Energy and the Physical Setting

Simple Machines, Part 5: Inclined Plane 3
The Screw and Wedge

Last week we talked about the inclined plane family. This week, we're going to continue our look at the inclined plane family. We left you with this question:

The **wedge** and the **screw** are members of the inclined plane family.

True or False?

If you answered TRUE, you are correct.

The inclined plane family has a lot of members. The following are just a few examples:

- **Wedge**: knife blade, shovel blade, nail tip, fork tines, your teeth (incisors)
- **Screw**: jar lid, stool that spins up or down to change its height, light bulb

Let's look a bit more closely at this simple machine family…

Wedge

Examples of wedges are everywhere in your life: knives, nails, fork tines, heads of regular screwdrivers, ax heads, your front teeth (incisors)

Imagine holding a block of wood and trying to pull it apart into two pieces. Mission impossible!

Now imagine wedge on the top of the block of wood. You hit the top of the wedge with a hammer

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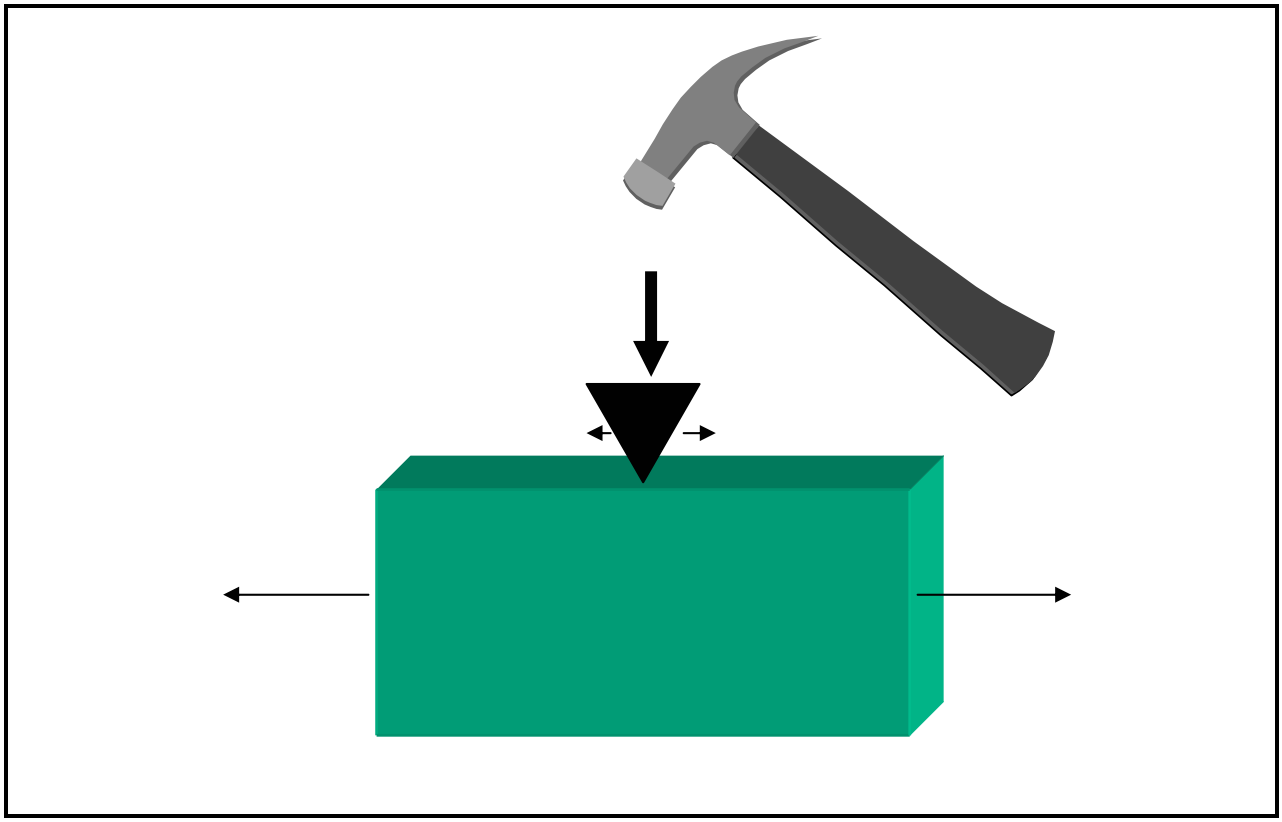
The force of the hammer is in a downward direction. The wedge changes the direction of the force outward, pushing sections of the block apart.



A knife cutting butter functions in the same way. You push downward on the top of the butter with a knife. The butter is not crushed under the edge of the knife, it is pushed apart into two pieces as the knife moves through it.

