School-based Activities

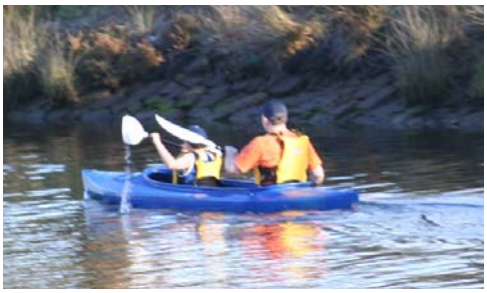
Forces & Physics in Sport

Using levers to row

Background

Rowers and paddlers are two sides of the same coin. Rowers use a first class lever to propel themselves through the water. The oar lock is the pivot point and hands/arms apply the pulling force.

Paddlers use one hand largely as a pivot point and the other to apply force. Paddlers are using a third class lever.



What you need

- Photographs of rowers and paddlers.

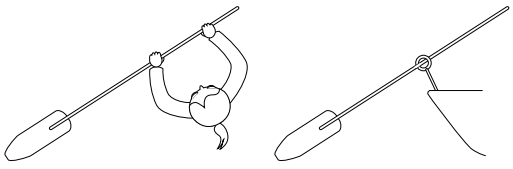
  If you live near a river, you may prefer to go and observe the science of rowing and paddling first hand.

What to do

1. What is the basic difference between a rower and a paddler?
2. Where does a rower pivot the oar?
3. Where does a paddler pivot the paddle? Which hand requires more effort, the hand lower on the paddle or the hand higher up?

Try, Think and Explain

1. Does a paddler generally use more strokes per minute than a rower?
2. Which form of propulsion is faster?
3. What are the advantages of paddling over rowing?

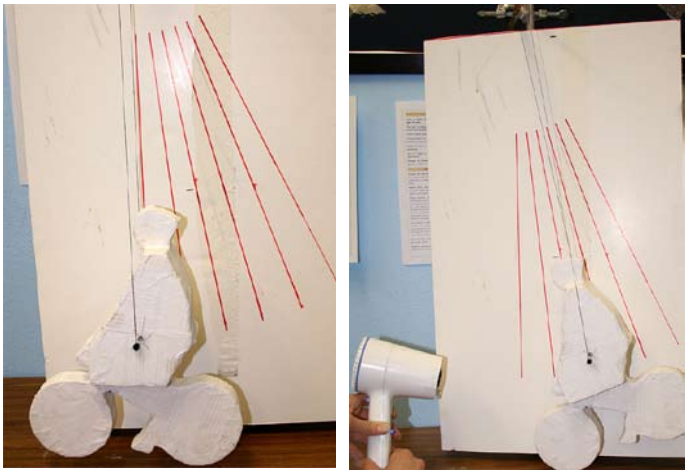


4. How much mechanical advantage is there if the rower uses a long oar?
5. What is the best oar length? What is the best paddle length?

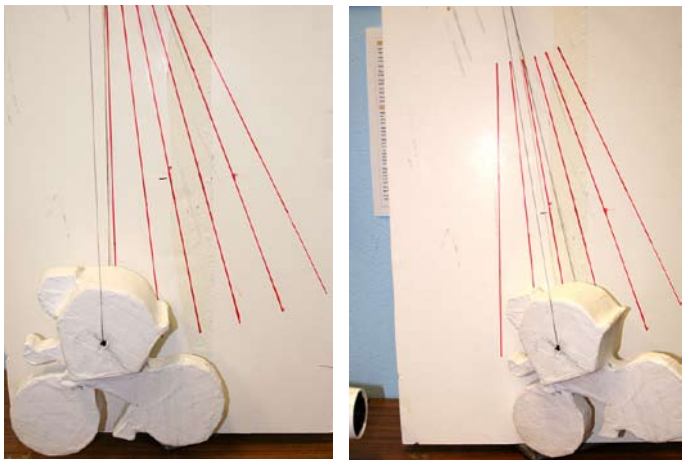
Air resistance, what a drag!

Background

The air is all around us but we rarely notice it except when we encounter it as wind. We have all experienced the increased difficulty of riding or running into the wind. Physics tells us that, as we try to go faster, more of our energy is used in overcoming this wind or air resistance. It has been calculated that increasing speed by 25% needs double the power output. Cyclists go to much trouble, therefore, to reduce the forces of wind resistance or 'drag'. They change their riding position, wear tight clothing, and use a streamlined helmet and streamlined bicycle.



Left: The upright rider before and after the 'wind tunnel' test.



Left: The crouched rider avoids more of the wind resistance tucked up.

