

## **Topic: Gear Ratio and Velocity**

**Teacher: Illana Gagliardi & Dawn Ramirez**

**Genre: Math & Science**

**Grade Level: 6th grade**

**Unit: Ratios & Proportions**

**Duration: 2 periods**

### **Essential Question**

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

- How do gears impact the velocity of moving objects?
- What gear ratios are best for speed?

### **Background Knowledge**

**Background Summary:** Students will already have prior knowledge of gear, ratio and proportions. Students will now use the Ultrasonic sensor and identify the velocity of their moving robot using the program, as well as learning the formula  $D/T$

#### **Lesson Objective:**

- Students will be able to identify proportional relationship and gear ratios velocity.
- Students will be able to understand the proportional relationship between gear sizes and how it affects the velocity the robots travel.
- Students will learn how to calculate velocity.
- Students will identify proportional relationships in a real world scenario .

### **Standards**

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

#### **Connection to Common Core Math Standards**

- 6.RP.A.1 - Using proper language to describe ratios.
- 6.RP.A.2 - Understanding a unit rate.
- 6.RP.A.3.A - Make tables of equivalent ratios relating quantities with whole-:) number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
- 6.RP.A.3.D - Using units properly
- 7.RP.A.1 - Computing unit rates of fractions
- 7.RP.A.2 - Recognize and represent proportional relationships between quantities.
- 7.RP.A.2.B - Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
- 7.RP.A.2.C - Represent proportional relationships by equations.
- 7.RP.A.2.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.

#### **NGSS Science Standards**

- **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.
- **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

<b>Vocabulary (Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)</b>	<b>Prep Work/Materials (Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Instruction Engaging Students in Learning)</b>	<b>Cross Curricular Connection (Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)</b>
Ratios Proportions Proportional Relationship Unit Rate Distance Gear Speed Velocity Ultrasonic sensor input output Simple Machine	Lego mindstorm kit and program Lego mindstorm robot with ultrasonic sensor notebook pencil video - Gear and wheels part 1 tape measure computer calculator SMART Board stopwatch/timer	Math Science Technology
<b>Differentiation (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)</b>		

- Visual: video <https://www.nbclearn.com/nfl/cuecard/50770>
- Auditory: Lecture and Class Discussions
- Verbal: Worksheets
- Kinesthetic: robot activities, active participation
- Students will be working in small groups 3-4 per groups

**Procedure:**

**(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 (Teacher Assessment)**

<p>Discussing with class the scenario:          You are building a few difficult vehicles for different situations. You need to decide which gear ratio works best for what you want the vehicle to do.          (different groups will receive different situations for their vehicles)</p> <ul style="list-style-type: none"> <li>● Teacher will discuss with the student the vehicle design scenario;</li> <li>● The teacher will introduction into data collection technique they will be using.</li> <li>● Students will break up into groups and begin velocity Gear Ratio activity and data collection.</li> <li>● Predictions for velocity activity</li> </ul> <p><b>Velocity Gear Ratio activity Data Collection:</b>  <b>(In groups of 3-4)</b></p> <ol style="list-style-type: none"> <li>1. Using built robot, students need to start the velocity gear ratio program.</li> <li>2. Use the ultrasonic meter, students will place their robot approximately 6 inches from the wall and run their program..</li> <li>3. Change the gear ratio for both of the back wheels. (from 1-1 to 1-3, etc)</li> <li>4. Repeat steps 1-3 until all gear ratios have been tested. Make sure to test each gear ratio more than once in case something goes wrong in data collection.</li> </ol> <p><b>*Note: If you have a double period, students may use the stopwatch and calculate the velocity and/or only use the velocity pre-programmed onto the brick.</b></p> <p><b>Velocity Gear Ration Activity Data Analysis. Facilitate the whole class discussion:</b></p> <ol style="list-style-type: none"> <li>1. Analyzing their results through group discussion</li> <li>2. Writing down their analysis, discussing why they think the robot moved differently with different gea</li> </ol>	
<p><b>Assessment (Formative or Summative)</b>  <b>(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)</b></p>	<p><b>Student Engagement (Teacher Assessment)</b></p>
<p>See word file:</p> <ol style="list-style-type: none"> <li>1. Do Now</li> <li>2. Assessment: - Calculating speed and velocity worksheet</li> </ol>	

**Additional Resources**

Homework - The Basic Gears

Assessment: - Calculatinng speed and velocity worksheet