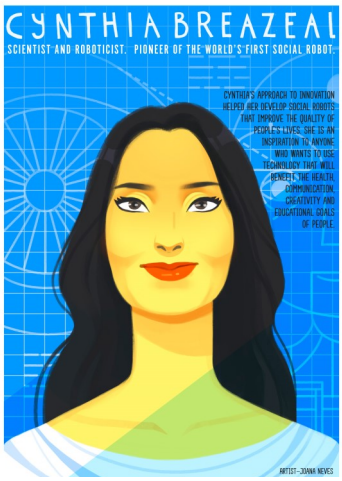
International Women's Day 2022

7-11 March 2022

Women in STEM



#STEMGlasgow

Contents

Women in STEM

As a nation, Scotland has a rich and diverse heritage of STEM expertise. We can proudly count in our number the likes of John Logie Baird, invertor of the television; Alexander Graham Bell, the inventor of the telephone; Alexander Fleming, the discoverer of Penicillin; and James Watt, with his steam engine contributing greatly to the industrial revolution. This heritage is not only historic—it continues today where 37% of our workforce are directly engaged in STEM activities. However, as demonstrated above, STEM skills and STEM recognition are more easily associated with males. There remains a significant gender gap in STEM further education and STEM employment.

This gap not only effects individuals who are constrained in employment opportunities, career progression and income opportunities; it effects our industries who need a steady flow of confident, qualified individuals to allow them to flourish. With the UK having 400,000 fewer STEM graduates than industry needs, imagine how we could grow as a modern society by inspiring our young women to pursue careers in a STEM field?

With this in mind, for International Women's Day 2022 which is on 8 March, STEM Glasgow are inviting you to take some time to inspire some of your pupils to explore STEM careers by learning about some of the world's most incredible women who have excelled in a STEM role, during the week beginning 7 March. Women such as Cynthia Braezeal, who is a robotics engineer creating robots that can respond to humans on an emotional level; or Mae Jemison, the first Black woman to leave our planet; Gladys West, who developed mathematical skills to ensure that we never get lost; and Rosalind Franklin, whose pioneering work helped us discover the structure of the very building blocks of life; Tu Youyou who used her ancestors knowledge to unlock a cure for a deadly disease; and Hayat Sindi, who is using engineering and science to bring health care to some of the poorest places on the planet.

This pack contains six sections, each focusing on a different influential woman in STEM. Each section includes a brief summary of the woman and her achievements; a variety of video links relating to the woman and her field; and some suggestions of activities that would further children's understanding of the life and work of the chosen woman. Each activity has a brief suggestion of how to deliver the activity and also some of the Experiences and Outcomes that the activity would cover. This is not an exhaustive list and dependant on the focus of the activity.

Please don't forget to share the fantastic and inspiring work done in our schools by using the hashtags #OurDearGreenPlace, #BreaktheBias and#IWD2022 and tag us at @STEMGlasgow and @EDISGlasgow.

