#3657

SIMPLE MACHINES:
INCLINED PLANE, WEDGE AND SCREW

Grade Levels: 7-12
15 minutes
CAMBRIDGE EDUCATIONAL 1998

DESCRIPTION

Uses animated graphics and real examples to illustrate an inclined plane, wedge, and screw. Offers a definition of each and examines the relationship between the three. Shows how they have been used historically. Also defines simple machines and mechanical advantage. Reviews main concepts.

ACADEMIC STANDARDS

Subject Area: Science

- Standard: Understands motion and the principles that explain it
  - Benchmark: Knows the relationship between the strength of a force and its effect on an object (e.g., the greater the force, the greater the change in motion; the more massive the object, the smaller the effect of a given force)
  - Benchmark: Knows that when a force is applied to an object, the object either speeds up, slows down, or goes in a different direction

Subject Area: Historical Understanding

- Standard: Understands and knows how to analyze chronological relationships and patterns
  - Benchmark: Knows how to construct time lines in significant historical developments that mark at evenly spaced intervals the years, decades, and centuries
  - Benchmark: Knows how to identify patterns of change and continuity in the history of the community, state, and nation, and in the lives of people of various cultures from times long ago until today

AFTER SHOWING

1. Point out objects in the classroom that incorporate inclined planes, wedges and screws.
2. Dissect a toy or household gadget. Record progress in science notebooks with written notations and drawings. Identify each part as to type of simple machine and function.
3. Study the history of simple machines.

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SUMMARY

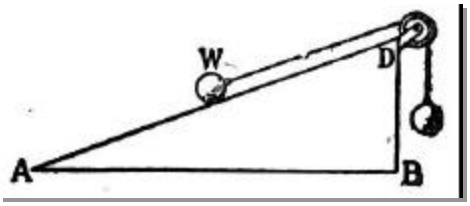
THE BASICS OF SIMPLE MACHINES

Machines help us do work. Work is done when a force moves something in the direction of that force. In order for something to be a machine, it must do one of the following things: make work easier, make work faster, or change the direction of a force. This is the equation for work:

Work = Force x Distance

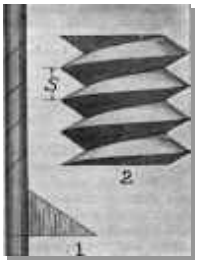
Machines make work easier by decreasing the amount of force needed to complete a task, but machines can not create energy. If a machine cuts the force needed to move something in half, the machine will have to move twice as far. The benefits of this relationship become obvious if you were asked, "Would you rather move 500 pounds 1 foot or five pounds 100 feet?" The same amount of work is completed in each example, but the latter would definitely be easier.

There are six simple machines: the inclined plane, wedge, screw, lever, wheel and axle, and pulley. These machines are used by themselves or in combination in all machines. If more than one simple machine is used in a machine, it is called a compound machine. This includes machines that use two or more of the same kind of simple machine.



An inclined plane makes work easier by breaking an upward or downward movement into smaller increments. Examples of inclined planes include slides, ramps, and hills. The wedge and screw are both based on the principles of the inclined plane (the reason for grouping these three together on one video).

A wedge makes work easier by taking a forward driving force and turning it into two sideways forces. A wedge is like two inclined planes placed back to back. You may also want to think of a wedge as an inclined plane with force behind it. Wedges are usually used for cutting or scraping. Plows, knives, scissors, and chisels all use a wedge.



A screw is like an inclined plane wrapped around a cylinder. A screw turns a small rotational force into a larger forward driving force. Screws can be found in drills, vices, large digging devices, and bolts.

HISTORY OF SIMPLE MACHINES

Unlike most inventions we study in school, the simple machines were invented prehistory (before things were written down and recorded). This makes questions like, "Who invented the inclined plane and when?" impossible to answer. This doesn't mean that the history of simple machines should be ignored. As demonstrated in the video, machines have been used throughout history. If the examples on the video seem arbitrary and almost random, it is because they are. The point is that machines were

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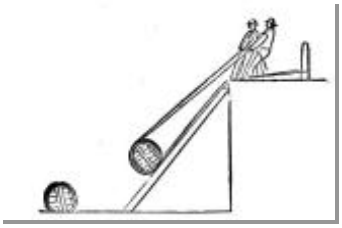
used throughout history in a variety of ways. You may want to start a classroom discussion by having students pick a period in time and a simple machine and then try to come up with a way that the machine could have been used at that time. Pulleys in the 1400s were on Columbus' ship, and less famously used to draw water from a well. A lever in the 1700s was used in the Liberty Bell.



CALCULATIONS

To find out how much a machine helps complete a task, we need to calculate the mechanical advantage. The mechanical advantage is the factor that a machine increases the force by. If a machine enables us to lift a 10-pound weight with one pound of force, it has increased the force output by the factor of ten. That means that the mechanical advantage is ten.

The mechanical advantage (M.A.) of an inclined plane can be found by dividing the incline's length by its height.

$$\text{Inclined Plane M.A.} = \frac{\text{Incline Length}}{\text{Incline Height}}$$

When calculating the mechanical advantage of a wedge, it may be easier to think of two inclined planes placed back to back. This is simply because it is easier to calculate the lengths and heights of right triangles. By breaking the wedge into two inclined planes (or right triangles), you can apply the equation for mechanical advantage of an inclined plane to each triangle and add them together.

Even though it may be difficult to calculate the mechanical advantage of a screw, we can still compare the mechanical advantage of screws. A screw is basically an inclined plane wrapped around a cylinder. The more gradual the slope of the incline, the closer together the threads of the screw will be when wrapped around the cylinder. A wood screw with large spaces between its threads will have a lower mechanical advantage than a machine screw with very closely placed threads.

RELATED RESOURCES

Captioned Media Program

- Simple Machines: Lever, Wheel, Axle and Pulley #3658

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World Wide Web

The following Web sites complement the contents of this guide; they were selected by professionals who have experience in teaching deaf and hard of hearing students. Every effort was made to select accurate, educationally relevant, and "kid-safe" sites. However, teachers should preview them before use. The U.S. Department of Education, the National Association of the Deaf, and the Captioned Media Program do not endorse the sites and are not responsible for their content.

- **SIMPLE MACHINES**

http://sln.fi.edu/qa97/spotlight3/spotlight3.html

Print information from the Franklin Institute written for (strong readers) children. Covers the basics with text and simple graphics. Great links to additional information.

- **SMITHSONIAN: INVENTORS AND INNOVATION**

http://www.si.edu/resource/faq/nmah/invent.htm

Offers a list of links that provide a short history of famous inventors and inventions. Among others, the telegraph, the light bulb, and the computer are featured.

- **RUBE GOLDBERG MACHINE CONTEST**

http://www.rubegoldberg.com/contest.htm

Information on kid contests to create machines using the famous Pulitzer Prize winner's wacky and wonderful 20-step method.

- **THE HISTORY OF INVENTION**

http://www.cbc4kids.ca/general/the-lab/history-of-invention/default.html

Smith College's time line of inventions through history. Click and scroll. Text and pictures.