

Section 2: Simple Machines

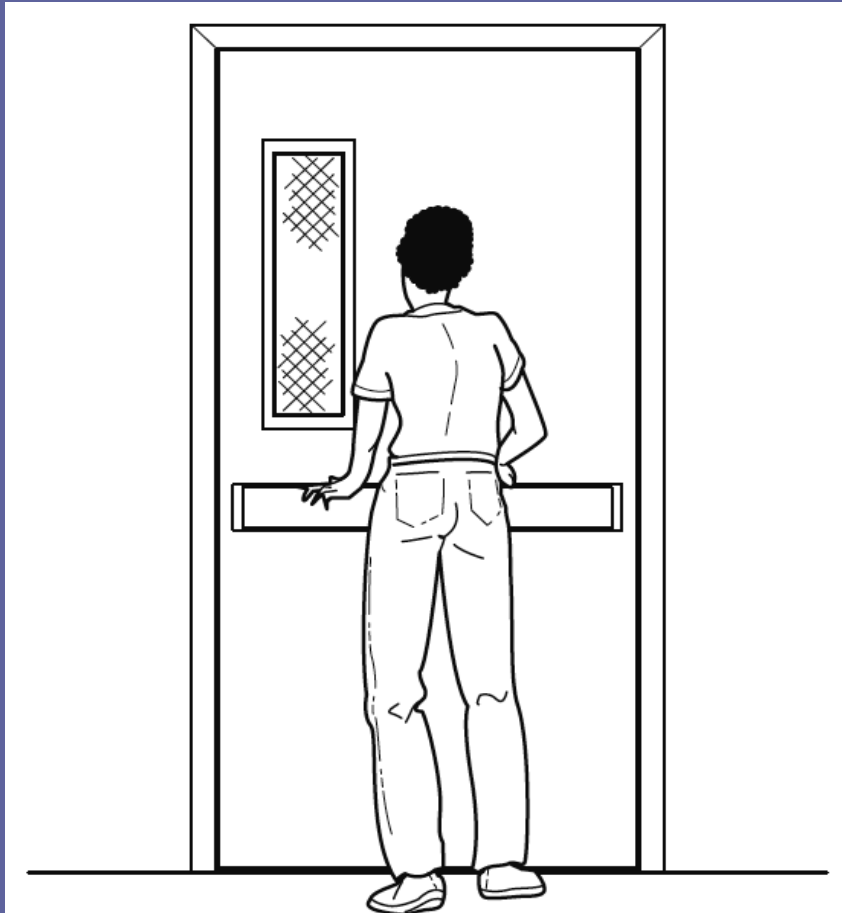
Preview

- Key Ideas
- Bellringer
- What Are Simple Machines?
- The Lever Family
- The Inclined Plane Family
- Compound Machines

Key Ideas

- › What are the six types of simple machines?
- › What are the two principal parts of all levers?
- › How does using an inclined plane change the force required to do work?
- › What simple machines make up a pair of scissors?

Bellringer



You may not think of a door as a simple machine, but it is one. The door functions like a lever. Like other levers, when you exert a force on it (an input force), that force is exerted along the entire door (the output force).

Bellringer, *continued*

1. For all levers, there is one point along the lever that remains still while the rest of the lever moves. This point is called the fulcrum. Where is the fulcrum of a door?
2. You can push at any point along the width of a door and it will open. Which position requires the least force: pushing the door near the hinges, in the middle, or near the side farthest from the hinges? (Hint: Which of these feels easiest to do?)
3. If you are trying to prop the door open with a small, light doorstop, where would you place the doorstop: near the hinges, in the middle, or near the side farthest from the hinges?

What Are Simple Machines?

- › What are the six types of simple machines?
- › The six types of simple machines are the simple lever, the pulley, the wheel and axle, the simple inclined plane, the wedge, and the screw.

What Are Simple Machines?, *continued*

- Simple machines are divided into two families: the *lever family* and the *inclined plane family*.

Lever family:

- simple lever
- pulley
- wheel and axle

Inclined plane family:

- simple inclined plane
- wedge
- screw

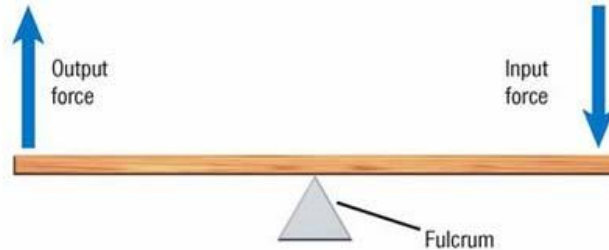
The Lever Family

- › What are the two principal parts of all levers?
- › All levers have a rigid arm that turns around a point called the fulcrum.
- Levers are divided into three classes.

