



Having a Blast with STEAM

STEAM Activity Guide

National Youth Council of Ireland

The National Youth Council of Ireland (NYCI) is the representative body for voluntary youth organisations in Ireland. We use our collective experience to act on issues that impact on young people.

This activity guide was produced as part of NYCI's STEAM in Youth Work project. This project aims to support the youth work sector to use STEAM to improve the lives of young people.

The activity guide was produced with funding from the Science Foundation of Ireland.

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Registered Charity Number: CHY 6823

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About this resource

This guide is for young people, youth workers and other practitioners who are interested in exploring inspiring and hands-on STEAM* activities. The activities:

- introduce STEAM in a simple and fun way
- explore some science
- can be carried out with groups and individuals
- are suitable for all age groups from 12 years old up.

*STEAM stands for Science, Technology, Engineering, Art and Maths.



Activity 1: Water Bottle Rocket

This rocket only needs water to fly. It's easy to build and can fly 100 meters into the air! All you need is an empty water bottle, a cork and a bicycle pump to launch it.



What you need

- Empty plastic bottle of any size
- Bicycle pump with needle top part (or a valve)
- Wine cork that fits in the bottleneck
- Launch pad

Where you do it

Outdoors

What you do¹

- Build a launch pad which is stable enough to hold the bottle straight upside down. You can use branches, bits of wood, plant pots or the handle of a garden fork, for example. You may need to try a few methods depending on your pump and the shape of your bottle.
- Fill up the bottle with water to a third or quarter of its capacity and stick the cork into the bottle.
- Stick the needle of the bike pump into the cork. You may need to make a hole through the cork with a drill or a small screwdriver beforehand. Cut the cork if it is longer than the needle and wrap tape around it in case it does not fit into the bottleneck.
- Put the bottle on the launch pad and start pumping until your rocket takes off!

Watch out!

- Make sure you have enough space for this activity.
- Do not bend over the bottle while you are pumping and do not fire it towards or over anyone!
- The person who is pumping will get a bit wet.

What's going on?

The pumping allows air to enter the bottle and bubbles to form. As soon as the pressure can no longer be held by the cork it is pushed out. The bottle flies off and water shoots out of the bottle opening. The flight slows down as soon as there is no more water in the bottle.

¹ This activity summarizes parts of 'Bang Goes The Theory – Water Bottle Rockets' by BBC at <http://www.bbc.co.uk/bang/handson/waterbottlerockets.shtml>

Backward and forward forces:

A rocket flies by ejecting something through the opening and the so-called "reaction force" pushes the rocket body forward. In this case, it is water and air that are ejected. Water is heavier than air, so the bottle is pushed forward harder. The energy to push the water out is related to the increasing pressure as air is pumped into the bottle. The pumping causes the air pressure to build up inside and the water is pushed out. The cork pushes back on the water, and for a while it stays in place. But as soon as the air pressure becomes too great, the cork is pushed out with the water.

Newton's laws of motion:

You may have heard of the 17th century British scientist Sir Isaac Newton, who had an apple fall on his head. His ideas about gravity and other forces have transformed science.

The water bottle rocket demonstrates two of his laws:

- Every action has an equal but opposite reaction. The water moves in one direction and the bottle in the opposite direction.
- The same amount of force can accelerate a heavy object slowly or a light object faster. The water is much heavier than the empty plastic bottle.

Tip!

- Because the launch happens very suddenly and the rocket flies quickly it is recommended that spectators stand away from the rocket while it is being launched.
- Film the launching of the bottle and have a look at what's going on in slow motion.

Thinking bigger

- Make your water bottle rocket look like a rocket by designing and adding a cone to its head and fins to its tail! Observe what happens – e.g. do certain designs impact on the flight path?
- Change the amount of water in the bottle. What impact does this have?
- Explore [projectile motion](#) with your rockets.
- Organise a team competition – whose rocket flies furthest or highest?
- Equip your rocket with a [parachute](#) for a smooth landing.

Get inspiration online

- [Water Bottle Rocket experiment on Youtube](#)
- [Water Bottle Rocket with a parachute on Youtube](#)
- [Water Bottle Rocket with parachute & attached camera on Youtube](#)
- [Homemade parachute on Instructables](#)
- [Projectile Motion online simulation](#)

Your notes and ideas



Activity 2: Bath Bombs

Design your own bath bombs! These fizzy, fragrant and colourful bath bombs make excellent gifts. All the ingredients are in your kitchen.



