SIMPLE MACHINES

Junior Cougar Championship

Workshop 3

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What is a machine?

A machine is anything that changes the force (either direction or magnitude) required to perform an action.

- The ratio of force out to force in is called the **mechanical advantage**.
  - A MA <1 means we have to use a larger force than normal to perform the action--it is harder to perform the action.
  - A MA>1 means we have to use a smaller force than normal to perform the action, it's easier to perform the action.
  - A MA=1 means the magnitude of the force has not changed, but the direction to perform it may be changed.

What is a moment?

A moment is calculated by force times distance. For a machine, this product is always constant. This means we can rewrite mechanical advantage also in terms of distances.

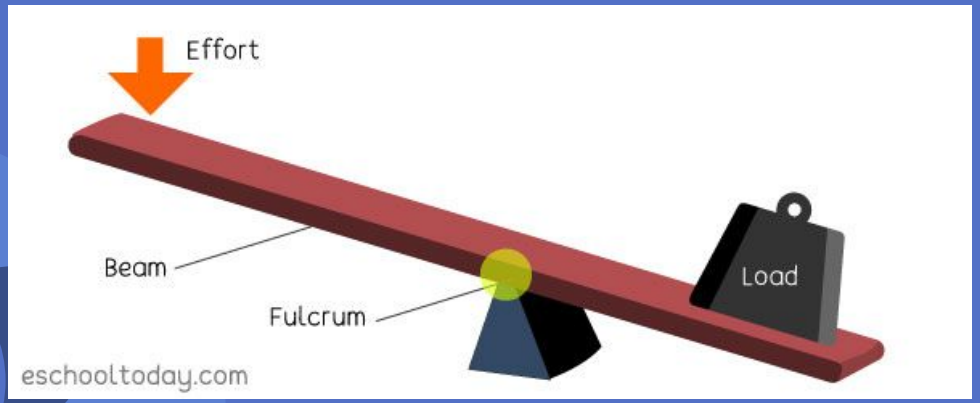
- $M = F_{IN} D_{IN} = F_{OUT} D_{OUT}$
- Force times distance is also known as **work**.

- So the **mechanical advantage** is also equal to the ratio of distance in to distance out.

01

LEVERS

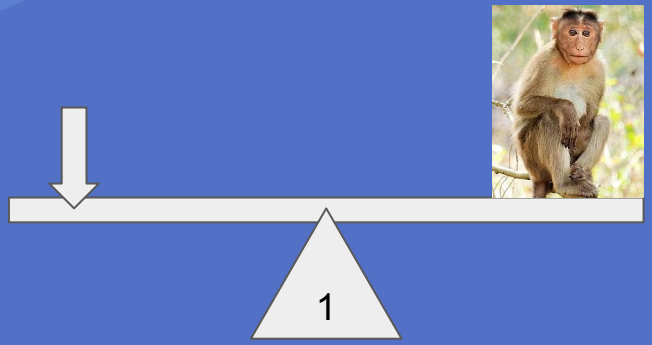
What is a lever?

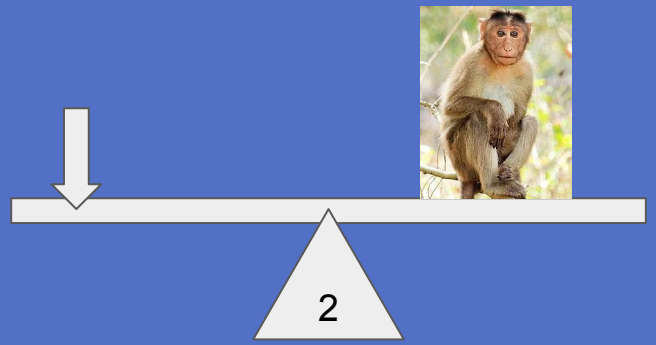


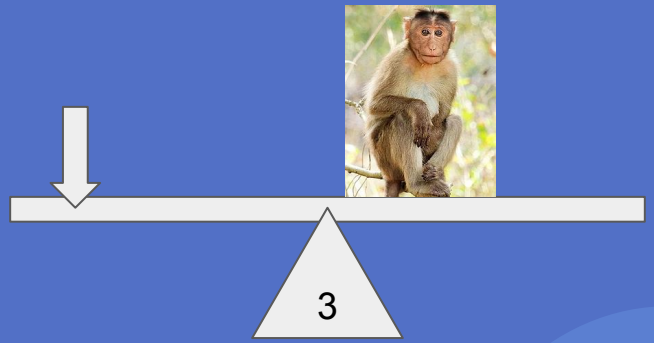
Lever

A simple machine made of a rigid bar and a fulcrum

Which monkey is the hardest to lift?







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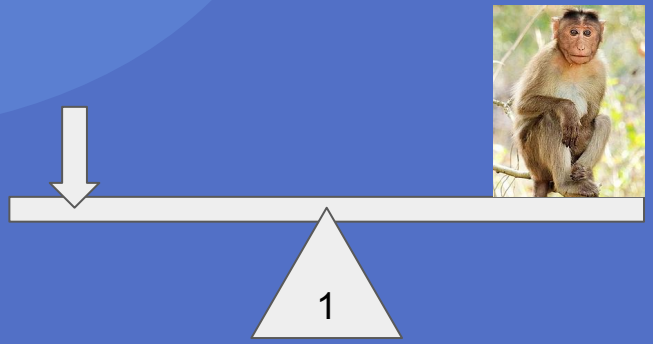
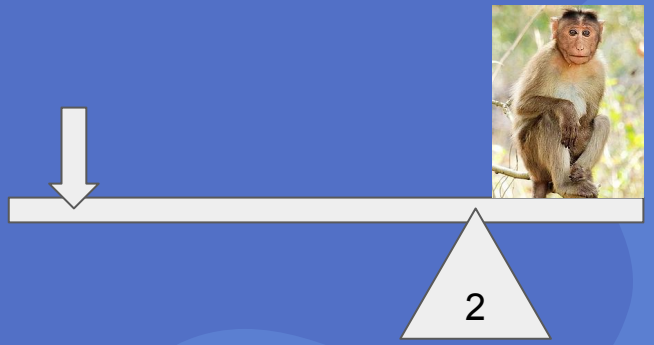
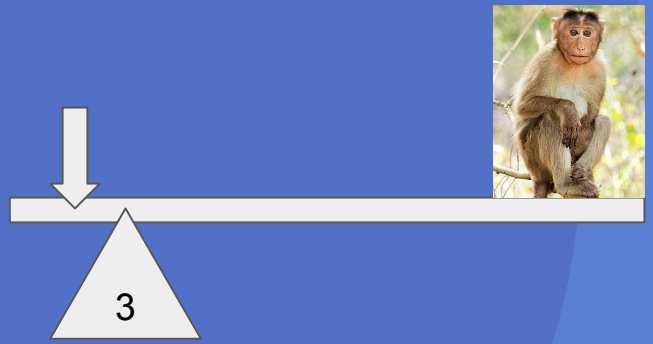
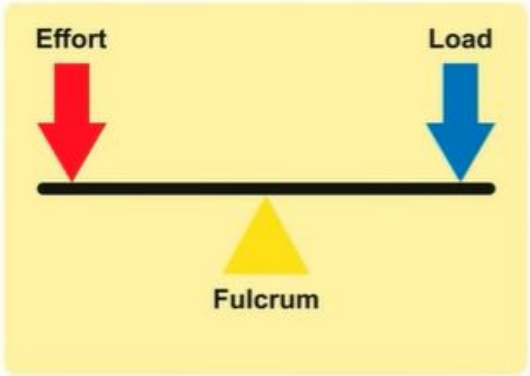


