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TEACHER'S GUIDE

CONTENTS

This edition of *Scientriffic* contains a number of great 'boredom busters' for the school holidays. In this Teacher's Guide there are some further activities based around the physical sciences that can be used either in the classroom or at home. They also reinforce the fact that science can be serious good fun!

After your well-earned January break you might consider planning for National Science Week for 2006 which will be celebrated from 12 to 20 August. The Australian Science Teachers Association (ASTA) has set the theme for 2006 as ***Our Dry Continent***. Early in the new year, watch out for articles and information about salinity, desertification, stormwater, water conservation and global warming in order to be prepared for National Science Week.

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2 TOPIC: CAMERAS AND PHOTOGRAPHY

AIMS

Students will make a pinhole camera and investigate the properties of light and photography. They can also use the design process to improve their pinhole cameras.

CURRICULUM FOCUS

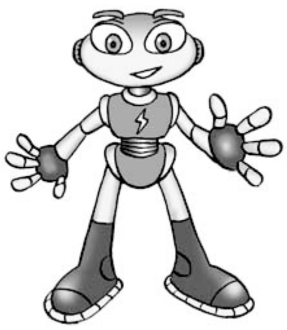
Physical science

BACKGROUND

Students will read the article "How does that work" *Scientriffic* pp. 14-15.

Cameras were invented in the early 1800s. It is believed that the first permanent 'light image' was made by Frenchman Joseph Niepce in1822. Englishman William Talbot is credited with inventing photography in 1835.

Before cameras, big pinhole cameras (sometimes called 'camera obscuras') were used by artists to create accurate pictures on paper, by tracing around the image created on the back of the pinhole camera.



A pinhole camera is very simple. It does not contain film; instead the image appears on a translucent paper 'screen' on the back of the camera. A pinhole camera does not have a lens. This means that you have to move the whole camera to get an image focussed on the screen.

How it works:
Light shines through a very small pinhole in a box. At the other end, an inverted image appears on a wax paper 'screen' taped over the opening. The pinhole camera works because light travels in straight lines. Light from one side of the image travels in a straight line through the pinhole to the other side of the screen.

Go to www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=55 to see an interactive explanation of how the image is created using a pinhole camera.

ACTIVITY

Make a pinhole camera

MATERIALS

(per student or pair of students)

- a small cardboard box (such as a shoe box or a cereal box)
- aluminium foil
- wax paper or baking paper
- sticky tape
- a pin

1. Cut a hole about 2 cm square in the middle of one end of the box.
2. Tape a piece of aluminium foil over this hole. At the opposite end of the box cut a large hole, at least 10 cm square.
3. Tape a piece of wax paper or baking paper over this hole.
4. Pierce a small hole in the aluminium foil.
5. Hold the box in front of you so that the hole is pointing towards a bright image (a torch, light globe or view out a window).
6. Look at the image formed on the paper screen at the other end of the box.

Teacher's tip: It is important that the pinhole is the only light source centering the box. You may need to use masking tape to seal up the lid and corners.

7. How does the image on the screen differ from the object? How must you move the camera to make the image move up, down, left or right?
8. What do you have to do to make the image on the screen smaller or larger?

EXTENSION

- ⇨ Try some design modifications to improve your pinhole camera.
- ⇨ What happens when you change the pinhole size?
- ⇨ What happens if you use a longer or shorter box?
- ⇨ What happens if you paint the inside of the box with black or white paint?
- ⇨ What is the best type of paper to use for the screen?
- ⇨ Try making a shield around the screen end of the box. Does this improve the image?
- ⇨ Look at photo sensitive paper and experiment with making images using sunlight (this paper can be purchased at photography and hobby shops).
- ⇨ Find out how to make a different type of pinhole camera at:

  http://acept.la.asu.edu/PiN/act/pinhole/pinhole.shtml
- ⇨ Ask a professional photographer to speak to the class.

Did you know?

William Talbot made the first permanent pictures in 1835. His pictures were made on glass plates. George Eastman invented photographic film in 1889.

In 1924 German mechanic Oskar Bernack invented the first small, hand-held camera.

Colour film for cameras was introduced in 1935 when Kodachrome was first sold.

