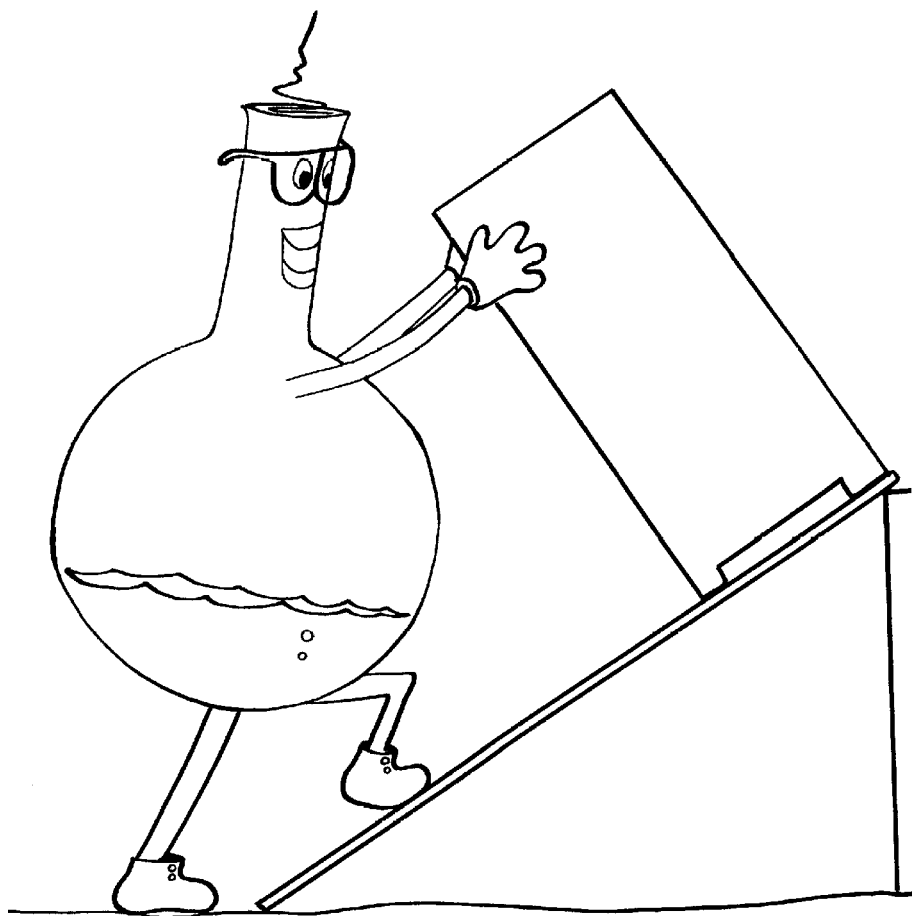


Professor Beaker's Learning Lab about Inclined Planes



Experiment description: A ramp, a load and a constructed scale are used to demonstrate that an inclined plane makes it easier to elevate a load.

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The Author has made every reasonable effort to ensure that the experiment in this publication is safe when conducted as instructed but assumes no responsibility for any damage caused or sustained while performing the experiment. Children should be properly supervised by adults while undertaking the experiment in this publication.

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Professor Beaker's Learning Labs - 147 Stewart Dr., Sudbury Ont. P3E 2R6

Toll free: 1-888-839-2153 - for local calls please use: (705)522-9365 - Email: pbeaker@vianet.on.ca

<http://www.canlink.com/profbeaker/>

ISBN 1-894120-38-8

Professor Beaker's Learning Lab about Inclined Planes

Processes for Elementary Science addressed in this Lab

Professor Beaker has evaluated this Learning Lab with reference to scientific skills and processes. Depending on how the educator chooses to present this Learning Lab, the following processes may be addressed:

Observing: using one or more senses to obtain information directly.

Communicating: exchanging information orally or by writing, reading, illustrating.

Co-operating: students working together, sharing ideas and tasks to achieve a single goal.

Measuring: using a system of units (standard and otherwise) to give a description in terms of quantity.

Inferring: making assumptions based on evidence from indirect observation.

Predicting: using previous experience and data to suggest what may happen in given circumstances.

Interpreting: making a conclusion based upon available data.

What is an Inclined Plane?