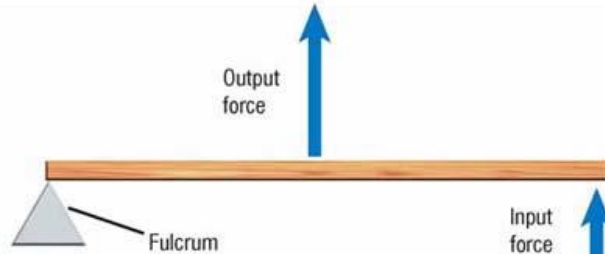
The Lever Family, *continued*

The Three Classes of Levers

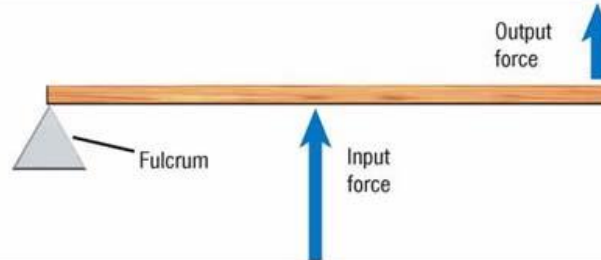
A **first-class lever** has a fulcrum located between the points of application of the input and output forces.



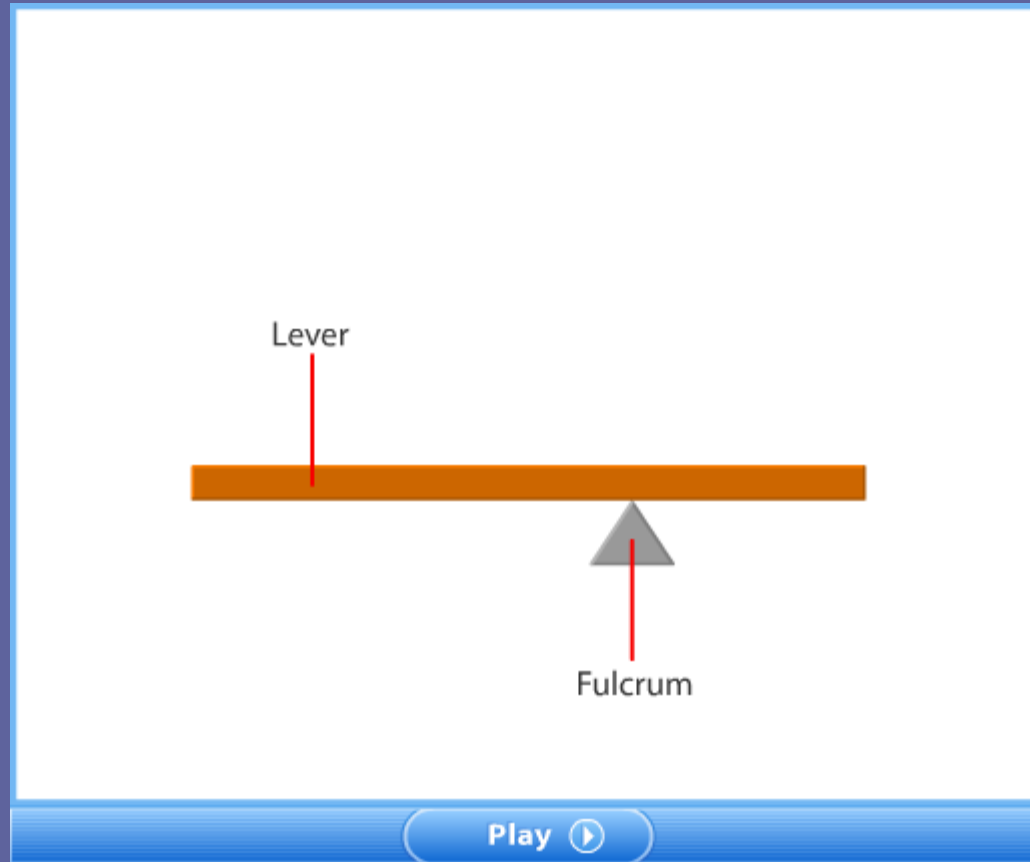
In a **second-class lever**, the fulcrum is at one end of the arm, and the input force is applied to the other end. The wheel of a wheelbarrow is a fulcrum.



