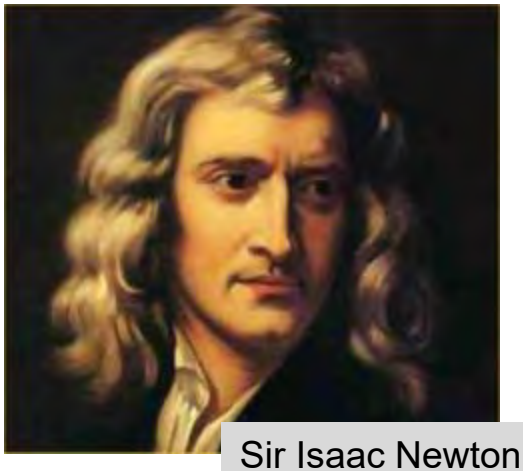
Law of Acceleration Part 1

Newton's Laws of Forces

Newton established three basic laws to explain how motion is caused by forces:



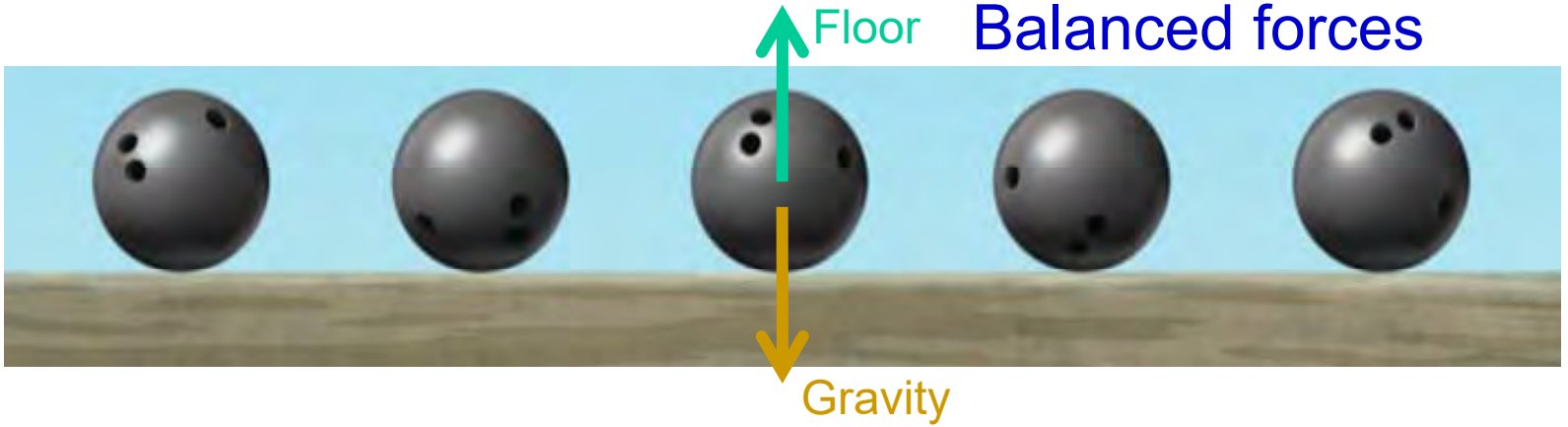
Sir Isaac Newton

- Law of Inertia
- **Law of Acceleration**
- Action-Reaction Principle

The Law of Inertia explains motion without forces (or with only balanced forces).
The Law of Acceleration explains motion *with* unbalanced forces.

