

Learning Objectives

- 1) Know that work is done when a force (effort) causes an object to move a distance.
Work = Force × Distance.
- 2) Understand that a machine is a tool that helps do work by reducing the effort that is required. Friction can slow a machine's ability to reduce effort.
- 3) Realize that a machine either amplifies the required force (effort), increases the distance, or changes the direction of the force (effort). No machine can increase both distance and force.
- 4) Know the six simple machines (lever, wheel and axle, pulley, inclined plane, and screw) and the important concepts about each one.
 - a) The lever is composed of a bar and a fulcrum, the device on which the bar pivots. The distance from the fulcrum to the end of the bar where the force is applied is called *the effort arm*, and the distance from the fulcrum to the resistance is called *the resistance arm*. The lever transfers and changes the direction of force. If the effort arm is made longer by moving the fulcrum, more weight can be moved with the same effort; however, the resistance would not be moved very far. If the effort arm is made shorter and the resistance arm is made longer, the resistance can be moved a farther distance, but it requires more effort. There are three classes of levers: first class (fulcrum in the center, resistance and effort arms are at the ends), second class (resistance arm is in the center, and the fulcrum and the effort arm are at the ends), and third class (effort is in the center, and the fulcrum and resistance arm at the ends).
 - b) The wheel and axle are just like the lever, except that the effort arm and the resistance arm can move freely around the fulcrum (wheel = "lever in the round"). The wheel and axle increase force. A doorknob and a screwdriver are both wheel and axle machines.
 - c) The pulley is a wheel with a rope, belt, or chain around it. Pulleys are used to change the direction of movement or the amount of force required to move an object. In a fixed pulley, like a flagpole, only the direction of movement is changed. In a moveable pulley, the pulley moves along with the resistance, multiplying the effort needed to move an object. A combination of fixed and

moveable pulleys, like a block and tackle, or a hoist, can move a lot of weight.

- d) An inclined plane is a slanted plane, like a slide or a ramp, which allows an object to be moved with less force, but with greater distance.
 - e) A wedge is two inclined planes back to back. Wedges multiply the force needed to penetrate hard objects. The longer and thinner (sharper) the wedge, the less force required to overcome the resistance force and move the resistance apart from each other. Blades, nails, and chisels are all examples of wedges.
 - f) A screw is an inclined plane wrapped around a central bar. The edges of the screw, which form an inclined plane, are called threads. As it rotates, the screw moves a certain distance up or down, in or out. A screw multiplies the effort force by acting over a large distance. The more the screw turns the tighter the hold.
- 5) Understand that compound machines are two or more simple machines combined. For example, a wood screw is both a screw and a wedge.
 - 6) Machines can be powered using human effort, fuel, wind, and electricity.

Suggested Activities

- 1) **Before viewing the video**
 - a) Anticipatory set: Have the children write down any simple machines that they know and draw diagrams of them. Collect and save for review after watching the video.
- 2) **After viewing the video**
 - a) Review the six simple machines in the video. Make directed art pictures of the diagrams shown in the video. The following homework activities help the students to discover simple machines in everyday life for themselves and to relate the diagram to the actual simple machine. Class activities may be tried at home.
 - b) **Inclined Plane and Wheel and Axle:** Make an inclined plane with a large, thin book placed on a thick book at one end. Have each child bring to class a small car, labeled with his/her name. Let each child have his/her car roll down the inclined plane and mark where it stops. Measure the distance and have the children try at least two methods at home to improve the distance that the car

travels. Have another race to see if the cars go farther this time and examine why or why not.

- c) **Wedge:** Find examples of wedges at home. Draw a diagram of each and tell what it does. In class, cut a stick of margarine with the long side of a 3" or 4" nail. Then cut it with a table knife (a wedge). Compare and discuss the results.
- d) **Screw:** Obtain 2 thin boards or pieces of plywood, a nail, a screw, a hammer, and a screwdriver. Have a different child do each activity below. 1. Hammer the nail into the two boards, joining them together. 2. Use the screwdriver to screw the same two boards together at a different spot. 3. Try to remove the nail with the claw of the hammer. 4. Try to pull the screw out the same way. Discuss the results. Why do screws hold objects together more firmly than do nails?
- e) **Lever:** Diagram two levers from home, showing the fulcrum, effort (force), and resistance (load) on each. If possible, bring one lever to school to demonstrate.
- f) **Pulley:** Find something at home that uses pulleys. Diagram and tell what it does.

Vocabulary

Axle — An axle is a bar that is attached to a wheel.

Force (Effort) — A force is a push or a pull.

Friction — Friction is a force that resists the motion between two objects in contact with each other.

Plane — A plane is a flat surface.

Resistance — The weight that needs to be moved

