.*



As you monitor the work, listen to the discussion.

Taking two class periods to complete all activities

If you have to divide the lesson into two class periods, you may want to have a way for students to save the work they have done with the place card sets. You may have each group tape the cards down with on their place cards. You may choose to have them do this even if you are not dividing up the class period just to use as a visual during the class discussion.

Sharing Work (10 – 20 minutes)

When students get as far as they can with placing Card Set B, ask one student from each pair to visit another pair's work. Students remaining at their desk should explain their reasoning for the matched cards on their own desk.

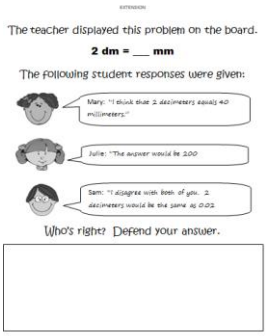
Teacher says: *If you are staying at your desk, be ready to explain the reasons for your partner's card placements. If you are visiting another partner, write your card placements on a piece of paper. Go to another partner's desk and check to see how that pair's work differs from yours. If there are differences, ask for an explanation. If you still don't agree, explain your own thinking. When you return to your desk, you need to consider, as a pair, whether to make any changes to your work.*

As a result of sharing their work with another pair, students may now want to make changes to their own work. After they have done this, they can make a poster. Give each pair a large sheet of paper and a glue stick and ask students to stick their final arrangement onto a large sheet of paper.

Extension activities

Ask students who finish quickly to place the remaining cards over their first placement of cards. This will encourage students to think about the remaining values of the cards.

Students then need to complete the extension worksheet by identifying the correct response to a teacher question. Together, students will discuss the three student answers and determine which student is correct. Then, they will write an explanation in the space provided. If multiple groups finish, have them talk about their answers together in a small group discussion.
**Julie is correct.



Whole-class discussion (10 minutes)

Conclude the lesson by discussing and generalizing what has been learned. The generalization involves first extending what has been learned to new examples, and then examining some of the conclusions students came up with.

Possible example: While one student may choose x 100, another student may choose x 10^2. This is a great discussion point of how they are equivalent.

Allow pairs to bring up some of their work samples and share their thinking. The purpose of this discussion is to explore the processes involved in a range of different approaches. The aim is to get students to understand and share their reasoning, not just checking that everyone found the correct matches.

Ask students:

Why did you decide to place that card there?
What clues did you use to help you in your decision?
Is there another card that could go there?

Improving individual solutions to the assessment task (10 minutes)

Give the students their original assessment task and **say:** *Think about what you have learned during this lesson. Using what you have learned try to improve your work. You will use the coloring pencils that have been provided to go back and make any changes that you wish, taking into consideration what you have learned during this lesson.*

Collaboration Activity: A Sample Solution of the Card Sort.

Metric Conversion: Assessment

1 cm = _____ m

1 dL = _____ L

1 g = _____ mg

Problem	Explain your reasoning, using pictures and/or words.	Answer
Jill said 10^2 is equal to 20. Sam said 10^2 is equal to 100. Who is correct?		
20 dg = _____ cg		
*Place the unit in the space. 1 m is 100 times greater than 1 _____. 1 dm is $\frac{1}{10}$ of 1 _____.	*Explain one:	

1 cm = 0.01 m

1 dL = 0.1 L

1 g = 1000 mg

Problem	Explain your reasoning, using pictures and/or words.	Answer
Jill said 10^2 is equal to 20. Sam said 10^2 is equal to 100. Who is correct?	Explanations will vary.	Sam
20 dg = _____ cg	20 x 10 Explanations will vary.	200 cg
*Place the unit in the space. 1 m is 100 times greater than 1 ____. 1 dm is $\frac{1}{10}$ of 1 ____.	*Explain one: Explanations will vary.	cm m