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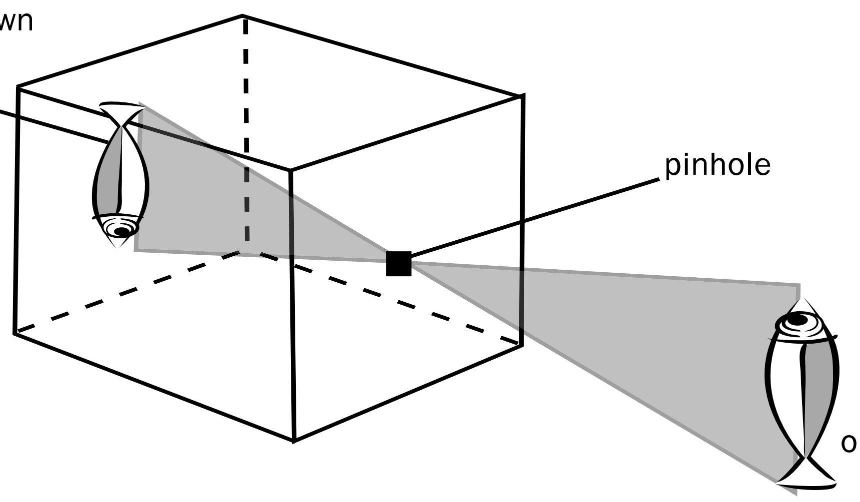


4 TOPIC: FESTIVE ACTIVITIES

AIMS

Students investigate physical phenomena including friction, balance and centre of mass by making some simple toys.

CURRICULUM FOCUS

Physical science

BACKGROUND

Students will read the article "Hands on activities boredom buster special" *Scientriffic* pp 20-23.

Friction

Friction is the name of the force that acts between two surfaces. Friction acts in the opposite direction from the direction of motion. The amount of frictional force depends on the force pushing the two surfaces together and also on their roughness.

The friction between two surfaces before they start moving is called static friction. The friction between two surfaces once they are moving is called sliding friction.

The activity below uses friction to make the monkey 'climb' up the string. The angle of the straws is the key to the activity. When you pull down on one string, the opposite straw twists, making it move a little way up the string. The angle of the straw is increased, as is the friction between the straw and the string, preventing the monkey from slipping down.

ACTIVITY

Climbing monkey

MATERIALS

(per student)

- stiff card
- a drinking straw
- string
- sticky tape
- scissors
- two weights (modelling clay or washers)

1. Trace or draw a picture of a monkey onto some card, colour it in and cut it out.
2. Cut two 3-5 cm pieces from the straw and attach them to the back of Monkey as shown in the diagram.
3. Put a thumbtack into a notice board or some other vertical surface.
4. Thread the string through the straws and attach weights to the ends.
5. Make the monkey climb by pulling on the weights, one at a time.
6. What force stops the monkey fallling down the string?

ACTIVITY

Make your own juggling balls

MATERIALS

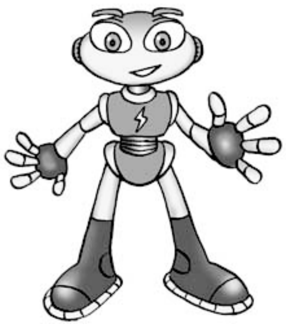
(per student)

- nine balloons (different colours)
- sand
- a small soda bottle
- scissors

1. Half-fill the soda bottle with dry sand.
2. Blow up one balloon a little way and twist off the balloon so that the air does not escape.
3. Put the neck of the balloon over the soda bottle. Turn it upside down and shake sand into the balloon until there is enough to make a good sized juggling ball.
4. Take the balloon off the bottle and squeeze all the air out of the balloon.
5. Cut the necks off two other balloons of different colours and snip

6. Make two more juggling balls.

7. Use the library or internet to find instructions on how to juggle. Teach yourself to juggle.



Background information:

When you juggle, you use hand-to-eye coordination. Juggling also works both sides of your brain. In fact, it's an exercise for your brain. Like any sport or game of skill, juggling requires patience and practice.

EXTENSION

Find instructions on how to learn to juggle at these websites:

www.frontiernet.net/~steve_glimpse/juggle.html

www.juggling.org/help/

www.thejimshow.com/juggle/

To find out about world records for juggling go to:

