
Nature Matters!
Edinburgh Science Festival 2018

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Sunshine4Palestine

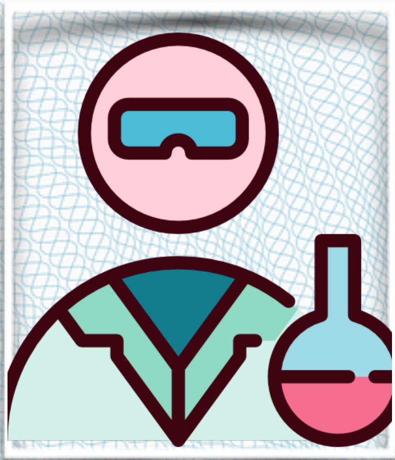
Nature Matters!

A squishy Science Workshop

Discover the wonderful properties of soft and squishy materials

6-8 April 2018
National Museum of Scotland

Edinburgh International Science Festival 2018



Name ______________________

Age ______

Favourite Science Topic ______________________

Draw yourself as a scientist here

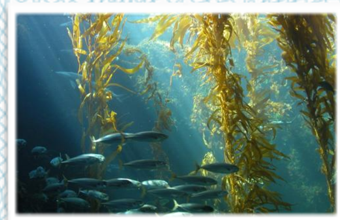
Potato Battery

Making butter as a scientist

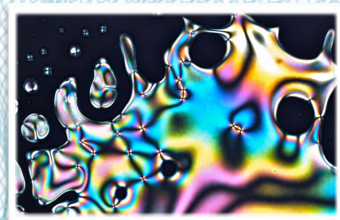
Magnetic Sculptures

Fluid or solid?

Make your own fibre



Science in a TV screen



Welcome to the Edinburgh Science Festival and to our workshop "Nature matters".

You have now crossed the border of the Republic of Squishy Materials, where you can marvel at the wonderful properties of materials from and inspired by nature.

While exploring these lands, you may cross paths with quick sands, magnetic hedgehogs and electric potatoes.

But fear not, because our enthusiastic team of young scientists is here to guide you in your journey. We will show you the best-kept secrets of amazing materials, and give you the keys to their almost magical properties!

Potato Battery

We make

An electrical battery out of a potato!

How we do it

We need some potatoes, copper bars (Cu), zinc washers (Zn) and coloured Led bulbs. Insert the washer and copper bar into two different cuts in the potato. The two bars must **not** touch. This is a single cell of a battery. The zinc and the copper bars are called **electrodes.** The potato juice is called an **electrolyte.** Now try to connect the Zn (-) bar at the cathode (+)(short lead) of the Led, and the Cu bar at the anode (-) (long lead) and see if the Led is lighting up!

How it works

Batteries are our easy portable way to store energy that can be converted into **electricity**, a flow of particles called **electrons.** Some metals like giving electrons away, while other metals like accepting them. Therefore, to have a flow of electrons in our battery, we need two different metals: one releasing electrons (anode) and one accepting them (cathode). Those two metals are suspended in a solution of **ions** which are contained in the potato. Electrons will flow from the anode (-) of the battery, towards the cathode (+) through a conductor material (the wires). If the wires are not connected the electrons cannot move! The **voltage** is a measure of the force moving the electrons.

Magnetic Sculptures

We make

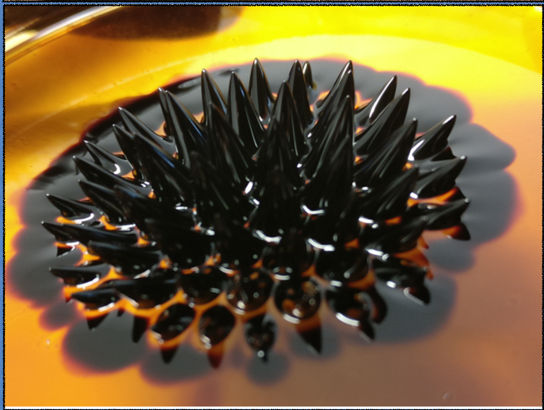
We observe the interesting behaviour of a magnetic fluid.

How we do it

We need a ferrofluid, a dish and some magnets.