Generally we do not think of an inclined plane or ramp as being a machine. However, an inclined plane may be used to reduce the effort (force) needed to do a job. Therefore, it is a simple machine. Raising any object a certain distance takes considerable work, but by moving that object up a gentle slope, instead of lifting it straight up, less effort (force) is needed. Think about why mountain roads wind around, rather than go straight up the mountain, or why we use ramps to load heavy things onto trucks, or why we are less tired after we walk up a gentle hill compared to a walk up a steep hill. These are all examples of inclined planes.

Vocabulary for this Learning Lab

effort: This is the push or pull needed to move an object. It is equivalent to force.

inclined plane: This is a sloping surface used to make an object easier to elevate.

simple machine: This is a device that makes a job easier.

Word list

effort ramp inclined plane simple machine slope steep force

Teacher's Guide to the Experiment about Inclined Planes

Hypothesis

We think it will take less effort to pull the bag of marbles up a ramp than to lift the bag straight up.

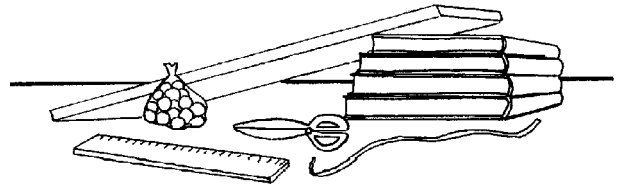
Teacher's Notes:

Even if the children choose a different hypothesis, it too will be tested by the experiment.

The aim of this experiment is to demonstrate that an inclined plane makes it easier to elevate a load.

Equipment

a plastic sandwich bag with a twist tie
35 marbles
string (30 cm long)
a stack of books
a long smooth board (or cookie sheet)
a rubber band scale (see instructions below)



Teacher's Notes:

The marbles can be replaced by any compact material weighing about 250 g (2 lb).

To make the rubber band scale

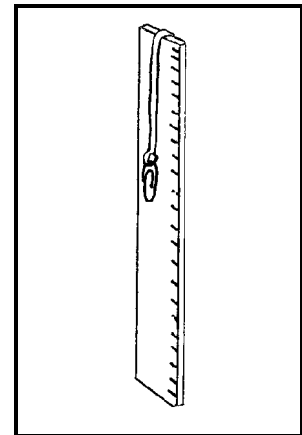
Equipment

a paper clip
scissors
a 30 cm ruler
tape
a medium weight rubber band

Method

1. Make one cut in the rubber band to make one long piece.
2. Tie a paper clip to one end of the rubber band.
3. Hold the paper clip so the tip is at the 9 cm mark on the ruler.
4. Drape the rest of the rubber band along the length of the ruler so its end hangs over the end of the ruler (the zero mark end).
5. While holding the paper clip at the 9 cm mark, tape the other end of the rubber band securely to the back of the ruler. Don't stretch the rubber band.

To use the rubber band scale (it is used often in *Professor Beaker's Learning Labs*) fix the load to the paper clip on the scale. Hold the ruler by its edges and let the load pull the rubber band down the length of the ruler. Read the number at the bottom tip of the paper clip. This is your measurement.

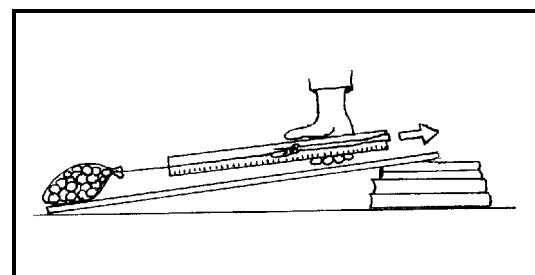
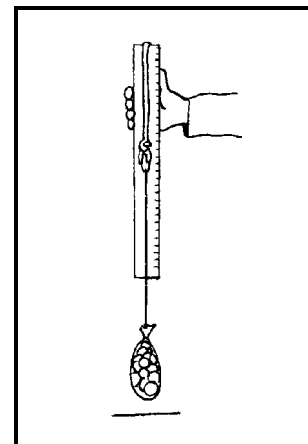


Teacher's Notes:

