Roller Coaster Math

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Target Grade: 4th-5th Math

Time Required: 90 minutes

Standards:

Common Core Math Standards

- **CCSS.MATH.CONTENT.4.MD.A.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

Standards for Mathematical Practice

- **CCSS.MATH.PRACTICE.MP3** Construct viable arguments and critique the reasoning of others.
- **CCSS.MATH.PRACTICE.MP6** Attend to precision.
- **CCSS.MATH.PRACTICE.MP8** Look for and express regularity in repeated reasoning.

Lesson Objectives:

Students will:

- Convert measurements of length within the same system of units.
- Generate a pattern for expressing measurements of a larger unit in terms of smaller unit.

Central Focus:

Students will use roller coaster data to discover how to convert measurements of length. Students will work in groups to analyze the data and generate a pattern that can be applied to other problems of the same nature. During this lesson, students will also collaborate on ideas, communicate their reasoning, and share their findings with others.

Background Information:

The metric system is the unit of measurement used by most countries in the world. While the United States does not use the metric system in most measurements, the fields of science, technology, engineering, and math do. The metric system uses 10 as a base, so that each unit is

10 times larger than the one before it. One metric unit can easily be converted to another metric unit by moving the decimal. If you are converting a number from a smaller unit to a larger unit, the decimal should be moved to the left. Alternatively, if you are converting a number from a larger unit to a smaller unit, the decimal should be moved to the right. Students often find it useful to remember "King Henry Died while Drinking Chocolate Milk," where each word represents a metric system prefix and "while" represents the base unit (such as gram, liter, meter, etc.).

Metric System Prefixes and Mnemonic Device

Prefix	kilo-	hecto-	deka-		deci-	centi-	milli-
Conversion	1,000 times larger	100 times larger	10 times larger	base unit	10 times smaller	100 times smaller	1,000 times smaller
Mnemonic Device	King	Henry	Died	While	Drinking	Chocolate	Milk

When converting measurements, it can be beneficial to use a "rail road track" organizational method. For instance, if you wanted to convert 234 feet to hectometers, you would first begin with feet in the first column. In the second column put the conversion from feet to meters, cancelling out the feet. In the third column, put the conversion from meters to hectometer, cancelling out the meters. The final answer will be left as hectometers.

234 ~~feet~~	0.3048 ~~meters~~	1 hectometer
	1 ~~foot~~	100 ~~meters~~

= 0.7132 hectometers

Materials

- Roller coaster video
- Rulers
- List of vocabulary terms
- Measurement conversion table
- Roller coaster statistics
- Recording sheet
- Exit ticket

Instruction

Hook/Opening (~7 min)

- Show students a point-of-view video (or a portion of a video) of a roller coaster ride. The following link is an example video which shows Thunderhead at Dollywood: https://www.youtube.com/watch?v=RxJsFaSIXVs. To increase engagement, encourage students to hold their arms up in the air as if they are riding the roller coaster.

- After the video is finished, ask students to take a moment to think about what they noticed and wondered.
- Have students turn and talk to a partner or group and discuss questions that could be answered about this roller coaster using math skills. Guide students to questions involving measurement, such as "What is the length of the roller coaster?", "How tall is the biggest drop?" etc.
- Once these questions have developed, ask students which units of measure they could use to answer these questions.

Review (~10 min)

- To activate prior knowledge, have students recall units of measure for length, weight, and capacity for both the customary and metric systems of measurement.
- Show students a list of vocabulary terms (attached) if they are unable to remember them.
- Within this brief discussion, compare the various units (e.g. inches are smaller than feet).

Introduction (~10 min)

- To help students discover patterns for converting measurements of larger units to smaller units, hold up 1 ruler and ask how many inches are in a foot.
- Record on the blank measurement conversion table (attached) that 1 foot equals 12 inches.
- Then repeat the process holding up two and three rulers and recording the information on the table.
- Allow students an opportunity to turn and talk about patterns they notice.

Instructions (~3 min)

- Explain to students that they will be applying their discoveries to answer some of the questions they developed about the roller coaster earlier.
- They will be assigned to groups (explained below) to work on determining facts about one of the roller coasters at Dollywood.
- Explain the objectives that students should be able to attain by the end of the lesson.

Group Work (~30 min)

- Students will gather with their predetermined groups and be given a fact sheet about their assigned roller coaster.
- Provided statistics will include height of the coaster, height of the biggest drop, length, and the minimum height requirement to ride. (Note: Although information is as accurate as possible, some data was approximated).
- Each group of students will also receive a recording sheet with questions to answer about their roller coaster using the given statistics. These questions will require students to convert the given measurements to smaller units within the same system of measurement.

