

## Helping Kids Learn – Post #14 5/5/20

# STEM: Science – Physical Sciences

This is Part 2 of a two-part lesson.

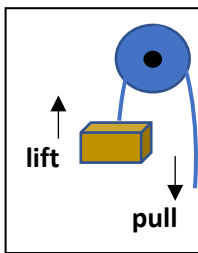
Simple machines can be combined to do even more work – to make hard tasks easier or to simplify our lives. When two or more simple machines are combined, they form a complex machine. **Mechanical Engineers** use engineering principles and a deep understanding of physics to create complex machines that do complicated tasks. See [Lift the Level](#) below for extensions to these investigations.

## Be a Physicist or Mechanical Engineer – Exploring Simple Machines Part 2

**Investigation 4: Inclined Plane** To incline means to slant. A plane is a flat surface. A ramp is an example of an inclined plane. You can roll or push something up or down an inclined plane that would be too heavy to lift and carry. If you have stairs in your house, they form an inclined plane.



Lay a book on a table. Prop up one end with a pen or pencil. Put a small can, or something shaped like one (not glass), at the propped up end of the book. Make sure there's nothing and no one in the way at the lower end of the book. Let go of the can. What happens?



**Investigation 5: Pulley** A pulley uses a wheel with a short axle and a rope or wire to lift or lower heavy objects. The wheel has a groove in the outer edge (circumference) to allow the rope to slide along it freely without slipping off.

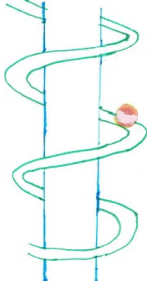
You will need the 2 wheels and axle from Investigation 3 in Post #13, some glue, a skinny string or heavy thread, a paperclip and something non-breakable to lift – a pack of pocket tissues, a toilet paper tube, the lid of a jar, etc. Spread glue thinly on one wheel so the outer  $\frac{1}{8}$ -inch has no glue. Press the second wheel exactly on top of the glued wheel. Make sure the  $\frac{1}{8}$ -inch edge stays glue-free. Let the glue dry. Thread the glued wheels onto the center of the axle.

Open the paperclip into an “S” shape. Tie an end of the string in one curve of the S with a double knot. Thread the string over the pulley (glued wheels) so it lets the paperclip hook hang down and you can hold the other end. [Hint: you might want to put a knot in the free end of the string to make holding it easier.] Hook the open end of the paperclip onto the thing you're going to lift. Hold the axle steady with one hand (or get someone to help you) and pull on the free end of the string with your other hand. Try to lift different objects.

**Investigation 6: Screw** A screw is made by wrapping another simple machine (an inclined plane or a wedge) around a center post. One use of a screw makes a tight, secure way to fasten two things together. Look for screws on your computer or cell phone. Screws can be used to lift things. A **corkscrew** is used to lift (pull) a cork from a bottle.



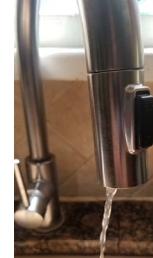
When is a screw a wedge around a center post? When is it an inclined plane around a center post? Ring the correct answer below each picture:



*Inclined plane* Wedge



*Inclined plane* Wedge



*Inclined plane* Wedge

**Lift the Level!** You can make this lesson deeper and/or suitable for older students by any of the following (you may want to use some of the [STEM Online](#) resources below):

1. Label the simple machines in a picture of a bicycle, which is a complex machine.
2. Create an annotated timeline of the invention of the 6 simple machines.
3. Complete this chart. (See sample [Solutions](#) below.)

SIMPLE MACHINE	EXAMPLE	Use(s)
<b>Inclined Plane</b>		
<b>Lever</b>		
<b>Pulley</b>		
<b>Screw</b>		
<b>Wedge</b>		
<b>Wheel and Axle</b>		

4. Physicists or mechanical engineers may work with other scientists or engineers or industrial designers (see Post #12). The machines they build may be the size of a whole building or may fit inside an animal. Research a machine used in humans and animals, a heart pump, and make a *research poster* summarizing your learning. Research posters are displayed at conferences by scientists to give people a brief understanding of their work.
5. Decide which one of the six simple machines is the most important. Write an opinion essay explaining why.
6. Archimedes Screw was invented thousands of years ago and it is still has many uses today – especially in the Netherlands. Research what it is, what it does, and why it is useful to the Dutch. Make a poster or slide show with illustrations that show how it works.
7. Explain why pulleys can do even more work in combination than they can singly.

## STEM Online

These are suggestions only and no endorsement is implied. Although they have been screened for appropriateness before posting, parents should vet the websites their children use as they may change over time.