The relationship between the amount of stretching of the rubber band and the amount of effort being expended may not be immediately understood by the students, and should be discussed with them. The rubber band scale could be prepared ahead of time and its use demonstrated. The instructions on how to make this scale are not included in the

Method

1. Put the marbles into the sandwich bag and tie it shut with the twist tie. This is your load.
2. Tie one end of the string to the paper clip on the scale.
3. Tie the other end of the string to the neck of the sandwich bag.
4. Stack the books on the end of a table.
5. Place the load on the table and slowly lift it to the height of the stack of books by lifting the ruler (let the rubber band stretch down the front of the ruler)
6. Observe how far the rubber band stretches. Find the number by the tip of the paper clip on the scale and record it.
7. Place one end of the board on the books to make a ramp. The other end is resting on the table top.
8. Place the load at the bottom of the ramp and move it up the ramp by pulling the scale up the ramp (let the rubber band stretch down the length of the ruler).
9. Observe how far the rubber band stretches. Find the number beside the tip of the paper clip on the scale and record it.



Teacher's Notes:

A ramp with a lower slope will better demonstrate the difference between the effort required to raise a load using a ramp and the effort required by lifting the load by hand. Keep this in mind when choosing the length of board and the height of the stack of books. The board may be replaced by a smooth cookie sheet if you wish.

Observations

In the rubber band scale, how does the amount of stretch in the rubber band indicate the effort being used? To what number on the ruler did the rubber band stretch when the load was lifted straight up? To what number on the ruler did the rubber band stretch when the load was pulled up the ramp?

Conclusions

The rubber band stretched farther when the load was lifted straight up compared to pulling the load up the inclined plane. This shows that it took more effort (force) to lift the load straight up than it took to move it up a ramp (inclined plane). It is easier to move something up an inclined plane than it is to lift it straight up.

What Happened?

An inclined plane is a lot like a long set of stairs that are built with low steps. It is easier

to climb the stairs when the steps are low compared to climbing straight up a wall. It

Science Shorts about Inclined Planes

- 1. There are 6 simple machines. Can you name them?**
The wheel and axle, pulley, screw, wedge, inclined plane and lever are all simple machines.
- 2. Why do we use simple machines?**
We use them because they make our physical work easier.
- 3. What is an inclined plane?**
It is a flat surface that has been tipped. It can be a ramp of some sort, or a sloping road.
- 4. Which simple machine do movers use to make moving furniture easier?**
They use an inclined plane (a ramp).
- 5. Most playgrounds have an inclined plane. Can you name it?**
A playground slide is a kind of inclined plane. A seesaw looks like an inclined plane but it actually works like a lever.
- 6. Which simple machine did the ancient Egyptians use to help them build huge pyramids?**
They used inclined planes to help move the big stones up to the top of the pyramids. They probably used levers, too.
- 7. Which is easier - lifting a bike up a height or pushing it up a ramp?**
It is easier to push it up a ramp (inclined plane).
- 8. Which is easier - riding a bike up a steep hill or up a gentle hill?**
It is easier to ride up a gentle hill because it is like an inclined plane.
- 9. Why do roads going up mountains usually wind around instead of going straight up the side of the mountain?**
It is easier for a car to go up a more gentle slope than up a steep one.
- 10. Name the simple machine that wheelchairs use instead of going up stairs?**
They use a wheelchair ramp which is really an inclined plane.
- 11. How do inclined planes affect your life?**

Experiment about Inclined Planes

Level 1

Hypothesis

We think it will be easier to pull the bag of marbles up an inclined plane than to lift the bag straight up.

Equipment

a plastic sandwich bag with a twist tie

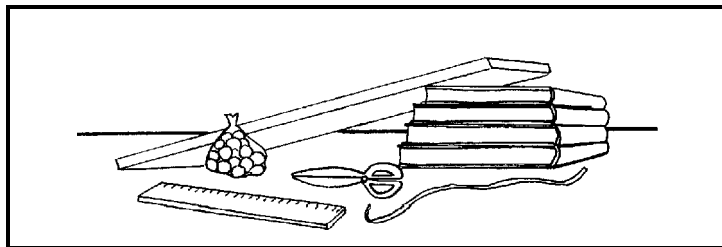
35 marbles

string (about 30 cm long)