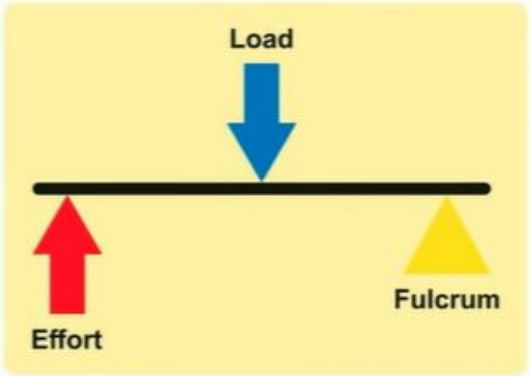




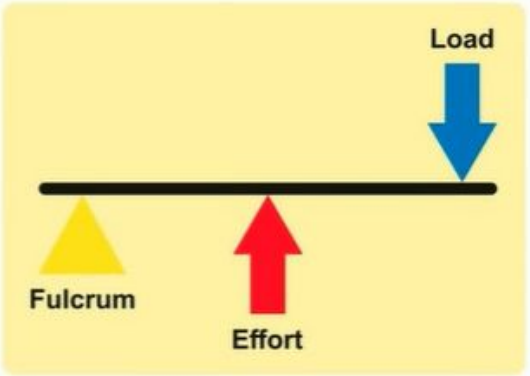
1st Class Lever



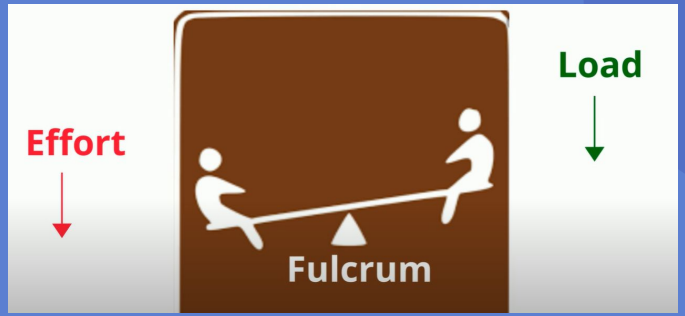
2nd Class Lever



3rd Class Lever

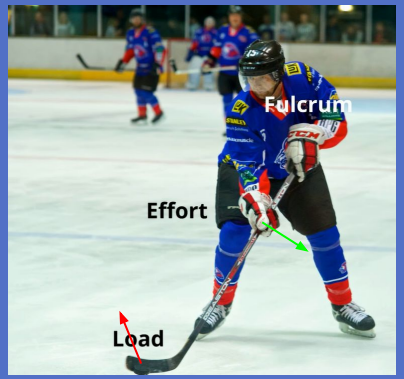


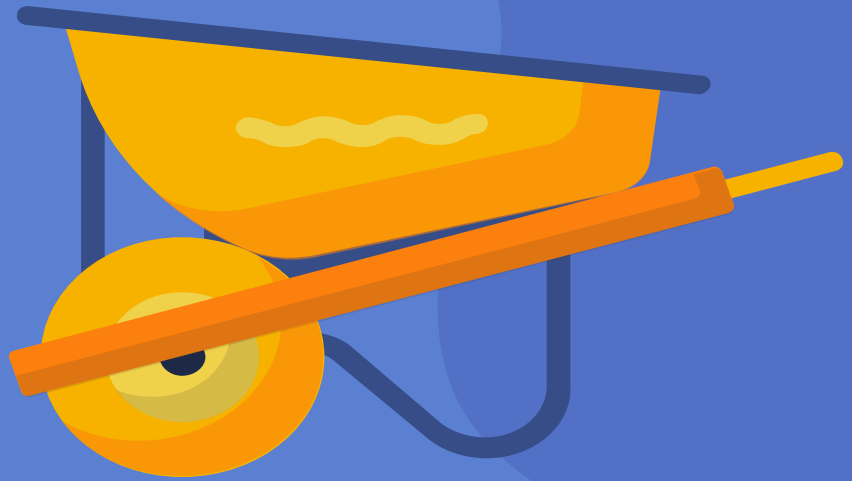
EXAMPLE: See-Saw



EXAMPLE: Wheelbarrow

