The six simple machines 1 + 2

The six simple machines: inclined plane, screw and wedge

Throughout history, humans have developed a number of devices to make work easier. The most notable ones are known as the "six simple machines": the wheel and axle, the lever, the inclined plane, the pulley, the screw and the wedge, although the latter three are actually just extensions or combinations of the first three.

Many machines combine more than one of these devices and even if these machines may seem simple, they continue to provide us with the means to do many things we could never do without them.

The **inclined plane** is simply a flat surface raised at an angle like a ramp and it is a way of lifting a load that would be too heavy to lift straight up. The angle, that is the steepness of the inclined plane, determines how much effort is needed to raise the weight. The steeper the ramp, the more effort is required. Usually the inclined plane stays in one place and something moves up or down the slope. A wheelchair ramp is an example. Some people find it easier to travel up the ramp than to take the stairs. Ramps also make it easier to load and unload a truck. Ancient Egyptians may have used ramps to build the giant pyramids. One theory is that they gradually built up a ramp in the sand which spiralled around the outside of the pyramid as it grew taller. The huge building blocks were then pushed up the ramp.

A **screw** is essentially a long, inclined plane wrapped around a shaft, so its mechanical advantage can be approached in the same way as the inclined plane. Many devices use screws to exert a force that is much greater than the force used to turn the screw.

Wedges are moving inclined planes that are driven under loads to lift them, or into a load to split or separate it. A longer, thinner wedge gives more mechanical advantage than a shorter, wider wedge. The main function of a wedge is to change the direction of the input force. For example, if we want to split a log, we can drive a wedge downward into the end of the log with great force using a sledgehammer, and the wedge will redirect this force outward, causing the wood to split.

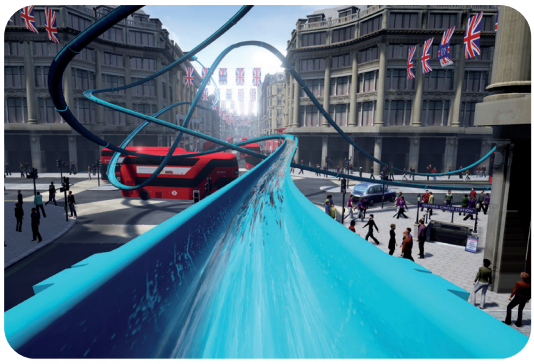
An inclined plane

axle: *asse*
to lift: *sollevare*
load: *carico*
log: *tronco*
pulley: *puleggia*
ramp: *rampa*
screw: *vite*
shaft: *albero*
sledgehammer: *martello, mazza*
slope: *pendenza*
steepness: *pendenza, inclinazione*
wedge: *cuneo*
wheelchair: *sedia a rotelle*
wrapped: *avvolto*

A screw

A wedge

1 Answer the questions.



1. Why have people always tried to develop new types of devices?
2. Which are the three basic simple machines out of the six?
3. Why are they considered the basic ones?
4. What is an inclined plane?
5. What is it used for?
6. How does a screw work?
7. What is a wedge?
8. How can a wedge be used?

2 Read the passage and choose the correct option.

Some uses of the inclined plane

1. Wheelchair ramps

A wheelchair ramp has become necessary in our society. The wheelchair begins at a **1.** ***lower/higher*** level and is used to **2.** ***push/pull*** the wheelchair up. The distance needed becomes **3.** ***lower/greater,*** but the force and energy needed to maneuver the wheelchair becomes less.

2. Slides

Although largely used for recreational **4.** ***goals/purposes***, the slide is also used to **5.** ***lower/lift*** heavy objects to a flat surface. Rather than dropping the object, it is slowly descended down the slide with less energy used and also a much **6.** ***healthier/safer*** result.