CARD SET A

A

Length of an ant leg

A

1 mm

millimeter

0.001 m

A

Length of a mouse leg

A

1 cm

centimeter

0.01 m

A

Length of a kitten leg

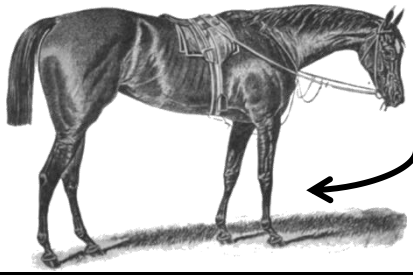
A

1 dm

decimeter

0.1 m

A



Length of a horse leg

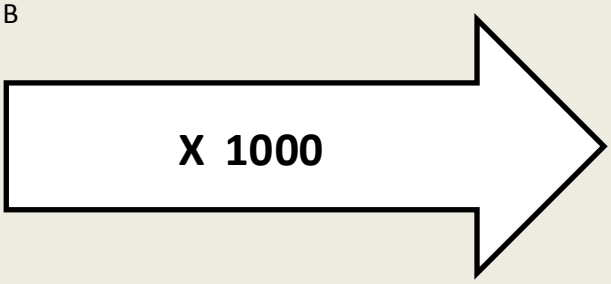
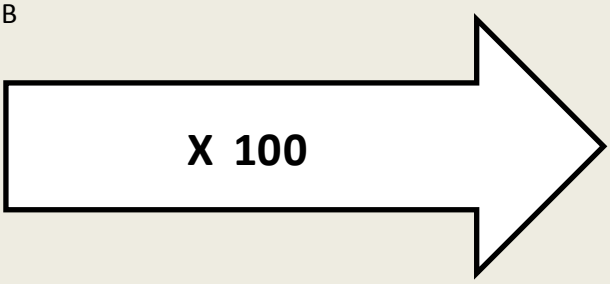
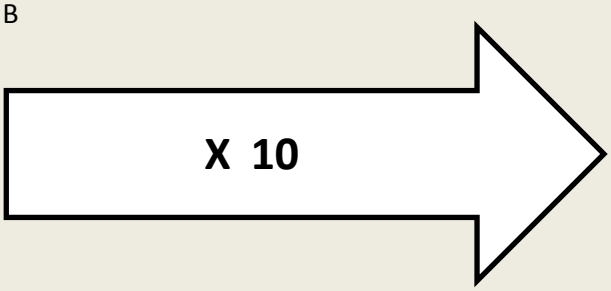
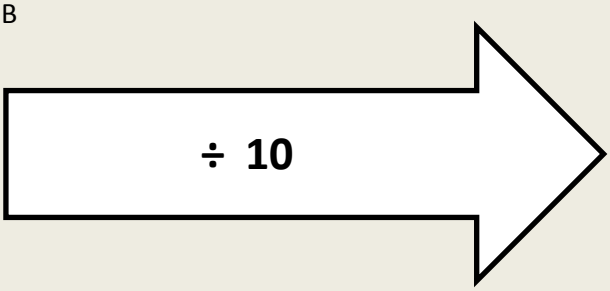
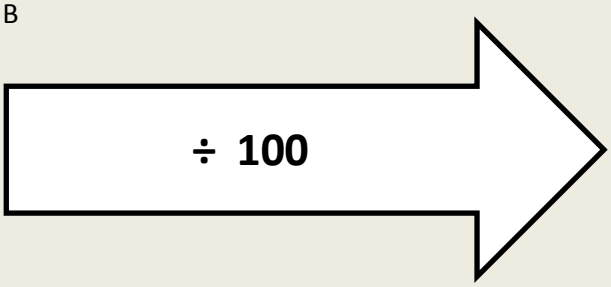
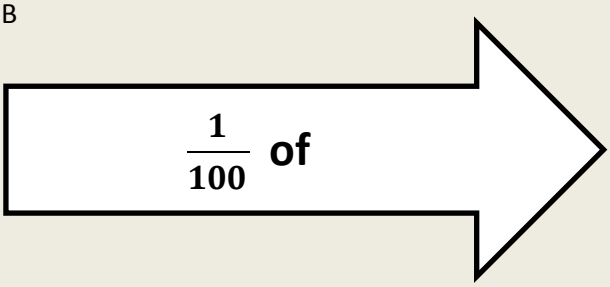
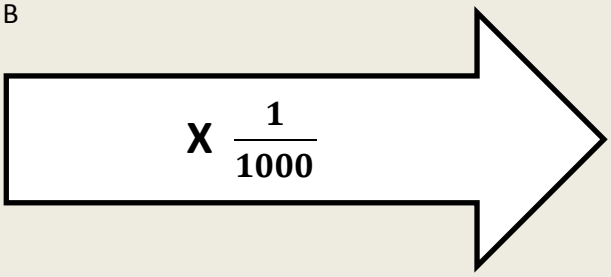
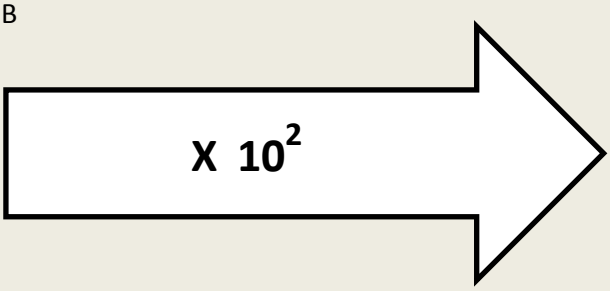
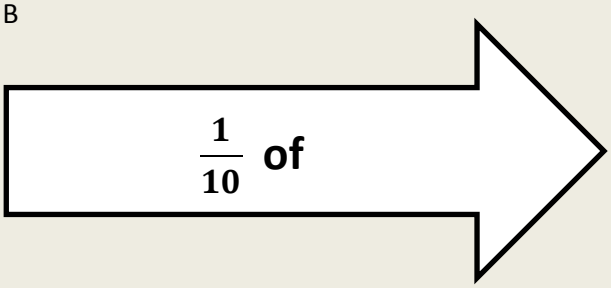
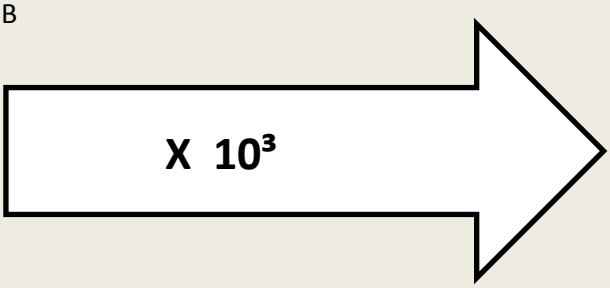
A

