



Let's invent more

-Learning materials for Invention Clubs

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A manual for club instructors, 2

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Triangular structures

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Foreword

Where do innovations come from? Can their emergence be influenced? Do we ever stop to think about the environment we live in, what we wear or what kinds of objects and things we need in our daily lives?

The “Let’s Invent more” material focuses on the built environment by examining, for example, its basic structures, such as triangular structures. The skills learned are applied to various problem solving exercises or are used to develop solutions to own needs.

In the manual, exercises are grouped together according to different themes, but it is also possible to choose individual exercises and form units that are appropriate to your needs. You can start by learning the basics or by generating ideas for future environments with the help of structures and circuit switches. The pupils’ designs for future houses with intelligent functions and forms may surprise even the most experienced instructor!

In the modern world, the environment often offers such a rich variety of stimulation that it is not always easy to find space for own ideas, new inventions or creative solutions. However, creativity and inventiveness are still needed, and these valuable skills should be developed. The aim of this material is to provide instructors with tools for creating an inventive atmosphere and instructing the pupils. The club instructor does not need to be or act as an expert in the club, but can participate in inventing things and generating ideas. The instructor has to be creative when using the material. Club activities at school provide an excellent setting for an invention club which combines knowledge and skills from different fields in a natural and easy way. The instructions in the manual can be used as such or can be applied to suit the group, materials available or other needs.

Club activities at schools have many objectives (In Finland, see National Core Curriculum for Basic Education 2004). High-quality club activities influence the well-being of individual pupils, but also of the entire school community. The central features of high-quality club activities are:

- *goal-orientation*: includes objectives for knowledge, skills and experience
- *methodical approach*: club activities are based on action plans and working plans
- *regularity*: a club has a regular meeting time
- *long-term focus*: clubs are available throughout the term and the entire basic education; in clubs that meet regularly and for a sufficiently long period of time, everyone has the opportunity for experiences of completion and accomplishment.

Clubs are quite a resource – children as well as adults have the freedom of creative thinking!

Safety

The club instructor is always responsible for the pupils in the club. A skilled club pedagogue understands the environment as a physical, mental and social entity. Each club is allowed to decide on their own rules which guarantee the safety of all members. At the same time, the school's rules and safety plan have to be taken into account in club activities. If a club assembles outside the school premises, the adult is responsible for safety issues. In principle, during club activities the same basic safety instructions are followed as during lessons. A calm and peaceful atmosphere, clear routes and an up-to-date first aid kit ensure the basic safety of the club members.

In addition to general safety, the instructor and the club members need to follow the instructions on safe use of materials and tools, as presented in the manual. Central safety issues in the "Let's Invent more" club manual include the use of sharp cutting tools and electrical safety. Even if the tools and appliances are simple and familiar to pupils, the instructor must ensure that everyone knows how to use them safely.

Storing and recording the outcomes

In purposeful club activities, work results in outcomes. An outcome may mean different things to each pupil. For some it might be learning a new skill, for others new knowledge. Club activities often produce concrete products or for example plays. The primary aim of "Let's Invent more" clubs is not to create new objects, but some are still bound to be made.

Pupils may decide together what is done with the ideas, models and objects created in the club. Especially if the club is new, it may be worthwhile to present the products and outcomes to other people. This can be done in many different ways:

- Club members can build *an exhibition* of the work done in the club.
- Club work can be recorded by *photographs* or *video*.
- Each club member can make *a poster* of his/her work.
- Club members can make *a presentation* of the club together and give it to other pupils.
- Making *a cartoon* is a fun way of telling about one's own club experiences and about what one has learned and done in a club.
- Club members can participate in *national competitions* with their ideas.

"Let's invent more", said Ristomatti

There are many people in the world who think that everything has already been invented. And then there are the people, like Ristomatti Ratia, who think barely anything has been invented. Everything is still in the beginning and ahead of us. We have only scratched the surface.



At first, a thought is shy and timid. It wants to hide itself. It is afraid of the tiniest crack and is ready to run away from all evaluation and criticism. Fear, fear of evaluation, is the biggest obstacle to creativity. Face the problem bravely. The spark of the idea is so strong that it cannot be hidden, even if it means taking the risk of being laughed at. When the pin was invented, people asked what such a thing would be needed for.



Many inventions are ordinary and simple, downright brilliant discoveries, such as the safety pin, paper clip and rubber band. New materials and applications are invented all the time, without knowing the ideas of a great inventor, you. Inventions sprout up in all corners of the world.

Where do ideas come from?

At first it felt silly to develop a "cool" sauna stove. I decided to work on the idea because mothers were afraid of their children burning themselves in the steaming hot sauna stoves. Good insulation was a solution to the burn problem. In a man's world a sauna stove should be burning hot, in a mother's world safe.



Upside down

At the same time, I found a new angle to sauna ladles. Instead of throwing water onto the hot stones, I decided to let the water run down along the handle.



*Tonttu (Elf) sauna stove and ladle,
RATIA Brand Co*

My ladle is an example of a thing turned upside down. Many solutions can be found by turning matters and objects upside down, by making them larger or smaller, by changing the material or the purpose of use.

Clothes pegs are used for more than just hanging washing to dry. Outsoles of training shoes and a wet street gave inspiration for the “sole bag”.

Some things are developed in use and with time, like the Lego bricks.

The joy of inventing is great! We all experience the world in our own way. Some have the gift of writing and others the gift of acting; perhaps you have the gift of inventing.

My friend Ellen was screaming and jumping for joy. I asked her what the matter was. “I came up with a great solution and could not express my joy other than by jumping up and down.”

The joy of inventing is the greatest reward – a reward for the mind!

Wah



Shoe sole bag, RATIA Brand Co

Children's pyjamas, RATIA Brand Co



Club symbol

Begin by generating ideas:
Making a symbol for the club

- Brainstorming is begun together with all pupils in the club. Before actually beginning to generate ideas, the instructor explains the goals of the planning session to the pupils. In this club meeting, the goal is to come up with ideas for a club symbol.

- Getting started is easier with a common theme to guide the flow of ideas. A theme could be, for example, "Einstein - the great inventor" or "the most important invention you know". The theme can also be suggested by the group members. Brainstorming can be continued in smaller groups (2 to 3 pupils) or as individual work.

- Brainstorming in groups of 2 to 3 people:
The group comes up with three to four suggestions to the theme given. Ideas are drawn on paper. The group chooses two of its suggestions and posts them on the wall. When all groups have posted their suggestions, the entire group votes on the best proposal. Voting takes place so that each pupil tags his/her favourite with a post-it note. The suggestion with the most tags is chosen for further development. If there is a tie between two or more suggestions, a new vote can be held or the group can discuss whether some ideas could be combined. If necessary, the development can continue for one or two rounds based on the chosen idea or ideas.

When the development of the club symbol is finished and an idea chosen, all pupils make their own symbols using polymorph plastic or make one symbol for the whole club. Polymorph is a plastic material that can be moulded when it is warm and hardens as it cools down. The plastic is warmed up in water that is heated to 60° C and moulded into a symbol.

- paper, pencils, coloured pencils
- post-it notes
- modelling clay
- masking tape
- polymorph plastic



"AT FIRST, A THOUGHT IS SHY AND TIMID. IT WANTS TO HIDE ITSELF. IT IS AFRAID OF THE TINIEST CRACK AND IS READY TO RUN AWAY FROM ALL EVALUATION AND CRITICISM."

-RISTOMATTI -

Extra exercise: The bathtub plug has gone missing. Design a plug that is easy to use, but won't get lost. Keep also in mind who is using the plug: are the users old or young or something in between? What if the plug could be used to gather energy... what would it be like? Put your ideas on paper and make a model using modelling clay or polymorph plastic.

Useless goods bash

The useless good bash can help in tuning thinking to the level that creativity and innovativeness require: there are no right answers, only more or less appropriate solutions.

The useless goods bash can be held, for example, at the beginning of a lesson, at the end of the week or as an additional silent work assignment. If the useless goods containers can be in the back of the class room permanently, ideas for useless goods may come up even days or weeks after the actual bash.

Collect in the class room things and material that would be disposed of or that would otherwise be useless, e.g. pull tabs from tin cans, empty reels of thread, old buttons...

- *Hand out the “useless goods”, one to each pupil.*
- *Think about what the objects could be used for and write down the ideas.*
- *Think also about the original uses of the objects.*
- *Put your ideas into practice.*

Story orientation

Story telling is a commonly used method for beginning a creative process. You can start the brainstorming session with a story that is appropriate to the theme. For example, Alice in Wonderland – How could you help Alice? The story can also be a newspaper clipping related to the problem: a flood in Bangladesh or a tornado in Texas. The assignment could then be, for example, to plan easily movable emergency housing or a bridge.

