Balanced Forces

Building Big Things

Balanced Forces

Balanced Forces in the Classroom

Have you ever tried to move something and just were not able to? You pushed or pulled with all your strength, and it did not budge. You may have thought that you were not strong enough, or that the object was too heavy. In science language, there were *balanced forces* acting on the object.

Balanced forces mean that the force you apply is opposed by another force that is (a) equal in size and (b) acting in the opposite direction. The other force could be friction, or gravity, or something else pushing or pulling on the object. When balanced forces are acting on an object, there is no change in motion. You will be learning about friction and gravity forces over the next few days.

Remember when you pushed lightly on the heavy bucket? It was at rest (standing still). Its motion did not change. It stayed at rest. The forces on the bucket were balanced. You pushed in one direction, but different force, called friction pushed in the opposite direction. The two forces were equal in size and opposite in direction.

Balanced forces are equal in size and opposite in direction.

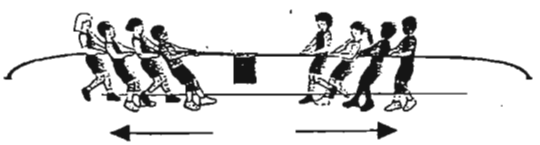
Think about another example from class to help you understand the idea of balanced forces. In class, you applied balanced forces to a heavy object. You pushed on the object with the same amount of force from opposite sides. The force probes measured the amount of force that you applied on each side and you saw that they were the same. You also pulled on the object with the same amount of force in opposite directions. The force probes showed that the forces were equal. In both cases, you observed that the motion of the object did not change. It stayed at rest and did not move.

Another Example of Balanced Forces

Another example of balanced forces is the game tug-of-war. The same number of people hold onto each end of a rope. A flag is tied to the center of the rope. Each team pulls on the rope and tries to move the flag to their side.

Imagine that you are playing tug-of-war with your friends. Your team starts by pulling really hard, with all of your strength. But the other team is also pulling with an equal amount of force and in the opposite direction. The motion of the flag in the middle of the rope will not change. It will not move. The flag does not move because the force that your team is pulling with is equal to the force applied by the other team, but in the opposite direction. The forces on the rope are balanced. When the forces are balanced, the motion of the flag in the center of the rope does not change.

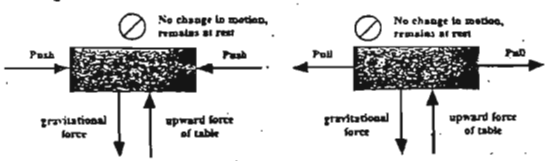
To win the tug-of-war game, one team must pull harder than the other. You will read more about this later when you learn about unbalanced forces.



When balanced forces are acting on an object, there is no change in motion. In other words, an object that is not moving will continue not to move, and an object that is moving at a constant speed will continue to move at a constant speed, when the forces applied to it are balanced.

Force Diagrams

You drew diagrams for each situation. They probably looked something like the following:



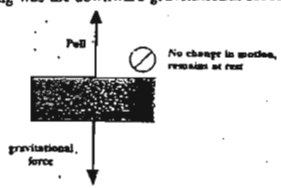
Force diagrams of balanced forces acting on an object

In these diagrams, the arrows represent the direction and size of the forces that you applied on the object. The arrows pointing towards the object represent pushing. The arrows pointing away from the object represent pulling. The arrows are the same size because you pushed or pulled on the object with the same amount of force. The arrows point in opposite directions because you pushed or pulled in opposite directions. Did the motion of the object change? No, the object did not move. It did not move because the forces that you applied to it were balanced. Go back and look at your POEs. How can balanced forces help you to explain some of the demonstrations?

Gravitational Force

It may seem strange to you that a table exerts an upward force on an object, because you don't see the table actually doing anything. Remember that a force acts when two objects interact. The object is sitting on the table. The object pushes down on the table and the table pushes back up on the object.

In class you also did a demonstration where you held an object in the air. You felt yourself applying a force to the object to hold on to it so that it didn't drop. You may have felt like you were just "holding" the object. However, you were applying a "pulling force." Even though you applied a pulling force to the object, the motion of the object did not change. The object did not move. You have seen that if the object does not move, then the forces acting on the object must be balanced. What is the force opposite to the force applied by your hand? The force that kept the brick from moving was the downward **gravitational force**.



Gravitational force is the force that pulls everything towards the Earth. When an object is suspended in the air, the force holding it up must balance the gravitational force pulling it down. To hold a bag of groceries you must pull up with a force equal to the downward gravitational force.

Gravitational force is the force that pulls everything towards the Earth

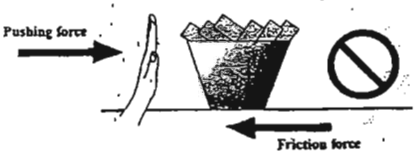
Friction

Think back to the heavy bucket demonstration that you did in class a few days ago. If you pushed on the bucket with a very small force, the bucket did not move. If the bucket did not move, there must have been a force to balance the small force that you applied. But there was nothing else pushing on the bucket. Or was there?

There is a force called friction between the bucket and the floor that is holding the bucket in place. Friction is a force that resists motion when two objects touch. In the case of the bucket and the floor, friction is the force holding the bucket in one piece. The force of friction balances out the small force that you apply to the bucket. This is why the bucket did not move when you applied a small force.

When the bucket is just sitting on the floor, the friction force does not act. Friction acts to resist motion. When you push on the bucket, friction acts to keep the bucket from moving.

Friction is a force that resists motion when two objects touch.



Friction force balances the small pushing force, resulting in no change in motion.

bob

building things big

Reading
blum/gramho

Name _____ class ____
team ____ seat ___ date ____

balanced forces

bob

1- Describe two (2) things you know about balanced forces.

2- Why didn't the heavy object move when you pushed or pulled on it with balanced forces?

3- Describe a time when you tried to move something and you couldn't. What was the force resisting your applied force? Tell about balanced forces.

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