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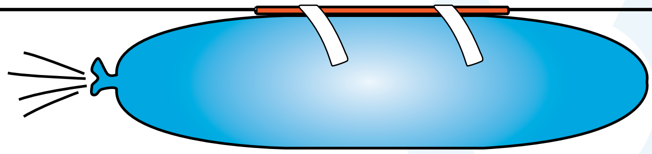
BALLOON ROCKETS

Focus: Physics

A balloon provides a simple example of how a rocket engine works. The air trapped inside the balloon pushes out the open end, causing the balloon to move forward. The force of the air escaping is the "action"; the movement of the balloon forward is the "reaction" predicted by Newton's Third Law of Motion.

AIM

For students to create a rocket balloon which travels the furthest



Equipment:

- A drinking straw
- Different shapes and sizes of balloon
- A peg
- Sticky tape
- Stop watch
- Washing up liquid
- Two chairs
- A metre ruler / measuring tape

Instructions:

- Blow up the balloon, fold over the neck and secure it with the peg it to stop the air coming out.
- Thread the string through the straw.
- Tie the string to two chairs about 2 metres apart.
- Stick the balloon to the straw as illustrated in the diagram.
- Remove the clip from the neck of the balloon and watch your rocket zoom away.
- One person measure the distance the balloon travels and one person time how long it takes the balloon to travel to a stop. Make a note of the time taken / distance travelled.
- Repeat the experiment after covering the string with washing up liquid, discussing the effect of friction with the students.

Discuss:

Why did certain balloon rockets travelled further than others? What could students have done differently to make their rocket travel further?

They will need to think things such as:

- The friction between the balloon rocket and the string.
- The shape / weight of their balloon rocket.
- The position of the 'mouth' of the balloon in relation to the string guide line.

Useful Links:

European Space Agency - Web pages on launchers, European rockets, rockets in war and peace and the first rockets.
www.esa.int/esaKIDSen/SEMVVIXJD1E_Liftoff_0.html

The Physics Classroom – Focus on Newton's Third Law of Motion
www.physicsclassroom.com/Class/newtlaws/u2l4a.cfm

NASA - Balloon Rocket activity extension activity
http://exploration.grc.nasa.gov/education/rocket/BottleRocket/Shari/propulsion_act.htm

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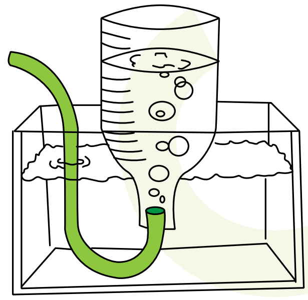
TAKE A DEEP BREATH

Focus: Human Biology

A spirometer is a device that doctors use to measure lung capacity. A spirometer may be used to diagnose certain types of lung disease (such as asthma, bronchitis, and emphysema) or to check lung function before someone has surgery. In this activity, students blowing air from their lungs into the bottle displaces some of the water. The volume of water is replaced with the same volume of air from their lungs providing a measure of their lung capacity.



AIM ***For students to measure how much air their lungs can hold***

Equipment:

- Water
- 2 litre plastic bottle
- Deep bowl (e.g. washing up bowl)
- Masking tape
- Measuring jug
- Beaker
- Flexible plastic tubing
- Marker pen or biro

Instructions:

- Attach a strip of masking tape to the plastic bottle, from bottom to top.
- Fill the measuring jug with 50ml of water and pour the water into the bottle. Mark the water level on the tape.
- Repeat until you've marked right up to the top of the bottle - the bottle should be full.
- Fill the washing up bowl with around 10cm deep of water.
- Completely cover the mouth of the bottle with your hand, so no water can escape.
- Invert the plastic bottle into the bowl of water.
- Don't remove your hand until ALL of the mouth of the bottle is completely underwater.
- Insert one end of the plastic tubing into the water bottle. Hold onto the other end.
- Take a deep breath in. Exhale into the plastic tubing.
- Measure how much air is now in the bottle. Count up the number of lines where there is air, not water. Multiply the number of lines by 50 ml. For example: 10 lines x 50 ml = 500 ml of air. Your lung capacity - how much air your lungs can hold - is 500 ml.

Discuss:

1. Whose lung capacity was biggest / smallest?
2. What sort of things might cause a decreased / increased lung capacity?

Useful Links:

Kids Health website – Your Lungs and Respiratory System
http://kidshealth.org/kid/cancer_center/HTBW/lungs.html

A short video illustrating a spirometry test
http://kidshealth.org/kid/htbw/lungs.html

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SOAPY STRESS

Focus: Engineering

Geotechnical engineers study the properties of earth materials. Their understanding of how rock behaves under stress is important for safety in our modern world. Engineers investigate rock and soil to determine its characteristics, and then design foundations for human-made structures, such as bridges or stadiums.

AIM ***For students to experience three types of material stress related to rocks by breaking bars of soap using only their hands***

Equipment:

- Several bars of cheap soap

Instructions:

1. Explain 3 types of stress that affect rock:

   Tensional stress: Rocks are pulled apart and become longer, or separate.
   Compressional stress: Rocks are pressed together and become shorter.
   Shear stress: Rocks are pulled one way on one side, and the opposite way on the other side, making them slip past each other.
2. Split students into groups of 3. Give each group one bar of soap.
3. One person in each group should demonstrate ‘tensional stress’ by pulling (not twisting or bending) the bar of soap apart with their hands. Two students may need to pull against each other!
4. The second person in each group should demonstrate ‘compressional stress’ by pressing or squeezing one of the smaller pieces of left-over soap.
5. The third person in each group should demonstrate ‘shear stress’ by pushing a piece of the soap one way with their left hand and the other way with their right hand.
6. Groups could explore how sedimentary rocks are formed, by smashing some of the remaining small flakes of their soap together to make a bigger piece of soap.
7. Groups could illustrate the effects of weathering on rock by holding a sharp corner of their soap under running water.

Discuss:

1. How would some of these stresses occur on a bigger scale in the natural world?
2. Why do geotechnical engineers need to understand stress in rocks?

Useful Links:

Teach Engineering website – provides a full outline of this activity plus supporting resources:
http://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_rock/cub_rock_lesson01_activity1.xml

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ENGINEERING

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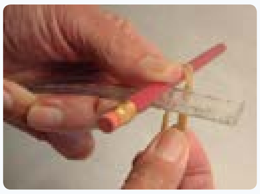
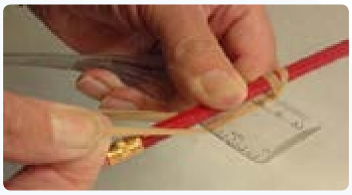
MAKE YOUR OWN ROBOT

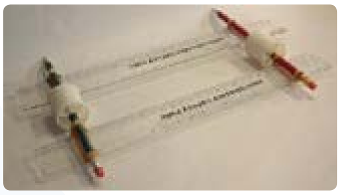
Focus: Design Technology

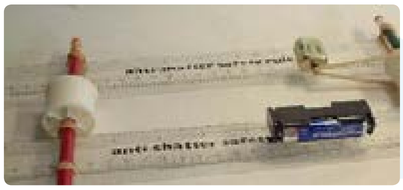
Robotic devices are anything that we make to take over a job which is boring, repetitive or dangerous to humans. The basic unit created in this activity imitates a robot buggy, the winding drum for a robotic lift, the drum of a washing machine, and lots of other robotic devices.

AIM ***For students to make a simple robot from everyday materials***









Equipment:

- two pencils
- two rulers
- two cotton reels
- rubber bands
- one electric motor
- one battery holder

Instructions:

1. Lie a pencil over one end of one of the rulers to create a 'T' shape.
2. Loop an elastic band over one end of the pencil, pull it down under the ruler and loop over the other end of the pencil so that the pencil is attached to the ruler
3. Repeat this action to fix the second pencil to the other end of the ruler.
4. Slide one cotton reel onto each of the pencils.
5. Loop an elastic band around one of the cotton reels.
6. Attach the second ruler to the pencils in the same way as No.2.
7. Attach the electric motor and battery holder to the rulers with blu-tac or plasticene. Connect the cotton reel to the motor using the elastic band. It only needs to be slightly tight.
8. Connect the electric motor to the battery and the cotton reel should rotate.