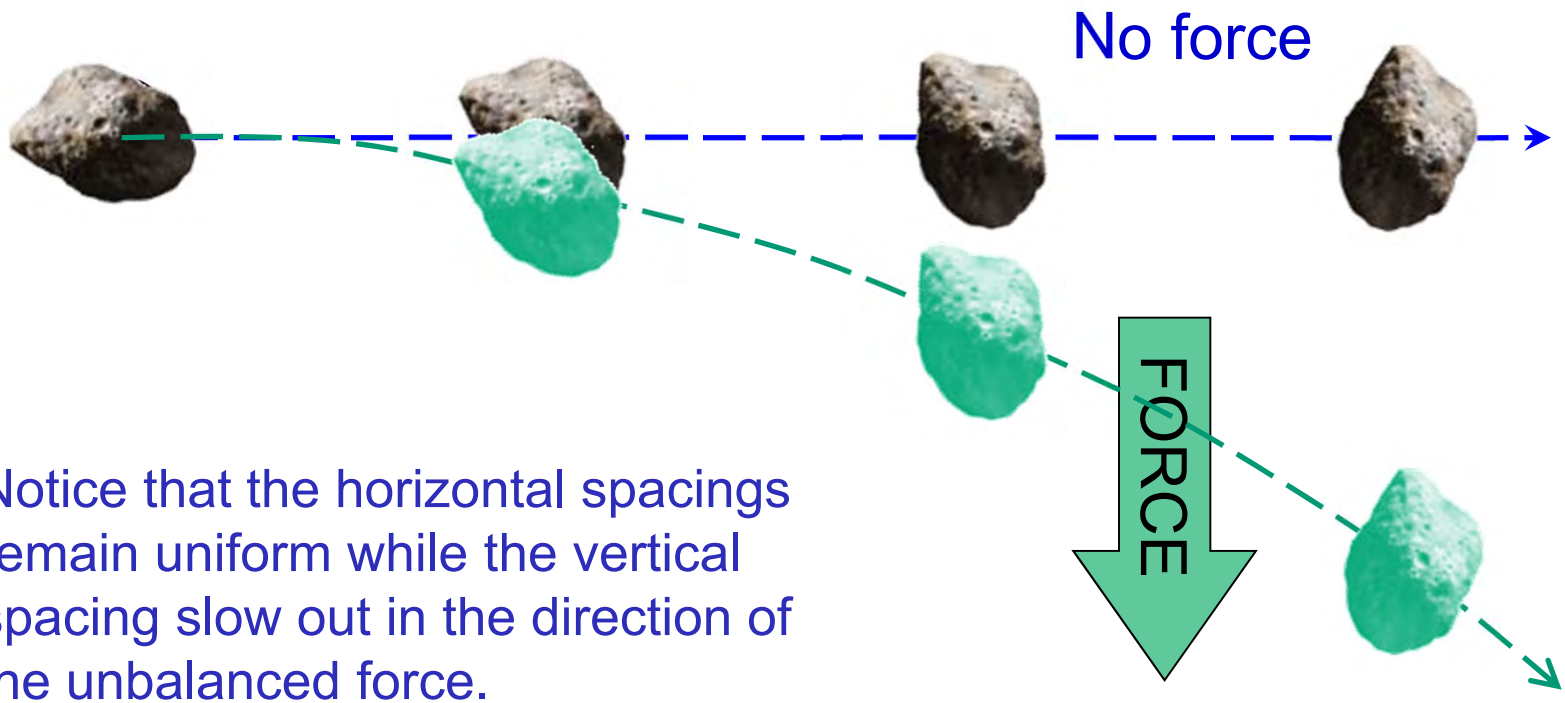
Motion, with & without Forces

When there are no forces (or when forces are balanced), an object moves with constant, uniform motion.



Law of Acceleration, Part 1

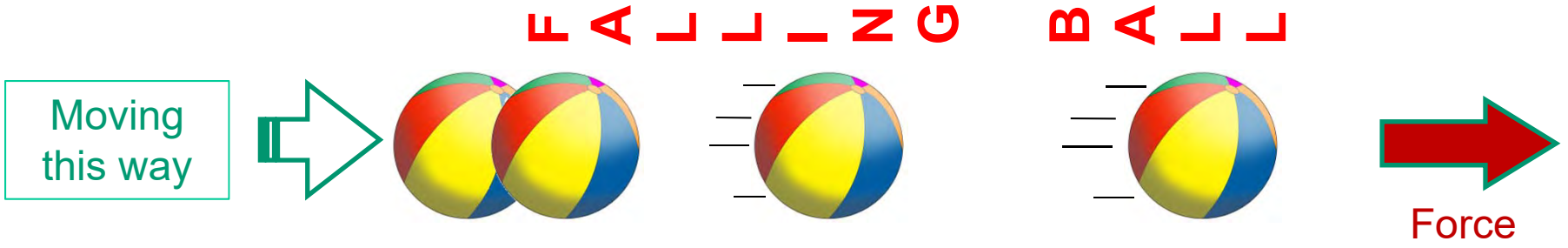
Objects always <u>change</u> their velocity in the direction of the unbalanced force.