http://en.wikipedia.org/wiki/Juggling_World_Records

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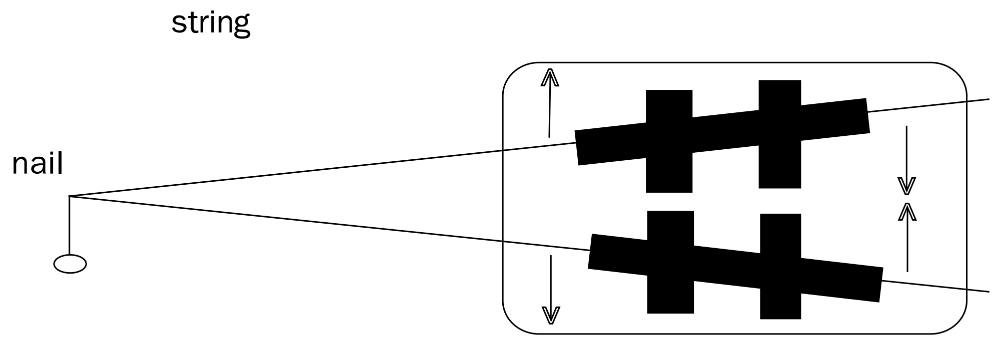

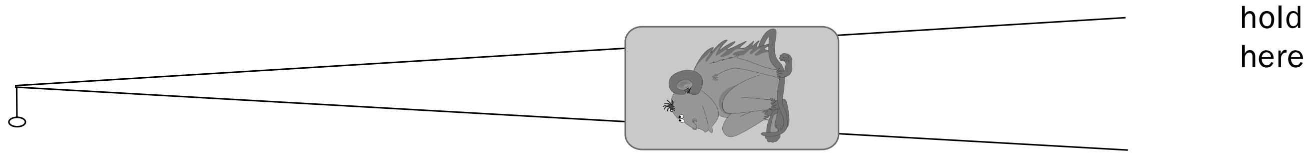

6 TOPIC: BALANCE

AIMS

Students will investigate how an objects centre of gravity affects its balance.

CURRICULUM FOCUS

Physical science

BACKGROUND

Finding an object's 'balance point' or 'centre of gravity' enables us to predict if it will fall over or balance.

With a long thin object such as a ruler or broomstick, you can support it on both hands and gradually move your hands together. The object should balance at the point where your hands meet. This is its centre of gravity.

With uniform geometric shapes such as building blocks, the centre of gravity is in the centre of the object. As long as the centre of gravity stays above the point of support, the block will stay upright, but if you tip it over and the centre of gravity moves outside the base of support, it will fall over. In general terms, to make an object more stable you can make its centre of gravity lower or its base of support wider.

Some toys actually have their centre of balance below their point of support, which makes them extremely stable. They look as though they are doing an amazing balancing act, but in reality they can be considered to be hanging, rather than balancing. Examples of this are balancing birds, where a bird sitting on a perch has a weight in its tail, and executive toys such as a figure standing on a point and holding a curved bar with weights on each end.

ACTIVITY

Make a balancing bird

MATERIALS

(per student or pair of students)

- stiff paper or cardboard
- bird shape template
- scissors
- sticky tape
- two weights (washers or coins)
- a pin
- thread with a small weight to make a plumbline
- red and blue pen

1. Carefully cut the bird shape out of the cardboard. Try balancing it on your fingertip.

2. Find the centre of gravity of the cardboard bird by pushing a pin anywhere into the bird so that it swings freely. Tie the plumbline to the pin, then use a pencil to trace the line of the thread.

3. Repeat step 2 by pushing the pin into another point on the bird. The point at which the two lines cross is the centre of gravity. Mark this with a red dot.

4. Tape the washers underneath the bird wings, near the tips.

5. Test your bird by resting the beak on the end of your finger. Does it stay there? If not, try adjusting it.

6. When your bird is correctly adjusted, it should be quite stable on the end of your finger.

7. Repeat steps 2 and 3 to find the centre of gravity of the weighted bird. Mark the new centre of gravity with a blue pen.

*** Amaze your family and friends by balancing your bird on your nose or the point of a pencil!**

Hints for adjusting your bird:

- ⇨ If it is falling backwards, try bending the tips of the wings down a little or making the tail shorter.
- ⇨ If it is falling forwards, try moving the weight back a little, away from the wing tips.
- ⇨ If it is leaning to one side, make sure the weights are on the same part of each wing, and that one wing is not bent down more than the other.

Did you know?

Your sense of balance is controlled by a number of sense organs that are continually sending messages to your brain. Your eyes send visual cues (such as the position of the horizon). Your inner ear sends messages about the position of your head. Your muscles also send messages about the position of your body.

