Important Concepts . . .

Preview Review

Science

Grade 8

W1 - Lesson 3A: Viscosity, Flow Rate, and Buoyancy

W1-Lesson 3B: Simple Machines

V5-07

Important Concepts of Grade 8 Science

Materials Required

Textbook:
Science in Action 8

Science Grade 8
Version 5
Preview/Review W1 - Lesson 3

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Preview/Review Concepts
for
Grade Eight Science

W1 - Lesson 3A:
Viscosity, Flow Rate, and Buoyancy

OBJECTIVES

By the end of this lesson, you should

- define viscosity and tell how it can be changed
- define flow rate and calculate it
- predict if a substance will sink or float in a given fluid

GLOSSARY

buoyancy - the tendency of an object to float when placed in a fluid

flow rate - the velocity or speed at which a liquid moves

viscosity - a liquid's resistance to flow

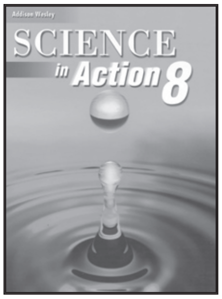
W1 - Lesson 3A: Viscosity, Flow Rate, and Buoyancy

Welcome to W1 - Lesson 3A. This lesson teaches you about **viscosity**, **flow rate**, and **buoyancy**. It should take about 30 minutes to complete.

Viscosity

Viscosity is a liquid's internal resistance or friction that keeps it from flowing. What does this mean? If you pour a certain liquid onto a flat table, how fast will it spill onto the floor? Will it ever reach the sides of the table to end up on the floor? For example, if you take a litre of water and dump it on a flat table, soon the water will be on the floor. One could say that water has a low viscosity. If you took a litre of hand lotion and dumped it on a table, it would probably sit there and move very little for a very long time. We could say that hand lotion has a high viscosity. **Fluids with high viscosity do not flow as easily as fluids with low viscosity**.

You may have heard the word **viscosity** associated with engine oil. A car engine has many moving parts that cause friction, which results in heat. There is also a considerable amount of heat made when fuel burns. To avoid overheating, engine oil is used between some of these moving parts. It acts as a lubricant and reduces friction, reducing the amount of heat that the engine produces. To do its job, oil must be at the correct viscosity. Most engine oils have additives that prevent them from losing their viscosity when they get hot. Some motor oils have additives that prevent them from getting too "viscous" (solid) when the temperature is very cold.



Activity 1

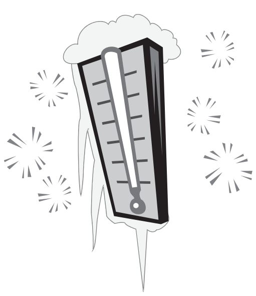
Read and understand pages 39 to 40 in *Science in Action 8*. Then, complete the following chart.

In the table below, make a list of items that have high viscosity and a list of items that have low viscosity. An example has been provided for each.

Answers will vary. Some examples are below.

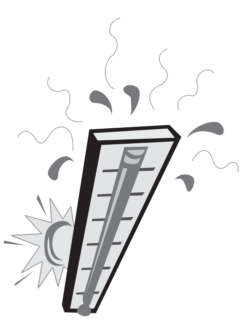
High Viscosity	Low Viscosity
Engine Oil	Water

Flow Rate



Flow rate is the velocity at which a liquid will move. This can be measured in metric units such as millimetres per second (mm/s), centimetres per second (cm/s), metres per second (m/s), litres per second (L/sec), or kilometres per hour (km/hr).

What do you think of when you hear the phrase, “It was slower than molasses in January”? Molasses, being a very thick sugary/syrupy substance, does not flow well in cold temperatures. This is because firstly, it has high viscosity and secondly, **temperature affects viscosity**. Generally, when a material is warmed it loses viscosity and when it cools, it gains viscosity. Depending on the liquid you are measuring, some might take hours or even days to move.



Some solids also have the ability to move very slowly. A glacier, for example, has a very slow flow rate. A flow rate for a typical glacier could be as slow as five metres per year (5 m/yr). On the other extreme, if you were caught in a “flash flood” the liquid water in a river could carry you at a flow rate of 40 km/hr.

1. Substance A flows 10 m in 60 seconds. Substance B flows the same 10 m in 150 seconds. Which substance has the lowest flow rate?