EXAMPLE: Hockey Stick

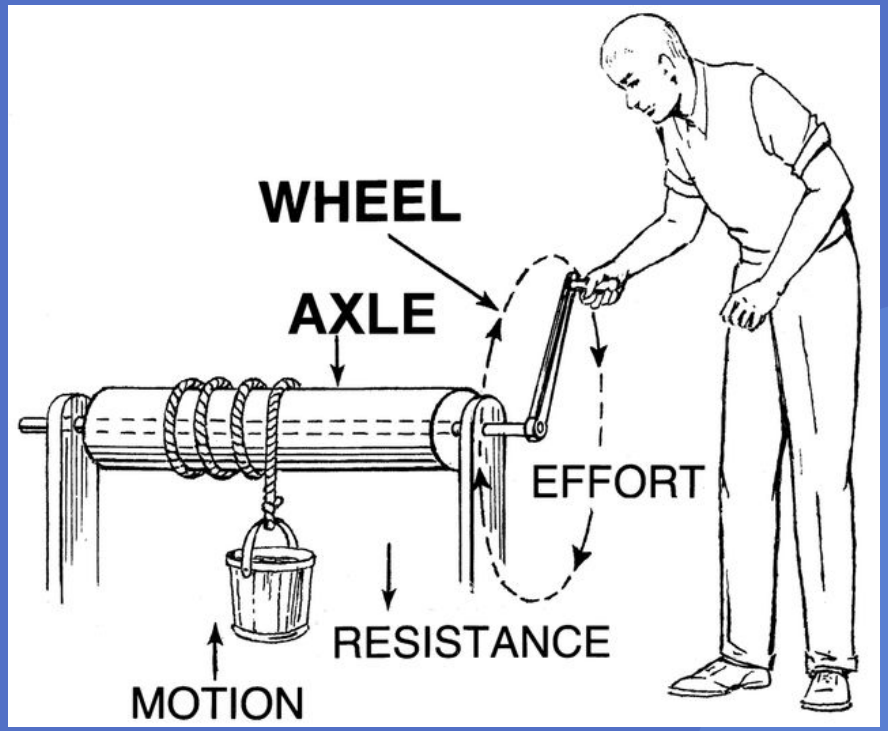




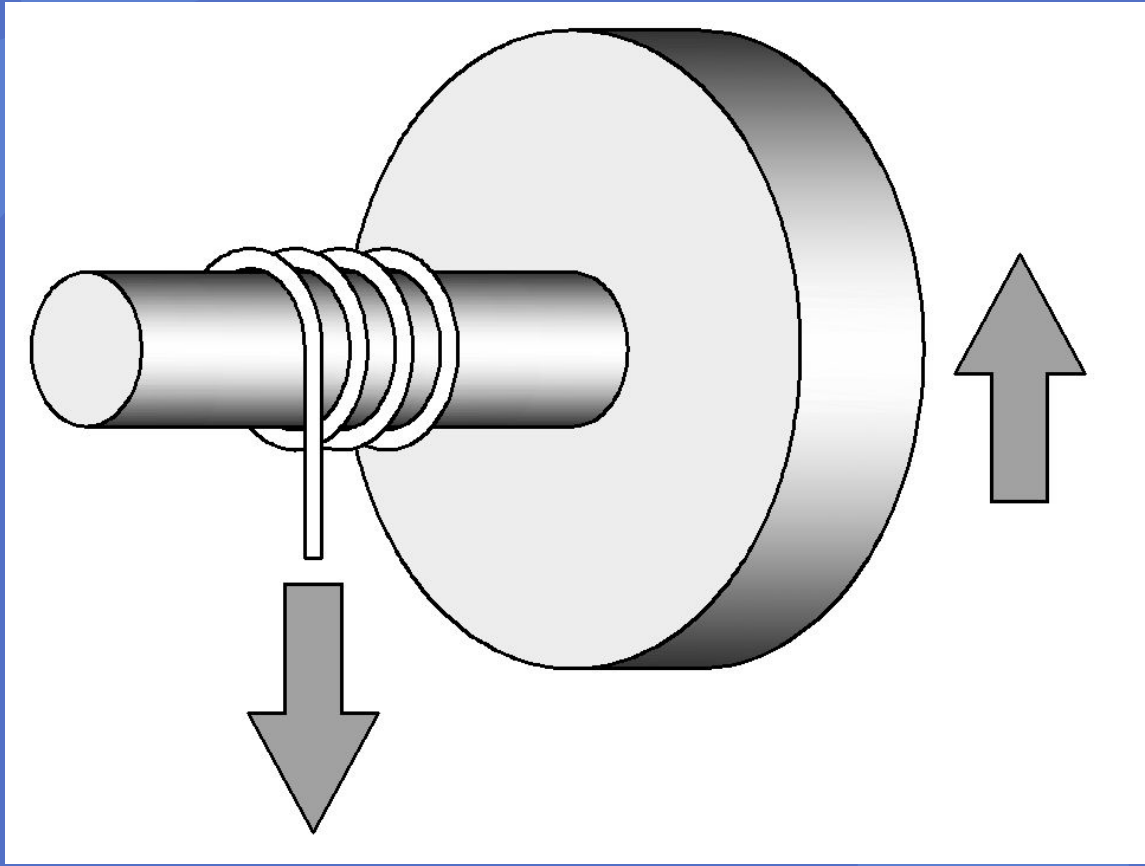
02
WHEEL AND AXLES

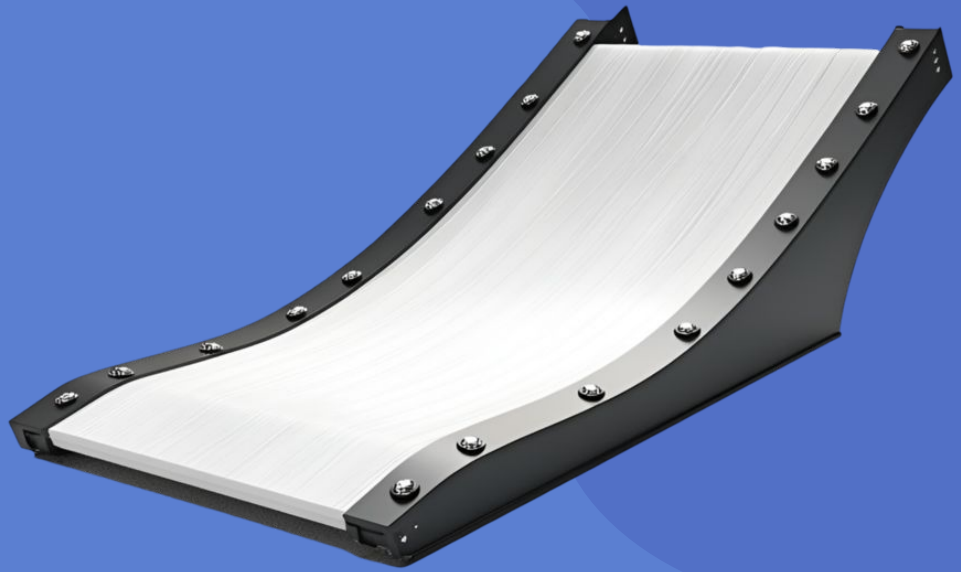
What are wheels and axles?

Wheels and axles can switch between spinning and sliding motion.



Which wheel spins faster?



