Simple Machines

Lesson 20

GPS

- **S8P3. Students will investigate relationship between force, mass, and the motion of objects.**
- c. Demonstrate the effect of simple machines (lever, inclined plane, pulley, wedge, screw, and wheel and axle) on work.

Work

- Work is the application of a force to an object to move it a certain distance in the direction of the force.
- Formula

  work = force x distance or W = F x D

Force

- A force is a push or a pull
- A force is measured in Newtons (N)

Distance

- An amount that an object travels
- Measured in meters (m)

* Not drawn to scale

Work

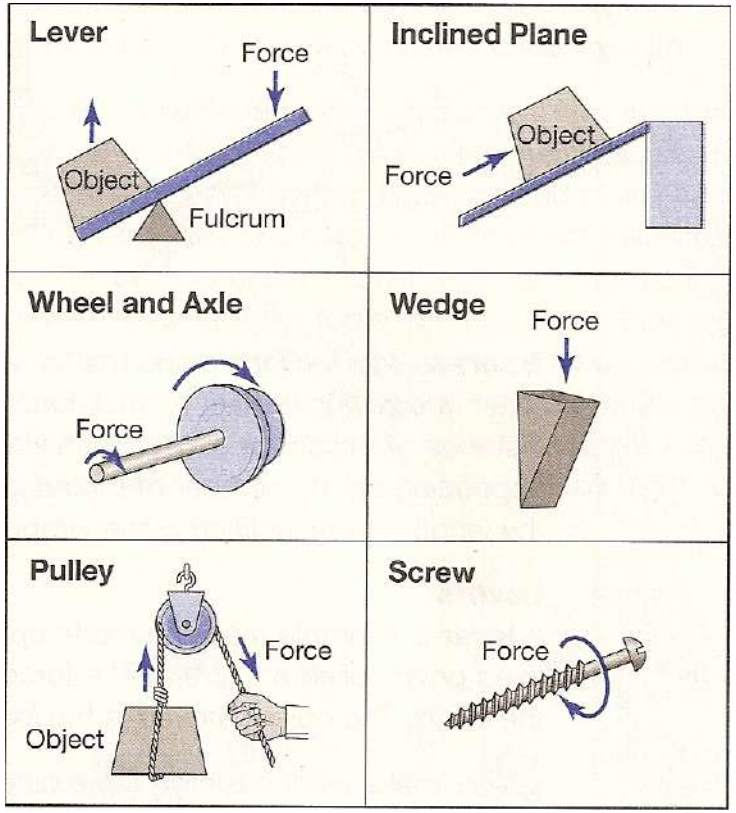
- Work is done only when an object moves in the same direction of the force that is being applied.
- NO movement!!!!
  NO work!!!!
- Example:
  - Picture a person wearing a backpack and climbing up the side of a mountain, the person is doing work because the direction of motion and force being applied are both upward. (same direction)

Work

- Work is not always done when a force is applied to an object.
- Example
    - A brick wall will not move no matter how much force you apply with your hands. The wall does not move, no work is being done when you push on it.

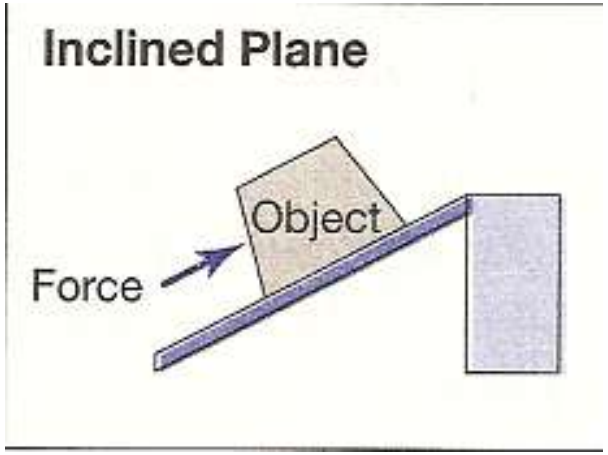
Simple Machines

- Six basic types
- Designed to make work easier by changing the size or direction of a force
- Have some moving parts
- Can combine to form compound machines