What you need

- Bicarbonate of soda, e.g. baking powder
- Citric acid powder or `Cream of Tartar`
- A tablespoon of water
- Two bowls or containers
- A tablespoon
- Something to shape the bath bombs, e.g. ice-cube tray or cupcake pan

Optional – but fun:

- Food colouring
- Essential oils

Where you do it

Anywhere

What you do

The following quantities will give you two small bath bombs:

- Mix the dry ingredients in a bowl: The mixing ratio needs to be 2 parts of bicarbonate of soda to 1 part of citric acid powder, e.g. 2 tablespoons of bicarbonate of soda and 1 tablespoon of citric acid powder.
- Mix the liquid ingredients in the other bowl: 1 tablespoon of water, 3-4 drops of essential oils and 3-4 drops of food colouring.
- Add the powder to the liquids and mix the ingredients together. The mixture will be quite soft and crumbly. When you press it down with the spoon it sticks together.
- Shape your bath bombs: Fill the mixture into your ice-cube tray or cupcake pan and press it down firmly with your fingers.
- Leave the bath bombs to set overnight so they become harder. Ease them out of your tray and add them to your bath!

Watch out!

- Consider any possible allergies before undertaking the experiment.
- Before using any equipment for food make sure that it's thoroughly cleaned after the experiment.

What`s going on?

When you drop the bath bomb into water it fizzes and eventually disappears. The acid and alkali (bicarbonate of soda) react with each other when they are added to water. They make a gas, carbon dioxide, which leads to the fizzing. This is a good example of a chemical reaction. In this case, it`s a non-reversible chemical reaction which means you can`t change them back into bicarbonate of soda and citric acid powder.

Tip!

- You can add some corn-starch to make your bath bombs more solid.
- If you use cooking oil instead of water, you can shape the bath bombs with your hands. However, they will need several days until they are dry.

Thinking bigger

- What happens when you vary the ratios of the ingredients used?
- For really colourful bath bombs, prepare several mixtures with different colours and combine them by layering them up in your ice cube tray.
- Mix different food colours to create new colours. If you have red, yellow and blue you can create all colours you wish!
- Look for alternative ways to add fragrance to your bath bombs. What about adding fragrant herbs or petals? What else might make your bath bombs smell nice?

Get inspiration online

- [Steps into Science website – Making Bath Bombs](#)
- [How to create bath bombs on Youtube](#)

Your notes and ideas



Activity 3: Soap Bubble Challenge

Learn how to create really big and strong bubbles. Find ideas for fun soap bubble team challenges, soap bubble artwork and for exploring the physics of soap films.



What you need

- Water
- Washing-up liquid
- Sugar or glycerine (available in pharmacies)
- Garden wire or a wire coat hanger
- Shallow tray

Optional:

- Yarn

Where you do it

Preferably outdoors

What you do

The bubble solution:

- Mix about 50 ml of washing-up liquid and a tablespoon of glycerine with 1 litre of water.

Building the hoop:

- Bend the wire into a hoop – you decide on the size! The bigger the hoop the bigger the bubbles.
- Where the circle closes, form a handle using the rest of the wire.
- Optionally, you can wrap some yarn tightly around the rim of the hoop. This way, the bubble solution will be absorbed by the yarn which will increase the chance of creating bubbles.

Creating bubbles:

- Pour the bubble solution into your tray and immerse your hoop in it. Make sure the whole hoop is under water.
- Start raising one side of the hoop slowly out of the solution until it is vertical. There should be a film of the solution extending across the hoop.
- Lift the hoop and swing it through the air to make a bubble. Finally, twist the hoop to seal the bubble off at the end.

Watch out!

Consider any possible allergies before undertaking the experiment.

What`s going on?

The bubble solution gets stuck in the hoop and forms a thin film that you can carefully blow up like a balloon. With pure water and with a very small hoop, it might be possible to stretch out the water to create a film. However, this film would burst immediately if you tried to blow it up. This is due to a property of water called surface tension – the water molecules cling to each other and cannot move very far apart. The washing-up liquid reduces this surface tension so that the water molecules cling together less, and the soapy water film becomes elastic. Adding sugar or glycerine makes the solution even thicker and the bubbles get stronger.

