

PHYSICAL SCIENCE

FORCE



Motion, Work, Gravity, Magnetism

FORCE: Motion

A force is necessary to make things move.

PRIMARY

Guide children toward discoveries about how things move:

- A force is needed to start, stop, or change the direction of motion of an object.
- A force can be a push or pull on an object.
- Different kinds of force can be used:
 - ↓ Muscles (of animals and of humans)
 - ↓ Moving air
 - ↓ Moving water
- It takes more force to move heavy things than light things.
- It takes less force to move an object if wheels are used.
(*Compare using muscles to push or pull an object first without, then with, wheels.*)

INTERMEDIATE - JUNIOR HIGH

Use experiences and experiments to teach these concepts:

- Newton's Laws of Motion:
 1. Anything at rest (not in motion) will stay at rest unless a force is applied (to make it move.) This is called INERTIA
 - ♥ When one object touches another to move it, **direct force** has been applied.
- Gravity is an **indirect force** that moves an object.

2. Anything in motion will stay in motion (forever) in a straight line with unchanging speed unless a force changes its motion.
 - ♥ Change in motion is the result of energy applied to produce an unbalanced force.
 - ♥ If all forces on an object are balanced, there will not be a change in motion.
- Force can be applied in one of two ways: pushing or pulling (Lifting is either pushing up or pulling up).
- When force is applied to an object (a mass), it accelerates.
- Pressure (a pushing force) equals force divided by area.
- Force can be measured. (Use a scale with newtons as units.)
- Different kinds of force can be used to make things move:
 - ↓ Electricity (See "Energy.")
 - ↓ Magnetism (See "Magnetism.")
 - ↓ Moving water
 - ↓ Muscles (humans, animals)
 - ↓ Springs
 - ↓ Wind (moving air)
- Forces can be combined.
- Define friction.
 - ♥ Describe its usefulness. (*There is little or no friction in outer space.*)
 - ♥ Discover how friction affects the force needed to move an object. (*More force is needed.*)

HIGH SCHOOL

The concepts above continue to be studied while investigating forces of gravity, work, magnetism, and energy. Exercises should include measuring and calculating.

- Students should understand Newton's three Laws of Motion:
 1. The **Law of Inertia** explains why a force is needed. If an object is at rest it remains at rest. If an object is in motion it remains in motion, moving in a straight line and at a constant speed UNLESS acted upon by unbalanced forces.
 - ♥ Friction must be overcome for an object to slide over another object.
 - ♥ Gravity must be overcome for an object to be lifted.

2. The second law explains why things speed up or slow down:
- ♥ The force acting on an object, the object's mass, and the change in speed that results are related.
 - ♥ Applying a small force to an object of large mass makes a small change in speed.
 - ♥ Applying a great force to an object of small mass makes a great change in speed.
 - ♥ The force can push or pull in the same direction, increasing speed.
 - ♥ The force can push or pull in the opposite direction, decreasing speed.
3. Action equals Reaction.
For every action force there is an equal and opposite reaction force.
- ♥ When one object causes a force to act on a second object, that second object causes an equal force to act on the first object, but in the opposite direction.

FORCE: Gravity

INTERMEDIATE - JUNIOR HIGH

- Identify the law of gravity and understand gravity as a force.
The force of gravity is a pull. Large objects attract (pull toward themselves) smaller objects.
- Define centrifugal force.
 - ♥ Explain how it and gravity keep the moon in an orbit around the earth.

JUNIOR HIGH - HIGH SCHOOL

- Explain why objects fall using Newton's idea of gravitational attraction.
- Explain the acceleration of falling objects.
- Define terminal speed.
- Define mass and weight in terms of gravitational attraction and explain the difference between the two.
- Calculate using the formula: $\text{Density} = \text{Mass} \div \text{Volume}$