## *Topic: Constant of Proportionality*

**Teacher: Camille Heron, Pui Lang He, Joe Macchia**
**Genre: Math** **Unit: Proportional Relationship**
**Grade Level: 7th** **Duration: 90 minutes**

**Essential Question**
**(Domain 1: Planning and Preparation-Component 1c: Designing Coherent Instruction)**

- How do you recognize, apply and represent proportional relationships between quantities in real world scenarios?

**Background Knowledge**

**Background Summary:**
Students will need to have understanding of how to create input/output table.

Students know how to identify ratio of two values and understand that it can be presented as fraction, with a colon or with the to.

Students know how to find equivalent ratios through different methodology.

Students also should know how to find unit rate/price from given information real-world situation.

**Lesson Objectives: Students should be able to:**

- Record accurate measurements and use them to create a table
- Transfer information to a graph by appropriately labeling the independent and the dependent variables
- Recognize the linear equation when graphed
- Calculate the constant of proportionality between points
- Write a linear equation from the graph and table
- Identify proportional relationship between two quantities such as distance and time etc

**Standards**
**(Domain 1: Planning and Preparation- Component 1a:Demonstrating Knowledge of Content and Pedagogy)**

**Common Core Learning Standards:**

- 7.RP.2. Recognize and represent proportional relationships between quantities.
  a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

  b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

  c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.

  d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.

**Mathematical Practices:**

- MP 1 Make sense of problems and persevere in solving them
- MP 2 Reason abstractly and quantitatively
- MP 4 model with mathematics

**Common Core Science Standards:**

- MS-PS4-1 Use mathematical representations to describe and/or support scientific conclusions and design solutions.
- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

| **Vocabulary (Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)** | **Prep Work/Materials (Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction-Component 3c: Instruction Engaging Students in Learning)** | **Cross Curricular Connection (Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)** |
|---|---|---|
| ratio<br>direct proportion<br>graph<br>constant of proportionality<br>unit rate<br>distance<br>proportional relationship | Lego mindstorm kit and program Lego mindstorm robot with ultrasonic sensor<br>notebook, pencil, video<br>tape measure<br>computer<br>calculator | Science - applied and used to describe variables. If the change in one variable is always accompanied by a change in another variable and if the change between the two are always related by a |

| | | |
|---|---|---|
| proportion<br>ultrasonic sensor<br>gear<br>rise<br>run<br>linear relationship<br>Steepness | SMART Board<br>tape | constant multiplier, two variables are termed as proportional to each other. And the constant multiplier is called the constant of proportionality c = y/x.<br>Technology<br>Engineering |
| **Differentiation**<br>**(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)** | | |
| ● Auditory: Lecture and class discussions<br>● Verbal: Worksheets<br>● Kinesthetic: Robot activities, active participation<br>● Students will be working in small groups 3-4 per groups<br>● Visual: computer simulation: https://www.brainpop.com/math/ratioproportionandpercent/ratios/ | | |
| **Procedure**<br>**(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)** | | **Student Engagement**<br>**(Teacher Assessment)** |

**Students will work in groups of 4, each group will use a robot to search for the appropriate runs and heights to build the scaffold for a skateboard ramp.**

**Activity #1**
**Materials:**

- **A robot for each group**
- **Tape 8 slanted straight lines on the floor to represent the skateboard steepness. 4 lines with a steepness of 2, and 4 with the steepness of ½.**
- **pens/pencils, notebook to record data**

**steps:**

1. **Pre-program 3 different sets of coordinate pairs in 8 robots**
2. **Students in each group will place the robot on the line to**

**test the program**

**3. Students will record the coordinate pairs each time when the robot stop on the line in the table as rise and run.**
**Discussion Questions:**
**-What pattern do you see from your data?**
**-Is there a relationship between the rises and runs in table?**
**-What affect the steepness of the ramp? How do you know ?**

**Activity #2**
**Materials**

- **a robot for each group**
- **tape 8 slanted lines on the floor to model skateboards with different ramp**
- **Pens/pencils and notebook to record data**

**Steps:**

Students will:
-read out the data from the robot and search for patterns
in activity #1;
- search data and test out data that fit the pattern of the line

Teacher will :

- Run a proper program for each activity
- Observe students' responses
- Ask students guided questions
- Monitor students' behavior and engagement
- Select students' to present their finding
- Sequence the order of students' presentation

| | |
|---|---|
| 1. **Students will work in a group of 4**<br>2. **put the robot on the line**<br>3. **enter the rise and the run on the robot to run the robot**<br>4. **If the robot stops on the line record the data in a table. If the robot doesn't stop on the line, change the rise, or the run, or both until it stops on the line.**<br>**5. Find at least 3 pairs of rise and run** | |
| **Assessment *(Formative or Summative)***<br>**(Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Engaging Students in Learning, Domain 3 Instruction- Component 3d: Using Assessment in Instruction)** | **Student Engagement**<br>**(Teacher Assessment)** |
| Observation<br>record data in input/output table<br>experiment<br>analysis of data collected from experiment | |

**Additional Resources**

Extended activity:

1. While driving on I-95, Geoffrey used his cruise control so that the number of miles he traveled was proportional to the time he spent driving. After five hours, Geoffrey had driven 340 miles. Determine the constant of proportionality and explain its meaning in the context of this situation. Show your work.

| | | | | | |
|---|---|---|---|---|---|
| Time (hrs) | | | | | |
| Distance (mi) | | | | | |

2. Create a real world situation that can be used to find the constant of proportionality between the two quantities.

Activity 1

Name _____ Date_____

**Topic: Constant of Proportionality**

Students will record the coordinate pairs each time when the robot stop on the line in the table as rise and run.

| Trials | Run (Horizontal) | Rise (Vertical) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |

What pattern do you see from your data?

