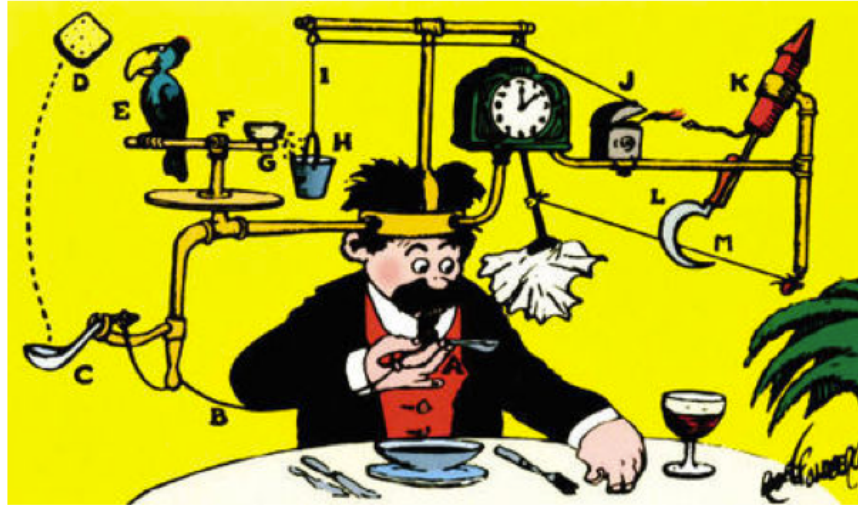


# ACTION-REACTION ENGINEERING DESIGN

Created by Lori Hashimoto on July 2, 2015  
STEM Pre-Academy  
Office of the Vice President for Research and Innovation  
University of Hawaii System

## “RUBE GOLDBERG” MACHINE



www.huffingtonpost.com

RUBE GOLDBERG MACHINE – complicated machine to create simple tasks

- Ask, how would you \_\_\_\_\_ (whatever the last step of your example machine is).
- Show sample rube goldberg machine made to \_\_\_\_\_.

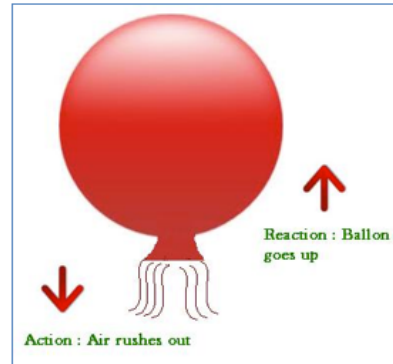
Ask what was happening? How?

# ACTION → ← REACTION

## NEWTON'S 3<sup>RD</sup> LAW OF MOTION



[www.theveryspringandroot.com](http://www.theveryspringandroot.com)



[www.physicstutorvista.com](http://www.physicstutorvista.com)

EXAMPLE – EASY ONES FIRST

THEN 2 PPL PUSHING AGAINST EACH OTHER, NOT MOVING.

Ask what would happen if one person moved out of the way?

Other examples of action/reaction – Ask them about one on the sample paper airplane machine

# WHAT MAKES IT WORK?



[www.aloha-hawaii.com](http://www.aloha-hawaii.com)



[www.allonrobots.com](http://www.allonrobots.com)



[www.powersolindia.com](http://www.powersolindia.com)



[www.oaolcdn.com](http://www.oaolcdn.com)

ENERGY – ENERGY IS EVERYWHERE.

Horses – converts food energy to biomechanical energy to move people from place to place

Roomba – converts chemical energy (battery) to clean floor

Wind turbine – converts wind energy to mechanical energy which then drives a shaft that turns a generator to create electricity

Car – converts chemical energy (fuel, battery, water) into mechanical energy to move people and things from place to place

# ENERGY TRANSFER

ENERGY **CANNOT** BE CREATED OR DESTROYED...

IT CAN ONLY BE CHANGED  
FROM ONE FORM TO ANOTHER.

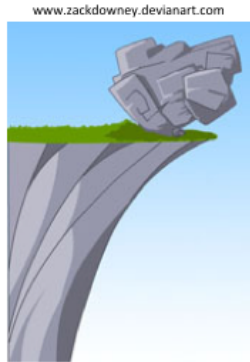
Each step is an energy transfer.

Ask for an example – pick an object that utilizes energy to move or do something (discuss and backtrack where the energy was transferred from).

Identify the energy transfers in the simple machine.

Give 2 examples first.