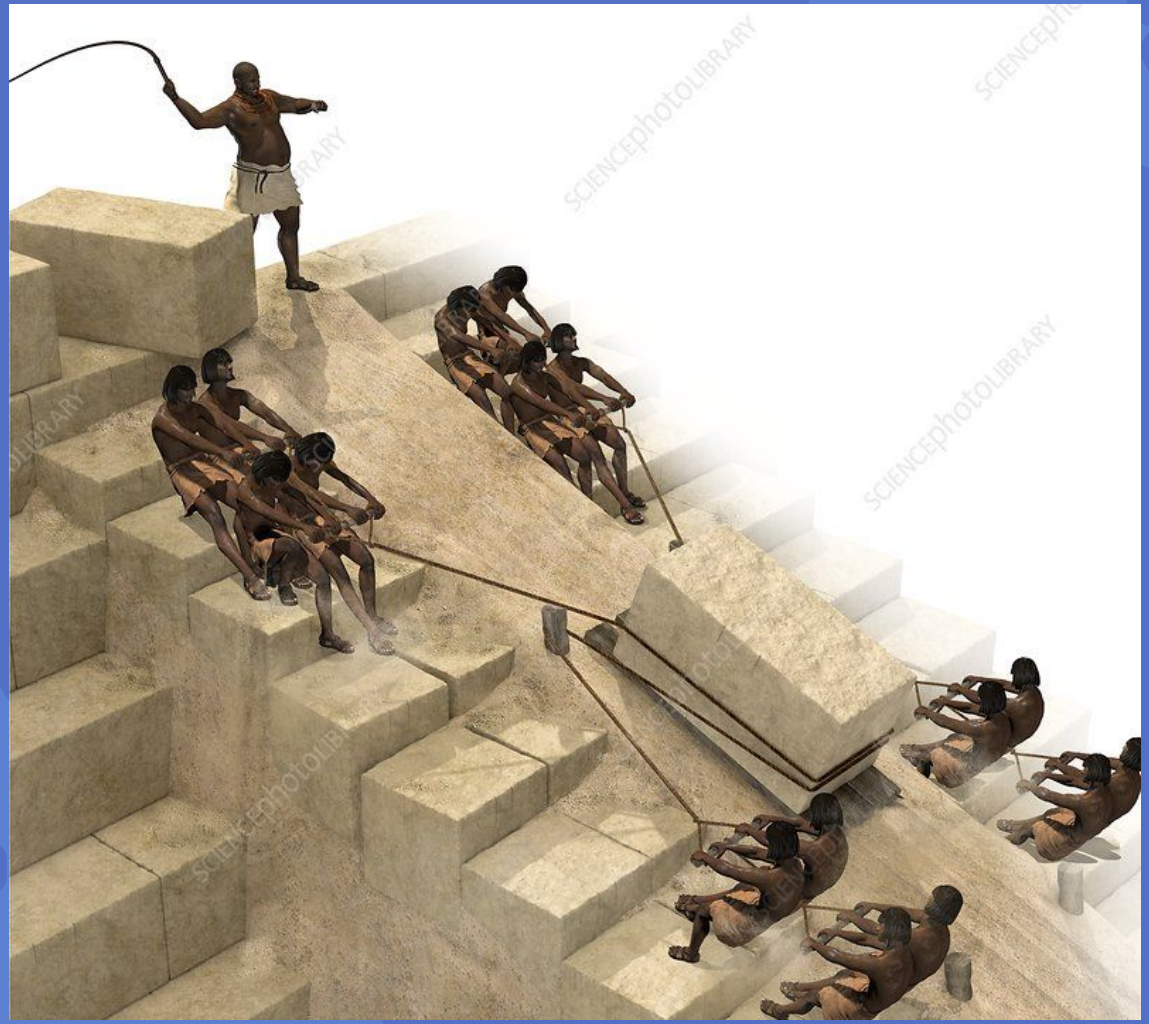


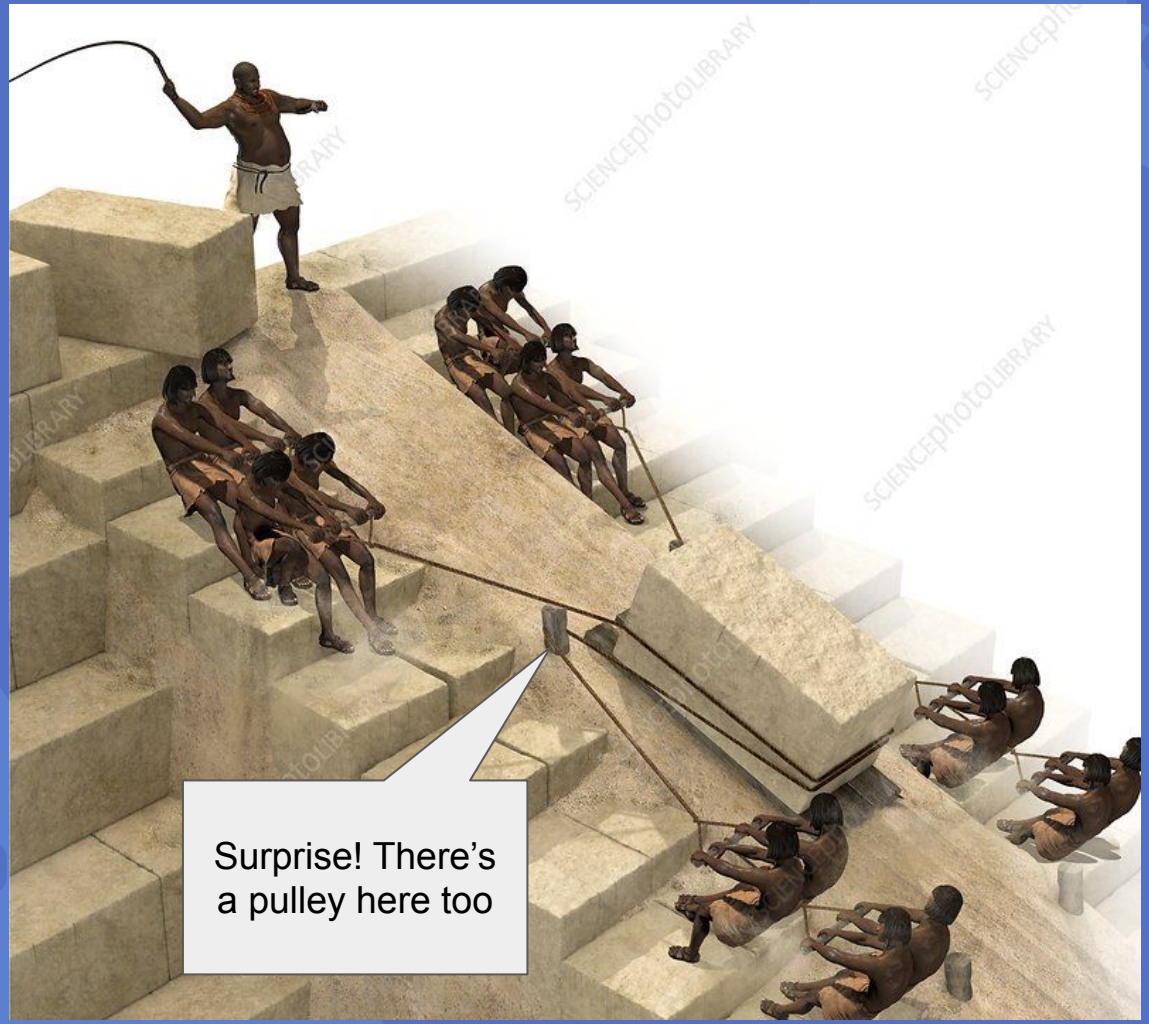
03
INCLINED PLANES

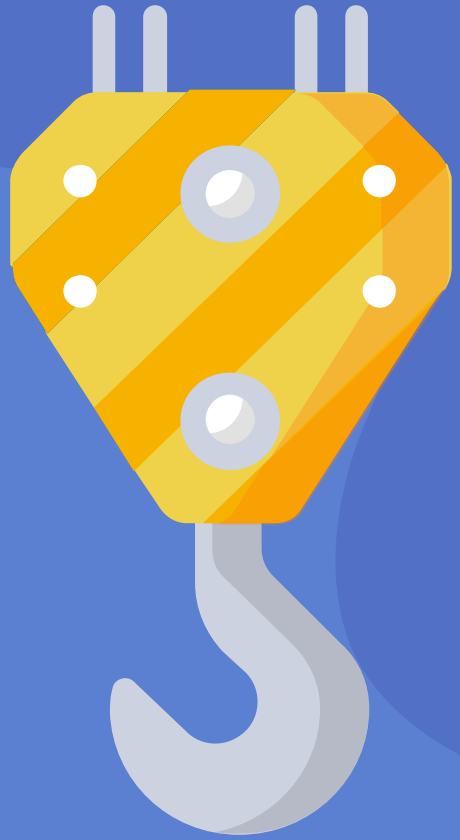
What are inclined planes?

Which ramp is longer?