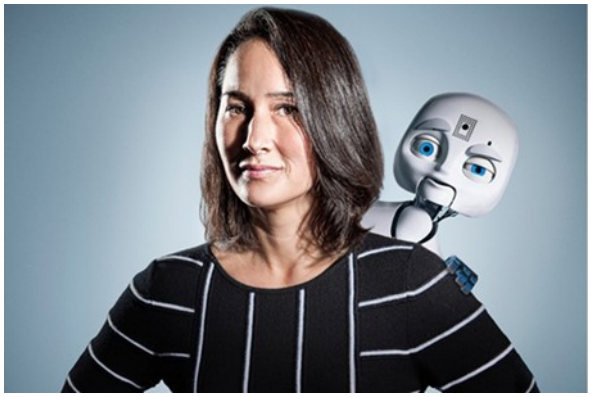
Cynthia Breazeal

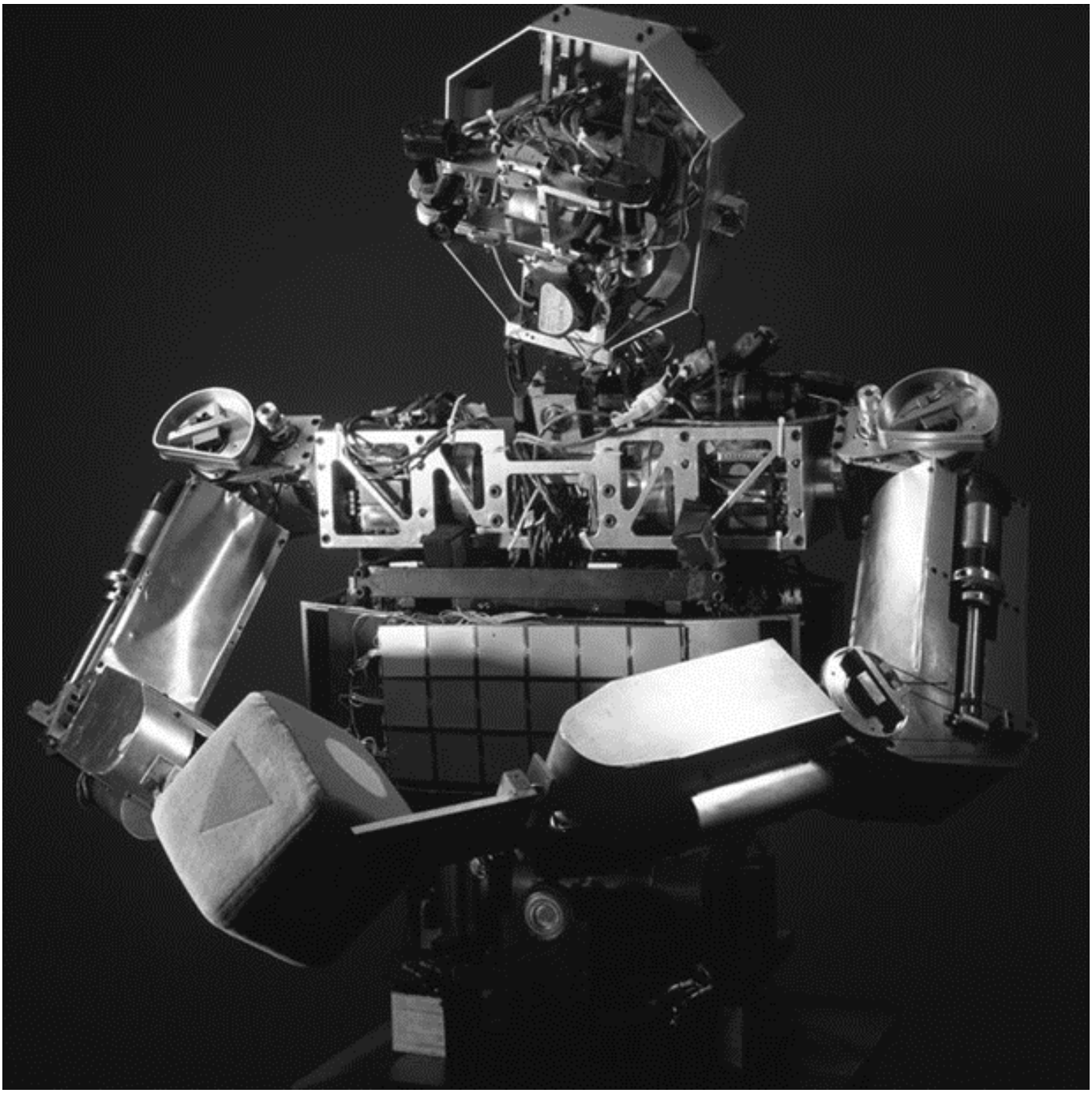
American Engineer, Cynthia Breazeal was born on 15th November 1967 in New Mexico. She first became interested in robots after she saw some in the Star Wars movies when she was young. This sparked a life long interest in robotics.

In 1989, Cynthia graduated from the University of California with a degree in electrical and computer engineering. While working towards her PHD in 2000, Breazeal helped to develop COG – a robot with physical abilities similar to a young child.

Cynthia became increasingly interested in promoting better social interactions between people and robots. This led to her developing Kismet, who was designed to recognise and express human emotions. Following this, in 2002, she co-created Leonardo – a furry robot that acknowledges faces, changes expressions and reacts to touch.

