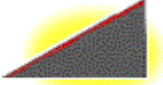


## Objective 5 Machines

Investigate and demonstrate mechanical advantage and efficiency of various machines such as levers, motors, wheels, axles, pulleys and ramps

Machine – A device that makes work easier.



### Inclined Plane

A plane is a flat surface. For example, a smooth board is a plane. Now, if the plane is lying flat on the ground, it isn't likely to help you do work. However, when that plane is inclined, or slanted, it can help you move objects across distances. And, that's work! A common inclined plane is a ramp. Lifting a heavy box onto a loading dock is much easier if you slide the box up a ramp--a simple machine



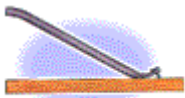
### Wedge

Instead of using the smooth side of the inclined plane, you can also use the pointed edges to do other kinds of work. For example, you can use the edge to push things apart. Then, the inclined plane is a wedge. So, a wedge is actually a kind of inclined plane. An axeblade is a wedge. Think of the edge of the blade. It's the edge of a smooth slanted surface. That's a wedge!



### Screw

Now, take an inclined plane and wrap it around a cylinder. Its sharp edge becomes another simple tool: the screw. Put a metal screw beside a ramp and it's kind of hard to see the similarities, but the screw is actually just another kind of inclined plane. To help you visualize. How does the screw help you do work? Every turn of a metal screw helps you move a piece of metal through a wooden space. And, that's how we build things! Machines make work easier by changing the size or the direction of the applied force.



### Lever

Try pulling a really stubborn weed out of the ground. You know, a deep, persistent weed that seems to have taken over your flowerbed. Using just your bare hands, it might be difficult or even painful. With a tool, like a hand shovel, however, you should win the battle. Any tool that pries something loose is a lever. A lever is an arm that "pivots" (or turns) against a "fulcrum" (or point). Think of the claw end of a hammer that you use to pry nails loose. It's a lever. It's a curved arm that rests against a point on a surface. As you rotate the curved arm, it pries the nail loose from the surface. And that's hard work!



### Wheel and Axle

The rotation of the lever against a point pries objects loose. That rotation motion can also do other kinds of work. Another kind of lever, the wheel and axle, moves objects across distances. The wheel, the round end, turns the axle, the cylindrical post, causing movement. On a wagon, for example, the bucket rests on top of the axle. As the wheel rotates the axle, the wagon moves. Now, place your pet dog in the bucket, and you can easily move him around the yard. On a truck, for example, the cargo hold rests on top of several axles. As the wheels rotate the axles, the truck moves. You can move your dog across the country!



### Pulley

Instead of an axle, the wheel could also rotate a rope or cord. This variation of the wheel and axle is the pulley. In a pulley, a cord wraps around a wheel. As the wheel rotates, the cord moves in either direction. Now, attach a hook to the cord, and you can use the wheel's rotation to raise and lower objects. On a flagpole, for example, a rope is attached to a pulley. On the rope, there are usually two hooks. The cord rotates around the pulley and lowers the hooks where you can attach the flag. Then, rotate the cord and the flag raises high on the pole.

### Mechanical Advantage

By means of a machine, a small force, or effort, can be applied to move a much greater resistance, or load. In doing so, however, the applied force must move through a much greater distance than it would if it could move the load directly.

Machines make work easier by changing the size or the direction of the applied force.

- Machines can multiply force.
- Machines do not multiply work.
- Work output cannot be greater than work input.

Mechanical Advantage (MA) simple machine tells you how many times a machine multiplies the force put into the machine.

$$MA = \frac{\text{output force}}{\text{input force}} = \frac{\text{input distance}}{\text{output distance}}$$

## HOW TO CALCULATE THE MECHANICAL ADVANTAGE OF SIMPLE MACHINES

<b>Simple Machine</b>	<b>Mechanical Advantage</b>	<b>Example</b>
Inclined plane	Length of incline $\div$ height of incline	Ramp
Lever	Distance from fulcrum to input force $\div$ distance from fulcrum to output force	Seesaw, crowbar, fishing pole, wheelbarrow
Wheel and Axle	Distance from center of wheel to outside of wheel $\div$ distance from center of axle to outside of axle	Hand mixer, screwdriver, doorknob, steering wheel
Pulley	Number of sections of rope supporting the load	Block and tackle, flag-pole lifting