_____

_____

_____

_____

Is there a relationship between the rises and runs in the table?

_____

_____

_____

What affect the steepness of the ramp? How do you know ?

_____

_____

_____

_____

**Activity 2:**

Name _____ Date_____

1. Students will work in a group of 4
2. put the robot on the line
3. enter the rise and the run on the robot to run the robot
4. If the robot stops on the line record the data in a table. If the robot doesn't stop on the line, change the rise, or the run, or both until it stops on the line.
5. Find at least 3 pairs of rise and run

| Number of trials | run(horizontal) | rise (vertical) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

1.What patterns do you see between rises and runs?

2. What are the similarities and differences between activity #1 and activity #2?

3. What can be concluded about the rise and the run in both activities?

Extended activity:

1. While driving on I-95, Geoffrey used his cruise control so that the number of miles he traveled was proportional to the time he spent driving. After five hours, Geoffrey had driven 340 miles. Determine the constant of proportionality and explain its meaning in the context of this situation. Show your work.


| Time (hrs) | | | | | |
|---|---|---|---|---|---|
| Distance (mi) | | | | | |

b. Explanation:

_____

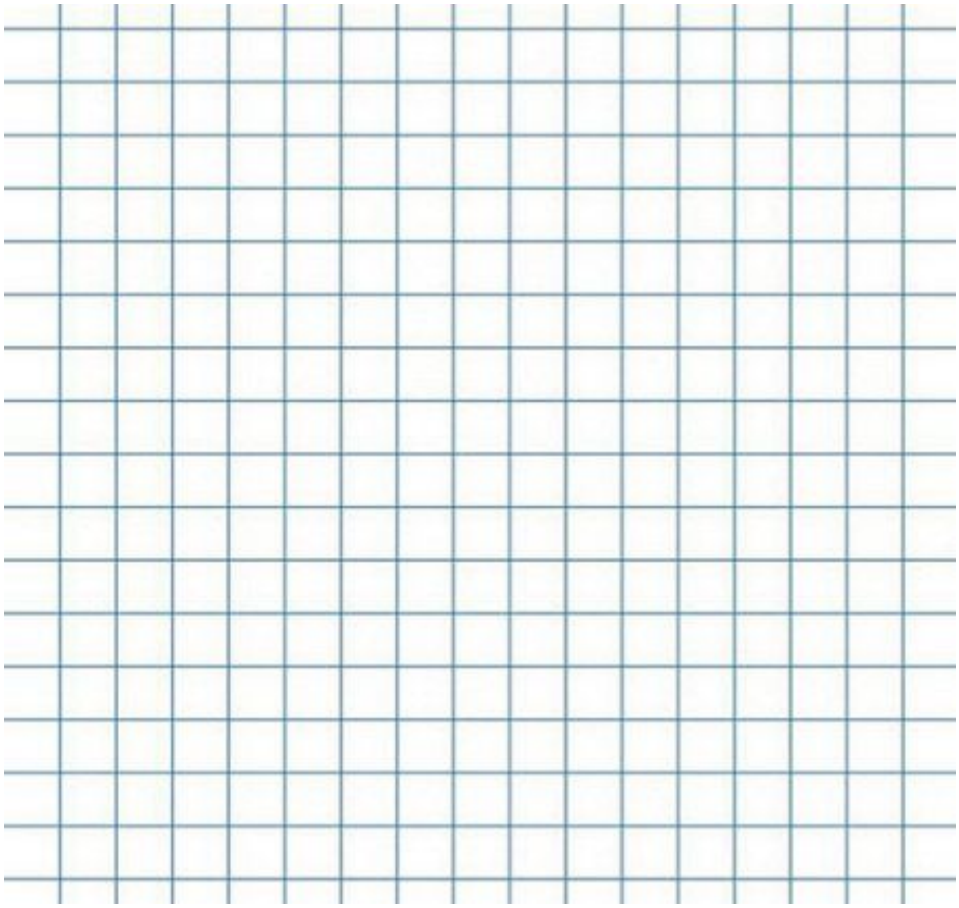
_____

_____

_____

_____

c. Graph the number in the table on the graph below.



d. What connection can you make between the table and the graph?

_____

_____

_____

_____

_____

_____

_____

2. Create a real world situation that can be used to find the constant of proportionality between the two quantities.