Sci 265 – Inertia in Action!

Inertia -

An object at rest remains at rest unless acted upon by an outside force.
An object in motion remains in motion at a constant speed unless acted upon by an outside force

http://paer.rutgers.edu/pt3/experiment.php?topicid=3&exptid=27

1. Watch the video of Eugenia on Rollerblades and describe how she demonstrates that "an object at rest remains at rest unless acted upon by an outside force"

2. What outside force was applied to put her body in motion?

3. Now describe how Eugenia demonstrates that an object in motion remains in motion at a constant speed.

4. Explain why she put marks on the chalk board as she went by, if you did not describe it above.

These demonstrate Newtons 1st law (listed at the top). If at rest, stay at rest unless a force is applied. She tried to move on the roller blades but could not until David came over and pushed her.

The second part shows that when she's in motion, she travels at a constant speed unless there's an outside force.

Both examples of natural motion.

☆ ***Check your answers with your instructor***

Part I - Objects at rest remain at rest

Egg Drop

Materials and Equipment: egg, glass, water, empty toilet paper roll, pie tin or light tray.

Fill the glass $\frac{3}{4}$ full of water.

Set the tray on the glass of water, stand the card board tube on the tray and balance an egg on the top of the tube.

With your writing hand, smack the edge of the pie pan horizontally. Don't swing up, and don't swing down! It's important that you hit the pie pan horizontally and use a pretty solid hit, so plan on chasing the plate and tube.

5. How does this experiment demonstrate that an object at rest remains at rest?

6. What outside force acts on the egg to put it in the glass of water?

Table cloth trick

https://www.youtube.com/watch?v=PLpav01H_60

Watch this video of the tablecloth trick. (Feel free to read the explanation here http://www.stevespanglerscience.com/lab/experiments/trick-with-tablecloth/ to help you answer the following questions.)

7. How does this experiment demonstrate that an object at rest remains at rest?

8. What outside force acts on the dishes to make them bounce around a little?

Both of these demonstrate the first part of Newton's first law. If at rest, objects stay at rest unless a force is applied. Jerking out the toilet paper roll or the table cloth apply a very small force over a very short time so the dishes and the egg don't move much to the side. They have a mass and it's hard to get them going. A tiny force for a short time, doesn't really get them going.

☆ ***Check your answers with your instructor***

Part II - Objects in Motion remain in Motion at a Constant Speed

Croquet Bowling

Materials and Equipment: Bowling ball, croquet mallet and chair

Get a feel for the ball and mallet. Attempt to start the ball moving with a tap of the mallet.

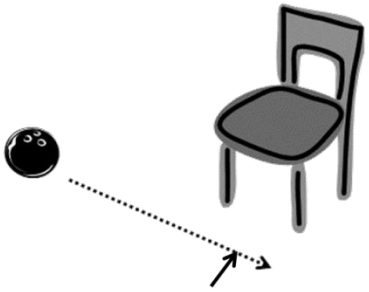
9. Does the bowling ball have more, less or an equal amount of inertia when compared to the egg?

10. How could you experimentally demonstrate this to someone?

Use the croquet mallet to tap the egg, it rolls across the floor. Use the same mallet with the same gentle tap on the bowling ball and it will barely move. It has more inertia because it's more massive.

Intergroup competition.

The chair legs are the goal. Each person gets **ONE roll and then passes the mallet** for a total of 5 rounds – who can make the most goals?



NO practice runs!

The bowling ball will be rolled by a group member who's not currently the shooter. The roll must be slow and perpendicular to the goal as shown.

The shooter uses the croquet mallet to *accelerate* the bowling ball in the correct direction to score a goal. No pushing but multiple taps are allowed.

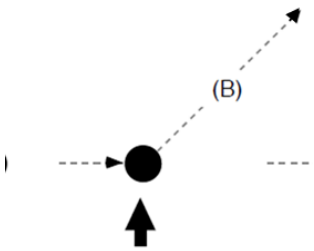
WARNING: It is possible to shatter the croquet mallet if you hit the ball too hard – be careful!

11. Describe your final technique for scoring.

12. Now describe your first try and why it did or did not work.

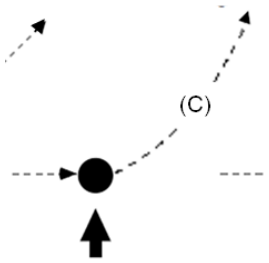
Motion Diagrams or trajectories:

13. Draw a motion diagram of a bowling ball's path if it is traveling in a straight line as shown and then a person taps it once firmly with a mallet at an angle of 90 degrees to the balls motion as shown by the arrow.



14. Draw a motion diagram of a bowling ball's path if it is traveling in a straight line as shown and then a person taps it multiple times a fraction of a second apart firmly with a mallet in the direction shown by the arrow.

15. Draw a motion diagram of a bowling ball's path if it is traveling in a straight line as shown and then a person pushes the ball continuously with a mallet in the direction shown by the arrow.



☆ ***Check your motion diagrams with your instructor***

16. **Question**: Joe is talking to his roommate who's in physics and he asks: "*Why is it that a heavier object falls with the same acceleration, -9.8 m/s^2, as a lighter object if the heavier object has more inertia? If an object has more inertia, it's harder to get it to move, the same force will give it less acceleration. Isn't that what we just learned?*" What is Joe missing?

Weight is greater for a more massive object – therefor pulled harder
Inertial is greater for a more massive object – therefor harder to get moving
They both depend on mass so they balance perfectly and every object falls at the same rate.

Individual forces add:

You just discovered that when you hit the bowling ball firmly but gently, lots of taps would make the ball turn when one tap just didn't do much. This happens because lots of small forces can add up to one big force.

Phone Book Friction

Materials and Equipment: Two thick phone books

Carefully interleave the pages of the two phone books. Have two group members each pull on a phone book.

17. How hard is it to pull them apart?

18. Use the idea of lots of small forces add to explain what is happening. What is the force in action here?

Lots of small forces add up to one big force. Like tapping the bowling ball multiple times, works out the same as pushing it with on big force.

Fun with rotation!!

Objects in motion remain in motion at constant speed and IN A STRAIGHT LINE

You just discovered with the bowling and saw Eugenia demonstrate that an object in motion remains in motion and IN A STRAIGHT LINE.

Centripetal Force Penny

Materials and Equipment: Wire hanger, a penny and finesse

Verify: Watch this Sick Science video. Determine if it's possible to balance a penny on the hook of a hanger as you swing it in a circle.

19. Draw a diagram of the forces on the penny at a few different key points in the circle and explain why the penny remains at each point or flies off.

☆ ***Since this takes patience and practice you'll earn 10 extra credit points if you can demonstrate this to your instructor.***

Bucket Swing

Materials and Equipment: Bucket, water, courage

Do you trust physics?

Take the bucket of water out in the hall and swing it around in a circle over your head. What do you have to do to make sure the water stays in the bucket and does not end up on your head?

Warning: A very tall person may hit the ceiling with the bucket so check this before swinging!

20. Draw a diagram of the forces on the water at a few different key points in the circle and explain why the water remains at each point or spills.

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