3. Stairs

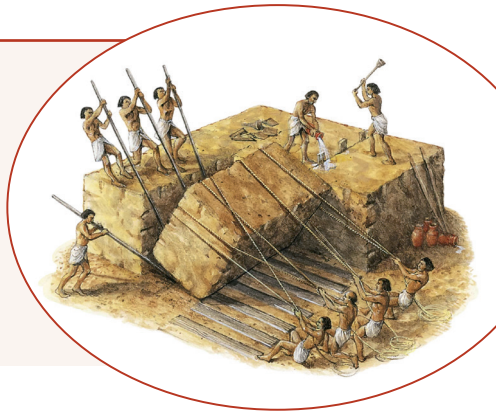
Stairs are inclined planes. **7.** ***More/Less*** energy is needed to walk up the stairs than it would take to **8.** ***jump/climb*** up. Similarly, escalators are inclined planes that propel a person or object up a distance without exerting energy.

4. Waterslides

A person climbs to the **9.** ***top/peak*** and, using the slippery water surface, that person accelerates **10.** ***himself/themselves*** down the plane at exciting speeds. The greater the inclined angle, the greater a speed is achieved.

PYRAMID-BUILDING TECHNIQUE

The techniques used to build pyramids were developed over a period of centuries. Pyramids originated from simple rectangular "mastaba" tombs that were being constructed in Egypt over 5,000 years ago; they were simple, rectangular tombs which developed into pyramids with underground tunnels and chambers.
To move the stones overland, the Egyptians used large sledges that could be pushed or pulled by groups of workers. The sand in front of the sledge was dampened with water, something that reduced friction, making it easier to move the sledge. When the stones arrived at the pyramids, a system of ramps was used to take the stones up.



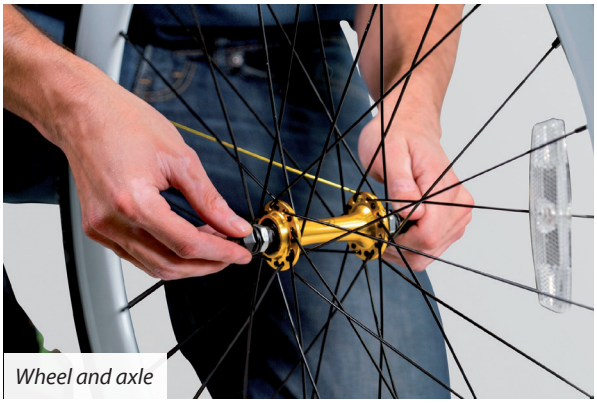
The six simple machines: wheel and axle, pulley and lever

The **wheel** is considered to be one of the most significant inventions in the history of the world as it greatly reduces the friction encountered when an object is moved over a surface. Wheeled carts facilitated agriculture and commerce by enabling the transportation of goods and allowed people to travel long distances. The great innovation, though, was in mounting a wheel on an **axle**. This led to the development of carts, wagons and chariots.

If we want to lift a weight with a rope, we could attach a **pulley** to a beam above the weight. This would let us pull down instead of up on the rope. However, if we were to use two pulleys – one attached to the overhead beam, and the other attached to the weight – and we were to attach one end of the rope to the beam, run it through the pulley on the weight and then through the pulley on the beam, we would only have to pull on the rope with half the force needed to lift the weight.

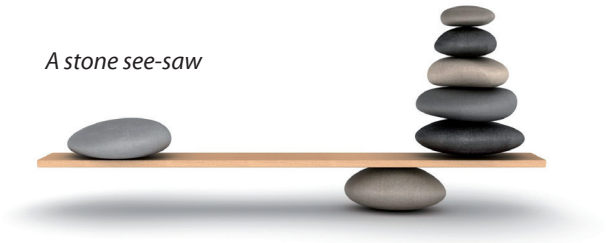
Levers are one of the basic tools that were probably used in prehistoric times. The lever consists of a rigid bar used to exert a pressure or sustain a weight at one point of its length by the application of a force at a second and turning at a third on a fulcrum (or pivot). Levers are classified by the relative positions of the fulcrum, the effort (input force) and the load or resistance (output force). This allows the identification of three classes of levers:

