



Simple Machines

Simple machines are all around and certainly make work easier for us.

Introduction

Students will review and observe the mechanics of simple machines and the work they do.

Students will use the mechanics of at least two simple machines to design a means to complete a given task for a given situation within a hypothetical candy factory.

Academic Content Standards

Ohio science academic content standards, benchmarks and grade-level indicators are currently in draft form. Official state adoption will not occur until December 2002. The suggested alignment to science strands for this lesson is subject to change as the draft standards are revised.

- ❖ *Possible alignments: Ohio Academic Content Standards for Science: Physical Sciences Standard, Science and Technology Standard and Scientific Inquiry Standard*

Getting Started

Materials

- A representative selection of each of the six simple machines displayed on individual trays (e. g. wooden models, lego models, photographs).
- Two trays per student group with access to two different simple machines, one machine on each tray. (Plan time for the groups to rotate the six trays if materials are limited. Assign trays so that combined groups have four different machines to explore.)
- A paper bag containing candy and situation card for each student group. (Students will design machines to hold the chosen candy. Candy suggestions include, rolls of Lifesavers, miniature size candy bars, a variety of Hershey kisses, Rolos, and Smarties.)
- *Handout A*, “background information,” description of the six simple machine types.
- *Handout B*, “inquiry lesson”—teacher copy
- *Handout C*, “inquiry lesson”—student copy
- *Handout D*, “situation” scenarios.
- *Handout E*, “website addresses”

Vocabulary

- Inquiry
- Observation
- Qualitative

- Simple Machine
- Mechanical
- Inclined plan
- Screw
- Lever
- Wedge
- Pulley
- Wheel and Axle

Lesson

Orientation Activity

Introduce the concept of machinery in action with the use of film and video excerpts, e.g. including *3-2-1 Classroom Contact*, *Minds On_Science*, *Science is the Solution*, and *Bill Nye the Science Guy*. (Preview segments and select those segments aligned to the lesson.)

Introduce pictures of the six simple machines for discussion and identification of the work each performs.

Learning Activity

Distribute the inquiry activity sheet for student completion. Facilitate and monitor student work through the checkpoints. (See *Handout B* for guiding questions.)

Each student group selects one situation card and one bag containing a candy product. Student groups design and create a machine to solve the stated task or problem provided on the situation card.

Students groups present their machine design to the entire class.

Evaluation and Follow-up

Assessment Tools and Methods

Use inquiry checkpoints to determine individual student and group understanding of materials and processes. (See *Handout B*) Record observations as anecdotal notes on a student roster, using a clipboard to hold paperwork and provide a solid writing surface.

Collect the student inquiry pages to check written, required short answers to posed questions. Questions in Part 5 of the student inquiry sheets provide evidence of individual student learning.

Critique student group presentations. (Students will answer questions based on the information gathered during the design process of their candy machine.)

Have students write a paragraph explaining how simple machines help to make work easier. The paragraph will include a written example and explanation of the

work accomplished by two representative simple machines used in the previous situation scenario.

Interdisciplinary Connections

The inquiry/observation activity requires group cooperation and communication. Students will verbalize their thinking to the teacher during checkpoints, before proceeding to the next activity. The group project requires critical thinking, problem solving, and creativeness. As a final evaluation, the written paragraph will illustrate a student's ability to write in non-fiction expository form to construct meaning.

Technology Integration:

- Use of a program such as *Power Point* software for student creation of an interactive presentation with the inclusion of illustrations and descriptions of the six simple machines to supplement the above activities.
- Use of the Internet and previewed websites for further student exploration of simple machines and mechanics. (See *Handout E* for a list of suggested sites.)

Web Links:

See *Handout E*

Handout A

Background Information

What is a **simple machine**? The purpose of a simple machine, rather any machine, is to accomplish work easily through the transformation of energy and/or motion. Simple machines have only a few, if any, moving parts to accomplish work. These machines help you to accomplish work with less effort by either changing the direction of the force or increasing the strength of an applied force.

A **lever** has a rigid bar that rests against a pivot point, called a fulcrum. They increase the effort and change the direction of the force. Examples: scale, seesaw, claw of a hammer, pliers, scissors, crowbar, door hinge, tweezers, nutcracker, screwdriver, wheelbarrow, bottle opener, shovel, hoe, baseball bat, paintbrush, fly swatter

A **pulley** is a grooved wheel that turns as the result of a rope, chain, or steel cable being pulled through the groove. The wheel acts as the fulcrum and the rope as a lever arm similar to a lever. No new energy is created with a pulley but it spreads the effort over a distance and changes the direction of the force. Examples, flagpole, water well, elevator, clothes line, block and tackle, mini-blind cord, construction crane, sails on a boat, fly rod

Wheel and axles have a large mechanical advantage. It is a handle, or axis, that is attached to the center point of a wheel. It is made of 2 circular objects that are fastened together and rotate around a common axis. The larger object is called the wheel and the smaller is called the axle. The wheel turns the axle, causing movement. Examples: wheelbarrow, rolling pin, door knob, ice cream scoop, steering wheel of a car, faucet handle, wrench, pencil sharpener, Ferris wheel, paint roller, roller skates, pizza slicer, bicycle

An **inclined plane** is a straight, slanted surface that does not move when it is used. They do not have any moving parts but make work easier by multiplying the effort. They increase the distance needed to move an object while decreasing the effort. Examples: slide, stairs, paint pan, wheelchair ramp, truck ramp, escalator, skateboard ramp, highway ramp, motorcycle jump ramp

A **screw** is an inclined plane that encircles a bar or wraps around a cylinder or rod. Examples: screw, jar lid, nut and bolt, drill and bit, corkscrew, C clamp, wrench, car jack, vice.

A **wedge** is an inclined plane or 2 inclined planes joined together usually back-to-back that pushes objects apart as it is pushed between them. It has 1 or more slanted surfaces. An effort force must move it. A wedge changes the direction of or increases the strength of the effort. The longer the wedge the less effort is needed. Examples: door stop, ax, knife, dust pan, fork lift, chisel, shim, snow shovel, nail, saw, bottle opener, ice cream scoop, teeth, flathead screwdriver

Handout B

Checkpoint Reminders for student inquiry

Introduction:

- Accept any machine that students can describe how it works. Look for use of scientific vocabulary and ease of explanation. Look for identification of simple machines in comparison to complex machines.
- Simple machine: See background information sheet
- Work happens only when an object is moved a distance by a force. There is always a change in distance when a change in force occurs.

Part 1:

- Check sketches. Encourage labels and titles for the sketches.
- Identify qualitative observations-use of senses.
- Isolate the simple machine and relationships between the objects.
- If group correctly identifies the simple machine, discuss characteristics that are evidence of the machine.

Part 2:

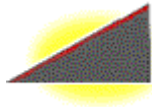
- Same as Part 1 checkpoint
- Look for additional use of vocabulary and more complete answers indicating application of knowledge from previous checkpoint

Part 3:

- Look for comparisons between machines
- Some items could be more than 1 simple machine depending upon the part of the machine. Be sure that students can identify the differences. Usage of the machine determines its "name".
- Definition of simple machine should be more complete and may include examples.

Part 4:

- To be completed as a group for presentation to the class. You may want to leave this activity open ended or you may want to establish specific guidelines.



Handout C Student Inquiry

Simple Machines Introduction:

Everywhere we look machines help make our life simpler. Sometimes we take for granted the work that these machines actually do. Think about a machine that you have used already today. Write a brief description of the machine and how it has helped you accomplish work. Draw a picture of it if that will help you write your description. Think about the individual parts that make up the machine. Try to identify the simple machine that is the basis for the machine you have chosen.

Communicate with your group about the machines each of you wrote about. Identify the simple machines. What do they have in common? How are they different? What kind of work do these machines do? How do they help you?

Based upon your conversations, write your definition of a simple machine.

Write a definition of work.