Why is the soap bubble a sphere?

A soap bubble floating in the air, which has no contact with other objects, has the shape of a sphere. A soap film always forms the smallest possible surface area for the volume of air it contains – a sphere.

Tip!

- Some bubble experts use wallpaper paste to create really big, strong bubbles!
- If you want to start smaller, you can use a simple straw to blow bubbles first. You can enlarge the straw opening by cutting a piece off at an angle, or by splitting the bottom end of the straw into four parts and bending them upwards. Another good way for creating medium-sized bubbles is to turn a pipe-cleaner into a hoop.

Thinking bigger

Do a soap bubble challenge:

- Who can make the biggest or longest lasting bubble?
- Blow a soap bubble with a straw on the table and try to blow up more soap bubbles inside the first one. Who can blow the most bubbles into one? And how does it work? [Bubble Challenge](#)

Soap bubble artwork:

- Photography: Take pictures of your soap bubbles. Experiment with different focusses and explore the colours of your bubbles.
- Colourful paper art: Add food colouring or water colour paint to your solution and blow up bubbles on paper. When the bubbles burst, they leave some colourful artwork on the paper. This way, you can create lovely gift cards, bookmarks or gift tags. [Bubble Painting](#)

Exploration:

- [Explore geometry with soap films](#): Build three-dimensional geometric frames with drinking straws or pipe cleaners to create geometric art with soap films.
- [Explore the colours of your bubbles](#): Observe the behaviour and colourful appearance of different wavelengths of light.

Get inspiration online

- [Create geometric art with the Exploratorium](#)
- [Explore wavelengths of light with the Exploratorium](#)
- [Bubble Painting on tinkerlab.com](#)

Your notes and ideas



Activity 4: Seed Bombs

Brighten up your world with a seed explosion! Learn about how seeds germinate, how flowers grow and how to do urban gardening projects. Find out about the world of pollinators and their importance for our environment.



What you need

- Mixed seeds of native or non-invasive flowers and/or herbs
- Compost
- Clay soil, clay powder or modelling clay
- Water
- Mixing container

Where you do it

Preferably outdoors

What you do

The mixing ratio is 5 parts of compost, 1 part of clay soil and 1 part of flower seeds.

- In a big container, mix together the compost with the flower seeds.
- Add the clay and give it a good stir. If you are using modelling clay, knead the mass thoroughly with your hands.
- Slowly mix in some water until everything sticks together.
- With your hands, roll the mixture into firm small balls. A size of about 4 centimetres in diameter is ideal for seed bombs.
- Leave the seed bombs in a sunny spot or indoors to dry.
- 'Plant' your seed bombs by simply throwing them at bare parts of your garden or property, or look out for other feasible spots. Plants don't need much to grow so be creative with finding the right spots that need brightening!
- Now you need some patience to see what pops up and explore the stages of a plant transforming from seed to fading.

Watch out!

Use unplanted spots for your guerrilla gardening to avoid annoying fellow gardeners.

What's going on?²

What do plants actually need to grow? Plants need soil, water, air, light and warmth. However, the growing conditions differ from plant to plant.

² This section was inspired by <https://www.sofatutor.com>

Light and warmth:

Perhaps you have noticed that sunflowers always turn their blossoms towards the sun. Or that many herbs and shrubs grow at the edge of the forest – but usually not in the middle where it is quite dark. Mushrooms, however, feel very much at home in the middle of the forest. Without enough warmth a plant seed cannot germinate. In unfavourable temperatures, even the growth of older plants is restricted. There are, however, a few exceptions. Certain plants can germinate and grow even at very low temperatures.

