

Simple Machines

In science, the word *work* has a special meaning. **Work** happens when a force moves an object through a distance. The greater the force and the greater the distance the object moves, the more work that is done.

Work equals force times distance.

$$W = F \times d$$

A **simple machine** is a tool that makes work easier. Most simple machines let you use less force to move an object. But when you use less force, you have to apply it for a longer distance. Some simple machines let you move an object a longer distance. You have to apply more force, but you can apply it for a shorter distance.

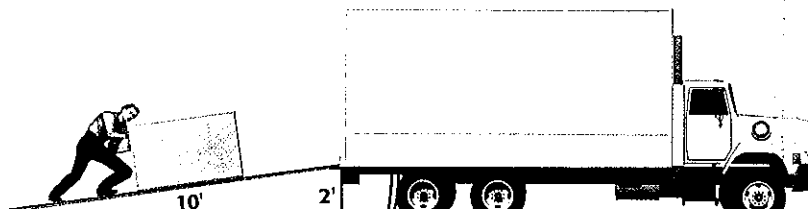
With any kind of simple machine, the amount of work you do doesn't change. What changes is the amount of force you apply and the distance you apply it.

There are six kinds of simple machines. They are an inclined plane, a wedge, a screw, a lever, a wheel and axle, and a pulley.

Inclined Plane

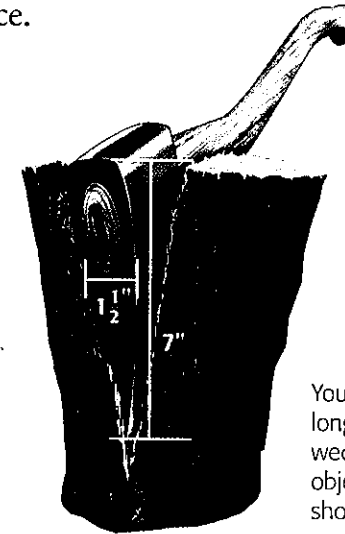
An **inclined plane** is a flat surface that slopes. Pushing a heavy box up an inclined plane takes less force than lifting the box straight up. But you have to push the box for a longer distance.

You apply less force, but you have to apply it for a longer



Wedge

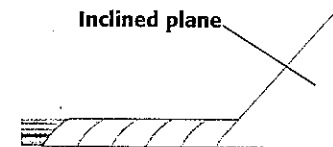
A **wedge** is an inclined plane that moves. An ax, a knife, and scissors are examples of wedges. A wedge reduces the amount of force that is needed to split apart an object. But you have to apply the force for a longer distance.



You apply force for a long distance. The wedge moves the object's pieces a short distance.

Screw

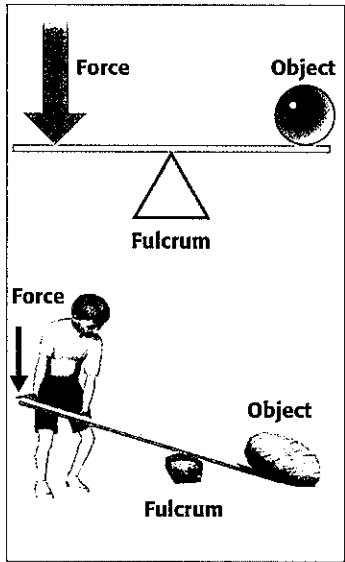
A **screw** is an inclined plane wrapped around a small rod. The inclined plane forms ridges on the screw. When you turn the screw, the ridges pull the board up the screw. You use less force to turn a screw than to hammer a nail of the same size into a board. But you have to turn the screw more times than you'd have to hammer the nail. You have to move the screw for the entire length of the inclined plane wrapped around it.



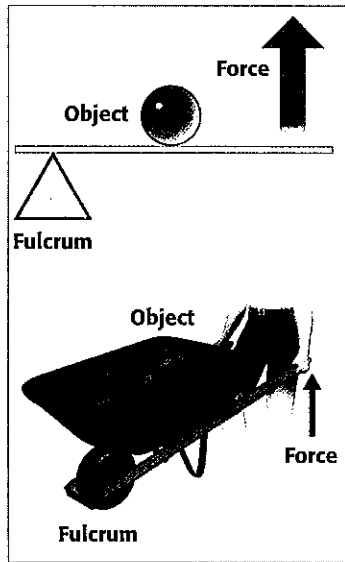
You use less force to turn the screw. But you have to apply the force for a longer distance.

