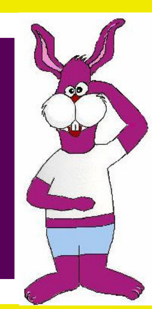
Mediator's handbook

COUNCIL OF EUROPE CONSEIL DE L'EUROPE

SCIENCE ACTIVITIES FOR CHILDREN

Scientific experiments



Council of Europe

Education of Roma children: training of mediators

Scientific experiments

Preamble

DISCOVERING THE LIVING WORLD

EXPLORING THE MATERIAL WORLD

RENEWABLE ENERGY SOURCES

PREAMBLE

This handbook is both **a compilation** of the activities proposed in the teaching kit (the experiments and topics suggested are not all necessary to acquire the relevant skills) and **a training tool** to enable "new" mediators to be familiarised with them.

This document charts the different stages of the activities proposed on the activity sheets contained in the kit. It should be borne in mind, however, that this document is an aid which has its limits : "**teaching someone**"or "**doing an activity with children**" is a skill and a human experience which it is difficult to express in writing.

This "handbook" is therefore not a set of instructions to be strictly adhered to, but an introduction to science activities for young children. To be fully familiar with an activity it is essential to have training , observe the activity conducted by someone with experience, practise it and, if appropriate, meet the teacher.

Each activity consists of three parts:

- the **aims** of the activity and relevant educational information,
- the **implementation** of the activity, outlining the chronological stages and the necessary prerequisites for engaging in certain activities,
- the **skills** which the children (or any other participant) will acquire on completion of the activity.

Education des enfants roms en Europe
Education of Roma children in Europe

ACTIVITY No. 1

"GROWING TOMATOES"

CULTIVATING PLANTS
- Sowing
- Watering
- Providing light

OBSERVATION NOTEBOOK (to be filled in)

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

Tomatoes are plants; they are living things. Once they are sown and watered, the seedlings begin to grow. The hairs on the roots draw in water and the tiny nutrients present in the earth. This is crude sap.
The sap nourishes the whole plant. Like us, the plant breathes day and night, using the oxygen in the air. It also sweats, because some of the water that is absorbed is given off again through the leaves.

For older children:
Chlorophyll colours the leaves green. It uses light as energy to change carbon dioxide (invisible but present in the air) and the water drawn in by the roots into sugar or nutritive sap. The plant then gives off a different gas: oxygen. This is photosynthesis.

AIMS:

- Learning to sow and care for seedlings.
- Knowing that plants are living things.
- Understanding the stages in growth, from seed to plant.
- Teaching children to record the activity in the form of simple drawings with captions and dates.
- Informing (older) children about the process of photosynthesis.

MATERIALS:

Tomato seeds, watering can, stakes, notebook, crayons.

PROCEDURE:

The children experiment with growing a plant. They observe its development "from seed to plant": sowing, planting, watering, germination, picking. They communicate their findings by means of drawings that everyone can understand.
Using a technological approach, they are able to carry out a project.

IMPLEMENTATION:

Stage I: Presenting the activity,
Identifying and describing the materials

Tell me what you can see on the sheet. If the child takes a long time to answer, the question should be rephrased

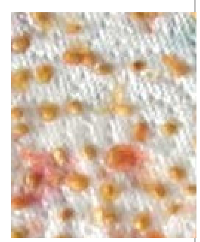
Name what you can see on the image! (showing him the differents images)

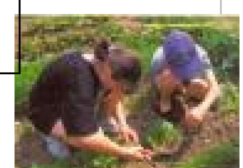
> ***At nursery school, the important thing is that children should identify and name what they see.***

- ***Have you any seeds in the box? Show them to me! Are they the same as the ones you just saw on the sheet?***

A question to be asked:

- ***How can you find out what a seed contains?*** (by growing it)

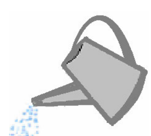




Stage II: Sowing the seeds

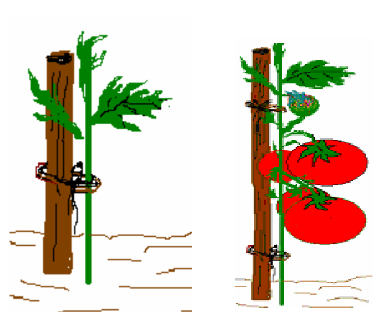
Soak the seeds in water for 15 minutes.
Prepare a hole large enough for each seedling.
Put the seedlings in the holes and cover them over again.

Water the seedlings regularly



Stage III:

Plant the stake outside the hole, just on tl
Attach the seedling to the stake as it grov



With children over 7

Stage I: Recording initial ideas about seeds

The children draw what they think they will find inside a seed. Some of the seeds are opened up. Using a magnifying glass, they then compare what they see with their drawings

Stage II: Demonstrating the "medium" for germination

In buckets, the children set out different media (sand, compost, gravel, cotton, salt, dead leaves, paper, water etc.).

An experiment record is kept to find out which medium is the best for germination.

Stage III: Demonstrating the importance of water and light as factors in germination

Together with the children, different possible combinations of water and light are identified:

- with and without light,
- with and without water.

The children then place the germinating seeds in the different combinations.

The children observe how the plants develop, at regular intervals draw how the seedlings are evolving under the varying conditions, and decide which is the most favourable environment.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO …

1. Identify the stages of development of a plant.

2. Reconstruct a picture of a plant from the separate parts.

3. Recognise manifestation of plant life and relate them to major functions: growth, nutrition, reproduction

ACTIVITY NO. 2

"OBSERVING BUTTERFLIES"

MORPHOLOGY
- Preserved butterflies and chrysalises
- Observation through a magnifying glass (questions)

THE LIFE CYCLE OF THE BUTTERFLY
- Observation of butterflies in nature
- Classification of enlarged images

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:
A butterfly is an insect, just like a wasp or a bee. Unlike many other insects, it does not bite or sting, nor does it carry disease.
The adult butterfly, the fully developed insect, has four wings, three pairs of legs, two large compound eyes and two antennae.
Unlike other insects, it undergoes a number of transformations that totally change its appearance and behaviour. From birth to death, it lives through four different forms: egg, caterpillar, chrysalis (pupa) and adult insect.
These changes are called: METAMORPHOSIS

AIMS:
- Understanding the morphology of the butterfly.
- Knowing that butterflies are insects.
- Learning the stages in the metamorphosis of a butterfly.
- Teaching children to record observations from nature by producing simple drawings with captions and dates.
- Telling (older) children about the danger of some species disappearing, and making them aware of the need to protect these insects.

MATERIALS:

Preserved butterflies and chrysalises, magnifying glass, illustrations, notebooks, pencils.

PROCEDURE:

The children observe the preserved insects. On the sheet, they look at the metamorphosis of the butterfly: egg, caterpillar, chrysalis (pupa), butterfly. They look for butterflies in different stages of development in nature. They communicate their findings by means of drawings.

IMPLEMENTATION:

Stage I: Presenting the activity,
…Identifying and describing the materials,
… Observing preserved butterflies.

A butterfly has four wings, three pairs of legs, two large compound eyes and two antennae. The mouth parts, designed for sucking, are equipped with a tube rolled up in a spiral that is used to suck up nectar from flowers.
A butterfly is an insect just like a wasp or a bee. However, unlike others, it undergoes a number of transformations that totally change its appearance and behaviour: metamorphosis.

At nursery school, the important thing is that children should <u>identify</u> and <u>name</u> what they see

Stage II: The stages of the metamorphosis

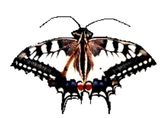
<u>The egg</u> is the first stage in the life of every insect. Eggs may be laid singly or in small groups. Many butterflies, especially nocturnal species, lay hundreds of eggs among small pebbles, in compost, or in holes or cracks in the ground.

Butterfly eggs, which are tiny but can be seen with the naked eye, have a hard outer covering that is less resistant at one particular point so the larva can make its way out. It is possible to tell from looking at eggs which species of butterfly they will be, since they are all different in shape, colouring and markings. This stage lasts about 2 to 3 weeks, but it may last all winter in the case of some species.

<u>The larva or caterpillar</u> 

The larva or caterpillar, which is like a worm and has no wings or compound eyes, is an insatiable eater. It has six legs on the thorax, and the abdomen has a varying number of appendages or false legs.
It grows very quickly and, having shed its skin between 2 and 17 times, it looks for a nest; it stops eating and makes no further movement. The salivary glands start functioning, secreting long strings of silk, which the larva wraps around its body, and which harden in contact with the air. The caterpillar has then turned into a pupa.

<u>The chrysalis (pupa)</u>
The pupa is surrounded by a brown, grey or sometimes green protective covering, which gives some indication of its shape. It sleeps in this cocoon, safe from all enemies, but its cells work unceasingly, and an adult insect will be formed after a few days. The chrysalis stage lasts one or two weeks or may extend throughout the winter or, in exceptional cases, for as long as four years.



<u>The butterfly</u>
When it has finished resting, the chrysalis will have turned into a butterfly; it breaks the covering with what seems like a huge effort; it takes several hours before the animal emerges into the open air, still damp and limp, with crumpled wings. Within a short while, the butterfly will have reached its final size and appearance. The adult has four wings, three pairs of legs, two large compound eyes and two antennae. The mouth parts, designed for sucking, are equipped with a tube rolled up in a spiral that is used to suck up nectar from flowers. During its few hours or days of life (depending on the species), it will lay eggs continually.

Stage III:

Life span

The first butterflies appear in the sunny days of March. They increase in number until June. This is the first generation, which will lay eggs and then disappear.
They are less numerous in July and August, but they can still enchant us on fine days in September and October. These are second generation butterflies. They are the ones that ensure the species survives the harsher weather. They may do so in two ways:
- the adults may lay eggs in sheltered places – the crack in the bark of a tree, a hollow stone, household linen – and then die. Their eggs, protected from the cold by a thick covering, will hatch on the first sunny days of spring.
- butterflies may find shelter in an attic, a window-shutter or a hollow tree. They will lay eggs in the spring, thereby ensuring survival of the species.

Protection

Butterflies were already around when the Earth was inhabited by dinosaurs.

Unlike many other insects, they do not bite or sting, nor do they carry disease. They are the most easily identifiable of insects.

