DO ~~DON'T~~ TRY THIS AT HOME!

Bicycles

It's spring time and you are itching to take your bicycle on the first ride of the season. Before setting off, stretch your scientific muscle by crash testing a helmet, experimenting with air resistance and finding out how fast you can ride. Discover how gears work and study the properties of polymers by making a bouncy ball.

These experiments are sure to get you pumped for your next bike ride!

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CANADA SCIENCE AND TECHNOLOGY MUSEUM

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AMAZING EXPERIMENTS!

Cantaloupe Crash Test Dummy

Don't know what to do with your old bicycle helmet? Use it to test how helmets protect your head during a fall, without taking the fall yourself.

TAKE NOTE!

DO NOT wear any of the helmets used after this experiment. When a helmet crashes, it loses its ability to protect in the future.

Materials

- 1 old helmet (can be any kind of helmet you no longer need)
- 2 cantaloupes
- duct tape
- balcony or step-ladder
- garbage bags (or tarpaulin)
- 1 permanent marker
- adult supervision

Let's get to work!

1. Choose an area for your crash test. This area needs to be directly below a launch platform (such as a balcony or step-ladder), in a big, wide open space.
2. Cover the crash test area with garbage bags or a tarpaulin. This will make the clean up after the experiment much easier.
3. Put one cantaloupe in the helmet and secure it using the straps. If the straps are not able to hold the cantaloupe in place, use duct tape to secure it in place.
4. Bring your protected cantaloupe to your launch platform and drop it, helmet first, on to the crash test area. Make sure no one is standing in or around the crash test area before letting go.
5. Carefully step off the launch platform and go investigate what happened to the cantaloupe.
6. If the cantaloupe isn't damaged, take it out of the helmet and use it to do the following steps. If the cantaloupe is cracked or broken, use the second cantaloupe.
7. Take your un-protected cantaloupe to your launch platform and drop it on to the crash test area. Make sure no one is standing in or around the crash test area before letting go.
8. Step off the launch platform and go investigate what happened to the cantaloupe.

What happened?

A cantaloupe falling without a helmet can end up in pieces and create a big mess! Typically, the helmets will protect the cantaloupe from breaking because it is made of strong material and is 'egg shaped' to better absorb the shock of a fall. Just like a helmet protects a falling cantaloupe, it also protects your head in case of a fall from your bike.

A Need for Speed

Want to know how fast you can ride your bicycle? All you need is mathematics, a bicycle and a need for speed!

TAKE NOTE!

Don't forget to wear your helmet when riding your bicycle.

Materials

- a timer
- a measuring tape or metre stick
- a calculator
- 2 pylons or empty garbage cans
- a bicycle
- a friend

Let's get to work!

1. Find a safe, wide open space where you won't be disturbed by cars, pedestrians or other cyclists.
2. Place one pylon on the ground. Using the measuring tape, place the second pylon 50 meters away from the first pylon.
3. Ask your friend to stand near the second pylon with a timer.
4. Bring your bike to the first pylon, climb on and get ready to bike towards second pylon.
5. Ask your friend to give you a countdown and start biking at the same time as he/she starts the timer.
6. Ask your friend to stop the timer when you reach the second pylon. Record your time in the chart:

	Distance (in metres)	Time (in seconds)
Example	50m	10s
Your turn…		

7. To measure how fast you travelled, divide the distance by the time it took you to travel it (using the following formula) and record your answer in the chart below.

Speed = Distance ÷Time

	Speed (in metres/second)
Example	50 ÷ 10 = 5m/s
Your turn…	

If you travelled 50 metres in 10 seconds you would divide 50 metres by 10 seconds. That would mean you were travelling at 5 metres per second.

If you would like to know how fast you are going in kilometres per hour to compare your speed to that of a car, continue with the following calculations.

8. First, convert the distance in meters into kilometres. You can do so by using the following formula. Record your answer in the chart below.

