Lesson 7

Can you hear me?

Communication through space

Curriculum links

England Sound | Uses of materials
Scotland Vibrations and waves
Wales How things work-sound | Enquiry skills
Northern Ireland Properties of materials and their uses

Artist rendition of CLUSTER spacecraft. Copyright: NASA

Background

ESA's four Cluster spacecraft have found that Earth and other planets with magnetic fields such as Jupiter and Saturn emit radio signals that travel through space in a narrow beam. These messages can only be detected and understood by using large radio telescopes.

In this activity, the children model different ways of sending messages across distances including the journey of radio waves through space, they work scientifically by investigating string telephones and listen to Earth's natural sounds.

Objectives

To learn:

- electromagnetic waves travel through space
- scientists collect these waves by using radio telescopes
- these waves are then changed into sounds
- to work scientifically by predicting, setting up a fair test, collecting and interpreting data

Resources per group of four

Disposable cups x 2
Cans x 2
String
Wire
Nylon thread
Metre stick/tape measure
Activity Sheet 2a

Resources for teacher demonstration

Airzooka or cardboard box
Length of aluminium foil
Polystyrene cups
Soft balls of different colours
Umbrella

An airzooka can be purchased online or made from a cardboard box if a commercially bought airzooka is not available. (See teacher information)
Have an analogue radio at hand.
Make a small hole in the base of each can and cup.
Teachers may wish to prepare role badges for 'radio astronomers' for this investigation.

Activity a To investigate ways of sending messages across a distance

Introduction

Start the lesson with a demonstration to capture imagination. Set up a line of string across the classroom and suspend a length of aluminium foil from the string or have one of the children hold up the foil. Use an airzooka to send an airwave across the room to vibrate the length of foil. Next, ask volunteers to place a polystyrene cup on their heads. Aim the airzooka at each cup and fire, causing the cups to wobble and fall. Can the children explain what they think is happening? (Clashing cymbals can also be used to demonstrate producing an airwave to put out a candle flame.)

Explain that although we could not see the air moving across to the foil or cup, we could see or feel the result of that movement. Similarly we cannot see radio waves travelling vast distances across space but we know that they are there once they are collected and changed into sound.

Ask the children if they can think of ways to send messages over a distance here on planet Earth. Discuss their suggestions. Show the children two simple items – paper cups and string – that could be used to send a message. Can they suggest how? Challenge them to test their ideas. In pairs, the children explore sending messages using paper cups and string. In groups, they identify the variables that could be changed and plan how they might set up an investigation. They may like to use Activity sheet 2a , (from lesson 2) to support their planning to answer such questions as:

Does the length of string/type of string affect the sound received?

What happens when the string is taut/loose?

Does the type or material of the cup have an effect?

Will the string telephones work around corners?

The children collect and record the data and share their results with the class.

Which type of string or cup would they recommend and why?

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Plenary

Explain that sounds are produced by vibrations that can travel through air, solids and liquids. Vibrations produced from speaking into the cup travel along the string to reach the second cup; air in the cup and bones in the skull vibrate and these vibrations reach our ears. Our brains decipher this information into recognisable sounds. The following short video could be used to consolidate learning: https://www.youtube.com/watch?v=HMXoHKwWmU8

Activity b Investigating radio waves

Introduction

Emphasise that radio waves are very different from sound waves. Explain that electromagnetic waves can travel through space without air being present. Some of these waves are called radio waves. Scientists have found a way of collecting the radio waves and turning them into signals which travel to our ears.

Activity

Next, the children model the journey of electromagnetic waves through space to the radio telescope. Using soft balls of different colours to represent the electromagnetic waves, volunteers on one side of the room throw the balls towards the 'radio telescope', an opened umbrella held concave side towards the class by a volunteer at the other side of the room. Choose one of the colours to represent the useful radio waves. When all the balls have been thrown, only the balls of the chosen colour 'caught' by the umbrella are kept, whilst the others are removed. Explain that a lot of radiation, represented here by the various coloured balls, is emitted by stars, represented by the children, and travels through space; it is collected by the radio telescope, represented by the umbrella. Only radiation of certain wavelengths, called radio waves, can be used by the telescope, where it is changed into signals that we can understand.

