week 8

It's So Simple Machines

The purpose of this activity is to learn about simple machines. There is no team challenge associated with this lesson; however, the understanding of simple machines will be important for students to know for future challenges.

Subjects and Skills

- The use of machines to make work easier
- Geometry

Materials Needed

- Rulers
- Pencil sharpeners
- Wedges
- Other examples of simple machines

Vocabulary

- Work
- Force
- Effort
- Simple machines
- Complex machines
- Lever
- Pulley
- Inclined plane
- Wedge
- Screw
- Wheel and axle

Purpose

An understanding of simple machines is fundamental for developing an understanding of physics concepts.

Objectives

Students will gain a better understanding of:

- the difference between simple and complex machines;
- the six types of simple machines;

- how simple machines make work easier, but do not reduce the amount of work;
- calculating work using Newtons and Joules; and
- the simple machines around us.

Activity Preparation

1. Run off activity sheets and the Instructor Key. The students should complete the chart over the course of several days.
2. Gather materials: rulers, pencil sharpeners, wedges, and other items to use as examples of simple machines.
3. Bookmark websites to be used in class.
   a. https://vimeo.com/38290259
   b. http://www.mikids.com/Smachines.htm
   c. http://www.angelfire.com/ego/mr.f/SubjectLinks/science/movies gr8/1work.swf
   d. https://vimeo.com/38291275
   e. https://vimeo.com/38290616
   f. http://atlantis.coe.uh.edu/archive/science/science_lessons/scienceles1/finalhome.htm

Activity Procedure

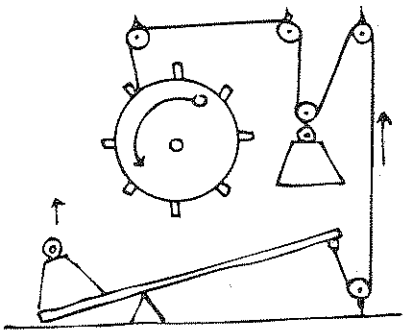
1. Explain that there are six types of simple machines. Show examples of each type of simple machine. Explain the definition of a machine (a machine is any device that makes work easier), as well as the definition of a simple machine (a machine with one working part).
2. Distribute the activity sheets to continue the class discussion, using the activity sheet as a guide. It is up to you how much time to devote to this lesson. If time is available, this lesson would be best taught within two class periods, with a 2- or 3-day break in between to allow students extra time to complete their charts.
3. Show the video (05:45) on simple machines at Link a.
4. For Question 1 on the activity sheet, use the simple machine images at Link b. Continue through Question 5. When the students have finished, discuss the answers for Questions 1–5. (For Questions 4 and 5, *force* is the pull or the push on an object, resulting in its movement, and *distance* is the space that the object moves.)
5. Introduce the terms *Newton* and *Joule* by watching BrainPOP video (02:20) at Link c.
6. Continue to Question 6 on the activity sheet. Here are explanations of the answers:
   a. Work = Force x Distance, so (100)(50)(0) = 0.

b. The boy applies force that moves the cat 2 m. Work = (90)(10)(2) = 1,800 Newton meters or Joules.

7. Show the video (05:23) on ramps at Link d.
8. Discuss friction. Friction is a force that slows down or stops motion. It's caused when two parts rub against each other. Friction can be reduced by using grease or oil or by adding wheels.
9. Show the video (06:05) on pulleys at Link e.
10. Distribute the worksheet on simple machines. Have students complete the chart according to the timeline that is most convenient for your class, and give them whatever resources you choose (e.g., library, Internet).
11. Review the chart, and then follow up with the information included on the attached Instructor Key.
12. Have students take the quiz at Link f.

Name: _____ Date: _____

It's So Simple Machines



There is no team challenge associated with this lesson. However, you will be able to use the information you learn in this lesson to complete future challenges.

Read the following information and answer the questions while you discuss simple machines as a class.

A machine is any device that makes work easier. There are simple and complex machines. Simple machines are called "simple" because most have only one moving part. When you put simple machines together, you get a complex machine.

1. Draw and label each of the six simple machines.

2. Define *machine*. _____

_____

_____

3. What is a simple machine? _____

_____

_____

All simple machines require human energy in order to function. Even though using simple machines makes the work easier, the same amount of work is actually being accomplished. The difference is that a simple machine reduces the amount of effort required to do the work or accomplish the job. When we use a simple machine to move something, we actually need to go a greater distance to accomplish the same amount of work. The energy has been modified, or traded. The muscle work has been traded for legwork, or preparation.