After having placed the dish on a flat surface, pour a small amount of ferrofluid, just enough to cover the bottom of the dish.

We can now lift the dish and observe what happens if we put our magnets near the ferrofluid. Spikes will appear!



How it works

Magnetism is one of the fundamental forces of the universe. At a very small scale, magnetism is caused by the motion of **electrons**, tiny particles carrying a negative charge. In most elements, the electrons' positions inside an atom are random and their small magnetic fields cancel each other out. However, there are some elements, called **magnetic metals**, where the electrons are aligned in an ordinate way that creates a **magnetic dipole.** In these materials, the tiny bar magnets of the electrons are aligned in small disordered groups, called domains. When a magnetic field is applied , all these domains rotate to align with each other and in the direction of the field. This creates a big force that attracts the iron to the magnet!

Fluid or Solid?

We make

We observe the interesting behaviour of a non-Newtonian fluid.

How we do it

We need water, a spoon and cornstarch.

Using the spoon, mix the cornstarch and the water together in a basin. Then play with it! Let's see how the fluid responds to different ways of touching it: try to stir it slowly or quickly, hit it or try to lift it.

With a pool, and sufficient amount of cornstarch, it is possible to run on the fluid without sinking!

How it works

An important property that describes the behaviour of a fluid is its **viscosity.** The viscosity of a fluid describes how easy (or difficult) it is to make it flow freely. Some fluids have a particular kind of viscosity which depends on the rate of deformation that is imposed on them. In other words, they will flow more or less easily according to how strongly we will hit or stir them. Those **non-Newtonian fluids** have a viscosity which increases as we increase the deformation rate : if we hit it hard, it will behave almost like a solid resisting the deformation; if we touch it slowly, it will behave like any fluid, flowing and assuming the shape of its container. This phenomenon is called **shear thickening.**

Make your own fibre

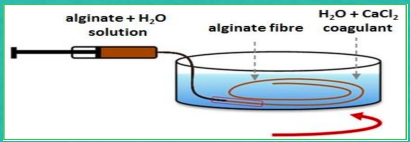
We make

Our own fibres from Alginate.

How we do it

We need a syringe with sodium alginate and a container with water mixed with calcium coagulant.

Using the syringe, inject the sodium alginate into the water mixture, moving circularly around the container. In a few second, you will be able to see your new fibre!



How it works

Alginate is a polymer which can be extracted from brown algae found in the sea. In its natural form, it comes as a type of salt, which can absorb water. The sodium alginate salt is **soluble** in water, which means that if immersed in water it can be dissolved. However, when it comes in contact with another salt, like calcium chloride, alginate salt changes its properties and becomes an insoluble calcium salt. Since it does not dissolve in water, we can form a solid fibre! This principle, called **coagulation**, is used in industry to create alginate fibre used for medical applications such as wounds dressing, which facilitates the healing process.

Science in a TV Screen

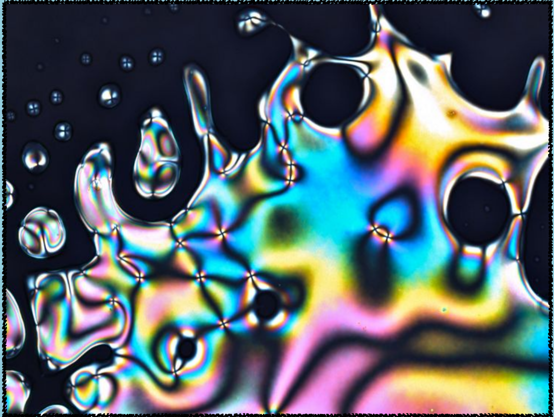
We make

We observe the interaction between light and a liquid crystal, just by moving a fish!

How we do it

We need a plastic fish (or a frog, or anything else ;)) placed in a solution of little rods with a lamp underneath and two polariser films.

The solution of rods is what we called a **liquid crystal.** Now move the fish with your hand and you will see that the liquid crystal will show a very colourful picture!



