Inclined Plane

Overview: Energy allows us to do work. We've had to come up with ways to allow us to do this more easily with things called simple machines. The inclined plane is one example of a simple machine. We'll learn why this is important.

What to Learn: You will learn how simple machines help us to do work, as well as some of the ways that they help us in our everyday life.

Materials

- Sheet of paper
- Short dowel or cardboard tube from a coat hanger
- Tape

Lab Time

1. Cut a right triangle out of paper so that the two sides of the right angle are 11" and 5 ½" (the hypotenuse – the side opposite the right angle – will be longer than either of these).
2. Find a short dowel or use a cardboard tube from a coat hanger. Roll the triangular paper around the tube beginning at the short side and roll toward the triangle point, keeping the base even as it rolls.
3. Notice that the inclined plane (hypotenuse) spirals up as a tread as you roll. Remind you of screw threads? Those are inclined planes.

Observations

1. How does this help you do work?

2. Draw a picture of the inclined plane (left) and then how it is the same as a screw (right).

Inclined planes have played important roles throughout history. Many of the wonders of the world were built using the aid of ramps and other inclined planes (not to mention handy pulleys and levers) to help laborers host the stones that built the pyramids, Great Wall of China, and other feats of engineering. The Assyrians used these ramps to allow their siege engines to tear down an enemy city's walls, and the Romans copied suit. Screws were used by the Greeks and Romans alike, creating fanciful ways to transfer energy, pump water, and even attack enemy troops. Leonardo da Vinci even used a creative screw shape to devise the earliest design for a helicopter!

Reading

Energy is the ability to do work. Simple machines enable us to do work over distance. Work happens when something moves a distance against a force. Although it seems a little hard to comprehend, this is truly one of the most useful concepts in physics. I'm willing to bet you spend a lot of your time moving things a distance against a force. Do you ever climb stairs, walk, ride a bicycle, or lift a fork to your mouth to eat? Of course you do. Each one of those things requires you to move something a distance against a force. You're using energy and you're doing work. Work is not that hard … it's force that can be difficult. Imagine getting up a 10-step flight of stairs without a set of stairs. Your legs don't have the strength/force for you to jump up, you'd have to climb up or find a ladder or a rope. The stairs allow you to, slowly but surely, lift yourself from the bottom to the top.

Now imagine you are riding your bike and a friend of yours is running beside you. Who's got the tougher job? Your friend, right? You could go for many miles on your bike but your friend will tire out after only a few miles. The bike is easier (requires less force) to do as much work as the runner has to do.

Now here's an important point, you and your friend do about the same amount of work. You also do the same amount of work when you go up the stairs versus climbing up the rope. The work is the same, but the force needed to make it happen is much different. Don't worry if that doesn't make sense now. As we move forward, it will become clearer.

This "making the force less" thing is where simple machines come in. Way back when, folks needed to move stuff. Long before there were cranes and bulldozers. They needed to move heavy stuff, rocks, boulders, logs, boats, etc. These clever folks discovered machines. A machine, in science language, is any device that transmits or modifies energy. In other words, energy is put into the machine and comes out of the machine, but along the way the energy does work, changes direction, changes form or all of the above.

We're going to focus on the fact that machines can allow you to use less force to do work. Most folks say that there are six simple machines. These are the inclined plane, the wheel and axle, the lever, the pulley, the wedge, and the screw. Every machine with moving parts, from a tape player to a car, from a computer to a freight train, is made up of simple machines. We are going to spend time with two of the simple machines. By learning how they work you will get a nice picture of all the simple machines and what they do. In this lesson, we will be spending some quality time with levers, and in the next lesson we will spend time with pulleys.

What's an inclined plane? Jar lids, spiral staircases, light bulbs, and key rings are all examples of inclined planes that wind around themselves. Some inclined planes are used to lower and raise things (like a jack or ramp), but they can also used to hold objects together (like jar lids or light bulb threads).

Exercises Answer the questions below:

1. What is one way to describe energy?
    a. The amount of atoms moving around at any given moment
    b. Electrons flowing from one area to another
    c. The ability to do work
    d. The square root of the speed of an electron
2. Work is when something moves when:
    a. Force is applied
    b. Energy is used
    c. Electrons are lost or gained
    d. A group of atoms vibrate

3. Name two simple machines:
    a.

    b.

4. Name one example of a simple machine:

Answers to Exercises: Inclined Plane

1. What is one way to describe energy? (the ability to do work)
2. Work is when something moves…(when force is applied)
3. Name two simple machines: (inclined plane, pulley, lever, wheel, wedge)

Name one example of a simple machine: