Studying Downhill Racers: The Nature of Scientific Activity
Ideas for a Mini-Unit: A Work in Progress

Major Concept: The Nature of Scientific Activity

Content	Skills
	describing
physical properties	collecting and recording data
force and motion	analyzing relationships
	reading charts and graphs
	predicting
	communicating results

The Challenge:

Science is about understanding the nature of things. It is observing, describing, and classifying objects and organisms. It is about looking for patterns, collecting, analyzing and interpreting data,looking for relationships, developing explanations based on evidence, verifying explanations, developing alternative explanations, and making predictions. One way to experience the nature of scientific activity is to start with a puzzling situation and try to develop a data-based explanation for what is observed. Another way is to begin with a problem, like the need for a better product and through scientific investigation come up with possible solutions.

Sometimes scientific activity simply involves studying a group of objects and looking for relationships. That will be the basis of this challenge: to study a collection of objects that roll. Connected to the study of this collection of round things is the problem of determining what kind of objects roll down hills the fastest. You could imagine you are trying to design the perfect wheel for a soap box derby racer. You want to design a wheel for a racer that will roll down a hill faster than anything used to date. Your challenge is to design a set of experiments that will give you clues to the possible shape of materials for a "perfect wheel."

Pre-assessment:

1. Give students a collection of six to ten objects and ask students to classify the objects from observation and describe their classifications.

2. What tools or instruments would enable you to further describe the objects in the collection? Explain how each tool might help.

3. Suppose you wanted to arrange these objects according to their density (mass per unit volume or weight per unit volume). Describe a process you would use to do this.

Learning Tasks:

Task 1.   <u>Classifying and describing objects based on physical properties.</u>

  (A). In the plastic bag, there are 12 different objects that roll down inclines. See how many different ways you can classify these 12 objects into groups.

  (B) How are the objects in each group alike?

  (C) What are the physical properties of the 12 objects that make them different?

  (D) Sketch pictures of each of the 12 objects and describe each according to different properties such as size, shape, etc.

Table for recording Task 1.D.

	Sketch	Shape	Other properties			Time to roll down incline
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Task 2. <u>Determining how different properties of round objects affect the time it takes them to roll down an incline.</u>

Measure the time it takes each of the objects to roll down an incline. Record the data on the table from Task 1. Make several tries and compute the average. Describe what factors affect how fast round objects roll down an incline.

Task 3. <u>Design an object that would roll down faster than any of the 12.</u>

Design or construct an object that will roll down the incline faster than any of the 12 objects you tested. Check out your design.

Task 4. <u>Given a mystery object, predict how it will perform.</u>

Classify and describe the mystery object provided to you. Based on the data from the table for Task 1, make a prediction of the time it will take the mystery object to roll down the incline. After you have made your prediction, measure the actual time. Record your measurement and calculate your percent of error.

Describe what you think were sources of your error.

Open Response Assessment:

1. Below is a table of data showing the braking distance of two automobiles. Based on this information, explain about the relationships between speed and weight.

Car Speed(km/hr)	Braking Distance(m)	
	Automobile A 2500 lbs	Automobile B 3500 lbs.
30	08	10
45	18	22
60	32	40
75	50	62
90	72	90

Open Response Assessment:

1. Below is a table of data showing the braking distance of two automobiles. Based on this information, explain about the relationships between speed and weight.

Car Speed(km/hr)	Braking Distance(m)	
	Automobile A 2500 lbs	Automobile B 3500 lbs.
30	08	10
45	18	22
60	32	40
75	50	62
90	72	90

SCORING GUIDE

Novice	Writer clearly sees no connection between weight and braking distance. May use speed (a constant) as a reason for differences.
Apprentice	The writer shows some recognition of the affects of speed and weight but makes incorrect assumptions
Proficient (Critical level)	Writer concludes that weight does make some difference in the braking distance. Writer may refer to speed as a constant in this data.
Distinguished	Writer explains that the heavier car requires more braking distance at each speed than does the lighter car. The writer may quote appropriate laws of physics. The writer may extrapolate a higher speed to support his/her statement.