Which ramp is harder to push the box up?




Surprise! There's a pulley here too

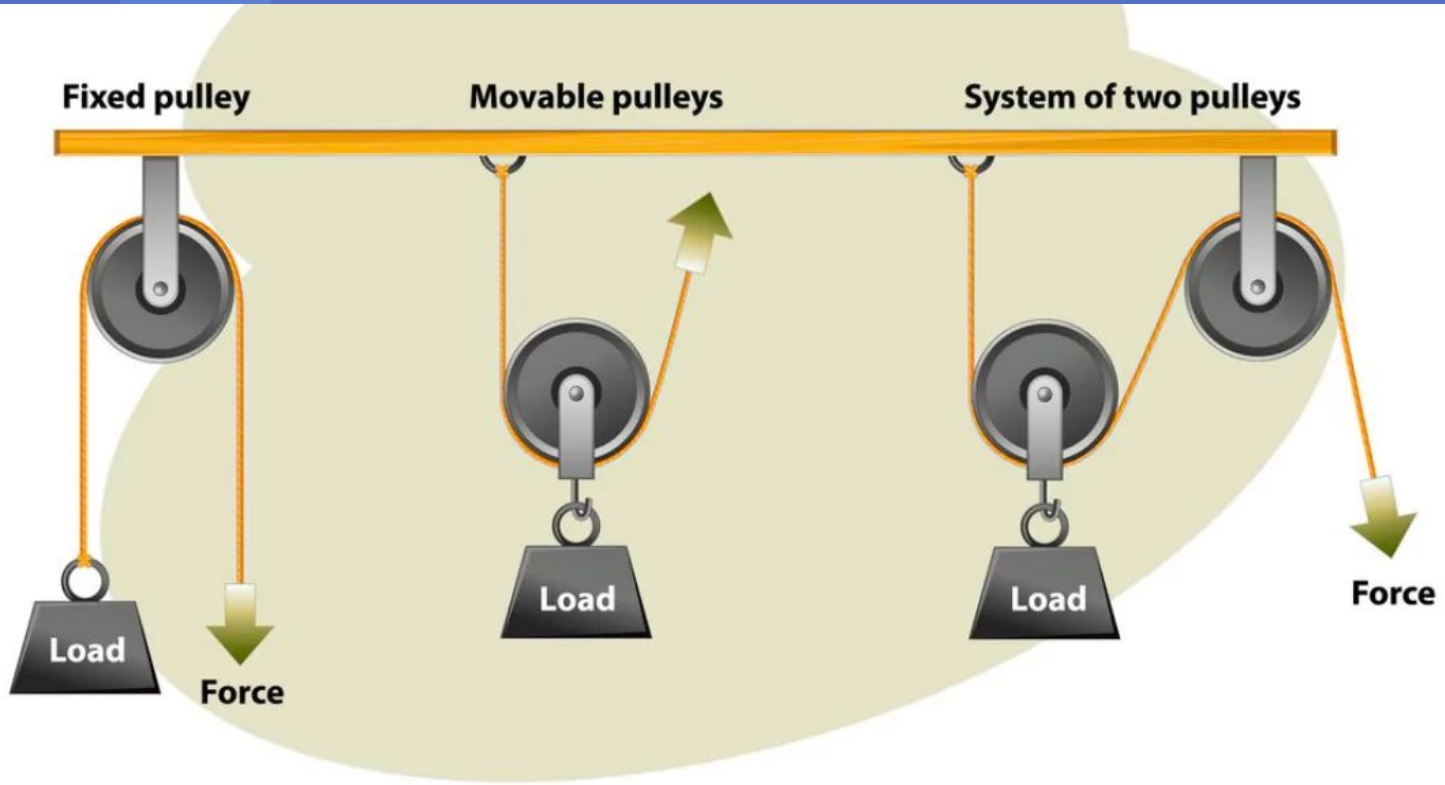


04

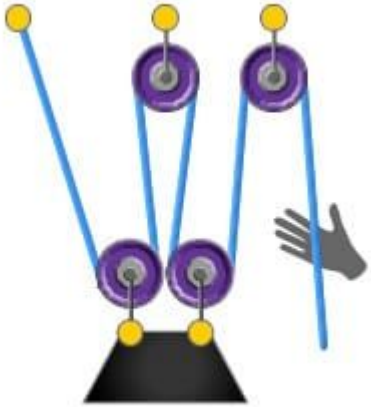
PULLEYS

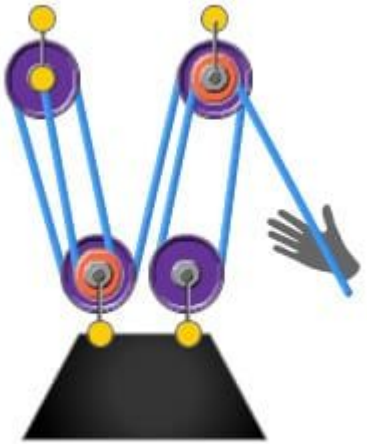
What are pulleys?

