STEM Program

Cool Camp Shirts

Light Waves and Refraction

Challenge Scenario: You're packing your clothes to go to a summer scout camp. What is the best shirt colour to wear to keep you cool?

Suited to Section

Joey Scouts | Cub Scouts | Scouts | Venturer Scouts | Rover Scouts

Challenge Area

COMMUNITY | PERSONAL GROWTH | OUTDOORS | CREATIVE

Key SPICES Growth

SOCIAL | PHYSICAL | INTELLECTUAL | CHARACTER | EMOTIONAL | SPIRITUAL

Likely Scout Method Elements

COMMUNITY INVOLVEMENT | LEARNING BY DOING | NATURE AND THE OUTDOORS | PATROL SYSTEM

PERSONAL PROGRESSION | PROMISE AND LAW | SYMBOLIC FRAMEWORK | YOUTH LEADING, ADULTS SUPPORTING

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Plan

Equipment:

1. Temperature gun
    i. Infrared thermometer (not a forehead thermometer as it doesn't have enough temperature range)
    ii. These can be sources from hardware stores or e-shops
    iii. They are a great investment for lots of different experiments
2. Coloured cardboard samples – white, yellow, red, blue, black
    i. A cheap source of these can be single colours paint swatches from hardware stores
3. Get your unit to bring along different colours shirts of their favourite camp shirt(s)
4. Paper and pen to record your results

This activity needs to be completed outside in the sun. Maybe you could test it at a Scout camp or day patrol activity.

Do

This is a great video to look at before you plan this activity. https://www.youtube.com/watch?v=ydfeJQ2cWv0 Time point in video 9-11:20min.

1. Spread out your cardboard and hang out your shirts in the full sun
2. Use the temperature gun to measure the temperature of each one immediately
3. Repeat this twice for each piece of paper and shirt.
4. Record each measurement on your paper.
5. Now wait half an hour
6. Re-record measurements
7. Wait another half hour or hour
8. Re-record measurements

Review

1. Was there a difference in the temperatures at the start?
2. Did it change over time?
3. What was the colour that changed temperature the least?
4. What was the colour that became the hottest?
5. Which coloured shirt would you pick to wear to camp based on these results?
6. Is the best temperature colour the one your mother would approve of? Are there other factors that might impact how cool a camp shirt stays aside from colour?

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Plan

1. Learn about sound and how it travels. Sound travels in waves, you could use a slinky to help visualise how sound waves move.
2. Investigate the structure of the human ear. What parts can you see? What parts can't you see? What does each part of the ear do? Try labelling a picture of an ear, or for a challenge, see if your patrol can come up with a creative model of the ear using items in your scout hall.
3. Investigate ears in nature. Are all ears the same? Why are human ears different from dog ears? Why does the human ear look the way it does?
4. Investigate ear trumpets. What do they look like? What do they do? Why did people use them?
5. Collect the materials required for the activity. Communicate with your patrol and leaders if you need to bring items from home.
6. Read the safety requirements and discuss with you leaders/adults supervisors what supervision and safety requirements might be needed.

Do

1. Build a basic ear trumpet by making a cone with construction paper. Roll the paper into a cone and use sticky tape to hold it in place. Your cone should have a large hole at one end, and a small hole at the other.
2. Test your basic ear trumpet using some very quiet music. Your music should be faint when listening without your ear trumpet. Hold your ear trumpet up to your ear and observe how it affects the sound. Does it make the music louder or quieter? Should you point the large hole or the small hole towards the sound source? What size holes work best?
3. As a patrol, engineer the best ear trumpet you can. Work through the engineering process: ask, research, imagine, plan, create, test and improve. Remember: the goal is to build an ear trumpet that helps make sounds louder. Think about what resources you could use, and what materials will work best. How can you make your ear trumpet both functional and usable?
4. Remember, in STEM we have to be creative! Think outside the box when designing your ear trumpet to come up with the best solution. Younger sections may think about decorating their ear trumpets. For older sections, when decorating your ear trumpets remember that their purpose is to function as a hearing aid. Consider if the appearance of your ear trumpet reflects its purpose.
5. Come up with a method for testing your ear trumpets. Do you think you should test the same sounds or different sounds as you build your trumpet?
6. Share your ear trumpet designs as a unit. Consider the differences between your ear trumpets. Think about what worked well and what still needs to be improved.

