

## **“Ramps” Teacher Guide**

### **Activity overview:**

This activity is designed to guide students to mastery of relating energy, force, and motion on an inclined plane. Students will use a free body diagram to visualize all forces acting on an object, whether in motion or standing still. Considering all forces acting on an object provides a great introduction to multiple upper middle school concepts like graphing motion, calculating work, and differentiating between speed, velocity, and acceleration.

### **Target Audience:**

- Grade range: 5-7 (Can be scaffolded up to 8<sup>th</sup> grade with deeper investigations of friction and force graphs)
- Activity annotations based on 7<sup>th</sup> grade classroom facilitation

### **Learning objectives:**

Students will be able to...

- Describe how the forces on an object change when the object is on an inclined plane.
- Relate energy, force, and motion with objects moving on a ramp.
- Use free body diagrams to explain the net (total) force on an object.

### **Student background:**

Before beginning the activity, students should have a basic understanding of the following topics:

- Forces can be represented with arrows
  - Friction opposes motion
  - Basic understanding of energy, force, and motion. (They have most likely not connected energy to force and motion in the past)
- 

### **Suggested Pre-activities:**

Before beginning the sim activity the following activities can be helpful:

- Work: Brainpop Video (Work) Lesson [Link](#) to power point and videos
- Ramp mini-lab. Students compare pushing an object up an inclined plane to pushing it across a flat surface. Discuss the differences in the amount of force applied, and the amount of energy used by person to accomplish each. Then have students push an object down an inclined plane, and across a flat surface. Have them again compare these experiences. \*Be sure surfaces are made of the same material

### **Annotated Activity with ...** (see linked annotated activity, include hyperlink)

- Prompts or potential questioning
- Checks for understanding/assessment
- Differentiation opportunities
- Links to video examples

### **Suggested Post-activities and Extension Opportunities:**

- Ask students to reflect on their perceived mastery of the learning objectives.
- Review responses from post-assessment with students to help them identify their own mastery and to inform further instruction and intervention.
- Contrast situations where work is done with different amounts of force to situations where no work is done. Use knowledge gained drawing free body diagrams to visualize and compare the force magnitude and the object displacement on flat ground versus on an inclined plane.
- Investigate relationships between force, work, and kinetic/potential energy.