Simple Machines are all around us.
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Machines Are All Around Us

Since ancient times, people have used machines. Ancient people and modern people use machines for the same reason. They help us get work done, build roads and buildings, and move from one place to another.

What is the definition of a machine? A machine is anything made by people which makes work easier to do. When most of us think of a machine we think of big, noisy ones, such as a car, a bus, or a tractor. But did you realize that a hammer, a nail, a pair of scissors, an ax, a wheelbarrow, and a corkscrew are machines, too. All of these things are machines because they are made by people and make work easier to do.
Work, Force, and Load

When scientists use the words force, work, and load, they use them differently than we use them in everyday conversation. Let’s better understand these words by thinking about a trip to the grocery store. Scientists define force as “a push or a pull”. When you push a grocery cart, you are applying a force. Scientists define a load as the object being moved by a machine. Scientists define work as “a force acting on a load to move it across a distance”. When you push a grocery cart in the store, the cart of groceries is the load, and your push is the force. When the cart moves, you have done work.
Let’s focus on the simple machines that help us perform work. **Simple machines** are “simple” because they have one or only a few parts. Simple machines include the **lever**, **wheel and axle**, **pulley**, **inclined plane**, **screw**, and **wedge**. When a person uses a simple machine, the person and the machine together become a **system**. The energy required to use the machine is provided by the person using the machine. Most of us don’t realize how many simple machines we use everyday and how much easier they make our lives.

**System** =

+ **Simple Machine**
  - lever
  - wheel and axle
  - pulley
  - inclined plane
  - screw
  - wedge
A lever can be used to move objects. In ancient civilizations, people used levers to transport large rocks and heavy pieces of wood to construct monuments. It is easier to use a lever than to pick up objects and carry them. The picture below is an example of a lever that helps us move boxes. This lever is called a hand cart. A hand cart is a lever that is used to lift several boxes at the same time.

A lever needs three parts to function. These parts are a fulcrum, a load, and a force. The boxes on the hand cart are the load because these are the objects we want to move. The force is the push or pull used to move the load, and the fulcrum is where the wheels are located on the hand cart. Other examples of levers include a seesaw, a tennis racket, and a wheelbarrow.
Seesaw

- Load
- Force (push down)
- Fulcrum

Wheelbarrow

- Load
- The wheel acts as the fulcrum.
Wheel and Axle

A wheel and axle is also a type of simple machine. It moves things from place to place. A wheel is a round disc, and the axle is a rod that runs through the center of the wheel. The wheel and axle makes work easier by rolling things instead of carrying them. There are three different ways in which a wheel and axle can make work easier. First, it can make moving things easier. Second, it can increase the force that is applied. Third, it can increase the distance an object moves.

It is easier to move bags of groceries in a cart than it is to carry them.
A pulley is a simple machine that is used to raise or lower a load. A pulley consists of a wheel with a groove around its circumference or around the outside. A rope is placed in the groove of the wheel. One end of the rope is attached to the load, and the other end of the rope is where the force is applied. When the force is applied, the rope is pulled, and the wheel turns. The load is then lifted.

A flag pole is a common object that uses a pulley to raise and lower a load. On a flagpole, a rope or cable is attached to a flag which is the load. The cable wraps around the pulley at the top of the pole. A person pulls down on the cable (force), and the flag (load) on the other end of the cable is raised. This allows the work of raising the flag to be done. Without a pulley, it would be a nearly impossible task to raise a flag up a flagpole.
A pulley is used on a flagpole.
Inclined Plane

An inclined plane is a flat surface raised up on one end. A ramp is an example of an inclined plane. Using an inclined plane makes it easier to move an object. It takes less force to move an object in an upward direction on an inclined plane than it does to lift the object straight up. Moving the object up an inclined plane requires moving it an increased distance. However, the inclined plane reduces the force needed to do the work.

Inclined planes are often used to move things. Look at the picture below. The stairs in the picture form a short and steep incline. It would take more force to move a load up this steep incline. However, the distance the load needs to be moved is short. The ramp is long and not as steep. The force needed when using this ramp is less because of the gentle slope, but the load must be moved a greater distance.
A hill is another example of an inclined plane. Think about how it feels to walk up a hill. The steeper the hill the harder it is to walk up it. Remember, the steeper the inclined plane the more force is needed to move the load. You are the load walking up the hill! The steepest hill route is the shortest and the hardest. Now if you took a path that has the gentler slope, it would be longer but much easier to move up it. The slope would be more gentle so less force would be required to move the load. Whether you take the steep, direct path or the path with the gentle slope, the same amount of work will have been done once you get to the top.
A screw is a type of inclined plane. The inclined plane is the thread of the screw that has been wrapped around a metal rod. It starts at the tip of the screw and ends at the top of the screw. A screw changes the direction of a force. Have you ever used a screwdriver? When you use a screwdriver, you apply force in a circular motion. But the screw moves down into the wood or metal. It is the threads of the screw that change the direction of the force from a circular motion to a forward motion.

Screws have many useful roles. The parts of different machines are held together with screws. A drill bit is a type of screw. This type of screw is used to make holes in things like wood or metal.
An **auger** (aw-ger) is like a gigantic screw used to make deep holes in the ground. As the auger turns, it moves into the ground and lifts the soil up its spiral slope. When the slopes are full of soil, the auger is lifted to the surface and emptied. It is then put back into the ground for another load.

**Auger**

Spiral slope (similar to a screw)

Soil is lifted on the slope.
A **wedge** is another example of an inclined plane. It has a thick side and a thin side. The pointed, thinner edge of the wedge helps it do work. The thin edge pushes things apart.

An ax is an example of a wedge. An ax is used to split wood. Force is used to swing the ax and bring it down on the wood. The ax moves forward into the wood, and the wood splits apart. The direction of the force has been changed.

![An ax is used to split wood. Swing ax down into the wood (force).](image)
There are natural wedges in our environment. Cracks in rocks allow water to get inside of them. In cold temperatures, the water freezes. When the water freezes, it expands as it turns to ice. As it expands, there is a force that is pushing on the rock on both sides of the crack. This force can break the rock. This is often the cause of potholes in roads in the winter.

Conclusion

Machines make work easier in one of three ways. They can help move the load from one location to another. They can change the direction of the force. Machines can also change the force’s strength and speed.

Think about the simple machines described in this book. Take a look in your home. How many simple machines can you identify? Look carefully. Sometimes simple machines are hidden or combined together. The jobs they do are so important. Remember they make our work easier. They help us get work done.
Auger
a machine shaped like a screw that is used to drill holes in the ground.

Circumference
the distance around a circle.

Force
a push or a pull.

Fulcrum
the fixed point on which a lever arm turns or balances.

Inclined plane
a flat surface raised on one end, such as a ramp.

Lever
a stiff bar that sits or turns on a fulcrum used to raise or move a load.

Load
an object to be moved or lifted.

Machine
an object made up of parts that each have a job, helps us do work.
Pulley
a simple machine that is used to raise or lower a load.

Screw
a simple machine used for holding things together.

Simple machine
a machine with few or no moving parts that helps make work easier.

System
a group of parts that work together or interact.

Wedge
a simple machine used for splitting or cutting.

Wheel and axle
a wheel that turns on a rod called an axle.

Work
what is done when force moves an object.
# Systems and Simple Machines

Simple Machines are All Around Us

## Correlation

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Written under funding from Monroe 2–Orleans BOCES by:

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Designed and Printed by the BOCES 2 Printing and Graphics Services.