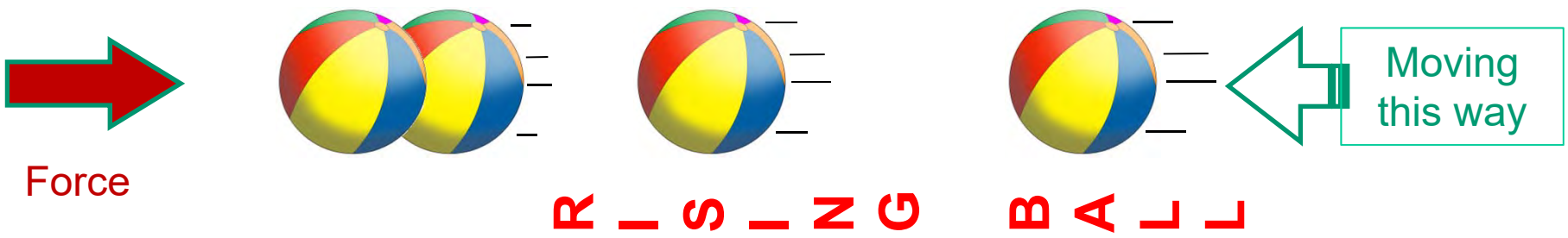
Notice that the horizontal spacings remain uniform while the vertical spacing slow out in the direction of the unbalanced force.

Forces & Slowing In/Out

When a force pulls in the direction that an object is already moving, the object slows out (accelerates)



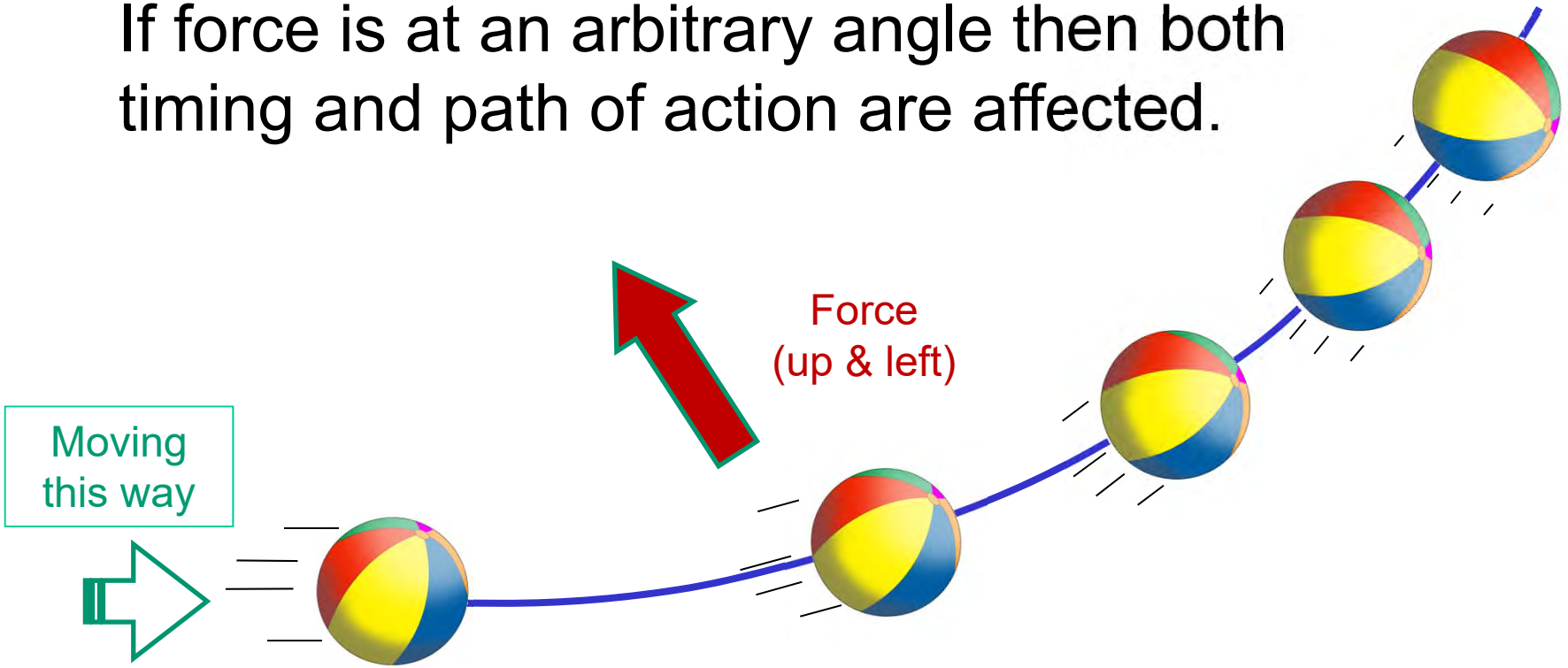
If a force pushes **opposite** to the direction of motion then the object slows in (decelerates)



Forces & Path of Action

When a force is perpendicular to the path of action then it deflects the motion into an arc.