Sometimes it is good to set the assignment in a completely foreign environment. Such assignments could include, for instance, an apartment at a space station or in the bottom of the sea. Often creative thinking is easier when the plans and designs are made regarding the future – What does furniture that is lighter than air look like in 2030? Write a story about a living room in the future. After writing the stories, it is time to come up with ideas for furniture that is lighter than air.



Built environment

Clubs can begin their work by discussing the concepts of living environment and built environment. The living environment is a very broad concept that can be examined on many different levels: from personal level to local and even global level. You can start from your own room and proceed to your neighbourhood, district, municipality or town or even national, continental or global level. There are similarities and differences between the levels. The scope of living environment can also be narrowed down by focusing on, for instance, the built environment, and further, the structures used in building the environment. The following takes a closer look at the structures which appear to have similar uses all the way to the global level.

As a basis for discussion you can use the advance assignments 1 and 2 that can be given to pupils during the previous club meeting. By discussing the built environment and by looking for and examining examples on different levels of the built environment you can find simple structures that are repeated everywhere, both in the man-made built environment and in nature. You can also name the structures found (triangular structures, arch structures, beam structures). You can also draw attention to building materials used in different places and situations and discuss why they were chosen.

Advance assignment 1: Observe the built environment. What kinds of structures can you find on your way home?

Advance assignment 2: Observe the nature. What kinds of structures can you find in the nature? Could they be applied to the man-made, built environment?

Getting acquainted with the structures by hands-on activities. The task is to build either a tower as high as possible or a bridge using newspapers and masking tape. The groups' products can also be tested, for example, with weights. The club can discuss the building process and the finished products as well as the pupils' feelings during the building process, the methods used, or how the groups would change the way they worked if they could start the project all over again.

Other possible exercises for clubs:

1. Plan emergency housing for disaster areas that is easy to build and move. (For example stories and newspaper clippings can be used as help for generating ideas).
2. A frame or skeleton construction for movable housing at a South Pole research station.
3. A piece of furniture from the future: it changes according to your needs and life cycle.
4. A bridge that is fun to cross.



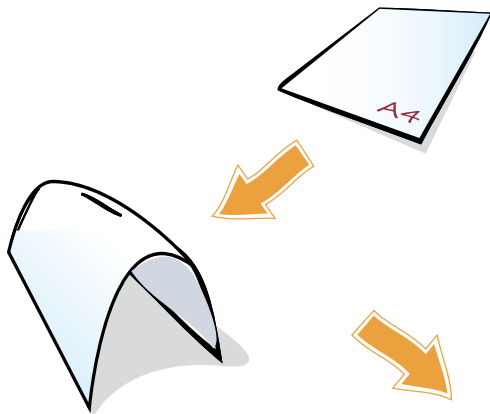
Arch structures

Where can you find arches in your immediate surroundings? How could the existing structures be improved? Where could you make use of them?

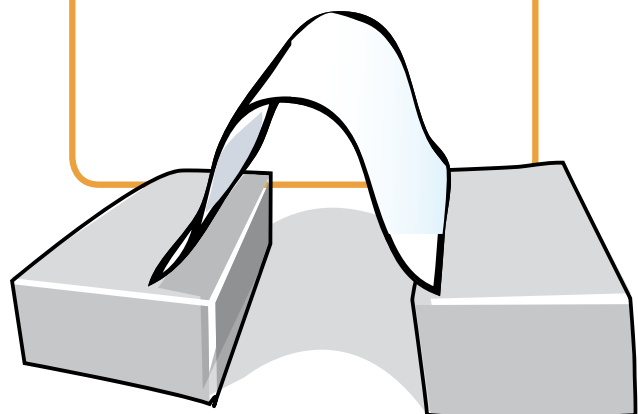
Fold sheets of paper. How can you make an “arched bridge” as strong as possible by using a single sheet of paper?



- paper, paperboard
- or cardboard
- correx/corriflute sheet
- paper pulp balls, sugar cubes
- modelling clay, clay
- blocks of wood
- extruded polystyrene foam (XPS)
- and tools needed for working the materials



FOLD AN A4 SHEET OF PAPER.
HOW DO YOU SUPPORT THE
ENDS AGAINST THE BASE?
TEST IT WITH WEIGHTS!

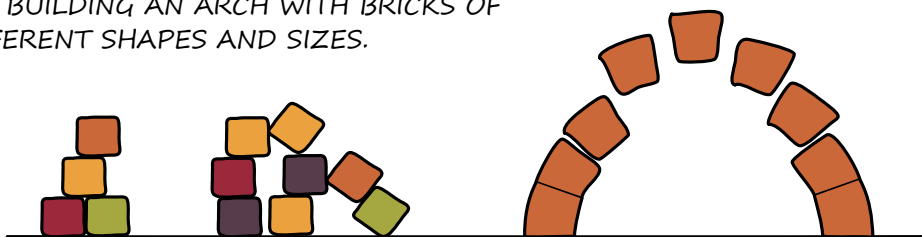


WHAT IF YOU USED PAPERBOARD,
CARDBOARD, CORRIFLUTE SHEET
PLYWOOD ETC. INSTEAD OF PAPER?

Which materials could be used for making pieces that would have the best possible shape for building an arch? Try building an arch with pieces of different shapes and sizes.

How long a bridge are you able to build? How low an arch is functional?

TRY BUILDING AN ARCH WITH BRICKS OF
DIFFERENT SHAPES AND SIZES.

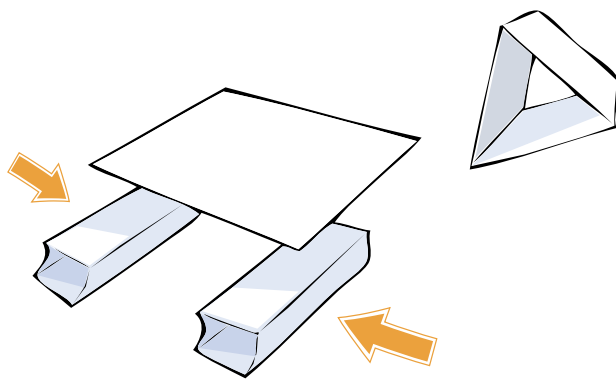




Beam structures

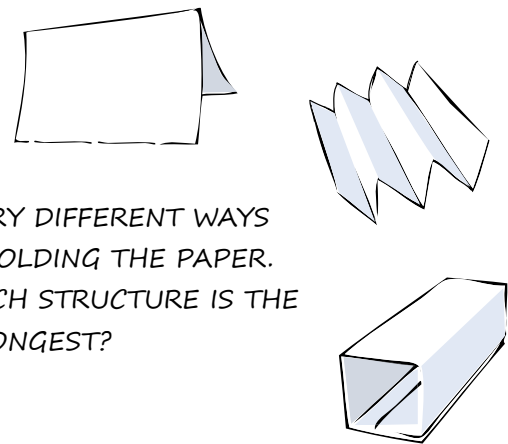
Where in your immediate surroundings can you find beam structures? How could the existing structures be improved? Where could you put them to use? How could you support your beam structure (support ropes, supporting columns)? How could you make use of the triangular structure in connection with beam structures?

- corrugated cardboard, paper or newspaper
- cardboard boxes
- glue/hot glue
- masking tape



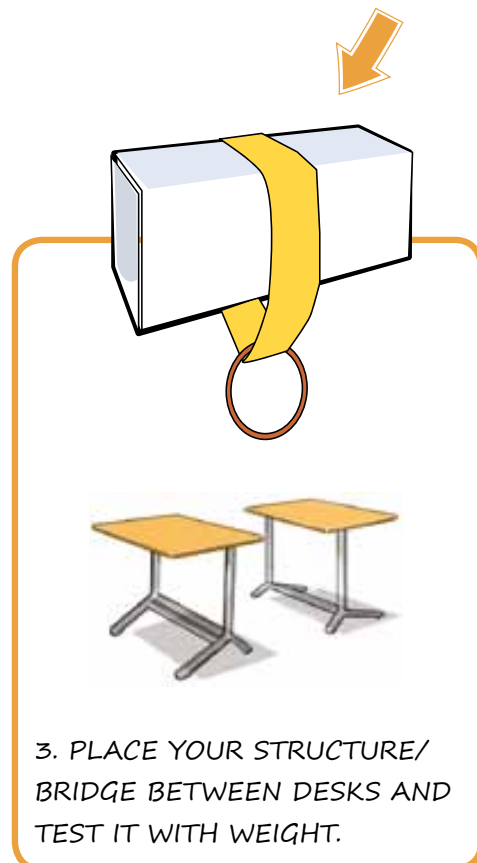
1. PLACE FOR EXAMPLE TWO EMPTY MILK CARTONS SO THAT THERE IS A SUFFICIENTLY LARGE GAP BETWEEN THE CARTONS, HOWEVER, AN A4 SHEET OF PAPER SHOULD REACH FROM ONE CARTON TO THE OTHER.