What happens if we make the wheel bigger?


Fixed pulley
Movable pulleys
System of two pulleys
Load
Force
Load
Load
Force

What if we added more wheels?

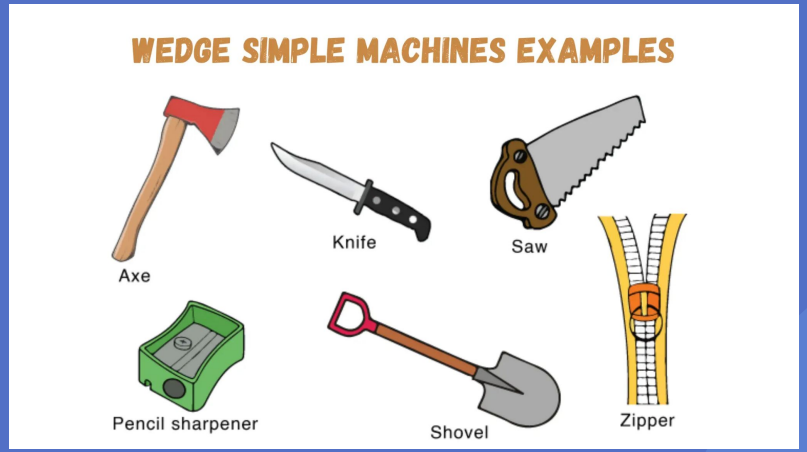


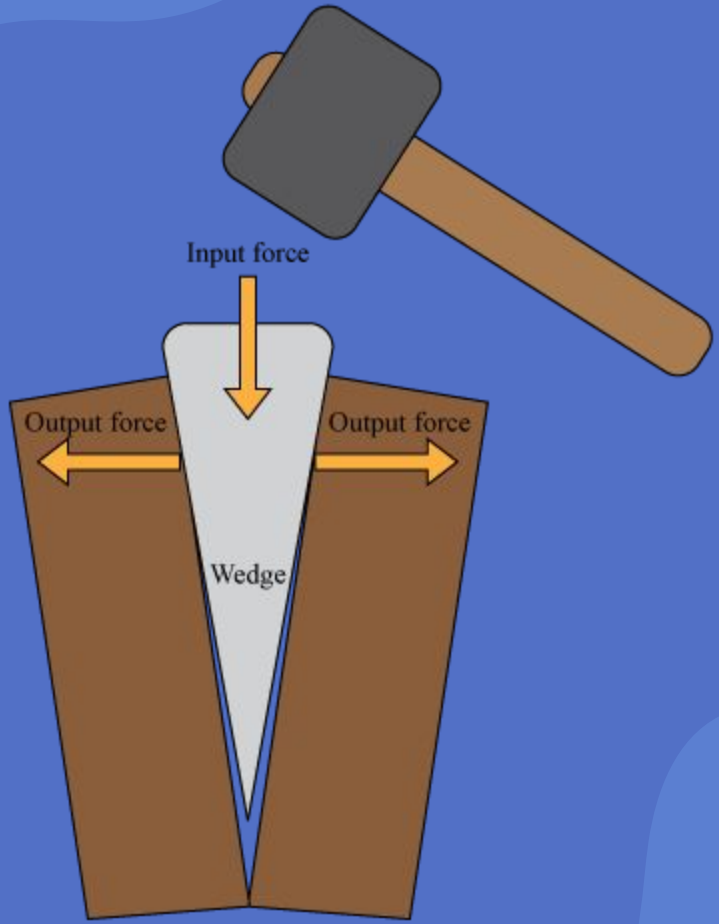


05

WEDGES

What are wedges?




Input force
Output force
Output force
Wedge

Which wedge is longer?

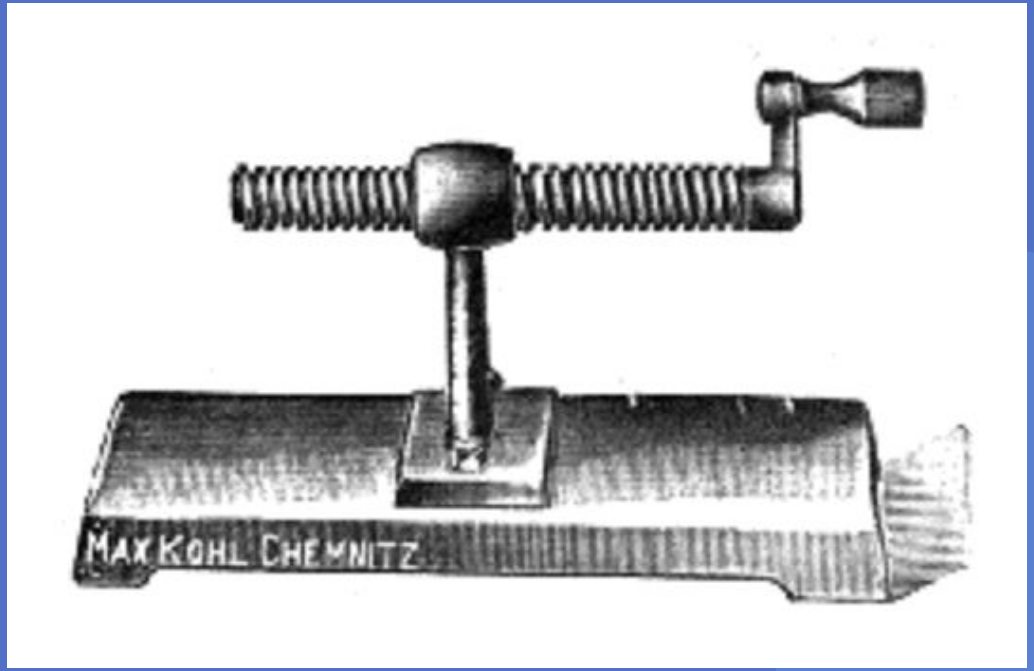
Which wedge is harder to push in?