If force is at an arbitrary angle then both timing and path of action are affected.

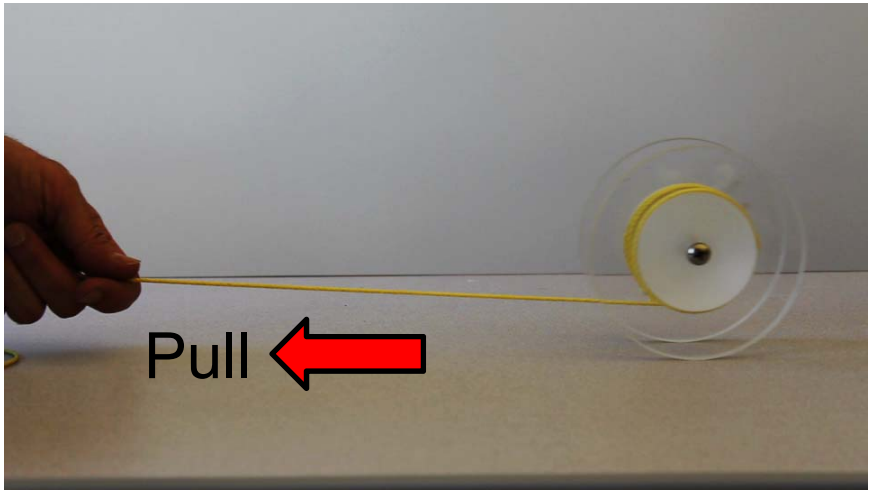


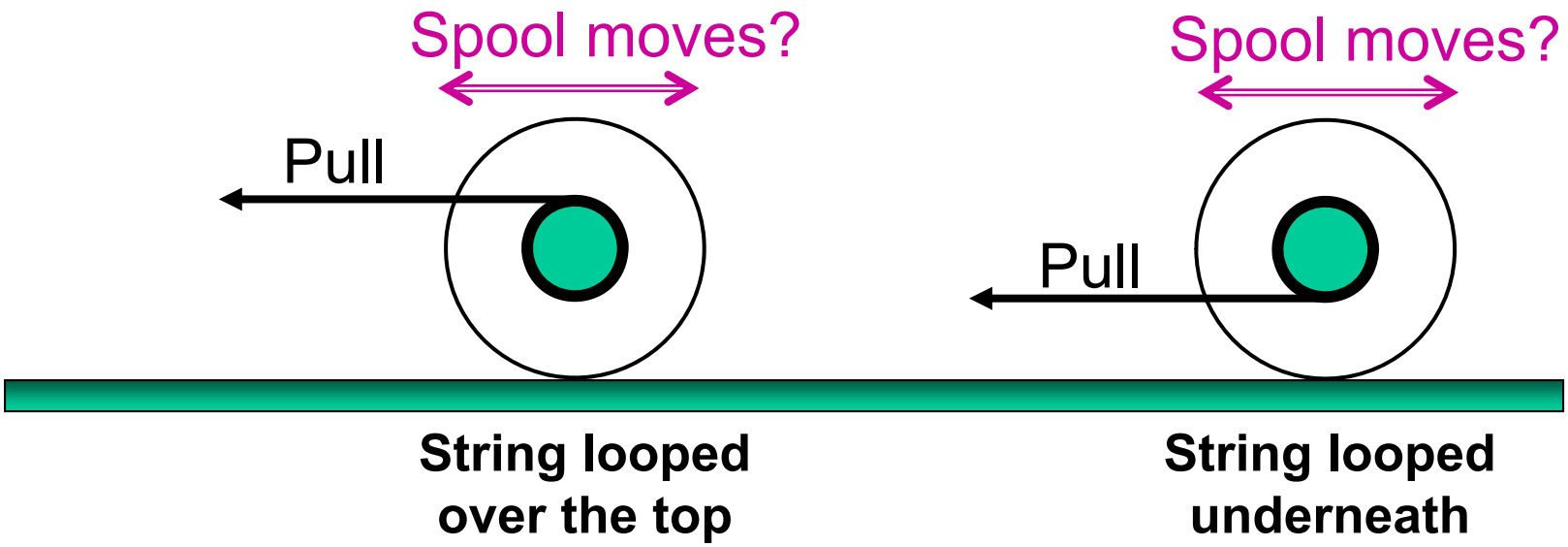
Pulling a Spool

Pull on string wrapped around a spool.

Force is to the right-to-left.

In what direction does the spool move?