Discuss:

1. Which objects can you see in the room that have been invented by humans to make life easier, quicker or safer?
2. What other situations can you think of where robots are used to do jobs that are boring, repetitive or dangerous to humans?

Useful Links:

NRICH website – a fuller outline of this activity, including supporting materials can be found here: https://nrich.maths.org/8044

Science Kids website – games, facts, quizzes, projects http://www.sciencekids.co.nz/robots.html

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BATH BOMBS

Focus: Chemistry

This activity aims to help students explore the chemistry behind bath bombs. When dissolved in water, the reaction between the acid product citric acid and the alkaline product sodium bicarbonate releases carbon dioxide gas and produces a salt called sodium citrate. The other components that are added, such as colouring or fragrance, are for aesthetic purposes only. Similar reactions take place with other everyday items such as Alka-Seltzer tablets or in carbonated drinks.

AIM ***For students to explore how acids and bases react***

Equipment:

- 10g sodium bicarbonate
- 5g citric acid
- baby oil
- glass stirrer
- dropper
- cling film
- beakers
- mould – e.g cookie cutter / muffin tray
- gloves / safety glasses

Instructions:

1. Students should wear safety galsses/gloves for this experiment, as citric acid can be irritating.
2. Put 10g sodium bicarbonate and 5g of citric acid into a beaker and mix well using a glass stirrer. (You could try making several bath bombs, to explore the effect of changing the ratio of these ingredients).
3. If desired, add a single drop of food colouring and/or a single drop of scented essential oil.
4. Add drops of baby oil, one at a time, mixing the ingredients until they start to hold together.
5. Press the mixture into your mould (or just roll into a ball) then wrap in cling film and leave to set overnight.
6. Store in a dry environment until bath-time then pop it in the water & watch it fizz!

Discuss:

1. Why do you need to add the baby oil slowly?
2. How might changing the ratio of ingredients affect the fizziness of the bath bombs?

Useful Links:

Alka-Seltzer Student Science Experiments
http://www.alkaseltzer.com/as/student_experiment.html

The Human Touch of Chemistry website – the science of soda water
http://www.humantouchofchemistry.com/the-science-behind-soda-water.htm

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AVALANCHE

Focus: Mathematics & Modelling

Engineers solve problems in the real world using 'mathematical modelling'. They investigate a real world phenomenon by using mathematics to explain what is happening and to make predictions. These can then be tested against the real events.

AIM

For students to model an avalanche, collect data and display their findings with graphs

Equipment:

- snow substitutes e.g. sand, gravel, couscous, dried peas, raisins, lentils, rice etc
- funnel
- clamp-stand
- weighing scales
- squared paper A4 or A3
- ruler
- protractor

Instructions:

1. Each group of students should use a different snow substitute so that a range of data is collected.
2. Place the squared paper underneath the funnel held by the clamp.
3. Pour 20g of one snow substitute through the funnel.
4. On the squared paper, mark the area covered and record it as 20g of the substance.
5. Measure both the height of the heap and the angle of the slope of the heap.
6. Students should repeat steps 2-5 until an avalanche occurs, recording number of 20g portions at each stage.

Recording Your Data:

Draw 3 bar graphs to show your findings. On each graph, put the number of 20g amounts along the horizontal axis then use the vertical axis to chart

- the height of the heap
- the angle of the slope of the heap
- the area covered by the heap (estimate by counting the number of squares covered)

Discuss:

1. What sort of snow is likely to have the most dangerous avalanches - snow with small or large particles?
2. Are slopes with slight (say up to 20°), moderate (say 20° to 50°) or steep (more than 50°, say) likely to have more avalanches?

Useful Links:

NRICH website – a full outline of this activity with supporting materials is available here
http://nrich.maths.org/7454

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