The vast majority of diurnal and nocturnal butterflies have “eye spots”. When predators see these eye spots, they attack them, thinking they are real eyes, yet only tear off part of the wing. When at rest, the upper wings are hidden, and when the butterfly feels threatened by an enemy, it opens its wings. The eye spots take the assailant by surprise, and it flees.
Camouflage is a technique often used by nocturnal butterflies. These are often chestnut brown in colour, which allows them to be mistaken, when at rest, for the bark of a tree. Other butterflies are the same colour as the leaves of a particular species of tree.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. reconstruct a picture of a butterfly from the separate parts
2. identify the stages in butterfly development
3. describe the conditions necessary for the development of a butterfly
4. recognise manifestations of life animal and relate them to major processes: growth, nutrition and reproduction

For those over 7

Stage I: Recording initial ideas about the morphology of the butterfly.
The children draw a butterfly as they imagine it. Having observed a preserved butterfly, the children then, with the aid of a magnifying glass, compare their drawings with the real thing.

Stage II: The stages of metamorphosis

The children are given the task of finding butterflies in nature, in the different stages of metamorphosis, and of monitoring their development.

A record is kept of their observations: the experiment notebook is filled in.

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Stage III: <u>Life span</u>

There are various sorts of butterfly. Currently, 150,000 species are known, spread more or less throughout the world. In Central Europe, there are 4,000 species of butterfly.

<u>Protection</u>

Butterflies are under increasing threat of disappearing. It is important to realise that each butterfly has a particular environment to which it has adapted. If one element in this is changed, the butterfly will die, with the result that its species may vanish from the Earth. If they are to be protected, there must be an end to the destruction of their habitats that has taken place in recent years: the meadows, forests, marshes and so on, known as biotopes by experts, are being replaced by artificial places – houses, polluted suburbs, fields full of fertiliser and other chemicals – that are totally unlike what was there before. In addition, some butterflies are caught by collectors: if you see a butterfly, do not pick it up unless you are sure it is dead. Here are some steps that everyone must take to preserve butterflies:

- Maintain lawns
- Stop using pesticides
- Stop using fertiliser when not absolutely necessary
- Do not build near the few places where the last butterflies live.

ACTIVITY N°3

"DRAWING AN ANT"

MORPHOLOGY
Observing an ant through a magnifying glass (questions)
Model or enlarged pictures
Ant hill

QUESTIONNAIRE (form to fill in)

AGE :
5-7 YEARS (or from age 5)

INTRODUCTION:

The body of an ant is in three parts: head, thorax and abdomen. Ants have six legs. The legs are joined to the thorax: three on one side and three on the other. All six-legged creatures are insects.

A knowledge of ant morphology makes it possible to produce a drawing in line with the instructions given in an activity book.

AIMS:

- Understand ant morphology.
- Learn that ants live in a community.
- Learn that ants have six legs.
- Produce a simple drawing.

MATERIALS :

Preserved ants, magnifying glass, illustrations, notebooks, crayons.

PROCEDURE:

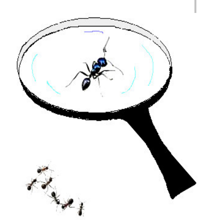
The children should be given time to study the problem so that they can suggest solutions to it and try them out. They will then compare their solutions and analyse the different operations involved. They will try to communicate their findings by representing them in the form of a drawing that everyone can understand.
A technological approach enables them to carry out a project.

IMPLEMENTATION:

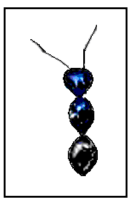
Stage I : Presentation of the activity
Identification and description of the materials
Observing a preserved ant

- Tell me what you see on the sheet. If the child takes a long time to answer, the question should be rephrased.
- What can you see in the picture!…. (while pointing out the magnifying glass, the ants, Isidor's thoughts in the "thought balloon"…)
- Are there ants in the box ? Show them to me!
- Are they alive? Why?
- Is there a magnifying glass in the box? What is it for ? What would you do with it ?

In the drawing, you point out to the child the size of the ants seen through the magnifying glass… (The magnifying glass enlarges the picture or the object to be observed)



Stage II : Observation and description of an ant's morphology



- Look at this drawing! What can you say about the ant? Is something missing? (yes, its legs…)
- Draw its legs!
- If the child hesitates, his/her attention should be drawn to what is shown on the activity sheet: look with the magnifying glass, observe the ant and count its legs…
- If the child draws the ant's legs, he/she should be asked to observe the ant through the magnifying glass and to check how many legs there are and what part of the body they are attached to.
- Using the magnifying glass, observe the ant's legs!
- How many parts is its body made up of? (three: head, body, abdomen)
- To which part of the body are the legs attached? (the abdomen : three on each side)
- Now you know how to draw the legs!

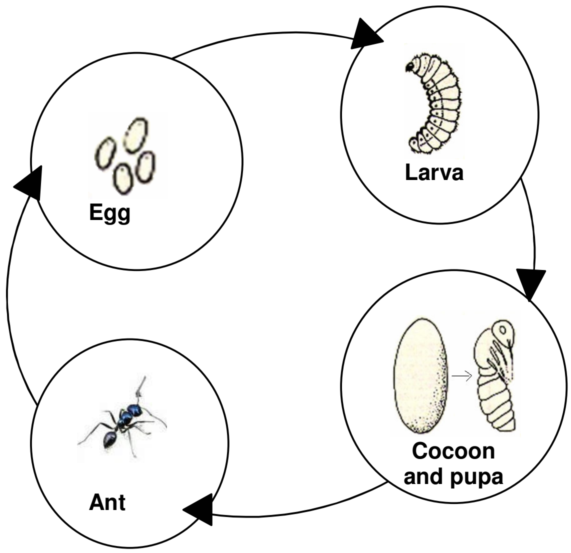
At nursery school, the important thing is that children should <u>locate</u> and <u>name</u> what they see..

Stage III : ***The life cycle of an ant***

- Do you know how ants reproduce (are born)? (let the child suggest several possibilities and then show him/her the sheet…)

The mediator should "read" each picture with the child….

The queen ant lays **Eggs**, which become **Larvae**, which become **Cocoons**. The **Pupa** inside each cocoon turns into an ant …



Observation and description associated with the naming of animals are the opportunity to draw attention to the major life processes: growth, nutrition and reproduction.

Suggestions for an unsupervised activity (if the season and the environment permit)

– ***Look in the playground and try to find some real ants. What are they doing ? Where are they going ? (to the ant hill)***
– ***Look for an ant hill… Observe it carefully…***
– ***When I come back you will show me the place where you made your observations…*** *(give the children a time-limit, suggest a timetable…)*
– ***If you like, together we are going to reconstruct the life cycle of an ant…*** *(show a photo album with photos of ant hills, ants etc), etc.)*

The main thing is to identify some of the features common to animals, to become aware of the diversity of the world we live in…

SKILLS:

ON COMPLETION OF THE ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. reconstruct a picture of an ant from the separate parts ;
2. remember the stages in the life cycle of an ant ;
3. describe the conditions necessary for the development of an ant;
4. recognise manifestations of animal life and relate them to major processes : growth, nutrition and reproduction;

ACTIVITY N°4

" WHAT IS A LIVING THING?"

CHARACTÉRISTICS OF LIVING THINGS
Observing living things in nature
Analysing pictures

QUESTIONNAIRE (form to fill in)

AGE :
5-7 YEARS (or from age 5)

INTRODUCTION:

On Earth there are living and non-living things. How can you tell them apart?
Living things need food, water and oxygen.
All living things are born, grow, reproduce and die.
A knowledge of the characteristics of living things provides an introduction to classification.
Children fail to recognise some life forms as such (plants, mushrooms etc); a knowledge of the characteristics of living things makes it possible to identify them as such and respect and/or protect them.

AIMS:

- Discover the world around / learn about the immediate environment.
- Understand the characteristics of living beings.
- Learn to observe: realise that there are different forms of living things in their familiar surroundings.
- Learn to compare and respect living beings.
- Introduction to classification

MATERIALS :

The world around, illustrations, notebooks, crayons.

PROCEDURE:

- Individual observation: open workshop (walking about)
- Saying and showing: demonstration, collective explanation
- Handling: individual and collective

IMLEMENTATION:

Stage I : Presentation of the activity
Description of the activity sheet

– On Earth, there are living and non-living things.
– How can you tell them apart? (…)

The different aspects of the discovery of living things can only be approached from real-life situations and observation satisfying children's curiosity.

Stage II : Identifying the characteristics of living things

– When you are looking at something and wondering if it is a living thing, ask yourself the following questions :

Does it eat ?

Does it drink ?

Does it breathe?
Can it have babies or reproduce?
Does it grow?
Can it die?

- *Is an ant a living thing? Why ?*
- *Are flowers living things ? Why ?*
- *Give me another example of a "living thing".*
- *Give me an example of a non-living thing*

The mediator should help the child to answer the questions using the questions set out above.

Observation and description associated with the naming of animals are the opportunityto draw attention to the major life processes: growth, nutrition and reproduction.

Stage III : The needs of a living being

A living thing needs to: **breathe, eat, drink…**

- ***What do you need to live?***
- ***What about flowers ?*** *(what do they eat?...)*
- ***What about dogs?*** *(do they drink?...)*

The main thing is to identify some of the features common to animals, to become aware of the diversity of the world we live in …

When you are a living being you are born, you grow, and one day you can have babies…

Suggestions for an unsupervised activity (if the season and the environment permit)

- Measure your height (by making a mark on a doorframe) several times during the year and compare the marks
- You can do the same for your brothers and sisters
- When I come back I will ask you to name the things around you which are living and those which are not (set a time-limit, suggest a timetable…)

- If you like we can complete the second sheet together…
  (show the sheet with the table, cf activity sheet)

The recording of observations in writing (or in the form of drawings) is an attempt at representation and helps to memorise knowledge, identify causal links etc…

The mediator should discuss the completed sheets with the child.

Together with the children he/she should analyse all the completed answers in the table, repeating for each picture the conditions necessary for life.

In the course of these exchanges with the adult, an orderly pattern of questioning, clear representations and, ultimately, knowledge will take shape.

The mediator should show the children pictures from books, putting the emphasis on growth (to give an idea of "*passing time*").

The recording of the size of a living being creates a sense of the "now" and makes it possible to compare the "before" and "after", identify causal links and become aware of relationships in time and space.

SKILLS :

ON COMPLETION OF THE ACTIVITY THE CHILD SHOULD BE ABLE TO…

1. describe the necessary conditions for the development of a living being;
2. remember the order of the stages of life;
3. recognise the manifestations of animal life and relate them to major processes: growth, nutrition, reproduction;
4. express and understand the oppositions between present and past and present and future by making proper use of temporal and chronlogical indicators;

ACTIVITY N°5

"THE WATER CYCLE IN NATURE"

THE STATES OF WATER IN THE NATURAL ENVIRONMENT
Identifying water in the natural environment
How it changes state

AGE :
5-7 YEARS (or from age 5)

INTRODUCTION:

By comparing tap water, rain, snow and ice, children will achieve a first, very modest level of abstraction and understand that these diverse realities relate to a single substance: water.

