ENERGIZE

Insight

Science Foundation Ireland sfi For what's next

STEM resources

STEM – Science, Technology, Engineering and Maths – this subject matter form the basis of a wide array of knowledge that is inter-connected to work based careers. Many schools cover these areas through the school curriculum in an academic way but STEM based subjects don't have to be boring.

In Scouting we offer young people a unique learning space where everything can be explored. Learning by doing, working in teams, sharing ideas and being creative, solving problems – these are some of the ways that Scouting uses to gain and impart knowledge.

Throughout our programme we already introduce many STEM type activities to young people – of course we do not 'tag' them in this fashion and they are presented to young people as challenges, games and explorations in the fun learning spaces of our meetings and activities.

This collection of resources highlights the many activities and ideas that can be incorporated into our programmes, so that young people can see STEM as fun and awaken their interest in these subject areas.

In today's world, many employers seek a wide knowledge of the STEM related areas. With the increased focus on science, technology and information transfer and interaction those new to a work environment are expected to have a solid base of knowledge of these areas. Another requirement of the work place and an increasing request from employers are young people who have addition life skills. These skills include what are called 21st century skills – ability to work in teams, take leadership and responsibility, be creative and innovative, be able to solve problems all key skills provided by Scouting.

By combining STEM related areas with what we do best in Scouting – develop young people - we have a package of activities and ideas that can provide young people with a solid base from which to develop their life long career path.

This resource has been funded by the Science Foundation of Ireland because they recognise the value of the Scout programme and how it provides learning spaces for young people that are unique and based on play and fun. Science can be perceived as 'boring' by many young people but we hope in this resource to provide a series of novel activities that will show science in a new fun way.

The resources have been created around a series of themes. By using themes it allows us to explore the wide area of STEM through many different scenarios. The resource only provides the ideas, it does not present a programme structure or how it might be developed as a programme cycle. This we will leave to the young people in your Section as they develop programme cycles and adventures in your programme. So, many possibilities are possible from simple insertions in meetings, to themed camps and activities, wide games or incident trails.

The ideas presented are only a sample of the millions of possibilities that can be used. The internet is widely distributed with many ideas related to STEM. This resource presents and links to the best ones that can be undertaken by Scouts in all Sections.

Using the resource

The resource is driven by the poster (cover of this handbook) – a full size series of posters will be provided to each Group for display. On the poster is a series of QR codes that when scanned by a QR code app on a mobile phone that will bring the user to an online

interface. That interface will lead to this PDF resource, Video links, Pinterest pins and other websites. Each of the links is related to the theme that is been presented. There are a number of different resources and they can be found collectively via the resource area www.scouting360.ie

The mobile phone – in a young person's pocket- is a powerful interaction tool and computer and can quickly present the ideas to young people to explore. Ideas are presented in an easy to understand way and then it is time for some hands-on experience and learning by doing as each idea is tried out at meetings and activities.

It is suggested that Scouts (in all Sections) are exposed to the resources so that they can discover the ideas and then create programme cycles and adventures at which they can be included. The themes can be used as presented or mixed and matched to create new themes/adventures/trails etc.

Included in the resources is an innovation and creativity exercise. The idea of this exercise is to allow young people to create and invent. All inventions are created by a process of knowledge (science), inventing the new item or process (engineering), refining and developing (maths can be used) and finally producing a new invention (a tool – a piece of technology). The creation process is STEM applied and how it is done is in teams (small team system in sections), gathering knowledge, working creatively as a team, engineering their idea and solving problems and creating new solutions. We do this every time we challenge young people at meetings and on activities and incident trails. So again, Scouting is good at this.

It is therefore suggested that each programme cycle will include one 'invention' session where Scouts can take the knowledge they have explored in the themed meeting or programme cycle and use this knowledge to invent something new and exciting. Ideally this session would be undertaken in week three or four of a programme cycle when some knowledge has been gained in a themed area.

Plan, do, review, is of course a cornerstone of our programme method and the review process should include a reflection on what has been learned or changing attitudes to STEM type activities.

Storylining

As Baden Powell once said – 'Scouting is a game for young people and a job for adults' and within this context story- lining is extremely important in holding together the programmes and activities we run. A series of incidents can be held together with an inventive storyline, for example, related to escaping from a prison camp or tasks to be completed in a treasure hunt. Likewise at our meetings we will run games and challenges and these should also be story-lined (or within a symbolic framework – Lands of Adventure in the Cub Scout Section).

By using story-lining and scenarios we allow young people to use their imagination and develop creative solutions to a challenge in context. Artificial time pressure is introduced – build this tower before the flood raises, or do this challenge before the door time lock engages. Time pressure enables leadership and organisation skills to be developed.

Real life scenarios such as accident setups are also useful for some situations and again relate to the subject matter under exploration.

In the context of the STEM resources they have been related to themes which in themselves suggest possible storylines and scenarios. Action hero's for example focuses on action hero films and situations, James Bond, Bourne, Indiana Jones, MacGyver and many such films and TV series provide the backdrop and the situations that an action hero must escape from, find clues, improvise or be inventive.

Therefore cracking a code or survival situations can be cloaked in mystery, suspense and excitement with the introduction of a creative storyline – 'defuse the bomb in 30 seconds or the world blows up' can make exciting the creation of an electrical circuit. Cracking a code is just a simple way of telling the team what is the next location they need to travel to.

In some incidences a storyline can run over a whole weekend or period of time. This involves a bit more work in organising the elements of the programme but often it adds to and enhances the overall experience – a Viking theme, Space camp or Desert island survival.

Wide games are another feature of story-lining to be considered. In general terms they are quest driven scenarios – a mission must be completed. So in the context of a wide game Patrols (small team system) are each competing to reach an objective – a treasure hunt for example – and must complete various challenges and situations to progress towards their objective.

In all sections within a Group the programme is presented through a 'Programme Cycle'. This programme cycle can have any timeline but it contains three crucial features – Plan, Do, Review.

Each programme cycle is built around an adventure or series of adventures leading to a key highlight. Normally, a programme cycle will last around 4 weeks (but can be shorter or longer)

The 'adventure' is the main highlight of the Programme cycle – the weekend camp, for example, and the meetings or associated activities are the 'learning spaces' to enable the successful completion of the adventure. So, for example, the Scouts will need to be able to build an oven on the camp - so that they can bake a cake. The weekly meeting or a special day activity might be created for the Scouts to learn how to do this so it can be completed with success on the weekend camp.

Within this process all of the Scouts will be involved in the creation of the adventure, the weekly meetings and activities. The team system will be used at all times and all the interactions associated with this process will be focused on the programme cycle and the planned adventure.

The Plan, Do, Review method is used….so the adventure is planned, it takes place and finally the programme cycle is reviewed and learning is determined.

The process

The first step in the creation of a Programme Cycle This is where the ideas for adventures are created and selected. This resource will highlight some ideas based around the theme but additional ideas can be added and created as young people wish in the programme creation stage.

Doing and discovering

This STEM based resource is designed to enable young people to discover science, technology, engineering and maths all around them and as part of their daily lives.

They are not subjects primarily associated with school, and that as Scouts we can have a lot of fun using, exploring and discovering knowledge based on fun, play and group interactions.