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2. A liquid flowed 10 m in 70 seconds. What is its flow rate in m/s?

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3. Compare the flow rate of a high viscosity fluid with the flow rate of a low viscosity fluid.

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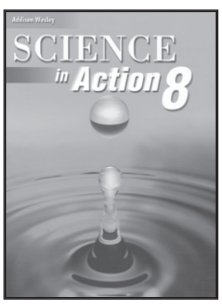


Activity 2

Read and understand page 40, which contains a description on how to measure viscosity using the ramp method. Read page 417, "The Inquiry Process of Science" in the *Science in Action 8* textbook.

In this activity a student designed an experiment to measure flow rates of the same liquid at different temperatures using this method. Use the information below to answer the questions in the **Your Conclusion** section.

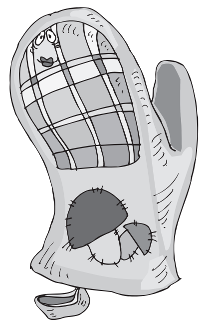
Note: You are not actually doing this experiment; you are using data from someone who has done it.

Experiment: Measuring Flow Rates

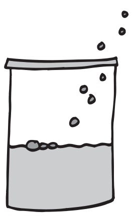
Problem

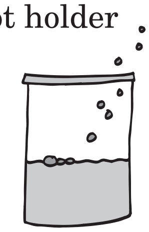
Does a liquid have different flow rates at different temperatures?

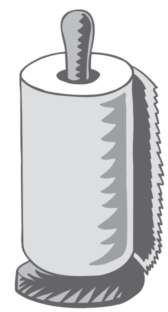
Materials



1 ramp (1 metre wooden plank with wood blocks beneath it)
sink
sturdy table
100 mL table syrup at room temperature
100 mL table syrup at fridge temperature (0 to 4°C)
100 ml table syrup microwaved on high for 2 minutes
(60 to 100°C)
timer
3 graduated cylinders
microwave
fridge
cleaner
paper towel
temperature safe/microwave safe containers
oven mitts
pot holder







Procedure

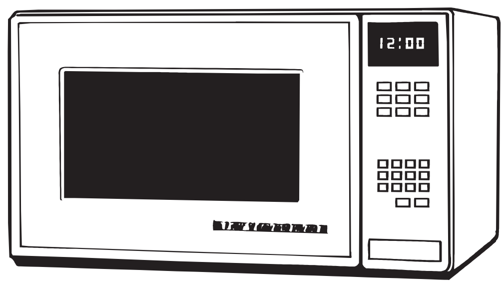
1. In each graduated cylinder measure 100 mL of table syrup. Let one stand at room temperature for 20 minutes and place the other cylinder in a fridge for 20 minutes.

2. After about 15 minutes of letting the first two cylinders stand, microwave the third 100 mL of table syrup for about 2 minutes on high.

3. Set up a 1 metre ramp. Make the high end 30 cm in height. If necessary mark a distance of 1 metre on the ramp.

4. With a timer, test all three samples (one at a time) for the time required to travel 1 metre. Pour the syrup on the highest point of the board. Measure the time needed for the syrup to reach the one-metre mark.

5. Record your findings in the Observations section.



Observations

Data Table
Flow Rate For Table Syrup at Different Temperatures

Table Syrup at Fridge Temperature (0 to 4°C)	Table Syrup at Room Temperature (21°C)	Table Syrup at Microwaved Temperature (60 to 100°C)
1 metre/310 seconds	1 metre/121 seconds	1 metre/12 seconds

Your Conclusion

1. Which sample in the experiment has the fastest flow rate?

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2. Which sample in the experiment has the slowest flow rate?

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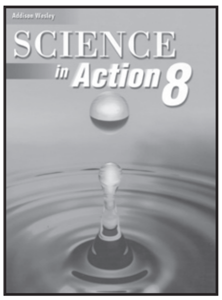
3. At which of these temperatures will oil have the highest flow rate: 10°C or 50°C ?

4. How does temperature affect the viscosity of a substance?



5. Page 41 of *Science in Action 8*, explains why a change in viscosity happens in relation to the particle model. In your own words, why does this change occur?

