Newton’s Laws of Motion

Objectives

- **Describe** Newton ’s first law of motion, and explain how it relates to objects at rest and objects in motion.
- Describe Newton’s second law of motion, and explain the relationship between force, mass, and acceleration.
- State Newton’s third law of motion, and give examples of force pairs.

I. Newton's First Law of Motion

A. Part 1: Objects at Rest Objects at rest will stay at rest unless they are acted on by an unbalanced force.

Newton's First Law of Motion

B. Part 2: Objects in Motion Objects will continue to move forever with the same velocity unless an unbalanced force acts on them.

C. Friction and Newton's First Law Friction is an example of an unbalanced force that stops motion.

Critical Thinking Time

If you are sitting still in your seat on a bus that is traveling 100 km/h on a highway, is your body at rest or in motion? Explain your answer. Use a diagram if it will help make your answer clear.

Newton’s First Law of Motion

D. Inertia and Newton’s First Law Newton’s first law of motion is sometimes called the *law of inertia*. Inertia is the tendency of all objects to resist any change in motion.

E. **Mass and Inertia** Mass is a measure of inertia. An object that has a small mass has less inertia than an object that has a large mass.

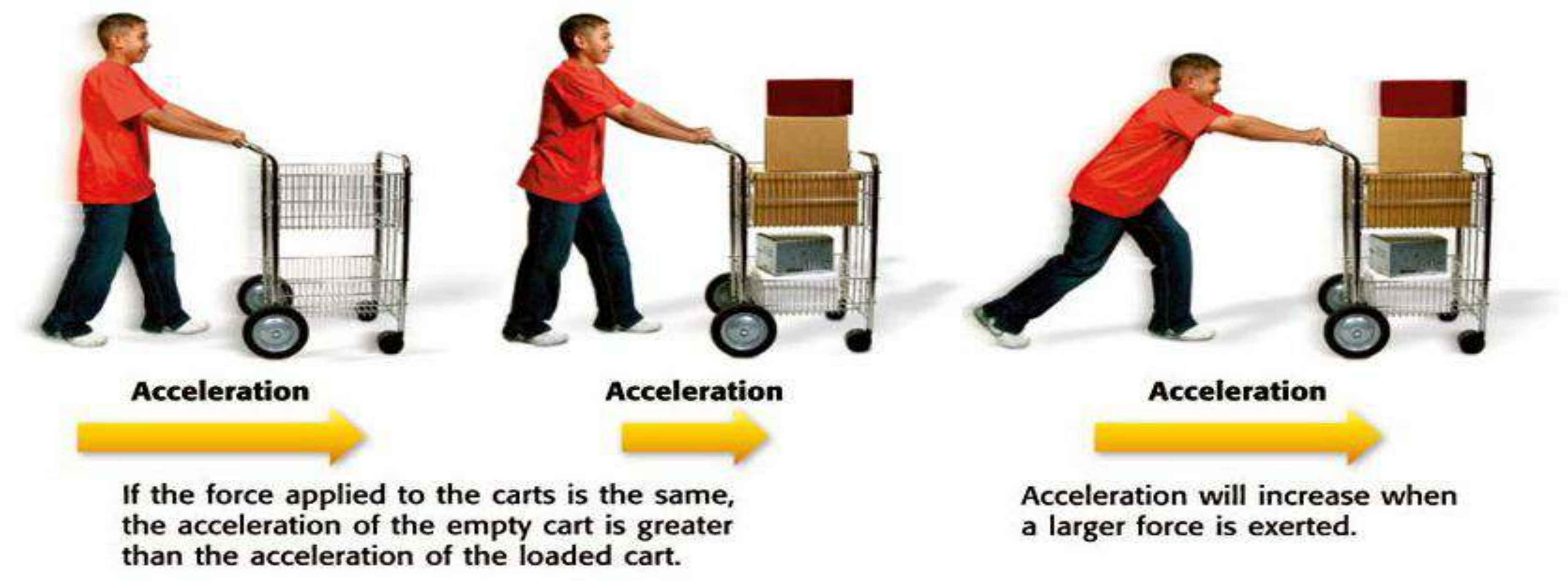
II. Newton’s Second Law of Motion

A. Part 1: Acceleration Depends on Mass

The acceleration of an object decreases as its mass increases. Its acceleration increases as its mass decreases.