# FORMS OF ENERGY



**Gravitational  
Potential**



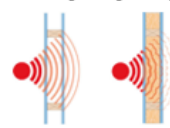
**Electric Potential**



**Chemical Potential**



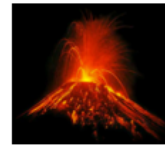
**Elastic Potential**



**Sound**



**Kinetic**



**Thermal/Heat**

Gravitational – ask, if table wasn't here, what would happen to this object? Ans – fall to the ground  
Chemical – also food  
Elastic – also springs  
Thermal – anything hot

# THE 6 SIMPLE MACHINES

MAKING OUR LIVES EASIER



<http://www.edheads.org/activities/simple-machines/glossary.shtml>

[www.teacher.scholastic.com](http://www.teacher.scholastic.com)

After each machine – ask them to identify it on your example action-reaction contraption

- Inclined Plane:
- Pulley:
- Lever:
- Wheel & Axle:
- Screw:
- Wedge:

# THE 6 SIMPLE MACHINES

IN EVERYDAY LIFE



A sloped surface to change the height of an object with less force. However, more horizontal distance is needed.

Skateboard Ramp

Stairs/Ladders

Slides



# THE 6 SIMPLE MACHINES

IN EVERYDAY LIFE



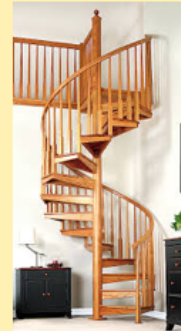
[www.teacher.scholastic.com](http://www.teacher.scholastic.com)



[Tvdsb.ca](http://Tvdsb.ca)



[www.ck12.org](http://www.ck12.org)



[Simplehomed.blogspot.com](http://Simplehomed.blogspot.com)

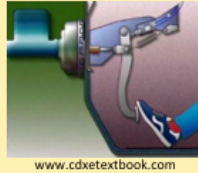
An inclined plane wrapped around a cylinder.

Things can move up/down or side-to-side taking up minimal space (unlike a regular inclined plane).

Holds things in place.

# THE 6 SIMPLE MACHINES

IN EVERYDAY LIFE



Material used along with a fulcrum to lift or push down on an object.

Uses less force than trying to directly lift the object.

The further the leverarm is from the fulcrum, the less force needs to be applied to move the object.

- (Can add math here with the lever-arm ratio equations)
  - [http://www.school-for-champions.com/machines/simple\\_machines.htm#.VZrBvPIVhBd](http://www.school-for-champions.com/machines/simple_machines.htm#.VZrBvPIVhBd)

# THE 6 SIMPLE MACHINES

IN EVERYDAY LIFE



[www.teacher.scholastic.com](http://www.teacher.scholastic.com)



[www.beaconlearningcenter.com](http://www.beaconlearningcenter.com)



[www.ed101.bu.edu](http://www.ed101.bu.edu)



[Solpass.org](http://Solpass.org)



[Idahoptv.org](http://Idahoptv.org)

Splits material, or forces 2 materials apart (door stop).  
Made of 2 inclined planes.

# THE 6 SIMPLE MACHINES

IN EVERYDAY LIFE



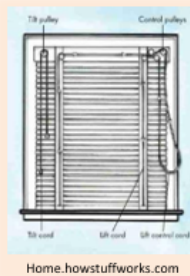
A wheel with a cylinder in between that the wheel rotates around.  
Translates rotational motion into linear motion.  
The wheel spins more, but required less force to move an object.

# THE 6 SIMPLE MACHINES

IN EVERYDAY LIFE



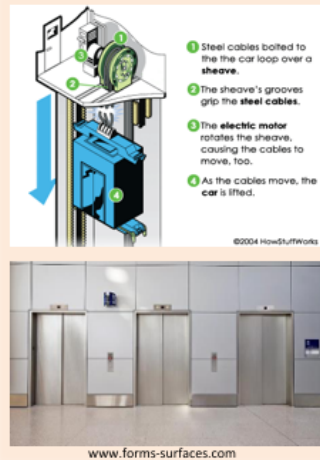
Window  
Blinds



Flag Poles



Elevators



A type of wheel and axle.

"Wheel has 2 raised edges so a rope/string can run along it without coming off."

<http://scienceforkids.kidipede.com/physics/machines/pulley.htm>

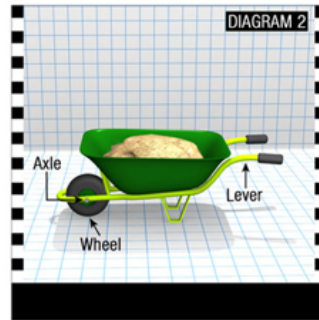
Used to change the direction of a force or make it easier to lift objects (whether it is too heavy, too high, or too low).