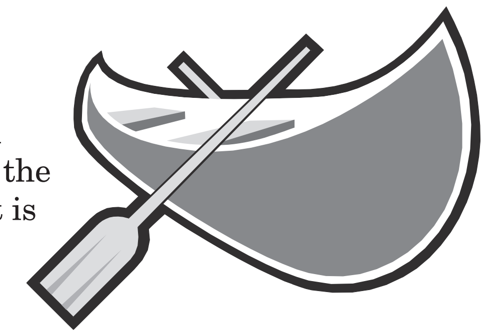
6. During this experiment, what two variables had to remain the same for the experiment to be accurate? (Which are the controlled variables?)

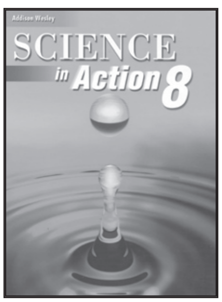
7. During this experiment, what variable had to change to solve the problem? (Which one is the manipulated variable?)

8. Imagine you have honey that has solidified in a squeeze tube container. What would be an easy solution to removing some of this honey?

Buoyancy

Buoyancy is the tendency of an object to float when it is placed in a fluid. Buoyancy occurs because fluids exert an upward force on objects in them. If the buoyant force on an object is greater than the downward force of gravity on it, the object floats. An object sinks when its density is greater than the density of the fluid it is in. It floats when its density is the same or less than that of the fluid it is in.





Activity 3

Read pages 50 and 51 in *Science in Action 8*. Then, answer the following questions.

1. What happens when an object with a density of 2.5 g / cm^3 (1 cm^3 = 1 mL) is put into water (density = 1.0 g / mL)?

 ____

2. What is neutral buoyancy?

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3. What is the Plimsoll line and why is it important to cargo ships?

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4. Why do hot air balloons float?

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5. In your own words, describe how a submarine sinks and rises through the water.

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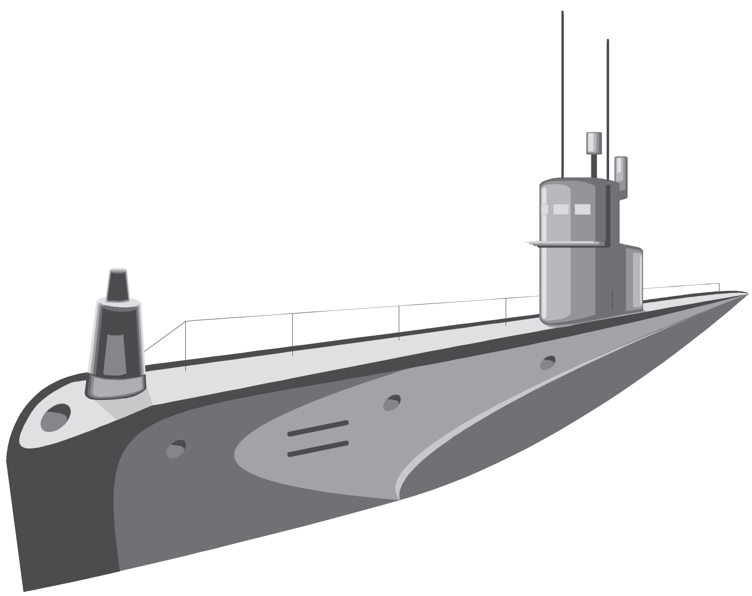


You should now be able to meet all of the objectives listed at the beginning of the lesson. Go through the list to see if there is anything you need to spend more time on.

Preview/Review Concepts
for
Grade Eight Science

W1 - Lesson 3B:
Simple Machines

OBJECTIVES

By the end of this lesson, you should

- identify and describe the six main simple machines
- explain why simple machines are used
- solve simple problems dealing with levers, inclined planes, and pulleys

GLOSSARY

effort arm - the part of the lever from the fulcrum to the applied force

inclined plane - sloping surface up or down which something can be moved

lever - solid bars that pivot or turn on a point called a fulcrum

load arm - the part of the lever from the fulcrum to the load

pulley - a grooved wheel over which a rope slides to move an object

screw - an inclined plane wrapped around a central core.

wedge - inclined plane used to pry things apart

wheel and axle - two wheels of different diameters which are hooked together at their centre points and move together