Think about a location that has both stairs and a ramp for people to go from a lower area to a higher area. A ramp reduces the amount of effort and strength (force) required to move up in the room; however, the actual distance traveled is increased. The amount of actual work done is the same.

Make a drawing of the example above (stairs vs. ramp), providing a written explanation of the relationship between effort, distance, and work on the drawing.

Scientifically speaking, work only occurs when something is moved. If you are pushing on a wall, you may get tired, but you are not actually doing work. If you didn't move the wall, then scientifically, you didn't do any work.

There are two components to work: force and distance. The amount of force is the pushing and/or pulling required to do the work. Distance is the how far the load (what has moved) has traveled once force has been applied. This formula is helpful: Work = Force x Distance. The work done is the force exerted multiplied by the distance moved.

4. Force is: _____

_____

5. Distance is: _____

_____

Work is measured in Joules (after James Prescott Joule). Force is measured in Newtons (after Sir Isaac Newton). Distance is measured in meters, m.

6. Try solving these two problems. Use the information you just learned.

   a. A 100-pound girl sits on a 50-pound bench. How much work is done on the bench?

   _____

   b. A 90-pound boy lifts a 10-pound cat 2 meters to the right. How much work did he do?

   _____

7. Rub your hands together. You've just created friction. What is friction? _____

_____

_____

8. How can you reduce friction? _____

_____

_____

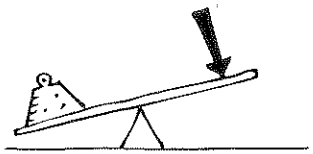
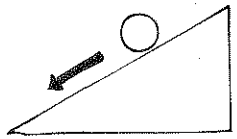
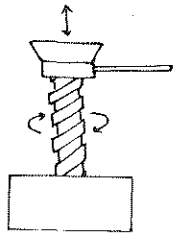
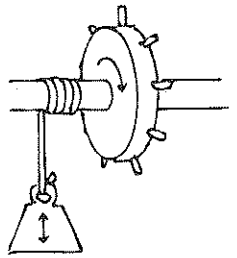
9. Complete the Simple Machines worksheet.

Name: _____ Date: _____

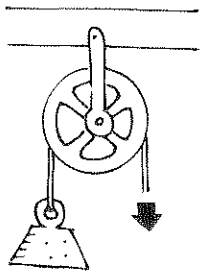
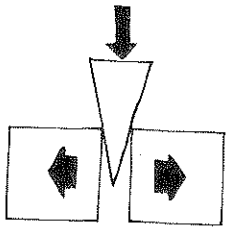
Simple Machines

Simple Machine	Definition and Description	Function	Examples
LEVER			
INCLINED PLANE			
SCREW			
WHEEL AND AXLE			
PULLEY			
WEDGE			

Instructor Key

Simple Machine	Definition and Description	Function	Examples
LEVER 	A lever is a board that rests on a support called a fulcrum. The balance point, or fulcrum, is between the applied force and the load. A simple lever has three parts: the fulcrum (balance point), the effort arm (where force or work is applied), and the resistance arm (where the object to be moved is placed).	Lifts or moves loads	Nutcracker, seesaw, crowbar, elbow, tweezers, bottle opener
INCLINED PLANE 	An inclined plane is a slanting surface connecting a lower level to a higher level. The ramp is an inclined plane. Although the distance up the ramp is greater than the distance straight up, less force is required to move the load over this greater distance.	Moves loads up or down a ramp	Slide, stairs, ramp, escalator, slope
SCREW 	The screw is actually just another kind of inclined plane that is wrapped around a cylinder.	Fastens or tightens one object to another	Cork screw, swivel chair, door lock
WHEEL AND AXLE 	A rod called an axle can be put through a wheel so that they both move together.	Lifts or moves loads	Wagon, pencil sharpener, bike, electric fan

Instructor Key, continued

Simple Machine	Definition and Description	Function	Examples
PULLEY 	A rope or cable is put through a grooved wheel that turns, moving the rope or cable through and around it.	Moves things up, down, or across	Curtain rod, mini-blind, fishing rod, flag pole, crane
WEDGE 	An object with at least one slanted side ending in a sharp edge.	Pushes two objects apart	Knives, forks, nails