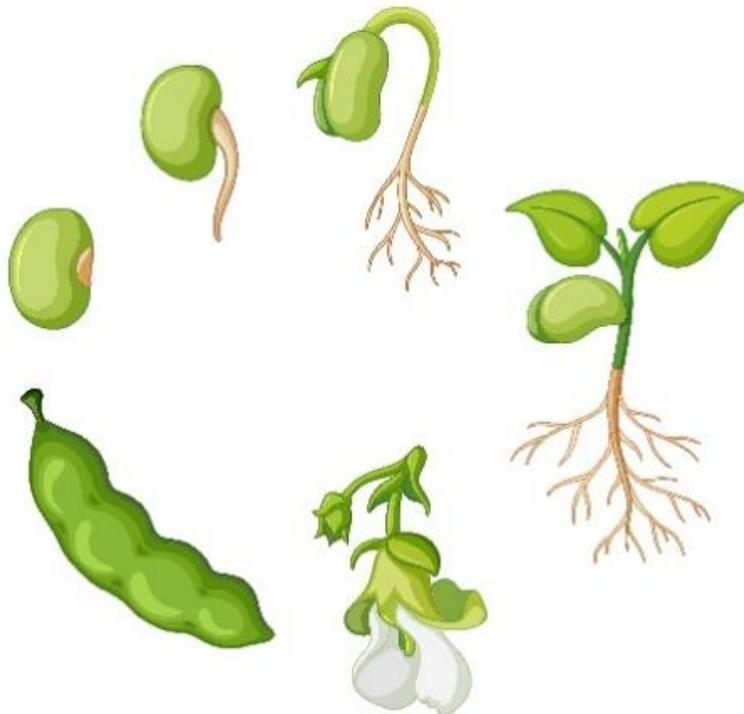
Air:

Plants also need air from which they take carbon dioxide. Ever heard of photosynthesis? In short, through photosynthesis plants use carbon dioxide, water and sunlight to produce oxygen (which we use to breathe!) and food (i.e. the sugar molecule glucose).

Water and soil:

Finally, a plant needs water and nutrients (which they can get from soil). Water is absorbed through the root hairs, which are found on the roots, and then passed on to all the other parts of the plant. The water also carries nutrients from the soil into the plant. Solid nutrients dissolve in the water before it is absorbed through the roots and passed on to other parts of the plant. Plants can even grow without soil! In hydroponics, all the nutrients the plant needs are dissolved in the water and soil is not used!

Life Circle of a Green Bean



Designed by Brgfx / Freepik

Tip!

- Contact your local library for seeds. Some libraries have Seed Arks for `borrowing` seeds. Also, libraries might know of other urban gardening projects in the community that you could get in touch with for seeds or for other kinds of collaboration.
- Your seed bombs didn't work? Do some research to learn how to prepare the soil and try again!

Thinking bigger

- Get in touch with your community to find out about public spaces in your town that you could use for your own urban gardening project.
- Start a plant diary and explore the anatomy of plants. You can also use pressed plants to design your own gift cards.
- Explore online apps for identifying plants. There is a huge range of free tools available, like Pl@ntNet or SmartPlant™.
- Field study: Do an urban walking tour in your town to explore the local flora and fauna.
- Build your own bug mansion to give a multitude of creepy crawlies a home. All you need is out there in the nature! Get some inspiration with [50 DIY Bug Hotels](#) or build a really [big bug mansion of pallets](#).
- Build a [bee observatory](#) to observe the life of the bees around your place and help them find a good place to lay their eggs.

Get inspiration online

- [Guerrilla Gardening in Ireland](#)
- [GuerrillaGardening.org](#)
- [Guerrilla Gardening on Wikipedie.org](#)
- [Ted Talk about Urban Community Gardening](#)
- [BíUrban.ie](#)
- [GrowItYourself.ie support people to grow some of their own food at home, at work, at school and in the community](#)
- [Ideas Hub on Pollinators.ie](#)
- [Learning Zone of the Irish Bee Conversation Project](#)
- [Building a Bee Observatory in Instructables.com](#)

Your notes and ideas



Activity 5: Cascading Mobile Sculpture

Mobiles are beautiful, balanced, kinetic sculptures that respond to environmental factors such as wind. Design your own cantilevered, cascading mobile sculpture and explore the magic of the balance of objects and your own body.