W1 - Lesson 3B: Simple Machines

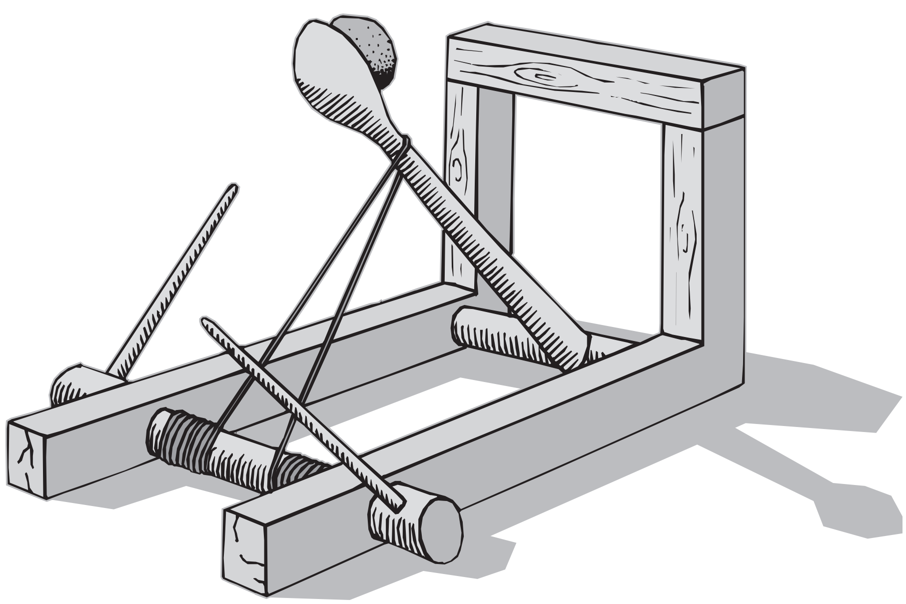
Welcome to W1 - Lesson 3B. This lesson is designed to teach you about simple machines; it should take about 60 minutes to complete.

Simple Machines

The major aspect that sets humans apart from other animals is our reasoning mind. One thing we have used our minds for is the development of machines that make tasks easier. We have accomplished many impressive feats through history using variations of these machines.

A **simple machine** is a tool or device made up of one basic machine. It is made of materials suitable for its function so that it does not fall apart while being used. Simple machines can be put together to make more complicated machines. This lesson helps you understand six simple machines: **lever**, **inclined plane**, **wedge**, **screw**, **pulley**, and **wheel and axle**.

When using machines, as you gain a force advantage, you lose a speed advantage and vice versa.



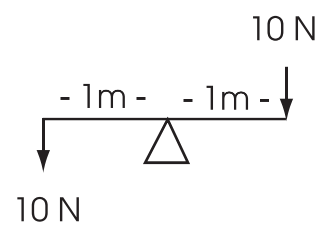
Lever

Levers are solid bars that pivot or turn on a point called the fulcrum. Some reduce the force needed to carry out a task such as lifting heavy objects.

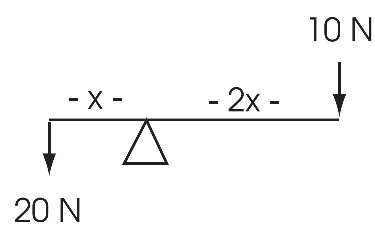
Levers are of three types:

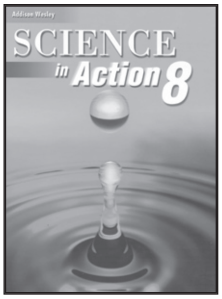
- The **first class** lever has the fulcrum between the force used to move an object and the object on the other side. An example is a pry bar. As you lengthen the side of the lever where you apply force, moving the load on the other side is easier.
- A **second class** lever has the weight or load between the force and the fulcrum. A wheelbarrow is an example. The closer the load is to the fulcrum, the easier it is to move the load.
- The **third class** lever has the force between the load and the fulcrum. Sports equipment such as golf clubs and tennis rackets are levers of this type. They speed the load - in this case, the ball.

Here is an example of how a class 1 lever works. If you have a load on one side of the fulcrum and you want the lever to balance, you must apply the same force the same distance from the fulcrum on the other side.



To balance a load with twice the force, but keep the applied force the same, you must move the applied force two times as far from the fulcrum.





Activity 1

Read and understand pages 261 to 262 in *Science in Action 8*. Then, answer the following questions.

