Up The Hill

Teacher's Guide

"Up the Hill" can be used independently, or in conjunction with the STC unit Motion and Design. The assessment addresses inquiry and physical science standards at the fourth grade level.

Materials: Adjustable ramps (inclined plane) can be purchased commercially or constructed for very little cost. Manufacturing the ramps and ladder needed for this task would make a great project for a local Tech Ed program. Inexpensive plastic cars can be purchased at any toy store.

Directions: The task is divided into four parts. Each part can be administered as an independent sitting, taking approximately ½ hour each. In Part 2 students design and conduct an experiment. That session will require some additional time.

Standards

VT:
7.1 b., c., d., e., f., h., i..
7.12 d.

Grade Cluster Expectations:
S : 21 (Physical Science—Force)

NSES:
Scientific Inquiry (K-4) SI 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.4

Score Guide

1a) A heavy truck and a light car are stopped on a road. Explain what is needed to get the vehicles to move.

Key Elements:

- A force (push or pull) is needed.

1b) Explain the relationship between the weight of the vehicles, the truck and the car, and what is needed to get each vehicle to move.

Key Elements:

- The heavy vehicle will need a stronger force to make it move than the light vehicle.

2) Once an object is moving, explain what we would have to do in order to make the object move faster.

Key Elements:

- An increase in speed will require an additional or continued force in the direction that the object is moving or a decrease in opposing force such as friction.

3) Here on Earth, all objects are pulled by a force. Explain what that force is and give an example of something that is affected by it.

Key Elements:

- Gravity and the example clearly demonstrate the concept.

4) What are two measurements you could record to describe the motion of a car?

Key Elements: (two out of three)

- Speed
- Distance
- Direction

5) Predict how the amount of **force** changes when you need to move the vehicle up a steeper ramp (hill)? **Explain or justify** your prediction.

Key Elements:

- Prediction links the variable (height of ramp) with the variable (amount of force) and gives a reason based on prior knowledge or reasoning.

6) Think of an experiment you can do to test your prediction. Develop a detailed plan for your experiment that uses the materials in front of you. Write the steps to your plan.

Key Elements:

- Plan is consistent with the question and prediction, will provide evidence to support or refute the prediction
- A procedure that lists steps sequentially (beginning, middle, and end).

7) What will you do to make sure that your plan is a fair test?

Key Elements:

- Describes how the experimenter will manipulate or change only one variable at a time. **("Fair Test")**

8) Use the materials in front of you to do the experiment that you planned. Record data from you experiment here.

Key Elements:

- Data is entered in a sequential order according to the independent variable (height of ramp), in the correct column, and matches height level with appropriate number of washers.

9) In order to help explain the results of your experiment, use the information in your table to make a graph below.

Key Elements:

- Student chooses appropriate range, accurate interval.
- Title
- Labels on X and Y axes
- Data plotted accurately

10) Look at the information in your graph. What did you discover about the force needed to move a vehicle uphill when you make the hill steeper?

Key Elements:

- Describes the pattern in the data (steeper the hill-more force needed).

11) Look back at your prediction (Question 6) Explain how the data either supported or did not support your prediction.

Key Elements:

- Relates the conclusion to the prediction and modifies thinking if prediction is not supported by the evidence of the experiment.

12) Your town has to pay for the gasoline the trucks use to take the garbage to the dump. Which dump do you think would cost the town more to use? Please circle your answer.

Not Scored

13) Use what you learned from your experiment to **explain the reason for your answer.**

Key Elements:

- Student makes a logical inference related to the choice selected and supports the inference with information gained from the experiment; student recognizes that it takes more force to go up a hill than along a flat surface.