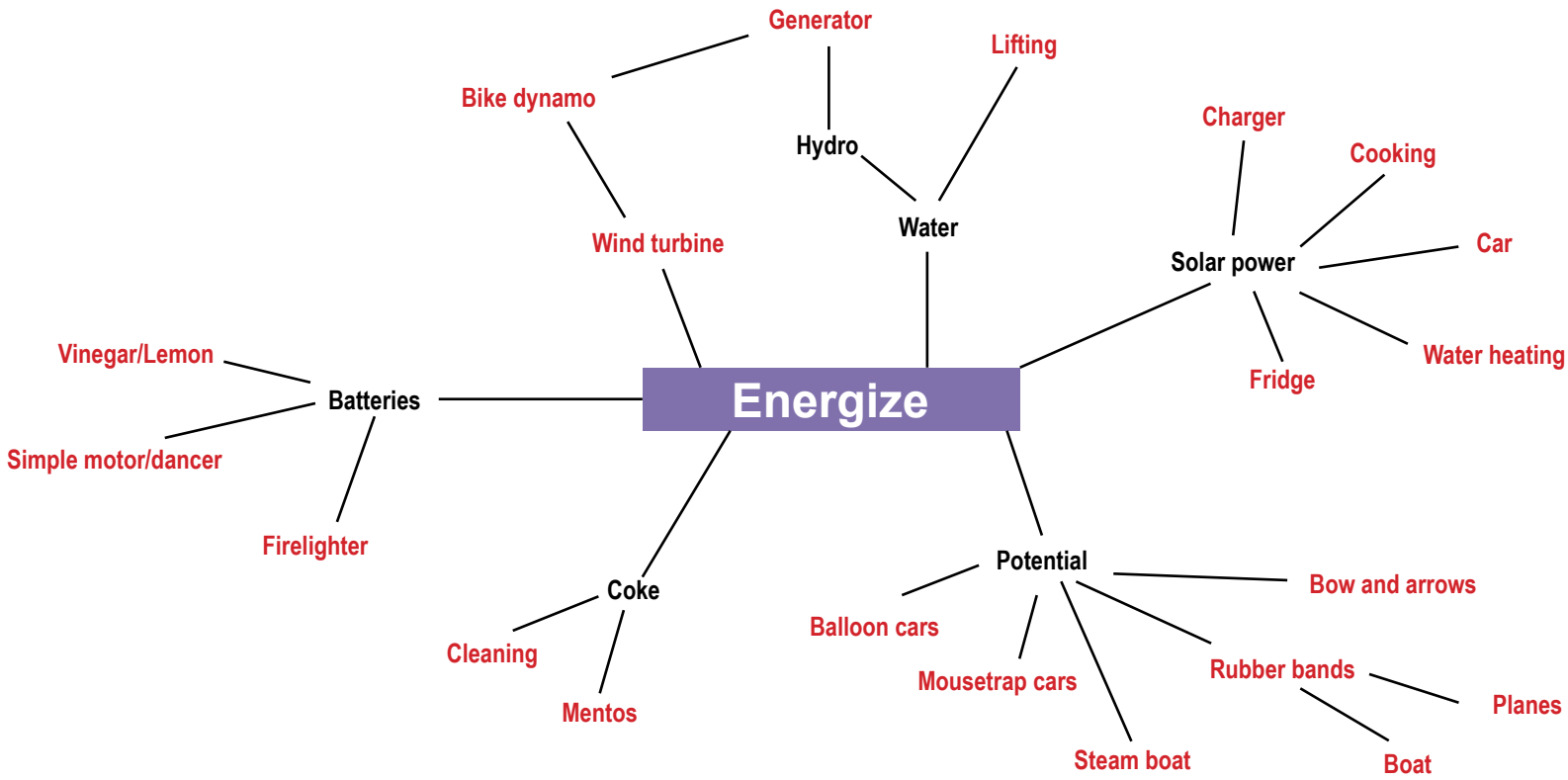
Each idea therefore has a 'science idea' that Scouts need to discover as they undertake each activity. In the review process it is hoped that Scouts express in their own way the things they have learned and the knowledge and new understandings they have gained.

Reviewing

The object of the review session is to understand what has happened, what we learned along the way and to 'mark up' and acknowledge how every Scout has progressed.

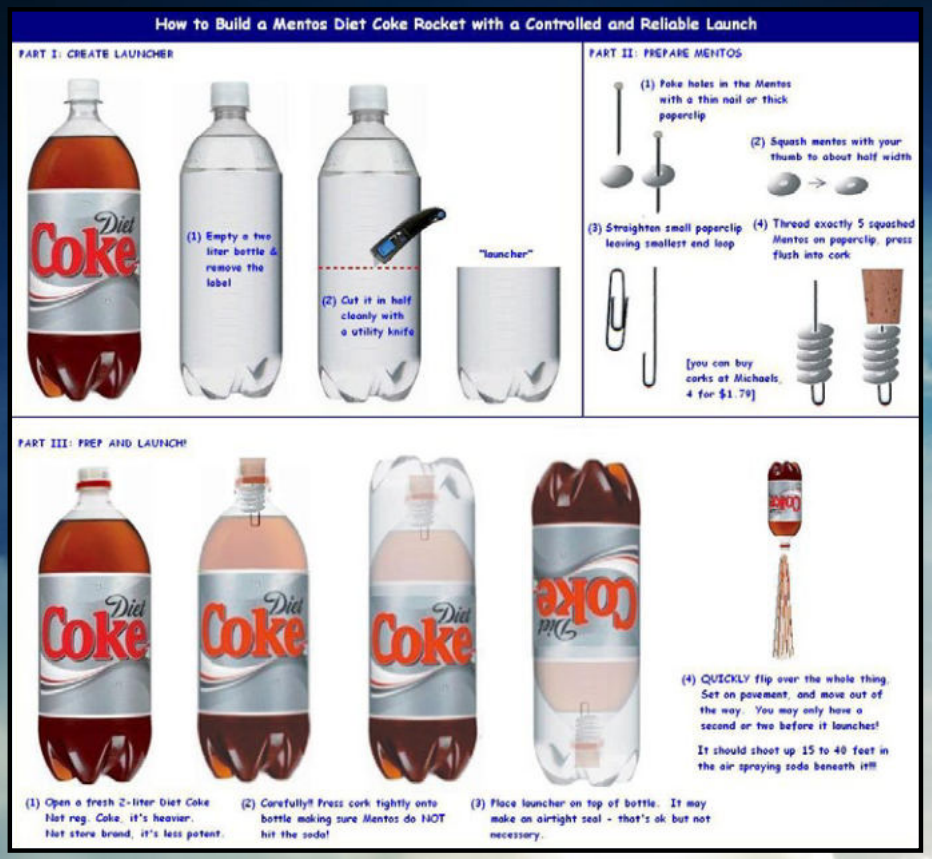
Reviewing is critical to the learning process. Until a Scout takes time to internalise and access what they have learned through an experience it serves no real value - bar entertainment.

As Scouting is in the business of assisting young people in their development the review process is a vital component of the Scout programme. There are many ways of conducting the review – it can be done as the activity progresses or at the end of each day or in a sit down discussion at the end of the programme cycle.



This resource has information on items coloured orange

Energize theme chart



Science Bit

A fizzy drink is a pressurised liquid - fizz is created in the drink by infusing carbon dioxide gas (C02). This is added by focing carbon dioxide gas and water into the mixture at high pressure. The fizzy sound you hear when your pour out the drink are millions of carbon dioxide molecules bursting free. When we shake a bottle of fizzy drink or introduce another reactor such as a mentos sweet we speed up the release process of the carbon dioxide from the liquid. When you consider that the gas is infused at 1200 pounds of pressure per square inch this pressure now needs an immediate realease and it creates a big force through the bottle top - which can be used to create some fun stuff.


Science Bit
Drinks like Coke and Pepsi contain many ingredients - phosphor in the form of phosphoric acid is one of them. This acid can be used for cleaning copper based objects and other items that become dull from exposure to the air. The acid breaks down copper-oxygen which form on shiny copper coins allowing a fresh unoxidized layer of copper to be exposed. Weak acids contained in the coke mixture and helped with the fizzy gases - help to dissolve oxides and can be used for many cleaning functions.
Fizzy drink power