# COMPOUND MACHINES

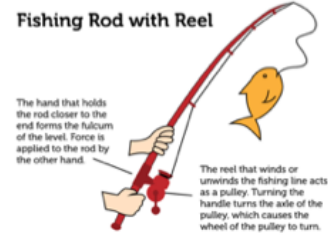
A TOOL WITH 2 OR MORE SIMPLE MACHINES



[learningideasgradesk-8.blogspot.com](http://learningideasgradesk-8.blogspot.com)



[www.engquest.org.au](http://www.engquest.org.au)



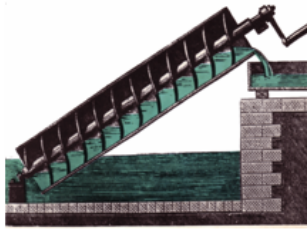
[www.ck12.org](http://www.ck12.org)

# Ancient Civilizations

## Inventors of the Simple Machines



**Egyptian Inclined Plane**  
<https://www.wikia.com>



**Archimedes' Water Screw**  
[Oliversalt.wordpress.com](http://Oliversalt.wordpress.com)



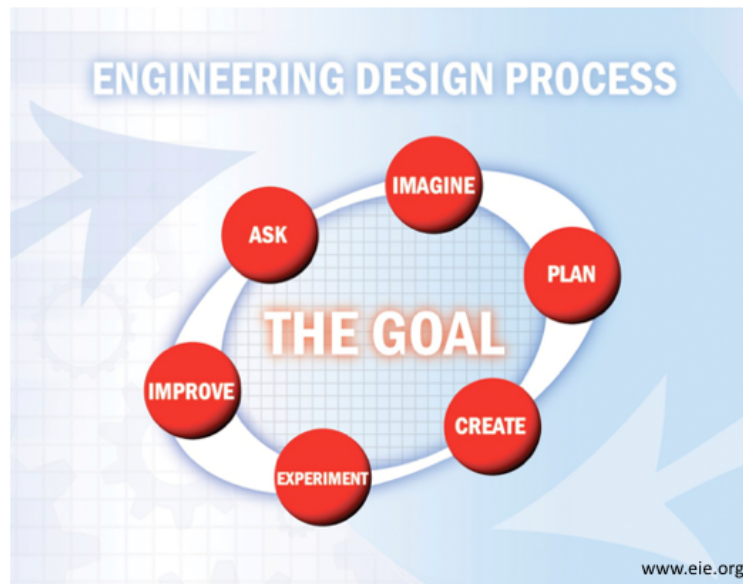
**Hunting Tools (wedges) from long ago**  
[Newsroom.unl.edu](http://Newsroom.unl.edu)



**Sumerian Wheel**  
[www.jenkinsancienthistory.weebly.com](http://www.jenkinsancienthistory.weebly.com)

With the advancement of technology (no matter how “simple” or complex), society evolves. We can see that today as technology is advancing so quickly.

# ENGINEERING DESIGN PROCESS

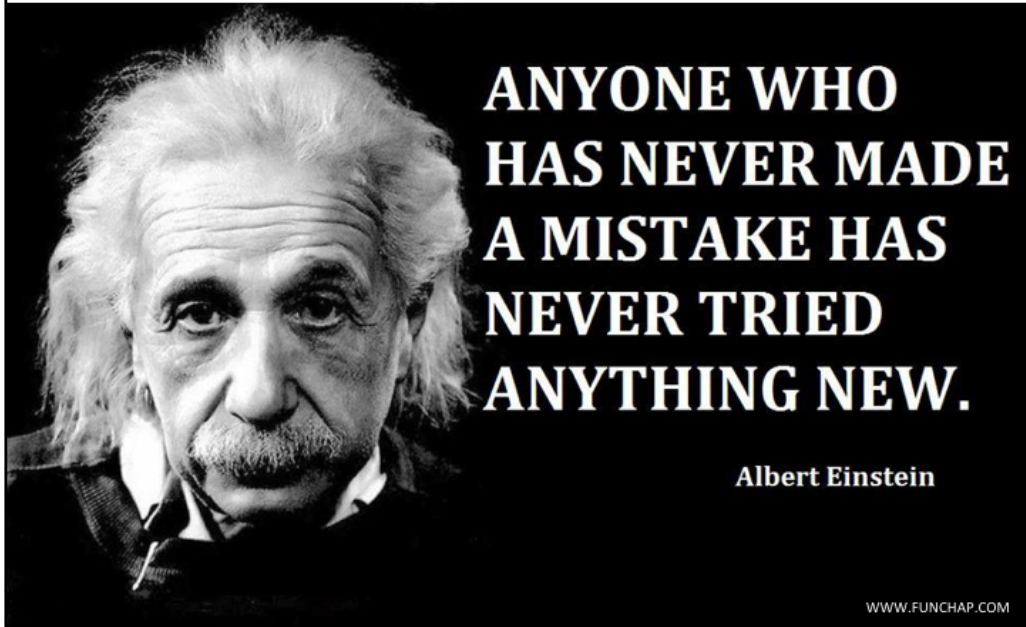


Teachers, please feel free to replace with the engineering design process your school has adopted or that you are most comfortable using. Any engineering design process has the same basic components, just called different things.

[www.eie.org](http://www.eie.org) has a great reference guide to the engineering design process.



LEARN FROM PROBLEMS & FIX THEM!



It's okay to make mistakes. It's part of the engineering design process. However, be sure to use what you learn from each mistake to think about and try out a different solution.



<https://www.youtube.com/watch?v=nfYJfHTkimk#t=226>

**NOW IT'S YOUR TURN!**

Pass out competition rubric.  
Homework deadline.