1.2 Read

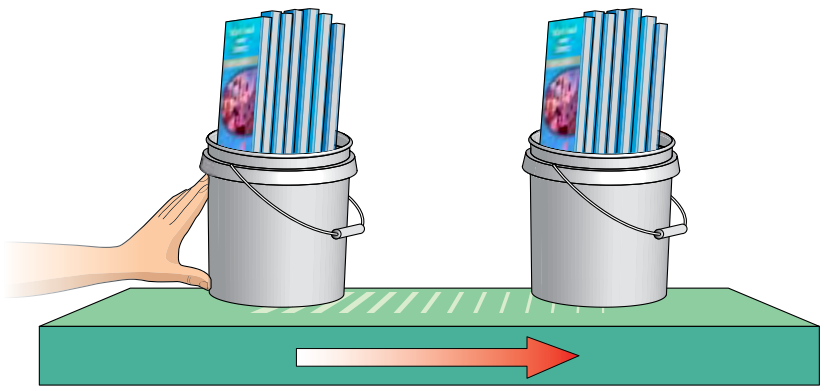
How Do Pushes and Pulls Relate to Force?

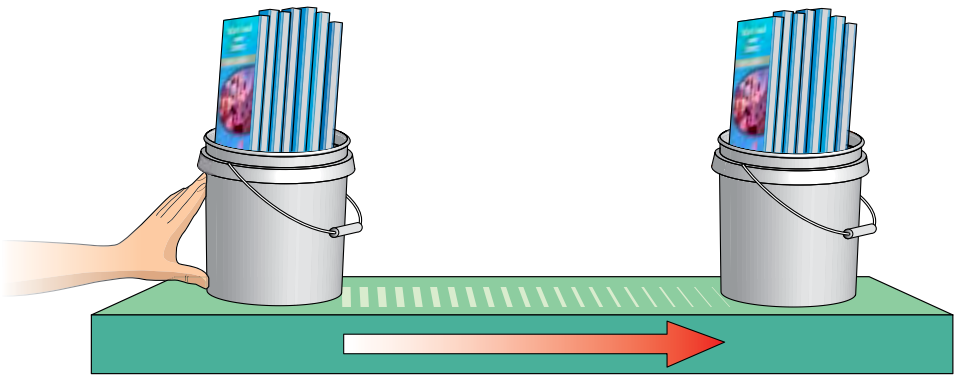
A force is being applied as the basketball player pushes down on the ball to bounce it.

A force is a push or pull. You apply a force to make an object move. There are many examples of things that you move in everyday life. Some of these examples include lifting a book to put it on the table, closing a door, dribbling a basketball, and lifting a trash bag to take out the garbage. To do each of these things, you have to apply a force. You push or pull something.

Think about the heavy-bucket demonstration. At the beginning of the demonstration, the bucket was sitting on the table. It was not moving. Scientists would say the bucket was *at rest*. When your teacher pushed and pulled the bucket very lightly, applying a small force, the bucket did not move. A force was applied, but it was not enough to make the bucket move. When your teacher applied a little more force, the bucket moved. Finally, your teacher applied a much larger force, and the bucket moved more.

In these demonstrations, a force was applied to move the heavy bucket. The bucket's motion was affected differently by greater amounts of force. With a small force, the motion did not change. The bucket stayed at rest. With more force, the bucket moved.





Forces can change motion. You need to apply forces to make things move and to make things stop moving. If a cart is moving across the floor, a force was needed to start it moving, and a force is needed to make the cart stop moving.

Forces are also needed to change direction. When you want an object to turn, you have to push or pull the object in the direction you want it to turn.

A force is needed to get an object moving, to change the direction an object is moving in, to slow down an object, and to stop an object from moving. In other words, a force is needed to change the speed and/or direction of an object. For example, riding a skateboard is all about using forces. To start riding a skateboard and build up speed, the rider pushes off the ground with one foot. To change direction or turn a corner, the rider applies a force by pushing down more on one side of the board.

