ASSESSMENT

Student Assessment Questions/Answer Key

Answers to 2 4 9

a Momentum - mass x velocity, which remains the same after an impact

b Shock waves - in objects too stable to be moved, waves of the impact travel through them, allowing momentum to continue until friction reduces it, or the source of energy is lost

c Friction - objects, even tiny ones, rub against another as it passes, taking some of the velocity away. The more mass or velocity, the more friction needed.

d Pendulum - an object which suspends items in a plane, allowing them to swing

e Middle balls seem to be still, (though they are transferring momentum through shock waves.)

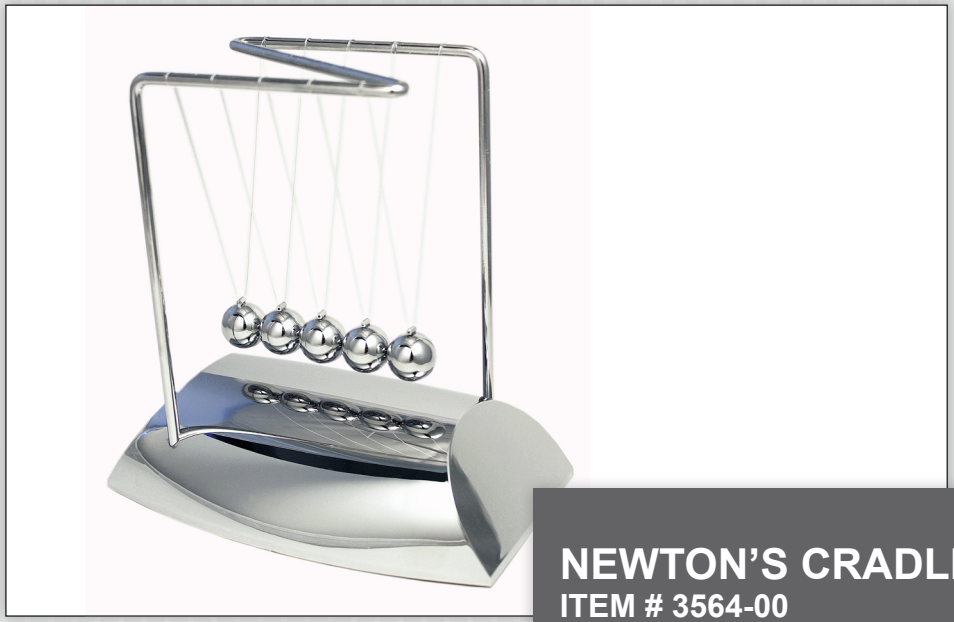
f The opposite end ball mimics the first, as the momentum traveled through to it and now it can rise and fall with seemingly the same momentum and height. (A slight difference will exist, though may not be noticeable yet, due to friction.)

g Students can try to measure, or informally describe.

h Answers will vary according to how high the first ball was dropped from.

i This should result in two balls coming off the other end.

TEACHERS GUIDE



NEWTON'S CRADLE
ITEM # 3564-00

ENERGY - MOTION

- What does the executive toy, Newton's Cradle, tell us about the physical world?

Observe the affect of momentum with this familiar desk toy. Five balls touch sides while hanging suspended from two wires, each of the same length. When one ball is pulled back and dropped, it impacts the ball next to it and magically forces the ball on the other end to bounce away from the others with the same height and speed as the first was dropped. To comprehend how this works, students must consider Newton's Laws, friction, and shock waves.

Materials

4 of each of the following:

- Newton's Cradle
- Shoe Box
- Sets of 3 large beads of various kinds (glass, wood, clay)
- balls of string of various kinds (cotton, nylon, fishing line)
- scissors.

Goals & Objectives

Students will:

- explain how 2 of Newton's Laws are demonstrated by the Cradle.
- observe the actual cradle to point out where momentum, shock waves, and friction are occurring.
- apply their observation to build their own model of a Newton's Cradle, noting how variables such as string length or ball weight causes variations in its operation.

Newton's three laws:

1. Items tend to keep doing what they are doing. If they are stopped, they stay stopped, and if they are moving, they will continue to move. (Also called the Law of Inertia.)
2. Force is Mass multiplied by acceleration. (The heavier and faster the object that hits you, the more you'll feel it.)
3. For every action, there is an equal and opposite reaction. (If you throw a stone in a pond, the stone goes in and causes ripples to go out.)

Assessment

Use: Student Handout, Model Cradle

Activities

1. List Newton's three laws on the board.
2. List the following terms on the board and have students write them on notebook paper.
   - **a. Momentum**
   - **b. Shock Waves**
   - **c. Friction**
   - **d. Pendulum**
3. Ask students to look these words up in their science text or online and create their own wording to define these.
4. Divide the class into 4 groups, and let someone from each group pick up a ball from one end and drop it. Each group should observe and informally note on their paper:
   - **e. what the middle balls do**
   - **f. what the ball on the other end does**
   - **g. how high the ball moves**
   - **h. how long the response lasts**

   Groups can do this multiple times to see if this response is reliable.
5. Now students can drop two balls at a time, and state in number 9 on their paper how the response is different.
6. Now have students, as a class, discuss their definitions of their vocabulary words, and hypothesize about where each is evident in this activity. Encourage students to see that momentum is transferred from the first ball through the middle balls as shock waves and out the last ball, which is why it moves. The pendulum set-up keeps the movement to one plane, and air friction eventually impedes the balls' movements.

Note

It is always best to DO an experiment ahead of time to be able to best present it to the class.

7. Now, back in groups, have one student from each gather equipment to make a model cradle. Students should try various beads, lengths and types of string, to eventually build a model that comes as close as possible to responding like the real Newton's Cradle.
8. Each group will present their model and discuss their choices and results.
9. **i. Each individual student should write a paragraph explaining how the Newton's Cradle works**, which should include the two of Newton's laws they saw demonstrated the most, and the vocabulary words.

STUDENT HANDOUT

Student Name: _____

a Momentum

b Shock waves

c Friction

d Pendulum

e When one ball of the Newton's Cradle is dropped, what do the middle balls do?

f What does the ball on the other end do?

g How high does the ball move?

h How long does the response last?

i Write a paragraph explaining how the Newton's Cradle works, which should include the two of Newton's laws you saw demonstrated the most, and the vocabulary words.

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