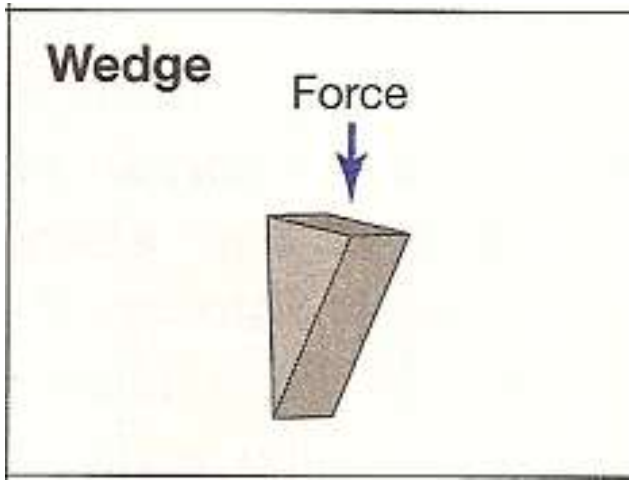
Simple Machines – Inclined Plane

- An inclined plane is a straight, slanted surface.
- Example:
  - A ramp is a stationary inclined plane.
- It is easier to push an object up a ramp than it is to lift the same object straight up to the same height.



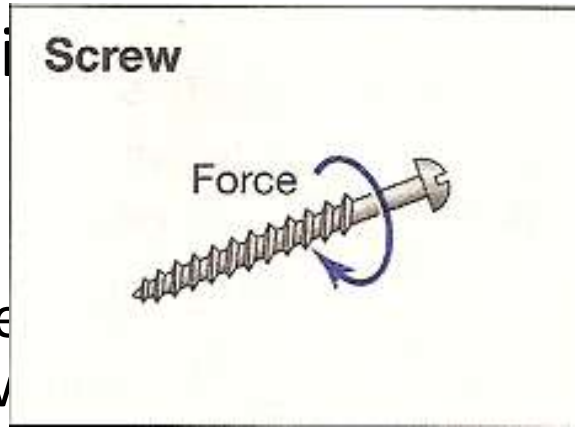
Simple Machines - Wedge

- A wedge is an inclined plane that is wider or thicker at one end than at the other.
- Example: Knife blade or axe
  - When moved it is used to cut, split, or pry apart objects



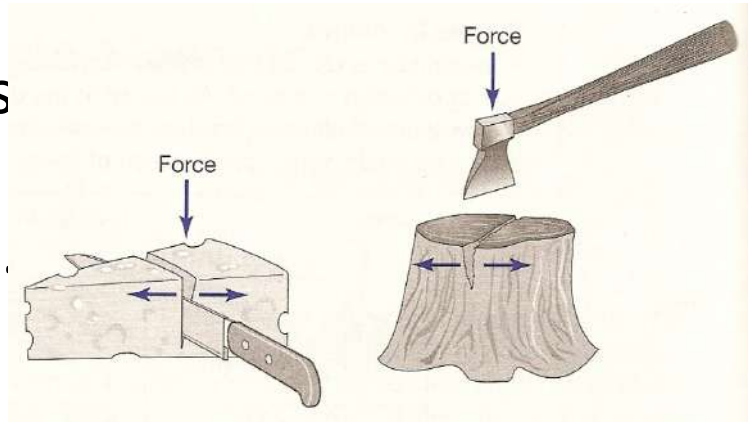
Simple Machines - Screw

- A screw is an inclined plane that i wrapped around a cylinder.
- Screw, bottle cap
  - When turned a small force is applie over the long distance of the screw threads
- The amount of work for a screw depends on the number of thread, which is actually the length of the inclined plane



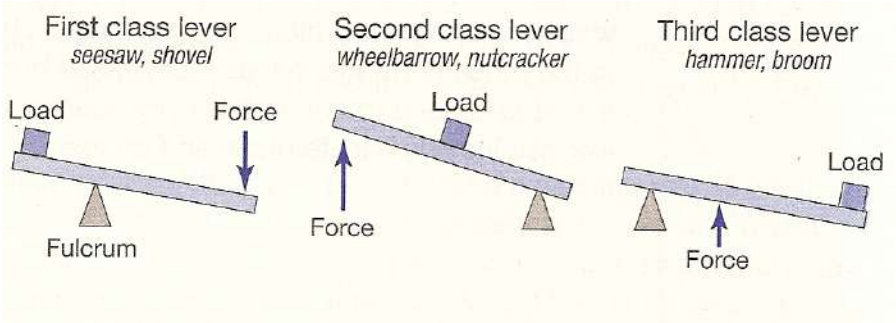
Simple Machines – A Lever

- What is it? Made up of a bar that pivots at a fixed point called a fulcrum
- The force applied to a lever is called the effort.
- The object moved is the load.
- They are classified into three different groups
  - The groups are based upon the locations of the fulcrum, load, and the input force