Lever

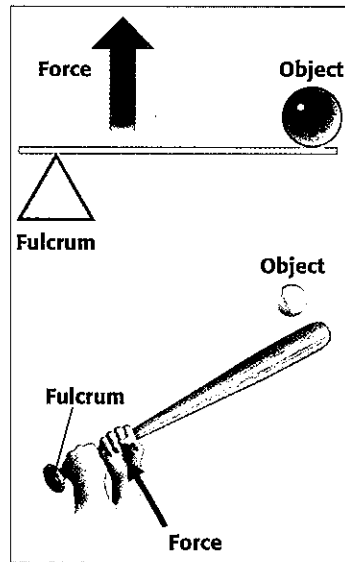
A **lever** is a long bar or board that turns around a support that doesn't move. The support is called the **fulcrum** (FUL krum). There are three kinds of levers.



The fulcrum is between the object you are moving and the force you are applying.



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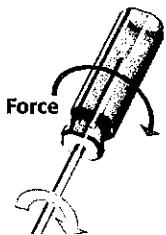


You apply force between the fulcrum and the object you are moving.

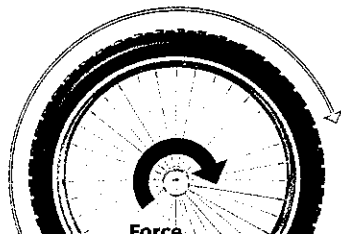
Wheel and Axle

A **wheel and axle** is a wheel that turns around a rod, called the axle. The axle goes through the center of the wheel. A wheel and axle reduces the force you have to apply *or* reduces the distance you apply the force.

When you turn the handle of a screwdriver, you apply force to the wheel part of a wheel and axle. A small force on the handle is magnified into a large force on the axle.

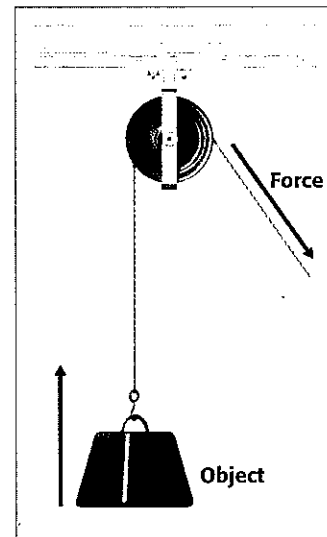


When you pedal a bicycle, you apply force to the axle. That's where the chain is attached. Every turn of the axle makes the tire turn a greater

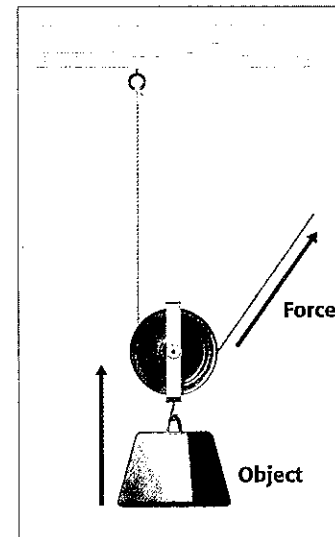


Pulley

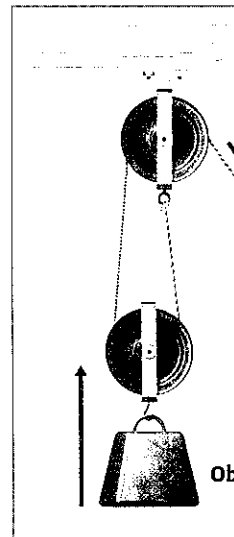
A **pulley** is a wheel with a rope or chain wrapped around it. Pulleys are used to lift heavy objects. For example, auto mechanics use pulleys to lift an engine out of a car. A pulley reduces the force that is needed to lift the object *or* it changes the direction of the force. There are three kinds of pulleys.



This kind of pulley changes the direction of the force you apply. You pull down, and the object moves up. The pulley does not reduce the amount of force that you have to apply.



This kind of pulley reduces the amount of force that you have to apply. Some of the weight is held by the object that the rope is attached to. So you don't have to pull as hard. The pulley does not change the direction of the force. You pull up, and the object moves up.



This pulley system is called a block and tackle. It's a combination of the other kinds of pulleys. Using more than one pulley reduces the force that is needed to lift the object. But you have to pull the rope a longer distance.

Compound Machines

A **compound machine** is made of two or more simple machines. A hand-operated can opener is a compound machine. Its two handles are levers. Its cutting part is a wedge. And you turn a

