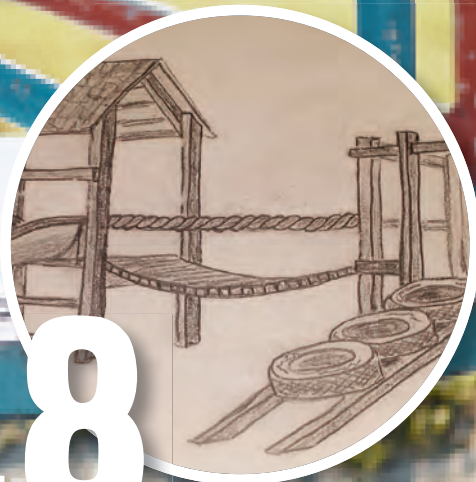


PLAYGROUND PHYSICS

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KICK THE BALL!

Forces at Play

A kickball rolls and bounces slowly toward the kicker. She swings her leg and kicks the ball. In an instant, the ball is sailing overhead!



Forces in Kickball

Anytime a kickball changes its motion or speed, it is because of forces. Even when the ball is still, forces are acting on it.

The pitcher holds the ball still. But he is exerting a force on the ball. His hands are pushing the ball upward, so it doesn't fall to the ground.

Forces

Forces make a ball change direction and speed during a game. Forces are pushes or pulls that act on an object, such as a ball. Forces can cause changes in an object's motion.

A force is applied to a ball when it is thrown, kicked, or caught. Forces act on a ball when it flies in the air and rolls on the ground, too.



Then, the pitcher exerts a force that pushes the ball forward. The force makes the ball start moving. The ball rolls toward the kicker.

Kicking the ball is an example of a type of force called a push.

The push makes the ball change the direction in which it is moving. This force changes the speed of the ball.

Strength and Direction

Some kicks send a ball flying over the heads of other players. Some kicks move the ball only a short distance. Some kicks send the ball in one direction. Other kicks send the ball in another direction. What causes these differences? The differences are caused by the strength and the direction of the force.

Strength

The strength of a force tells how much the force pushes or pulls an object. The stronger a force, the more it can change an object's motion. A ball kicked with less force will not move as far as one kicked with a greater force.

Direction

The direction of a force tells which way the object is pushed or pulled. When a pitcher's arm moves back to pitch a ball, the force pulls the ball backward. When the pitcher tosses the ball, the force pushes the ball forward.

All forces have strength and direction

In diagrams that explain forces, an arrow shows the strength of a force. The longer the arrow, the bigger the force. The arrow also shows the direction of the force.





What would happen if two kids playing soccer kicked the ball at the same time in the same direction? The ball would move faster and farther than if only one player had kicked it.

When two forces act in the same direction, they combine and make the force bigger. The forces can be added together

to find the total force acting on the object. The total force acting on an object is called the net force.

Two Forces Are Greater Than One!

Tony is pushing a heavy box of softball bats and gloves across the infield. Pushing as hard as he can, he is able to move the box only a short distance. But when a friend helps him push, the box moves more easily. This is because the force Tony's friend applies to the box is added to the force Tony applies. If each person pushes with the same force, then two people can push the box with twice as much force as one person alone.



Balanced or Unbalanced?

In a soccer game, the ball is thrown, kicked, and punted. It is often in motion, flying through the air and bouncing on the ground. The ball changes its direction, too, and at times, stops moving.

Remember that all forces have strength and direction. All the forces acting on the ball combine to determine the net force. When the forces on a ball act in opposite

directions, the net force is the difference between the forces.

Sometimes, the different forces acting on a ball are balanced. Balanced forces are forces that are the same strength but act in opposite directions. The net force is zero.

When the net force is not zero, the forces are unbalanced. Unbalanced forces cause changes in a ball's motion. The ball might change speed, or direction, or both. The ball moves in the direction of the net force.



BALANCED FORCES AT WORK

When a soccer goalie catches a ball coming toward him (yellow arrow), he pushes back at the ball with the same force (red arrow). But because the force is applied in the opposite direction, the ball stops moving.

BALANCED FORCES	UNBALANCED FORCES
Net force is equal to zero.	Net force does not equal zero.
An object's motion does not change.	An object's motion changes.
An object that is not moving will stay still.	An object that is not moving will start moving.
An object that is moving will keep moving at the same speed and in the same direction.	An object that is moving will speed up, slow down, or change direction.

UNBALANCED FORCES AT WORK

When a soccer ball is thrown in, the thrower applies a force to it (red arrow). The ball moves in one direction. A player on the other team, however, will try to kick the ball in the other direction. If the defender kicks with more force (yellow arrow) than the incoming throw, the ball will change direction. It moves in the direction of the kick.