Distance in Kilometres = Distance in Meters ÷ 1000

9. Now convert the time in seconds into hours using the following formula. Record your answer in the chart below.

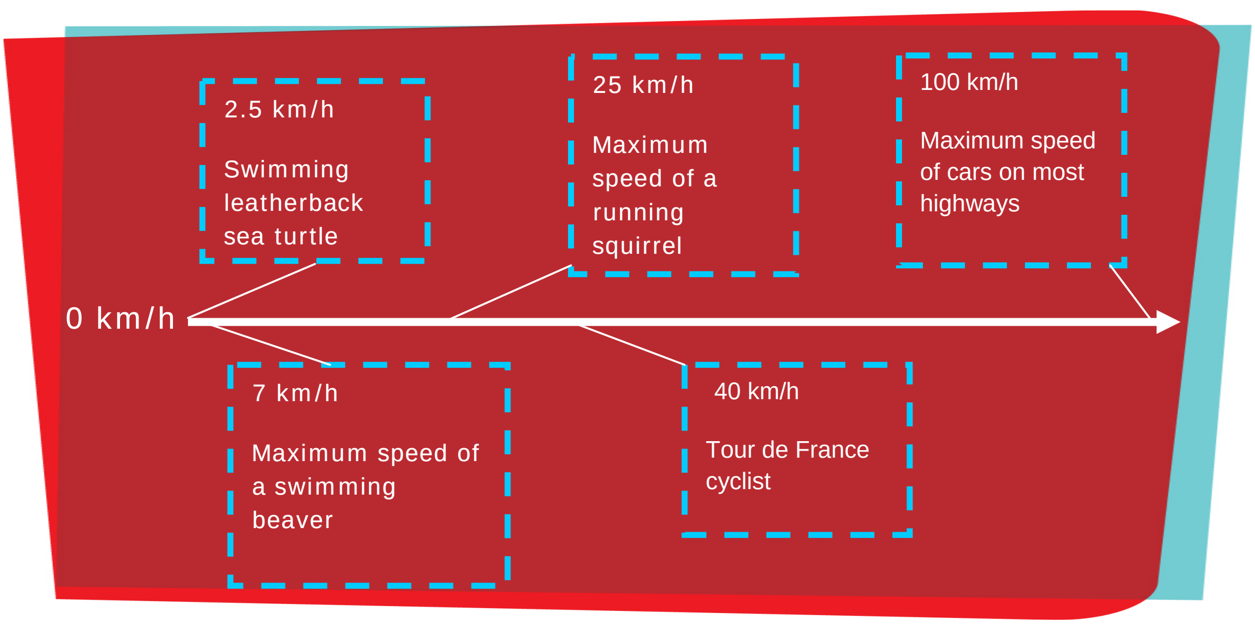
Time in Hours = Time in Seconds ÷ 3600

10. Finally, divide your answer to step 8 by your answer to step 9 to get your answer in Kilometres per hour.

	Distance in Kilometres	Time in Hours	Speed in Kilometres/hour
Example	0.05 Km	0.0033 h	15 km/h
Your turn...			

How fast were you going?

Compare your speed with that of your friends, family members or to the speeds in the following chart.

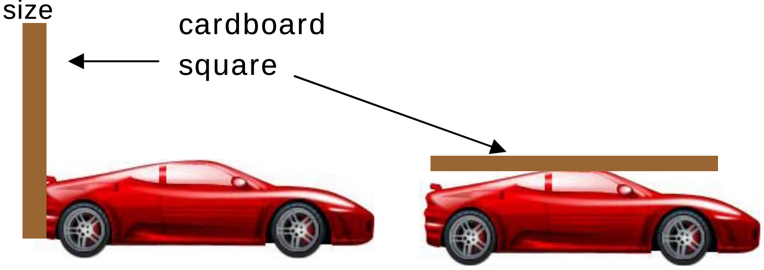


Riding Through the Air

Have you ever biked against the wind? If so, you know that moving through air can be very difficult. Some shapes are better at slicing through the air than others. For this reason, competitive cyclists change how they sit on a bicycle, have streamlined helmets and never wear baggy clothing. Discover how shapes can affect the speed of objects moving through the air.

Materials

- a wooden or plastic plank
- 2 toy cars of equal or similar size and weight
- tape
- cardboard
- a marker
- a ruler
- scissors



Let’s get to work!