06

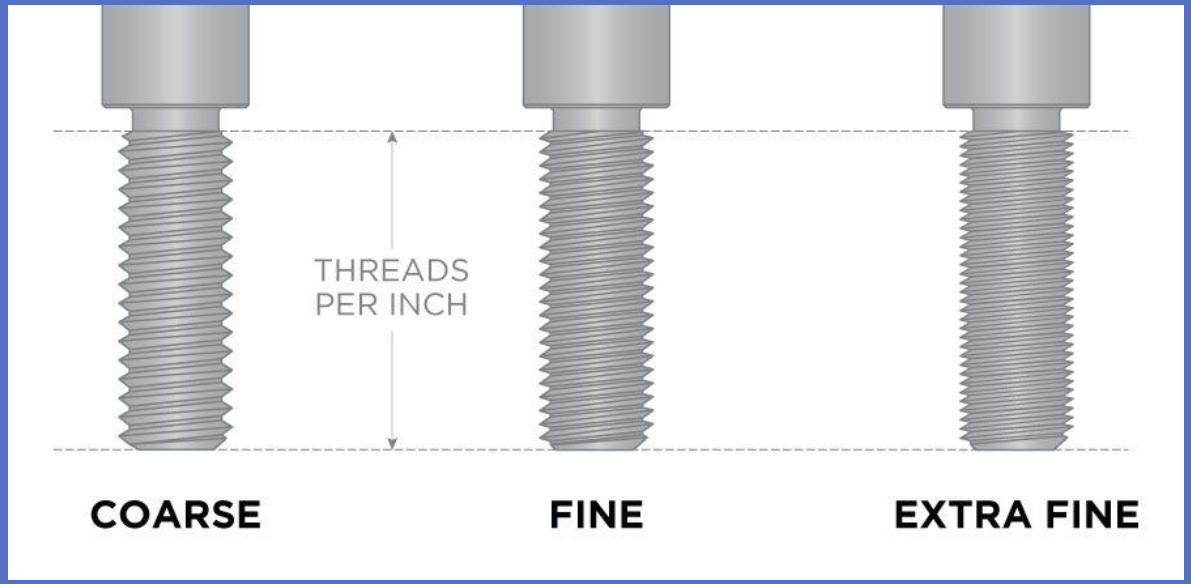
SCREWS

What are screws?