Third-class levers multiply distance rather than force. As a result, they have a mechanical advantage of less than one. The human body contains many third-class levers.



Visual Concept: Lever

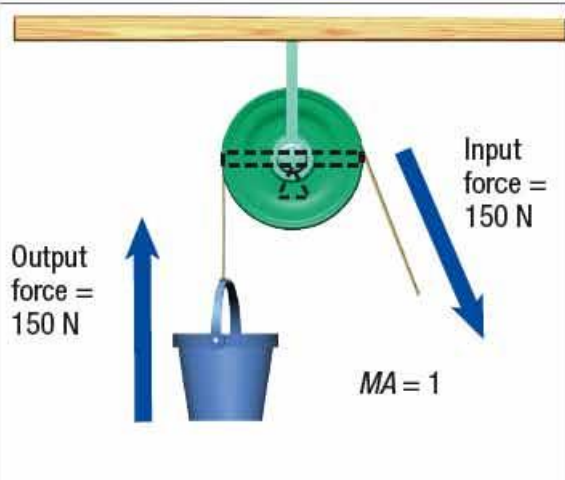


The Lever Family, *continued*

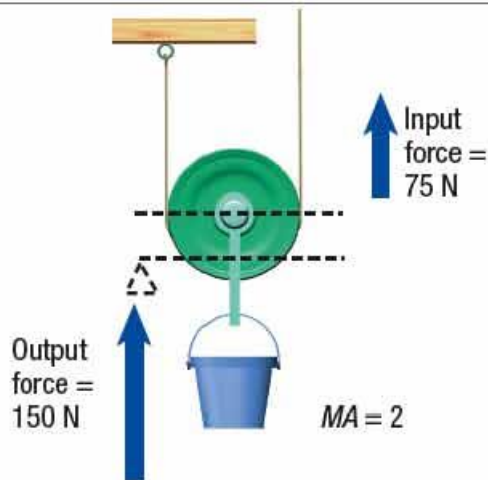
- Pulleys are modified levers.
 - The point in the middle of a pulley is like the fulcrum of a lever.
 - The rest of the pulley behaves like the rigid arm of a first-class lever.
- A wheel and axle is a lever or pulley connected to a shaft.
 - Screwdrivers and cranks are common wheel-and-axle machines.

The Mechanical Advantage of Pulleys

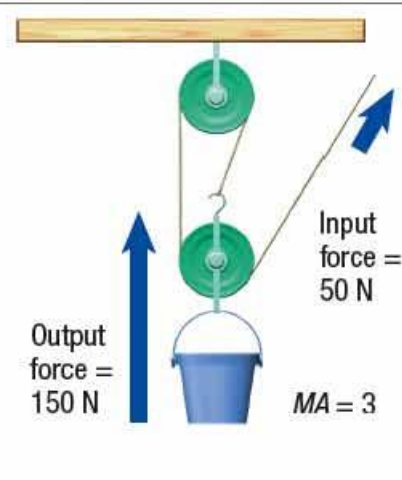
The Mechanical Advantage of Pulleys



When a 150 N weight is lifted by using a single, fixed pulley, the weight must be fully supported by the rope on each side of the pulley. This kind of pulley has a mechanical advantage of one.

