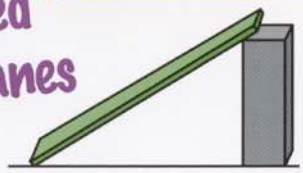
Getting Started with Inclined Planes



What is an inclined plane?

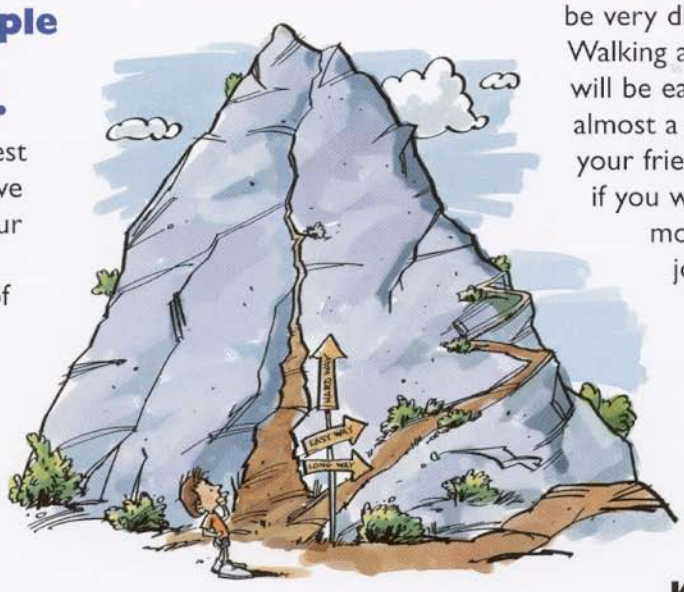
- It's a flat surface with one end higher than the other.
- You can use an inclined plane to move yourself or an object up or down.
- Inclined planes can make work easier. You use less effort to move an object, although you have to move the object over a longer distance.

How does an inclined plane help you?

This machine makes work easier. When you move an object up or down an inclined plane, you travel a longer distance than if you moved the object straight up or down. However, you don't need to supply as much effort as you would without the inclined plane. Either way, you do the same amount of work but the reduced effort makes the job easier.

Here's an example of how inclined planes can help.

Imagine that your very best friend moved away. You live in Tree Top Village and your friend moved to another town on the other side of the Tree Top Mountains. You were invited to visit for the weekend. The mountains run the whole length of your town and you're allowed to go but you must walk there.



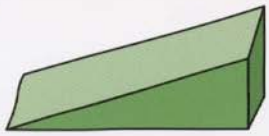
Picture this.

The mountain is an inclined plane so you have a few options for how to get to your friend's house. You can travel straight up the Tree Top Mountains along a steep path, take a longer path over the mountain on a gentler climb or go a long way around the mountain. Which would you choose? Why?

The mountain is very tall and the hill is steep going almost straight up. If you climb this, it will be very difficult for you. Walking around the mountain will be easier but it will take almost a whole day to get to your friend's house. However, if you walk up a gentle mountain path your journey will be easier and take less time. Is this what you decided? If not, would you choose differently now?

K'NEX® Simple Machines

Getting Started with Wedges



What is a wedge?

- A wedge is a special kind of inclined plane made of two flat slopes, back to back.
- Wedges can help you move objects apart.
- A wedge can change the direction of your force: when you push down, the wedge makes the object it's pushing against move sideways.
- The forces involved in using a wedge are not always equal.

How does a wedge help you?

When you use most types of inclined planes, the objects move across the surface of the inclined plane. However, a wedge is an inclined plane that does the moving when you use it. The wedge lets you use less effort to move objects apart, but you have to cover a greater distance to do it.

Here's an example of how wedges can help.

Most wedges or combinations of wedges are used for cutting. Although scissors, shears, axes and knives are levers—these levers are combined with wedges. The wedges enhance the upward and downward movement of the levers and turn them into machines which cut and separate as they move up and down.

Picture this.