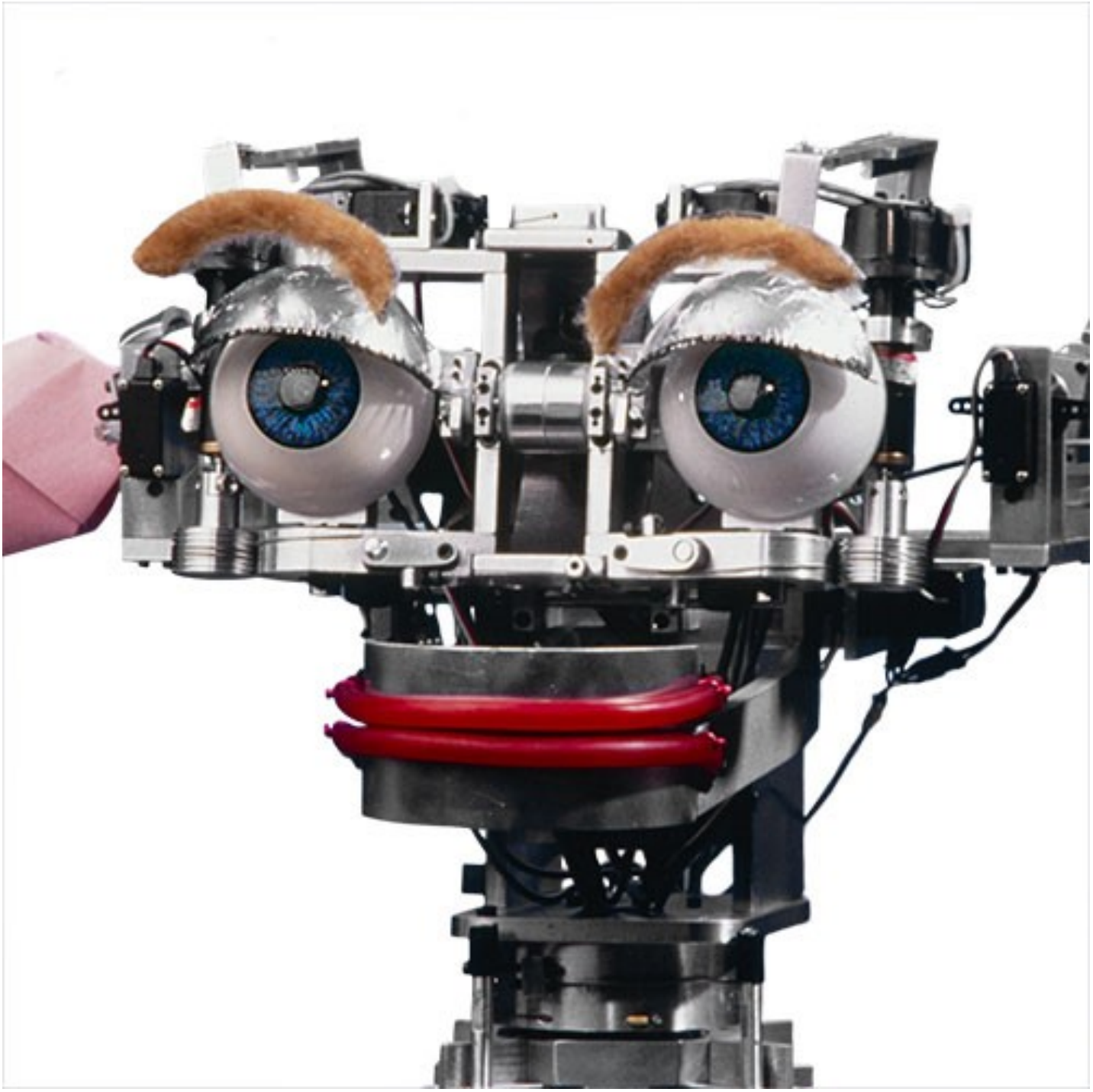
Throughout her career, Cynthia has supervised the development of robots for particular purposes. For example, Autom helps people to stay on track with diet and exercise while Huggable (designed to resemble a teddy) helps doctors and nurses interact with children.





Cog

Cog is able to move much like a young child.



Kismet

Kismet can recognise and express emotions.

Watch Kismet in action here

https://www.youtube.com/watch?v=8KRZX5KL4fA

Leonardo

Leonardo acknowledges faces, changes expressions and reacts to touch

Watch Leonardo in action here

https://www.youtube.com/watch?v=ilmDN2e_Flc

Autom

Autom helps people stay on target with exercise and weight management.

Watch Autom in action here

https://youtu.be/vzzcKa4bPzQ

Huggable

Huggable helps doctors and nurses interact with children and takes some of the anxiety and fear out of hospital visits.

Watch Huggable in action here

https://www.youtube.com/watch?v=UaRCCA2rRR0

Suggested Tasks

Robots work using coding. Try some coding tutorials and games:

Code Monster: This is a website that teaches children how to use Java Script. It starts with basic tasks but becomes increasingly more complex as they move through the programme. Suitable in upper Primary or Secondary.

http://www.crunchzilla.com/code-monster

Scratch Coding/Scratch Junior: this is a programme where children can use block coding to code animations and simple games. Scratch Junior is on the school ipads and suitable for lower primary. Scratch is suitable for upper primary/BGE.

https://scratch.mit.edu/

CfE Links: TCH—14a (all levels), TCH –15a, MTH 1-13a

Debate:. Have some heated discussions on the future of robotics:

Cynthia Breazeal was a pioneer of Social Robotics, designing robots with aspects of human personality to enable us to interact with them. When does a robot stop being a machine and start being something more? Can they truly feel emotion or do they just copy it? Do they have rights? Do they have a conscience?

CfE links: LIT –02a (all levels) , LIT—08a (all levels) , LIT –09a (all levels), SCN—20a (all levels), SCN 4-20b

Are you the next Cynthia Breazeal? Can you design the next generation of robotics?

