

Loaded Up

Lesson at a glance:

Students will conduct an investigation to learn how the weight of a moving object affects the force of friction.

Skills:

Investigating, Measuring, Observing, Predicting Communicating, Comparing

Grades:

3-5

Materials:

For each pair of students:

- A wind-up car
- A stop watch
- A ruler
- Tape
- A paper clip
- 20 washers
- Data Sheet



Background:

The force of friction opposes objects in motion. The amount of friction is dependent on the nature of the two surfaces that are in contact and the force pushing the two surfaces together. Generally, the rougher the two surfaces are, the more friction there is between them, and the heavier an object is, the greater the amount of friction between it and the surface with which it is in contact.

Static friction (the friction that keeps an object in place) is greater than kinetic friction (the friction working on a moving object to slow it down and stop it). So it is more difficult to get something moving than to keep it moving.

Activity:

1. Divide your students into groups of two.
2. Hand each pair the supplies.
3. Have the students bend apart the two loops of the paper clip (so it looks like an "S").
4. Pull out the loose end of the larger loop.
5. Attach the smaller loop to the back end of the moving toy.
6. Have each pair place a piece of tape on the floor to serve as their starting line.
7. Have one student from each team wind-up the toy, place it behind the starting line and release it.
8. Have the other student record the time the car travels.



9. Have one of the students measure the distance traveled from the starting line to the where the car stopped moving.
10. Have the students write the time and distance on their data sheets.
11. On their data sheets have the students predict what will happen as washers (weight) are added to the paper clip.
12. Tell the students to place two washers on the paper clip and have them repeat steps 6-9. Compare the results to the first run.
13. On their data sheets have the students predict what will happen as four washers (weight) are added to the paper clip.
14. Now have the students place four washers on the paper clip and repeat steps 6-9. Compare the results to the first two runs.
15. On their data sheets, have the students continue to predict what will happen as more washers are added. Repeat steps 6-9, with two additional washers on each new run, until the toy cannot move the weight. Compare the results of each run with previous runs.
16. Have the students write a paragraph about their experiment. Make sure they discuss their predictions and whether or not they were correct. Have them state why they were correct or incorrect.

Discussion:

1. Have the students share their results. Which number of washers stopped their car? When did they see the car begin to slow down?
2. If not all pairs got the same results, have the students discuss why they think this was.
3. What do they think was happening?

Answer: It is the force of friction that opposes the motion of an object. Without the washers, the car should have continued moving for the longest period of time and should have moved the greatest distance because the force of friction was least.

The more an object weighs, the greater the force of friction will be. Adding washers on each subsequent run, therefore, increased the amount of static friction that the car had to overcome to move the washers. At first, the amount of washers (weight) added may not have noticeably affected the toy's performance because the weight of the washers was not great and the amount of friction was therefore, only slightly greater. As more weight was added, the force of static friction steadily increased until it was greater than the force supplied by the wind-up car. When this occurred, the car failed to move at all.



AMERICA'S CAR MUSEUM®

Loaded Up Data Sheet

Number of Washers	Prediction	Time Traveled	Distance Traveled
0			
2			
4			
6			
8			
10			
12			



AMERICA'S CAR MUSEUM®