

# Newton's First Law: The Law of Inertia

## Safety Precautions

- This activity should be done on the floor.

## Vocabulary

- force - something that changes the motion of an object
- gravity - the force that attracts a body toward the center of the Earth
- inertia - a property of matter by which it continues to stay at rest or in uniform motion in a straight line, unless that state is changed by an external force

## Materials and Equipment

- plastic cup
- index card
- 11 quarters
- empty plastic water bottle
- wooden loop
- penny

## Questions (review the Experiment, below)

1. In Activity 1, why does the quarter fall into the plastic cup?
2. Compare Activity 1 and Activity 2. Why is it more difficult to replace the bottom quarter with the flicked quarter, than it is to get the quarter to fall into the cup?
3. Compare Activity 2 and Activity 3. Is it more difficult to replace the bottom quarter in the stack of 5 quarters, or the stack of 10 quarters? Why? Which has more mass and more inertia?
4. In Activity 4, why is it difficult to get the penny to fall into the empty plastic bottle?

## Research

Isaac Newton was born in 1642 and died in 1726. He was a very famous physicist, and derived Newton's Three Laws of Motion, and Newton's Law of Gravity, all of which we still use today. In this lab, you will investigate Newton's First Law of Motion, also called the Law of Inertia, which states that an object at rest will remain at rest unless acted on by a force, and an object in motion continues in motion with the same speed and in the same direction unless acted upon by a force. This means that objects that are not moving will stay where they are unless they are pushed or pulled by you, gravity, or some other force. Objects that are moving will keep moving unless they are slowed down by friction, or stopped by you, or some other force. If two objects have the same speed, but different masses, the object with higher mass has higher inertia.

## Hypothesis

What is your hypothesis? Be sure to include your "best guess" answers to the 4 questions above.

- 1.
- 2.
- 3.
- 4.



## **Experiment**

1. You will need a partner.
2. There are 4 different activities. Be sure that you count the number of times required to successfully complete each activity and record in the table on the next page.
3. Activity 1, Quarter Drop: Cover the top of a small cup with an index card and place a quarter on it.
4. Without touching the quarter or the cup, and using only horizontal motion, push or pull only the index card to get the quarter in the cup.
5. Practice this a few times if necessary until you and your partner can get the quarter to fall into the plastic cup.
6. Activity 2, 5 Quarter Flick: Stack 5 quarters on the floor.
7. Get another quarter and place it several centimeters from the stack of quarters on the floor.
8. Flick the quarter with your fingers, trying to replace the bottom quarter in the stack on the floor with the flicked quarter, without the stack of 5 quarters falling over.
9. Practice this several times until you and your partner can replace the bottom quarter in the stack with the quarter that you flicked with your fingers.
10. Activity 3, 10 Quarter Flick: Now add 5 more quarters to the stack and try flicking the quarter again to replace the quarter in the larger stack, without the stack of 10 quarters falling over.
11. Practice this several times until you and your partner can replace the bottom quarter in the larger stack with the quarter that you flicked with your fingers.
12. Activity 4, Penny Drop: Remove the lid from the empty plastic bottle.
13. Balance the wooden loop vertically on top of the opening of the plastic bottle.
14. Place a penny on the top of the balanced wooden loop.
15. Hold the bottom of the plastic bottle so that it doesn't move.
16. Push or pull the wooden loop to get the penny to fall into the plastic bottle.
17. Practice this several times until you and your partner can get the penny to fall into the bottle.

## **Data and Observations**

Activity	Number of trials
1 Quarter Drop	
2 5 Quarter Flick	
3 10 Quarter Flick	
4 Penny Drop	

## **Analysis**

1. In Activity 1, why did the quarter fall into the plastic cup instead of staying on the index card?
2. Comparing Activity 1 and Activity 2, which was more difficult? Explain why.
3. Comparing Activity 2 and Activity 3, which was more difficult? Why?
4. Activity 4 was probably the most difficult. Explain why.



## Conclusions

In Activity 1, Quarter Drop, the quarter is not moving on the index card. When you remove the index card, the only force acting on the quarter is gravity, so the quarter falls into the cup. In Activity 2, 5 Quarter Flick, the stack of 5 quarters is not moving, so it shouldn't move when you try to remove the bottom quarter by flicking another quarter to take its place, but it may fall over if you merely bump it. This is also true for Activity 3, 10 Quarter Flick, but the stack of 10 quarters has higher mass and higher inertia than the stack of 5 quarters, so the stack of 10 quarters is more likely to stay in a stack rather than falling over. Activity 4, Penny Drop, is probably the most difficult because you need to remove the wooden hoop quickly without disturbing the penny. The opening in the bottle is much smaller than the opening of the plastic cup, so the penny also needs to be placed exactly above the bottle opening.



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