In the natural environment, water is constantly changing from one state to another: raindrop, groundwater, water vapour, condensation…
These changes are known as: THE WATER CYCLE IN NATURE

AIMS:

- To be familiar with the water cycle in nature.
- To know that a droplet of water can change and go from one state to another (liquid, solid, vapour).
- To be familiar with the different states and forms of water in nature (lakes, seas, dew, snow, glaciers…)
- To teach children to record their nature observations in the form of simple drawings with captions and dates.
- To inform (the older) children about the risks of water pollution and build an awareness of sustainable development

MATERIALS :

Fact-sheets, pictures representing the water cycle in the immediate environment, notebooks, pencils and crayons.

PROCEDURE:

The children will observe water in nature.
They will observe water's changes of state on the fact-sheet. They will carry out simple experiments with an adult.
They will present their findings in the form of drawings.

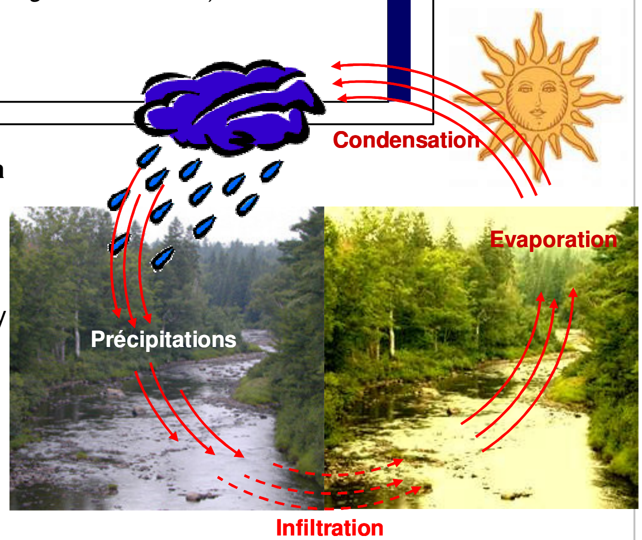
IMPLEMENTATION:

Stage I : Presentation of the activity
Observing the diagram

- Say what you can see in the picture !...
(point out the rainy landscape and the cloud, the sunny landscape and the sunl).

Look at the arrows in the photo; they show the " journey" of a droplet of water in nature…. (point out the drops falling from the cloud).

Stage II : Charting the "journey" of a droplet of water



- Look at the arrows in the photo ; they show the journey of a droplet of water in nature…. (show the drops falling from the cloud).
- Where can the droplet fall? (in the river or on the land…).

- When it's hot, what can happen to the droplet? (make an analogy with water boiling on the stove).
- What about clouds ? What happens when there are a lot of clouds?

Concepts to be introduced and explained : precipitation, infiltration, evaporation, condensation. The mediator could perform simple experiments to show water's changes of state: boil some water, observe the steam, observe the condensation on the lid (material needed: stove, recipient with water, lid and ice cubes).

By playing and observing, children build up an initial fund of knowledge. They describe their experiences, put their actions into words, listen to the teacher when he/she comments on them and discuss them with him/her.

Presentation of the activity sheet "Drawing the water cycle in nature" (cf. sheet n°5).
The child should use simple drawings to complete the "journey" of a droplet of water in nature.

Drawings and pictures are aids to discussion, attempts at representation, which are in turn subjects of discussion.

Stage III : Water's different states in nature

In nature, water can be found in different states and forms: snow, lakes, the sea, rivers, dew, clouds, snowflakes, rain etc… The children will observe the drawings illustrating some states in which water is found (cf. sheet n°5). They will name others if they know any; they will be given the opportunity to draw water in its different states.




- Have you ever seen a lake? When ? Where? (if not, show a photo of a lake).
- Have you seen the sea? (if not, show a photo of the sea…).
- Have you ever seen a river?
- Do you think a droplet of water could go to all these places?
- Look at all the forms it can take! …
  (show the children and ask them to name the different states of a droplet of water – which are on the same sheet: dew, clouds, a snowflake, rain).

In the course of these exchanges with the adult, an orderly pattern of questioning, clear representations and, ultimately, knowledge will take shape.

Make a notebook with the children in which they will be able to note down their observations as they make them :

- rainwater,
- water in a fountain,
- water evaporating (when it boils),
- droplets on the lid (condensation).

The written recording of observations (dictated to an adult) helps to memorise knowledge, become aware of relationships in space and time and identify causal links.

SKILLS :

ON COMPLETION OF THE ACTIVITY CHILDREN SHOULD BE ABLE TO…

1. describe the water cycle;
2. describe the necessary conditions for evaporation and condensation to take place and for snow to form;
3. recognise the different forms that a drop of water can take and relate them to the major stages in the cycle: precipitation, infiltration, evaporation and condensation.

For children over 7…

For a long time, people showed little concern for their natural environment, using natural resources unsparingly, developing at breakneck pace and discharging waste of all kinds on a wide scale. The situation today is dramatic. Whole regions have been devastated and many rivers, lakes and groundwater basins across the world are now polluted, a pollution not easily absorbed by the natural environment.

When does water pollution occur? Where do the pollutants come from?
What are the risks to aquatic environments?

Water is said to be polluted when its balance has been altered on a long-term basis by an excessive influx either of substances that are toxic in varying degrees, of natural or man-made origin, or of water that is too hot. This pollution can lead to dangers of various kinds: increased mortality of some animal and plant species, sometimes to the point of making them extinct, impairment of their physiological capacities, or deterioration of water quality, to the point of making it unfit for certain uses, such as human consumption.

To prevent and combat the general deterioration of these ecosystems, it is important to identify and assess the effects of the different sources of pollution and of all the changes which the physical environment may undergo.

This pollution may be permanent (domestic waste in large cities, for example), periodic (seasonal increases in discharges due to tourism, flooding etc), or accidental or acute, caused by spills of toxic substances of industrial or agricultural origin, or leaching of soil in urban areas following heavy rain.

How can water be protected ?

Having access to sufficient quantities of good-quality water is one of the major challenges of the 21st century. What can be done to meet this challenge ?
There are two possible courses of action :

Reducing consumption and limiting wastage
The most direct way of saving water is to reduce consumption. From now on, everyone – farmers, industry, households – will have to pay attention to how they use water, being careful not to waste it or misuse it.

Recycling
Another way of saving water is to recycle it : the same water can be used several times for different purposes, or even for the same purpose.

" HOW TO MAKE WATER CLEAR"

CLEAR WATER AND DIRTY WATER

Building a water filter
How to maintain a water filter

AGE :

5-7 YEARS (or from age 5)

INTRODUCTION:

To get clear water you have to allow it to settle and then filter it.

- You have to allow it to settle so that any dirt in it is deposited at the bottom of the jar.
- Filtering the water involves pouring it through a water filter.

To build a water filter you need: charcoal, sand and two buckets.
To have a clean filter you have to replace the charcoal roughly every two weeks because the pollutants gradually contaminate the charcoal.

AIMS:

- To know the difference between clear and dirty water.
- To learn that clear water is not always fit to drink.
- To know the stages for getting clear water: settling and filtering.
- To build a water filter with adult supervision.
- To learn to "read" a plan for building an object.
- To teach children to record experiments in the form of simple drawings with captions and dates.

MATERIALS :

Two buckets, charcoal, a sharp object to make holes, dirty or muddy water, the sheet showing the stages in the building of the filter, notebooks, crayons.

PROCEDURE:

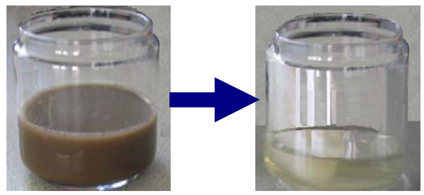
This activity requires the supervision of a mediator or other adult. The children will observe the clear water and the muddy water. They will be encouraged to suggest ways of obtaining clear water.
The building of a water filter will be suggested. The children will follow the stages in the process on the relevant sheet. Together with an adult, they will conduct simple experiments. They will report their findings in the form of drawings.

CONDUCT:

Stage I : Description of the activity
Observing two receptacles containing water

- Because of heavy rain, the tap water or well water is dirty. How can the dirty water be cleaned?

Take some muddy water and ask the children to make it clean.



Stage II : The children's suggestions for cleaning the water
Testing the suggestions

Suggestion from Group 1 : To clean the water, it must be boiled.

Materials - dirty water
- a kettle
- transparent glass jars

Some of the water is placed in a glass jar for checking after the experiment. The rest of the water is put in the kettle and boiled. When the water boils, its level goes down.

The boiled water is poured into another glass jar. To check whether the water is cleaner after being boiled, the children are asked to compare the two jars : the water is dirtier than before.

<u>Conclusion</u> :
Boiling water doesn't make it cleaner. It simply kills the germs. To make the water clean you have to filter it. When the water boils, some of it evaporates, but the dirt remains. There is less water but as much dirt as before, so it is darker.

Suggestion 2 : To clean the water, you have to filter it.

Materials : - muddy water
- a "home-made" filter (coffee filter, cotton etc)
- transparent glass jars

Some of the water is kept in a glass jar for control purposes. The filter is placed over another jar and the water is poured. To begin with the water flows freely, then it stops. To make it go faster, you press on the filter or you blow.

The two jars are compared. In the second one the water is clearer but not yet clean. You have to repeat the procedure with another filter to make the water cleaner.
<u>Conclusion</u> :
The more the water is filtered, the cleaner it becomes. The procedure would need to be repeated several times to get water that is very clean, or a more effective filter would have to be made.

Stage III : Building a water filter

Materials - two buckets
- sand
- charcoal

Make a few holes in the bottom of one of the buckets. Check that the water can go through but not the sand.

Wash the sand 5 or 6 times : mix it with your hands.
Break the charcoal into small pieces.

Place a layer of sand 5 cm thick in the bottom of the bucket and cover it with a layer of charcoal 8 cm thick. Add a layer of sand up to 10 cm from the edge of the bucket
The filter is finished.

Cleaning the filter before using it for the first time.
The water should start to run into the bottom bucket, at the rate of roughly half a litre per hour. At first the water will probably be black, containing a great deal of charcoal dust. After about an hour the water will become clear
The filter will then be ready for use.

USING THE FILTER :
First make sure that the water poured in the filter has been left to settle for long enough. Then pour the dirty water gently into the filter. The bottom bucket will fill up with clean water.

The experiment takes a long time. At the end of the morning (3 hours later) the filter is finished, has been cleaned and is ready for use. By the end of the day all the water has run into the second bucket.
In the first bucket, only the dirt is left. All the water has gone through.
Maintaining the filter
The charcoal needs to be replaced more or less every fortnight. The pollutants gradually contaminate it. The water is much cleaner, but it is still not very clear. The procedure would need to be repeated for the water to be completely clean.