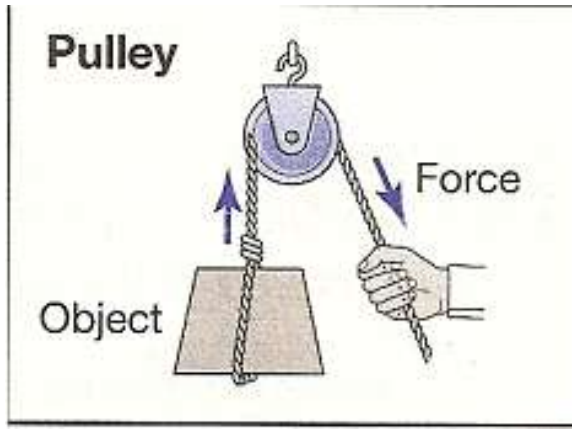
Simple Machines - Levers

- In a first class lever, the fulcrum is in the middle, load and force on the ends
  - Example: seesaws
- In a second class lever, the load (resistance) is in the middle, force and fulcrum are on the ends. Example: nutcracker, wheelbarrow
- In a third class lever, the force (effort) is in the middle, the load and fulcrum are on the ends. Example: baseball bat or fishing rod

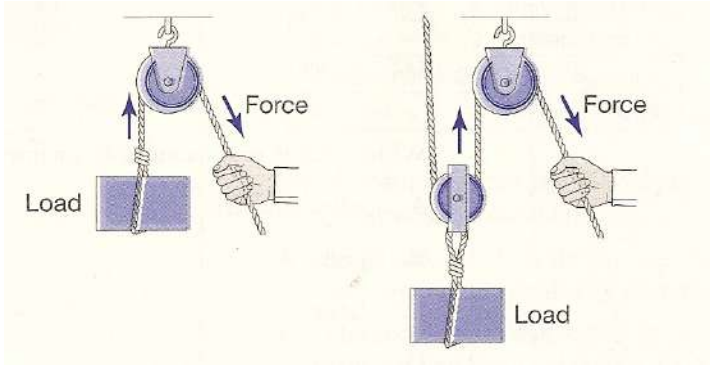


Simple Machines - Pulleys

- A pulley is a rope or chain wrapped around a wheel.
- A load is attached to one end of the rope and a force is applied to the other end of the rope.



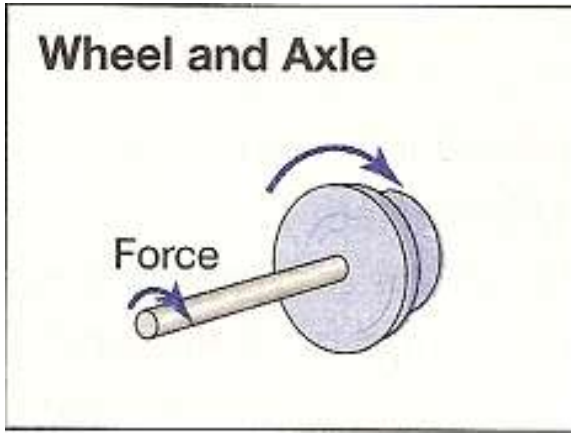
Pulley



- A double pulley makes work easier not only by changing the direction of the force, but also by multiplying the effort
- A single pulley makes work easier by changing the direction of the effort force
  - When you pull down on the rope, the load moves up