Review

1. What have you learnt about sound during this activity? How do our ears work to hear sound?
2. Hearing aids are the modern day version of an ear trumpet. What type of things would engineers need to think about when they design hearing aids?
3. What are ways your unit could learn more about deafness and the deaf community in Australia? Plan an activity that will allow your unit to learn more about deafness or being hard of hearing. Perhaps you could take an Auslan course, explore what accessibility means and how your community can improve, or invite a special guest to share with you their experiences.
4. If you were to do this activity again, what would you do the same? What would you do differently? What did you enjoy most about this activity?

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Variations

- Can you test more colours?
- Can you test the same colour but different fabrics?
- Can you test in winter sun versus summer sun?
- Can you test for different amounts of time?
- Can you use other coloured substances?
- Can you test the effect of temperature without an infrared thermometer?
- Can you plot a graph of the differences?

Variation resources

- https://www.youtube.com/watch?v=61JT9SYBk4A – if you don't have a temperature gun then this is a simple alternative using ice cubes but you won't be able to test your own shirts.
- https://www.raisingglobalkidizens.com/heat-absorption-experiment-for-kids/ - a variation using thermometers & painted jars
- https://raisinglifelonglearners.com/does-color-affect-temperature/ - a variation using coloured water & food thermometer
- https://kidscraftroom.com/sweet-wrapper-science/

Can you use your infrared thermometer for other experiments?

- Soil temperature in garden across the day
- Water temperature in different locations/different times of day
- Best insulating camp esky
- Temperature of different ground covers eg road, concrete, grass etc.

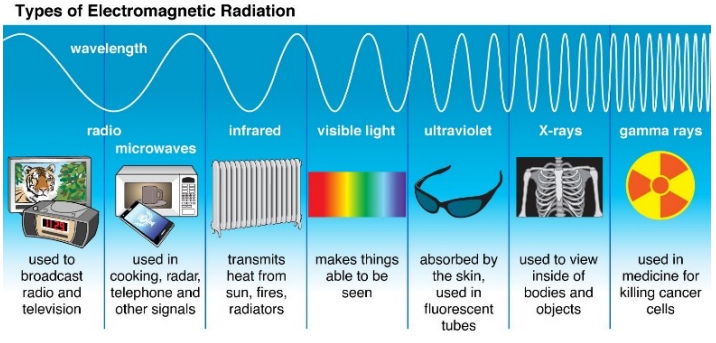
Safety Tips

- Remember that this activity is out in the sun so Slip, Slop, Slap, Slide.

Why Does This Happen?

Useful Science Terms:

- Electromagnetic Spectrum – Light travels in waves of different lengths and these make different colours



https://www.britannica.com/science/electromagnetic-spectrum

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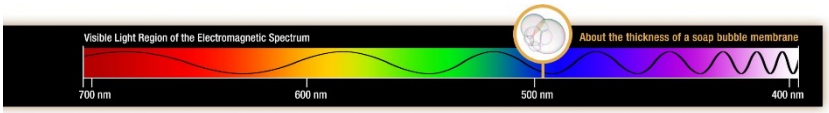
Why Does This Happen?

- Light waves –
    - Light vibrates in a wave pattern as it moves.
    - The size of the wave is known as a frequency (how often the wave repeats in a time)
    - Some of these waves we can see – Visible Light Region (rainbow)



https://science.nasa.gov/ems/09_visiblelight

- White light – is a mixture of all the different wavelengths of the visible light spectrum
- Radiation – light is a form of radiation
- Absorption – happens when light goes into a material. It's like water being soaked up by a dry sponge. The darker the colour, the more light absorbed.
- Reflection – when light bounces back. Like off a mirror. Reflection is the opposite of Absorption.

Why do I see colour?

Only light waves in the Visible Light area of the electromagnetic spectrum can be seen by the naked eye. When you see one colour this is because the material is reflecting that light wave and absorbing all the others.

How are colour and temperature related?

When light waves are absorbed by an object, the object converts the light waves into heat waves which causes the temperature of the coloured item to rise.

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SciScouts Physics of Waves

The SciScouts Physics of Waves is a National Science Week project, undertaken in collaboration with Fizzics Education. These instructions were prepared by Scouts for Scouts. This National Science Week project is supported by the Australian Government.

Scouting has always been strong on STEM skills. Maths to calculate catering quantities and navigate, the science of water purification, the physics of abseiling, and the engineering of pioneering structures – they all have their place. In the current program for our youth members, STEM and Innovation forms one of six Special Interest Areas that enable Scouts to set goals and pursue their own ideas.