1 m

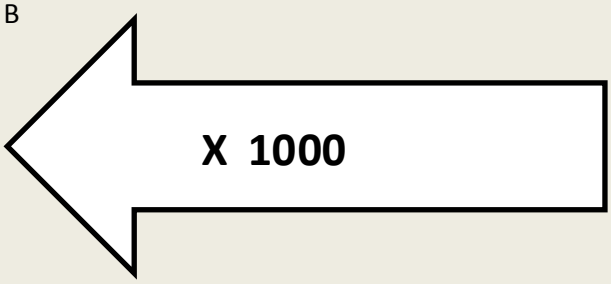
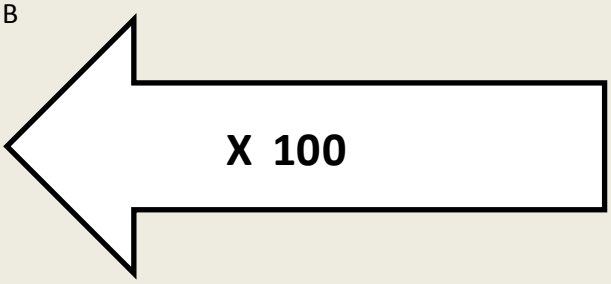
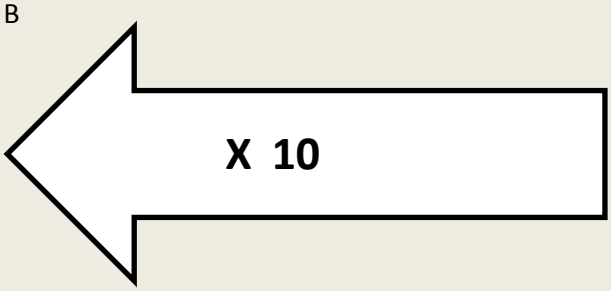
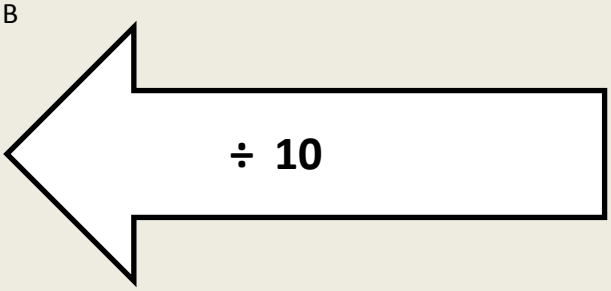
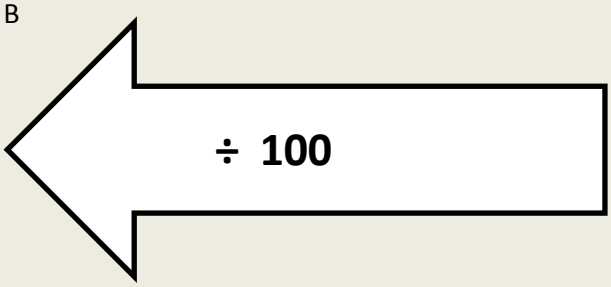
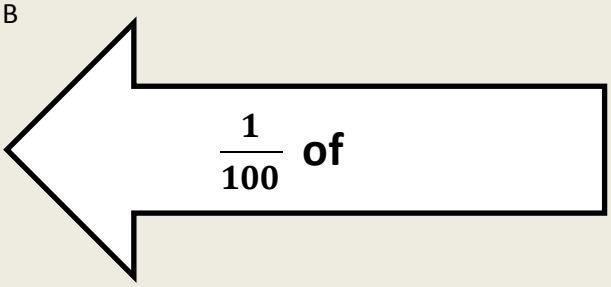
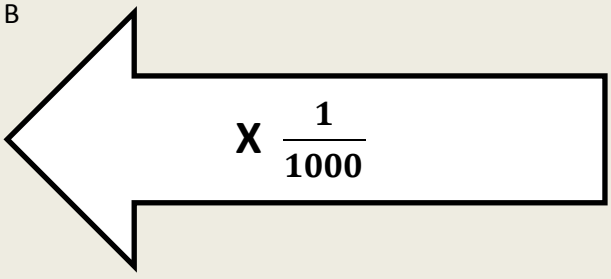
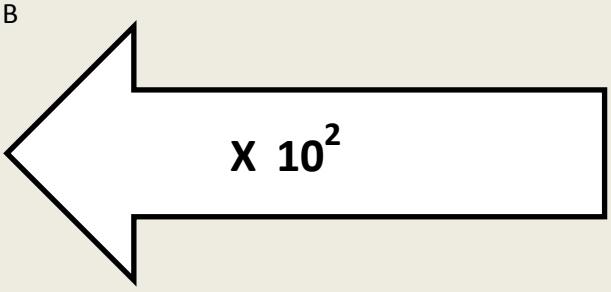
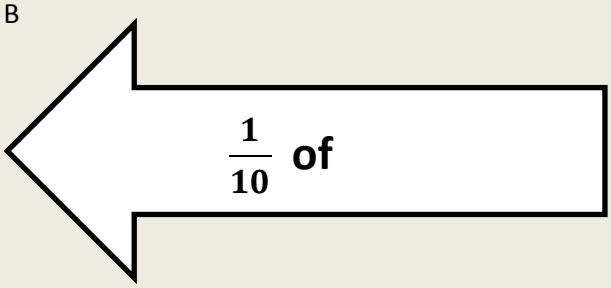
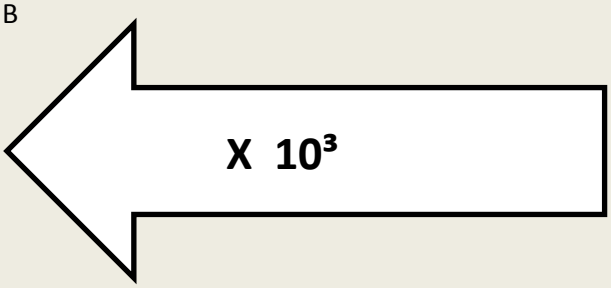
meter

1.0 m

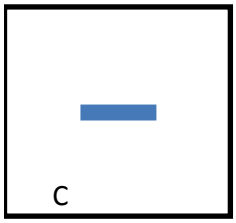
CARD SET B

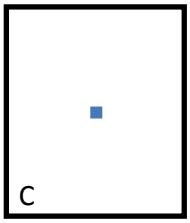
B 	B 
B 	B 
B 	B 
B 	B 
B 	B 

CARD SET B

B 	B 
B 	B 
B 	B 
B 	B 
B 	B 

CARD SET C





Extension

The teacher displayed this problem on the board.

2 dm = ___ mm

The following student responses were given:

Mary: "I think that 2 decimeters equals 40 millimeters."

Julie: "The answer would be 200

Sam: "I disagree with both of you. 2 decimeters would be the same as 0.02

Who's right? Defend your answer.

Projector Resources: Cut and paste these pictures into a PowerPoint slide or place under a document camera.

P-1

Metric is to Measure
What's Missing?

length of a marker : dm :: width of a pencil tip : _____

dg : cg :: dL : _____

mg : g :: mm : _____

dL : mL :: dollar : _____

dollar : penny :: one : _____

Metric is to Measure
What's Missing?

- length of a marker: dm :: width of a pencil tip: mm
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- dollar : penny :: one : $\frac{1}{100}$