



LAB 11

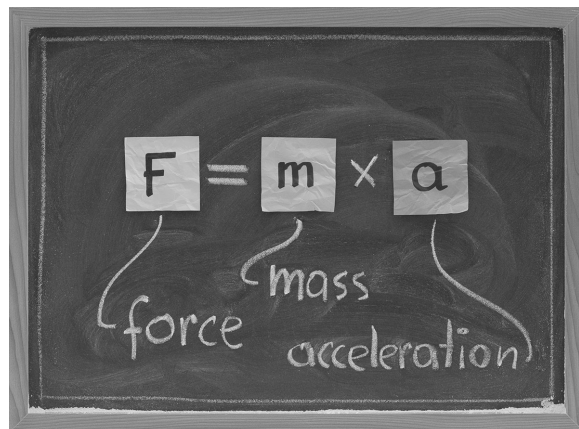
Newton's Laws of Motion

Objective:

Investigate Newton's three laws of motion.

Materials:

- Small toy car and wood block
- Flat board, cardboard, or book (to create an incline)
- Marble or small ball
- Balloon (uninflated)
- Straw (1)
- Tape
- String (about 1 meter)
- Small cup or lightweight container
- Paper and pencil for observations
- Ruler or measuring tape
- Timer or clock
- Coins, washers or fishing weights



Concept: Newton's Laws of Motion

Newton's Laws of Motion describe how forces affect the movement of objects and can easily be observed in everyday life. These three laws explain everything from a rolling ball to a rocket launch.

- The first law of motion, also called the law of inertia. An object at rest stays at rest, and an object in motion stays in motion with constant velocity, unless acted upon by a net external force.
- The second law of motion, also called the law of acceleration. The acceleration of an object depends on the net force acting on the object and on the object's mass. The mathematical equation that describes this relationship is Force = Mass $\times$ Acceleration ($F = ma$).
 - Force (F): Measured in newtons (N). $1 \text{ N} = 1 \text{ kg}\cdot\text{m/s}^2$.
 - Mass (m): Measured in kilograms (kg).
 - Acceleration (a): Measured in meters per second squared (m/s^2).
- The third law of motion, also called the law of action and reaction. For every action, there is an equal and opposite reaction.

Investigating the First Law (Inertia)

- Place the toy car on a flat, smooth surface (e.g., table).

1. After placing the car on the table, why doesn't it move? _____

- Gently push the car to set it in motion. Observe how it slows and stops.

2. If the first law of motion says an object in motion will stay in motion, why did the car not keep traveling forever after you pushed it? _____

- Place the block at rest on the table. Try to move it without touching it (e.g., blow air on it).

3. The first law of motion says that an object at rest will stay at rest unless acted upon by an external force. So, why didn't the block move when you blew on it? _____

- Balance a marble on the car.
- Push the car so that it rolls but the marble stays on the car.
- Without touching the marble, quickly stop the car while it's in motion.

4. What happens to the marble and why? _____

Investigating the Second Law (Acceleration)

- Here, we will use the distance the car travels to represent how much acceleration the car experienced down the ramp. The more acceleration, the farther the car will roll across the table.
- Create an incline by propping a flat board or book at a low angle (15–20 degrees) on a table.
- You will perform three trials each of releasing an unweighted and weighted car down the incline.

- Pay particular attention to the time it takes each car to “get moving” down the incline. This is something that you could measure with a stopwatch, but it is probably just as effective to especially note which car—unweighted or weighted—begins to move “sooner/faster” when you initially let it go. The car that moves faster has less inertia.
- Be sure not to push the car when you release it. Just gently lift your finger straight up off the car.

- Release the toy car from the top of the incline.
- Use a ruler to measure how far it travels on the table.
 - Distance traveled: _____
- Repeat two more times.
 - Distance traveled: _____
 - Distance traveled: _____
 - Average the three distances: _____
- Tape a weight (e.g., 6–10 coins) to the car and repeat the three trials from the same height on the incline.
 - Distance traveled: _____
 - Distance traveled: _____
 - Distance traveled: _____
 - Average distance: _____

5. Which car, weighted or unweighted, began to move sooner/faster upon releasing it down the incline, and why? (Remember, that even though we are testing acceleration, we know that $F=ma$, so the mass of the car influences the effect of gravity’s acceleration of the car. The more mass the car has, the less the effect of gravity’s acceleration on it).

6. In which trial, weighted or unweighted, did the car travel the farthest? _____

7. What factors affect the distance the cars traveled? _____

Investigating the Third Law (Action-Reaction)

- You might need a little assistance from another person for this!
- Thread a string through the straw and stretch the string tight between two fixed points (e.g., two chairs).
- Inflate a balloon with a good amount of air, but don't tie it. Just keep it pinched with your fingers.
- Tape the straw to the top of the balloon so that the straw is in-line with the long axis of the balloon (an open end of the straw is pointing the same way as the opening of the balloon).
- While still pinching the balloon, move it to the end of the string that is closest to the balloon's opening.
- Release the balloon.

8. Why does the balloon move? _____