2. TRY DIFFERENT WAYS OF FOLDING THE PAPER. WHICH STRUCTURE IS THE STRONGEST?



Bridge and tower competitions are fun ways of learning about and testing different structures. For example, story orientation (see p. 9) can be used in the exercise.

Build as long a bridge as possible! You can also build a bridge that holds a certain weight or some other structure that is as strong as possible (see triangular structure). The work can be limited to different materials, e.g. pupils can only use newsprint and masking tape or A4 sheets of paper or paperboard and glue.



3. PLACE YOUR STRUCTURE/ BRIDGE BETWEEN DESKS AND TEST IT WITH WEIGHT.



Triangular structures

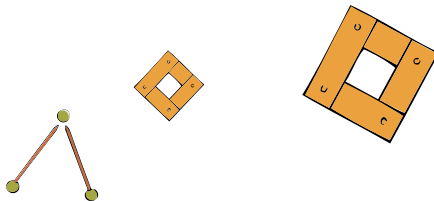
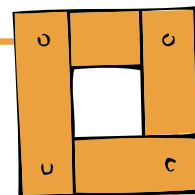
Triangular structures are stable and commonly used structures that can be used in diverse ways. Where in your immediate surroundings can you find triangular structures? How could you improve the existing structures? Where could you make use of them?



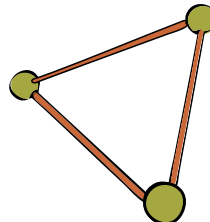
- paper or paperboard
- correx/corriflute sheet
- wooden skewers, toothpicks
- common reeds
- peas, paper pulp balls
- modelling clay, clay
- extruded polystyrene foam (XPS)

Use different materials to build triangular structures in different sizes and shapes. After experimenting, you can begin to come up with ideas of how and where the structures could be used.

1. BUILD A SQUARE USING STRIPS OF CORRUGATED CARDBOARD. TEST THE STRUCTURE. WHAT DO YOU NOTICE? HOW COULD YOU MAKE THE STRUCTURE STRONGER?



2. TEST THE TRIANGULAR STRUCTURE. WHAT KINDS OF STRUCTURES COULD YOU USE TO MAKE A TOWER USING PEAS AND TOOTHPICKS?



3. BRAINSTORM: WHAT WOULD IT BE LIKE? A SEAT LIGHTER THAN AIR, A LAMPSHADE, A ROOM DIVIDER, A SPACE STATION...

...A HOUSING SYSTEM THAT PROTECTS FROM WIND AND RAIN (AND STORES HEAT) FOR DISASTER AREAS?

...OR A BRIDGE FOR THE BOY?





Force from levers!

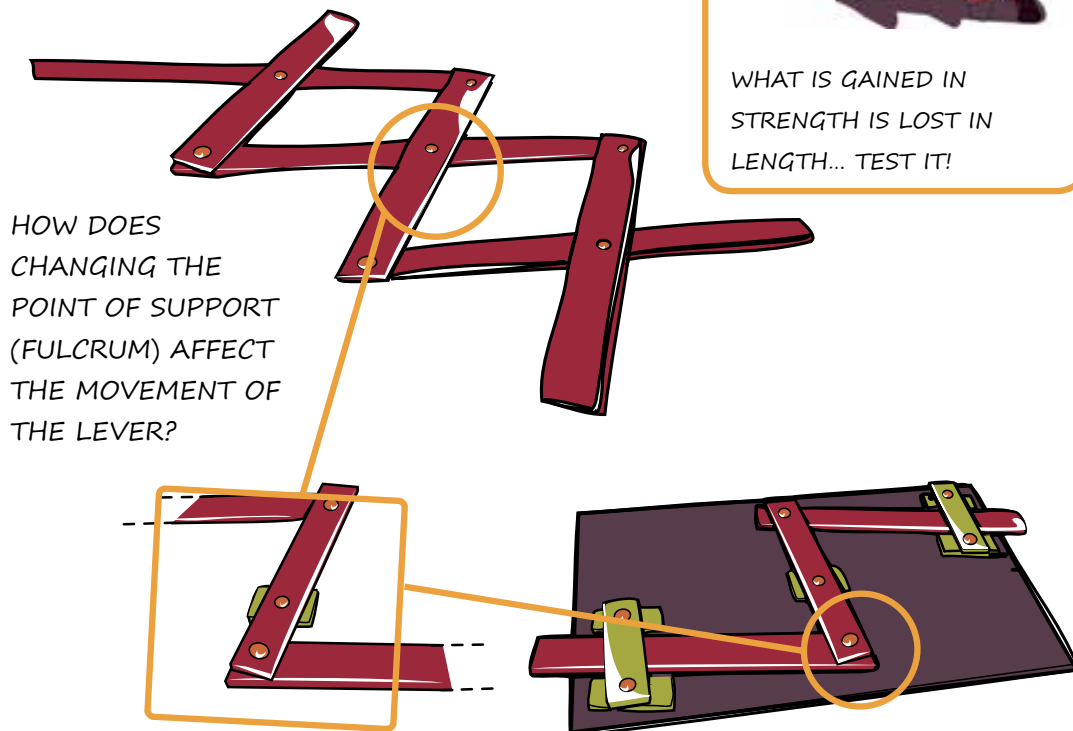
What are levers? Where do we need levers? How do levers work? Define the concepts single-arm lever double-arm lever. What examples can you find (crowbar, wheelbarrow, oars, scissors...)?

- cardboard
- correx/corriflute sheet
- brass fasteners (brads)
- decoration materials



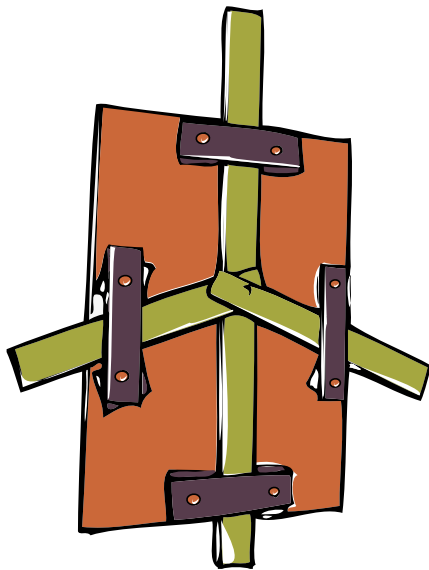
Is it true that what is gained in strength is lost in length? Test it for example with your school bags like in the picture.

Make 2 to 3 different simple mechanisms that change the amount or direction of force, for example using ideas from the pictures below.



In the first picture, the parts of the “scissor structure” are of equal lengths. Can the movement be changed by making the parts shorter? What happens, if you change the place of the axis or the fixing point of the brass fastener? Try it.

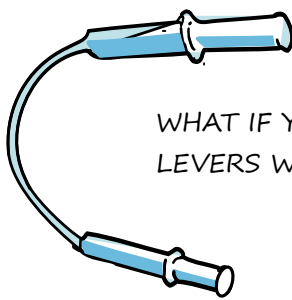
What could you use these structures for?



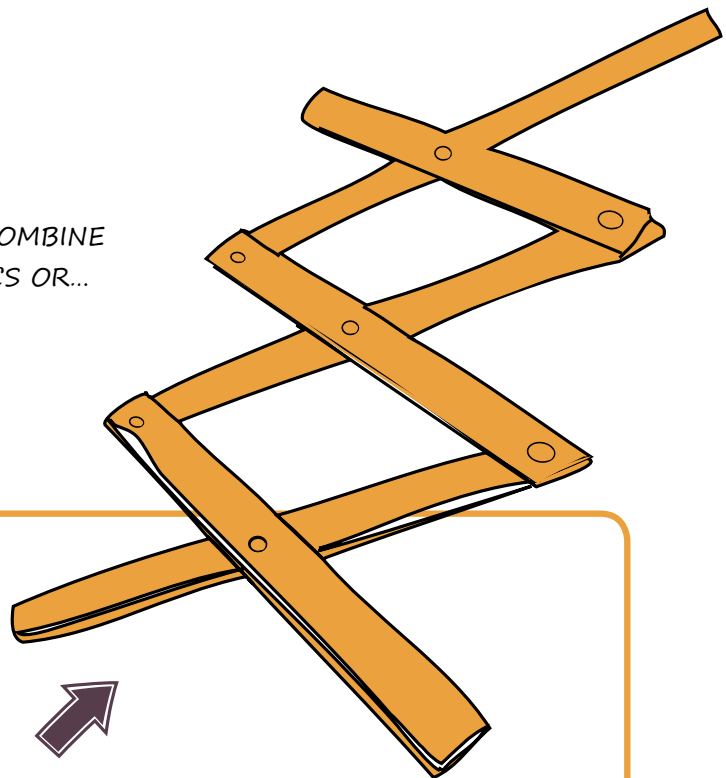
Explore, test and develop

Move the parts of the mechanisms, work in groups and circulate the mechanisms among the pupils. What do the movements remind you of? (For example, a jack-in-the-box, snake, rowing boat...)