Simple Machines – Wheel & Axel

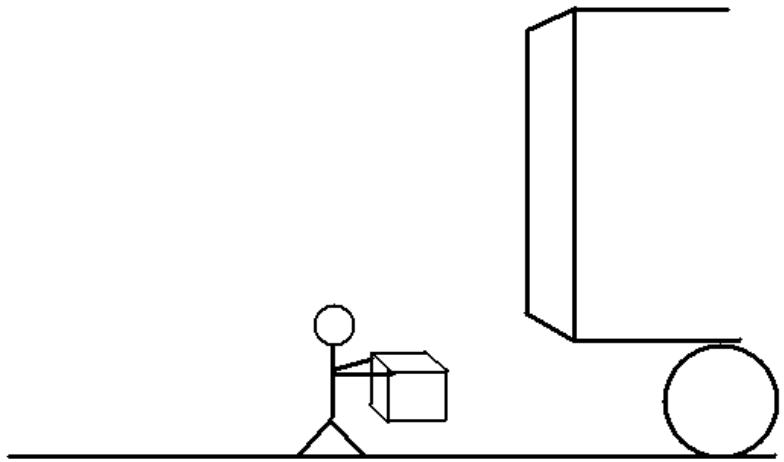
- A wheel and axle is a simple machine that consists of two circular objects of different sizes.
- The wheel is always larger than the axle
- Example: door knob
- By getting more force from the effort put in when compared to the amount of distance



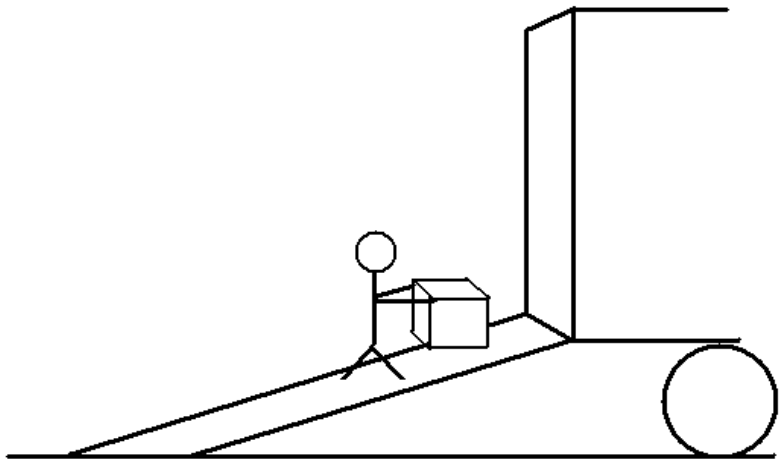
Eduardo is helping his family move out of their old house. Help him decide which task would be easier, and then help him figure out what simple machine makes the job easier.

Eduardo has to move some heavy boxes into the moving truck.

A



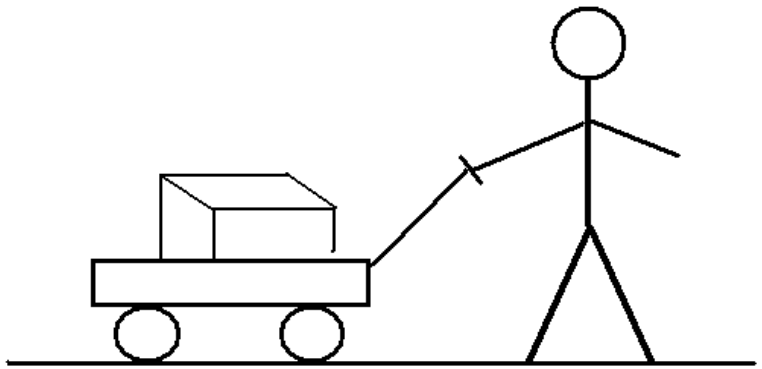
B



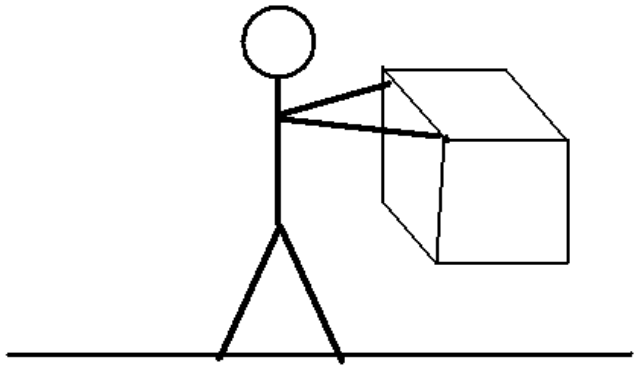
B would be easier because a ramp is an *inclined plane*.