1. Define the term **simple machine**.

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2. In your own words describe how to make a **lever**.

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3. Draw and describe the three different kinds of levers. Explain how each is used.

4. Which class of lever has the load between the effort and the fulcrum.

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5. A class 1 lever with load arm and effort arm is 2 metres long. The fulcrum is in the middle. A 100 N load is at the end of the load arm. How much effort must be applied to the end of the effort arm to lift the load?

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6. What happens to the amount of effort needed if the effort arm is lengthened to 2 m?

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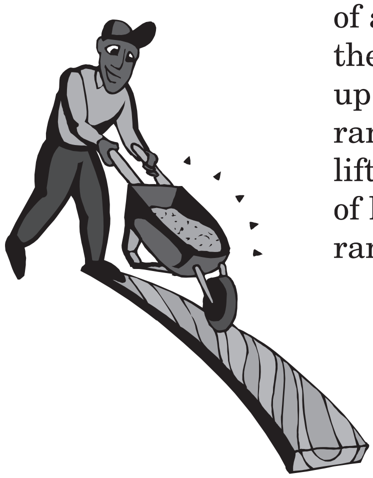
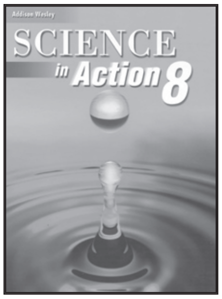
Inclined Plane



The easiest way to describe an **inclined plane** is to say it is a sloping surface up which something can be moved. A good example of a ramp or inclined plane is a plank used to put a motorbike into the back of a truck. Instead of lifting the heavy motorbike straight up (which would require a force equal to the weight of the bike), a ramp can be used to make the job easier. However, the object being lifted using a ramp must travel a greater distance than the distance of lifting straight up. For example, to halve the force required, the ramp must be two times longer than the height the object is lifted.



Activity 2

Read and understand the **inclined plane** section on page 263 in *Science in Action 8*. Then, answer the following questions.

1. Draw and describe an inclined plane. Explain how is it used.

2. Describe a scenario (other than the one provided) where an inclined plane could be used.

3. Refer to page 263 in *Science in Action 8*. To lift an object straight up 1 metre requires 1000 N of effort. However, to pull the same object up a ramp requires 250 N of effort. How long is the ramp?

4. Imagine you moved a load along an inclined plane that is 6x as long as the height the object was lifted. You applied 200N of effort. What was the weight (in N) of the load?

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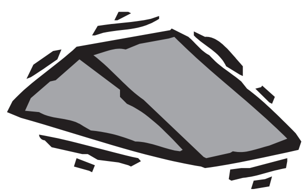
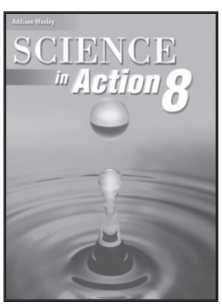
Wedge

A **wedge** is used to make the job of prying things apart easier. The small pointed end is forced into an object followed by a continuously wider part, and the object is forced into two pieces. Some examples of wedges are knives, axes, and scissors. As well, the teeth on a zipper are wedges.





Activity 3

Read and understand the **wedge** section on page 263 in *Science in Action 8*. Then, answer the following question.

1. What might you use a wedge for in your daily life?

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2. Name and describe a machine that has a wedge as one of its parts.

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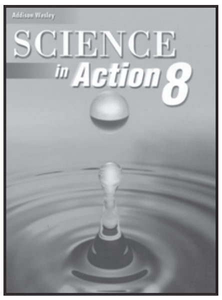
Screw

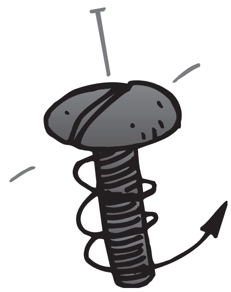
Think of an inclined plane wrapped around something. That is a **screw**. It turns rotational motion into straight motion. A screw has a power advantage; less force is needed than if it was not used. A screw can be used to lift things (car jacks), move things (a grain auger), or fasten things together (a wood screw).



Activity 4

Read and understand the **screw** section on page 264 in *Science in Action 8*. Then, answer the following questions.