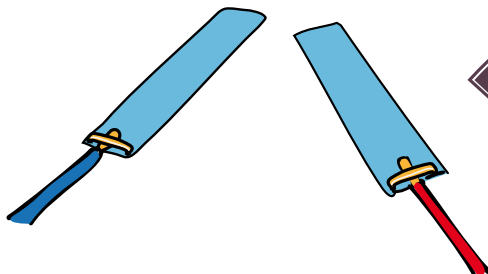
In what situations could you make use of the levers you developed? What could a “reacher”, a “rowing helper” or a “gatekeeper” be like?



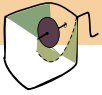
WHAT IF YOU TRIED TO COMBINE
LEVERS WITH PNEUMATICS OR...



....ELECTRONICS, SUCH AS
MEMBRANE SWITCHES!



The products can be finished, decorated and grouped for example according to themes: a jungle park, a fairy-tale animation, things I will need in the class room...



Crank shaft machines

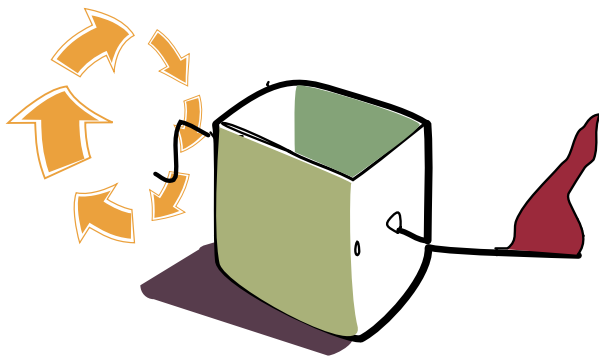
The central questions in the Wonder machines theme include what machines are, why machines exist, where machines are used, and what machines are like. They facilitate our work. With simple machines we can change the amount or direction of force used, or both.

- wire
- cardboard boxes
- hot glue
- wooden sticks
- decoration materials



These simple machines are the basis for all the machines we know. They may be needed for moving or moving an object up, down or along a plane, for example by pushing, cranking, striking, digging, lifting, sliding or rotating.

1. Bend the ends of a straight wire to a curve as shown in the picture (a crank handle). Spin the wire by rotating the crank. Bend the free end of the wire sideways. How does the movement change?

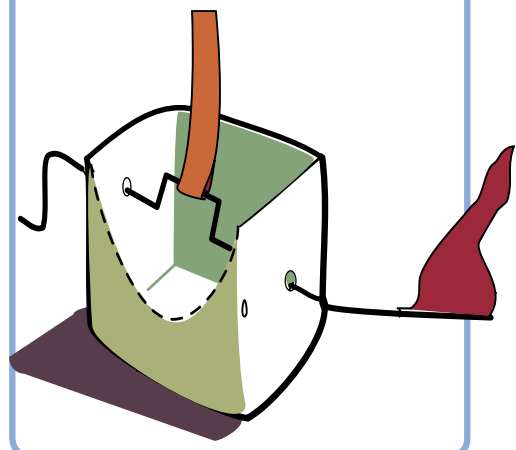


1A. BEND ONE END OF A WIRE TO A CRANK HANDLE AND SPIN IT.

1B. BEND THE FREE END AND SPIN. HOW DOES THE MOVEMENT CHANGE?

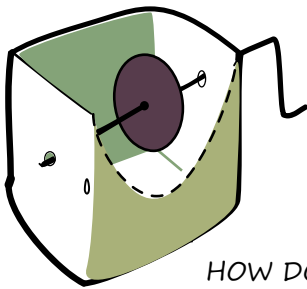


2. BEND THE WIRE EITHER OUTSIDE OR INSIDE THE BOX. HOW DOES THE MOVEMENT CHANGE?

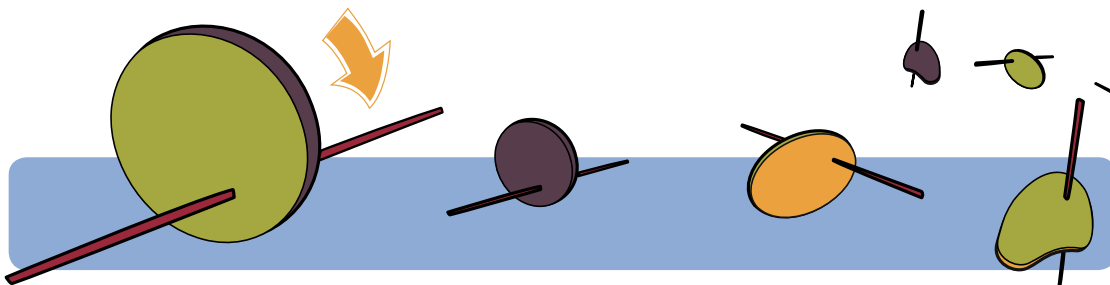


2. Push the wire through the sides of a cardboard box (e.g. empty milk carton) as shown in the picture. Bend the wire the way you like and test the movement with e.g. thin strips of paper. You can bend the wire parts outside the box as well as the wire inside the box.

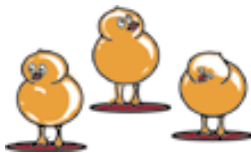
What does the movement remind you of?



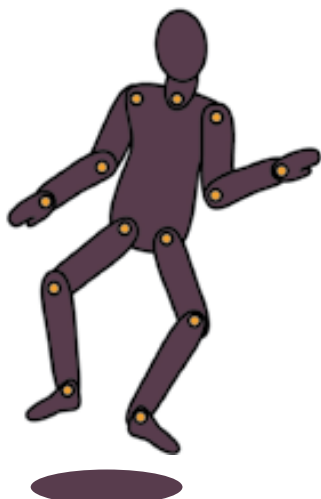
HOW DOES THE
MOVEMENT CHANGE
WHEN YOU CHANGE
THE PLACE OF THE
AXIS?



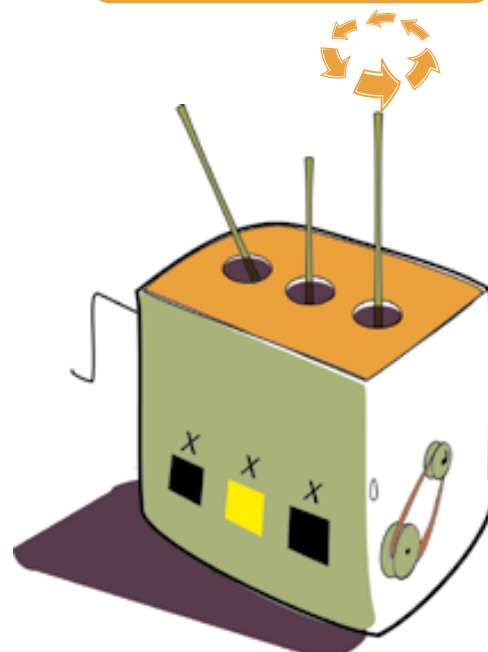
TRY ALSO OTHER SHAPES...



WHAT WOULD A WONDER
MACHINE BE LIKE, AND
WHAT WOULD IT DO?



CAN YOU MAKE THE
STICKS MOVE UP AND
DOWN OR TO SPIN BY
ROTATING THE CRANK?



Switch workshop

How does a flashlight (torch) work? How do you turn on the light in your room? Can you find switches in your living environment? Where are they and what are they used for? In the club, pupils will learn to build simple switches and to apply them in their daily lives. Brainstorming themes can be, for example, safety, communication or party games.

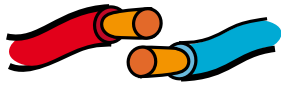
Switch workshop (2 to 3 club meetings)

Pupils have access to LEDs and power supplies. The task is to get first one and then two LEDs to light up and turn off. Discuss with the entire group what you just did. How is it possible to turn off the LEDs? And how do you turn off the lights at home? In the discussion, concepts such as open and closed circuits are likely to come up and possibly also the concepts of parallel and series connection. The concept of switches is also defined.

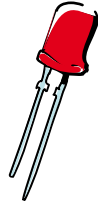
5 min	Introduction to the theme of the switch workshop, discussion on the topics: Where are switches found at stores, at home, in telephones etc.?
	Pupils are divided into smaller groups (2 to 3 people).
5 min	Getting to know the concepts of open and closed circuits. The small groups have access to pieces of electrical wire, LEDs and power supplies. The groups' task is to first light up one LED and then two LEDs.
30–60 min	The significance of switches and their uses. Each group builds three switches. Examples can be found on pages 19 - 21.
5 min	Presenting the finished products.
5 min	Discussion (the entire group): How can a circuit be opened and closed? Could it be closed by sitting, throwing something at it, using your hand, blowing...?
10 min	Brainstorming in small groups: Where could you use a switch? Assignment for the next meeting: Come up with an idea and plan a device that would make your life easier.
50 min	Developing the idea and building the device.
10 min	Presenting the idea to other pupils.