Eduardo has to move a heavy box a long distance.

A



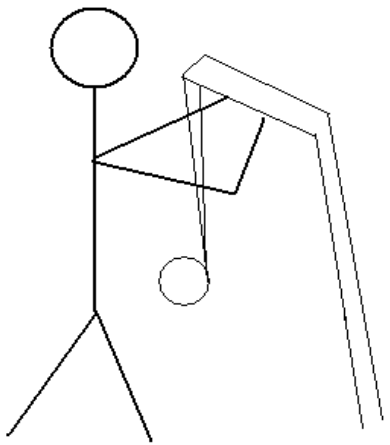
B



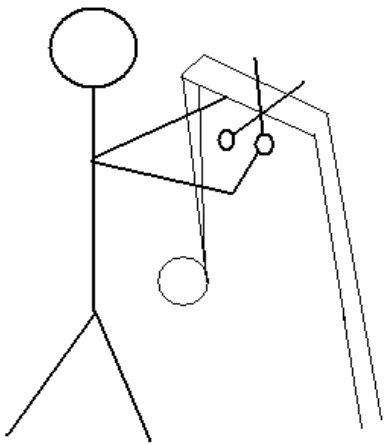
A would be easier because the wagon has *wheels and axels.*

Eduardo needs to tear off a piece of packing tape.

A



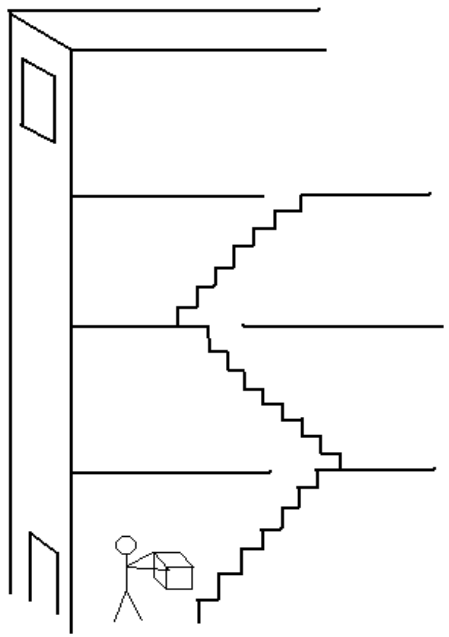
B



B would be easier because the edges of the scissors are *wedges*.

Eduardo needs to move a heavy box to his room on the fourth floor.

A



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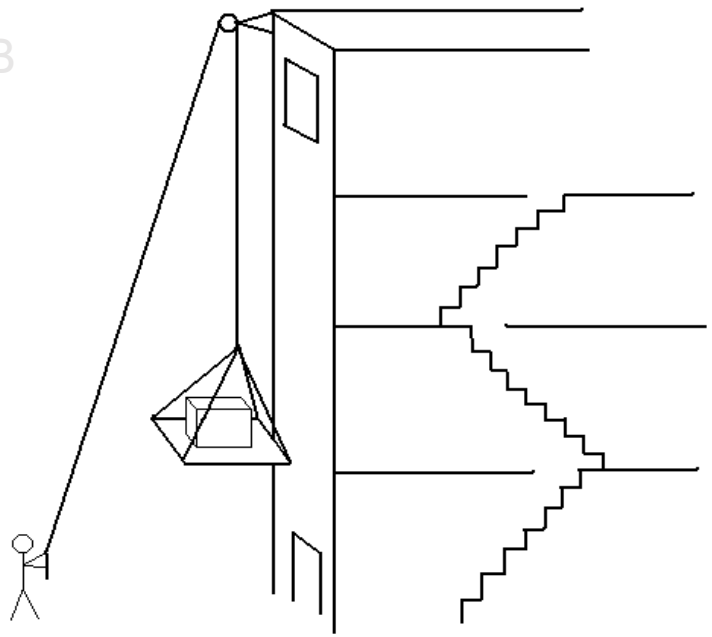
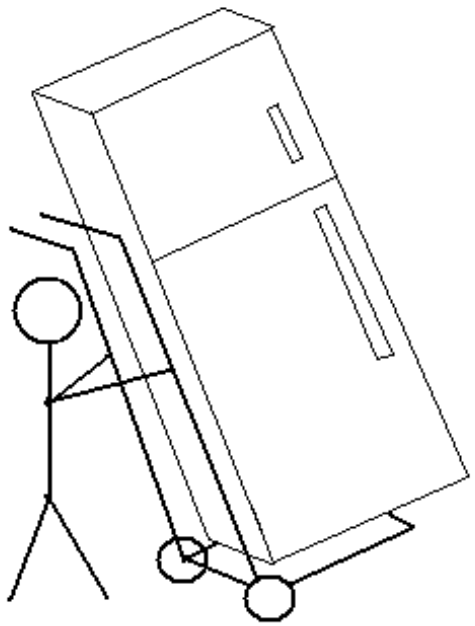
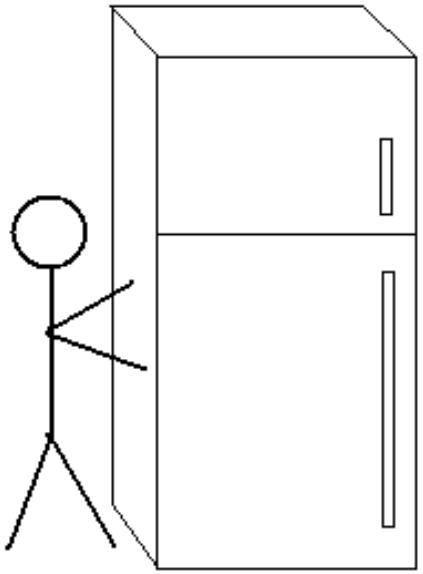