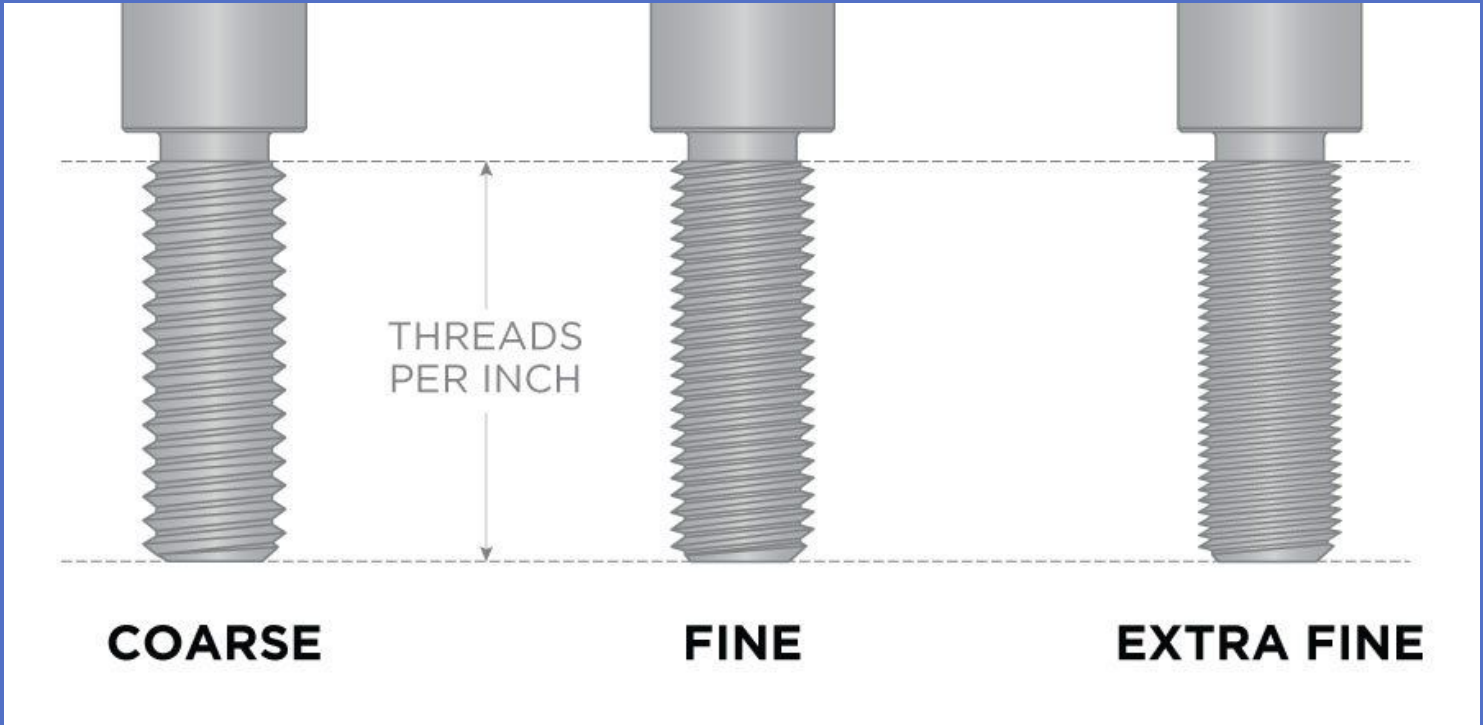
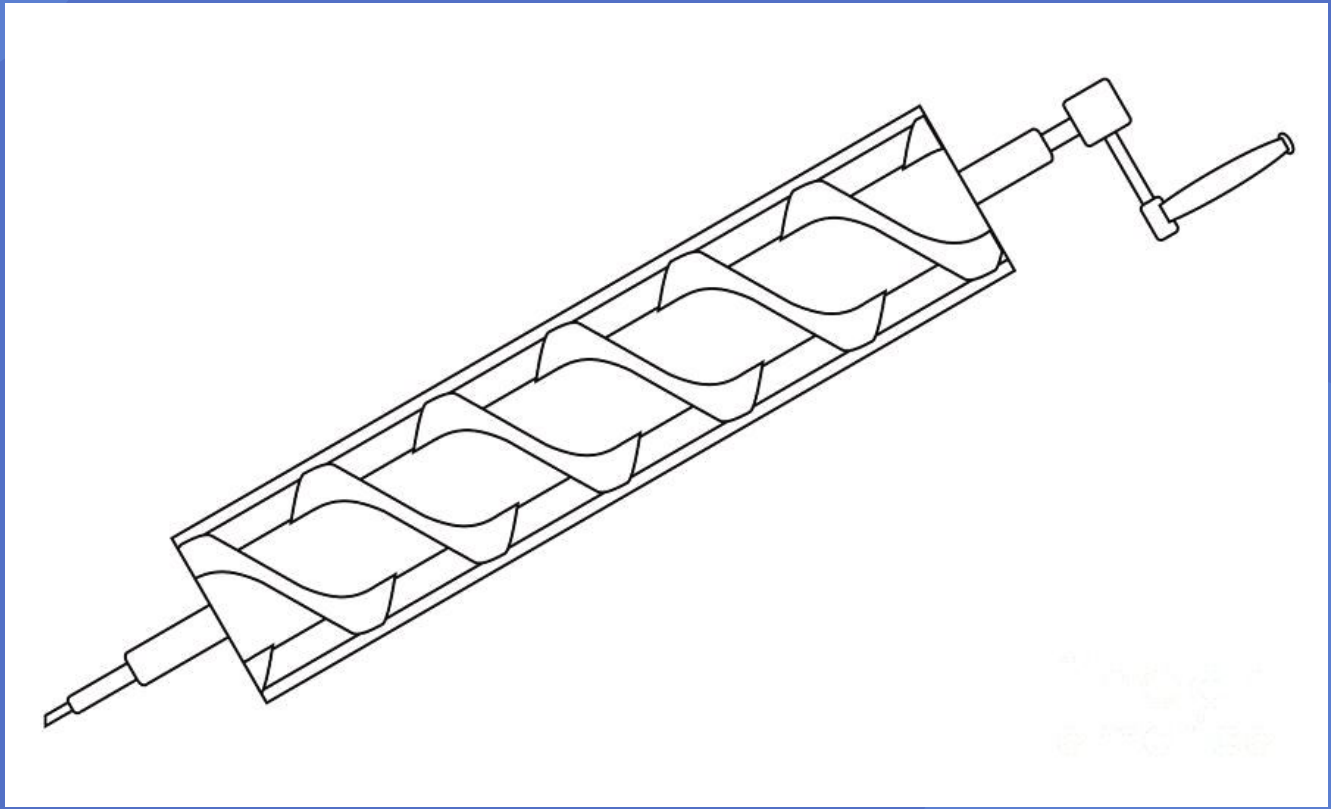
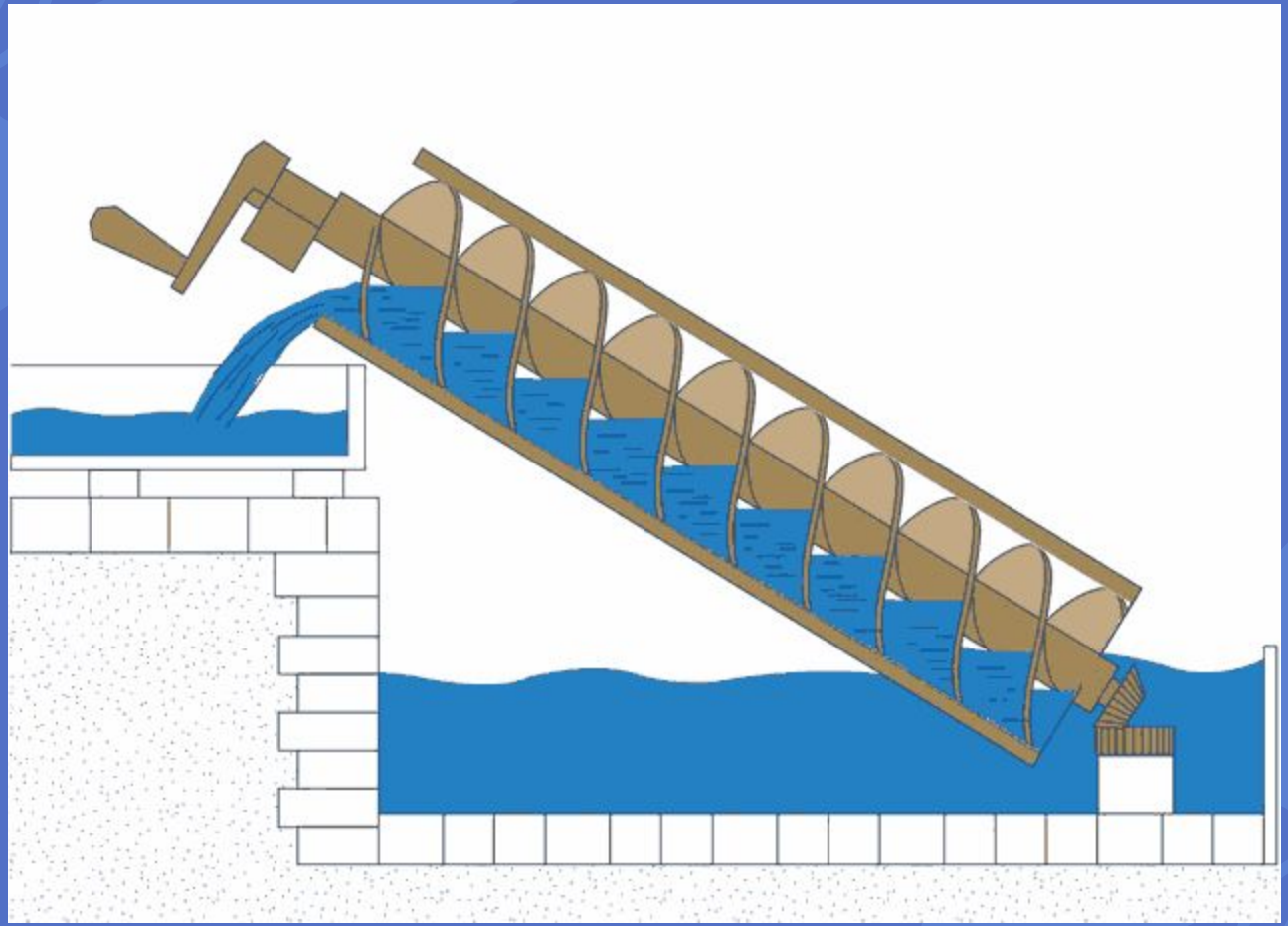
Screws also turn spinning motion into sliding motion!



Which screw needs to turn the most to get all the way in?



Which screw is the hardest to turn?



How does this pump water?