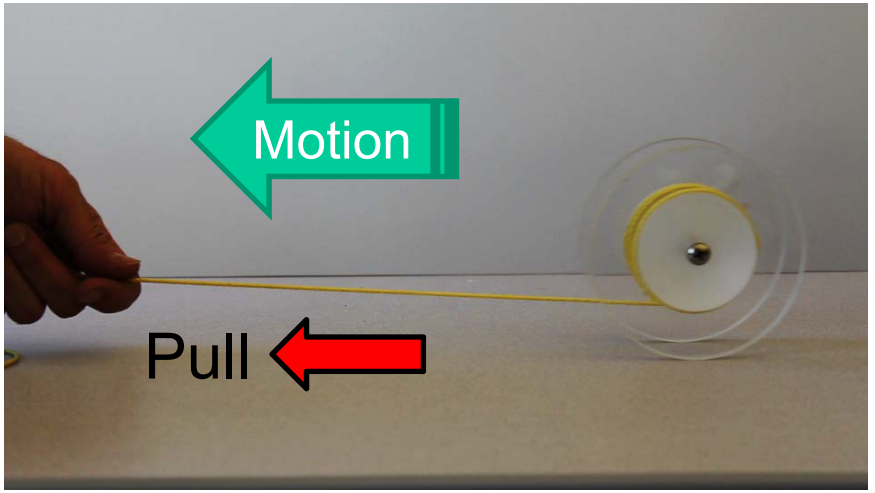


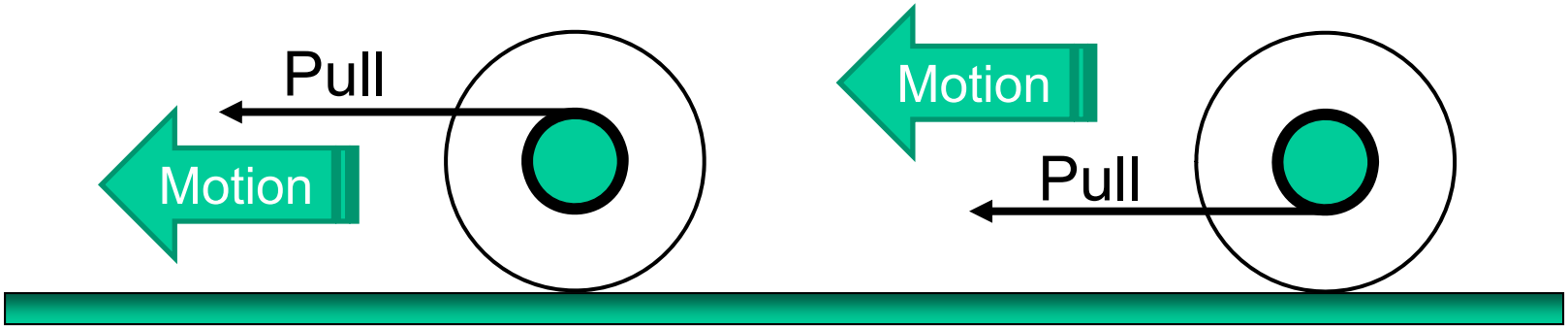


Pulling a Spool

Force and Direction

Objects always change their velocity in the direction of the applied force.