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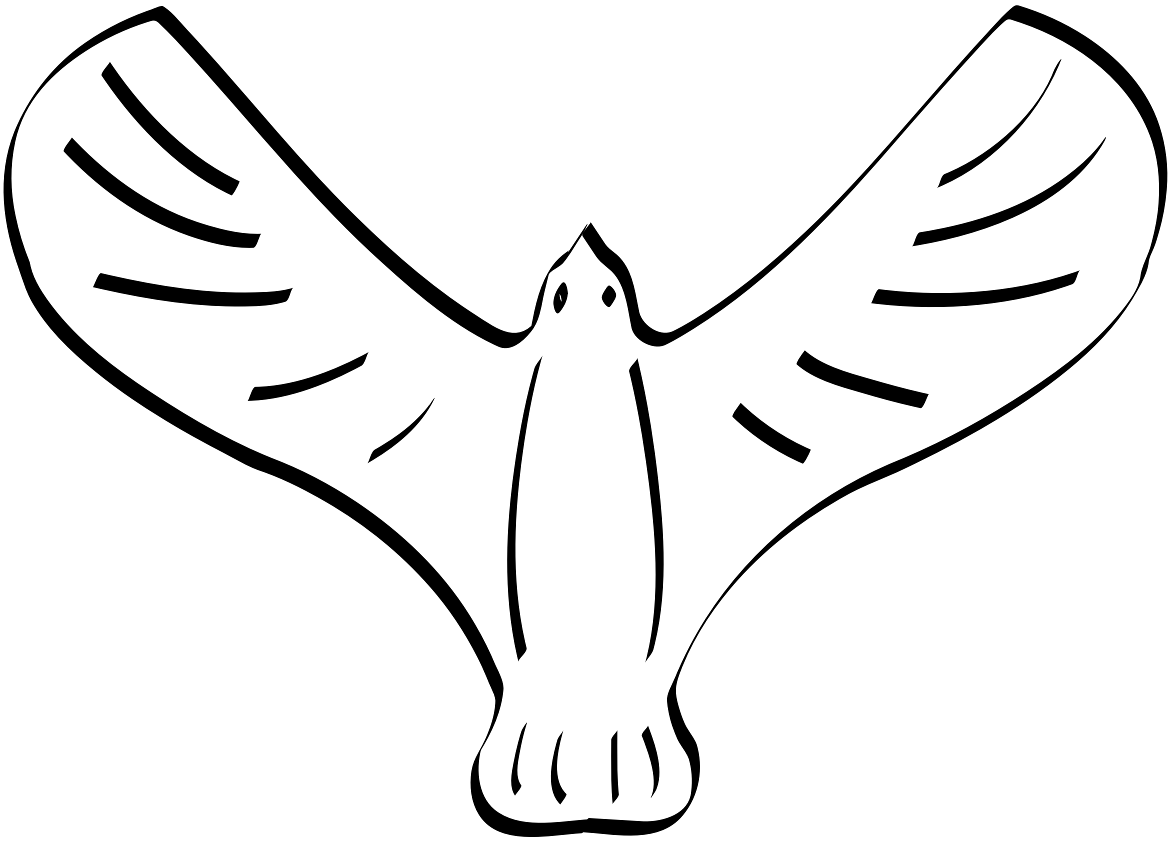

8 TOPIC: MORE ON MOMENTUM

AIMS

Students will investigate momentum and how it can be transferred from one object to another.

CURRICULUM FOCUS

Physical science

BACKGROUND

Students will read the article "SCOPE this out!" *Scientriffic* pp. 26-27.

Momentum keeps moving objects moving. For example, momentum causes you to fall off your seat when the bus stops suddenly. Momentum depends on an object's mass and velocity (speed). If you have two different objects travelling at the same speed, the heavier one will have greater momentum. If you have identical objects travelling at different speeds, the faster one will have greater momentum.

One object's momentum can be transferred to another object when they collide. This happens all the time in motor vehicle crashes.

ACTIVITY

Marble momentum

MATERIALS

(per student or pair of students)

- two rulers
- six marbles
- sticky tape

1. Tape the rulers to a table so that they are parallel and about 1.3 cm apart.

2. Put two marbles between the two rulers.

3. Flick one of the marbles so that it hits the other one. Describe what happens.

4. Now put two marbles between the two rulers so that they are touching. Place a third marble about 15 cm away.

5. Flick the single marble so that it collides with the other two.Describe what happens.

6. Now try flicking two marbles into three stationary marbles. Describe what happens.

EXTENSION

⇨ What happened to the momentum of the single marble when it collided with one stationary marble?

⇨ What happened to the momentum of the single marble when it collided with two stationary marbles?

⇨ What pattern can you see when you compare the number of marbles being flicked and the number of marbles that roll off after being hit?

⇨ What do you think would happen if two marbles are flicked into one stationary marble? Try it!

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