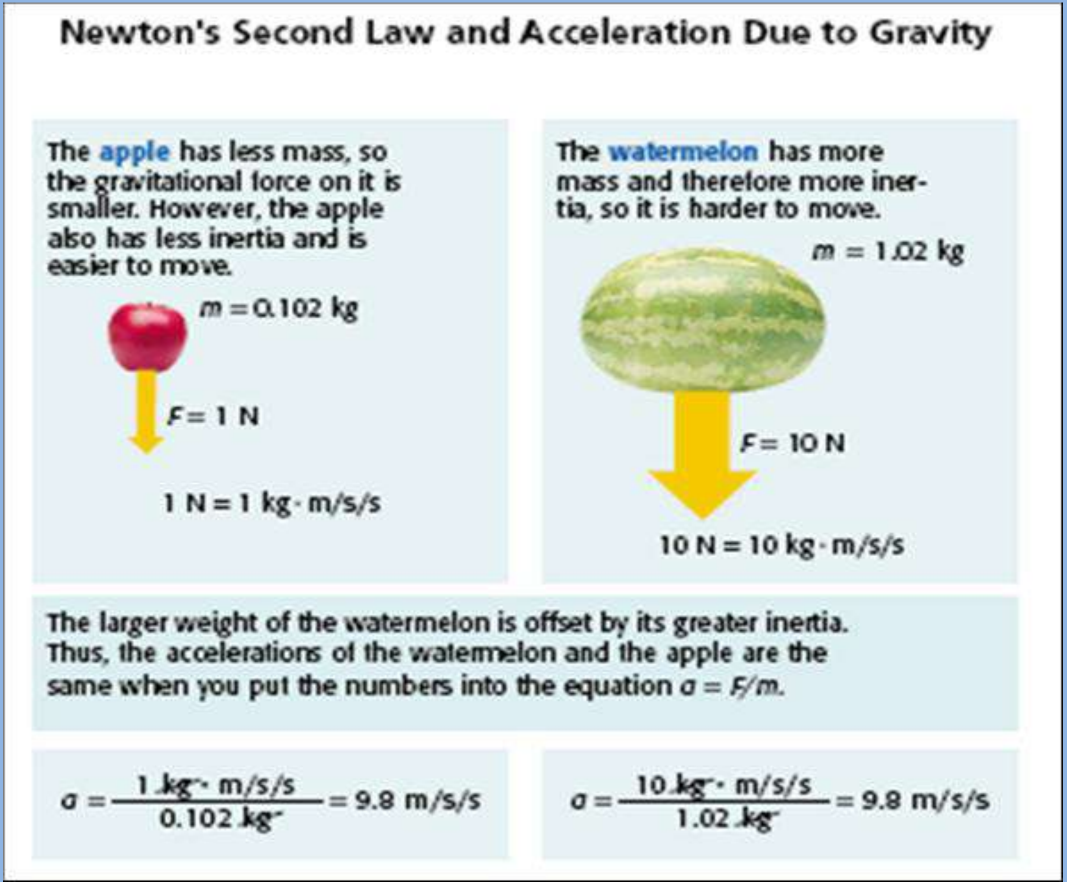
II. Newton's Second Law of Motion

B. Part 2: Acceleration Depends on Force The acceleration of an object is always in the same direction as the force applied. The cart shown on the next slide moved forward because the push was in the forward direction.



II. Newton's Second Law of Motion

C. Expressing Newton's Second Law Mathematically Acceleration equals force divided by mass.



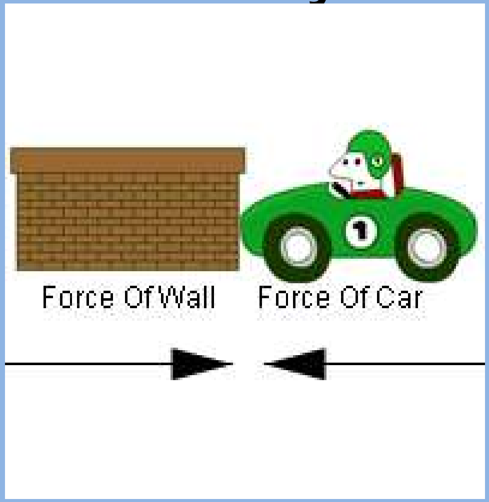
III. Newton’s Third Law of Motion

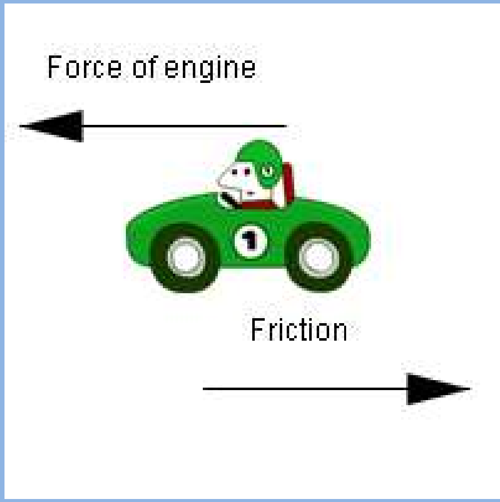
A. Force Pairs Do Not Act on the Same Object A force is always exerted by one object on another object. This rule is true for action and reaction forces. However, action and reaction forces in a pair do not act on the same object.

Squid

III. Newton's Third Law of Motion

B. All Forces Act in Pairs—Action and Reaction Newton's third law says that all forces act in pairs.





C. **The Effect of a Reaction Can Be Difficult to See** The force of gravity pulling the Earth toward objects is an example.