a stack of books

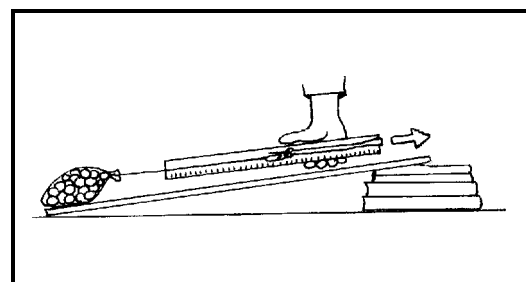
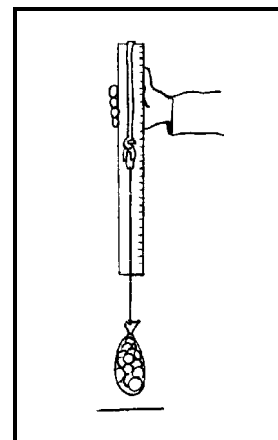
a long smooth board

a rubber band scale



Method

1. Put the marbles into the sandwich bag and tie it shut with the twist tie. This is your load.
2. Tie one end of the string to the paper clip on the scale.
3. Tie the other end of the string to the neck of the sandwich bag.
4. Stack the books on the end of a table.
5. Place the load on the table and slowly lift it to the height of the stack of books by lifting the ruler (let the rubber band stretch down the front of the ruler)
6. Observe how far the rubber band stretches. Find the number by the tip of the paper clip on the scale and record it.
7. Place one end of the board on the books to make a ramp. The other end is resting on the table top.
8. Place the load at the bottom of the ramp and slowly move it up the ramp by pulling the scale up the ramp (let the rubber band stretch down the length of the ruler).
9. Observe how far the rubber band stretches. Find the number beside the tip of the paper clip on the scale and record it.

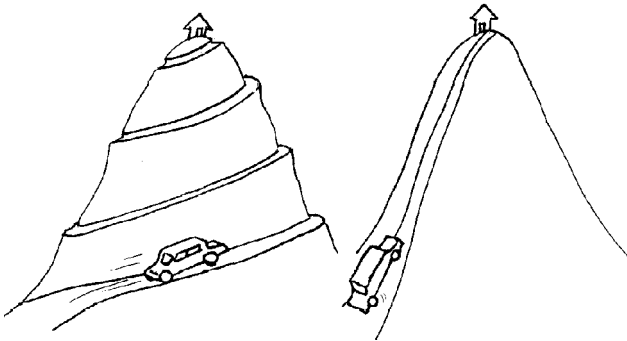


name _____

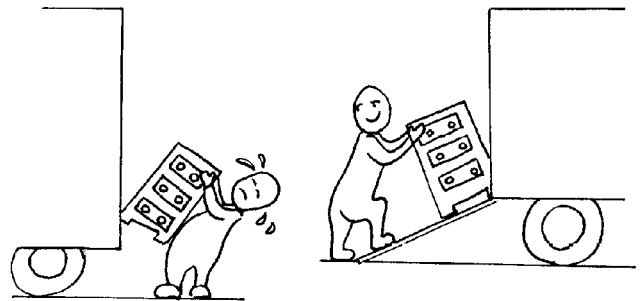
Level 1 - assessment

Inclined Planes

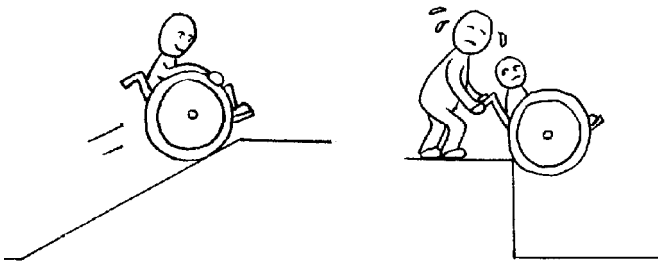
Circle the pictures that show an inclined plane being used to make the job easier.



mountain roads



moving furniture



raising a wheelchair

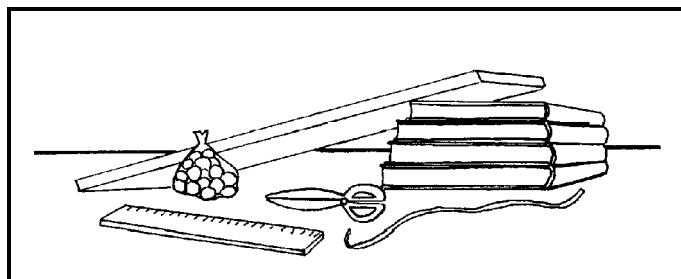
Experiment about Inclined Planes

Hypothesis

We think it will be _____ (easier/harder) to pull the bag of marbles up the inclined plane than to lift it straight up.