What you need

- Two light-weight 3-dimensional models of cyclists sitting upright & in racing attitude. For example: 25mm polystyrene foam to form the two models (approx 25cm x 20-30 cm); PVA glue to build the layers for the foam cyclists; a polystyrene cutter.
- flax thread or thin and flexible string
- a stand to suspend the model cyclists
- a hair dryer
- a background panel, eg cardboard, inscribed with lines for measuring deviation.

What to do

1. Suspend the model cyclists on strong thread/string from a stand.
2. Use a hair dryer to simulate the effects of wind and air resistance on a cyclist.
3. Note the extent of deviation caused by the 'wind' on the two cycling positions. Which cyclist was more affected by the 'wind' from the hair dryer?

Try, think and explain

1. What is 'drafting' in cycling? How does it help cyclists go faster?
2. What other sports involve crouching and riding behind someone else to reduce the wind resistance?

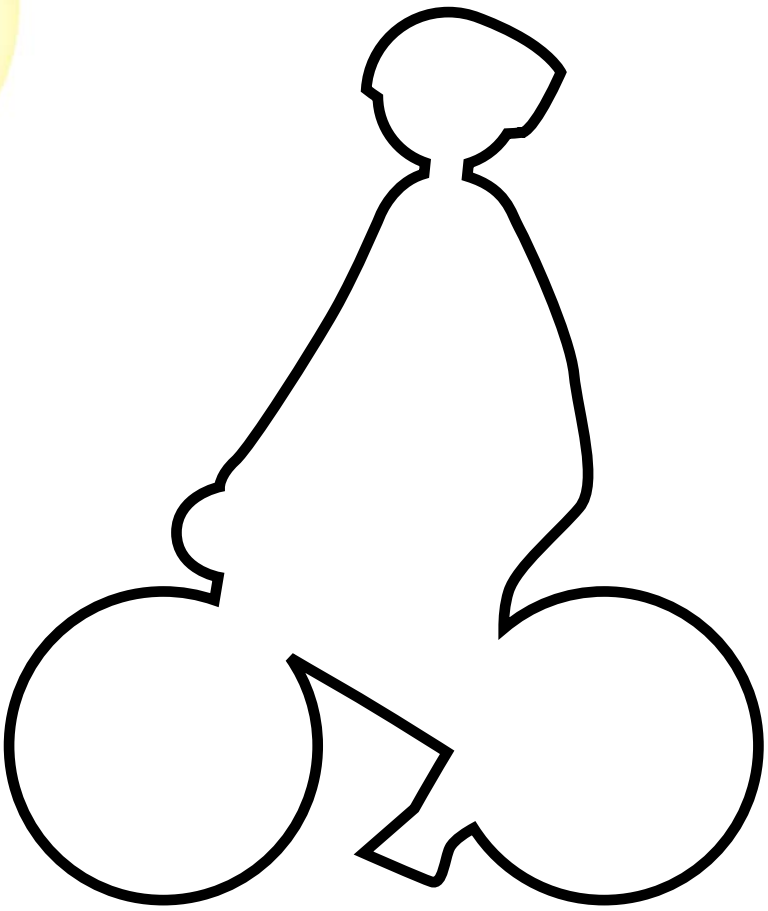
Above: Cyclists reduce air resistance by crouching and riding in someone else's slipstream.

Useful websites

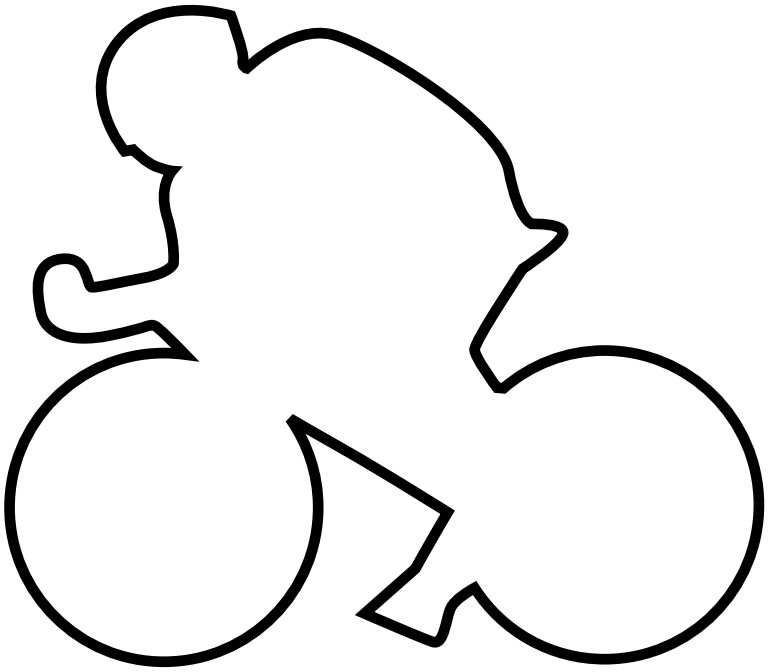
http://www.cptips.com/energy.htm for tips on reducing air resistance;

http://www.sportsci.org/jour/9804/dps.html discusses the various forces facing a cyclist.

