SMALLab Learning

Gear Ratio Game – FLOW Teacher Guide

Grade Levels: 4th through adult

Learning Goals: This is a prerequisite before the Lifting Gears Scenario is played. It familiarizes the student with the game mechanics and how the gear size and direction are embodied.

Duration: One day.

Prerequisite: It is best to start with Gear Size Explorer. Students will learn the correct movements that will help them succeed in this game.

Common Core Standards:

Relevant Common Core Math Standards (7th & 8th grade):

- developing understanding of and applying proportional relationships
- developing understanding of operations with rational numbers and working with expressions and linear equations
- formulating and reasoning about expressions and equations
- grasping the concept of a function and using functions to describe quantitative relationships

Representative National Science Education Standards (grades 5 – 8):

Physical Science: Content Standard B:
- The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.
- Energy is a property of many substances & is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
- Examine forces and motion through investigations using simple machines (e.g., wedge, plane, wheel and axle, pulley, and lever).

Science and Technology: Standard E
- Abilities of technological design
- Understandings about science and technology

Deeper Competencies:

- Graphing
- Representational Fluency
- Proportional Reasoning
- Systems-thinking
- Positive attitudes toward science

How is this Embodied and Collaborative? The distance of the hand to the shoulder controls the diameter of the gear. Two students play against each other.

Section	Notes	Teacher
Introduction	Pick 2 students	This is the Gear Ratio Game. It lets you practice your arm movements to achieve the gear size so you understand how to move the gears for the NEXT big game we play called Lifting Gears.
	Exploring the space You can turn off 'Gear Helper' in the configuration panel.	Just like in the Gear Size Explorer, there is a skeleton with an arm that rotates. The white end ball still represents the hand moving around the shoulder. The input and output gears are on the shoulder. With the 'Gear Helper' on, notice which one is the input gear and which one is the output gear.
	Playing the game	Now we are going to turn this into a game. Whoever is the first one to make the input gear go around twice, maintaining the gear size, will win the point. The ratio to match appears in the middle on top. The first number is the input size to achieve. Players have 40 seconds to make as many matches as they can.
Applications	Note: You need to get the entire class up to experience this – it is not something that is well-learned observationally. The student must **individually experience** gear turning in this low stakes activity before Lifting Gears.	What is the relationship between the size of the input gear and how do you think this might help us – humans – do work? How much effort does it take to create the different sized gears? Which gear is easiest to turn? Why? How does the circumference or distance around the gear affect the effort or work? How many times does the output gear rotate in relation to the size of the input gear? Once the students understand there is a relationship between the size of the gears and the effort used to turn them, they should be ready to move on to Lifting Gears.

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