



TeachEngineering

STEM Curriculum for K-12

Powerful Pulleys



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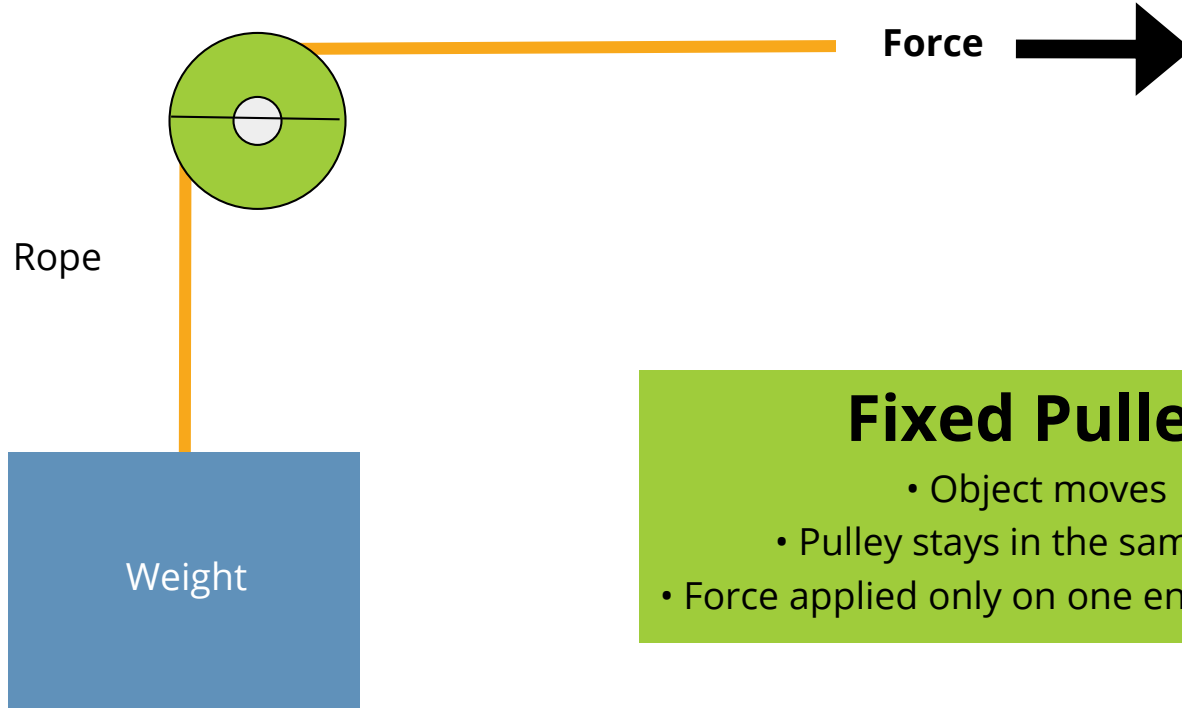


What is a pulley?

- ❑ A pulley is a wheel
- ❑ A pulley uses rope that goes around the wheel (often in a groove)
- ❑ The rope attaches to objects
- ❑ The other end of the rope has a **force** applied
 - Applied force is a push or pull