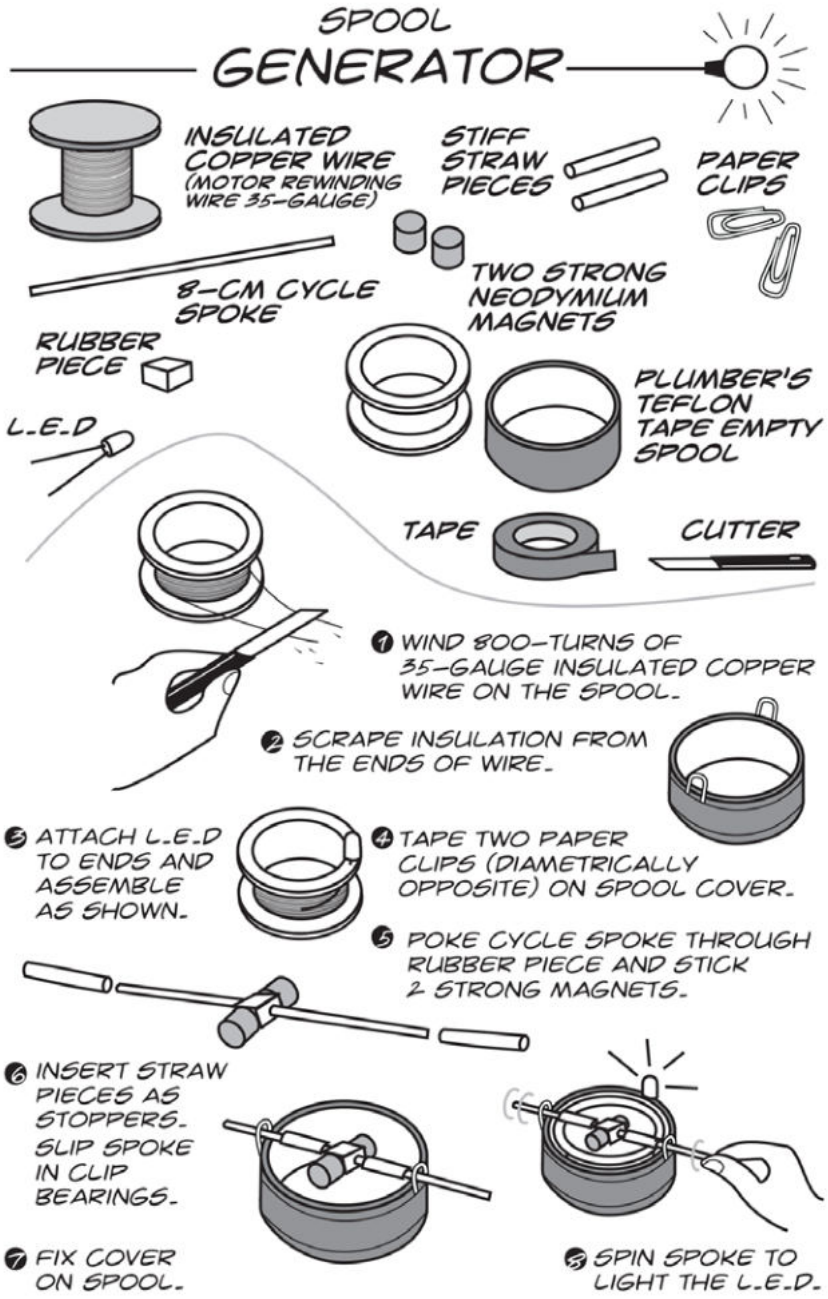
Science Bit

Rubber bands are stretchy and have the ability to store energy. If you've ever been shot with a rubber band then you know it has energy in it—enough energy to smack you in the arm and cause a sting! There are actually two different kinds of energy: potential energy, which is stored energy, and kinetic energy, which is energy in motion. A rubber band aeroplane is powered by twisting a rubber band (inserting potential energy). When the propellor is relased the stored energy is converted to kinetic energy and moves the plane foward by the aerodynamics qualities of the propellor and the engery powering the propellor.

Rubber band power

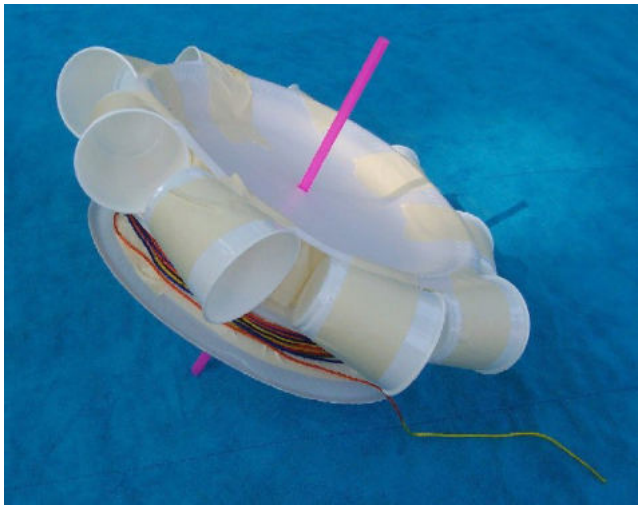
Rubber band power

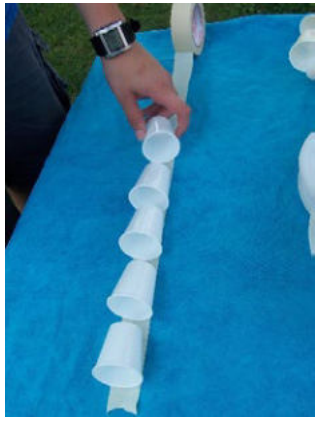

Science Bit
A bicycle wheel dynamo is a simple machine for converting mechanical energy (the turning of the wheels) into electrical energy, This is achieved by rotating coils of copper wire in a magnetic field which produces an electrical current that in turn can be used to charge a battery or power a light source. Dynamos acan also be used on small windmills and water wheels for the purpose of generating electricity.
Cycle generator



Spool Generator


Science Bit
Wind power is the process of turning energy from the wind into other forms of useful energy. Energy can be harnessed in a number of different ways. For example, windmills create mechanical energy as it turns, sails move boats and wind turbines generate electricity.
Windmills have been around for a long time, they were used in Persia (Iran) as far back as 200 B.C.
Wind power





Water power

Mouse trap cars

Making mouse trap cars is a fun activity for all. The cars can take many shapes and forms depending on design. Propulsion is achieved by using the inherent energy contained within the spring mechanism of the mouse trap.

What do you need

You will need a range of lightweight building materials such as cardboard, light wire, CDs to use as wheels, dowel and pieces of light wood. A mouse trap for each car.

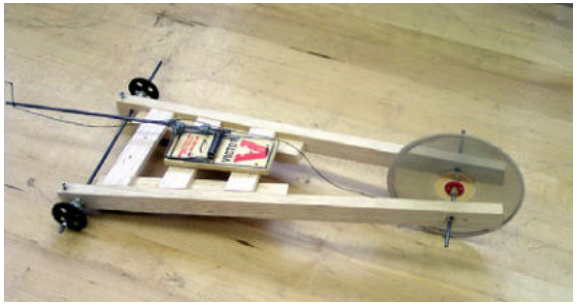
The idea

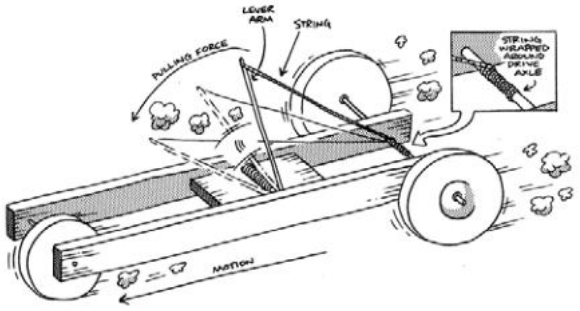
The idea is to harness the energy in the spring mechanism to provide a driving force for you 'car'. This is done by transferring the force to the axle of your vehicle. A string is attached to the spring mechanism and placed around the axle. When the trap is released the spring moves forward and as a result causes the axle to move thus propelling the car forward. The secret is to maximise the force in the spring , perhaps by adding a pole to the spring mechanism which will multiply the force available to move your car. There is also the question of reducing the 'drag' or friction factor of your car by using a lightweight slim design. Below are pictured a number of designs and details of the mechanism. The idea of mouse trap cars is experimentation and creativity therefore let you Cubs at it. Explain the how to and leave the rest to them. You will of course need equipment and some basic tools to ensure their dreams become a reality. Leaders should move around the Sixes offering guidance and assistance.

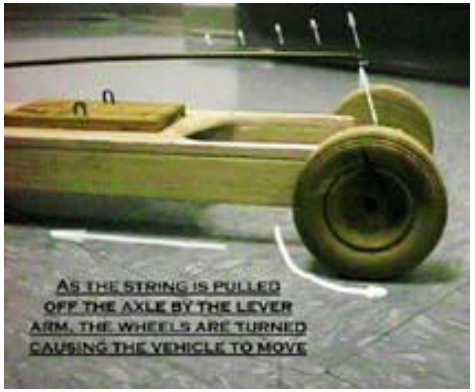
Testing

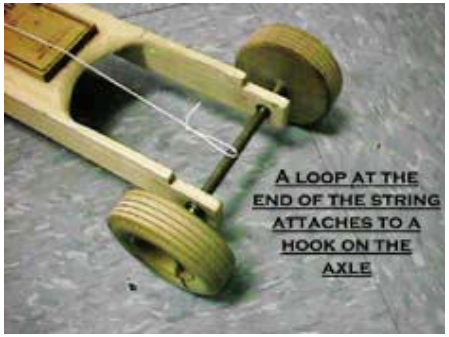
When all the cars are build then it off to the test circuit - a large hall. Set up a test track and run an number of events - longest distance travelled, best design, fastest start etc.