What you need

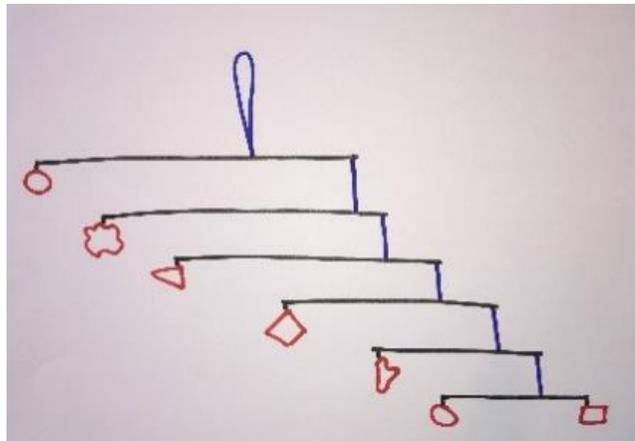
- A handful of light objects. You can simply craft your objects from cardboard, paper (origami), foam or anything you wish. Alternatively, you can `upcycle` natural or household objects by using e.g. sea shells, feathers, small toys, buttons, old CDs and much more.
- A handful of sticks or strong wire.
- Thread or wire.
- Craft glue.

Where you do it

Anywhere

What you do³

There are no limits to the variety of mobiles that can be made! In this example, we will be using the following model:



³ This activity is a summary of Art Edu Guru's video `Engineering the Calder Cascade` at <https://www.artedguru.com/home/engineering-the-calder-cascade>

- Prepare your sticks in different lengths. Lay the sticks on a table, with the longest at the top and then descending in length as in the above photo.
- Fix your light objects to the left end of each stick and a string at the right end. The way of fixing the objects and string will vary depending on the mass of the object you are using. Attach two objects of similar sizes to the bottom stick, one on the right and one on the left, as in the above photo. A thread is not needed here.
- Tie an additional string close to the middle of the top stick and turn it into a hook.
- With the string, connect the lowest stick to the one above, as in the above photo. Make a double knot (but don't tie it too tightly). Make sure consecutive sticks are far enough apart so that the objects don't hit each other when the mobile is hung up and moving. Repeat this step for all sticks.
- When all the sticks are tied you will need to balance them out. Hang the mobile so that it can float in the air or ask someone to hold it for you. Starting at the bottom, begin adjusting the sticks so that the objects and the mobile begin to balance out (this is called finding the balance point). Slide the string on the lowest stick so the stick is entirely balanced. Repeat this step for the second lowest stick and so on until you have reached the top stick.
- Glue the knots and, when they are dry, trim off the ends of the strings.

What's going on?

Balance:

When balancing out the sticks you are looking for the centre of gravity. With a simple and straight stick, this is exactly in the middle. As we have attached objects to the sticks of our mobile, the centre of gravity is unlikely to be in the middle of the stick. Even adding a very light object causes the centre of gravity to shift. The centre of gravity is where we have equal weight on both sides.

Energy of motion:

Due to the architecture of this cascading mobile sculpture with its free-floating sticks (called cantilevers), even the smallest movement of air can cause a dramatic effect. All moving objects have energy of motion, also called kinetic energy. As the objects are floating in the air the gravitational pull of the earth also influences the movements of the mobile. And so do environmental factors like wind or someone pushing an object on the mobile.

Tip!

You can find the centre of gravity simply with your fingers: Place the stick on your index fingers with the fingers at each end of the stick. Slowly slide your fingers together until they meet. The fingers will meet under the centre of gravity of the stick.

Thinking bigger

- Design your own cascading mobile sculpture by trying out different models, arrangements, objects, and sizes. Do the elements always need to be connected at their centre of gravity?
- Explore the balance of your body by [picking up a sweet from the floor](#). You could even try [slacklining](#), a fun outdoor balance activity for all age groups.

- Explore the [kinetic energy](#) of colliding objects and the [balancing act](#) of a see-saw with online simulations.

Get inspiration online

- [Video Instruction – Engineering the Calder Cascade on arteduguru.com](#)
- [Mobile Building on Youtube](#)
- [Designing Balancing Sculptures with the Exploratorium](#)
- [Experiments around the Centre of Gravity on Exploratorium.com](#)
- [More experiments around Balance on Exploratorium.com](#)

Your notes and ideas



Health and safety

Every youth organisation should have a health and safety policy, a first aid kit and a youth worker trained in first aid. When introducing STEAM in a youth work setting, health and safety policies and procedures should be reviewed. As with any new activity, a risk assessment is needed with necessary precautions taken, when new STEAM activities are introduced. Minor injuries are sometimes part of the STEAM process and it is important to be prepared.



Your notes and ideas



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