Name _____

1

Exploring Gravity from the *Basics of Physics Series*
Pre-Test

A. Directions: Answer the following multiple choice questions by circling the best answer.

1. This scientist established the law of universal gravitation.
   a. Galileo b. Einstein c. Newton d. Edison

2. This scientist had ideas about falling objects tested on the moon by astronauts more than 400 years after his death.
   a. Galileo b. Einstein c. Newton d. Edison

3. A spring scale is used to measure the _____ of an object.
   a. mass b. length c. weight d. height

4. A balance scale is used to measure an object's resistance to motion. This measurement is called the object's _____.
   a. mass b. length c. weight d. height

5. When a massive star collapses, it may form a _____.
   a. mass b. weight c. black hole d. gravity

B. Directions: Answer the following questions with a short answer.

1. Describe how mass and weight are different.

2. Why are stars, planets, and moons round?

3. Gravity is often defined incorrectly as the pull towards the center of the Earth. What is a better definition for gravity?

4. Why do astronauts on the moon seem to bounce around so effortlessly?

5. On the moon, a feather and hammer dropped from the same height and at the same time will land at the same time. Why doesn't that happen on Earth?

Name _____

2 

Exploring Gravity from the *Basics of Physics Series* Program Quiz

Directions: At the end of the program, there is a short quiz. You can answer the questions on this sheet.

1. Gravity is often defined incorrectly in dictionaries and textbooks. How would you define gravity?

2. The terms weight and mass are often used to mean the same thing. However, they are different. Give a definition for each term.

3. Why would a feather and a hammer dropped at the same height and time on the moon land together?

4. Why would a feather and hammer dropped at the same height and time on Earth land at different times?

5. How does weightlessness affect astronauts living in space?

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Exploring Gravity from the *Basics of Physics Series*
Hammer Toss

Directions: Try this experiment to learn more about falling objects.

Purpose: To investigate the behavior of a falling object that is obviously heavier on one end than on the other.

Materials: hammer

soft surface, such as a carpet

Procedures: Part A.

1. Hold the hammer horizontally and release it above the carpeting.
2. Make observations at Observation #1 below.

Part B.

1. Flip the hammer into the air about 10 times.
2. Record how each flip lands on the carpeting. Fill in the chart in the Observations section. Record whether the hammer lands handle first, metal hammer head first, or flat.

Observations:

1. How did the hammer land? _____
2. Make recordings of the hammer landings on the following chart.

Trial	Handle First	Head First	Flat
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Conclusion: What can you tell about the way an object with uneven weight falls?

Name _____

4

Exploring Gravity from the *Basics of Physics Series*
Egg Drop Experiment

Directions: Put your thinking cap on and design a container no larger than a shoebox (no size 14 shoes, please) to protect a raw egg from a fall onto cement from a height of about 50 feet. The container doesn't have to be a shoebox, it can be smaller. Anything may be used inside the container to protect the egg. The egg may not be altered in any fashion: no nail polish or tape. It must be raw, not hard boiled. Write up your solution to this problem using the format for an experiment as shown below.

Purpose: To create a container to protect a raw egg from a dramatic fall.

Materials:

Procedures:

Observations:

Conclusions:

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Exploring Gravity from the *Basics of Physics Series*
Egg Drop Directions

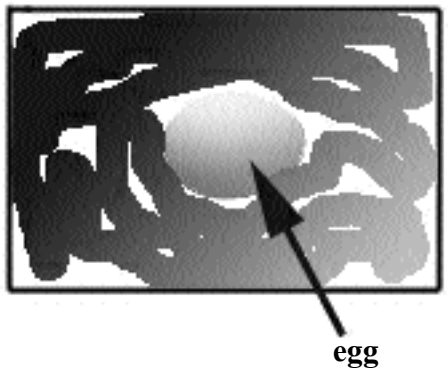
This is no yolk! You are challenged to design a container that will protect a raw egg from a fall of 50 to 60 feet onto solid cement or pavement. This is an eggcellent opportunity for you to use what you have learned about falling objects. The container may not be larger than a shoe box (no size 14 shoes, please). There must be a raw egg inside the container. You may not alter the egg in any way by boiling or applying anything to its surface. You may use whatever you want on the inside of the container to protect the egg. However, the outside of the container may only be taped. Nothing may be added to the outside of the container. No parachutes, wadded newspaper, or other cushioning devices may be added to the outside of the container.

The containers will be thrown into the air or dropped from the roof of the school onto a hard surface such as cement or pavement.

So scramble off and get the materials you will need. No poaching, I mean coaching, from home.

Write your design up as an experiment.

