Workshop 1.
Making an Impact

What would happen if an asteroid were to hit the surface of the Earth? How large a crater would the impact create? In this workshop, the ideas of force and motion are introduced, as seventh-grade students drop balls to simulate asteroid impacts. By varying a ball's mass, the height from which it is dropped, or the material being struck, the students explore what factors affect the size of the crater. They also learn about data collection and the proper use of measurement units.

On-Site Activities and Timeline

Getting Ready

30 minutes

How Well Do You Understand Force and Motion?

Below are 10 questions related to force and motion. Answer them as best you can. Do not panic! This is not a test. At the final workshop you will be able to see if any of your ideas about force and motion have changed.

Site Leaders: Please collect participants' questionnaires and bring them to Workshop 8.

_____ _____

Name Date

Force and Motion Questionnaire

Please put the letter of your choice in the space provided next to the question.

___ 1. You are given two balls. One is twice as big as the other (twice the diameter). What can you say about the two balls?

a. The larger one has four times the surface area.

b. The larger one has eight times the weight.

c. The larger one has twice the volume.

d. Can't answer without knowing what they are made of.

___ 2. You are given two balls made of the same material. One is twice as big as the other (twice the diameter). What can you say about the two balls?

a. The larger one has twice the surface area.

b. The larger one has eight times the weight.

c. The larger one has four times the volume.

d. None of the above would be correct.

Base your answers to Questions 3 through 6 on the choices a through d on the next page. The graphs represent the position of a moving car after equal time intervals. The cars are moving from left to right, and each travels for the same amount of time.

___ 3. Which car travels the greatest distance?

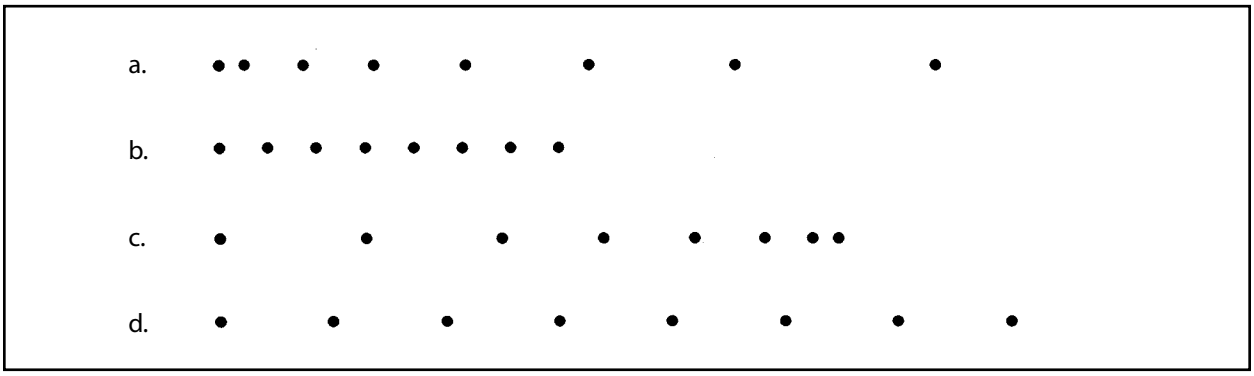
___ 4. Which car is slowing down?

___ 5. In which car would a speedometer read the highest?

___ 6. Which car is moving at the slowest constant speed?

On-Site Activities and Timeline, cont'd.

_____
Name



___ 7. If a ball is dropped from the window of a building to the ground,

a. it speeds up because of the downward force of the air pushing it.

b. it falls because it is natural for objects to rest on the Earth.

c. it speeds up because the gravity gets stronger as the ball gets closer to the ground.

d. it falls at a constant speed.

e. it speeds up because of the constant force of gravity.

___ 8. While you are driving on the highway, a bug collides with the windshield of your car. What can you say about the forces involved in the collision?

a. The windshield exerts a greater force on the bug than the bug exerts on the windshield.

b. The bug exerts a greater force on the windshield than the windshield exerts on the bug.

c. The forces of the bug on the windshield and the windshield on the bug are the same.

