Teacher Worksheet: Soap Box Derby Data

Subject: Physics **Grades levels:** 6 - 8

Description: Students roll vehicles down and inclined plane placed at various heights and measure distance traveled. Recorded and graphed data reveals an unexpected data trend (due to friction force).

• Uses graphing paper or spreadsheet

This icon is used for teacher suggestions throughout the lesson. Answers to the questions will be inline in **red**.

What is a Soap Box Derby?

The Soapbox Derby competition began in 1934. It is a series of events where girls and boys race homemade gravity-powered cars, down a gradually sloping road. The bodies of cars were originally constructed from boxes which were used to ship soap – hence the name soapbox derby. More information on the Soapbox Derby and be found at the official website (http://www.aasbd.org/) and Wikipedia (http://en.wikipedia.org/wiki/Soap_Box_Derby).

We will be conducting our own version of a soapbox derby, but instead of measuring time and speed, we will be measuring distance.

Material for each team:

One 1 foot board (inclined plane), a sheet of graphing paper, 1 meter stick and 1 toy car or ball (this will be our vehicle).

Each student team will need a 1 ft. long board several times wider than the vehicles. If using toy cars, test to make sure they roll straight. Mark 1 meter lines on the floor out from the start line.

Procedure:

In our derby we will not be competing against each other. We will be releasing our "vehicle" from the top of an inclined plane that has been raised to various heights and measuring how far it travels. Our racetrack has been laid out on the classroom floor. To make our distance measurements, there are lines drawn on the floor for each meter distance from the start line. If you vehicle stops between lines, use your meter stick to measure the additional distance.

Whenever you see a, , partners should record data in your data log or lab book

You may want to walk students through creating a table for their data logs.

First trial:

- Place the downslope end of your clipboard on the start line.
- Using your meter stick to measure, raise the upslope end of the clipboard 2 cm. Have a teammate hold the clipboard at this height or use a book to keep it at that height. Record this height in your data log.
- Place your vehicle at the very edge of the top of the clipboard and release. As this is a gravity-powered event, do not give it a push.
- When the vehicle comes to a rest, use your meter stick and the meter marks on the floor to measure and record the total distance traveled from downslope edge to the board to farthest tip of your vehicle.

Whenever you see a ?, partners should write out answers **together**. If you don't know the answer, ask another group for help before moving on.

In this lab, we set the initial height of the top of the clipboard – the first variable recorded. The second variable is the distance traveled.

1. What influenced the outcome for the second variable? Board height
2. Which of the two is the dependent/respondent variable? Distance traveled
3. The independent/manipulated variable? Board height

Hypothesis/prediction:

4. If we doubled the height of the incline to 4 cm, will the vehicle travel twice the distance? No
5. Explain your reasoning. Friction and gravity decreases distance

TRY IT! (second trial):

- Using your meter stick to measure, raise the upslope end of the clipboard to 4 cm. Have a teammate hold the clipboard at this height or use a book. Record this height in your data log.
- Place your vehicle at the very edge of the top of the clipboard and release. Do not give it a push.
- When the vehicle comes to a rest, use your meter stick and the meter marks on the floor to measure and record the total distance traveled.

Results/analysis:

6. How would you explain your results for the second trial with respect to your hypothesis? May be different than expected results
7. What forces may have affected your results? Friction & gravity

Let's try it a 3rd time. This time set the height to 3cm.

8. Do you think the distance will be midway between the 1st and 2nd trial?
9. Or (if not)…what's your best guess? A little more than midway

Record your 3rd trial data in your data log.

Before the lab, try the vehicle to make sure the floor space will be adequate AND to determine the Y axis limit.

Graphing the data:
Using your data log, and graphing paper, create a line graph to show the data for the 3 trials. The x (horizontal) axis should have units extending up to 10 cm. The y (vertical) axis will be used for distance units. Your teacher will tell you what the total range for this axis will be.

10. Use the meter stick to draw a line from the 2 cm plot point to the 3 cm plot point. Is the 4 cm point on this line? No
11. Is this a linear graph? No
12. If you were to extend the curve/trend of your graph where would the distance travel point be for incline height of 6 cm? *Variable answers*

Try it setting it to 6 cm and see!

Applying what we have learned:
Science is about learning about the world. One of the ways scientists study the world is through trial and error. The data/results from trials can sometimes fall into patterns. Scientists often use patterns to make predictions.

13. What pattern did you see in your results? This distance traveled did not increase in proportion to increase in height – it gradually got shorter and shorter than one would have expected.
14. How did you make your prediction for the 6 cm trial? Extended out the graph curve.

If there is time, try setting to heights of 8 cm and 10 cm, to see if the trend continues.

CA 8th Grade Science Standards

Focus on Physical Sciences

Forces

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept:
   a. Students know a force has both direction and magnitude.

b. Students know when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.

c. Students know when the forces on an object are balanced, the motion of the object does not change.

d. Students know how to identify separately the two or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.

e. Students know that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).

Investigation and Experimentation

9. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

a. Plan and conduct a scientific investigation to test a hypothesis.

c. Distinguish between variable and controlled parameters in a test.

e. Construct appropriate graphs from data and develop quantitative statements about the relationships between variables.

g. Distinguish between linear and nonlinear relationships on a graph of data.