Cynthia Breazeal has designed many robots that help people in different ways. Design a new robot to help solve a problem that people experience today. Present your design to a peer review panel, explaining what problem it solves, how it solves it and who it will help.

CfE links: EXA –6a (all levels), TCH1 – 04d, 2-04d and 4-04d, TCH –09a (all levels), TCH—11a (all levels)

Mae Jemison

Astronaut Mae Jemison was born on 17th October 1956 in Alabama. As a young girl, Mae had a keen interest in science and dreamed of going into space like one of her heroes, Lieutenant Uhura in Star Trek.

At the age of 16, Mae graduated from High School and began Stanford University where she received her first degree in Chemical Engineering. From here, Mae attended medical school and became a qualified doctor in 1981. After spending some time working in West Africa and Cambodia as a doctor, Mae applied to NASA to become an astronaut.

She was one of only 15 selected from over 2000 applications and began her astronaut training in 1987. She achieved her life-long dream of going into space when she blasted off on board the shuttle Endeavour in 1992 as a science mission specialist and the first African-American woman to leave our atmosphere. On board the shuttle, she conducted many experiments on the astronauts to explore the effects of space travel on humans.

On leaving NASA in 1993, Jemison created her own company, The Jemison Group, which specialises in creating technology to help solve some of the challenges faced in developing nations. She also became the first real-life astronaut to star on her beloved Star Trek.

Mae Jemison videos

Short video where Mae talks about her journey to becoming an astronaut.
https://youtu.be/B0vGDfuWhfI

Short biography on Mae Jemison
https://www.youtube.com/watch?v=rWxGAoggr4M

Short story read aloud about Mae Jemison
https://youtu.be/b_mfdqyBqT8

Suggested Tasks

Film cannister rockets

Rockets are launched using a force called "thrust". Thrust is a force that demonstrates Newton's Third Law - that for every action, there is an equal and opposite reaction. This can be demonstrated using some simple equipment: a film cannister, Alka-Seltzer tablets and some water. The tablets react with the water to produce CO2. As the gas builds up, the pressure inside the cannisters increases until it "pops" open and the cannister is launched upwards. This use of pressure is very similar to how rocket fuel works.

To make: take the pupils outside (when this works well, the cannisters really do fly!), remove the cannister lid and place half a tablet inside along with a small amount of water. Firmly replace the lid and place it on the ground, lid side down. Step back and wait (around 10-20secs). If the cannisters do not launch, wait another 30 seconds before going to examine them. The likely cause is the lids not being firmly shut and the gas escaping.

CfE links: SCN 1-07a, SCN 2-19 a (when the explanation of the reaction inside the cannister is the focus of the lesson), SCN 3-19a (when experiment is adjusted to ask how to increase the rate of reaction etc)

Parachute Landings

Often, when astronauts return from space, parachutes are used to slow their descent. During this experiment, children can explore the concept of gravity and air resistance. Creating parachutes and experimenting with their designs allows pupils to explore the concept of air resistance and how it can act as a counter –force to gravity.

You'll need: eggs (at least one per group and a few spares), string, bin bags, paper, Sellotape, balloons, any other junk material you happen to have.

To make: ask the groups to create a parachute/landing device that will allow the egg to be dropped from a height (top of ladders etc) and survive the fall. Allow the groups time to explore the materials and have some trial and error before testing their designs.

CfE links: SCN 2-07a, SCN 4-07b, SCN 2-08a, SCN 3-08a, EXA –06a (all levels), TCH –09a (all levels), TCH –10a (all levels)

Constellations

The Night Sky app is available on the school ipads and is a great tool to allow children to understand that the stars are always there, even in daytime (we just can't see them) and allows them to gain a sense of what constellations there are in our sky and where they are. The following videos help explain what constellations are and tells some of their stories:

https://www.youtube.com/watch?v=MZffhapfOgg explains what constellations are

https://www.youtube.com/watch?v=BbzCA0Lgf3Y explains why we see some in summer and others in winter

https://www.youtube.com/watch?v=eBIS17Va9sA explanation of the zodiac constellations

Using black card and chalk, pupils could draw a chosen constellation. They can also use a hole punch to punch holes in black card in the pattern of their chosen constellation. When held to the window or a torch is shone through these holes, the constellation will shine onto a wall etc. Pupils could also research the stories behind their chosen constellations.

CfE links: SCN 0-06a, SCN 2-06a, LIT-09a (all levels),

Gladys West

Mathematician, Gladys West, was born on 27th October 1930 in Virginia. Gladys' family owned a farm and from a very early age Gladys knew she "didn't like working in the sun from sunrise to sunset" and so she was determined to attend university.