You will be including a cross-section drawing of your design. This kind of drawing shows how the materials used in your design are arranged inside the container. Think of it as a drawing of your container if it were cut in half.



When your container is thrown, make careful observations. Record these observations, for they may help you determine why your design worked or didn't work. Try to guess how high the container was thrown into the air and how far it fell to the cement or pavement landing area. How did it behave in the air? Did it spin or roll? How did it land? Did it flip or bounce? How many times?

Make careful observations when you bring the container inside to open it. Examine the outside of the container for obvious damage. Slowly open the container and observe how things may have shifted. How is the container different from when you originally assembled it?

Name _____

6 

Exploring Gravity from the *Basics of Physics Series*
Projectiles

Directions: Try this experiment to learn more about falling objects.

Purpose: To demonstrate the effects of velocity and gravity on projectiles.

Materials: two pencils
your hands

Procedures:
1. Hold the pencils in one hand side by side with each other.
2. With your other hand, flick one of the pencils out away from you and at the same instant, pull the hand that was holding the pencils out from under the remaining pencil so that it can fall freely.
3. Do this a number of times and record your observations.
4. Remember to flick the one pencil and release the other pencil at approximately the same time.

Observations:
1. What do you notice about the way the two pencils fall?

2. Did this happen consistently after many trials?

Conclusions: What does this show about two objects falling from the same height where one is projected outward and the other is simply dropped straight down?

Name _____

7 

Exploring Gravity from the *Basics of Physics Series*
Craters

Purpose: To examine how distance of fall affects crater size.

Materials: marble
clay
meter stick
chair

Procedure:
1. Flatten the clay into a large pancake.
2. Set the clay on the floor.
3. Use the meter stick to measure the heights for dropping the marble onto the clay.
4. After each drop, observe the size and depth of the crater made by the marble in the clay.
5. Make observations and record your results in the chart below.

Observations:

Height	Description of impact

Conclusions: What does this show about falling bodies and the height from which they are dropped?

Name _____

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Exploring Gravity from the *Basics of Physics Series*
Pendulums, Page 1

Galileo Galilei was 19 when he noticed a lamp suspended from a church ceiling swing back and forth. He was fascinated by the nature of the swings and later conducted many experiments related to pendulums.

Purpose: To discover some of the properties of pendulums. What affects the number of swings of a pendulum within a minute? Is it the height the pendulum is released? Is it the weight at the end of the pendulum? Is it the length of the pendulum?

Materials: strings of various lengths
washers or fish weights

PART A: HEIGHT OF RELEASE

Procedures:

1. Cut a piece of string of any length and attach a washer or a weight to one end.
2. Hold the other end in one hand and with your free hand pull the weighted end of the string up to be released in a pendulum swing.
3. Release the weighted end and count the number of complete swings the pendulum makes in exactly one minute. You may have to have someone else do the timing for you. Record the number of swings on the chart marked Part A on the next worksheet.
4. Repeat this procedure at least two more times but change the height at which you release the weighted end of the string.

PART B: LENGTH OF STRING

Procedures:

1. Cut pieces of string of various lengths to make pendulums.
2. Tie a washer or a weight to one end of each string.
3. One at a time, test each pendulum for the number of complete back and forth swings it makes in a minute's time.
4. Record results on the chart marked Part B.

PART C: WEIGHT AT THE END OF THE STRING

Procedures:

1. Use a single length of string for this experiment.
2. Tie a washer or weight to one end and record the number of complete swings made by the pendulum in one minute.
3. Now add another weight and count the number of swings in a minute. Record your findings on the chart marked Part C.
4. Repeat this a couple more times adding additional weight each time.

Name _____

Exploring Gravity from the *Basics of Physics Series*

Pendulums, Page 2

Observations:

Part A: Height of Release

Height of release	Number of swings in one minute
Low release	
Middle release	
High release	

Part B: Length of String

Length of string	Number of swings in one minute

Part C: Weight at End of String

Number of weights	Number of swings in one minute

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Exploring Gravity from the *Basics of Physics Series*

The Center of Gravity

The center of gravity for an object seems to be the point where all the weight of the object seems to be concentrated.

Purpose: To locate the center of gravity for objects of irregular shape.