1. Make a race track using a wooden or plastic plank. Lean one end of the plank against a table or chair so that the racetrack is sloped downwards.
2. Draw a starting line at the top of your race track with a marker.
3. Place the two toy cars behind the starting line and let them go at the same time. The two cars should get to the bottom of the race track at the same time. If this doesn’t happen, find another pair of toy cars that do.
4. Cut out two 5 cm by 5 cm square of cardboard.
5. Tape one of the cardboard squares to the back of one of the toy cars. Make sure the tape doesn’t stop the wheels from turning. (See the diagram above)
6. Tape the other square flat on the roof of the other toy car.
7. Bring both cars to the same starting line and let go of them at the same time. Did one car take longer to race down the track than the other?

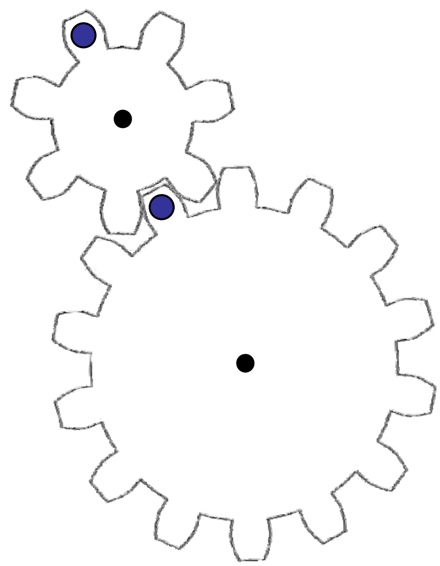
What happened?

The car with the cardboard square taped to its back was not able to roll as fast as the other car. The piece of cardboard changed the shape of the car and made it harder for it to move through the air. The other toy car was less affected because the air had to move around less surface area. Many fast-moving objects such as cars, trains and airplanes are given streamlined designs to make them more efficient at moving through the air. Since humans can’t change the shape of their body, we often change the positioning of the head, arms and legs to make it easier for the air to go around us.

Gearing Up

Modern bicycles have gears to make it easier to pedal up and down hills. Find out how gears work and what they do to make your bike ride a little easier.

Materials

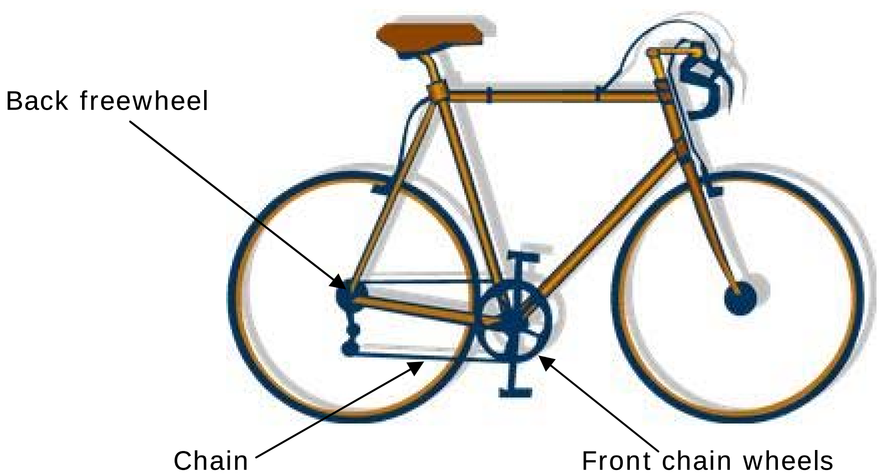


- gear template (see next page)
- 2 thick pieces of cardboard
- scissors or hobby knife (such as an X-Acto knife)
- a glue stick
- a marker or pen
- 2 split pin fasteners
- 1 sharp pencil