Gladys graduated from university in 1952 with a degree in mathematics. She later returned and gained her masters in mathematics in 1955. Following this, Gladys joined the navy, one of only four black employees at her base at the time. Here she solved complex equations and programmed the computers used to calculate satellites' orbits. By performing many, many calculations, Gladys was able to create a model for the exact shape of Earth. This model allows the GPS systems to make accurate calculations of anywhere on Earth at a given time. Without Gladys' work, we would not have sat nav or Google Maps.

Gladys is proud of her determination and hard work. Even after retirement in 1998, she did not stop working and learning, Despite suffering a stroke, Gladys earned her PHD in 2000 at the age of 70. In 2018 she was inducted into the USA's Air Force Space and Missile Pioneers Hall of Fame and was also chosen by the BBC as one of their 100 Women of 2018.

Gladys West Videos

Short video of Gladys telling her story https://www.youtube.com/watch?v=McIemoQWv64

Gladys's message for girls https://youtu.be/98iVA_9jRIU

Short video explaining how GPS works https://www.youtube.com/watch?v=RSA3feQ9gKk

Ted Ed video explaining (in detail) how GPD works (secondary level) https://www.youtube.com/watch?v=70cDSUI4XKE

Suggested Tasks

GPS technology, which Gladys was instrumental in helping to develop, is a very sophisticated was of finding out where you are. Before GPS, there were a variety of different ways to find out where you were in the world. Below are some activities around this theme: creating a compass, drawing basic maps and using devices to navigate them and orienteering.

Compass (STEM card)

Following these simple instructions, children can create a basic compass.

You'll need: water, a straight bar magnet, a steel needle and a bowl.

To make: Fill the bowl with water. Magnetise the needle by quickly stroking it over the bar magnet about 50 times. Make sure the needle is pointing to the north of the magnet every time. Drop the needle onto the surface of the water from as close as possible (not from a height) and let it rest on the surface tension. The needle will turn to point north. This is because the magnetised needle naturally wants to align with the Earth's magnetic field. The Earth has a magnetic field generated by its molten core. This causes it to act like a giant bar magnet (with the south pole of the magnet located near the planet's north pole) because opposite poles of a magnet attract, the north pole of the magnetised needle is attracted here.

CfE links: SCN 2-08a

Beebots and spheros

Using Beebots or Sphero, have pupils design a maze and then try to code the devices to successfully navigate it. Children could design a map of their classroom with a "x marks the spot" before having their peers attempt to program the device to navigate the room to find the X.

CfE links: TCH—14a (all levels), TCH –15a, MTH 1-13a

Orienteering

Blairvadach Outdoor Education Centre has mapped school campuses in Glasgow which can be accessed here https://www.blairvadach.org.uk/Pages/View/30. They have also produced a very simple "How To" guide to explain how to organise an orienteering course in your school which can be accessed at https://www.blairvadach.org.uk/Content/UserGenerated/Image/School_Maps/Orienteering_Mapwork_Outdoor_Learning_Ideas.pdf

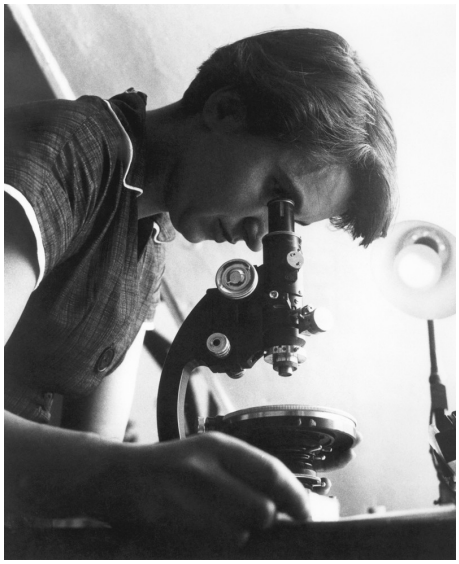
CfE links: MTH 2-17d, MTH 3 –17b, SOC 1-14a, HWB 0-25a, HWB 1-25a, HWB –23a (all levels)

Rosalind Franklin

Rosalind was born on 25th July 1920, in London. After school, she went onto study physics and chemistry at Newnham Women's College at Cambridge university.

Following graduation, Rosalind studied the formation and make up of carbon and coal as part of the war effort during World War 2. This important work led to more efficient gas masks for soldiers and her PhD, which she received in 1945. Following this, Rosalind began working on the science of X-ray diffraction. This is when scientists use x-rays to help them see the make up of tiny molecules. During this work, Rosalind took the infamous photo 51 which showed the diffraction pattern of DNA. This photograph formed a crucial part of James Watson and Frances Crick's work on the double helix structure of DNA.

Rosalind died before Watson and Crick received their Nobel Prize for their revolutionary work and so many believe missed out on the recognition she deserved. She may have missed out on her Nobel Prize but she left behind a huge legacy. She received her PhD at a time when there were very few female chemists. She was often the only female presenter at conferences and had to fight to have the same recognition and pay as her male counterparts.