B would be easier because Eduardo is using a *pulley.*

Eduardo needs to help his father move the refrigerator.



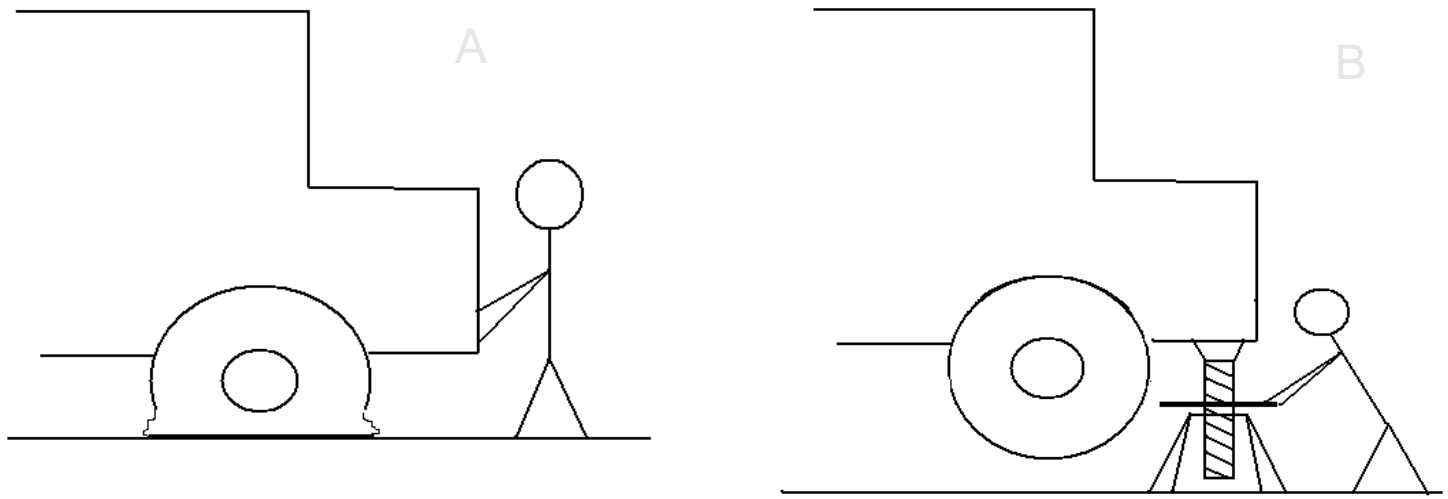
A



B

A would be easier because the dolly is a *lever* (with wheels and an axel).