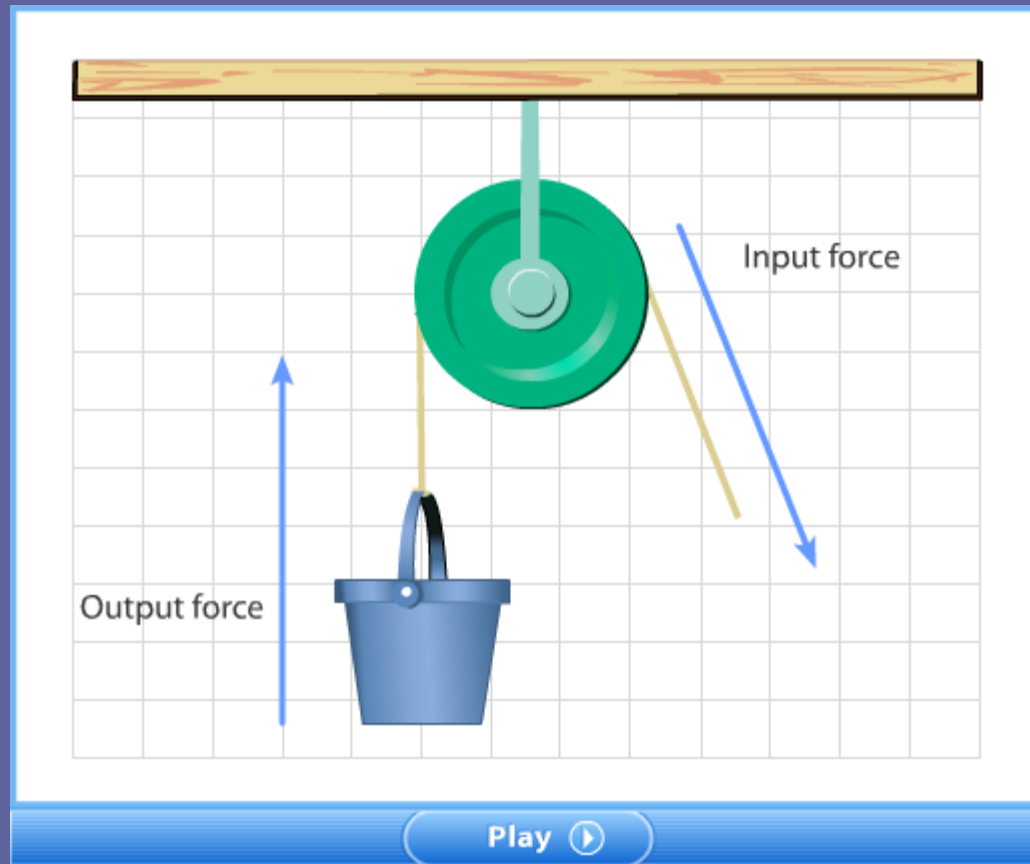


When a moving pulley is used, the load is shared by two sections of rope pulling upward. The input force supports only half of the weight. This pulley system has a mechanical advantage of two.



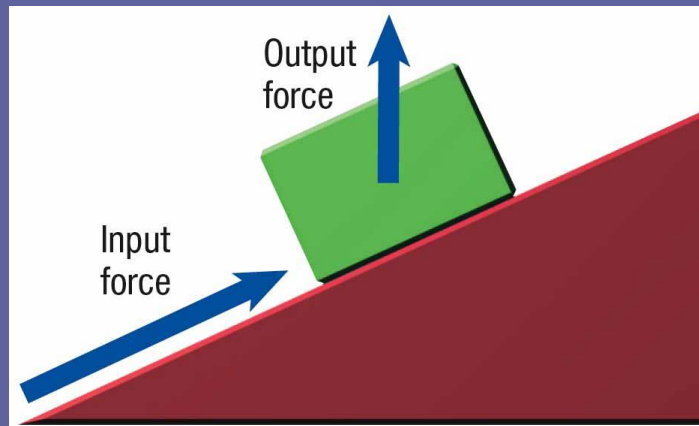
In this arrangement of multiple pulleys, all of the sections of rope are pulling up against the downward force of the weight. This arrangement gives an even higher mechanical advantage.