_____ **Checkpoint**

Part 1

Pick up a tray of materials. Examine the materials. Discuss the objects with your group. Draw a sketch of the objects and write down qualitative observations. Determine what the objects have in common and what kind of work they do. Make a prediction what kind of simple machine is involved with the objects.

___ **Checkpoint**

Part 2

Pick up another tray of materials. Complete an examination like the previous one. Additionally, on a separate piece of paper, create a chart that compares the objects.

___ **Checkpoint**

Part 3

Work together with another group to discuss and make comparisons of the objects on your trays. How are they alike? How are they different? What kind of work do they do?

Look back at your definition of a simple machine. Make any additions or changes to it based upon your discoveries of the objects on the trays. Write a complete definition of a simple machine.

Checkpoint

Part 4

Select an envelope and a paper bag. Read the instructions in the envelope. The bag contains the candy that you will need for this activity. Work together as a group to complete the activity. You may use any materials that you can find if you would like to build your simple mechanical device. You will share your products with the class on _____. Be sure that your illustrated design has labels identifying the simple machines in your device and that you can explain the effort and work that is accomplished with your device.

Part 5

Answer the following questions by yourself. Feel free to discuss them with your group, however, your answers should be written in complete sentences and your own words. You will be graded on your answers to these questions as a means of demonstrating your understanding of the concepts.

1. Describe what makes a machine a simple machine.
2. What must happen in order for something to be considered work?
3. Explain the advantages or disadvantages of using simple machines.
4. Explain how mechanical devices have an impact on human activity.
5. List four simple machines. Explain a characteristic that is unique to each machine.

Handout D

Situation Scenarios

The chocolate factory has hired your group to design the latest piece of machinery to transport their newest candy from the end of the production line to the shipping department. The shipping department is on the ground level and the production line is below ground level. Design a simple mechanical device to transport the candy using at least 2 simple machines.

The candy is made and wrapped but it still needs to be placed into a shipping box. The company has hired your group to design a machine that will place the candy into the shipping box. Design a simple mechanical device using at least 2 simple machines. (You may determine the size of the box and the number of candies that go into each box.)

The scales for weighing the candy for accuracy of mass became jammed with candy today. The machine cannot be fixed for several days. A major customer needs a shipment of candy within the next couple days. Your group has been hired to create a temporary simple mechanical device of weighing the candy. Design a scale that weighs the candy that includes moving it onto and off the scale. Use at least 2 simple machines.

The large vat for mixing the candy usually has workers that add the special ingredients. The flu bug has hit the production line causing all but 2 Oompa Loompas to stay home from work for several days. Your group has been hired to create a simple mechanical device that will add the 2 special ingredients to the mixing bowl. Your design should use at least 2 simple machines.

The candy is packaged and ready to be transported to the customer but needs to be transported from the production line to the shipping dock. Your group has been hired to design a simple mechanical device for moving the full boxes of candy to the dock for loading on the delivery trucks. Be sure to use at least 2 simple machines in your design.

The huge chocolate vats stand 20 feet high. Workers need to be able to look inside the top of the vat to be sure that the chocolate is melting completely. Your group has been hired to design a simple mechanical device for raising the workers from the floor to the top of the vats. Your design must include at least 2 simple machines.

Handout E

Simple Machine Websites

Background information:

Work is Simple with Simple Machines

www.ed.uri.edu/SMART96/ELEMSC/SMARTmachines/machine.html

Moving Along with Simple Machines

www.henry.k12.ga.us/cur/simp-mach/default.htm

Simple Machine Questions, Canada Science and Technology Museum

http://216.94.16.40/english/schoolzone/Info_Simple_Machines.cfm

Other activities:

Simple Machines

www.bgsu.edu/colleges/edhd/programs/STAR/McCleary6-6.html

Exploring Simple Machines

www.lakelandschools.org/EDTECH/Machines/Machines.htm

Simple Machines Webquest

http://outreach.rice.edu/~dgabby/science/simp_mach/

Simple Machines Invention Webquest

www.jsd.k12.ak.us/ab/el/simplemachines.html