Enlarge templates to suit available materials and equipment.



Template for upright cyclist

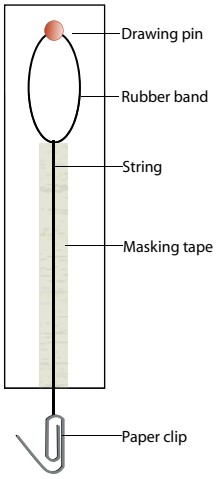


Template for crouched cyclist

Build a force measurer

What you need

- Ruler or flat piece of wood
- Drawing pin
- Masking tape
- Weights
- Paper clip
- Thin rubber band
- Piece of string



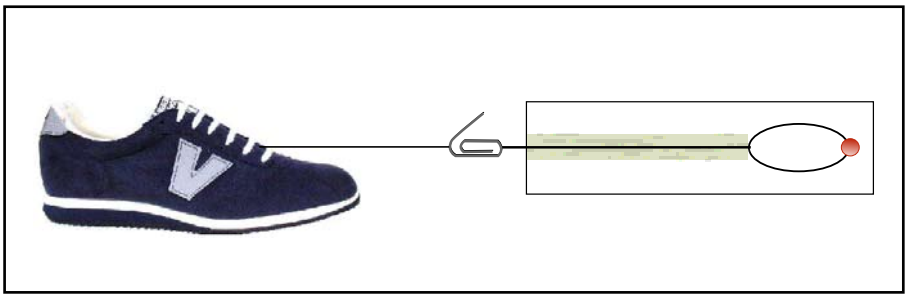
What to do

1. Attach the masking tape along the centre of a face of the ruler.
2. Attach the rubber band to the top of the ruler using the drawing pin.
3. Tie string onto the rubber band and the paper clip onto the other end of string.
4. Pull gently on the string to just extend the rubber band. Mark on the masking tape the position of the knot where the string is tied to the rubber band. Label this position 0.
5. Hold the ruler vertically. Add equal-sized weights onto the hook and for each addition mark the position of the knot.
6. Label these positions 1, 2, 3, etc.
7. Think of a name for the units on your force measurer. You might like to name them after yourself. For example, you might have a force of 10 gertrudes.
8. Your force measurer is now ready to use. Use it to find the weight force acting on different objects such as pens, cups and so on.

Which running shoe has the best grip?

What you need

- Shoes
- Force measurers



What to do

1. Put the shoe on a horizontal surface and attach the force measurer.
2. Pull the shoe with the measurer until it starts to move. Note the force required to move the shoe.
3. Get the shoe moving at a steady speed and note the force needed to do this.

Results table

Shoe Brand	Shoe Size	Force to start moving	Force to keep moving at a constant speed

Try, think and explain

1. Try different shoes on different surfaces.
2. Which shoe brand has the best grip?
3. Explain why this brand is better than the others.

Buoyancy forces

Can you make a lump of plasticine float on water?

What you need

- A lump of plasticine
- Ice-cream container
- Water

What to do

1. Half fill the ice-cream container with water.
2. Mould the plasticine into a shape that will float. (Hint: think about the shape of boats.)

Try, think and explain

1. Draw a picture of a shape you made that floated.
2. What happened to the water level in the ice-cream container when your plasticine shape was put in?

Extra buoyancy challenge

How many marbles can you float in your lump of plasticine?

What you need

- Marbles, all the same size
- Your plasticine boat from 'Buoyancy forces' activity

What to do

Load up your floating plasticine shape from the previous activity with as many marbles as it can hold before it sinks.

Try, think and explain

1. Try different shapes.
2. Which shape held the most marbles?
3. How many marbles could you float?
4. What was the greatest number for your class?

Centre of gravity

The centre of gravity of an object is a place where gravity seems to act on that object. When an object hangs from a point, its centre of gravity will be exactly below its hanging point.

What you need

- Thick card
- Pen or pencil
- Scissors
- Drawing pin
- Thread
- Blu-tack
- Notice board

What to do

1. Draw a picture of a person on the card and cut it out.
2. Attach a lump of Blu-tack to the thread.
3. Tie the other end of the thread to the drawing pin.
4. Make two small holes near the top and one side of your picture of a person.
5. Pin the picture to the notice board using one of the holes so that it hangs freely.
6. Mark where the thread crosses the picture.
7. Pin the picture to the notice board using the other hole so that it hangs freely.
8. Mark where the thread crosses the picture.
9. Where the two lines cross is the centre of gravity.