Simple machines: <https://www.britannica.com/technology/machine>,  
<https://www.livescience.com/49106-simple-machines.html>

Wheel: <https://en.wikipedia.org/wiki/Wheel>

Archimedes Screw: [https://kids.kiddle.co/Archimedes' screw](https://kids.kiddle.co/Archimedes'_screw)  
[https://en.wikipedia.org/wiki/Archimedes' screw](https://en.wikipedia.org/wiki/Archimedes'_screw)

Heart pump: <https://www.scienceabc.com/pure-sciences/how-does-the-heart-pump-blood.html>  
<https://www.health.harvard.edu/heart-health/tiny-pumps-can-help-when-heart-failure-advances>  
<https://www.mayoclinic.org/tests-procedures/ventricular-assist-device/about/pac-20384529>

Pulley: <https://en.wikipedia.org/wiki/Pulley>

## NJ Student Learning Standards

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

4-PS3 Energy: ETS1.A: Defining Engineering Problems

HS-PS3-2, HS-PS3-5: Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

## Solutions

Investigation 4: The can rolls down the inclined plane with little-to-no effort (work) on your part.

Investigation 5: If you have difficulty pulling the string, you may need to bend the free edges of the wheels slightly outward.

Investigation 6:



*Inclined plane*

Moves a ball from top to bottom



Wedge

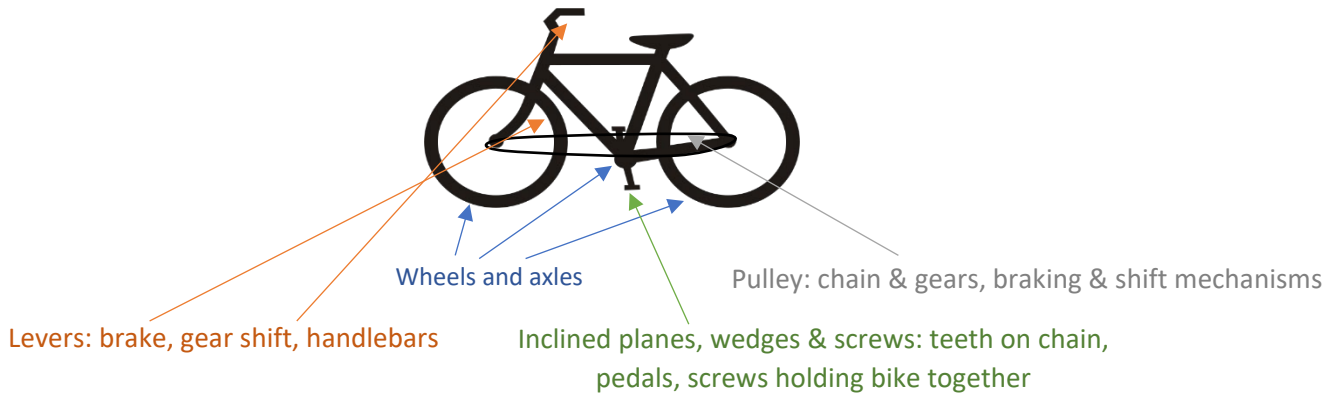
Holds cap to bottle



Wedge

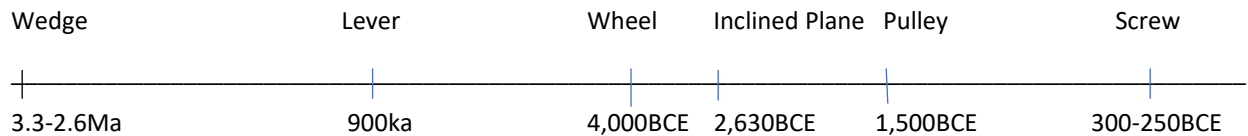
Regulates valve to control water

Lift the Level 1:



Lift the Level 2: Since the machines were invented before history was systematically recorded, we have only anecdotal evidence to support claims of invention dates (and civilizations doing the inventing, for that matter). Women may have been key to many inventions but they were often written out of the historic record along with many minority cultures being studied by dominate cultures.

Your answers may vary from this timeline. Lengths not proportional to time:



Lift the Level 3: Many other examples are possible.

SIMPLE MACHINE	EXAMPLE	Use(s)
<b>Inclined Plane</b>	Playground slide	Move object through an elevation
<b>Lever</b>	Balance scale	Pry or balance something
<b>Pulley</b>	Window blinds	Raise and lower weight
<b>Screw</b>	Water wheel or screw	Lift or bind things
<b>Wedge</b>	Door stopper; teeth!	Push objects apart or join with force
<b>Wheel and Axle</b>	Ferris wheel	Move object across a distance

Lift the Level 6: Archimedes Screws are used, for example at Kinderdijk, to control water levels in areas of the Netherlands that are below sea level, allowing agriculture to flourish.