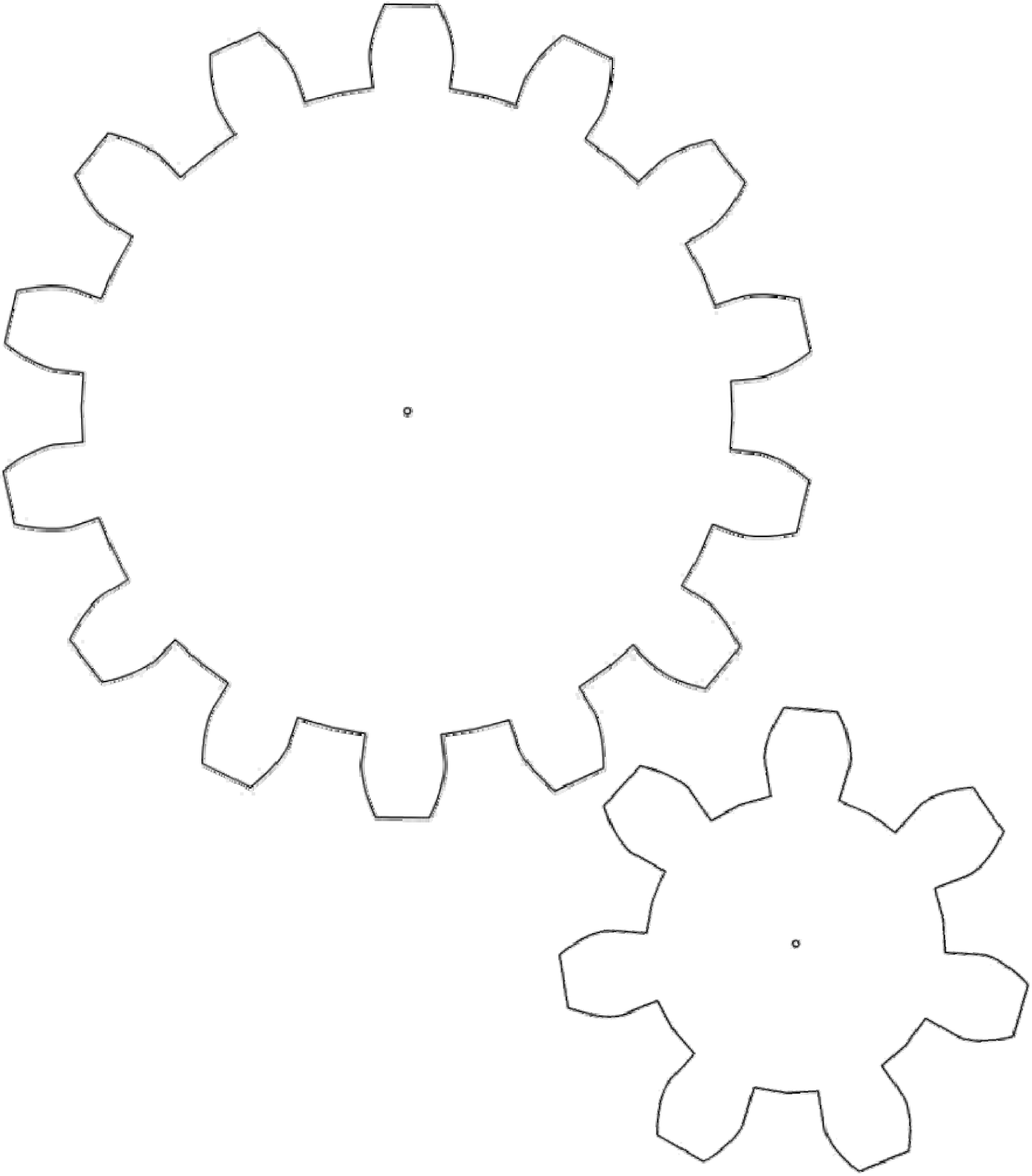
Let's get to work!

1. Print out the gear template and using a glue stick, adhere it to a piece of cardboard.
2. Cut along the outside edge of each gear carefully using the scissors or hobby knife. You can ask an adult to help you with this step.
3. Using a sharp pencil, poke a hole in the middle of each gear.
4. Place the two gears on the second piece of cardboard. Arrange them so that their spokes are intertwined. Use the diagram on this page as a guide.
5. Without disturbing the position of the gears, insert the fasteners through the hole in the middle of each gear. Press hard enough on the fasteners to make a mark on the back piece of cardboard.
6. Take both gears off the piece of cardboard and, using the sharp pencil, make a hole in the cardboard at the spot marked by the fasteners.
7. Place the gears back at their original spots on the cardboard. The holes in the gears and the cardboard should be aligned.
8. Thread the fasteners through the gear holes and the hole in the cardboard backing. Split the pins to secure them into place.
9. The gears should rotate freely around the fasteners.
10. Using a marker, colour in one spoke on both gears.
11. Begin spinning the smaller gear. Using the marked spoke, count how many times you have to rotate the small gear to cause one full rotation of the large gear?
12. How many times does the small gear rotate when you turn the large gear one full turn?