Membrane switch

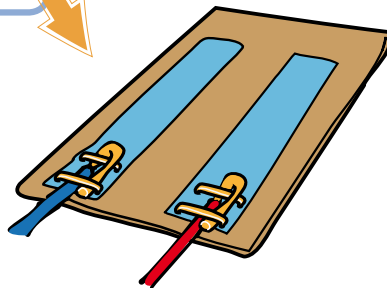
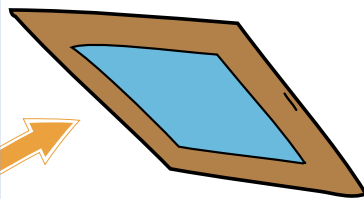
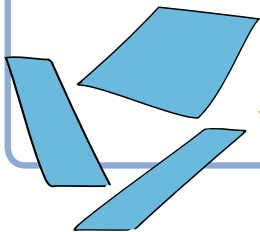


CAN YOU LIGHT UP A LED
OR SOUND A BUZZER?
BUILD A CIRCUIT!

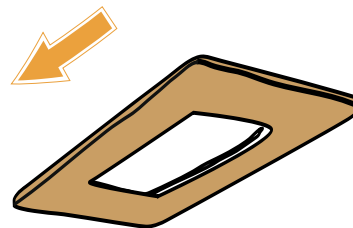


cardboard/paper •
aluminium foil •
batteries with electric conductors •
components that you will control,
for example LEDs or buzzers •
hot melt glue or glue •
staplers and scissors •

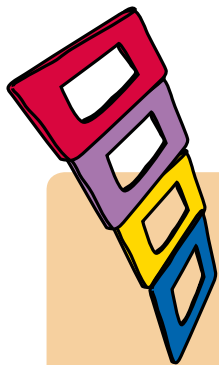
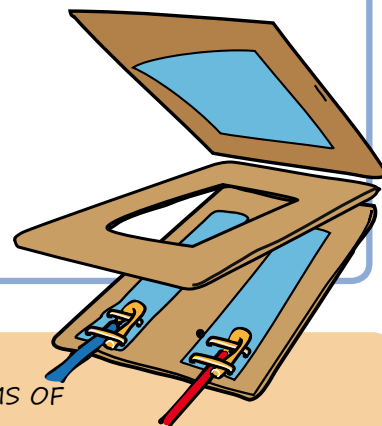
ATTACH PIECES OF
ALUMINIUM FOIL
ON THE INSIDE
AND ATTACH
ELECTRICAL
WIRES TO THEM
(USING E.G. A
STAPLER).



CAN YOU INFLUENCE THE
SENSITIVITY OF YOUR
SWITCH? HOW DOES THE
METHOD OF CLOSING
THE CIRCUIT (THROWING,
SITTING, BLOWING)
AFFECT YOUR CHOICE OF
MATERIALS?



TEST THE FUNCTIONING OF
YOUR MEMBRANE SWITCH!



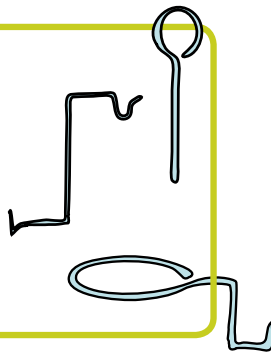
COME UP WITH MORE DIFFERENT FORMS OF
MEMBRANE SWITCHES AND TRY DIFFERENT
MATERIALS, FOR EXAMPLE PLASTIC,
CARDBORAD, CLOTH, LEATHER OR METAL.



Pendulum switch

Bend electrically conductive wire into a switch that reacts to changes in balance.

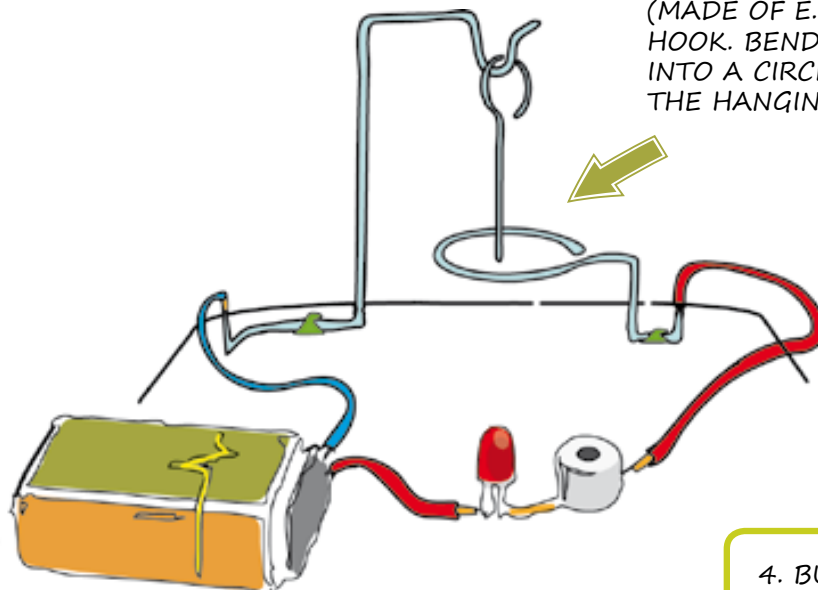
1. USE FOR EXAMPLE WIRE AND BEND IT INTO PARTS LIKE THE ONES IN THE PICTURE. ATTACH THEM TO THE BASE AS SHOWN IN THE PICTURE.



- electrically conductive wire
- batteries with electric conductors
- components, for example LEDs or buzzers
- hot glue
- cardboard /correx/corriflute sheet
- nose pliers
- soldering irons and tin solder

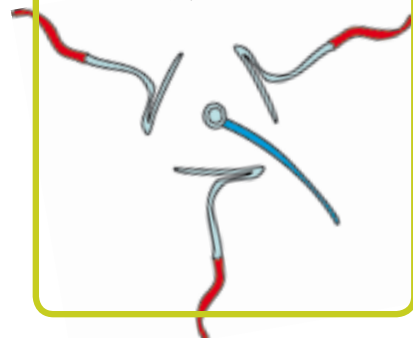


2. HANG A SWINGING WIRE (MADE OF E.G. IRON) TO THE HOOK. BEND ANOTHER WIRE INTO A CIRCLE INSIDE WHICH THE HANGING WIRE IS.



3. CONNECT THE LED, BUZZER AND POWER SUPPLY AND ATTACH THEM TO THE BASE. TEST YOUR COUPLING.

4. BUILD SEVERAL TARGETS THAT CONNECT DIFFERENT CIRCUITS AND PLACE THEM WITHIN THE MOVEMENT AREA OF THE PENDULUM.



Where could you make use of such a switch? What machines could you operate with the switch? Based on the same principle, what kind of a switch could you use in your own plans? Make a switch that is appropriate to your plan and apply it to the use of your choice.

Balance switch

Cover a paper pulp ball with aluminium foil or use a metallic ball. Bend an overhead transparency into a cylinder (tube) into which the aluminium foil ball fits. Fix the transparency with paperclips in both ends to keep it from unfolding. You can also use tape.

BEND THE TIP OF THE PAPERCLIP UP TO KEEP THE BALL FROM ROLLING OUT OF THE TUBE.

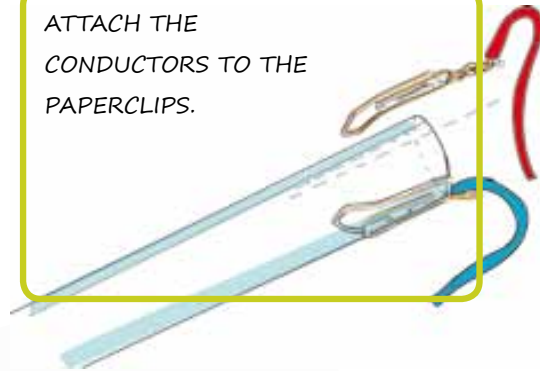


You can test the functioning of the switch by connecting the circuit to, for example, a buzzer or a LED. You can also use metallic balls, paper or any tube you can find.