Clean water and drinking water
It is important not to confuse clean water and drinking water. Clean water is clear, but it may not be fit for drinking.
If I put sugar in water, it’s clear and it’s nice to drink.
If I put salt in water, it’s clear but it’s not nice to drink.

SKILLS :
ON COMPLETION OF THE ACTIVITY THE CHILD SHOULD BE ABLE TO…

1. remember the stages in the construction of a water filter
2. distinguish between clear and dirty water;
3. recognise the settling process.

ACTIVITY NO. 7

"CLEAN WATER IS TRANSPARENT"

CLEAN WATER AND DRINKING WATER

Clean water is transparent
How to maintain a water filter

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

Clean water is water which is clear, but that does not mean it is drinkable.
Drinking water means water that is safe to drink.
Beware! Clean water should not be confused with drinking water: both may be "clean" and clear, but they are not always fit to drink.

Water may contain products that change its taste and quality while still being transparent.

AIMS:

- Knowing the difference between clear water and drinking water.
- Knowing that clear, transparent water is not always fit to drink.
- Carrying out simple experiments to change the taste of water.
- Teaching children to record the experiments carried out in the form of simple drawings with captions and dates.

MATERIALS:

Drinking water, transparent glasses, sugar lumps, salt, washing-up liquid, something to mix with (spoon, small stick etc.), the sheet setting out the different experiments, notebooks, pencils.

PROCEDURE:

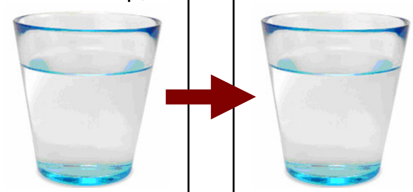
This activity should be carried out only under supervision (with the mediator or another adult). The children observe clear, transparent and drinking water.
They are asked to put forward hypotheses about its qualities: Is it fit to drink? Where is it from? How might its taste be changed while it still remains clear?
The children carry out simple experiments with an adult.
They communicate their findings by means of drawings.

IMPLEMENTATION:

Stage I: Presenting the activity,
***Observing two glasses of water*.**

- Is this water fit to drink? (Yes) How can we be sure? (It's from a tap, from a well, from a bottle).

  Water that is fit to drink is colourless and transparent.
-



Stage II: Clear water and drinking water; *Experimenting, testing hypotheses*

If we do not know where clear water comes from, it may contain ingredients that change how it tastes. How might the taste of water be changed?

Hypothesis of Group 1: Add sugar.
Materials - drinking water
- sugar
- a spoon to mix with

The children are asked to taste the water from two glasses before the experiment. It is suggested that they should carry out the experiment by following the activity sheet (a drawing showing the mixing of sugar with water). Once the sugar dissolves, the children are asked to taste the water contained in the two glasses again. The water in the two glasses is no longer the same. The children are asked to shut their eyes; the position of the two glasses is changed, and they are asked to identify the glass containing the water with added sugar.

<u>Conclusion from the experiment:</u>
Water is transparent. We cannot know how it tastes unless we taste it. In order to drink it, and sometimes even to taste it, we have to be certain where it came from.

The same experiment is repeated using salt. If I put sugar in water, it is clear and nice to drink. If I put salt in the water, it is clear but not nice to drink.

Hypothesis 2: Water is prepared for washing up.
Drinking water is mixed with clear washing-up liquid.

<u>Conclusion from the experiment:</u>
This water cannot be tasted because it is no longer drinkable! Drinking it would give us stomach- ache, or might poison us if the product is dangerous.
Clean water and drinking water.
Beware! Clean water must not be confused with drinking water. Clean water is water that is clear, but it may be undrinkable.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. distinguish between clear water and drinking water;
2. formulate hypotheses and test them;
3. know how to carry out simple experiments.

ACTIVITY NO. 8

"DRINKING WATER"

FINDING DRINKING WATER AND MAKING WATER DRINKABLE

How to make water drinkable
Identifying drinking water

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

Drinking water is water that must fulfil a number of criteria that render it fit for human consumption. Drinkable water can be found in nature: rain water, spring water, water from a well, a fountain, etc.

If we are not sure of its quality, we can make it drinkable:
- by boiling it
- by purifying it in the sun

AIMS:

- Learning to make water drinkable by boiling,
- Knowing that water can be made drinkable by solar treatment,
- Knowing that rain water is drinkable.

MATERIALS:

A container for boiling water, water, lid, activity sheet.

PROCEDURE:

The children put forward suggestions for identifying sources of drinking water. They "read" the activity sheet and experiment to obtain drinking water by boiling.

IMPLEMENTATION:

Stage I: Presenting the activity

Drinking water is found in nature: tap water, still water bought from a shop, spring water, water from a well, a fountain, etc. However, in times of flooding, or in periods of drought, drinking water has to be obtained by other means.

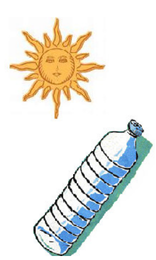
You are going to suggest different ways of getting water that is fit to drink. You will test your ideas and record them in the notebook.

Stage II: To obtain drinking water:

In order to get drinking water, I can suggest several experiments for you to note down in your notebook:

- When it is raining, stand a carefully cleaned container outside to collect **rain water**. People can drink this water without danger since it contains neither micro-organisms nor toxic chemical products. In some parts of the world, a tree called the traveller's tree has small receptacles between its leaves from which it is possible to quench one's thirst.
- You can also get drinking water by **boiling** clear **water**. Let it cool down again thoroughly so that it is all right to drink. It is strongly recommended that water from rivers, pools, etc., is boiled in order to avoid contamination by bacteria. This method does not prevent the presence of toxins. To get rid of deposits and particles in suspension, you can try to decant the water, by leaving it to settle and keeping the clearest portion, discarding the portion that is cloudy (at the bottom and/or on the surface).
- Collect the humidity from the air (in the form of **morning dew**). The cool and dampness of the night cause water to condense on vegetable and other substances. Using a system of plastic bags half-buried above a hole, it should be possible to collect drinkable condensation water.
- Boiling water and collecting the steam from it **through condensation** is one method of getting pure water (without toxins, bacteria and viruses, deposits or particles). In practice, the result is uncertain except in laboratory conditions.
- It is also possible to put chlorine tablets into the water that has been collected (these can be bought from a pharmacy or obtained from health organisations). This technique produces the same results as boiling, and therefore does not get rid of toxic substances.
- You can also get drinking water by treating clear water in sunlight.






Etape III : Des informations pour aller plus loin…

Stage III: More advanced aspects

Here are seven common methods of purifying water:

1. **Filtration:** the water is passed through a filter, which traps small particles. The smaller the mesh of the filter, the smaller particles have to be to pass through. Filtration is not sufficient, but it is often necessary as a preparatory stage to stop the largest particles interfering with more advanced methods of purification.
2. **Boiling:** the water is kept boiling for a sufficiently long time to deactivate or kill off the micro-organisms that live in the water at the ambient temperature.
3. **Carbon filtering**: charcoal adsorbs many other components, including certain toxins. *Chlorine is eliminated through catalysis, and organic substances are dissolved through adsorption*. The water is passed through active carbon from coconuts or coal, to purify it of these components. This method is used above all to filter waste water and water from aquariums.
4. **Distillation:** water is boiled so that it produces steam, which rises, and comes into contact with a cold surface, where the steam condenses into water once again and can be collected.
5. **Reverse osmosis:** strong mechanical pressure is applied to an impure solution to force the water through a semi-permeable membrane. This is called reverse osmosis because under normal osmosis, the pure water would move in the other direction, diluting the impurities. Reverse osmosis is in theory the best method for large-scale purification of water, but it is difficult to create good semi-permeable membranes. This method is sometimes known as hyperfiltration.
6. **Ion exchange chromatography:** in this instance, the water is passed through a column filled with resin, which captures ions by releasing in exchange hydroxide or hydronium ions that recombine to form water. In many laboratories, this method of purification has replaced distillation since it produces a large volume of pure water more rapidly, using less energy. The water obtained using this method is called deionised or demineralised water.
7. **Photo-oxidation:** the water is subjected to high-intensity ultraviolet rays. This makes it possible to split and ionise the organic components, which can then be removed in ion exchange columns. It also leads to the appearance of oxidising compounds that are capable of destroying micro-organisms and certain molecules.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. distinguish between clear water and drinking water;
2. formulate hypotheses and test them;
3. know how to carry out simple experiments to obtain drinking water.

ACTIVITE N°9

"TREATING WATER USING SUNLIGHT"

SOLAR WATER TREATMENT

Solar disinfection of water

AGE :

5-7 YEARS (or from 5 years)

INTRODUCTION:

Research has shown that heat plays an important part in the process of destroying bacteria. The solar method of treating water calls for bright sunlight and has proved to be extremely effective.

The scientific foundation for these techniques:
Solar water treatment seems to have been first studied at the University of Beirut in 1984 by Acra et al., who reported that 99.9% of bacteria were destroyed in 300 minutes of treatment in direct sunlight.

AIMS:

- Learning about the solar method of treating water,
- Carrying out experiments following an illustrated set of instructions,
- Teaching children to report experiments in their observation notebooks.

MATERIALS:

Transparent empty bottles that have been thoroughly cleaned; clear water.

PROCEDURE:

This activity should be carried out only under supervision (with the mediator or another adult). The children experiment with the solar method of treating water, and record the stages by means of drawings in their observation notebooks.

IMPLEMENTATION:

**Stage I: Presenting the activity,
Reading the activity sheet**.

Solar disinfection of water is a simple method that must be used if it is not possible to boil the water.

We shall learn together about another method of making water clear and drinkable: solar treatment.

Stage II: ***Experimenting with the solar treatment of water***

Materials
- transparent bottles
- clear water (previously decanted)
- a sunny day

Early in the morning, the bottle is half filled and closed by screwing on its top.

The bottle is shaken vigorously for 30 seconds. The water needs to be shaken up so that it fills with oxygen, which helps the ultraviolet rays of the sun to kill off the micro-organisms present in the water.
The bottle is topped up with clear water.

They can supplement each stage with drawings, notes and photographs showing the different stages of the experiment.

The bottle is laid on a roof or some other place where it will warm up. The bottle is left in the sun until late in the afternoon, at least 5 hours in direct sunlight, 2 days if the sky is cloudy.

At the end of the day, the sun will have killed off most of the microbes present in the water. The water is now drinkable.

Research has shown that heat plays an important part in the process of destroying bacteria, and it is recommended that one side of the bottle (the side away from the sun) be painted black in order to absorb the maximum amount of heat.