1. Draw and describe a screw. How is it used? Give some examples of a screw.



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Pulley

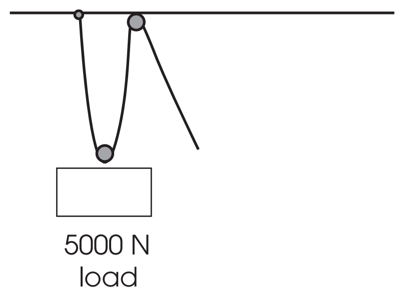
A **pulley** is a grooved wheel over which a rope slides to move an object. Pulleys can be used to lift objects. If a force advantage is gained with a pulley, the amount of rope to pull is longer than the distance the rope will lift an object. Each rope going up from the object, moves the same distance as the object. If there are four “up-ropes”, the end of the rope will have to be pulled four times as far as the object is lifted. The rope can go over or under the pulley. The more pulleys used in the system, the heavier the load that can be lifted. The more “up-ropes” from a load, the less input force is required.

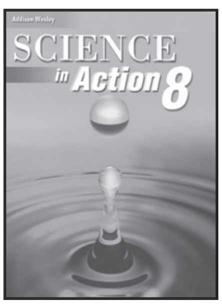
If there are four ropes going up from the load, one quarter the force is needed than if the load was lifted straight up without the pulleys.

2 pulleys, 2 up-ropes from load; therefore, force needed is halved

5 000/2 = 2 500 N

The rope will need to be pulled 2 m for every 1 m the load is lifted (each up-rope moves the height the load moves)





Activity 5

Read and understand the **pulley** section on page 264 in *Science in Action 8*. Then, answer the following questions.

1. Draw and describe a pulley. How is it used? Give three examples of the things that might be common for pulleys to lift.

2. Draw a pulley system with six up-ropes with the load having a mass of 1 000 N. How much force must be applied to move the load?

3. Imagine you have a large load to lift, but are able to apply only 1/10 the force needed to lift it. If you attach pulleys to the load, how many "up-ropes" should be attached to the load?

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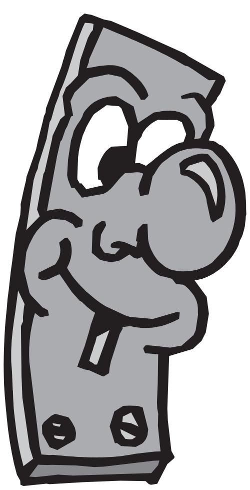
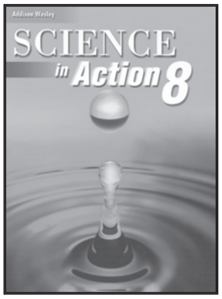
4. Draw a pulley set-up that uses five pulleys to reduce effort.



Wheel and Axle

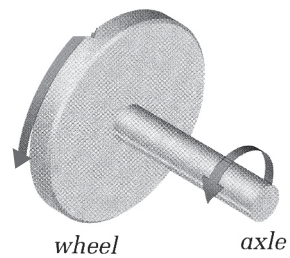
The **wheel** and **axle** is a combination of two wheels of different diameters that turn together because they are solidly attached. If the wheel makes one complete rotation, the axle makes one rotation also. Force applied on the larger wheel allows the smaller wheel (the axle) to turn with a greater force, allowing it to do the work more easily. A door knob is a good example. You turn the larger knob or wheel, and it provides greater force for the smaller axle, allowing enough force for the door mechanism to open. If force was applied to the smaller axle, the larger wheel would spin faster. This is a speed advantage.



Activity 6

Read and understand page 265 in *Science in Action 8*. Then, answer the following questions.

1. Draw and describe a wheel and axle. How is it used? What are some examples of a wheel and axle?



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2. If an axle turns 10 times in 5 seconds, how many times does the attached wheel turn in the same time?

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3. If you turn the small wheel on a wheel and axle, would the larger wheel spin slower or faster than the small axle?

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4. If you turn the large wheel, would the smaller wheel (axle) spin slower or faster than the large wheel?

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5. Some of the older semi trucks had very large steering wheels. What is the reason for this?

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You should now be able to meet all of the objectives listed at the beginning of the lesson. Go through the list to see if there is anything you need to spend more time on.

Extended Activity (Homework)

At your home, make a list of items that are examples of each of the following simple machines: lever, inclined plane, wedge, screw, pulley, and wheel and axle. Try to find at least one example for each.

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