Rosalind Franklin videos

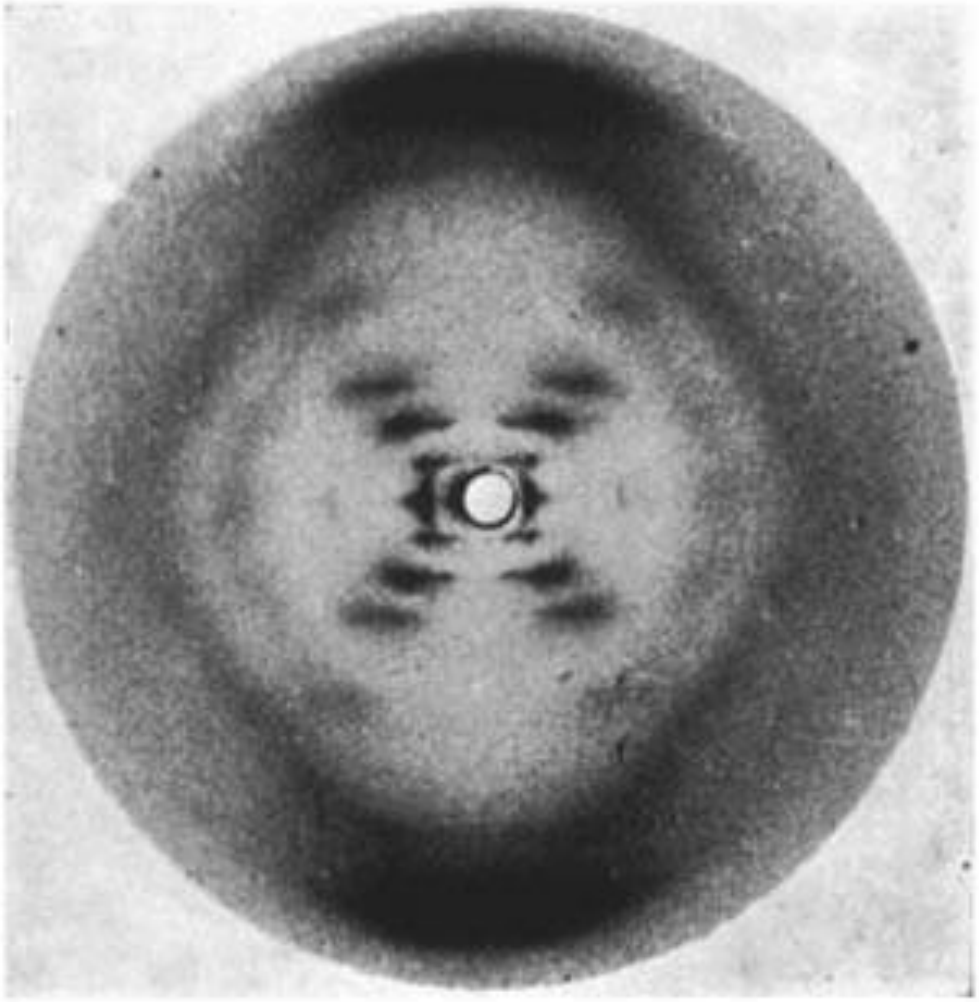
Ted Ed biography on Rosalind Franklin https://www.youtube.com/watch?v=BIP0lYrdirI

Biography of Rosalind Franklin (this is narrative by a child and has some cartoon thought bubbles etc that randomly pop up, however, the information is really good and explained in a child-friendly way)

https://www.youtube.com/watch?v=OfGghFy8M6M

Short video explaining DNA https://www.youtube.com/watch?v=kYIzJmJbN6A

Photo 51 showing the structure of DNA



Suggested Tasks

Create a model of DNA

Rosalind's famous photo 51 showed the double helix—the structure of DNA. This structure can be modelled using some simple resources:

DNA consists of two back bones holding together nucleotides: adenine, thymine, cytosine and guanine. We call these bases and usually refer to them by the first letter of their name. the two backbones twist together giving a double helix shape with the two strands held together by hydrogen bonds between the base pairs.

You'll need: four colours of gummy sweets (midget gems or jelly tots work well), toothpicks or cocktail sticks, liquorice or other long thin sweets (strawberry laces work well).

Make it: remember C and G and T and A always pair up so assign a colour to each nucleotide and add pairs of sweets to your cocktail sticks. Attach each end of your cocktail sticks to your liquorice, spacing them evenly apart. Once you have a long enough string, twist it to give the classic spiral of a double helix.