http://www.wikihow.com/Adapt-a-Mousetrap-Car-for-Distance

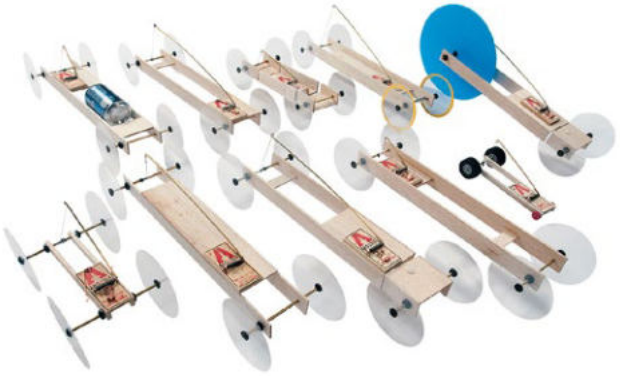


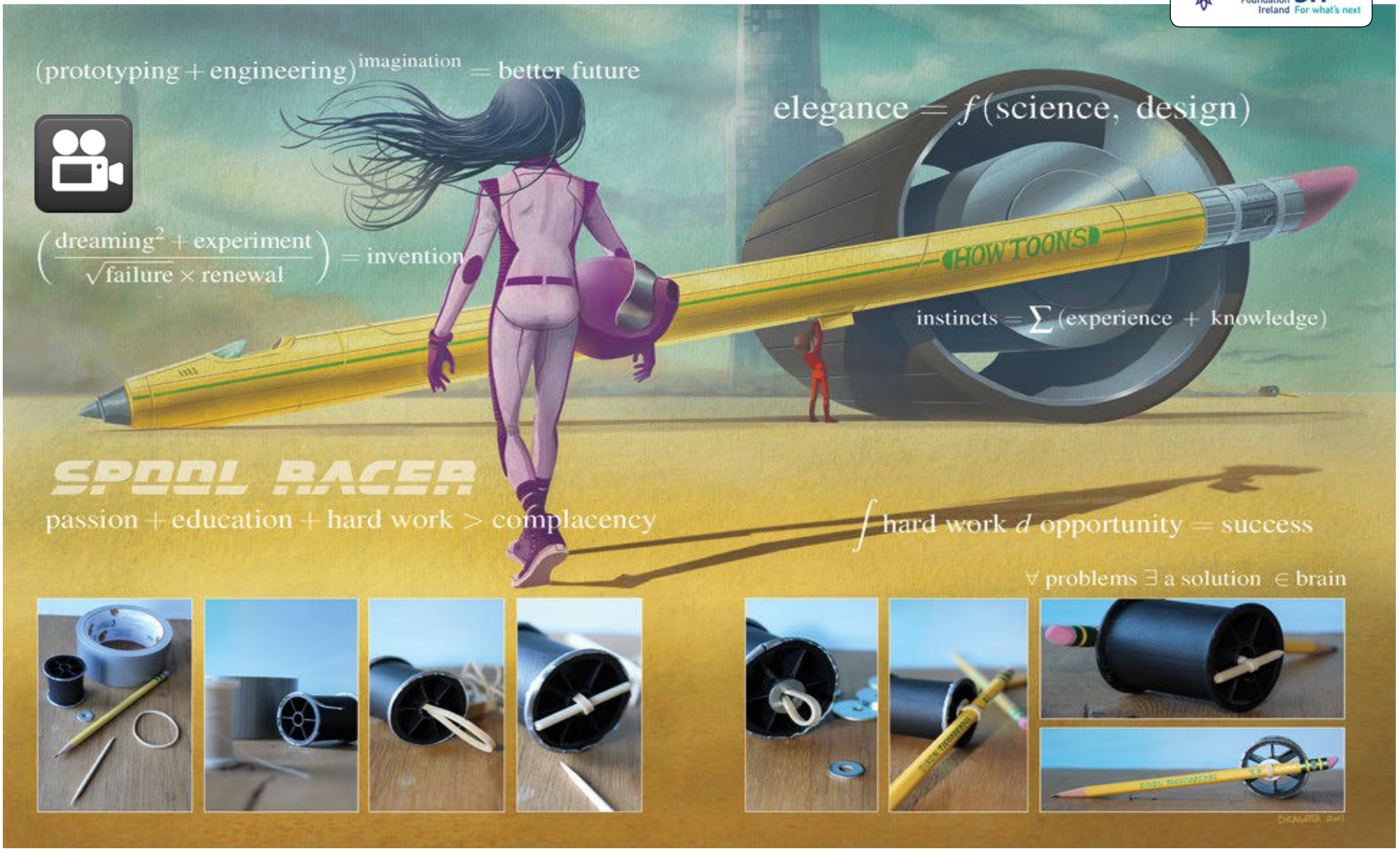

LEVER ARM
STRING
PULLING FORCE
STRING WRAPPED AROUND DRIVE AXLE
MOTION


AS THE STRING IS PULLED OFF THE AXLE BY THE LEVER ARM, THE WHEELS ARE TURNED CAUSING THE VEHICLE TO MOVE


A LOOP AT THE END OF THE STRING ATTACHES TO A HOOK ON THE AXLE

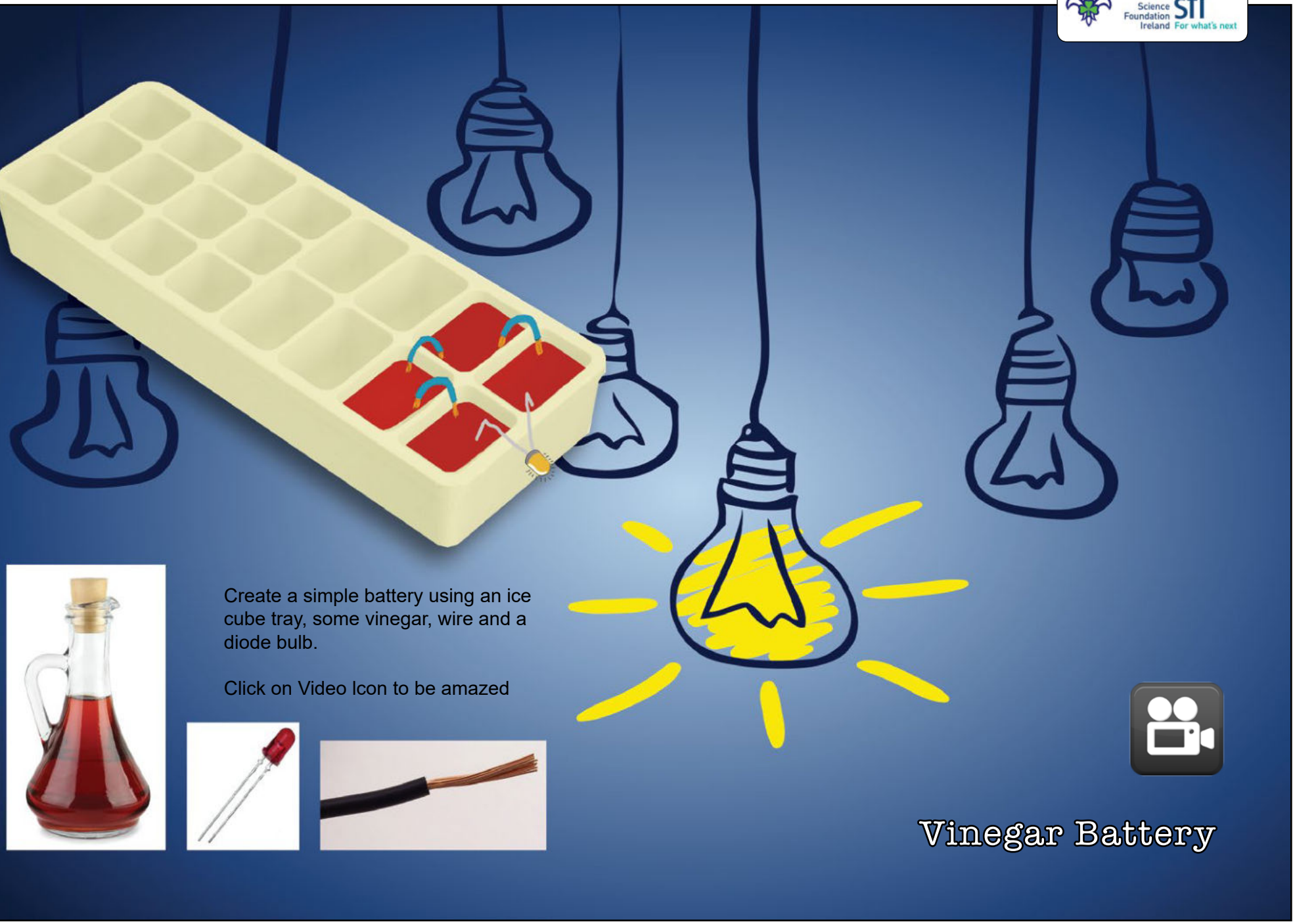

THE AXLE IS TURNED THE OPPOSITE DIRECTION OF VEHICLE MOVMENT CAUSING THE STRING TO WIND AROUND THE AXLE

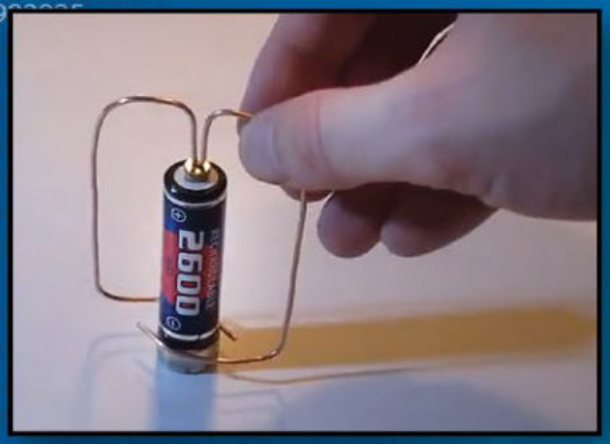




Howtoon collection

Visit howtoons.com for a full library of interesting activities you can try and explore.