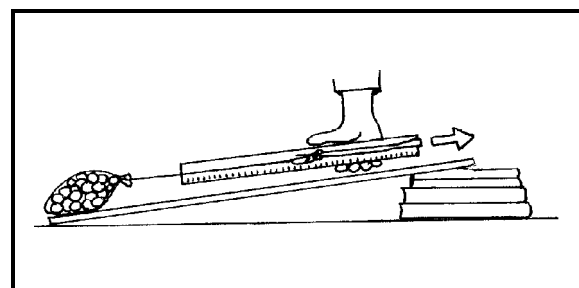
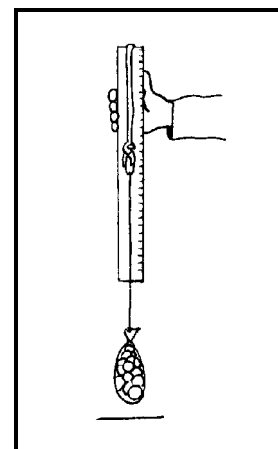
Equipment

a plastic sandwich bag with a twist tie
 35 marbles
 string (about 30 cm long)
 a stack of books
 a long smooth board
 a rubber band scale



Method

1. Put the marbles into the sandwich bag and tie it shut with the twist tie. This is your load.
2. Tie one end of the string to the paper clip on the scale.
3. Tie the other end of the string to the neck of the sandwich bag.
4. Stack the books on the end of a table.
5. Place the load on the table and slowly lift it to the height of the stack of books by lifting the ruler (let the rubber band stretch down the front of the ruler)
6. Observe how far the rubber band stretches. Find the number by the tip of the paper clip on the scale and record it.
7. Place one end of the board on the books to make a ramp. The other end is resting on the table top.
8. Place the load at the bottom of the ramp and slowly move it up the ramp by pulling the scale up the ramp (let the rubber band stretch down the length of the ruler).
9. Observe how far the rubber band stretches. Find the number beside the tip of the paper clip on the scale and record it.



name _____

Level 2-3 - assessment

Inclined Planes

Answer the questions. The words below may help you. Put your answers in the blanks.

When you are done solve the phrase at the bottom of the page.

1. The inclined plane belongs to a special group of machines. What kind of machines are these?

1 2 3 4 5 6

2. Does using an inclined plane make it easier, or harder to lift something up?

7 8 9 10 11 12

3. Moving companies use a kind of inclined plane to move heavy things. What are they called?

13 14 15 16 17

4. What is the name of the inclined plane that you use to go up inside a house?

18 19 20 21 22 23

5. What part of an experiment tells you how to do it?

24 25 26 27 28 29

Words to choose from. Not all will be used.

simple method ramps stairs ropes people easier
ladder harder

22 8 24 4 1 20 12 7 27 25 13 6

19 28 9 26 14 y !

Experiment about Inclined Planes

Level 3

Hypothesis

(You will be lifting and pulling the sandwich bag of marbles up the slope. Which method of raising the bag of marbles will take less effort - lifting straight up or pulling the bag of marbles up the inclined plane?) _____