CfE links: TCH 0-09a, 1-09a, 2-09a, TCH 0-10a, 1-10a and 2-20a

Extract DNA From a Strawberry

Rosalind's work ultimately helped further our understanding of the structure of DNA and therefore how it works. DNA is the building blocks of life. You can extract the DNA from a strawberry using some basic ingredients and tools. The full instructions can be found here: https://www.genome.gov/Pages/Education/Modules/StrawberryExtractionInstructions.pdf

Tip: you can get rubbing alcohol from any chemist. This needs to be very cold (keep it in a freezer until just before the lesson)

CfE links: SCN 3-14b, SCN 2-14b

Inheritance using pom poms

We inherit our DNA from our parents. However, our individual DNA is unique as we inherit a random mixture of their genetic material, 50% from each parent. This can be demonstrated using pompoms.

You'll need: 7 cups, a collection of four different coloured pom poms (8 of each colour).

Do it: in four cups place the pom poms so that each cup contains a different colour (eg pink in one, blue in another, green in another and yellow in the other) label these cups: 2 "Gran" and 2 "Grandad" these represent our grandparents and their genes (or DNA). Next label one cup "Mum" and the other "Dad". Take one "Gran" and one "Grandad" and randomly select four pom poms from each cup and place them in the cup labelled "Mum". Repeat with "Dad" and the other two grandparents. Show that "Mum" has inherited a mix of DNA from her parents, as has "Dad". Now randomly select four pom poms from "Mum" and four from "Dad" and place in the final cup labelled "Me". This demonstrates the mix of DNA that we have comes from our parents. If you repeat the demonstration, a different mix should appear in the "Me" cup, explaining how siblings have similar but not identical DNA.

CfE links: HWB 0– 47a, SCN 1-14a

Tu Youyou

Tu was born on the 30th December 1930 in Nigbo, Zhejiang Province, China. As a teenager, Tu missed two years of school as she had caught Tuberculosis—a disease that effects the lungs. This experience convinced her to study medicine and she received her degree in 1955.

Following this, Tu entered the China Academy of Chinese Medical Sciences where she studied the use of traditional medicine. She then began to combine her medical skills with her new knowledge of traditional medicine.

During the Vietnam War, Tu was selected to head a top secret project named Project 523. This project aimed to discover a cure for malaria, a disease that was effecting thousands of soldiers. By this point, 240 000 different compounds had been tested but none worked effectively. Tu and her team studied texts from hundreds of years ago and discovered that sweet wormwood had been used to treat the symptoms of malaria. After many experiments, Tu extracted artemisinin—the active ingredient in the wormwood and bravely tested on themselves.

In 2000, the WHO recommended the use of artemisinin for the treatment of malaria. To date more than 200 million people have been treated using Tu's discovery. In 2015, Tu became the first Mainland Chinese scientist to receive a Nobel Prize in a scientific category.

Tu Youyou Videos

ITV news section on Tu Youyou receiving her Nobel Prize https://youtu.be/S0_SbojHGeo

Short biography on Tu Youyou and her discovery . https://www.youtube.com/watch?v=JZQc9S12ZvM

Short cartoon explaining what causes malaria https://www.youtube.com/watch?v=PGiqxnAr2fQ

Suggested Tasks

Cabbage pH Indicator

Tu used plants and traditional medicine to create her malarial cure. Plants have many uses in our society, beyond the obvious of eating or as CO2 absorbers. One example is the use of red cabbage as a simple pH indicator. Knowing whether a substance has a high or low pH is incredibly important in many areas such as medicine (our blood, for example, has a neutral pH, we don't want to be injecting substances that may alter this) or agriculture (particular plants prefer different pH soils, for example Blueberries grow better in acidic soil).

You'll need: one red cabbage (roughly chopped), a large bowl, kettle, sieve , beaker or cup, 4 test tubes or smaller cups, syringe/pipette, lemon juice, baking soda, vinegar, Rennies.

Make it: put the cabbage into the bowl and pour the water over it. Leave to cool. Strain the cabbage and water, saving the water—this is your indicator. Place into a beaker or cup. Create solutions using the baking soda and water and the Rennies and water. Pour each solution plus the lemon water and vinegar into each test tube (I.E one test tube of lemon juice, one of vinegar, one of baking soda solution and one of Rennies solution). Using a pipette or syringe (or pouring if you have a steady hand), add some indicator to each test tube. They will change colour depending on the pH of the liquid inside. A guide to the colours and pH can be found here https://www.compoundchem.com/2017/05/18/red-cabbage/. A neutralising experiment can also be done by adding a weak acid to a weak base—it should return to a purple colour.