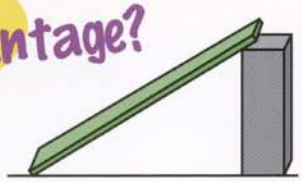
When you push a knife into a carrot, the carrot moves along the sloping sides of the knife.

Which is greater—the distance the carrot traveled along the blade of the knife or the distance the two pieces of carrot moved apart after the cut was made? The carrot traveling along the blade moves a greater distance BUT you don't have to provide as much effort to separate the carrot into two pieces as you would without the knife.

A Bright Idea!

It may be hard to think about a wedge as a simple machine which does work. For example, a door jamb is a wedge which does work but is difficult to see. It looks like an inclined plane but it serves a different purpose. Can you determine how and why a door jamb functions as this type of simple machine?

What's the Mechanical Advantage?



How much does an inclined plane, screw or wedge help you?

Do some measuring and dividing to find out.

1. Every inclined plane, screw and wedge has a sloping surface. Measure the distance from one end of the slope to the other. (If you're measuring a screw, you'll have to go around it.) This distance is your slope's **length**.

2. Next, measure the distance straight up from the ground to the top of the slope. (If you're measuring a screw, find the screw's length. If you're measuring a wedge, find its thickness.) This distance is your slope's **height**.

3. Divide the length by the height to find the **Mechanical Advantage (MA)**.

$$MA = \text{Slope length} \div \text{Slope height}$$

The MA tells you how much easier your job is when you use an inclined plane, screw or wedge, as well as how much more distance you cover.

Try It Out!

Imagine you want to reach the **top** of a rocky bluff. You can get there by hiking along a sloping path up a hill.

The length of the path is 1.8 kilometers, which equals 1,800 meters. The height of the bluff is 150 meters. Divide the length by the height to find the Mechanical Advantage.

$$MA = 1800 \div 150$$
$$MA = 12$$

The Mechanical Advantage is 12. This means that it's 12 times easier to climb the long path then it is to try to scale the bluff going straight up! The longer the slope, the easier the job.

Getting Started with Screws

What is a screw?

- A screw is a rod with an inclined plane spiraling around it.
- The rod is called the body of the screw. It might have the shape of a cylinder or a narrow cone.
- The spiraling inclined plane forms ridges around the body. These ridges are called the threads of the screw.
- Some screws move objects in a spiral along their threads.
- Other screws twist in a spiraling motion as they move through different kinds of materials.

How does a screw help you?

Like all simple machines, a screw lets you do work by changing the amount of effort or distance you need to do a job. The distance around the threads of a screw is much longer than the length of the screw top to bottom, but it requires less effort to cover that distance.

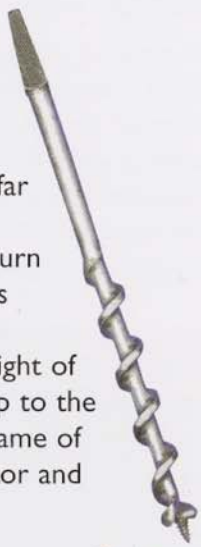
Here's an example of how screws can help.

When you turn the handle on a vise, you make the screws in the vise turn around and move deeper into the metal block that holds them. This movement makes the jaws of the vise move together. You have to do a lot of turning, and the screw threads travel a long distance, going round and round. Slowly, the jaws of the vise grip a block of wood tightly. Without the screws in the vise, you would have to push the jaws together. You wouldn't have to push far, but it would be difficult to push with enough strength to secure the wood.

Picture this.

You are visiting the Statue of Liberty. If you had to climb to the top of her crown on a ladder, it would be exhausting and dangerous. So, engineers built a circular staircase. The climb to the top takes longer but it's much easier and therefore more enjoyable for those visiting this historic landmark.

A Bright Idea!



One very famous type of screw was designed long ago. This machine was needed to bring water (which is very heavy) for villagers to use from a river far away from their town. The amount of force needed to turn this giant and unique screw is small compared to the force needed to overcome the weight of the water while bringing it up to the town. Research to find the name of this famous screw, the inventor and more about it.