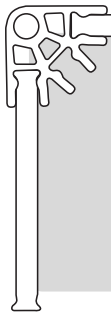




# The Splitting Wedge:

An example of a wedge.



## OBJECTIVES

Students will:

1. Explore how a wedge, a special type of inclined plane, can be used to move things apart.
2. Investigate how a wedge makes work easier by reducing the amount of force needed and by changing the direction of the applied force.

## MATERIALS

Each group of 2 students will need:

- |                                                                                              |                 |                    |
|----------------------------------------------------------------------------------------------|-----------------|--------------------|
| - 1 K'NEX Wheels & Axles and Inclined Planes Building Set with building instructions booklet | - Ruler         | - Student Journals |
|                                                                                              | - 4 heavy books |                    |

## PROCEDURE

### Introduction

- Review with the students how an inclined plane makes it easier to move objects from one height to another. Explain that they will investigate how they could use an inclined plane to move things apart.
- Encourage them to think about the way in which a knife cuts through an object. Demonstrate this using a piece of cheese or modeling clay. Ask the students to explain precisely what happens as they watch the process.

*As the knife goes through the cheese or clay, the 2 pieces separate and move away from the blade.*

- Explain that the blade of the knife is an example of a special type of inclined plane called a wedge.
- Provide the students with a definition and a diagram of a wedge. (See: Key Terms and Definitions.)
- Ask the students to use the library or the Internet to investigate further and discover how a wedge is used. (For example, visit the following site for information: <http://coe.uh.edu/archive/>)

### Building Activity

- Distribute a K'NEX Wheels & Axles and Inclined Planes building set to each group.
- Invite the students to build the **SPLITTING WEDGE** model (Pages 12-13 of the building instructions booklet.) We recommend that one student builds Steps 1-6, the log, and the other student builds Steps 7-11, the wedge.
- Allow them a few minutes to investigate the model and determine what it does.
- NOTE:** *In the inset diagram of Steps 1-6 it appears that the 2 sets of red rods are further apart at the top than at the bottom. This is not the case – they are parallel to one another. Only when the wedge is inserted do the upper edges move further apart.*

**Inquiry Activity: How does the splitting wedge help you do work?**

Review with the students the fact that wedges are actually inclined planes that move. Their purpose is to make work easier by reducing the amount of effort force that is needed to do the job. The students will determine how they do this by using the model they have constructed.

**Steps**

1. Look at the splitting wedge. Think about why it is considered to be a type of inclined plane.

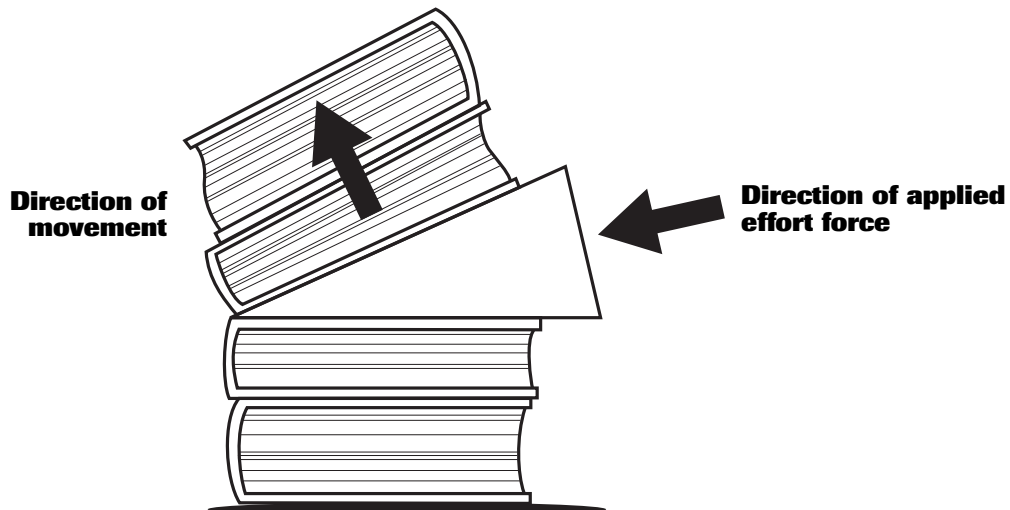
*The splitting wedge is made up of 2 inclined planes arranged back to back.*

2. (a) Set the edge of the splitting wedge (constructed in Steps 7-11 of the building activity,) between the two sides of the 'log' so that it is approximately half way down the first set of blue rods.
  - (b) Measure and record the distance between the top edges of the 'log'.
  - (c) Push the wedge in further and measure again. What do you notice?

*Students should notice that as they push down, the sides of the 'log' move sideways. This should be reflected in their diagrams – the wedge makes the log's green connectors separate a greater distance than just the width of the wedge's tip. The more they push down, the further apart the log's sides separate. The sides of the log move at right angles to the movement of the wedge.*

3. Draw and label a diagram to show in which directions the wedge and the 'log' halves have moved.
4. (a) Take 4 heavy books. Stack them on top of each other. Using your finger-tips, lift up two of them. Notice how this feels.
  - (b) Now use the splitting wedge to lift the same two books.
  - (c) When you tap in the wedge, which way do the books move?
  - (d) How does this compare with moving the books with your finger tips?
  - (e) Try the experiment again, this time lifting all four books.
  - (f) What do you notice this time?

*Students should notice that it is much more difficult to lift the books using their finger tips than it is with the wedge, especially when they try to lift all four books. As the wedge goes in sideways, the books move vertically.*





### Applying The Idea

- Ask the students to record in their journals how a splitting wedge functions as inclined plane and also how it is different from the inclined planes they have used in the previous activity.

*Students should note that wedges make it easier to raise objects up and this makes them like inclined planes. They are different because the wedge changes the direction of the force. Instead of an object moving up a slope, the slope (wedge) is moving under the object to lift it. Unlike most inclined planes, the wedge moves when it is used.*

- Encourage the students to think of other machines that function like a splitting wedge. Ask them to draw a picture or build a K'NEX model of one of the machines and explain how it works.

*Other examples include a fork, axe, chisel.*



### Extending The Idea

- Using wedges, Abraham Lincoln earned himself a nickname, The Railsplitter. Use the library or Internet to research the life of Abraham Lincoln to find out how he got his name and how he used wedges.

(Visit <http://lincoln.lib.niu.edu/> for information about the early years in the life of Abraham Lincoln.)

*When Lincoln was a boy, he helped his father clear the land in a wooded area in Indiana, where he lived. He used an axe, a type of wedge, to cut trees. Later on in life, he worked for others chopping firewood for heating and cooking, cutting logs for houses and splitting rails for fences and cabins. To split a log into rails, he would drive a wedge into the log. He was given the nickname "The Railsplitter" when he ran for political office in 1860. It reminded voters of his background and helped them relate to him.*

- Ask the students to calculate the Mechanical Advantage of the K'NEX splitting wedge. This can be calculated using the following formula:

$$\frac{\text{Slope length} \times 2}{\text{Thickness of the end you strike}} = \text{MA}$$

**JOURNAL CHECK**

- ✓ Diagram and definition of a wedge.
- ✓ Distance measurements.
- ✓ Diagram of the direction that work is performed, with labels for distance and direction.
- ✓ Explanation of how the wedge functions as an inclined plane and how it differs from other inclined planes they have used.
- ✓ List of everyday wedges, with diagrams.