Try, think and explain

1. Where is the centre of gravity on your cardboard person?
2. Try to balance your cardboard person on your finger by placing the point where the lines crossed on your fingertip. What happened?
3. Try lying down with your tummy on a basketball and try to balance on it. Where is your centre of gravity?
4. In most sports it is important not to fall over. If it is hard to tip a thing over, it is said to be stable or balanced. Can you think of any sports where falling over is an advantage?

Bendy bones

Bones need calcium and other minerals to keep them strong. We need to eat foods that are high in calcium and we need vitamin D and exercise to help our bodies absorb calcium.

See what happens when we soak a bone in vinegar to remove the calcium.

What you need

- chicken leg bone (clean and uncooked)
- glass jar with a lid
- vinegar (a mild acid)

What to do

1. Look at the chicken bone and feel how strong it is.
2. Put the bone in the jar, cover with vinegar and put the lid on.
3. Leave the bone in the vinegar for two weeks, changing the vinegar every two days.
4. What do you think might happen to the bone?
5. Remove the bone, wash and dry it.
6. Look at the bone and feel how strong it is now.

Try, think and explain

1. Try to bend the bone.
2. Describe how the bone changed after being in the vinegar for two weeks.
3. The vinegar dissolves the calcium and removes it from the bone and leaves behind what was once living tissue. What did you learn about calcium and bones?

High calcium

A diet with sufficient calcium will help to promote strong bones, but vitamins and exercise are also vital for healthy bones.

What you need

- A variety of cheese, milk and yoghurt containers that have the nutritional information on them
- Calculator

What to do

1. Write down the name of each of the foods in the table.
2. Copy the amount of calcium (in mg) into the next column.
3. Copy the serving size (in mg) into the next column. If the serving size is in gram (g), multiply this by 1000.
4. Now use the calculator to work out the percentage of calcium in each of the foods.

Food	Calcium per serve	Serving size	% calcium

Try, think and explain

1. Which food has the highest percentage of calcium?
2. Use the results in the table to draw a bar graph to illustrate how much calcium is in different foods.
3. Which vitamin do we need to help our bodies absorb calcium into our bones?
4. Find out about how exercise affects bone strength.
5. Find out about the diseases called rickets and osteoporosis. Write a brief report on each.

Make a model arm

Your arm is a lever. It is pivoted at the elbow. Your biceps muscle at the front of your upper arm contracts (gets shorter and thicker) to lift your forearm. Your triceps muscle at the back of your upper arm contracts to straighten your arm. Tendons connect muscles to bones.

What you need

- 2 rectangles of stiff cardboard, 4 cm x 20 cm
- 2 elastic bands
- String
- 6 paper fasteners
- Scissors

What to do

1. Put together your model arm by following the diagram below.
2. Shorten the front rubber band to lift the forearm.
3. Shorten the back rubber band to lower the forearm.

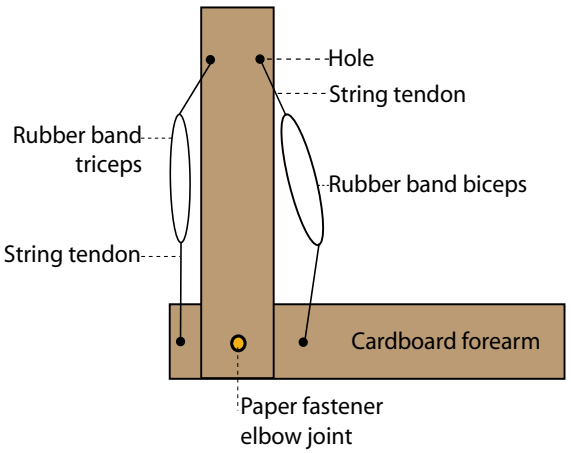
Try, think and explain

1. What parts of the model represent:

- the bones
- the biceps muscle
- the triceps muscle
- the tendons?

2. Find out what the words biceps and triceps mean.
3. Lift and lower a book with one hand and feel your biceps and triceps with the other hand.

   Describe what happens



School-based Activities

Good Sports

Strong bodies, strong families, strong communities

Background

We are becoming a very sedentary nation. Government television advertisements have promoted the idea of exercising for an hour a day with a catchy tune, 'get your body moving'. Some community organisations are also promoting healthier lifestyles.

What you need

- Internet access

What to do

1. Go to the YMCA website homepage. This organisation aims to 'build strong people, strong families and strong communities'.
2. Discuss what the YMCA statement means to you.
3. Design a poster which encourages participation in a sport. It should include an eye-catching image and a simple message.
4. What other non-government organisations are you aware of that promote healthy lifestyles?

Useful website

www.ymca.org.au/