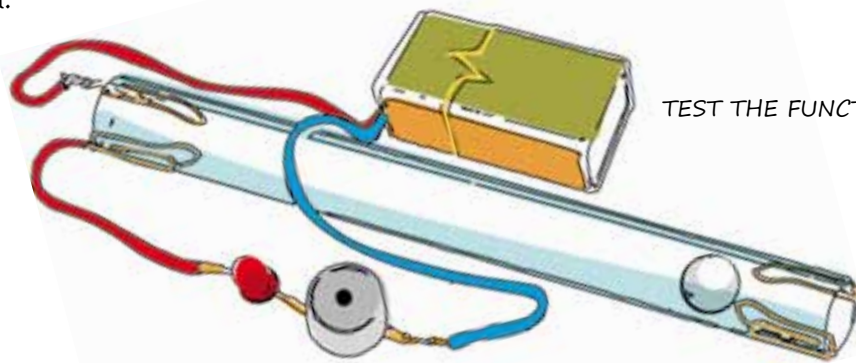


- paper, transparencies
- batteries with electric conductors
- components for signalling, for example LEDs and buzzers
- aluminium foil
- paper pulp balls or metallic balls
- paper clips, tape and glue
- cardboard/corrugated sheet
- (mounting pad)

ATTACH THE CONDUCTORS TO THE PAPERCLIPS.



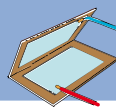
TEST THE FUNCTIONING.



YOU CAN ALSO USE A CAPACITOR IN YOUR APPLICATION. WHAT POSSIBILITIES WILL THAT GIVE TO YOU AND YOUR SYSTEM?



WHAT IF YOU ADD A PENDULUM OR MEMBRANE SWITCH TO YOUR COUPLING? HOW DOES THE RANGE OF USE OF YOUR APPLICATION EXPAND THEN?



How could you apply the principle of the balance switch? Could it be a game or a security system? Plan and build your own.

Meow buzzer

A piezoelectric buzzer with an oscillator circuit makes a howling or squealing sound when it is coupled to a circuit. When the circuit is opened, the sound ends immediately. With the help of a capacitor, the sound can be prolonged to be audible even after the circuit is opened.

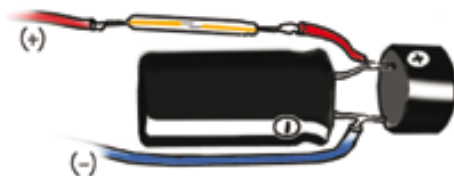
A capacitor stores electric energy, and can, therefore, act like a battery. This quality of capacitors is used in many applications. Capacitors are used, for example, to smooth the variation in electric current.

- sound sources
(a piezoelectric buzzer with an oscillator circuit)
- capacitors (2200 μ F/25 V)
- magnetic reed switches (relay)
- power supplies 9 V
- battery magazines (9 V)
- soldering irons and tin solder



1. Build a coupling. Take into account especially the polarity of the capacitor and the piezoelectric buzzer. Connect a magnetic reed relay between the positive (+) leg of the piezoelectric buzzer and the positive (+) pole of the power supply.

CONNECT A REED RELAY BETWEEN THE POWER SUPPLY AND THE PIEZOELECTRIC BUZZER.



THE NEGATIVE (-) LEG OF THE CAPACITOR IS USUALLY LABELLED WITH A WHITE STRIPE AND A MINUS SIGN.

CONNECT THE (+) LEG OF THE PIEZOELECTRIC BUZZER TO THE RED ELECTRIC WIRE.



TEST THE FUNCTIONING OF THE REED RELAY. TAKE A MAGNET CLOSE TO THE REED RELAY. WHAT HAPPENS IN THE COUPLING?



Operating principle of the magnetic switch, the reed magnetically coupled relay:

The switch has two metal blades placed close to each other. A magnet causes the blades to touch and close the circuit. As the magnetic field is removed, the metal contacts bounce apart, and the circuit opens. Where could you use such a switch? Could it be a secret switch that alarms or opens something?



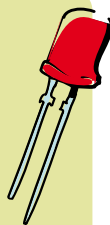
Photocell switch

How are lights turned on in the yard or on the streets when it gets dusky? The theme of the club meeting is to get acquainted with the operating principles of a photocell switch (sometimes also called a PECU) and to come up with different inventions for the switch and its applications.

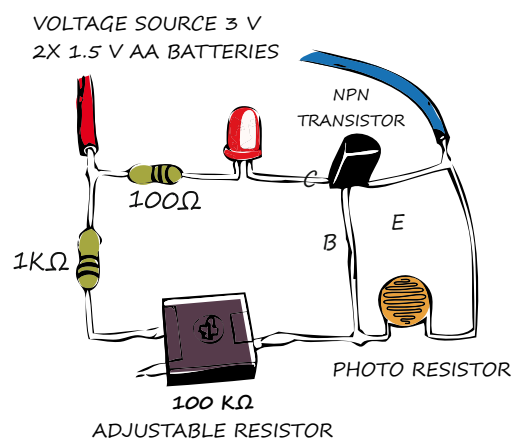
Build a simple coupling as shown in the adjacent picture. The amount of current is limited at the base of the transistor with resistors. Try an adjustable resistor. What happens? A separate 1 k Ω resistor protects the transistor when the adjustable resistance value is 0 Ω . A light dependent resistor (photo resistor) LDR between the base and emitter allows the current to flow through when it is light. In the dark, the resistance of the LDR increases and the base of the transistor is open.

The voltage source can be 3 V, 4.5 V or 9 V. Notice that the rating of the ballast resistor of a LED depends on the power level of the voltage source and the properties of the LED.

LED coupling: The LED's anode (longer leg) is connected to the positive wire (red) and the cathode (often marked by a flat spot in the body of the LED) is connected to the negative wire (blue/ground). With a LED, you have to use a ballast resistor to prevent it from breaking. The resistor value can be calculated using Ohm's law ($R = V/I$). (R =resistance, V =voltage and I =current).



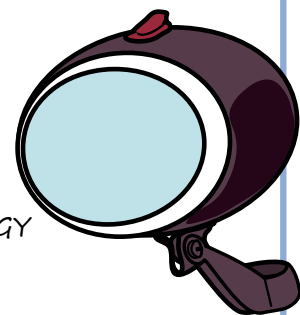
- photo resistors (LDR) and a LED
- resistors
- transistors (e.g. NPN bc547)
- 2 AA batteries per coupling
- battery magazines (2xAA)
- soldering irons and tin solder



Brainstorm

Where could you use a light dependent resistor (LDR) and LEDs? Think about where you could make use of an application utilizing the changes in light intensity? The theme can be, for example, safety. What if there was a device that reacted to light intensity and acted as a safety device? What could it be? Come up with ideas and build your version of such a machine!

AT THE SCRAP
YARD YOU CAN
COMBINE OLD
WITH NEW...
RETRO WITH
THE TECHNOLOGY
YOU HAVE
DEVELOPED!





Getting to know

What is energy? What do we need energy for, or do we need it at all? Where do humans get energy from? How about cars and houses?

Exercise: Think about how you could have cold beverages, a warm shower or charge the battery of your mobile phone at a summer cottage without electricity? Next, we will get acquainted with generating electric power using solar panels and an electric motor.

- solar panels, (5 V / 100 mA)
- solar motors
- supercapacitors (e.g. 10 F / 2.5 V).
- recycled materials for building



...WARM SHOWER...COLD BEVERAGES...CHARGING A MOBILE PHONE BATTERY...

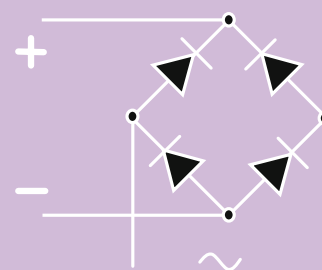


Acquire quality solar panels and solar motors for the club. The energy is stored in a supercapacitor (e.g. 10 F / 2.5 V).

In generating energy, the central aim is usually rotation in the generator. Power plants commonly produce heat which is used to evaporate water. The hot steam is, in turn, used to rotate the generator. In wind power and hydropower, wind and water flow are used directly to rotate the generator. The electric power is transmitted to consumers with power cables.

Capacitors store electric energy quickly, which is a property that is used in many applications. Capacitors are used, for example, to smooth the variation in electric current.

How could you rotate a generator?