The Wedge and the Inclined Plane

A **wedge** is two inclined planes placed back to back.

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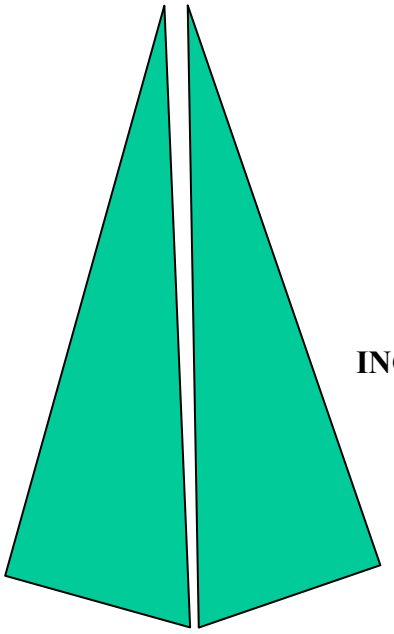

INCLINED PLANE 1 **INCLINED PLANE 2**

An inclined plane allows you to push a heavy load upward, parallel to the plane of the inclined board with less force than you would need to lift the object straight up.

A **wedge** (in the form of nails and cutting wedges) allows you to push through and cut apart substances such as wood with less force than you would need to push through or pull the substance apart without the wedge.

The inclined plane is stationary; the object you want to lift moves along the incline parallel to the plane of the incline. Because the plane supports some of the object's weight, you need only exert a force that is a part of the object's weight to push it up the incline.

The wedge moves through a substance that is stationary. The wedge's flat surfaces cut parallel paths through the stationary substance. The wedge changes the direction of the downward force on the top of the wedge to forces pushing outward against the surface of the substance.

Sometimes you use a wedge simply to hold two things apart or a single object in place. Carpenters use wooden wedges to level pieces of wood. A rubber wedge you use to keep a door open is an example of the second use of the wedge.

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What's a screw?

A **screw** is really a combination of *simple machines*: it's an *inclined plane* that wraps around a shaft with a *wedge* at the end of the shaft. The thread that wraps around the **screw** can vary in width; the farther the distance between the threads, the harder it is to work the **screw**.

Sometimes it's hard for students to visualize how a screw is actually a version of an inclined plane; the pictures below illustrate the fact.

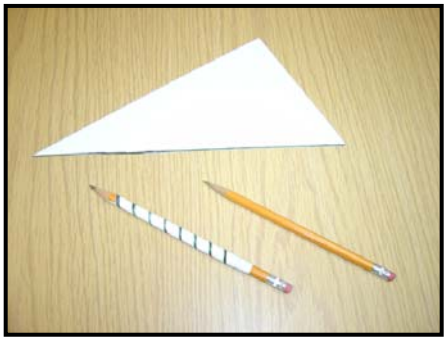
A simple demonstration shows how a screw is actually an inclined plane. (You may want to do this as a demonstration for your class or have every student make his or her own.)

Materials: Pencil, Paper, Colored felt tip marker, Scissors

Procedure:

1. Cut a right triangle from the paper. The dimensions should be about 5 inches, by 9 inches, by 10.3 inches.
2. Use the felt tip marker to color the longest edge (10.3 inches) of the triangle.
3. Position the shortest side (5 inches) of the triangle along the side of the pencil and then evenly wrap the paper around the pencil by rolling the pencil.

This demonstration illustrates that the thread of screw is simply an inclined plane twisted around a metal shaft. But the simple screw's tip is also an inclined plane: a **wedge**. The top of the screw is an example of yet another family of simple machines, the **lever** which we will begin to consider next time.



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Coming up

A question to ponder:
In what sense is the screw an example of a lever?

Next week we will take a look at yet another simple machine, the **lever**. The following website will give you a preview.

http://teacher.scholastic.com/dirtrep/simple/lever.htm

What do the NYS standards say?

In the Elementary Core Curriculum, Standard 4, The Physical Setting, one Major Understanding states:

- 5.1f Mechanical energy may cause change in motion through the application of force and through the use of simple machines such as pulleys, levers and inclined planes.

In the Intermediate Core Curriculum, Standard 4, The Physical Setting, Major Understandings state:

- 5.2f Machines can change the direction or amount of force, or the distance or speed of force required to do work.
- 5.2g Simple machines include a lever, a pulley, a wheel and axle, and an inclined plane. A complex machine uses a combination of interacting simple machines, e.g., a bicycle.

[1] Our working definition for friction has been: *Friction is the resistive force acting between bodies that tends to oppose and damp out motion*. From http://scienceworld.wolfram.com/physics/Friction.html

[2] The distance between threads is called the **pitch**.

[3] http://sln.fi.edu/qa97/spotlight3/screwdemo.html

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