READING MATERIAL

Read About Forces

DEFINITION OF FORCE

A *force* is a push or pull. Sometimes forces cause objects to move, and sometimes forces slow, stop, or change the direction of an object's motion. Gravity is an example of a force that pulls all objects toward the center of the Earth. When you jump on a trampoline, gravity constantly pulls you down.

To better understand how balanced and unbalanced forces work...

LET'S BREAK IT DOWN!

Forces are all around us!

Forces are needed to lift, turn, move, open, close, push, pull, and so on. When you throw a ball, you are using force to make the ball move through the air.

More than one force can act on an object at the same time. Think about all the different forces you need to ride your bike. Your feet push on the pedals, your hands push and pull the handlebars, and the muscles in your body help you stay balanced. The tires are pushing against the pavement, while the pavement is pushing back on them. Wow, that's a lot of forces!

A force has strength and direction.

When soccer players kick the ball to another player, they are using a certain amount of *strength* to push the ball in a certain *direction*. Forces always have strength and direction.

Forces can be weak, like in the video when Zoe lightly hit the golf ball. Or a force can be strong, like when Izzy hit the ball really hard.

Forces also have direction. Rocket scientists must be very careful about the direction that a rocket is launched. If there is even a small mistake in calculations, the rocket's direction will be off course and the mission will not be successful.

The strength and direction of a force are equally important.

Unbalanced forces can cause an object to change its motion.

Unbalanced forces change the motion of an object. This happens in two ways. If an object is at rest and an unbalanced force pushes or pulls the object, it will move. Unbalanced forces can also change the speed or direction of an object that is already in motion.

A game of tug-of-war is a great way to illustrate an unbalanced force. If the players on one side of the rope use more force than other side, they will win the game.

Another good example is when you and your dog play with a tug toy. If you let go of the toy when the dog is tugging, the dog will fall backwards because it experiences an unbalanced force.

Balanced forces do not cause a change in motion.

When two forces are the same strength but act in opposite direction, they are called *balanced forces*. Again, tug-of-war is a perfect example. If the people on each side of the rope are pulling with the same strength, but in the opposite direction, the forces are *balanced*. The result is no motion.

Balanced forces can cancel each other out. Any time there is a balanced force, the object does not move.

EXAMPLE OF BALANCED AND UNBALANCED FORCES

Forces have direction. To steer the hovercraft, Zoe needed a way to change the direction of the force.

Forces can be balanced or unbalanced. Tug-of-war is a great example of balanced and unbalanced forces.

Gravity pulls objects down. In Zoe's DIY, the force of gravity pulled the egg down into the cup when the other objects were forced out of the way.

BALANCED AND UNBALANCED FORCES VOCABULARY

Force	A push or a pull that can cause the motion of an object to change. It has two important properties: strength and direction.
Balanced Force	When two equal forces act in opposite directions the result is that the forces are balanced and there is no motion.
Motion	The process of moving or changing position.
Unbalanced Force	When one force is stronger than the other the result is motion.
Strength	The amount of force that is applied to an object.
Gravity	A force that attracts objects toward the earth. "What goes up, must come down!"

BALANCED AND UNBALANCED FORCES DISCUSSION QUESTIONS

Why did Izzy's golf ball fail to go in the hole?

Izzy hit the ball too hard. He used too much STRENGTH when applying a force.

What was the difference between Zoe's first and second golfing attempts in terms of force?

In Zoe's first attempt she used the right amount of STRENGTH when applying a force to the ball, but did not know the right direction because she was wearing a blindfold. In Zoe's second attempt she applied just the right amount of strength and knew the right direction to win. (A force has both strength and direction.)

How did Zoe make Izzy fall down while they were playing tug of war?

When Zoe pulled with a lot of force while Izzy wasn't pulling at all, the strength of the force was greater in Zoe's direction. That made Izzy move in that direction.

Explain how Dr. Jeff cutting the tug of war rope is an example of unbalanced forces causing motion.

Before Dr. Jeff cut the rope, the forces were balanced. The force from Izzy pulling in one direction was cancelled out by the force of Zoe pulling with the same amount of force in the other direction. When the rope was cut, suddenly the forces were no longer balanced and the result was motion!

What makes the ping pong ball hover above the hair dryer?

The moving air from the hair dryer pushes the ball upward and the force of gravity pulls the ball downward with a force that is equal and opposite. The upward and downward forces on the ball cancel each other out so it is not in motion. When the hairdryer is turned off, the upward force is removed and the force of gravity causes the ball to fall down.

How could Zoe have kept from crashing her hovercraft?

Zoe's hovercraft only moved in one direction. The force pushed her forward. If she wanted to stop, she needed to apply an equal force in the opposite direction, which she could have done by aiming the fire extinguisher in front of her.