Although less effective than other methods, this method is an emergency solution that demands little technical skill. The solar method of treating water requires bright sunlight and has proved effective whenever the sun throws clear shadows. Exposure to direct sunlight for 4 to 5 hours has demonstrated a very considerable reduction in bacteria.

To sum up:

When there is flooding, three kinds of water are usually found:

- dirty water
- clean water
- drinking water

Dirty water is water that is not clear and is generally contaminated.

Clean water is water that is clear. If you look down a bottle of this water, you will be able to see the bottom of the bottle because the water is clear. However, clear water is not always drinkable. It may contain micro-organisms or microbes that cannot be seen with the naked eye. Clear water may be water that is contaminated.

Drinking water is water that may safely be drunk by humans. It contains neither micro-organisms nor chemicals that are dangerous to health. It is generally clear and uncontaminated.

Qualities of water	Clean water	Drinking water
Description	If you can see the bottom of the bottle when it is full of water, the water is clear. Beware! This clear water may not necessarily be drinkable. It may contain micro-organisms that you cannot see with the naked eye, and it may be contaminated.	Water that may safely be drunk by people, and contains neither pathogenic micro-organisms nor toxic chemicals
What is it to be used for?	Washing (showering, bathing) Washing clothes	Drinking Washing one's hands Cooking
Where does it come from?	Water that has not become dirty Drinking water that has become contaminated	Pure rain water Boiled water Water treated by sunlight (as a last resort)

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. identify the stages in the solar treatment of water;
2. formulate hypotheses and test them;
3. know how to carry out simple experiments.

ACTIVITY NO. 10

"SOME PHYSICAL PROPERTIES OF WATER"

WATER PRESSURE
Feeling the force of the water on your hand
Feeling deep and surface water pressure

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:
Water exerts a force, a pressure that we can feel on our hands. The pressure of the water, the force of the water, is stronger deep down than on the surface of the water.

It is easier to blow down a straw on the surface of the water than deep down.

As they do things and make experiments, the children will notice:

- the pressure of the water that they feel on their hands through a glove
- the effect of blowing on the surface of the water
- the effect of blowing deep down in the water

AIMS:

Learning about some physical properties of water, *pressure,*
Making and testing simple hypotheses,
Reporting the findings by means of drawings.

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MATERIALS:

A container for water, thin rubber gloves, straws (with a red mark 1 cm from one end)

PROCEDURE:

This activity may be carried out under supervision (with the mediator or another adult). The children read the activity sheet in order to carry out the proposed experiments. They are asked to make hypotheses and test them. They find out about some physical properties of water.

They communicate their findings by means of drawings.

IMPLEMENTATION:

Reading the experiment sheet.

Experiment I: Feeling water pressure

Ask the children to put a glove on one hand

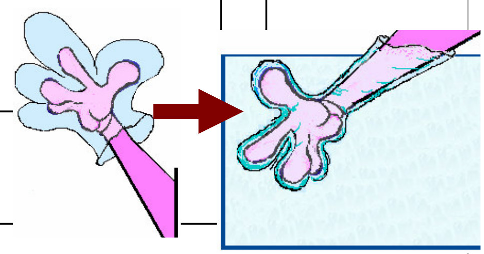
- How does the glove feel on your hand?
- Is the glove tight on your hand?
- Can your fingers move inside the glove?

Now, put your hand into the water:

- What do you feel?
- Is the glove tight on your hand?
- Can your fingers move inside the glove?
-

Conclusion from the experiment:

The glove sticks to your hand: the water in fact exerts a force on the glove and sticks it to your hand, you can feel the force, the pressure of the water on your hand



Experiment II: Water pressure is greater lower down

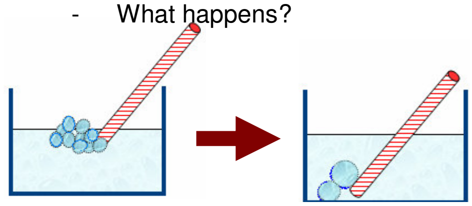
Ask the children to blow through a straw on the surface of the water; the straw has to be inserted very slightly (mark the straw beforehand to make the experiment easier to do)

- What happens?

Blowing lightly will produce lots of bubbles: it is easy to make bubbles on the surface of the water. The bubbles seem to be "light".

Ask the children to put the straw right down into the container (without touching the bottom) and then blow

- What happens?



You have to blow harder to make bubbles: it is more difficult to make bubbles at the bottom of the container. The bubbles are bigger and make a duller sound. They seem "heavier".

Conclusion from the experiment:

Water pressure, the force of the water, is greater at the bottom of the container than on the surface, and stops the air escaping easily from the straw.

SKILLS

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. recognise when water exerts a force (on the glove, sticking it to their hand);
2. describe the pressure of the water, the force of the water: this is greater at the bottom of the container than on the surface and stops the air escaping easily from the straw.

ACTIVITY NO. 11

"SOME PHYSICAL PROPERTIES OF WATER."

BUOYANCY

Does it float or sink?

If the force of the water is greater than the force of the object, it will float

AGE :

5-7 YEARS (or from 5 years)

INTRODUCTION:

- Every body immersed in a liquid (or a gas) receives an upward vertical thrust equal to the weight (in newtons, not to be confused with mass, in kg) of the volume of liquid displaced (Archimedes principle). NB: for an object to float, the Archimedes thrust must be equal to the weight of the object.
- For an object to float, its force must not be greater than that of the water.
- For an object to sink, its force must be greater than the force of the water.

AIMS:

Learning about some physical properties of water

- Pressure
- The Archimedes principle
- Buoyancy

Making and testing hypotheses

Learning to report observations by means of drawings

MATERIALS:

A container for water, potatoes, corks, toothpicks, modelling clay (plasticine).

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PROCEDURE:

This activity should be carried out under supervision (with the mediator or another adult). The children read the activity sheet in order to carry out the proposed experiments. They are asked to make hypotheses and test them. They find out about some physical properties of water.

They communicate their findings by means of drawings.

IMPLEMENTATION:

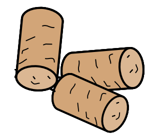
Reading the experiment sheet.

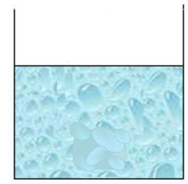
Experiment I: The Archimedes thrust

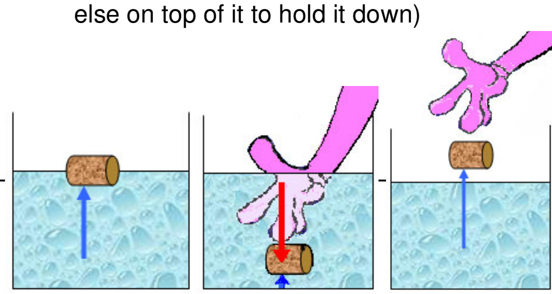
- Do you think a cork will float or sink?
- What does floating and sinking actually mean? (The cork floats)
- And if you want to make it sink, what can you do? (Push it down)

When you push the cork down, you exert your force on it, and it goes down into the water.

- If you take your hand away, what happens? (The cork rises up again, ……it bobs up out of the water)
- If I want the cork to stay at the bottom of the water without pushing it down with my hand, what can I do? (Put something else on top of it to hold it down)







<u>Conclusion from the experiment:</u>
The force of the water makes the cork float; the force of my hand is greater than the force of the water, and the cork sinks; (the hand is taken away) The force of the water pushes the cork, and it rises up again.

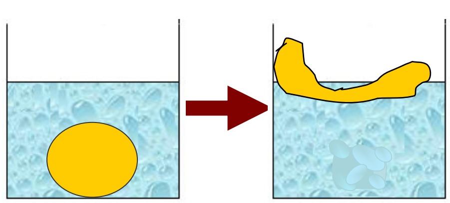
In the course of these exchanges with the adult, an ordered series of questions, clear concepts and, ultimately, knowledge will take shape.

Experiment II: Buoyancy and the shape of the object

Let us do the same experiment with the modelling clay.

- If you roll the clay into a ball, what happens? (It sinks)
- If you make a "little boat"? (It floats)

When the force of the modelling clay is greater than the force of the water, it sinks. When the force of the water is greater than the force of the modelling clay, it floats.

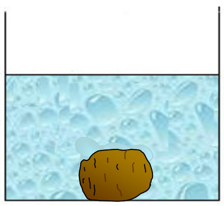


<u>Conclusion from the experiment:</u>

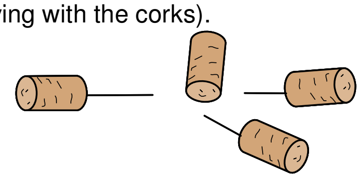
Buoyancy also depends on the shape of the object

Experiment III: Making an object float that would naturally sink

Here is a potato. How can we make it float? (Let the children suggest ideas and then experiment; introduce the notion of floats if necessary).



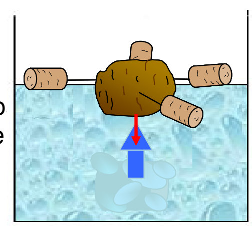
- When you go to the swimming pool or the seaside, if you can't swim very well yet, what can you put on to help you float? (armbands, rubber-rings, etc.)
- We are going to make some floats for our potato. What can we use as materials? (Let the children make suggestions, try things out, and then if necessary suggest trying with the corks).



- Fix a cork to the potato with a toothpick, and put it in the water.
- Observe. What happens? (The potato sinks)
- What do we have to do? (Put on another float)
- The potato is not stabilised ……we need to put on several floats and to spread them around.

<u>Conclusion from the experiment:</u>

If the force of the object is spread acro
this force will be greater than the force
object can then float.



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The written recording of observations (dictation to an adult) helps to memorise knowledge, become aware of relationships in space and time and identify causal links.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

1. Describe buoyancy and use terms relating to the "force of the water";
2. Carry out simple experiments to make objects float that would naturally sink:
   - by changing their shape,
   - by adding floats to them.
3. Formulate and test simple hypotheses;
4. Observe phenomena and suggest solutions to the problems put by the adult.

ACTIVITY NO. 12

"ELECTRICITY"

QUELQUES NOTIONS SIMPLES…

LA PILE
LA LAMPE
L'ELECTRICITE

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

In order to have an electric circuit (of electric current) we need: a source of energy (a battery), a receptor (a bulb) and electric wire linking the receptor to the source of electricity.

The term current: the word current can be used empirically without encountering problems.

For the battery terminals: use the word contact strips.

The term open circuit / closed circuit: the term circuit may be expanded on by the mediator, using for example, the term "path".

For the current to flow, the circuit must be closed.