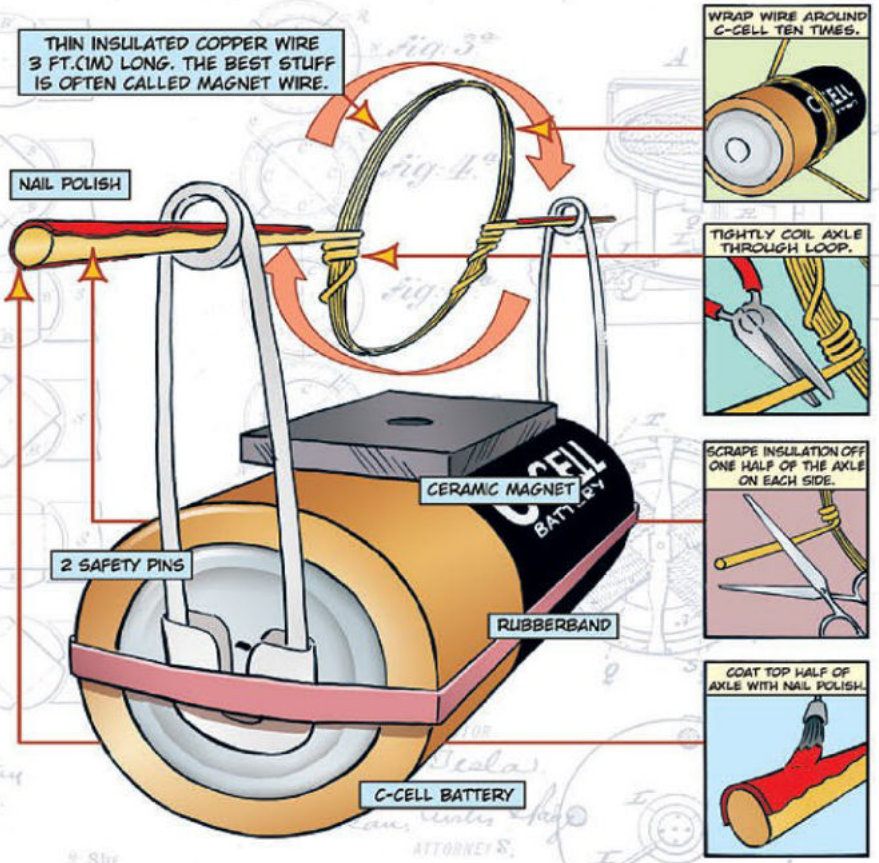

Create a simple battery using an ice cube tray, some vinegar, wire and a diode bulb.
Click on Video Icon to be amazed
Vinegar Battery



Make the simplest motor in the world
You will need a battery, some wire and a small magnet.

Click on video icon to see youtube videos

Simplest motor in the world



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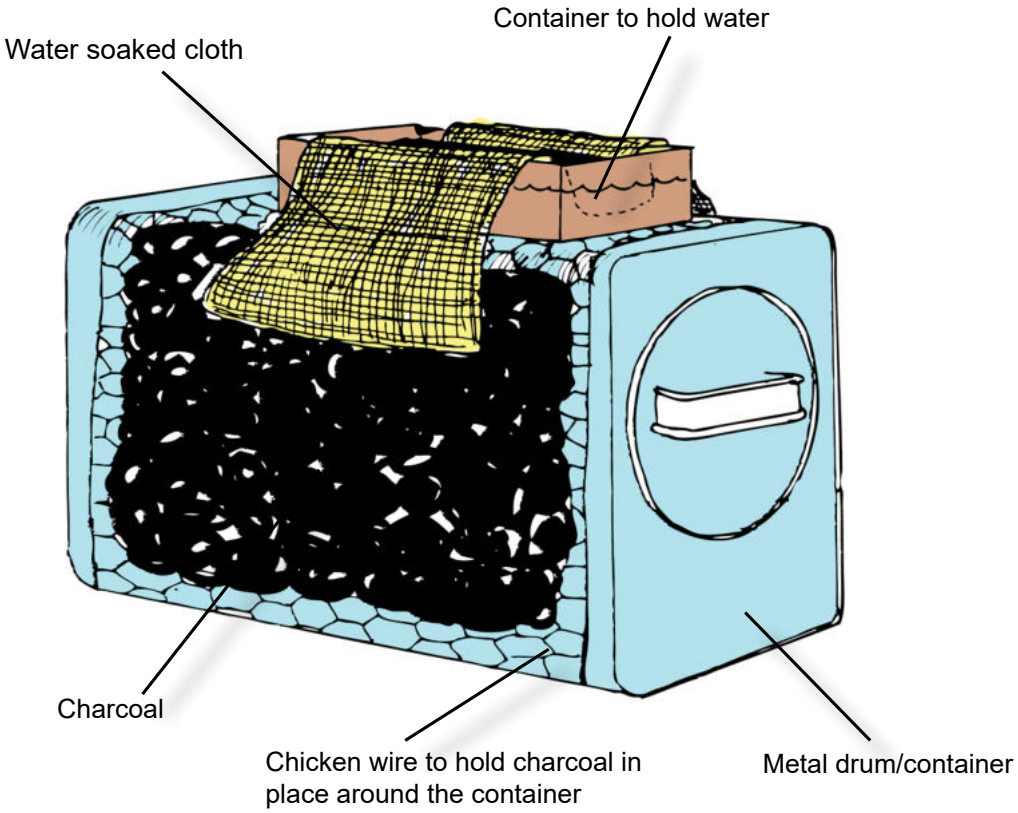
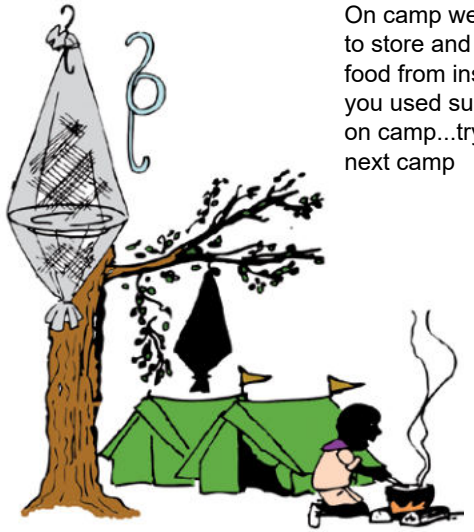
Simple Fridge

Here is a simple fridge that can be used on camp and is a low-tech solution to conserving food in developing countries. The fridge runs on charcoal and solar heat, not electricity. You need a container, a metal drum is best. Wrap chicken wire around the container. Place charcoal in the layer of chicken wire. The top of the fridge is a pail of water with rags coming out of it towards the side. The rags provide for water flowing to the charcoal filled sides. As the water evaporates, heat is withdrawn from the inside of the fridge. And your food is conserved and preserved!





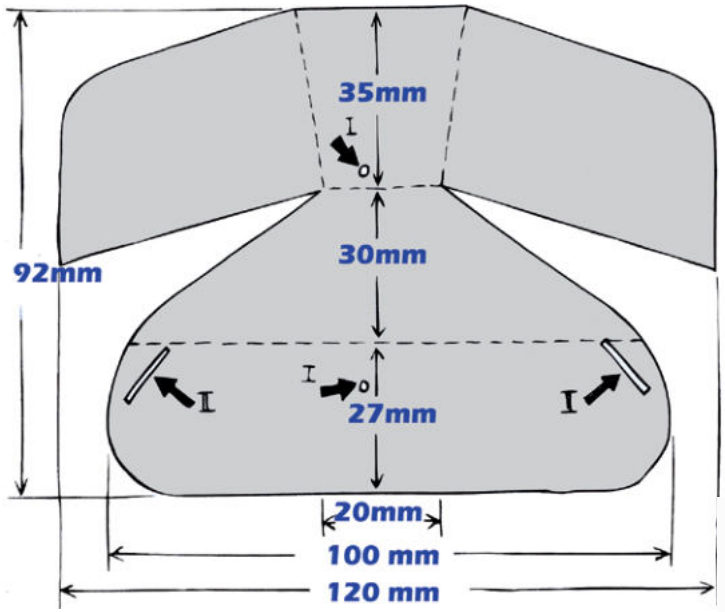
On camp we use larder to store and protect food from insects...have you used such a device on camp...try it on your next camp

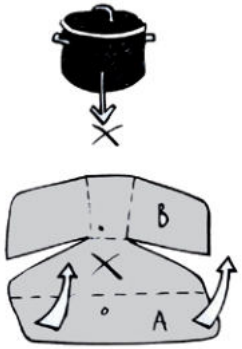
Approximately 1.2 billion people suffer from hunger (deficiency of calories and protein), according to globalissues.org