- Students are encouraged to practice accountable talk when having discussions within groups. During this time, the teacher should monitor work and ask questions to assess, remediate and extend student learning. Example questions include the following:
  - How did you calculate the height in inches?
  - What strategies did you use to get your answer?
  - How did we determine the number of inches in two feet earlier in class? Can that strategy help you solve the problem?
  - How could you use a conversion chart to help you?
  - Do you notice any patterns in your work? Which operations have you used?
  - What if I gave you the number of inches and asked you to convert to feet? What would you do?
- If groups struggle to find a starting point, provide them with a blank conversion chart. As groups finish, instruct them to create two additional questions about their roller coasters that could be answered using the same data.

Discussion (~20 min)

- Facilitate a discussion about how students solved each of their four questions, and record their answers. Each group of students should describe the strategy they used to find the answer.
- After answers have been written on the board, students can analyze the data to determine which roller coaster was the longest, tallest, etc.
- After students have shared their work, have students think about and discuss the commonalities across the work. What patterns do they notice? What operations are being used? What happens to the number when converting from a larger unit to a smaller unit?
- If there is time remaining, have groups pair up and answer the questions that each of the groups created about their roller coaster.

Closing (~10 min)

- To determine whether students have individually mastered the lesson objectives, they will complete an exit ticket which requires them to convert two measurements of length to smaller units and explain how they would teach the process to a third grader.

Differentiation

The teacher should create homogeneous student groups based on students' place value and multiplication abilities prior to the lesson. Student groups should then be given the roller coaster that is at the most appropriate level for them. The order of the roller coasters in increasing difficulty is Mystery Mine, Tennessee Tornado, FireChaser Express, Thunderhead, Wild Eagle and Lightning Rod. If student groups struggle to get started during the group work phase, the teacher should provide those students with blank copies of the measurement conversion table. The teacher can also help the students fill in portions of the table to guide them to discover the necessary patterns.

Assessment

Formative

The teacher should observe student work and listen to discussions during the group work portion of the class and make anecdotal notes. Student work should be collected at the end of class to analyze the work in greater detail.

Summative

Students will complete an exit ticket at the end of class to determine whether they have mastered the lesson objectives.

Measurement Vocab

Kilometers   Pound
Meters   Ounce
Centimeters   Inch
Kilograms   Foot
Grams   Yard
Liters
Milliliters

Measurement Table

MYSTERY MINE

Statistics:

Height: 29 yd (27 m)

Biggest Drop: 85 ft (26 m)

Length: 603 yd, 2 ft (552 m)

Minimum Height Requirement:

4 ft (122 cm)

TENNESSEE TORNADO

Statistics:

Height: 54 yards, 1 foot (50 m)

Biggest Drop: 128 ft (39 m)

Length: 894 yd (817 m)

Minimum Height Requirement:

4 ft (122 cm)

FIRECHASER EXPRESS

Statistics:

Height: 40 yd (37 m)

Biggest Drop: 118 ft (36 m)

Length: 809 yd (740 m)

Minimum Height Requirement:
3 ft, 3 in (99 cm)

THUNDERHEAD

Statistics:

Height: 33 yd, 2 ft (31 m)

Biggest Drop: 100 ft (30 m)

Length: 1,076 yd, 2 ft (980 m)

Minimum Height Requirement:
4 ft (122 cm)

WILD EAGLE

Statistics:

Height: 70 yd (64 m)

Biggest Drop: 135 ft (41 m)

Length: 1042 yd, 1 ft (953 m)

Minimum Height Requirement:
4 ft, 2 in (127 cm)

LIGHTNING ROD

Statistics:

Height: 66 yd, 2 ft (61 m)

Biggest Drop: 165 ft (50 m)

Length: 1,266 yd, 2 ft (1,200 m)

Minimum Height Requirement:

4 ft (122 cm)

Name: _____

ROLLER COASTER RECORDING SHEET

1. What is the height of the roller coaster in feet?

2. How many centimeters high is the biggest drop?

3. How long is the roller coaster in feet? In centimeters?

4. How many inches tall do you have to be to ride?

5. Create two additional questions that you could ask and answer using your roller coaster data.

Name: _____

EXIT TICKET

1. How many inches are in 8 feet?

2. How many centimeters are in 72 meters?

3. Imagine you are teaching a 3rd grader how to convert measurements to smaller units. What directions would you give him or her?