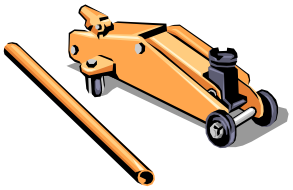


ON A ROLL

BENCHMARKS and TASKS

SC.C.1.2.1 The student understands that the motion of an object can be described and measured.
SC.C.2.2.2 The student knows that an object may move in a straight line at a constant speed, speed up, slow down, or change direction dependent on net force acting on the object.

- The student demonstrates that work is done every time a force is used to move something.
- The student identifies the six types of simple machines (screw, inclined plane, wedge, pulley, lever, wheel and axle).
- The student describes the motion of various objects (e.g., forward, circular, wave).
- The student measures the distance traveled by various objects.
- The student classifies the motion of an object as traveling in a straight line at a constant speed, speeding up, slowing down, or changing direction.
- The student experiences that the greater the force, the greater the change in the motion of an object.

KEY QUESTION

How do toy cars move down an inclined plane?

BACKGROUND INFORMATION

A **force** is a push or a pull on an object. Forces can affect objects in several ways. For example, forces acting on a stationary object can set the object in motion or they can change a moving object's speed and/or the direction in which it's moving. A force can also affect an object by just changing its shape. More than one force can act on an object at the same time. Sometimes these forces are applied in the same direction; sometimes they are applied in different directions. The net force on an object is the combination of all the forces acting on it.

Motion can be described as a change in an object's position. It takes force to change an object's motion. The greater the force is, the greater the change in motion will be. The more massive an object is, the less effect a given force has. Something in motion will move in a straight line forever without slowing down unless a force acts on it.

Friction is the force that opposes motion between two surfaces that are in contact with each other. Friction might prevent motion from starting, or it might oppose motion in progress.

Gravity is the force of attraction between objects that have **mass**. Since all objects have mass, gravity acts between all objects. The strength of gravity between two objects depends on two things: the mass of the objects and the distance between them. In this activity, the car accelerates as it moves down the ramp. This acceleration is due to the effect of gravity pulling the car down. Gravity pulls all objects towards the center of the earth with a force we call weight.

MATERIALS

Per group

1 flat board or other surface for the ramp
1 toy car (per student)
1 tongue depressor (optional)
On a Roll activity sheet

1 meter stick books stacked 2-3 inches high for the ramp

TEACHING TIPS

1. Set up a ramp for demonstration purposes before the activity.
2. Let students know in advance that they should bring a favorite toy car or truck – small enough to be used on the ramps. Have some extra cars on hand for those students who do not bring a car.
3. The ramps will need to be set up on a smooth surface, because the cars will roll down the ramp and stop immediately if they roll onto carpet.
4. Folded game boards (e.g., Monopoly, checkers) can be used as inclined planes.

ENGAGE

Ask students if they have ever played on a sliding board on a playground. Encourage a few students to share their experiences. Ask: *What caused you to move from the top to the bottom of the slide? What made you eventually stop sliding?*

EXPLORE

1. Have students set up a ramp using books stacked 2-3 inches high for a base and a game board or other flat piece for the ramp. The ramp should be set up on a smooth surface, such as the floor or the table. (If students use the table, they may have to make adjustments if the cars roll beyond the edge.) The ramp should be taped to the top book so that it will not slide out of position after each trial.
2. Distribute the activity sheet and materials to each group.
3. Explain that students should take turns placing their cars at the top of the ramp and letting them roll down. Students are not to push the cars; they should just release them. (A piece of stiff cardboard or a tongue depressor could be held in front of the cars and then quickly removed to allow the car to roll without pushing.)
4. Each car should be given three trial runs.
5. The measurement of the distance rolled should be taken from the end of the ramp to the far or back edge of the car. (If the car curved, the student should be careful to keep the meter stick straight when measuring.) Record the measurement each time.
6. Find the median number of the three trials.

EXPLAIN

What type of simple machine is a ramp? (inclined plane)
What was the order of the cars according to the distance they rolled?
Which car rolled the farthest?
Which car rolled the least distance?
What may have caused the difference in distances rolled? (The mass of the cars will make a difference.)
Describe the motion of each car as it rolled. Did the car roll forward in a straight line or did it curve? At any point, did the car seem to speed up, slow down, or change direction?
What force slowed down the motion of the car and eventually caused it to stop rolling? (friction)
Was any work done? (Gravity caused the car to move down the inclined plane.)

EXTEND/APPLY

1. Ask: *Do you think the height of the ramp makes a difference in the distance the cars roll?*
   - Have students change the height of the ramp by adding more books or by removing some books. Students should repeat the activity exactly as they did it before.

- Ask: *Did the height of the inclined plane increase the distance the car rolled?* (Yes, the cars have more stored (potential) energy with the greater height. The greater the force is, the greater the change in motion will be.)

2. Have each group send the student whose car traveled the farthest distance to a "roll off." First, have students observe the cars to see if they have any properties in common, compared to the other cars used. Repeat the activity with these cars to determine the car that rolls the greatest distance.

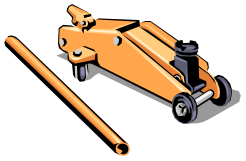
EXTENSIONS

1. Try a similar activity using full soda cans and empty soda cans instead of cars.
2. Have students ask other questions about toy cars and inclined planes and then allow them to carry out those investigations (e.g., Will the surface onto which the car rolls make a difference?).

ASSESSMENT

Have students write in their journals summarizing what they have learned about the motion of cars rolling down inclined planes.

Investigators _____



ON A ROLL

CAR	TRIAL 1	TRIAL 2	TRIAL 3	MEDIAN
1				
2				
3				
4				
5				