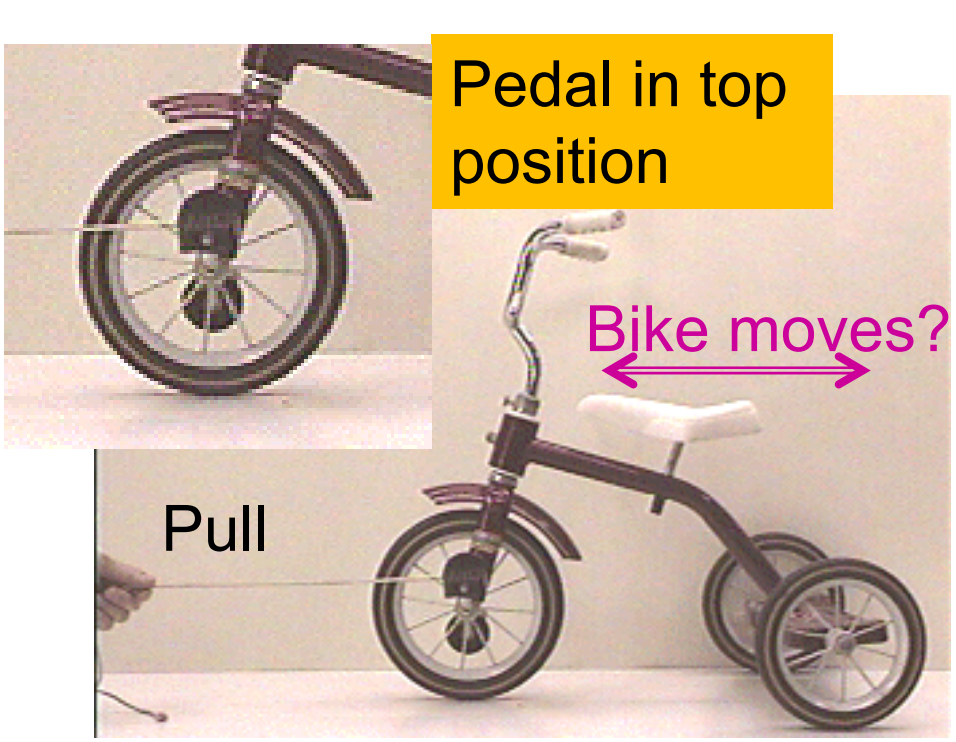


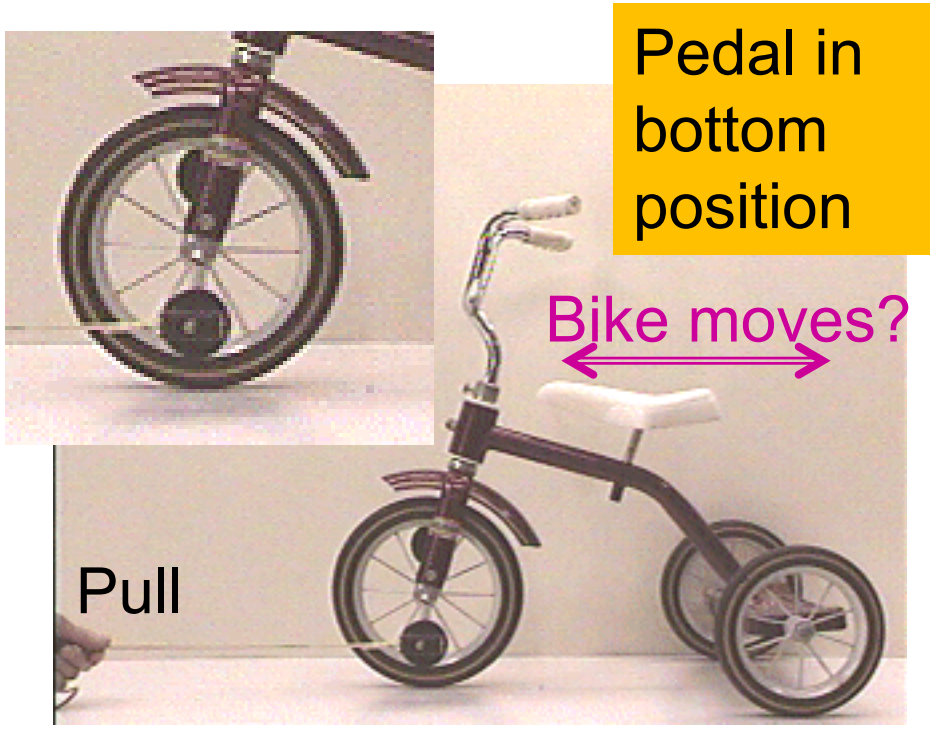


Pulling a Tricycle

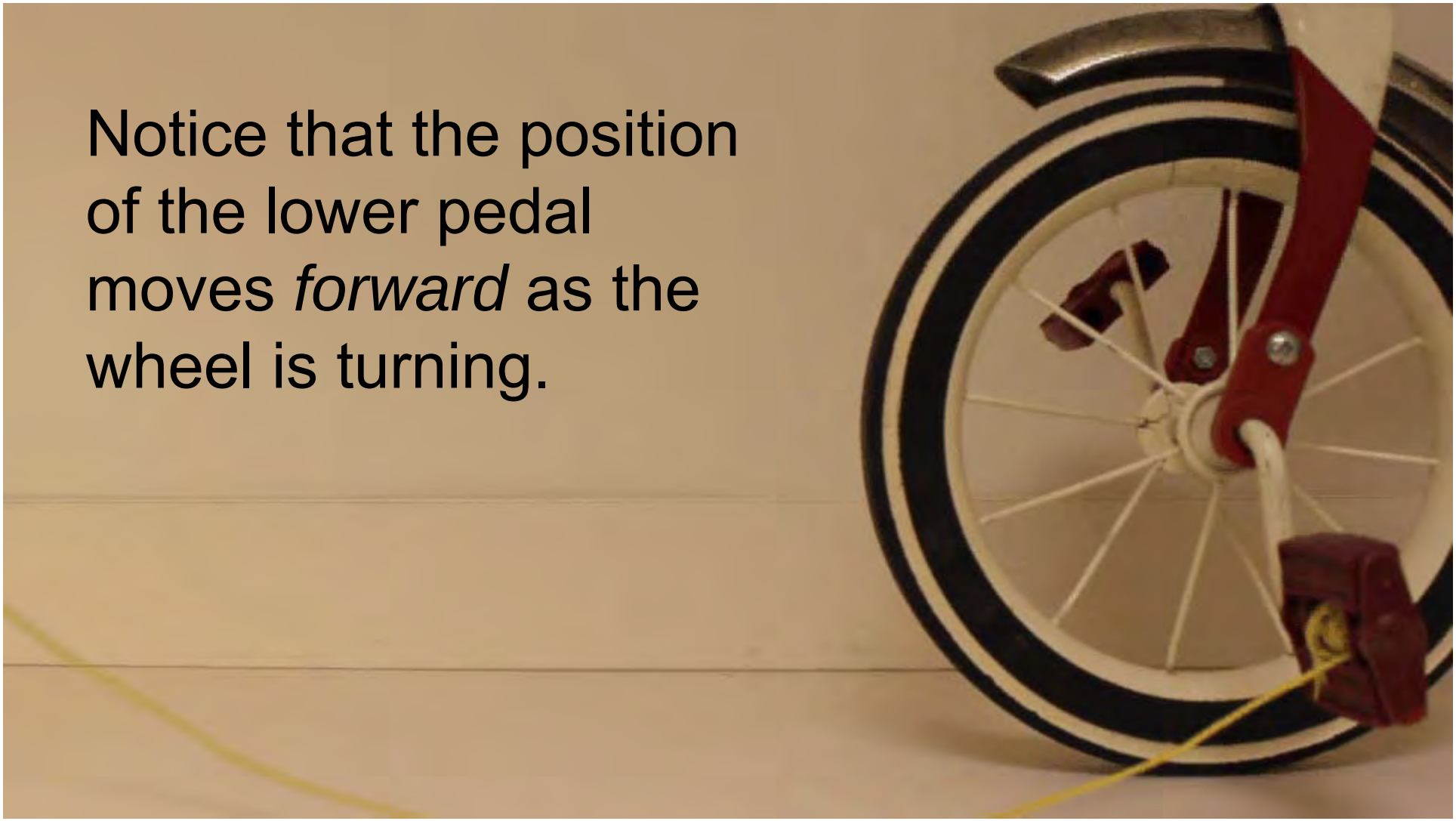
Pull on tricycle pedal with a string.

Which direction does the tricycle move?