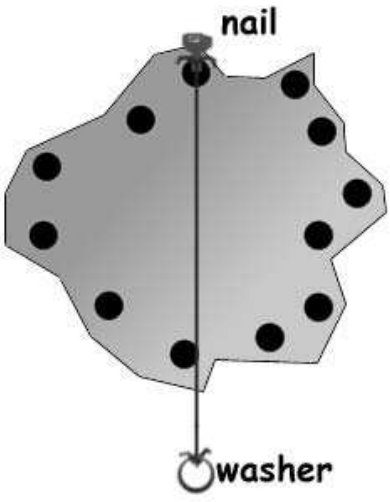
Materials:

cardboard	hole punch	scissors
washer or fish weight	string	nail sticking out from wood or wall

Procedures:

1. Use the scissors to cut the cardboard into irregular shapes.
2. Use the hole punch to make a few holes on the outside border of the cardboard. The holes should be spaced well around the cardboard. Refer to the illustration.
3. Place the cardboard on the nail so that it is hanging by one of the holes.
4. Tie the weight to one end of the string. Tie the other end of the string to the nail so that the string hangs down across the cardboard.
5. Use a pencil to mark where the string falls across the cardboard.
6. Remove the string and cardboard from the nail. Now place the cardboard on the nail again but through a different hole.
7. Repeat steps 5 through 6 until lines have been drawn on the cardboard representing each hole punch.

Observations: The lines on the cardboard will all cross each other at one point on the cardboard. This should be the center of gravity for the cardboard. To test it, balance the point where these lines crossed on the end of your finger or on the point of a pencil. What happens?



Name _____

11

Exploring Gravity from the *Basics of Physics Series*

Tides

The oceans' waters rise and fall about twice each day. This rising and falling is called tides. It is a result of the gravitational attractions of the sun and moon on our planet's water and solid ground. Ocean tides are mainly the result of the pull of the moon's gravity and they occur in a regular pattern that is based on the movement of the moon around the Earth. The drawing below may help you to see how the moon causes two low and two high tides each day.

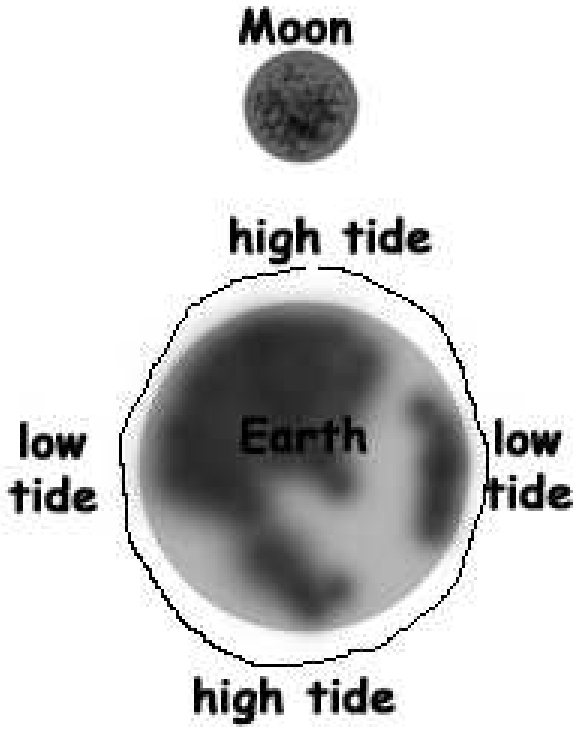
The moon's gravity pulls on the water directly below it, causing that water to bulge into a high tide.

On the opposite side of the world, the moon's gravity pulls the solid earth away from the water, causing a bulge there. This produces a high tide on that side of the world.

As the moon orbits the Earth, the high and low tide centers change. It takes a little more than six hours to change from high tide to low tide or from low tide to high tide.

There are two high and two low tides each day because the Earth is rotating or turning, bringing different parts of the oceans and surface into the influence of the moon's gravity. There is always a high tide directly below the moon and another one on the opposite side of the world.

Directions: Find out more about tides by locating information about the following topics:
spring tides, neap tides, ranges of tides, uses of tides.



Name _____

12 

Exploring Gravity from the *Basics of Physics Series*

Post-Test

Directions: Answer the following questions in the space provided.

1. Most textbooks and dictionaries define gravity as the pull towards the center of the Earth. Give a better definition.

2. Weight and mass are not the same thing. Tell how they are different by supplying a definition for each?

3. Mass is measured with a balance beam. If we mass an object on Earth and then take the object and balance beam to the moon, the mass would be the same. Why?

4. Astronauts on the moon can bounce around easily. They can jump higher than they could on Earth. Why?

5. Why are stars, planets, and moons round?

6. On the moon, a hammer and feather released at the same height and at the same time will land at the same instant. Why doesn't that happen on Earth?

7. Give a definition for the term vacuum.

8. What factors determine the amount of gravitational attraction between two objects?

9. What is a black hole?