AIMS:

- Familiarising the child with batteries and bulbs:
  Bulb terminals: pin, base
  Battery terminals: small contact strip, large contact strip
- Familiarising the child with the concept of electricity
- Familiarising the child with the concept of a circuit (open, closed)
- Knowing that a circuit has to be closed for the current to flow

MATERIALS:

A square 4.5V battery, a large bulb (60W), a bulb with a broken filament, electric wire, a small bulb.

PROCEDURE:
This falls into two phases.
- The discovery phase:
  Active hands-on learning.
  Observing: applying previous knowledge.
  Making hypotheses: organising knowledge.
- The experimentation phase:
  Thinking up a logical explanation that presupposes a result.
  Constructing an experiment to prove or disprove that thinking.

IMPLEMENTATION:

Stage I: The electric lamp and the battery

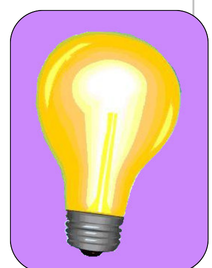
What can you see inside the bulb? (expected answer: “the filament” – or a description of it).

What must it be like for the lamp to work? (provide a lamp with a broken filament and a lamp with a complete filament).

What material is the bulb made of? (expected answer: “glass”).

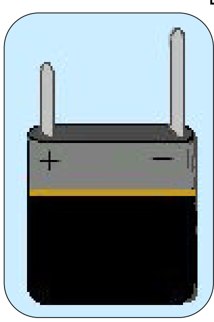
And the bottom of it? (expected answer: “metal”). Show the children the cap and have the children repeat the word.

And at the base of the cap? (point out the pin and have the word repeated).



Conclusion:

What matters in a lamp is: the “cap” and the little grey knob, the “pin”.
An electric lamp is in good condition if the filament is not broken.



Do you know what the battery is for? (expected answer: “it provides electricity”)

What end does the electricity come out of? (point out the two contact strips: the small strip and the large strip; they have different symbols: “+” and “-”).

During observation and description, their attention can be drawn to the functions of the different parts of the object studied

Stage II: The concept of current and electricity.

They have to solve the following problem: how to light up the electric lamp (the bulb).

They find that something else is needed to light up a bulb: electricity.

So that the children discover the two elements essential to an electric circuit, a battery and a lamp, they handle an everyday object: a torch. The children turn on the torch.

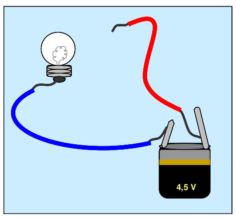
Together with the children, the adult identifies the elements in the circuit: the lamp and the battery, getting them to talk about them. What’s this? What’s it for? How does it work? What’s inside?

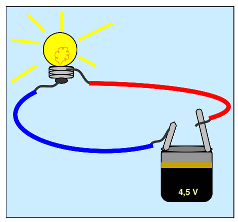
The children test their hypotheses by turning on the torch. They identify the 2 essential elements: the battery and the lamp.

Stage III: Open circuit, closed circuit

We shall now find out how the battery and the lamp work: **"for the current to flow, the circuit must be closed".**

The term circuit may be expanded on by the mediator, using, for example, the word "path". The terminology should be adapted to suit the age range concerned.





The children examine the two pictures and describe them: the mediator draws the children's attention to the colour of the bulb and the position of the wires (questions cf. Powerpoint).

The path along which the electric current circulates is then interrupted. If the electrical circuit is interrupted (open), the bulb gets no electricity. It is off.

When there is no interruption to the electrical circuit, it is said to be closed.
The bulb gets electricity. It lights up.

Define the term "path":

Electricity leaves from one of the terminals of the battery, passes along the wires, goes through the receptors and always comes back to the other terminal of the battery. This path is always travelled in the same direction: the current starts from the + terminal of the battery and comes back to the – terminal (choosing to give the children the conventional direction of the current, without mentioning that there is an alternative).

With the mediator's help, the children create a closed circuit and an open circuit. In this activity, the mediator does not emphasise the points of contact between the electric wires and the battery and bulb, but merely the terms: path of the current (circuit), closed circuit, open circuit.

When the wires touch the two sides of the lamp and the two sides of the battery, it is a closed circuit: the lamp will light up!

When the wires do not touch all the sides, the circuit is open: the lamp will not light up!

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

- recognise a bulb that is burnt out and a bulb in good condition;
- construct a simple circuit to turn on an electric lamp;
- produce a drawing of an open circuit and a closed circuit.

ACTIVITY NO. 13

"CONDUCTOR, NON-CONDUCTOR"

CONSTRUCTING A SIMPLE CIRCUIT…

BATTERY, ELECTRIC LAMP, WIRE THAT CONDUCTS ELECTRICITY

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

For a lamp to light up, it needs to be connected to the battery by a closed circuit.

In order to construct a closed circuit a material has to be used that will "conduct electricity": electric wire.

Materials that let current flow are called "conductors".

Materials that do not let current flow are called "non-conductors".

AIMS:

- Consolidating knowledge acquired previously about electric circuits:
  Closed circuit
  Open circuit
- Knowing how to construct a simple circuit.
- Knowing which materials conduct electricity.

MATERIALS:

A square 4.5V battery, a small bulb, electric wire, tissue paper, plastic wire, a stick of wood, a glass stick, etc., clips or adhesive tape.

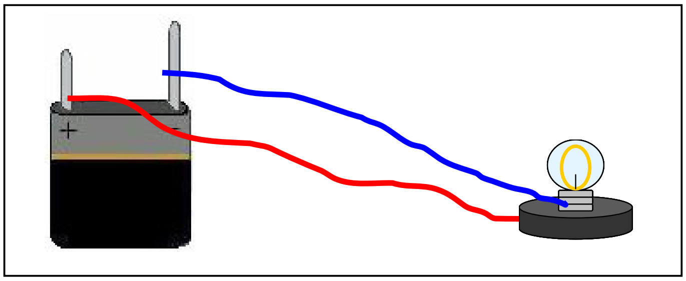
PROCEDURE:

Problem posed:
The right material to close the circuit (between the battery and the bulb).
Target concept: Finding the right contact materials: "conductors".

Problem posed:
If I take the bulb further away from the battery, will it be less bright?
How can the bulb be turned off without dismantling the circuit?

IMPLEMENTATION:

Stage I: Exploring further the concept of an "electric circuit"



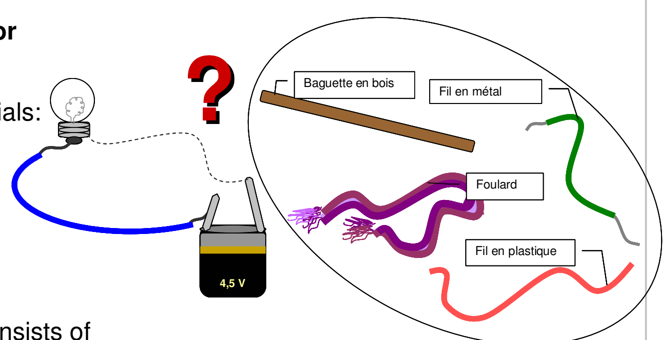
The lamp is in good condition.
The battery is in good condition.
They are properly joined by wire and correctly connected (the circuit is closed). **The lamp does not work!**

Not all wires allow electric current to flow: some materials are not conductors of electricity (questions cf. Powerpoint)

Stage II: Conductor / non-conductor

An attempt is then made to connect the battery to the bulb using different materials: fingers, hair, a pullover, string, etc

They don't work! !
So what do we need? An electric wire!
(cf. question Powerpoint)



We discover what electric wire consists of
What material is the wire made of (the outside): plastic….
"Does it work with plastic?" No….
We then see that inside the plastic, there are metal wires.
We now try the experiment using the metal parts of the wire

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO …

- recognise some materials that are conductors and non-conductors of electricity;
- close an electric circuit in order to light up a lamp;

"BATTERIES"

A FEW SIMPLE CONCEPTS…

MAKE-UP OF A BATTERY
- acid
- two different metals

RANGE OF DIFFERENT BATTERIES

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

Batteries are designed to provide electric current on demand.

They are made up of two electrodes in contact with an electrolyte (an acid and two metals).

When the battery is connected to a receptor, chemical reactions occur and produce a flow (a movement) of charged particles, that is to say, an electric current.

The voltage of a battery indicates its capacity to make current flow in a circuit.

AIMS:

Discovering that a battery is made up of two different metals (the electrodes), immersed in an appropriate solution (the electrolyte), contact with which produces chemical reactions.

MATERIALS:

A square 4.5V battery, a 9V battery, round batteries, a battery taken to pieces, a piece of chalk, acid.

PROCEDURE:

The children are asked to suggest possible solutions to a problem.
Experiments, counter-experiments and critical observation of phenomena enable them to see whether their solutions are valid or not, and thus to build up new knowledge in the course of the workshop.

IMPLEMENTATION:

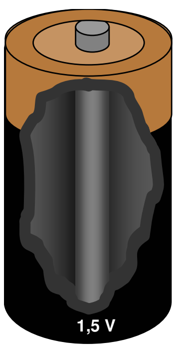
Stage I: All sorts of batteries

Several different sorts of battery are shown to the children. The c hildren handle them freely, and describe their characteristics.

A picture is shown of the first battery and its inventor, Volta.

*Point out to the children that the different shapes of the batteries are associated with different **voltages**.*

Stage II: What does the inside of a simple battery consist of?

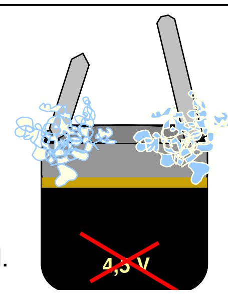


Show and describe (or draw) the inside of a new round battery cut in two.

- What are the elements that make up the battery? What do the "+" and "-" poles consist of?
- Every battery is surrounded by a zinc envelope that corresponds to the - pole.
- In the centre, there is a stick of graphite which projects slightly from the battery and corresponds to the + pole.
- Between the two, contact is established by a black substance.
- The zinc and the graphite are called "electrodes", and the black substance is called "electrolyte".
- Do the two electrodes touch? (No).

Stage III: What happens when the battery supplies electricity?

Show worn-out batteries taken to pieces.
Compare them with the new batteries that have been taken to pieces.



Question:

- What has changed? The zinc been attacked and "eaten away" and a white substance has formed while the battery was being used.

The voltage at the two terminals of the worn-out battery is zero or very low.

Show a spectacular rapid chemical reaction:
The mediator pours vinegar onto a piece of chalk.

A "froth" forms on the chalk, which is eaten away and tr ... d by the

Conclusion:
A chemical reaction is a change that takes place in two substances when they are put together.

When a battery is connected up, reactions start occurring and an electric current is delivered.