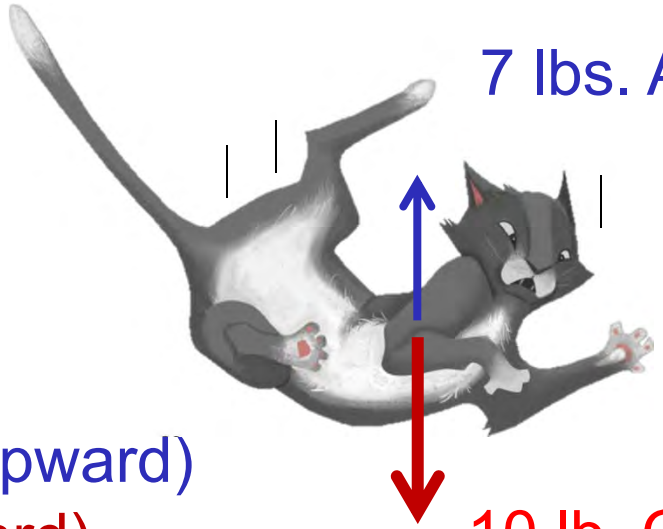


Pulling a Tricycle



Net Force (or Total Force)

When there are two or more unbalanced forces we need to add them up to find the **net force** (also called the total force).