What happened?
On a modern bicycle, there are two sets of gears: the front chain wheels that are turned by the pedals and the back freewheel which is attached to the back wheel. The two are connected with a chain. By selecting the size of the two gears the chain will link, you can vary how far the bike will travel with one turn of the pedals. If the front gear is large and back gear is small, you will travel very far with only one turn of your pedals. However, your legs will have to work very hard to turn your pedals. On the other hand, if the gear at the front is very small and the back one very large, turning your pedals will be easy but you won't travel very far.
Explore this with your bicycle.



To learn more about the history of bicycles, visit the Cycles Collection Profile on the Canada Science and Technology Museum website:
http://www.sciencetech.technomuses.ca/english/collection/cycles.cfm



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Polymer Bouncy Ball

Bicycle tires can be made of natural or synthetic rubber. Both are made of very long chains of molecules called polymers, are very resistant and have elastic properties. In this experiment, make your own polymers and discover their bouncy properties.

TAKE NOTE!

Borax can irritate your skin and eyes and should never be consumed. Be sure to wash your hands after this experiment.

Materials

- 1 tablespoon (15 mL) of white PVA glue
- ½ tablespoon (2.5 mL) of borax
- 3 tablespoon (45 mL) of cornstarch
- 4 tablespoon (60 mL) of warm water
- food colouring (optional)
- 2 small cups or bowls
- 1 craft stick or spoon (for stirring)

Let's get to work!

1. In one cup, add the water, cornstarch and borax and mix well.
2. In the other cup, add the glue and the food colouring if you are using it. Mix well.
3. Add the water, cornstarch and borax mixture into the cup with the glue.
4. As you stir, the mixture should thicken immediately and start forming a ball. Take the ball out of the cup and roll it between the palms of your hands to make it round and smooth.
5. Once it is no longer sticky, you can bounce your new bouncy ball.

What happened?

White PVA glue is also a substance made of polymers. When the borax is added to the glue, it links the glue molecules together to make something that looks like a large web of molecules. The result is a solid mixture that is stretchy and elastic. Try changing the amounts of glue, borax and cornstarch and see what effects it has on the appearance of the ball and on its bounciness. You may end up with something more stretchy, bouncy, sticky or slimy.

To make a different kind of bouncy ball, check out the Do Try This at Home on Elastic Science: http://www.sciencetech.technomuses.ca/english/schoolzone/try-this-out-12-elastic-science.cfm

For the Experiments

- 1 old helmet (can be a any kind of helmet you no longer need)
- 2 cantaloupes
- duct tape
- balcony or step-ladder
- garbage bags (or tarpaulin)
- 1 permanent marker
- a timer
- a measuring tape or metre stick
- a calculator
- 2 pylons or empty garbage cans
- a bicycle
- a wooden or plastic plank
- 2 toy cars of equal or similar size
- adhesive tape
- cardboard
- a ruler
- scissors or hobby knife (such as an X-Acto knife)
- a glue stick
- a marker or pen
- 2 metal split pin fasteners
- 1 tablespoon (15 mL) of white glue
- ½ tablespoon (2.5 mL) of borax
- 3 tablespoons (45 mL) of cornstarch
- 4 tablespoons (60 mL) of warm water
- food colouring (optional)
- 2 small cups or bowls
- 1 craft stick or spoon (for stirring)

Movie
The Triplets of Belleville
(Les Armateurs, 2003)

Book
Franklin's Bicycle Helmet by Paulette Bourgeois *et al.*
(Kids Can Press, 2000)

Web Link Suggestions
To learn more about the history of bicycles, check out the following web site:
http://www.sciencetech.technomuses.ca/english/collection/cycles.cfm