___ 9. A small car is used to tow a broken-down truck to the service station. What can you say about the force provided in this situation?

a. The small car exerts a greater force on the truck than the truck exerts on the car.

b. The truck exerts a greater force on the small car than the car exerts on the truck.

c. The forces of the car on the truck and the truck on the car are equal.

___ 10. Two balls of equal size are rolled down a ramp. One ball is twice as heavy as the other. What can you say about the motion of the two balls?

a. Both will reach the end of the ramp with about the same speed.

b. The heavier ball will reach the higher speed.

c. The lighter ball will reach the higher speed.

Force and motion questionnaires such as this are based on ideas taken from Physics Education Research, especially the "Force Concept Inventory," originally published by Hestenes et al. in *The Physics Teacher* (March 1992).

On-Site Activities and Timeline, cont'd.

A Force Is a Force, of Course, of Course?

Many scientific terms are also used in our everyday language. When scientists use a term it has a precise meaning, but this is not always true in casual conversation.

1. Please read the following example:

   "The PRESSURE exerted on the candidate by the polls will FORCE her to change her POSITION after she considers the GRAVITY of the situation."

2. Working alone, make a list of scientific terms that are also used in our everyday language. Try to list terms that you might use to describe how and why objects move.

3. Share your list with a partner. Do you agree on both the scientific and everyday meaning?

If you do not agree on the scientific meaning of the terms you are sharing, you are not alone. We hope that by the end of the workshops many of these key ideas will be clearer to you.

Watch the Workshop Video

60 minutes

As you watch the video, look for the "10-Cent Experiment." You may want to try it yourself at home. Instructions can be found on page 22.

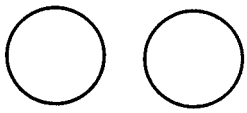
Going Further

30 minutes

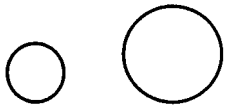
Mass, Weight, and Volume

After watching the video, discuss the following questions with a partner, or in a small group:

1. These two balls have the same volume, which means they take up the same amount of space. Do the balls have the same mass? How could you find out if your answer is right?

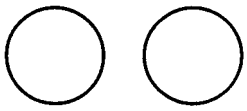


2. These two balls have different volumes. Do they have the same mass? How could you find out if your answer is right?

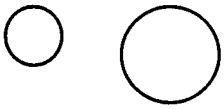


On-Site Activities and Timeline, cont'd.

3. These two balls have the same mass. Do they have the same weight? How could you find out if your answer is right?



4. These two balls have the same mass. Do they have the same weight? How could you find out if your answer is right?



5. You have two balls with the same volume, but one is made of steel and one is made of plastic. If you drop them from the same height, which ball will be traveling faster when it hits the sand? Which one would make the larger crater? Why do you think this is true?

6. Now, you have two balls with the same volume *and* the same mass. One is dropped from three times the height of the other. Which ball will be traveling faster when it hits the sand? Which one would make the larger crater? Why do you think this is true?

Make Your Own Spring Scale!

Materials:

A paper cup

A rubber band

Small objects for weighing

Instructions:

1. Make a small hole near the lip of the paper cup and slip the rubber band through the hole. Loop the rubber band through itself so that the cup hangs from it.
2. Put an object in the cup and measure how much the rubber band stretches.
3. Replace the first object with a different object and again measure the stretch. Observe what happens to the rubber band when you increase the weight.

Question:

If you took your cup scale to the Moon, would it stretch more or less than on Earth?

For Next Time

Homework Assignment

How Fast Is It Going?

1. In your journal, make a list of ways that you could determine the speed of a car as you watch it drive down the street. You may wish to divide your list into two columns labeled:

   a. Real, practical ways that should work; and

   b. Whimsical, impractical ways that would work but might be hard to do.

   Be prepared to discuss your ideas at the start of the next workshop.

2. Make a list of ways that you could stop a car that is in motion. Again, think about practical and impractical ways. Be prepared to discuss your ideas at the start of the next workshop.

The 10-Cent Experiment

Materials:

A marble

A muffin baking paper or a coffee filter

Instructions:

1. Drop the muffin paper (or filter) and the small ball side by side, from the same height.
2. Next, crumple the muffin paper into a ball and repeat the drop.

Questions:

What was the difference in the two drops?

Why?