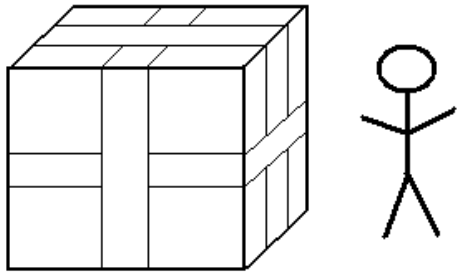
Eduardo needs to help his father change a flat tire on the moving truck.

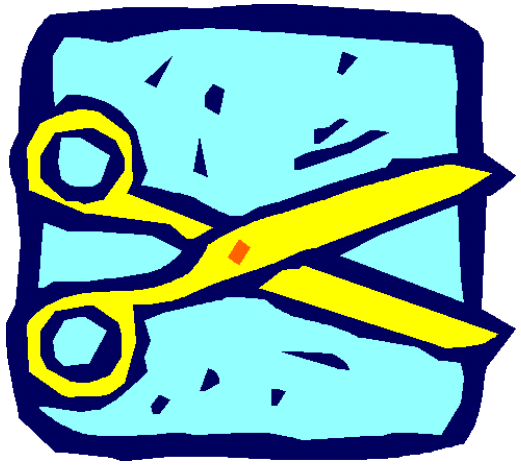


B would be easier because a jack uses a *screw*.

Now that Eduardo and his family have reached their new house, they need some help in unpacking their belongings. Help Eduardo decide on the best simple machine to use in each situation.

Eduardo needs to open the boxes his mom sealed with packing tape. What simple machine should he use?

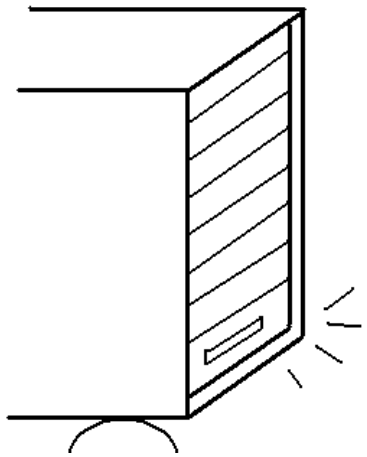


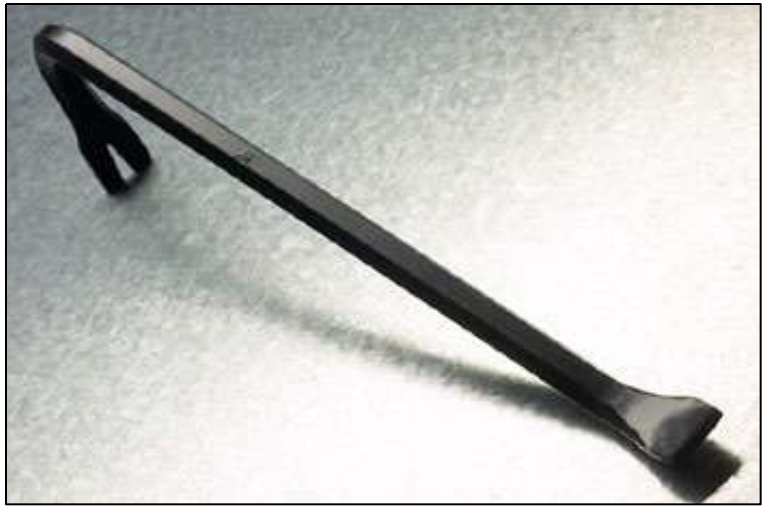


Eduardo should use a *wedge*

(probably a pair of scissors).

The door to the moving truck is jammed shut. What simple machine might Eduardo's father use to open it?

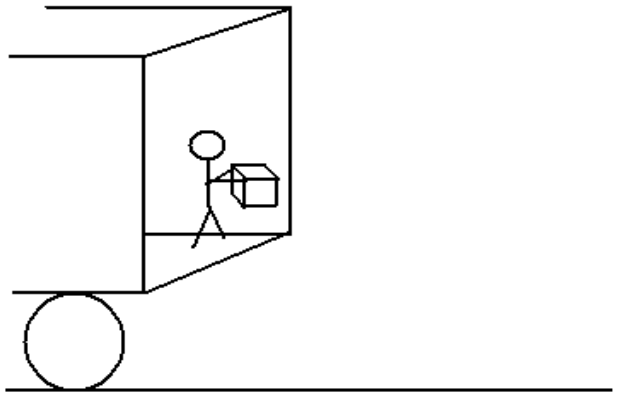




Eduardo's father should use a *lever*

(most likely a crowbar).