To start riding a skateboard and build up speed, the rider pushes off the ground with one foot. To change direction or turn a corner, the rider applies a force by pushing down more on one side of the board. A common way to slow down or stop a skateboard is to press down on the tail, or back, of the board until it drags on the pavement.

Moving a skateboard	
to stop the skateboard	apply a force to the skateboard.
to speed up the skateboard	apply a force to the skateboard.
to change the skateboard's direction	apply a force to one side of the skateboard.

To change the speed or direction of an object, a force must be applied to the object.

Moving objects do not have any force of their own. Forces are a result of interactions between two objects. This interaction requires contact. For example, imagine you are catching a baseball. As the ball is moving through the air, it is interacting with Earth (that is, pulling it down toward it) and it is interacting with the air (that pushes against it). When the ball lands in your glove, the ball applies a force to your glove. You can feel it. Your glove also applies a force to the ball. This force slows down the ball and makes it stop moving. Neither the ball nor the glove had a force by itself. The force acts when the two objects interact. In this example, a force acts when the ball hits the glove.

Stop and Think

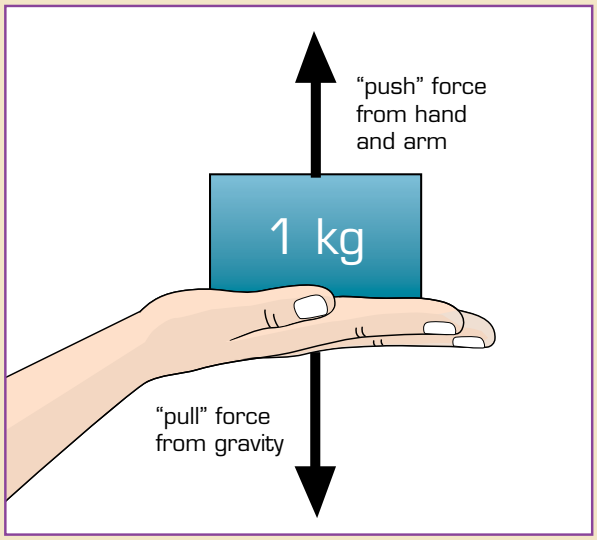
1. Give two examples of something you pushed or pulled today. Use different examples than those in the reading.
2. Compare the amount of force used to move the bucket with how much the bucket moved in each part of the demonstration.
3. When pushing the heavy bucket, what two objects interacted? Draw a picture of pushing the bucket. Make sure your picture includes all the objects that are interacting and the forces on the objects.

Force Diagrams

You drew a picture of the heavy bucket being pushed. You might have found it difficult to include in your picture all the information about forces. When scientists want to show the forces that are acting on an object, they use force diagrams.

Force diagrams provide a simple way to show the forces acting on an object. Instead of drawing the object, scientists simplify the object. Usually, the object will be shown as a square or other simple shape. Scientists then use arrows to show forces acting on the object. The direction of the arrow shows the direction of the force. You would show a push to the right with an arrow pointing to the right. The length of the arrow shows the size of the force. If two forces were the same size, the arrows would be the same length. If one force were twice as big as another, that arrow would be two times longer.

An example of a force diagram is shown below. The arrows are equal in length because the forces on the object are equal. The forces are acting in opposite directions, so they are pointing in opposite directions. One force is pushing up, and the other force is pulling down.



Stop and Think

Redraw your picture of the heavy bucket as a force diagram. Remember to indicate the direction and size of the forces.

What's the Point?

Forces cause objects to change motion. Forces can change the speed of an object, slowing it down or making it speed up. Forces can also change the direction of an object, and make objects turn. A small push or pull might not be enough to make an object change its speed or its direction. It might be necessary to apply a lot of force to an object to make it change its motion.

Previously, you discussed the idea of lifting the crate from the beach to the top of the cliff. This *lift* could be a push or a pull, depending upon how you build your machine. You will have to apply a force to move the crate. In the next section, you will learn more about the nature of that force.

Locomotives provide the force needed to move train cars. Locomotives usually pull the train from the front. Other times, locomotives are used to push the train.