Teacher Handout | **SPECTROSCOPE**

Dear Teacher

We have a colourful STEM challenge for you. We would like you and your class to make a SPECTROSCOPE. These instructions are to guide you rather than tell you exactly what to do – we want you and the class to create your own unique designs!

We would really like to see your designs! If you have time, send a photo of your creations to craftmaker@mic.ul.ie or tag the CRAFT Maker Space, Research Ireland and, Science week across our many social media channels.

Science Content Included in this Activity:

Light refraction and dispersion

White light is made up of all the colours in the rainbow. If you shine white light through a prism, it slows down and **bends (refracts)** and this bending causes the light to separate into its component colours (all the colours of the rainbow). This is called **dispersion.**

When you see a rainbow, you are seeing rays of light from the sun that bend (refract) and disperse, into its component colours, when it passes through rain drops.

How Does a Spectroscope Work

Light hitting the shiny underside of a CD reflects in a different way. All the colours reflect but each one bounces off in a different direction. The different colours spread out to form a spectrum.

A viewing window lets you see and examine the spectrum or range of colours present in the light.

Scientists use a spectroscope to study the range of colours (the spectrum) in different kinds of light.

Chemists can identify which different elements are in different substances by using spectroscopes to study the light they give off when burned. Sodium burns: Yellow, Copper burns: Bluish/Green, Lithium burns: Crimson Red.

Astronomers also use spectroscopes to study light from stars. From lines in the spectrum, they can tell which elements are present and so they can investigate the chemicals found in objects trillions of kms away.

The Challenge

Design and build a spectroscope to observe and examine the spectrum of light from a light source.

The Engineering Design teams will be required to brainstorm, imagine and draw their possible designs, build their prototypes, test them, modify where necessary, and re-test their spectroscope.

Questioning

What do you think a spectroscope does?
Why do you think we are using a CD in the design?
Why do you think the black card is needed?
What do you think will happen when light travels down through the tube and hits the CD?

Identify Criteria & Constraints

Engineers look at challenges through the lens of criteria (what does my device have to do?) and constraints (what are the limitations I face in making, testing, and using the device?). Discuss what the criteria and constraints of this challenge are.

The Spectroscope must

- Split light into a visible spectrum: show the colours such as red, orange, yellow, green, blue, violet.
- Be safe to use: no sharp edges or dangerous materials.
- Be portable and easy to carry: small enough to hold or carry.
- Allow clear viewing of the spectrum: the user should be able to see the colours clearly.
- Include a light entry slit and a viewing window.
- Be designed using only the materials provided.

How to Make Your Spectroscope

1. Gather all your materials

- Black electric tape
- Scissors
- Torch
- Pencil
- Old CD
- Black card
- Cardboard tube
- Ruler

2. Imagine

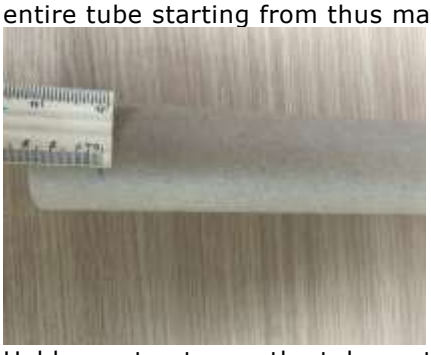
Using the materials provided, ask the Engineering Design teams to imagine and sketch their designs.

3. Plan and Design
Gather all materials and plan how your design will be constructed.

4. Create
It is time to build the spectroscope.

Watch the Science Week video from the CRAFT Maker Space at Mary Immaculate College.

Part 1:
Using a pencil, mark 3 cm from one end of the cradboard tube. Wrap black card around the tube at this mark. Use it as a guide to draw a line around the entire tube starting from thus mark.



Hold a protractor on the tube so that the protractor's zero line runs along the pencil line on the tube. Mark the angle at 30 degrees. Move the protractor and mark another 30 degree angle in the other direction. Extend both lines (30 degree angles) so that they meet the line that goes around the cardboard tube, forming a triangle.

On the oppositite side of the tube from the triangle, draw a rectangle 2cm high and 1 cm wide above the pencil line.

Cut along the two slanted lines so that you end up with an angled slot. This is where you will slide in the CD.
Now carefully cut out the small rectangle (viewing window) at the other side of the tube.
Push the CD into the angled slot with the shiny, bottom surface facing upwards.

Secure the CD in place using black electrical tape.
Using strips of tape to close off the end of the cardboard tube closest to the CD. Make sure no light can get into the tube.

Part 2:
Draw around the open end of the tube onto a black piece of card using a pencil. Cut out around the circle ~ 2cm beyond the circle drawn.
This circle of card will cover the open end of the tube. To make a slit in the circle that will leave in light, fold the circle in half and cut a line in the middle of the circle using the fold as a guide. Unfold the circle and cover the open end of the tube with the circle, securing it with black tape.

Questioning
What challenges are you facing while building? How are you solving them?

Your spectroscope is now ready to use! Shine a torch into the top slit and look through the viewing window to see the spectrum.

Safety

When you use your spectroscope hold it close to your eye and cover your other eye with your hand. Never look directly at bright lights. Never use the spectroscope to look at the sun.

5. Test and Evaluate

Questioning

What do you see when you look at a light source through your spectroscope?

6. Modify (if required)

Think about:

- *What part of your spectroscope could be improved to make the spectrum clearer?*
- *If you could add one new feature to your design, what would it be and why?*
- *Could we make the inside of the tube darker?*

The teams can also add any other decorations to the outside of the spectroscope at this point.

The design could be improved by sticking black card to the inside of the tube or painting the inside of the tube black before the challenge.

Extension Activities

Think about:

- Try using different light sources?
- Do they all show the same spectrum?

The CRAFT Maker Space at Mary Immaculate College Limerick

CRAFT at MIC is a dynamic STEAM engagement centre that delivers inclusive, hands-on educational experiences to children, families, educators, and communities across the Mid-West Region of Ireland and beyond.

Through workshops, camps, CPD courses, and public events—delivered both on-campus and in schools, libraries, and community spaces, CRAFT promotes equity of access and builds capacity among educators. Activities include engineering challenges, coding, robotics, 3D printing, and much, much, more.

To find out more and to avail of our STEAM workshops for your school click on our website at: https://stemcraft.mic.ul.ie/

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