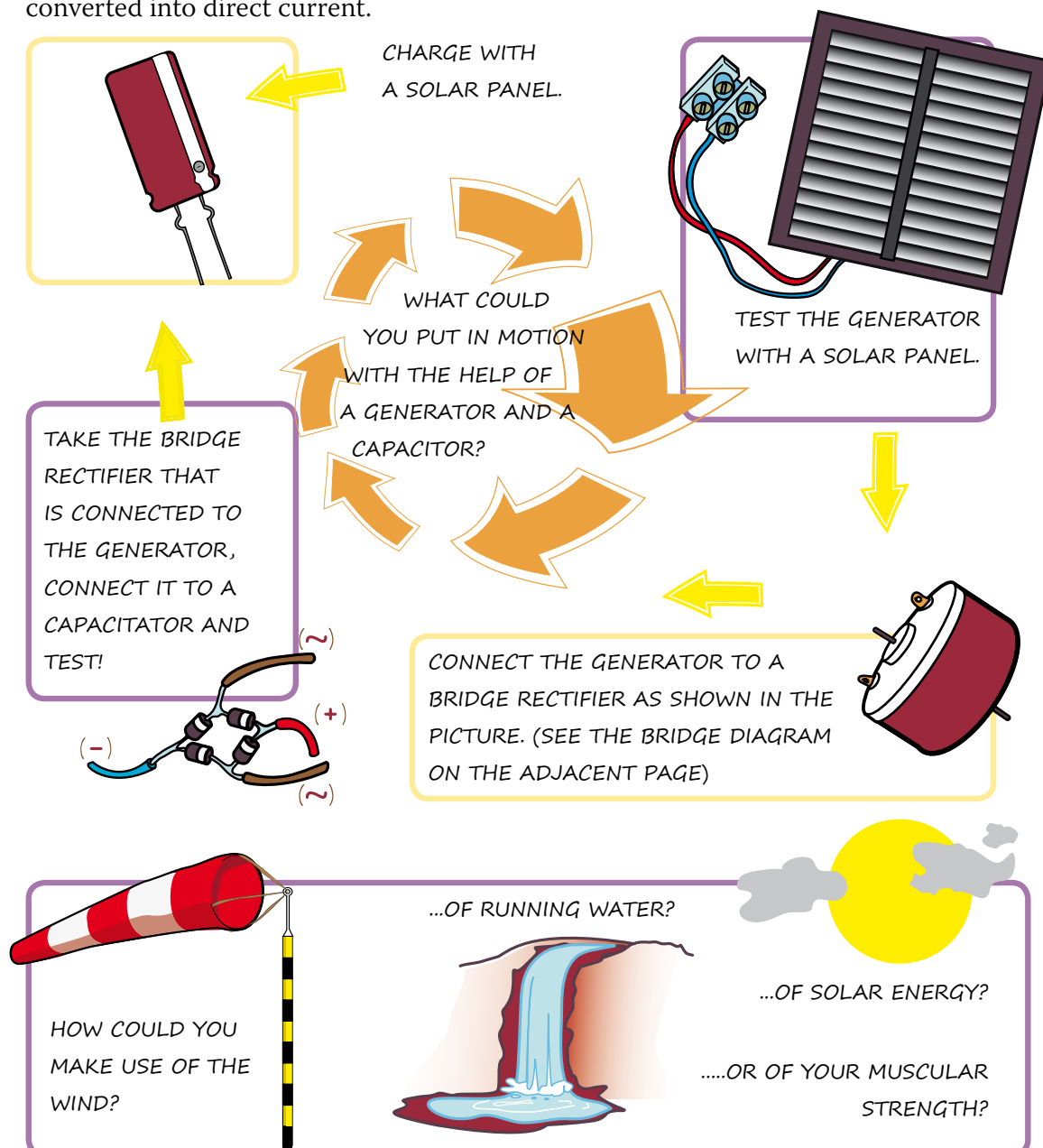
DIODE 1N4001 4 PIECES

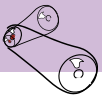
Diode bridge: To charge a capacitor you will need a bridge circuit which converts the alternating current (AC) produced by the generator to direct current (DC).

Wonder motion machine

Build a vehicle that keeps moving as long as possible or moves as far from a given starting point as possible. You can also build a creature that stays put but moves his parts for as long as possible.

Test the functioning of the solar panel by connecting it to a solar motor. You can charge the capacitor with, for example, a solar panel. Connect the capacitor to a solar panel and test! Alternatively, you can charge the capacitor with a solar motor. With a diode bridge rectifier the alternating current produced by the motor (generator) can be converted into direct current.





Toy repair shop

In the scrap yard workshop old toys are examined, disassembled and repaired as well as built into new toys.

Old toys can be painted, combined to others or be used to build entirely new toys (e.g. a teddy bear on wheels). A soft toy that lights up when pressing the nose. You can also examine toys: How do gears work? How is force transmitted to gears?

- mechanical toys
- dolls
- dollhouses and multi-storey car parks

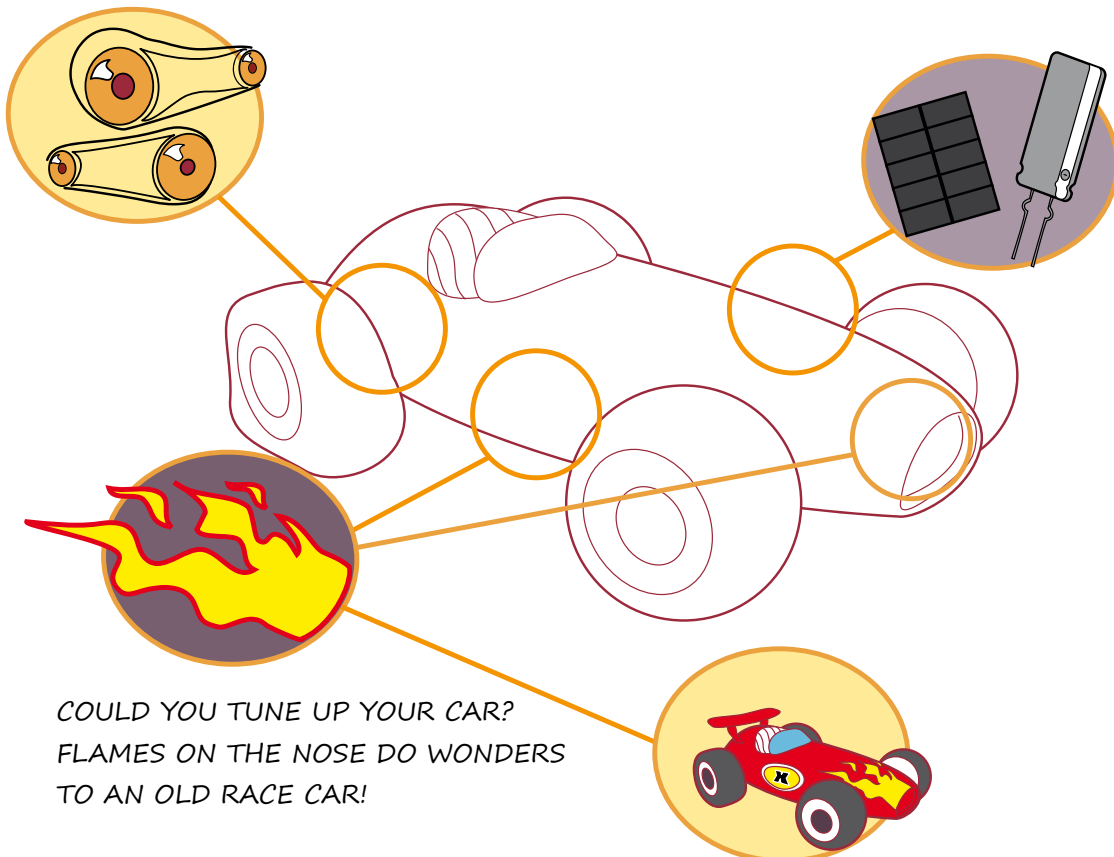


NB!
Devices using
mains current
should not be
disassembled or
repaired!



GET TO KNOW POWER
TRANSMISSION AND REPAIR IT IF
POSSIBLE. COULD YOU FIND SPARE
PARTS FROM ANOTHER CAR?

INSTEAD OF BATTERIES, COULD
YOU USE SOME OTHER SOURCE
OF ENERGY AS A POWER
SUPPLY? E.G. A CAPASITOR
OR A SOLAR PANEL?





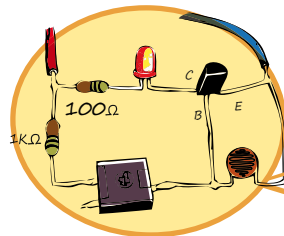
Tuning up a soft toy

Could you build a system into your toy that reacts to changes in the environment? What kinds of changes could it react to and how could it communicate about the changes (see On/Off workshop)? Or could you put your teddy bear in motion or to make movements (see Wonder machines, pages 14–17)?

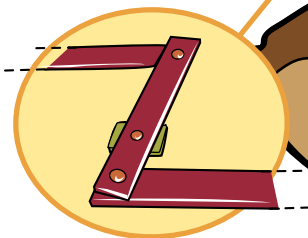


- teddy bears •
- hand puppets •
- soft toys •

HOW WOULD YOU TUNE UP A TEDDY BEAR? COULD YOU ADD FOR EXAMPLE ELECTRONICS TO IT?



COULD YOU MAKE YOUR TEDDY BEAR "COME ALIVE" WITH LEVERS AND ARMS?



COULD YOUR OBJECT BE A PIECE OF CLOTHING OR A BAG? WHAT COULD AN INTELLIGENT BAG BE LIKE, OR HOW ABOUT A NONSENSICAL ONE?