Fixed Pulley



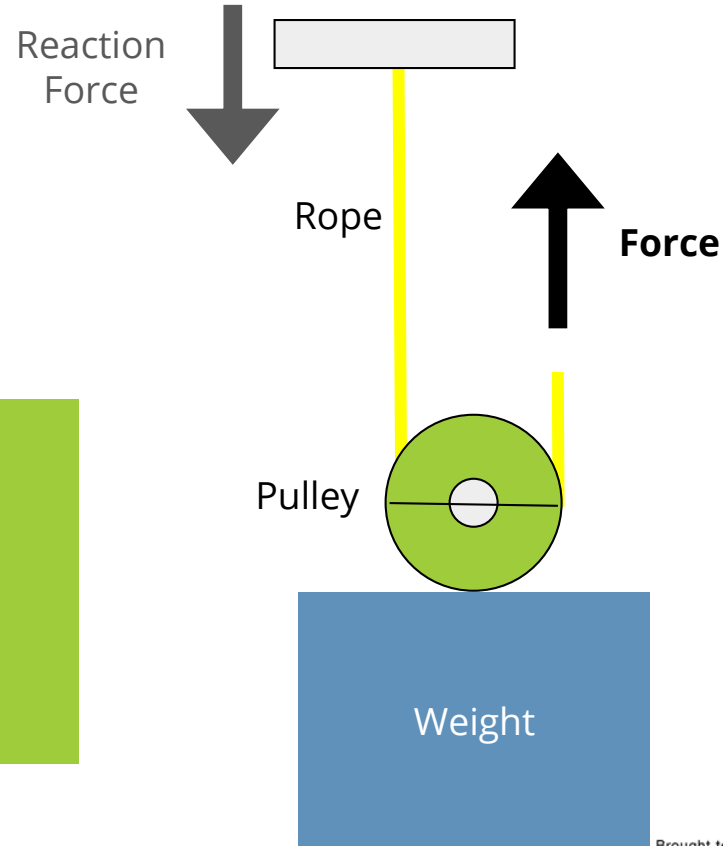
Fixed Pulley

- Object moves
- Pulley stays in the same spot
- Force applied only on one end of the rope

Moveable Pulley

Movable Pulley

- Pulley is attached to object
- Pulley and object move together
- Rope is attached to something that does not move
- Force applied to other end of rope



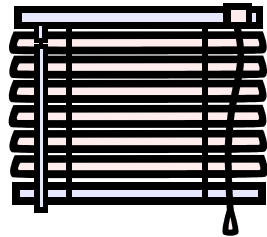
Who has seen pulleys?

...Pulleys are all around us...



← Elevator

Flagpole →



← Window shades and blinds

More examples



← Cranes ↓



← Sails
and
fishing
nets

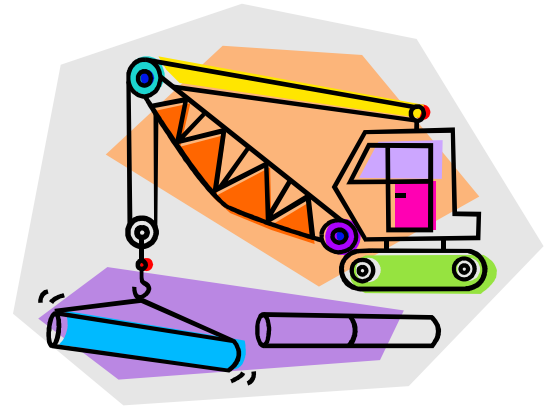
+ clothes lines

+ gym training equipment

+ rock climbing gear

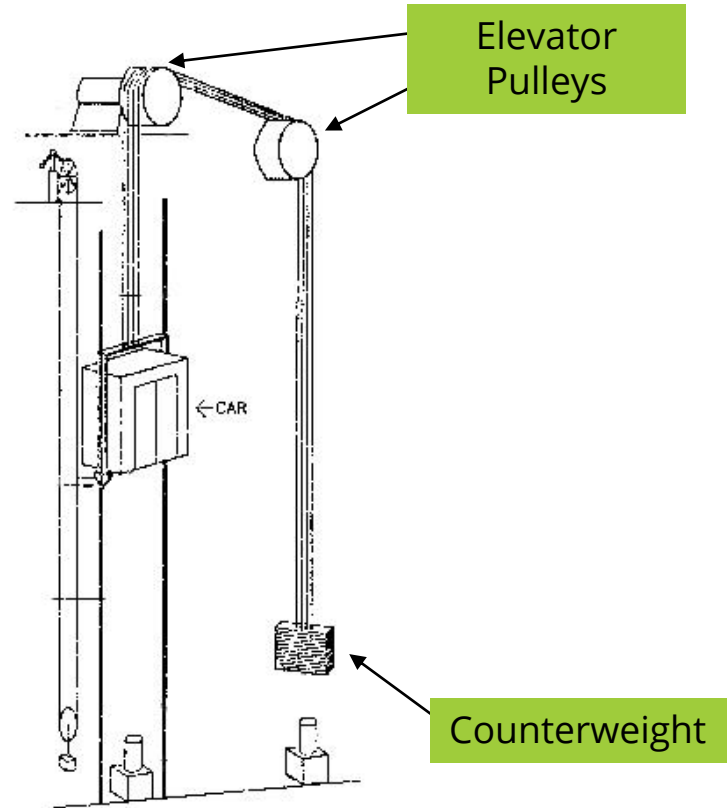
Why use pulleys?