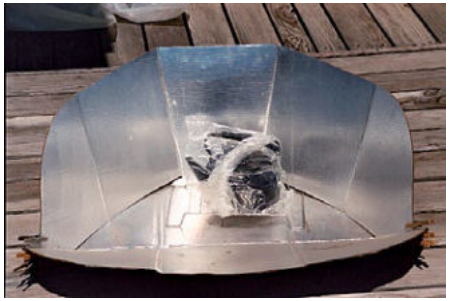
Solar Powered Fridge

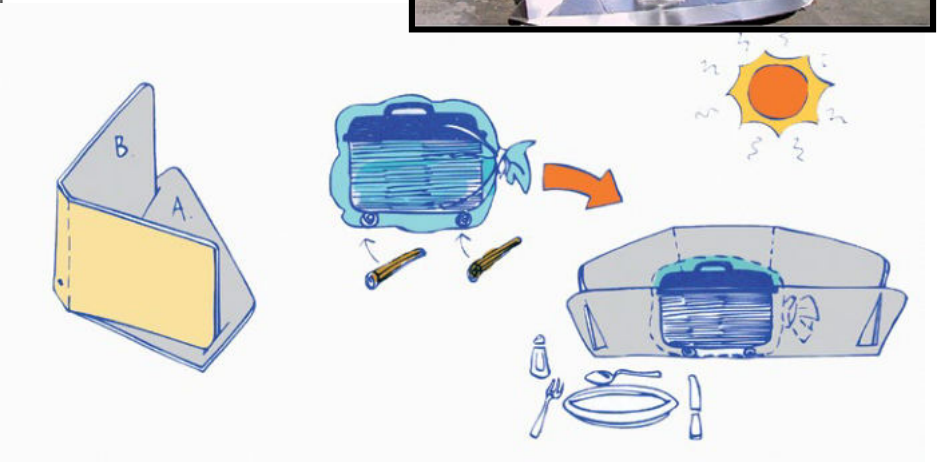
Solar Cooking

The solar cooker is a light weight, low budget and environmentally friendly alternative to the heavy cookers we find in our kitchens. All you need is a piece of heavy cardboard, some aluminum foil, a transparent plastic bag and a black pan.
This cheap solar cooker has been developed for use in developing countries where fuel is scarce. They are easy to make....make one and try it out!!!



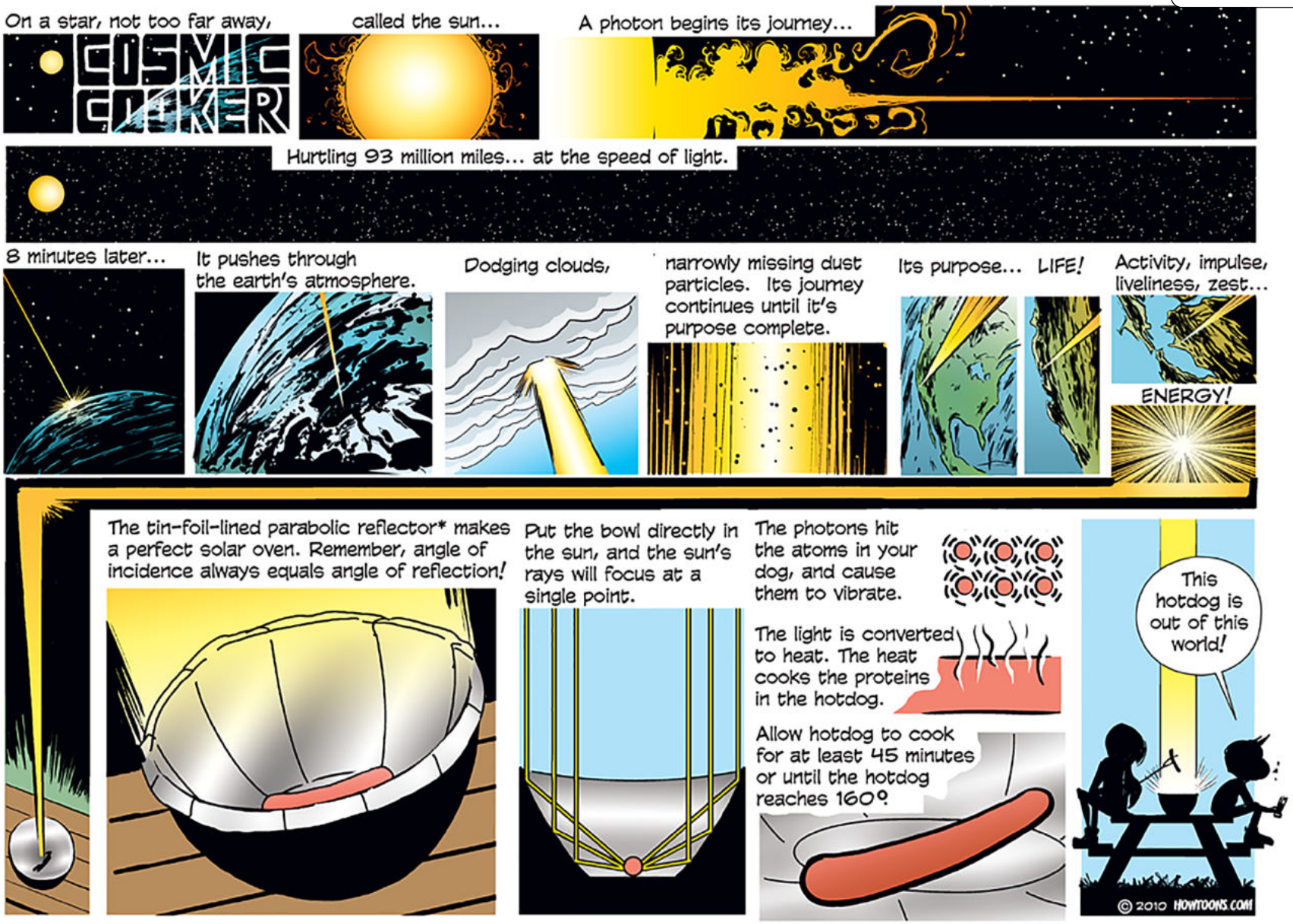






In many villages there is a complete lack of fuel wood and the people have resorted to burning dried animal dung or crop residues. These practices deprive the soil of much of its potential fertility. (Journey To Forever)

Solar Cooking



Howtoon collection

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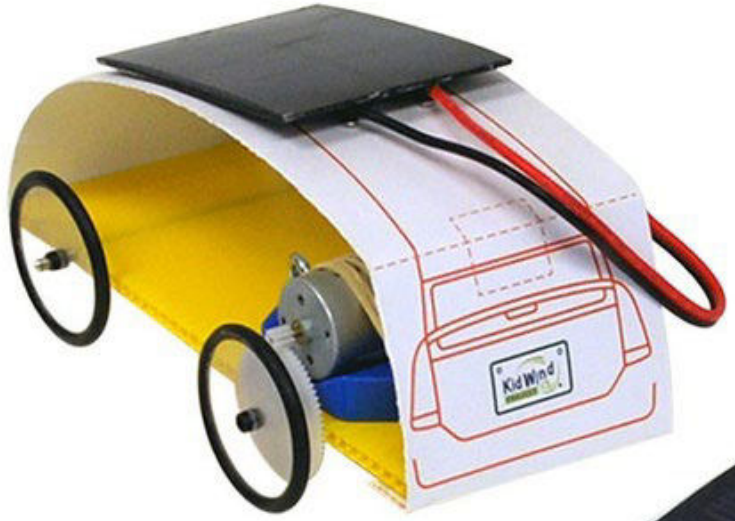
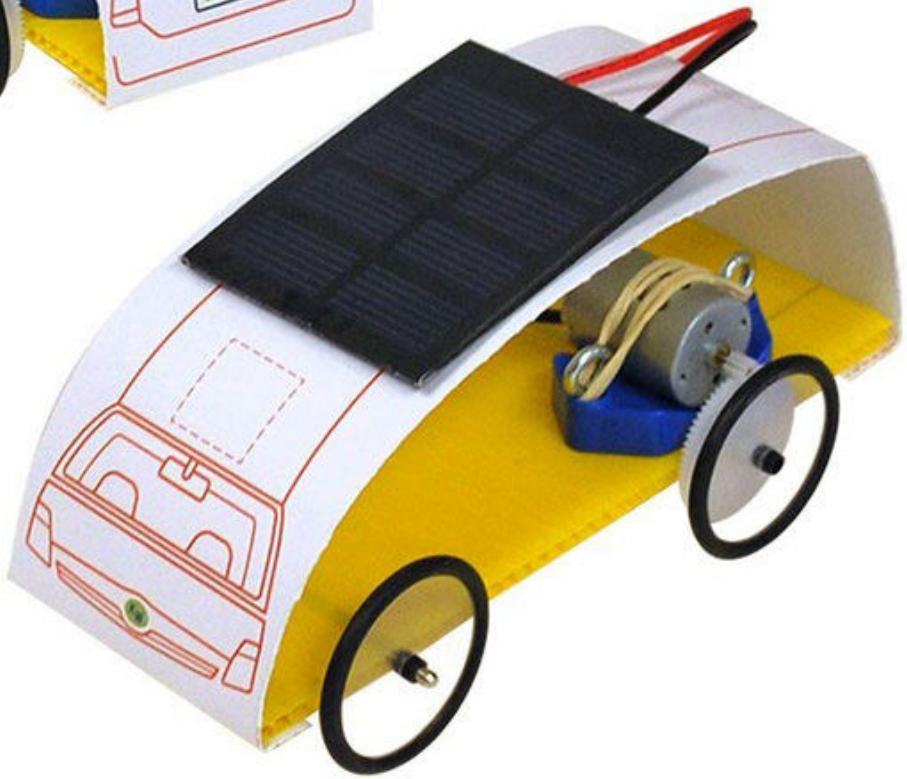
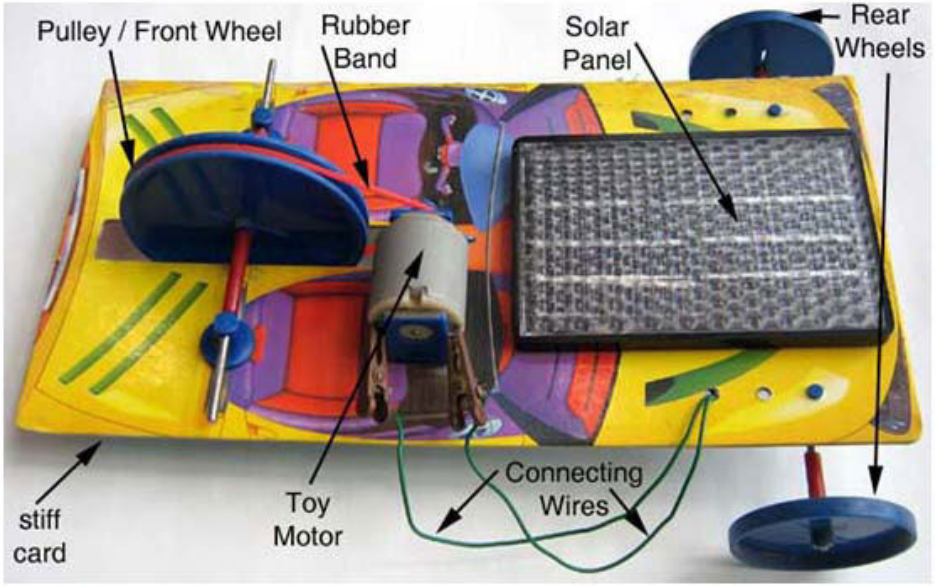
Science Bit

Solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels are made of many, smaller units called photovoltaic cells. These smaller cells convert sunlight into electricity. A collection of cells linked together make up a solar panel and provide a useful power source. The solar panels harness the power of sunlight to either create electricity or to heat water or air.

Solar powered Charger





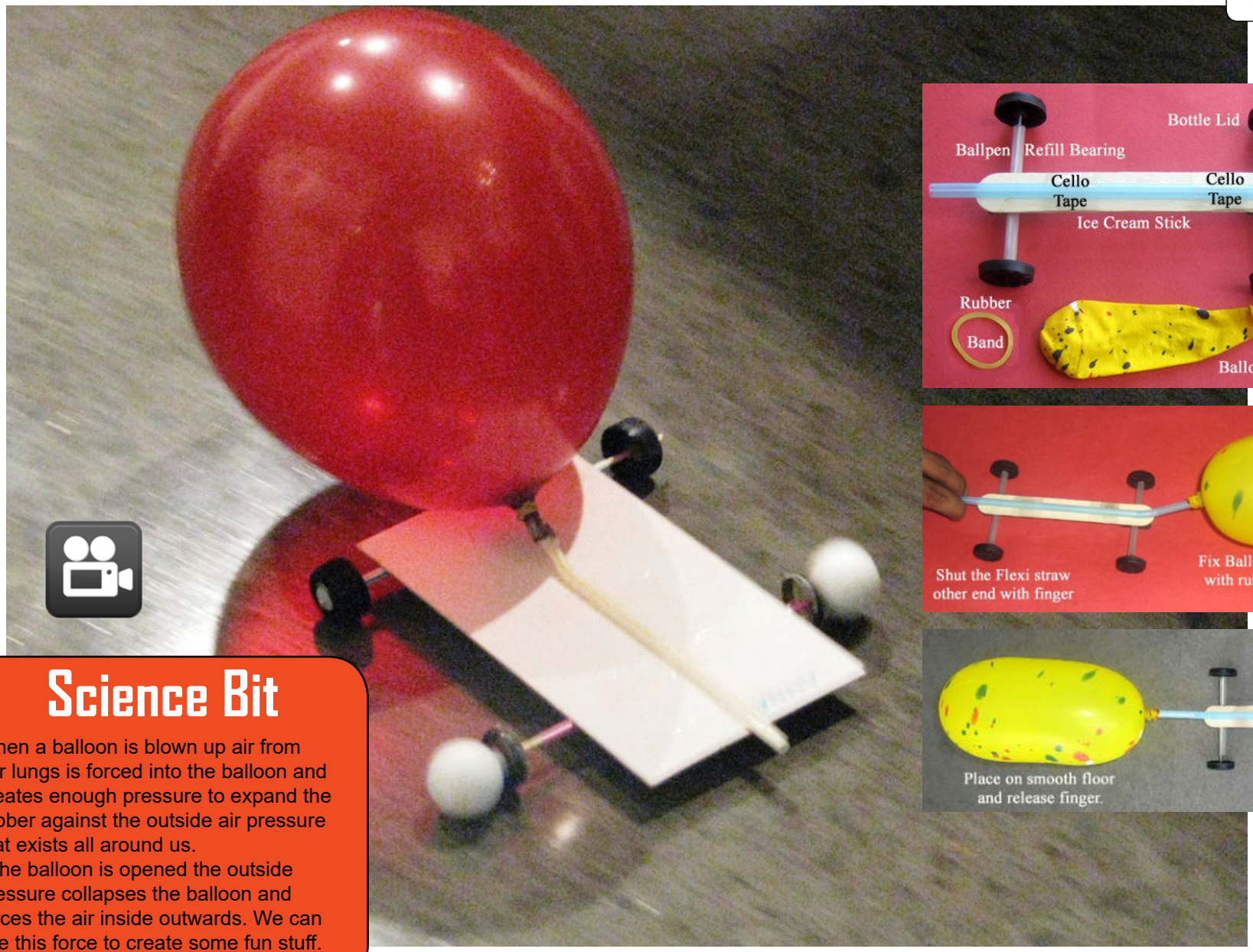


Solar powered car

Science Bit

The colours we see are determined by the amount of light a subject absorbs and reflects. For example, a red apple is reflecting red light and absorbing all other colors of light. The more light the object absorbs, the more heat absorbed since light is energy. Black absorbs the most heat. A black object absorbs all wavelengths of light and reflects none. This principle can be used to transfer energy absorbed into heat - by heating up water. Camp showers are a good way of seeing this process in action. Heat is absorbed into a black bag of water or collected by water as it slowly moves through a spiral frame.

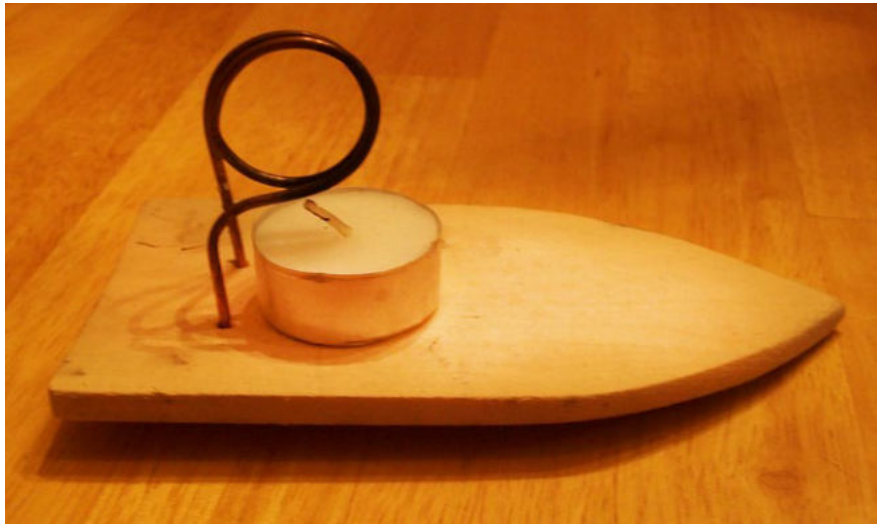
Camp Solar Shower

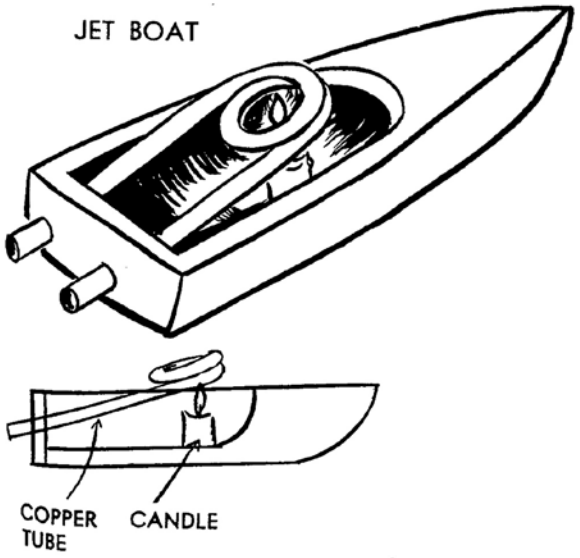


Science Bit

When a balloon is blown up air from our lungs is forced into the balloon and creates enough pressure to expand the rubber against the outside air pressure that exists all around us.
If the balloon is opened the outside pressure collapses the balloon and forces the air inside outwards. We can use this force to create some fun stuff.