Advice for an inventor

The Foundation for Finnish Inventions provides advice and funding for inventions, it is a helper of all inventors. The Foundation supports and promotes Finnish invention work and the development and exploitation of the inventions. Experts at the Foundation give advice, evaluate inventions and help develop the invention. Assistance is also provided in matters regarding the protection and commercialisation of the invention.

INVENTOR'S CHECKLIST

- DO NOT PRESENT YOUR INVENTION PUBLICLY AT TRADE FAIRS, IN THE MEDIA OR IN WRITINGS BEFORE APPLYING FOR PROTECTION FOR YOUR INVENTION THROUGH INDUSTRIAL PROPERTY RIGHTS, FOR EXAMPLE A PATENT.
- EVALUATE THE ADVANTAGES, TOPICALITY AND MARKETABILITY OF YOUR INVENTION.
- THINK ABOUT THE PROBLEM YOUR INVENTION SOLVES, HOW YOU CAN MAKE A PRODUCT OUT OF THE INVENTION AND WHO WILL NEED THE PRODUCT.
- EVALUATE THE NOVELTY AND PATENTABILITY OF YOUR INVENTION.
- EVALUATE THE TECHNICAL SOLUTION, FUNCTIONALITY, COST EFFICIENCY, COSTS AND FINANCING AS WELL AS MANUFACTURING OPTIONS COMPARED WITH PRODUCTS THAT ARE ALREADY ON THE MARKET.
- CONSIDER WHETHER YOU WANT TO KEEP THE INVENTION TO YOURSELF OR SELL THE RIGHTS TO YOUR INVENTION.
- CONSIDER WHETHER YOU SHOULD DEVELOP THE INVENTION FURTHER OR LET SOMEONE ELSE BE RESPONSIBLE FOR THE DEVELOPMENT.
- CLARIFY WHO OWNS THE RIGHTS TO YOUR INVENTION. IS IT AN EMPLOYEE INVENTION?
- CONSIDER WHETHER YOU WANT TO MANUFACTURE THE INVENTION OR SELL YOUR RIGHTS TO THE INVENTION.
- CONSIDER WHO WILL BE RESPONSIBLE FOR THE FUTURE DEVELOPMENT OF YOUR INVENTION.
- THINK ABOUT HOW TO HANDLE THE SALE AND MARKETING OF YOUR INVENTION.

School children may make employee inventions, for example in their summer jobs, and they have the right to an award or remuneration for the employee invention just as all adults do.

It may be difficult to assess the patentability of an invention without help from experts. However, the novelty of an invention can be examined, for example, by using common search engines on the Internet or the patent database Espacenet which is a free online database and functions similar to search engines. It may be useful to conduct search in different languages. If your invention is clearly different from all the search results, it may be a new invention. In that case, you should contact a specialist for a closer examination and evaluation.



Financing for the development of an invention

From the Foundation for Finnish Inventions, you may receive funding for the protection, product development and commercialisation of your invention as well as help with finding manufacturers and other partners. The goal of the Foundation is to make Finnish inventions successful on the market. Protecting an invention helps in its commercialisation.

Protecting inventions

New inventions and creative and economic activity benefit the society. The society encourages inventors for trade-offs with intellectual property rights: the inventor makes his invention public and in return gets a fixed-term exclusive right to benefit financially from the invention. The exclusive right can be sold or licensed to someone else. After the protection expires, anyone can exploit the invention.

Immaterial property rights, considered a part of intangible assets, are known by the abbreviation IPR (Intellectual/Industrial/Immaterial Property Rights). Such rights include industrial property rights, copyright and domain names. In Finland, industrial property rights are granted by the National Board of Patents and Registration, copyright is administered by the Ministry of Education and domain names are administered by the Finnish Communications Regulatory Authority. Immaterial property rights also protect the products and business operations of creative work even if they do not portray inventiveness as such.

What do rights include?

1. Industrial property rights

Industrial property rights include trademark, design right, utility model, patent and trade name.

Trademark is a symbol that distinguishes goods or services from other similar ones. A trademark can be kept in force by paying a renewal fee every ten years.

Design right protects the appearance of a product. It is a quick and inexpensive form of protection, but does not necessarily provide strong protection. Design right is valid for a maximum of 25 years.

Utility model protects a product or equipment, but not a method. A utility model reminds a patent, but requires less inventiveness and the applications are processed faster. The novelty of an invention is not examined. The novelty of the invention should be ensured in other ways, because utility model rights granted to a previously known invention can be declared invalid. A utility model is valid for 10 years at most. Filing a utility model application grants a similar priority as a patent application and with this priority a utility model or patent for the invention can also be applied abroad.

Patent protects a product, device or method. In order for an invention to be patentable, it has to be novel, involve an inventive step, and be industrially applicable. An invention is new only when it has not been presented in public anywhere. An inventive step means that the invention can not be an obvious solution for a person familiar with the field in question and that it has to be substantially different from previously known solutions. The invention is industrially applicable when it is a functional and feasible solution for a technical problem. Patents are valid only in the country they are granted, but an invention can be patented in several countries. If a registered patent is kept in force by paying annual fees, it is usually valid for a maximum of 20 years from the filing of the application.

Trade name protects the name of a business or a company. A trade name is valid for as long as the company operates.

2. Copyright

Copyright is established to the author of a literary or artistic work without application or registration. There are no requirements for a level of quality or artistic nature. A work within the scope of copyright is an independent and original product of the author's creative work. For example, an object, picture or a text made by a pupil at school can be considered such a piece of work regardless of the age of the creator.

Protection is valid for 70 years calculated from the end of the author's death year. Regarding copyright, related rights (or neighbouring rights) concern the cases where the criterion of originality is not met. Such cases include performances of a literary or artistic work, phonograms, film recordings, radio or television broadcast, registers/tables/databases, and photographs when they are not pieces of creative work. Protection is valid for 50 years after the end of the year they are made.

3. Domain name

Domain names are intangible assets. They are valid for as long as they are renewed.

4. Trade secret

A trade secret is any financially significant information that is kept secret. Keeping an invention as a trade secret is an alternative for other ways of protecting inventions. A trade secret is valid until it is made public.

FOUNDATION FOR FINNISH INVENTIONS



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Materials and tools for Invention clubs

The materials and tools needed are indicative only. The club instructor may also choose other materials than the ones on the list.

- paper (A4, A3, coloured)
- cardboard or cardboard boxes (recycled materials)
- correx/corriflute sheet
- overhead transparencies
- newsprint paper
- extruded polystyrene foam (XPS), "styrofoam"
- brass fasteners (brads)
- paper clips
- toothpicks or skewers, wooden sticks (length approx. 300 mm)
- peas
- glue (all-purpose adhesive or hot glue)
- masking tape
- aluminium tape or kitchen foil
- syringes, silicone tubes
- wire (e.g. Ø approx. 1.6 mm)
- axes (wire, Ø 2 mm)
- tinned copper wire (e.g. Ø 0.8 mm)
- batteries 1.5 V AA
- battery magazine 2xAA
- electric wire (pair cable)
- LEDs (different colours: red, green, yellow, orange)
- resistors (e.g.)
 - 100 Ω
 - 1 k Ω
 - adjustable resistor 100 k Ω
- buzzers
- LDR photoresistor
- transistor, 547B (nnp)
- piezoelectric buzzer (including oscillator circuit)
- capacitor (100 μ F, 16 V or 2200 μ F / 25 V depending on the piezoelectric buzzer)
- magnetic reed relay
- magnets (powerful)
- solar panel (5 V / 100 mA)
- supercapacitor (10 F / 2.5 V)
- solar motor
- diodes (e.g. 1N4001)
- terminal strip
- gears
- belt pulleys
- rubber band
- broken toys from pupils' homes
- polymorph plastics, polymorph
- tuning material (decoration material)
- colours
- materials from previous club meetings
- useless goods (bring pull tabs from tin cans etc.)

Tools

- scissors
- paper cutter
- stapler and staples
- soldering iron and tin solder
- pliers for bending and cutting wire
- low-temperature glue gun and glue (hot glue gun)
- glue (all-purpose adhesive)
- snap-off blade utility knives
- awls
- small screwdrivers
- wire strippers
- electric water boiler (for heating up water)



Creativity and Innovation European Year 2009

The most difficult part of inventing is often finding a problem that needs to be solved. It feels like everything has already been invented, that the world is ready. The aim of this material is to provide teachers and club instructors with tools for creating an imaginative atmosphere and instructing an inventive club.

In the "Let's Invent more" material we get to know the built environment by examining the basic structures in the environment. The knowledge and skills learned are applied in different problem solving exercises or solutions are developed based on own needs.

School clubs provide time and opportunities to find problems, to examine them thoroughly and to come up with creative solutions.



Leverage from
the EU
2007–2013



UNIVERSITY of OULU
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