

Warm-Up | Simple Machines



Lesson Question



Lesson Goals

Identify the types of simple machines and their uses.

Calculate the advantage of a simple machine.

Explain how two or more simple machines can be combined to form a machine.

Compare parts of the human to simple machines.



Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

_____ simple machine

A. a device that consists of two or more simple machines operating together

_____ transmit

B. one of six devices that have few or no moving parts and make work easier

_____ compound machine

C. to move force or energy from one medium or part of a mechanism to another

W
2K**Words to Know**

- _____ mechanical advantage A. to coil around an axis or an object
- _____ spiral B. a calculation of how much a machine multiplies a force, or the ratio of output force to input force

**Work**

- Is caused by a
- A force is a or a .
- Occurs when force acts over a
- If there is no , no work is done.
- The motion is in the of the force.
- Is the of force times distance

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Six Simple Machines

have few or no parts. They make work easier.

- Inclined (ramp)
- (doorstop)
-
-
- and axle
-

Inclined Plane

- An inclined plane is a surface, such as a ramp.
- Inclined planes make it easier to objects.
- The distance is greater, but the amount of force used is .
- The amount of done is the .

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Wedge

- A is used to split things apart.
- is applied to the area of the wedge.
- The force is concentrated on a smaller area at the end.
- The wedge looks like two planes placed back to back.

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Screw

- A can hold things together. The grips materials.
- The threading on a screw looks like an inclined plane around the outside of the screw.
- Large screws are also used to things.
 - A car lifts a car by using a large screw.

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Lever

- A lever is a strong bar that turns about a , or fixed point. It can be used to lift heavy objects.
- Force applied at one end is to the other end.
- A lever can change the of a force.
- Moving the position of the fulcrum affects how much is needed.

Wheel and Axle

- A wheel and axle consists of two circular objects of different that are connected.
- The smaller-diameter object, the , is a that goes through the wheel and lets the wheel turn.
- When the axle is turned, the wheel moves a greater , but less force is needed to move it.

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Pulley

- A changes the of a force.
- A pulley consists of a grooved and a .
- Pulling on the rope lifts objects.
- A construction crane uses a series of .
- A has a pulley at the top.

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Compound Machines

- A machine is a device that consists of two or more machines operating together.
- machines used every day are compound machines.
- A is a compound machine. The bicycle are wheels and axles. The pedals and the gearshift are .

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Mechanical Advantage

- Mechanical advantage is a calculation that tells you how much easier a machine makes it to do .
- Mechanical advantage is abbreviated as .

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

The Mechanical Advantage of a Wedge

- MA of a wedge = slope/thickness ()
- A short wedge with a wide angle requires more force than a long wedge with a angle.

$$MA = \frac{\text{output force}}{\text{input force}} = \frac{0.25 \text{ m}}{0.1 \text{ m}} = \text{$$

The force applied to the top of the wedge is 2.5 times at the bottom of the wedge.

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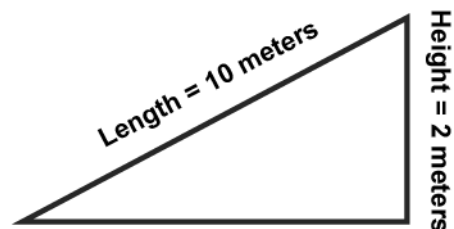
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The Mechanical Advantage of an Inclined Plane

- MA of an inclined plane = /height
- The the ramp, the less or effort is needed to move an object up it.

$$MA = \frac{10 \text{ m}}{2 \text{ m}} = \text{ }$$



The is multiplied 5 times using this inclined plane.

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The Mechanical Advantage of a Screw

- MA of a screw = / (1/number of threads)
- To find the mechanical advantage of a screw, you need to know the distance between the .
- The circumference of the screw is measured in the same .

Example:

threads = 5 per cm

circumference = 3 cm

Step 1: Divide 1 by the number of threads: $1 \div 5 = \text{ }$

Step 2: Divide 3 cm (circumference) by the result above: $3 \text{ cm} \div 0.2 \text{ cm} = \text{ }$

The mechanical advantage is 15.

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The Mechanical Advantage of a Lever

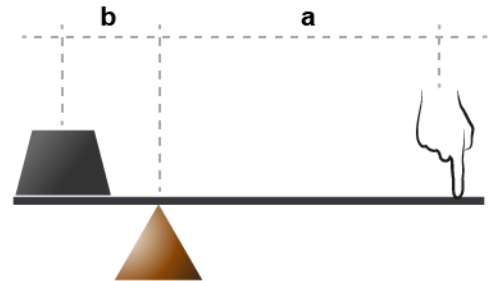
- MA of a lever =
- The length of the lever on the side where the force is applied is labeled as .
- The length of the lever on the side where the force is being is labeled as *b*.

Example:

$$a = 1 \text{ m}$$

$$b = 0.5 \text{ m}$$

$$MA = \frac{1 \text{ m}}{0.5 \text{ m}} = \text{ }$$



The mechanical advantage of the lever is 2.

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The Mechanical Advantage of a Wheel and Axle

- MA of a wheel and axle = $\frac{\text{radius (large)}}{\text{radius ()}}$

Example:

$$\text{radius of wheel} = 10 \text{ cm}$$

$$\text{radius of axle} = 2 \text{ cm}$$

$$MA = \frac{10 \text{ cm}}{2 \text{ cm}} = \text{ }$$

The mechanical advantage of the lever is 5.

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The Mechanical Advantage of a Pulley

- A pulley has a mechanical advantage of .
- The pulley changes the the load is moving, but the force is the same as the force.

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Incisors as Wedges

- Your front – your incisors – act as .
- When you bite down, the tapered shape transmits the that cuts into .

Arms as Levers

- The , between the elbow and the wrist, is the .
- The elbow is the , or pivot point.
- The hand is the .
- In this lever, the fulcrum is at one end, not near the .

Summary

Simple Machines


**Lesson
Question**

What are simple machines?


Answer

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Review: Key Concepts
APPLICATIONS OF SIMPLE MACHINES

Simple Machine	Applications
	Wheelchair ramp, truck loading ramp, highway ramp
	Axe, incisor
	Screw, nut and bolt, jar lid
	Seesaw, crowbar, forearm, jaw
	Bicycle, steering wheel
	Flagpole, fishing pole, blinds

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Review: Key Concepts**MECHANICAL ADVANTAGE**

Simple Machine	Mechanical Advantage
Inclined plane	MA = length/ <input type="text"/>
Wedge	MA = slope/thickness (<input type="text"/>)
Screw	MA = <input type="text"/> / (1/number of threads)
Lever	MA = length of <input type="text"/> side/length of <input type="text"/> side
Wheel and axle	MA = <input type="text"/> (large wheel)/radius (axle)
Pulley	MA = <input type="text"/>



Summary

Simple Machines

Use this space to write any questions or thoughts about this lesson.