Balloon powered Car





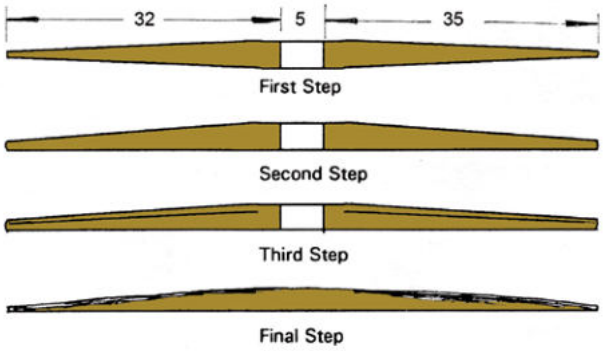
Science Bit

When water is heated to the point of vaporizing - turning into steam - the steam takes up more space than the liquid water did. Steam can occupy more than a thousand times more volume than the water it came from? If it is prevented from expanding, it builds up pressure instead and wishes to escape. When the escape of pressure is controlled it can be used to perform a particular task -- like turning a turbine, powering a steam engine or causing a kettle to whistle. That's what happens with popcorn, which ideally has a 14% moisture content inside. The hard shell keeps the bit of moisture contained. The steam pressure builds until the kernel explodes. Putt putt boats are sometimes called "pop pop" boats.

Putt Putt Steam Boat


Science Bit
A bow is made ideally from yew wood which has the capability to restore itself to its resting form. When a bow string is pulled the energy exerted to pull the bow back is stored in the bending wood of the bow. When the string is released this energy can be used to propel an object. There are actually two different kinds of energy: potential energy, which is stored energy, and kinetic energy, which is energy in motion. When the string is released the stored energy is converted to kinetic energy and is transferred to the arrow that now travels with force through the sky to its target.
Bows and arrows

Make a bow and arrows

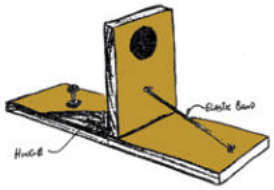


Note the tapering of the bow shaft from thick in the middle to thin at the tips. Note also the D shape rather than round shape of the shaft

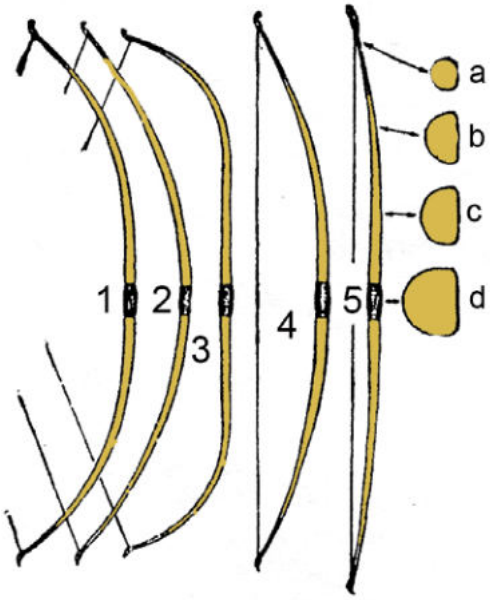
For the bow well seasoned wood is best but unseasoned will do if that is all that is available. Yew is the best wood. hickory, oak, elm, birch and willow are alternatives.

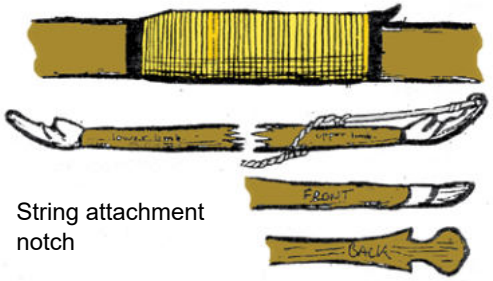
For your bow stave select a supple stave. It should be about 120cm long, but match its size to the individual. To determine the correct stave length for you, hold one end of the stave at the hip with the right hand, reach out sideways with the left hand and mark the extent of your reach as the length of the bow. This will give you a standard type of bow. Fashion the stave so that it is 5cm wide at the centre, tapering to 1.5cm at the ends. Notch the ends to take the bowstring about 1.25cm from the ends. Remove the bark if you chose. When the bow has been whittled into shape rub it all over with oil.

Any straight wood will do for arrows but birch is one of the best. Make arrows about 60cm long and about 6mm wide. Keep them straight and as smooth as possible. A piece of string tied between two points will give you a straight edge to check them against. At one end make a notch 6mm deep to fit the bow string. Check that the notch in the end of each arrow is wide enough to fit over your bowstring. To increase flight accuracy attach three feathers to the end of the arrow. A sharp point needs to be on the other end. Tin or flint can be fashioned into a really sharp arrowhead.

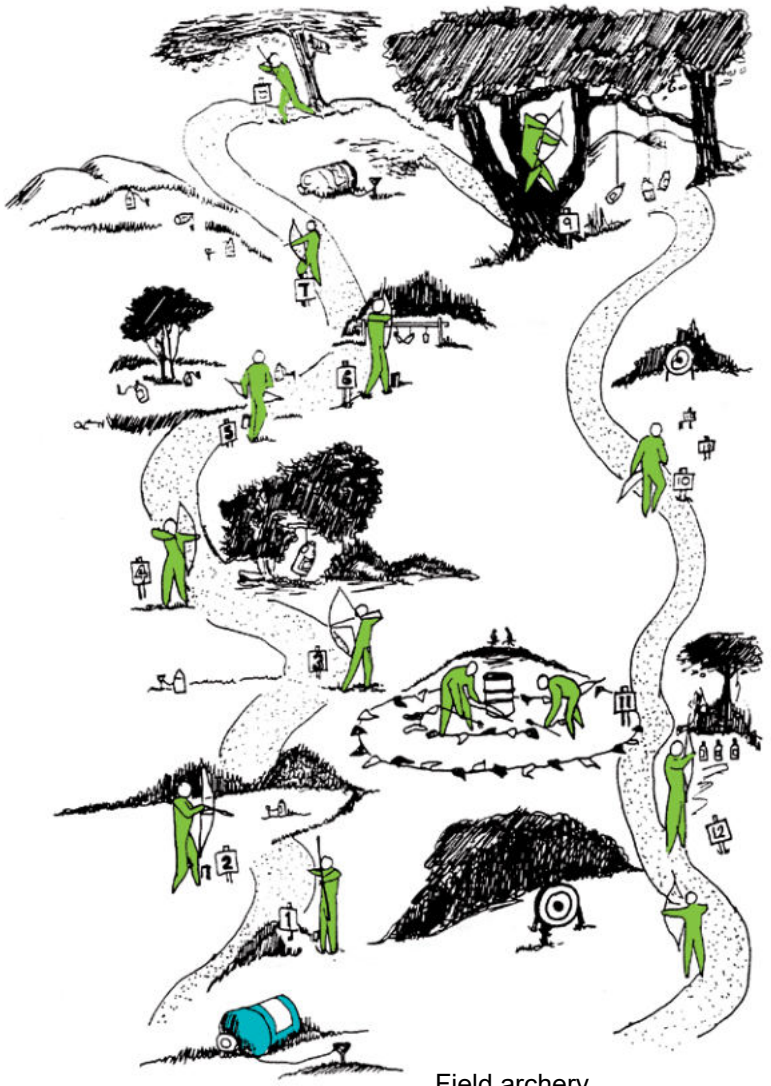


Field target



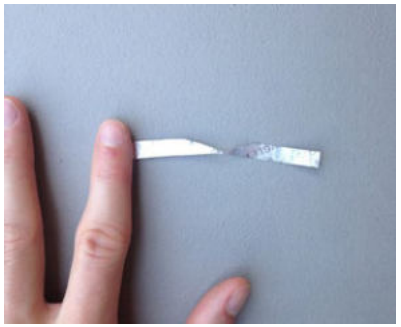


String attachment notch



Field archery

Bows and arrows



Using a battery and chewing gum paper to light a fire

Science Bit

Electric heaters work by passing electricity through a coil of resistance wire or an element in the case of an electric kettle or cooker ring. This causes the wire to heat up and provide a hot energy source. In our survival skill the chewing gum paper is comprised of a tissue paper layer with a metallic surface. This surface acts as a resistor. When electrical current - from the battery - is passed through a resistor - the chewing gum paper - it creates heat. The inner surface of the paper is tissue and this then acts as a tinder to convert the heat energy into a flame.

Battery firelighting