- ❑ Makes lifting things easier
- ❑ Pulleys **redirect force**
 - Enables us to use gravity to help us (it is usually easier to fall down than to lift something up)
- ❑ Using several pulleys reduces the force required to lift an object
 - We have to use more rope and make the rope go further
 - **Mechanical Advantage:** More distance traveled, but less force required

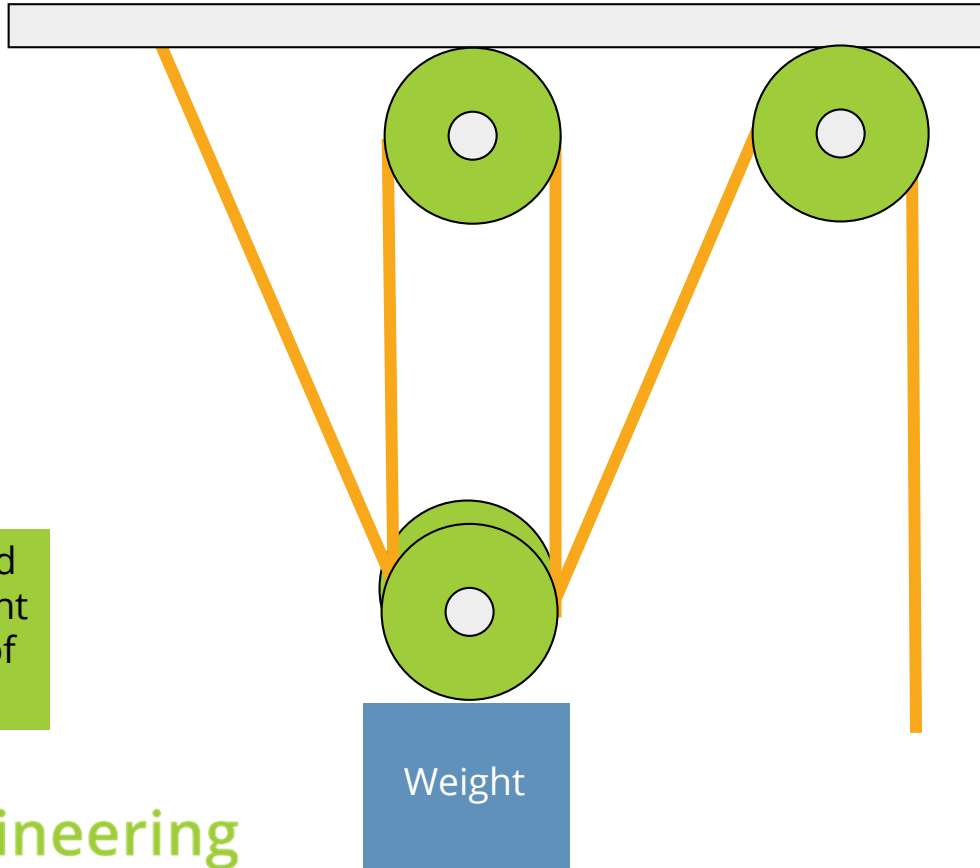


Using Gravity

- ❑ Easier to pull down than up
- ❑ Elevators use gravity
 - Counterweight on the other side of the cable
 - Gravity already applying force on counterweight
 - Less powerful motor required