CfE links: SCN 2-02b, SCN 3-18a

Lifecycle of Mosquito

Using the attached video (https://www.youtube.com/watch?v=PGiqxnAr2fQ) and the life cycle of a mosquito resource (https://www.cdc.gov/dengue/resources/factsheets/mosquitolifecyclefinal.pdf), pupils could design a poster detailing a mosquito lifecycle and how this relates to malaria. Additionally, pupils could highlight the parts of a mosquito lifecycle that are dangerous in the transmitting of malaria and discuss/demonstrate ways to reduce the prevalence of malaria.

CfE links: SCN 2-14a, SOC 3-08a. SOC 3-10a

Managing Malaria

Free STEM Learning account must first be created

A role play lesson aimed at secondary level where pupils are charged with the challenge of eliminating malaria from an endemic area. Pupils are given a range of solutions which they must research before creating a proposal and presenting it to the class.

https://www.stem.org.uk/resources/elibrary/resource/29834/malaria-challenge-managing-malaria

CfE Links: SOC 3-08a, SOC 3-10a, SOC 4-10a, SOC 4-12a, SOC 3-16a, HWB –09a (all levels), LIT 3-02a, LIT4-02a, LIT 3 -05a, LIT 4-05a, LIT 306a, LIT 4-06a,

Hayat Sindi

Hayat was bon on the 6th of November 1967 in Mecca, Saudi Arabia. She recalls that at an early age she was inspired by Arab scholars such as Averroes and the National Geographic magazine. In a deeply conservative country, Hayat was lucky to have parents that encouraged her love of learning and allowed her to travel, alone, to pursue her studies.

In 1995 Hayat graduated from Kings College London with a degree in pharmacology before heading to Cambridge University where she became the first woman from the Persian Gulf to receive a PhD in biotechnology.

Hayat has a strong desire to more closely link science and social impact. This desire led her to co-found a non-profit organisation called Diagnostics for All. This organisation creates portable and affordable medical devices for diagnosing diseases. These devices are used in areas of the world where access to hospitals and scientific labs is difficult. They require no power, water or trained doctors yet provide diagnosis' in minutes, allowing thousands of people to receive treatment for many diseases and conditions.

Hayat Sindi Videos

Ted talk by Hayat Sindi on the potential of science for social impact

https://www.youtube.com/watch?v=-a9YziNtntU

Short video where Hayat Sindi talks about Diagnostics for All https://www.youtube.com/watch?v=5UX5bGvbSi8

Suggested Tasks

"Science was born to solve problems"

Hayat Sindi believes that "science is born to solve problems". She became a scientist because she wanted to solve the problems of the world. Discuss what scientific skills and knowledge your class have, what problems could this solve? Can they create a new, simple idea using science to solve some of the problems in their neighbourhood or another part of the world? This could also be linked to the UN Sustainable Development Goals.

CfE links: EXA –6a (all levels), TCH1 – 04d, 2-04d and 4-04d, TCH –09a (all levels), TCH—11a (all levels)

Potato Powered Clock

Hayat's life's work has been to use technology and science to create simple solutions for every day problems, particularly where resources may be too expensive or non-existent. In the spirit of this goal, pupils can power a small clock using some basic materials. This demonstrates that by applying scientific knowledge, solutions out with the normal can be found. In this experiment, the potatoes work as cells, releasing electrical energy through chemical reactions. Wiring the potato cells together creates a small circuit.

You'll need: 2 large, clean potatoes, two galvanized zinc nails, 2 copper wires, 3 jumper wires (with the crocodile clips on the end) and a battery powered LCD clock

To make: label the potatoes—one "A" and the other "B". Stick one nail into each potato. Stick a piece of copper wire into each potato (as far away from the nail as possible). Remove the battery from the clock. Connect the first jumper wire to the positive terminal of the clock and the copper wire in potato A. Connect another jumper wire to the negative terminal of the clock and the copper wire in potato B. Connect the final jumper wire from the nail in potato A to the nail in potato B. The clock should now be running.

CfE links: SCN 1-09a, SCN 2-09a, SCN 2-10a, SCN 3-10a,

Edible Water Bottles

Hayat firmly believes that science should be used to help solve problems. One of the biggest problems facing us today is the increase in use of nonreusable plastics, such as that in disposable water bottles found in the School Dinner Hall. In the UK, we use more than 3 billion litres of bottled water each year—enough to fill more than 1000 Olympic swimming pools. By using some simple ingredients, pupils can make edible (or if they chose not to eat them, completely biodegradable) water bottles using alginate. Alginate is a product that comes from brown seaweed, it is a jelly like substance the seaweed produces that helps it stay subtle and strong so that it isn't torn apart by waves, it also protects the seaweed from drying out when the tide goes out. Instructions on how to make these water bottles can be found at https://www.thoughtco.com/make-an-edible-water-bottle-607470

all ingredients can be found on Amazon

CfE links: SCN 2-15a, SCN 2-19a, SOC 2-08a, TCH 2-06a, TCH 2-12a