Visual Concept: Pulley

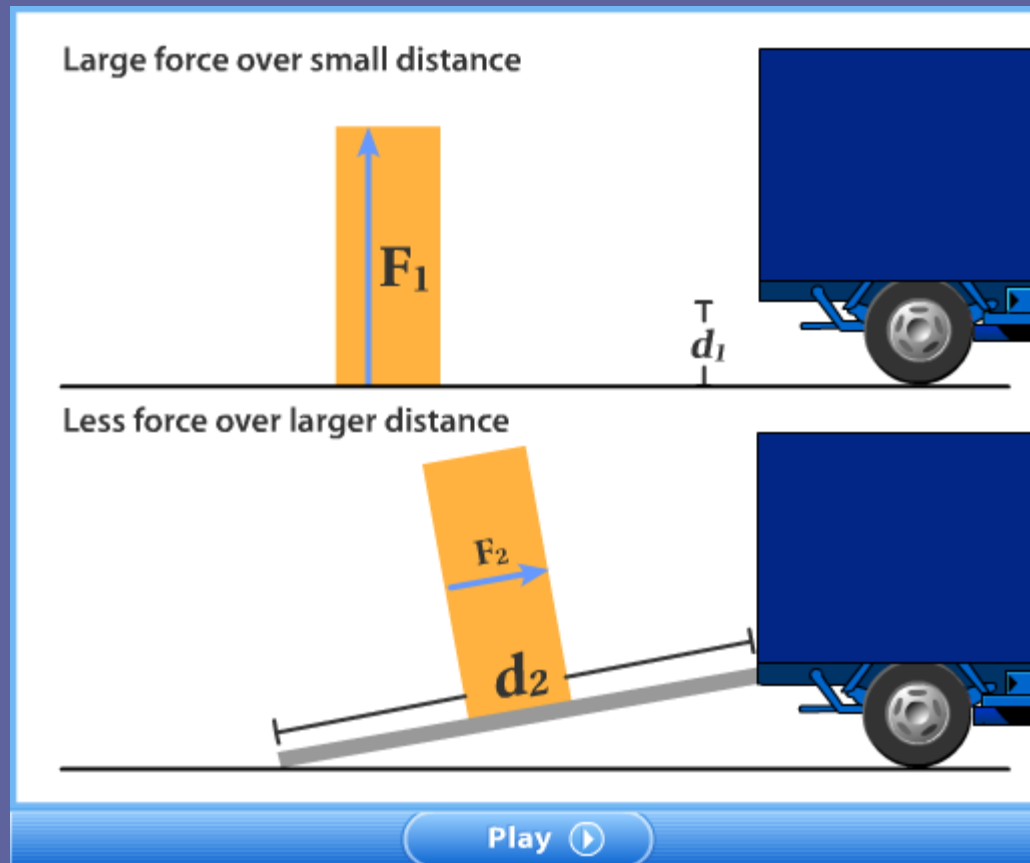


The Inclined Plane Family

- › How does using an inclined plane change the force required to do work?
- › Pushing an object up an inclined plane requires less input force than lifting the same object does.

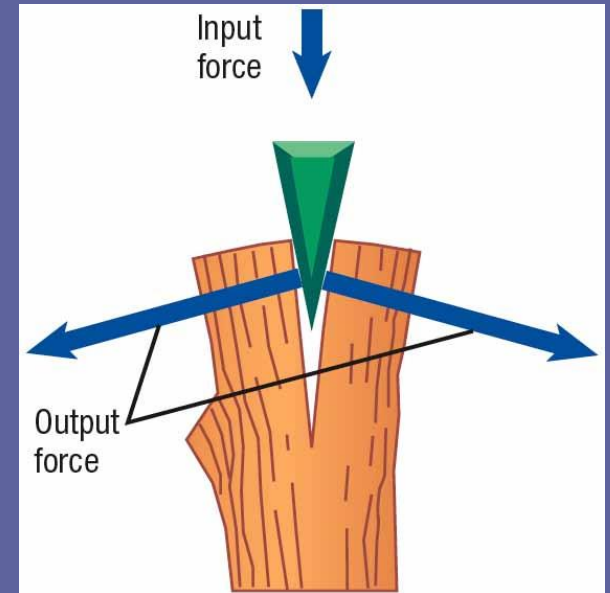
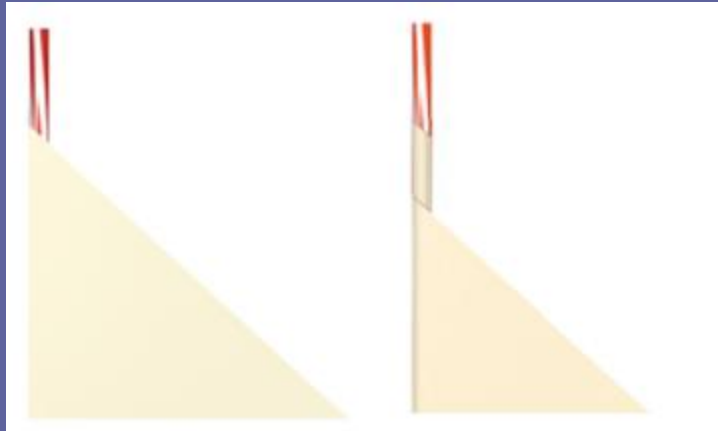


Visual Concept: Inclined Plane



The Inclined Plane Family

- A wedge is a modified inclined plane.
- A screw is an inclined plane wrapped around a cylinder.



Visual Concept: Screws



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Main 🏠

Compound Machines

- › What simple machines make up a pair of scissors?
- › A pair of scissors uses two first-class levers joined at a common fulcrum; each lever arm has a wedge that cuts into the paper.
- **compound machine:** a machine made of more than one simple machine