System of Pulleys

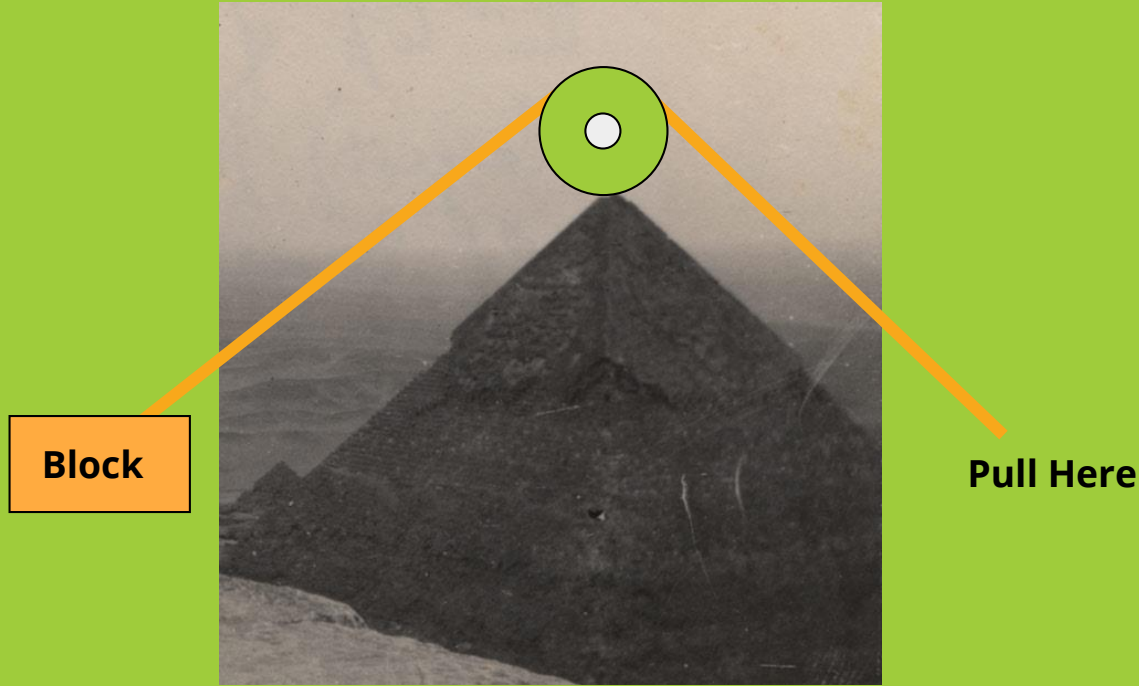


The force needed to raise this weight is $\frac{1}{4}$ the weight of the object

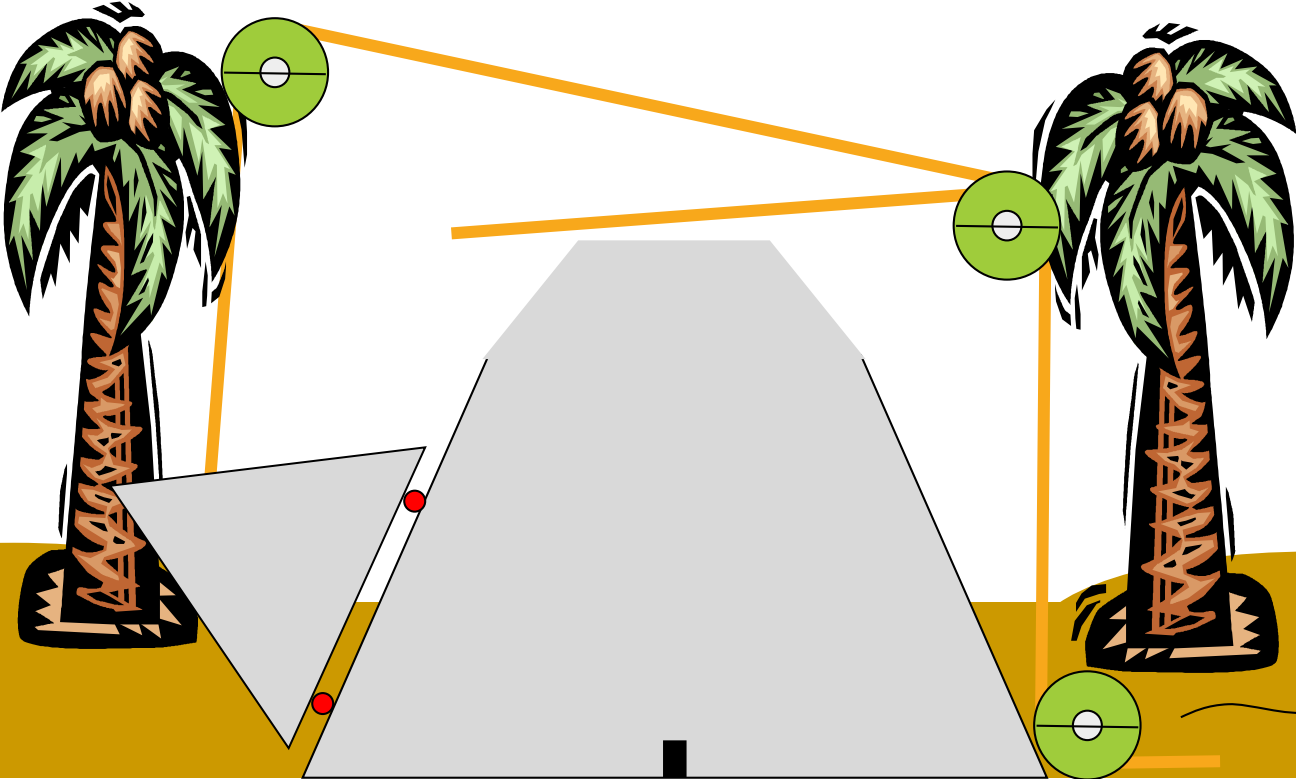


How do they help us?

How do they help us build the pyramids?



Building the Pyramids



Vocabulary & Definitions

Force: A push or pull on an object.

Fixed pulley: A pulley attached to a fixed point with the rope attached to the object.

Movable pulley: A pulley attached to the object itself, with one end of the rope attached to a fixed point.

Redirect force: To change the direction of a push or pull to gain advantage over a task.

Mechanical advantage: The advantage gained by using simple machines; trading distance for force.

References

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<http://www.fhwa.dot.gov/environment/fspubs/05232810/page16.htm>

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