Teacher demonstration

Use an analogue radio to let the children experience the sound we hear when a radio station is not tuned in and how tuning produces a clear sound. Similarly, we would be unable to make sense of radio waves unless their energy was changed into vibrations that we hear as sounds.

Plenary

Explain that Earth and other planets have a way of shouting "I'm here!" to the rest of the Galaxy. However, the messages can only be heard and understood by using large radio telescopes. Listen to a recording of Earth's natural 'sounds': http://www.esa.int/esaKIDSen/SEM5QPSHKHF_LifeinSpace_0.html

Extension

Enthusiasts could build or buy a transmitter to enable the children to send messages.

The children could also make their own radio recording.

Morse code could be researched. There is an iPhone app called Morse-It that translates text into Morse beeps or flashes. The children might construct an electrical circuit including a buzzer and send messages using the patterns of Morse code. An LED lamp could be substituted for a buzzer. Alternatively a torch could be used to send messages as patterns of flashes. Explain that light can be used in this way to transfer information.

A	·–	J	·–––	S	···	1	·————
B	–···	K	–·–	T	–	2	···–––
C	–·–·	L	·–··	U	··–	3	···––
D	–··	M	––	V	···–	4	····–
E	·	N	–·	W	·––	5	·····
F	··–·	O	–––	X	–··–	6	–····
G	––·	P	·––·	Y	–·––	7	––···
H	····	Q	––·–	Z	––··	8	–––··
I	··	R	·–·	0	–––––	9	––––·

Morse code shown on above chart

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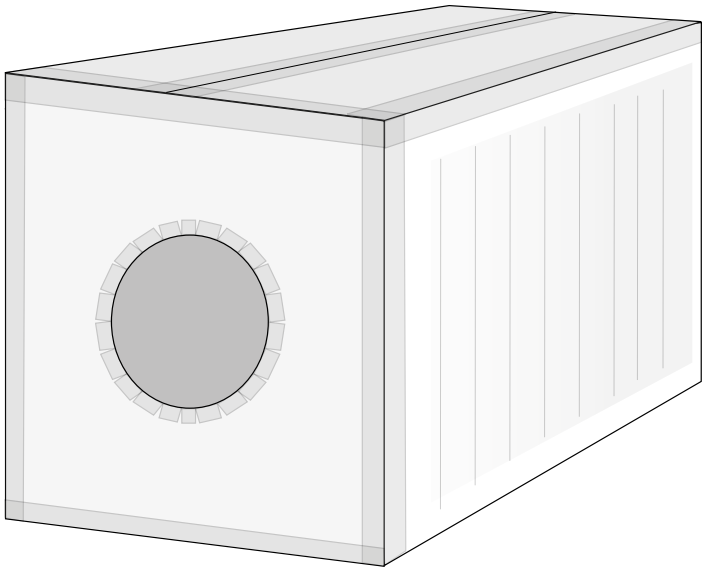
Teacher information

Objects in space, such as planets, exoplanets, stars, dust and gas emit electromagnetic waves at many different wavelengths. Some of the light they emit has very long wavelengths, some as long as a mile. These long waves are known as radio waves and are part of a larger group of waves classified all together as the electromagnetic spectrum. Since the radio waves are so large, special telescopes called radio telescopes are used to capture them. They are much larger than the telescopes used to capture visible light. These huge telescopes are pointed towards the stars or planets and astronomers can learn about their structure, motion and composition by studying the radio waves originating from them. Astronomers can use instruments to convert the radio waves into sounds and pictures.



To make an airzooka
You will need:

Cardboard box
Tape
Scissors
Compass
Pen

Completely seal all edges of the box. Draw a circular hole in the centre of one side of the box, cut it out and seal the edges of the hole with tape. Hit opposite sides of the box simultaneously with your hands, forcing air to travel out through the hole. Direct the escaping air towards a target, such as a pile of paper cups and try to knock them down.