Net force is sum of:
Air resistance force (upward)
Gravity force (downward)

Net Force & Acceleration

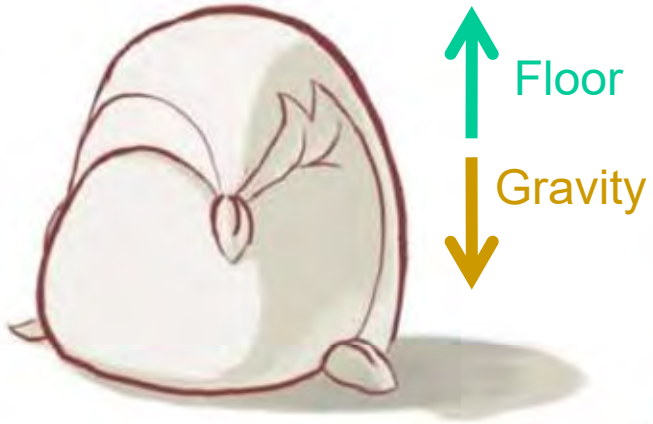
The Law of Acceleration tells us that the motion *only* depends on the net force, not on the individual forces.

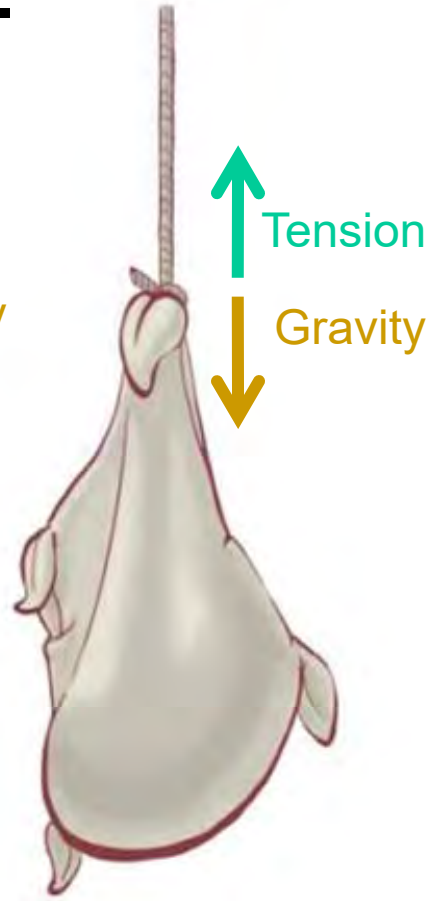
Only the total force on the boat matters, not each separate force by these guys pushing it.

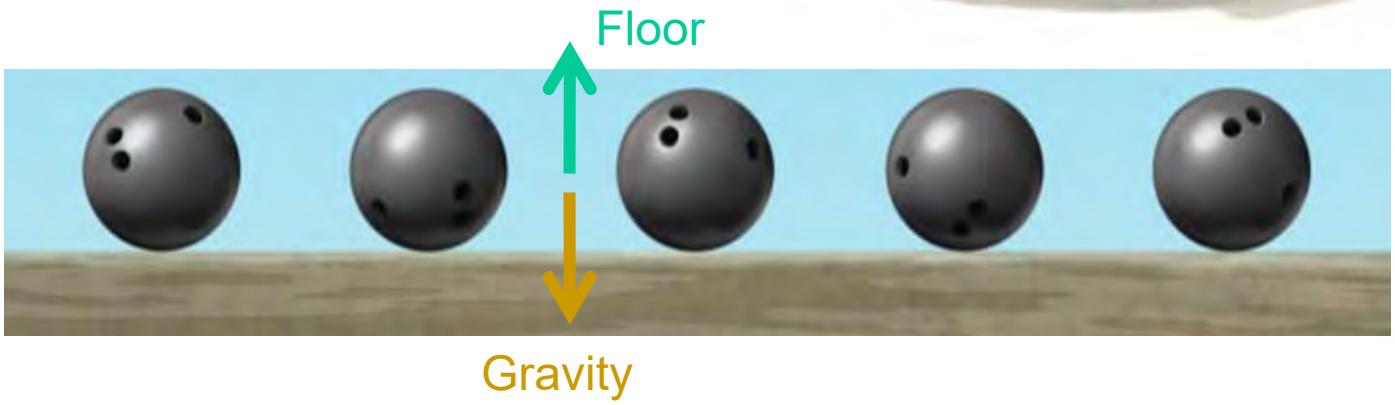
Balanced Forces

Having balanced forces is the same as saying that the net force is zero.

Remember:
Balanced forces does not mean that there's no motion!







Summary

- The Law of Acceleration explains the link between forces and motion; it is also known as Newton's Second Law of Motion.
- The first part of the Law of Acceleration says that objects always change their velocity in the direction of the unbalanced force.
- With multiple forces we need to add up the forces to find the net force (or total force).
- The acceleration only depends on the net force, not on each individual force.