Equipment

a plastic sandwich bag with a twist tie

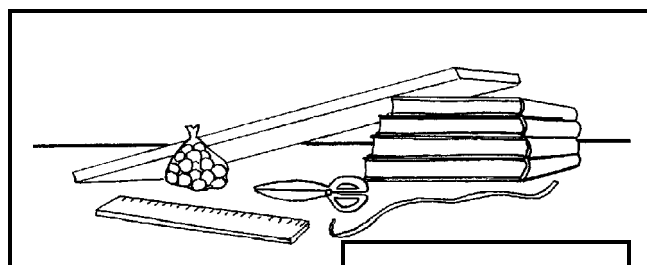
35 marbles

string (about 30 cm long)

a stack of books

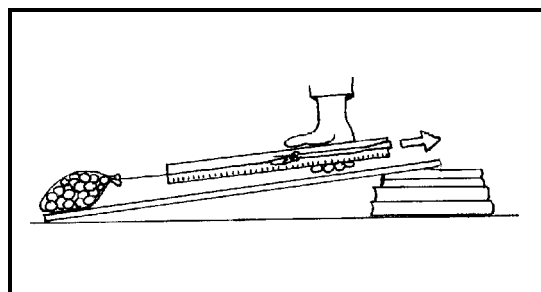
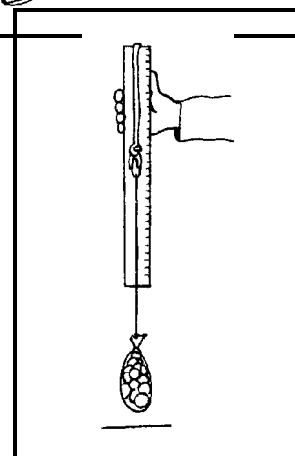
a long smooth board

a rubber band scale

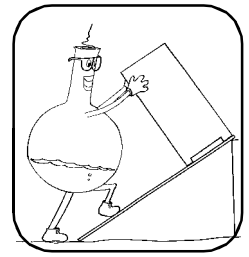


Method

1. Put the marbles into the sandwich bag and tie it shut with the twist tie. This is your load.
2. Tie one end of the string to the paper clip on the scale.
3. Tie the other end of the string to the neck of the sandwich bag.
4. Stack the books on the end of a table.
5. Place the load on the table and slowly lift it to the height of the stack of books by lifting the ruler (let the rubber band stretch down the front of the ruler)
6. Observe how far the rubber band stretches. Find the number by the tip of the paper clip on the scale and record it.
7. Place one end of the board on the books to make a ramp. The other end is resting on the table top.
8. Place the load at the bottom of the ramp and slowly move it up the ramp by pulling the scale up the ramp (let the rubber band stretch down the length of the ruler).
9. Observe how far the rubber band stretches. Find the number beside the tip of the paper clip on the scale and record it.



Scientist: _____



What I learned about Inclined Planes!

Inclined Planes

Today I learned about inclined planes!

I can show you if you will help me tie a thin stretchy rubber band to a fairly heavy object (such as an apple in a plastic sandwich bag). Hold onto the rubber band and lift the object up. See how much the rubber band stretches. Now, hold the rubber band and pull the object up a gentle slope (an inclined plane) made with a smooth hard book cover (or a smooth cookie sheet) raised about 4 or 5 inches (about 10 cm). How far did the rubber band stretch this time?

An inclined plane is a sloping surface like a ramp. As your demonstration showed, it takes less effort (force) to move an object up a ramp than it takes to lift it straight up. An inclined plane is a simple machine.

The ancient Egyptians knew about inclined planes. They used them to help them move massive stone blocks so they could construct the pyramids. Moving companies today use ramps to move furniture. Wheelchairs need ramps to get up heights. Mountain roads winding their way gradually up mountains are really inclined planes.

The inclined plane, found everywhere, is being used to make many jobs easier.



Inclined Planes- take home page

Teacher's name _____ date: _____

I worked with _____ (child's name) to conduct the activity.

Did the child appear to understand what happened during the activity? yes sort of no

Was the experience pleasant for you both? yes sort of no

_____ (name of person who did the activity with the child)

Word Search on Inclined Planes

Word List

easier
effort
force
inclined
machine
plane
ramp
simple
slope
stairs
up

s	d	f	m	q	f	o	r	c	e
r	r	v	a	s	i	m	p	l	e
i	a	m	c	n	b	v	c	x	z
a	m	t	h	t	r	o	f	f	e
t	p	j	i	l	j	k	f	g	d
s	a	q	n	c	u	p	l	p	p
t	r	e	e	q	p	o	i	k	l
z	d	e	n	i	l	c	n	i	a
c	e	p	o	l	s	b	c	v	n
e	a	s	i	e	r	u	y	n	e