- **Class 1** – Fulcrum in the middle: the effort is applied on one side of the fulcrum and the load on the other side, for example, a seesaw or a pair of scissors;
- **Class 2** – Load in the middle: the effort is applied on one side of the load and the fulcrum is located on the other side, for example a bottle opener, a stapler or the brake pedal of a car;
- **Class 3** – Effort in the middle: the load is on one side of the effort and the fulcrum is located on the other side, for example, a pair of tweezers, nail clippers or the human mandible.



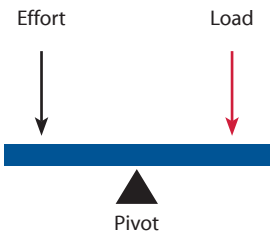
Wheel and axle

A pulley

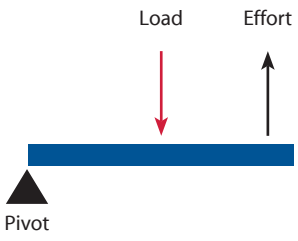


A stone see-saw

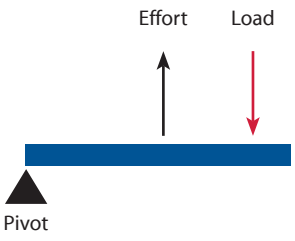
cart: *carretto*
beam: *trave*
chariot: *carro*
nail clippers: *tagliaunghie*
overhead: *in alto*
pivot: *perno*
seesaw: *altalena*
stapler: *pinzatrice*
tweezers: *pinzette*



First Class Lever



Second Class Lever



Third Class Lever

3 Match these words with the correct definition.

1.	Friction	☐	**a.**	To provide someone with adequate power, means, opportunity, or authority to do something.
2.	To enable	☐	**b.**	A device for slowing or stopping a vehicle, wheel, shaft, etc., or for keeping it stationary, especially by means of friction.
3.	Goods	☐	**c.**	The point around which a lever turns.
4.	To lift	☐	**d.**	A quantity of material twisted or wound in the form of a cord.
5.	Rope	☐	**e.**	A long thick straight-sided piece of wood, metal, concrete, etc., especially one used as a horizontal structural member.
6.	Beam	☐	**f.**	To apply.
7.	To exert	☐	**g.**	Resistance encountered when one body moves relative to another body with which it is in contact.
8.	Fulcrum	☐	**h.**	To rise or cause to rise upwards from the ground or another support to a higher place.
9.	Effort	☐	**i.**	Articles of commerce; merchandise.
10.	Brake	☐	**j.**	An applied force acting against inertia.

4 For each picture, write the name of the device and the class of lever it belongs to.


1 .....


2 .....


3 .....


4 .....


5 .....


6 .....

5 Choose the correct option.

1. What simple machine uses grooved wheels and a rope to raise, lower, or move a load?
a. A lever. **b.** An inclined plane. **c.** A wheel and axle. **d.** A pulley.

2. What simple machine uses a wheel with a rod or rods through its centre that will help it lift or move a load?
a. An inclined plane. **b.** A wheel and axle. **c.** A screw. **d.** All of the options.

3. What simple machine uses a slanted surface that connects a lower level to a higher level?
a. An inclined plane. **b.** A screw. **c.** A wedge. **d.** A lever.

4. Which of the following would you use a pulley for?
a. To hold pieces of plastic together. **b.** To help guide a sail on a sailboat. **c.** To cut food. **d.** All of the options.

5. What type of a simple machine would the bottom of a light bulb be?
a. A screw. **b.** A wedge. **c.** A lever. **d.** A pulley.

6. A fork would be an example of what type of simple machine?
a. A pulley. **b.** A wedge. **c.** A lever. **d.** A screw.