To sum up:

The battery observed is made up of two electrodes (one made of zinc and the other of graphite) in contact with a black substance called electrolyte. When the two electrodes are joined by a circuit, a chemical reaction is produced (between the zinc and the black substance), which gives rise to an electric current between the electrodes.

Question:
- Can you tell me what there is inside a battery?

The mediator recapitulates, noting down their answers in the notebook, and then shows the children the diagram of "The inside of a battery".

Another possible experiment (possible chemical reaction) for older children

The mediator drops an iron nail into copper sulphate (a blue solution). After a few seconds, the nail is covered in metallic copper.

What happened?

Usually, copper is "salmon pink" and metallic. In this state, it is not soluble. In the copper sulphate solution, it is blue and soluble: the copper is present but in a different form (ion Cu^{2+}). On contact with the iron, it is transformed and recovers its metallic form (it regains 2 electrons). The children can be shown that an iron nail that has remained for long enough in the solution is also transformed: under the coating of copper, it is "eaten away" (the iron gives electrons to the copper and is itself in the form of a soluble ion).

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

- recognise the components of a battery
- identify batteries according to their tension
- make a simple chemical reaction.

ACTIVITY NO. 15

"MAKE YOUR OWN BATTERY"

COMPOSITION OF A BATTERY
- an acid
- two different metals

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

Batteries are designed to provide electric current on demand.

They are made up of two electrodes in contact with an electrolyte (an acid and two metals).

The most effective metals are Cu/Zn.

The voltage in several batteries can be added together to create a more powerful battery.

AIMS:

- Knowing that a battery is made up of two different metals (the electrodes), immersed in an appropriate solution (the electrolyte), contact with which produces chemical reactions.
- Discovering that the voltage of a battery depends on the electrodes and the electrolyte used.
- Learning that the voltages of batteries are added together when in series, and that a "flat-pack battery" is made up of three "round batteries" mounted in series.

MATERIALS:

Lemons, a glass or other receptacle (for vinegar), sets of 2 metal plates (Cu/Zn), vinegar, 5 lamps, 5 sockets, electric wire and "crocodile clips".

PROCEDURE:

The children are asked to suggest possible solutions to a problem.
Experiments, counter-experiments and critical observation of phenomena enable them to see whether their solutions are valid or not, and thus to build up new knowledge in the course of the workshop.

IMPLEMENTATION:

Stage I: Knowledge reinforcement

Question: "To make a battery, I need 3 things. What are they?"

To make a battery, you need:

Black paste
A zinc case
Sticks of graphite

"We are going to replace the black paste with vinegar." The vinegar allows us to make a battery because it is an acid.

Question:

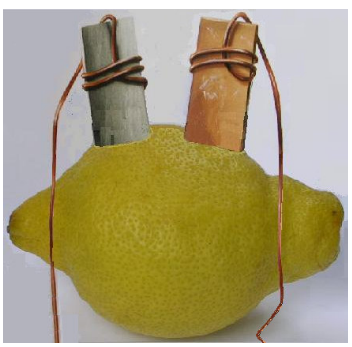
- Do you know any other acid substances? Lemon juice can be used instead of vinegar.

"The graphite can be replaced by a metal plate, and so can the zinc."

Stage II: Making a home-made battery…

The mediator distributes lemons to the children (or a jar of vinegar) and a set of 2 metal plates (Cu/Zn).

Question: - Where do you need to put the two plates?
The two plates must be immersed in the vinegar without touching each other, as in the commercial battery observed in the previous activity



To make a battery I can use:

Black paste	- an acid
Zinc case	- a metal
Sticks of graphite	- a different metal

Stage III: Let's find out whether we have in fact made a battery

Questions:

- How could you check whether your batteries work?
  The mediator gives a lamp to each child
  They can try to make a lamp light up. It does not light up.
- What suggestions can you make to explain that?

Hypothesis 1: is the bulb burnt out? (checking by connecting it to a 4.5V flat-pack battery shows that it is not)

Hypothesis 2: the battery is not producing electricity (if possible, measure the voltage it is delivering using a voltmeter).

Conclusion: Note in the exercise book that to make a battery, you need an electrolyte (an acid) and two different metals.

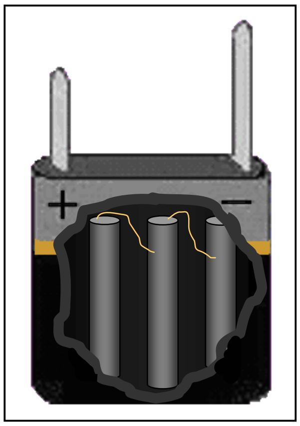
Taking the experiment a stage further with older children:

How to use the home-made (1V) batteries to light a diode

Show the diode to the children: our home-made batteries will not produce a current that is strong enough (not enough intensity) to light an ordinary lamp. So we are going to use a diode.
A diode is a rather special kind of lamp: it can only light up if it is connected in one particular direction. We may need more than one battery (one volt) to light it…

Questions: - How can we make a 2V battery? (By linking two "home-made" batteries).

Tip: - Assemble two of your batteries correctly so as to create a 2V battery



Remind the children:
- the way in which the commercial batteries were linked
- that the copper has replaced the graphite: it is therefore the + of the battery
- that the zinc is the - of the battery.

The mediator may at the same time link commercial batteries in the same way as the children.
In that way, they will notice any mistakes more easily.

Check the voltage at the terminals of the whole assembly using a voltmeter.
Around 2V, 3V or 4V will be obtained, depending on the type of

To sum up:

A battery can be made using two different metals immersed in an acid. The tension of a battery depends on the materials used. The voltage at the terminals of a set of batteries joined in series is the sum of the voltages of each of the batteries. In order to link batteries, the terminals of the different metals must be properly joined.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO …

- recognise the components of a battery
- name the different components
- make a home-made battery using everyday objects.

ACTIVITY NO. 16

"TORCHES"

MAKING A SIMPLE CIRCUIT…

BATTERY, ELECTRIC LAMP, ELECTRIC CONDUCTOR WIRE

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

The main reason for choosing a topic such as electricity for young children is its potential for hands-on activity and the concepts that it raises.
We can therefore cover a large number of the stages of an experimental approach.

To make a torch, we need: a battery, a bulb, electric wire.
For the bulb to light up, it must be joined to the battery by a conductor wire, electric wire. For the current to flow, the circuit has to be closed.

AIMS:

- Consolidating the knowledge about batteries and bulbs already acquired:
  Bulb terminals: pin, cap
  Battery terminals: small strip, large strip
- Learning to light a bulb using only one battery,
- Familiarising children with the concept of a short-circuit,
- Knowing how to construct a simple circuit.

MATERIALS:

A square 4.5V battery, electric wire, a small bulb, clips or adhesive tape.

PROCEDURE:

This has two phases.

- After the discovery phase, the reinvestment phase:
  Using the results to carry out a project.
- The experimentation phase:
  Thinking up a logical explanation that produces a result.
  Constructing an experiment to prove or disprove that thinking.

IMPLEMENTATION:

Stage I: Building on the concept of a "closed circuit"

In a closed circuit: one battery terminal needs to be in contact with the cap of the lamp, and the other in contact with the pin of the lamp.

They are asked to repeat the important points about the objects observed:

- *In the case of the battery, it is the strips that matter.*
- *In the case of the lamp, it is the screw "cap" and the small grey knob, the "pin".*

The mediator shows them that the bulb lights up, but does not reveal the solution: How did I light the lamp in contact with the battery?

Tip: you have to use the battery to get the bulb to light up.

- *The children proceed by trial and error. They need to identify the two battery terminals and then the two lamp terminals.*
- *The children who are successful show the others how to do it.*

The mediator explains the procedure to the whole group.

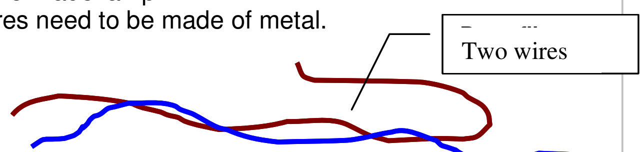
- *The two contact strips need to touch the lamp simultaneously (one touches the cap and the other touches the "pin" or grey knob).*

Stage II: Making a torch

The children are faced with a new problem: the battery is on a stand this time, some way away. There is therefore something missing.

What is missing is what links the lamp terminals to the battery.

Remember what we have just seen: "The two contact strips need to touch the two sides of the bulb." What do you need to make a home-made lamp?
Remember the previous activity: the wires need to be made of metal.

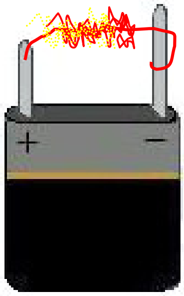


Ask the children to draw a simple circuit (battery, bulb, switch, wires) using the symbols developed in the preceding activities.
Ask the children to define the concept of "path" (the mediator helps the children):
Electricity leaves from one terminal of the battery, flows along the wires, goes through the receptors and always comes back to the other terminal of the battery. This path is always travelled in the same direction: the current leaves from the + terminal of the battery and comes back to the – terminal.
Now make your lamp.

Stage III: Short-circuit

If the + and – poles of the battery (the two contact strips) are in direct contact via a wire, they can burn your fingers or catch fire: this is a short-circuit.

A short-circuit is a direct path between the two terminals of the battery without any obstacle getting in the way of the current. If two paths for the current are constructed from the same battery, one circuit with a bulb and the other without a bulb, the current will choose the route with no "obstacle" and will no longer flow to the lamp: the lamp will be short-circuited.



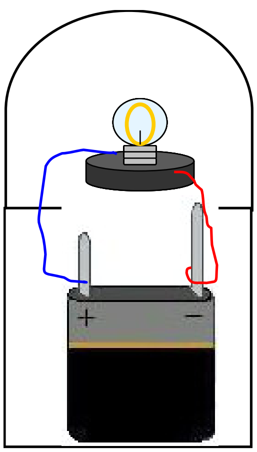
BEWARE of short-circuits!

In a short-circuit, the current that runs through the wires is extremely intense; it heats them and may cause a fire.

Short-circuit = DANGER!

To avoid having a short-circuit, every "path" must therefore include an obstacle (the bulb).

For the torch to work, several requirements have to be met:



Why doesn't your bulb light up?

Encourage the children to put forward various suggestions:
The bulb is burnt out,
The battery is dead,
The circuit isn't properly closed.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO…

- recognise a closed electric circuit and an open electric circuit
- name the different components of a torch
- build a home-made torch using everyday objects.

