Radiation

Learning Objectives:

- To know that other kinds of rays exist, beyond the visible spectrum;
- To know that our eyes can only detect light in the visible spectrum;
- To know that some of these rays are harmful to us;
- To know how to protect our skin from harmful UV rays.

Science Skills:

- Making a reasoned prediction;
- Designing a simple test;
- Collecting a set of results;
- Using the results to answer a question;
- Evaluating the test design.

Resources:

- Marie Curie PowerPoint
- UV colour changing beads - 20 per group of children (available on Amazon)
- A selection of materials including fabric, clear plastic and aluminium foil, darker fabrics with a loose weave and paler fabrics which are thick – enough for 4 pieces of materials per group
- Squared paper for bar charts – one per child

WHAT YOU NEED TO KNOW BEFORE YOU START

Marie Curie (born as Maria Skłodowska) was born in Poland in 1867. Her father was a physics teacher and her mother ran a boarding school and they were keen to educate their own children. Maria was a good student and enjoyed learning. However, as a woman, she could not go to university, so she joined a secret organisation called 'The Flying University' (or 'Floating University), an organisation which allowed women to study but changed the locations of the lectures to prevent them being discovered by the Russian authorities, who controlled Poland at that time.

In 1891, Marie attended The Sorbonne' in Paris where she gained a degree in maths and a degree in physics. She also met and married her husband Pierre Curie in Paris and together they embarked on their studies of radioactive materials. It was Henri Becquerel, who in 1896, showed that uranium salts would interact with photographic paper, leaving a black smudge on the paper, even through the thick black wrapping. He correctly concluded that this was evidence of radioactivity. Marie Curie was fascinated and embarked on a massive project to find out if any other materials emitted this kind of radiation. Pierre soon joined her and together they discovered two new elements – radium and polonium. In 1902, they managed to make a tiny, 0.1g pure sample of radium chloride but they had to process a tonne of pitchblende (a mineral) to get it.

In 1903, Marie and Pierre Curie, along with Henri Becquerel, were awarded The Nobel Prize for their work in this area. It was originally an honour only given to men but after Pierre complained and pointed out that Marie had been fundamental to the whole study, she became the first woman to receive the accolade. In 1906, Pierre was killed in an accident, leaving Marie and her two young daughters bereft but Marie continued with her studies and even took over her husband's job as a university professor and became the first female professor.

In 1910, Marie finally managed to isolate pure radium and was honoured again in 1911 with a Nobel Prize for chemistry for her discoveries in this field.

WARM UP

Show the children the first slide on the *Marie Curie PowerPoint.*
Ask:

- Can you think of anything that glows in the dark?

Generate as many ideas as you can for things which glow. Accept all offers – especially if they suggest nuclear waste or radioactive materials. Write all the ideas on the board. Then eliminate (rub out) all the ones which require electricity and see what you are left with. Depending on the life experiences and background knowledge of the group, you may end up with some of the following:

- Glow stars
- Glow sticks
- Angler fish
- Fire-fly
- bioluminescence
- Radioactive material
- Fire
- Candles
- Embers
- Stars
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Watch this video about animals which glow:
https://www.youtube.com/watch?v=x5mNhsMT8R0

You could also watch this video about how bioluminescence is beautiful but indicative of climate change:
https://www.youtube.com/watch?v=oKjFVBVGad0

Show *Slide 2* of the *Marie Curie PowerPoint.*

Then show the children the giphy on this link of Homer Simpson:
https://media.giphy.com/media/3o6MbixkqyjwdsVH20/giphy.mp4

Tell the children:
In reality, only a few radioactive materials create a glow and only in certain conditions and they don't necessarily glow green.

INTRODUCTION

Watch this video:
https://www.youtube.com/watch?v=8nCbI-Jj8ZI

Show the children *Slide 3 of the Marie Curie PowerPoint.*

Discuss how electromagnetic radiation comes in many forms and we can only see some of it as light.

- Radium makes the air around it glow with a pale blue glow.
- If mixed with other chemicals, you can make a paint which glows green.
- Polonium makes the air around it glow pale blue.
- Uranium, in nuclear reactors under water, will glow blue – see *Slide 4 of the Marie Curie PowerPoint.*

Now watch this video on Marie Curie:
https://www.youtube.com/watch?v=w6JFRi0Qm_s

Notice that the illustrators have given all the images a characteristic green glow which has become the shorthand for radioactive materials.

Show *Slide 5*.
Tell the children:
This is Uranium. It doesn't look as exciting as you might expect! We are going to investigate UV radiation. This is invisible to our eyes although bees can see it. It is a smaller wavelength than X-rays and Gamma-rays so it is safe to work with. UV light is the part of sunlight that gives us sunburn. Marie Curie and her daughter both suffered with the damaging effects of radiation from the radioactive materials with which they worked. UV rays can also damage our cells, so we need to protect ourselves from them.

Lead will block X-rays. Which materials will block UV light?
Show the children:

- UV colour changing beads (available on Amazon) in a dark bag or box so they are not exposed to UV light to begin with.
- A selection of materials including fabric, clear plastic and aluminium foil. You should also include darker fabrics with a loose weave and paler fabrics which are thick.

Allow some time for the children to handle the beads and watch the colours change. This happens really fast in strong sunlight. They will change back more slowly so allow time for this to happen. Cooling the beads speeds up the transition.

Explain the task:
You are going to find out which of these materials is the best UV blocker. The better the blocker, the paler the beads. You must design a way to test these materials using the beads to tell you how much UV passes through them. (The simplest arrangement is to place some beads under different pieces of fabric and then place them in a sunny place for a while. They should be white when they go under the fabric so you may need pull down the blinds and shade the area in which the children are setting up the experiment.)

Ask the children to record:

- A prediction of which material will make the best blocker
- A diagram of how the experiment was set up
- A table of results
- A bar chart of their results
- An answer to the question "Which is the best UV blocker"
- An explanation of why this material is a good UV blocker. (Is it the colour? Is the thickness? Is it the tight weave?)

Ask:

- What did you find out?
- Did you have to change your experiment at any point?
- Do you trust your results? If not, why not?
- Which fabric would you use to make summer clothes, to wear on a hot sunny day to protect your skin?

EXTENSION

You can also test different brands of sun-cream by smearing it over a plastic bag of UV beads. Or you can test sunglasses in the same way. You may want to extend this task by testing these as well.

REVIEW

ALL: children can design a simple test and collect a set of results and say what their results indicate.
MOST: children can evaluate their experiment design and explain how to protect their skin from UV rays.
SOME: children can explain that light and UV and X-rays are all forms of radiation but only are harmful.