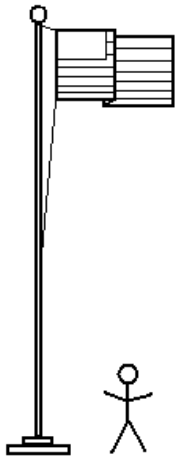
Eduardo needs to carry the boxes out of the moving truck. What simple machine will make this easier?



Eduardo needs an *inclined plane*

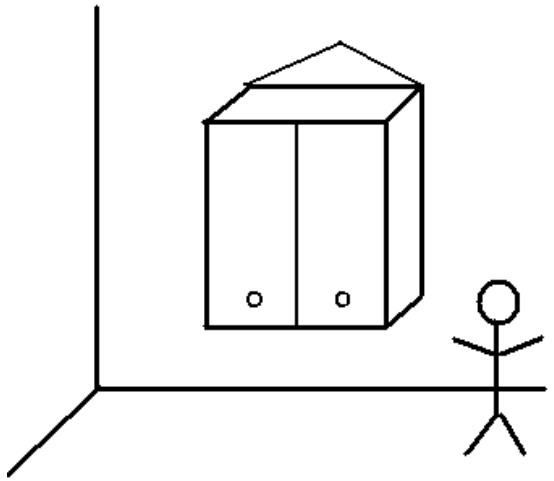
(a ramp) to carry the boxes out of the truck.

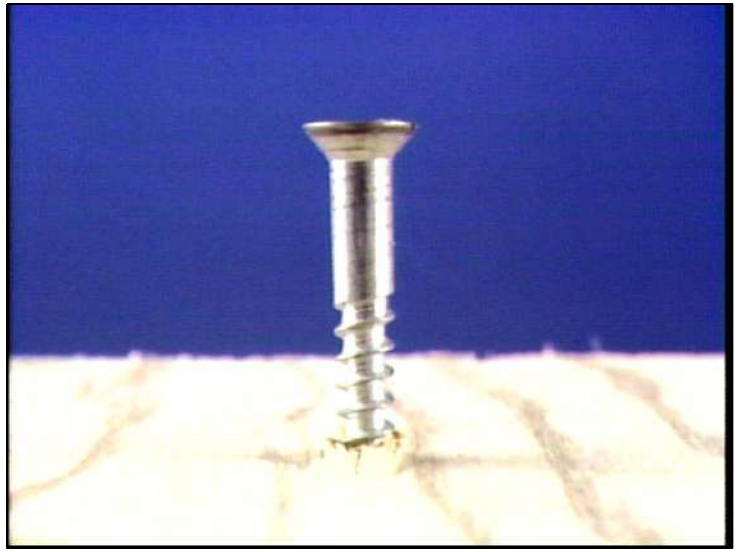
There is a flagpole outside Eduardo's new school. What simple machine could be used to raise and lower the flag?



A pulley is used to raise and lower the flag.

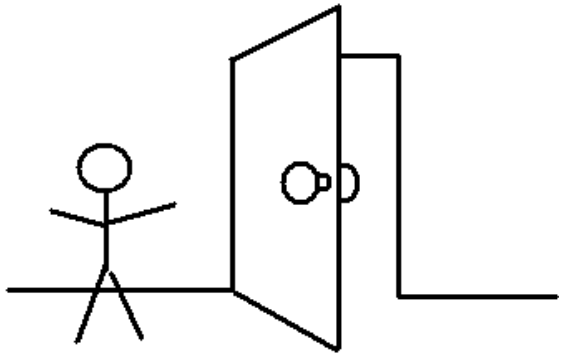
Eduardo's mom wants to hang a cabinet in the new kitchen. What simple machine might she use to attach it to the wall?





Eduardo's mom could use a *screw* to attach the cabinet to the wall and hold it in place.

Eduardo helped his father install doorknobs in the new house. What kind of simple machine is a doorknob?



A doorknob is a *wheel and axel.*