ACTIVITY NO. 17

"BUILDING AN ITEM THAT WORKS WITH A BATTERY…"

BUILDING SIMPLE CIRCUITS
- Lamp, battery, wires
- Motor, battery, wires

AGE :
5-7 YEARS (or from 5 years)

INTRODUCTION:

The children are told that they are going to make a number of objects that use electricity: a car, a doll, etc. They will therefore need to light the headlamps and turn the engine, or light up the doll's eyes and nose.

To do that, they will need to put into practice everything they know about circuits.

AIMS:

- Developing children's pleasure in discovery and research, using their own experience,
- Allowing children to structure their empirical knowledge and develop concepts,
- Developing "true-to-life" practices, making it easier to construct experimental approaches and acquire knowledge
- Developing creativity.

MATERIALS:

Various batteries, bulbs, diodes, electric wire, clips, foam board cut into various shapes, a motor, wooden sticks.

PROCEDURE:

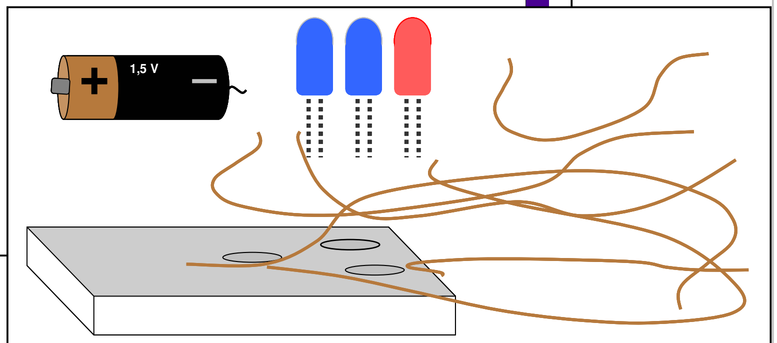
The reinvestment phase
Using the results to carry out a project.
Observing: applying previous knowledge.
Putting forward hypotheses: organising one's knowledge.

IMPLEMENTATION:

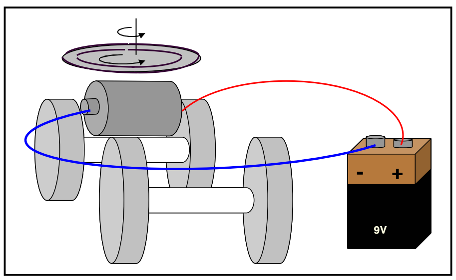
Tip:
Build something that allows the bulb to go on and off
Build your doll

The mediator should provide the child with some assistance.

He/she helps with leading questions.



Tip:
Build something that allows the motor to go on and off
Build your item or toy.



The children have to solve the following problem: How can I make the wheel turn? How can I light up the car headlights? Together with the children, the adult identifies the elements of the circuit: the lamp and the motor, getting the children to talk about them.

Current has a direction

The children are asked to look at the direction in which the wheel is turning (the motor has to be made to turn). Question: How would you get the wheel to turn in the other direction?
If the children cannot answer after some trial and error, suggest that they change the way the wires are connected.

SKILLS:
ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO …

- recognise a closed electric circuit and an open electric circuit
- build two circuits in parallel
- build home-made toys using everyday objects.

ACTIVITY N°18

"AIR AS A SOURCE OF ENERGY"

WIND POWER
The different forms of energy
Renewable energy sources

AGE :
FROM 10 YEARS

INTRODUCTION:

Some sources of energy used to produce electricity are not renewable (fossil fuels) and pollute the environment.
Sun, wind, water, animal and vegetable waste (biomass) are always there and will be usable in the future.
Cleaner replacement sources will have to be used to meet the growing energy needs of tomorrow.

AIMS:

- Explaining the three sorts of power station (how they work, their role, limitations and dangers, etc.)
- Raising awareness of the finite resources that currently exist.
- Providing knowledge about other renewable energy sources (advantages/disadvantages).
- Making the children more conscious of the role they can play in their environment: respect for nature.

MATERIALS:

Generator, paper windmill, battery, electric wire, diode

PROCEDURE:

Ask the children questions, encouraging them to think about the possibility of a different environment.

Building a renewable "source of energy" – using this model to raise awareness of sustainable development.

IMPLEMENTATION:

Stage I: On what forms of energy should we be focusing?

There are several sorts of energy from which electricity can be produced. These forms of energy have both advantages and disadvantages.

Oil

Oil comes from the decomposition of microscopic living organisms, called marine plankton, which lived millions of years ago. It is found underground, on a layer of water. Gas is lighter, and is therefore on top. The layer of rock still covering it does not let it escape.
In thermal power stations, oil is used to produce electricity by combustion: oil is burned in order to make water boil, and the steam given off turns a turbine.
This turbine is attached to a generator, which produces electric current.
Unfortunately, oil reserves were formed over millions of years, and are not renewable. This is a disadvantage. Besides having limited reserves, it can lead to ecological disasters when it is accidentally spilled into the sea.

Nuclear energy

Nuclear energy is derived from a substance, “uranium”, that is present in the ground. In power stations, the nuclei of uranium break and split. This is nuclear fission, which produces enormous heat. This heat is simply used to boil water, and the steam, under pressure, turns a turbine. This turbine is attached to a generator, which produces electricity. It too is a thermal power station.

It must be borne in mind that radioactivity is dangerous to living beings. An accident in a power station can result in an ecological disaster such as Chernobyl in 1986. Have you heard about that?

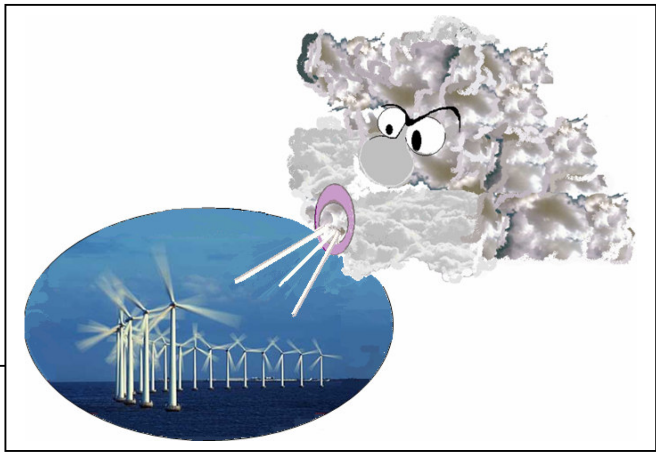
Moreover, nuclear waste can remain active for millions of years.

Biomass

Biomass means all living animal or vegetable matter. In 1776, Alessandro VOLTA discovered that the decomposition of vegetable waste in marshland produced biogas, called “methane”. At night, in fact, flickering lights created by this gas may emerge from a marsh (“will-o’-the-wisp”).
Methane may also be produced from animal excrement placed in a closed, heated vat known as a “digester”. This methane can then be used as fuel in a motor to turn a turbine attached to a generator, which produces electricity.

Wind

This form of energy does not pollute and costs nothing!



Stage II: **“How wind turbines work”**

(Describe/read the wind power sheet)
“The blades turn with the wind, the generator makes electricity, and the electricity makes light”
To test this, we are going to use a “wind machine”, the fan, … and, it works! The little diode lights up.
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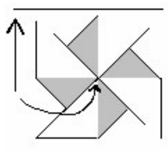

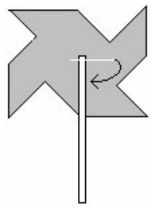

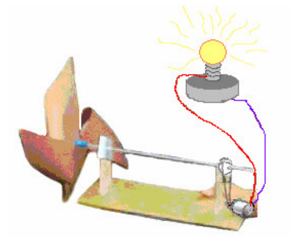

In order to make the “windmill”, the children follow the instructions set out on the sheet (the mediator may make another windmill at the same time to make it easier for the children).
Before putting it together and creating a circuit, the mediator explains to the children what the generator consists of.

Stage III: The generator

When the shaft turns, the coils turn between fixed magnets.

The coil turns between the magnets, and this is what produces the electricity.

It is a brilliant invention! It’s clean and, what’s more, wind is never used up, unlike wood in the forests!
In France, electricity is chiefly produced in power stations.

Some of these power stations, e.g. nuclear stations, give rise to serious worries about safety, while others create serious global warming problems.

SKILLS:

ON COMPLETION OF THIS ACTIVITY, CHILDREN SHOULD BE ABLE TO …

- recognise a wind turbine and what it is used for,
- make a simple windmill from a plan, with the help of an adult
- recognise a generator and what it is used for,
- build a simple circuit using a wind turbine.

1. Command of language.

Naming objects and substances in a real-life situation.
Using precise vocabulary related to a project.
Interacting with others, defending one's point of view and organising one's knowledge in order to structure one's thoughts.

1.1. Cross-disciplinary objectives

Socialisation
- Adapting one's behaviour to a group situation
- Interacting with the other children and the adult
- Co-operating on a project
- Putting away materials after use

Psychomotricity
- Acting and measuring the impact of one's action
- Motor co-ordination
- Fine motricity

Methodological skills
- Supporting an effort to carry out a project
- Noticing one's mistakes and correcting them
- Explaining one's actions, being proactive in responding to an instruction
- Using one's senses to gather information
- Discerning similarities and differences
- Understanding and following an instruction

2.1 General aims :

- Teach children the pleasure of discovery and a sense of enquiry based on their own experience.
- Enable them to use empirical knowledge and identify concepts.
- Develop real-life practices making it easier to devise experimental procedures and acquire knowledge
- Apprehend the physical realities of their close environment.
- Use technical objects in a range of functional situations.
- Experiment with ways of handling a familiar object to give it a scientific and technical dimension

And also…
- Ask oneself questions about…
- Make observations and conduct experiments
- Collect and interpret data
- Develop a sense of critical analysis and argue a case

Hints on how to introduce certain activities…

Children may be overwhelmed by some activities in which they will be participating. Anxiety, discomfort or rejection, curiosity, amusement or excitement – it's hard to imagine what may be going through their minds.

It will be necessary to try and create a more relaxed atmosphere by presenting the theme of the activity and explaining its purpose: experiments can make learning fun.

How can their needs and expectations be identified ?

One way is to give the children a say from the outset and to take advantage of that to get an idea of their knowledge and interests.

Suggestion :

"**Have you heard of…. ? What do you think about it ?**"

Listen to the answers and comment on them if necessary. Where appropriate, give your views on a particular aspect.

"**In this activity, we are going to talk about…. By the way, what do you know about…? Have you come across any… ?** etc."

Clearly identify the different ideas…be ready for everything.

"**I note that your answers are very varied and that some children have not said anything. Perhaps they don't know much about the subject. To make things clearer, I would suggest a game (an activity) in the form of questions and answers (or experiments) so that we can hold a discussion and look at different viewpoints…**

Perhaps at the end of the activity you'll be able to explain to the others how it works… Let's try ! …"

END

Notes…