How it works

Liquid crystals are special substances that are usually liquid but that show certain properties of a solid crystal. A liquid crystal can flow like a liquid, but its molecules can be rotated like a solid. A very common use of liquid crystals is in our TV or computer screens. We can think of the light we see as a wave that passes through our screen. The screen is composed of a many tiny blocks, called pixels. Each of these small blocks is filled with liquid crystal and covered by a coloured filter. Light is unable to pass through liquid crystals when they are rotated a certain way, so we can use them as light switches by rotating the liquid crystals. Therefore, our screen is actually a bunch of light switches being turned on and off very quickly!

Making Butter

We make

We use a microscope to look at cream, and then we make butter!

How we do it

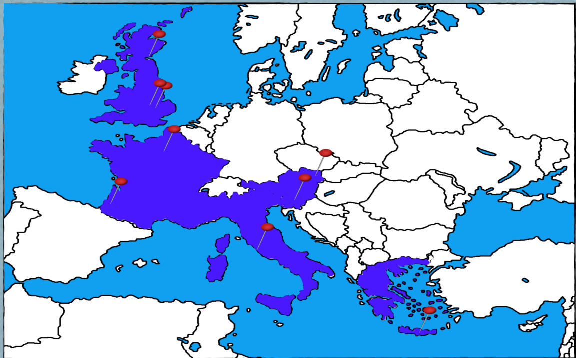
We need double cream and a kitchen mixer (or a small tube and a marble). We mix the cream and see that it becomes thicker at first, and then separates into a white liquid and a yellowish blob of fat. The fat is actually homemade butter! You can keep the liquid (buttermilk) to make scones, and don't forget to rinse your butter several times so that it will last longer!

How it works

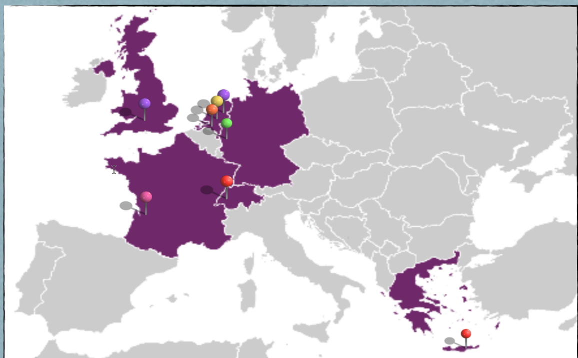
If you look at cream under a microscope (like the origami-inspired Foldscope), you will see that it is formed of tiny droplets of fat in water. This is what scientists call an emulsion, and it is not the only example in your food: mayonnaise, salad dressing and milk are also emulsions. Without this arrangement of fat and water, your cream would just be a big chunk of fat floating in water, yuck! It is however pretty easy to break out the fat droplets by mixing the cream. When we smash all the droplets and remove the water, or buttermilk, we obtain butter. So by knowing more about cream and milk, it is very easy to understand how all your dairy products, these delicious materials, are made.

Who are we?

COLLDENSE



DiStruc



Marie Sklodowska-Curie Actions (MSCA) provide grants for all stages of research career developing training networks, promoting staff exchanges and mobility programmes.

COLLDENSE and **DiStruc** are Innovative Training Networks funded by MSCAs. Each consortium is formed of 15 young researchers and their supervisors based in leading academic institutions and R&D centres all over Europe. The researchers are working in the field of soft materials, and regularly collaborate to make scientific advances and interact with a wider audience. Find out more about these networks at www.colldense.eu and distruc.eu.

Sunshine4Palestine (S4P) is an international NGO whose goal is the development of sustainable alternatives to assess energy and water emergency situations. Founded in 2013 by Barbara Capone, the team of **S4P** is now formed by physicists, engineers, journalists and specialists in human sciences. They promote innovative projects for intercultural dialogue through sustainable development, science and dissemination, working towards equal access to essential goods like clean water, health care and education. More information about how to support this project, as well as about all the various activities they are developing, can be found at **www.sunshine4palestine.com.**

S4P is independent from political parties and collect funds through public grants, private donations and participation to cultural events.

Sunshine4Palestine

This workshop is presented by

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- Alexander Cumberworth, University of Cambridge, Cambridge, UK
- Shari Finner, Eindhoven University of Technology, Eindhoven, Netherlands
- Martina Foglino, University of Edinburgh, Edinburgh, UK
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Lab Book

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COLLOIDS with DESIGNED RESPONSE

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