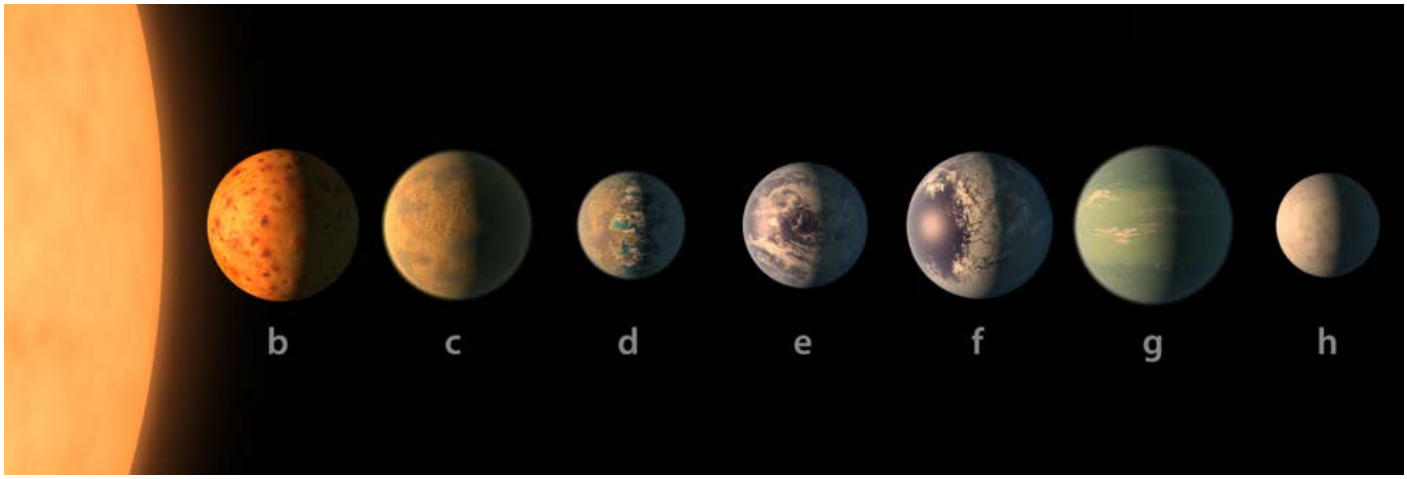
Lesson 8

Making music 'exoplanet style'

Curriculum links

England Sound
Scotland Vibrations and waves
Wales How things work-sound
Northern Ireland Sound



TRAPPIST-1 System - Illustration Copyright: NASA

Background

The Spitzer Space Telescope recently revealed seven Earth-like planets astronomically named b, c, d, e, f, g and h, orbiting the TRAPPIST-1 star. The planets could be detected as they transited across the front of the star, periodically blocking a tiny bit of the star's light. There is a pattern to the way in which the planets orbit the star.

In this lesson, the children use everyday materials to make simple instruments such as pan pipes from straws, to produce seven notes and use their imaginations to devise melodies using permutations of those notes.

Objectives

To learn:

- sounds are produced by vibrations
- the pitch of a sound can be changed
- exoplanets may transit their stars in a regular pattern

Resources per group of four

Straws (preferably paper)
Scissors x 2
Bottles or jars filled to different levels with water
Drumsticks x 2
Elastic bands (various sizes)
Empty tissue box
Plastic rulers x 2

Lesson 8

Making music 'exoplanet style'

Advance preparation

Teachers may wish to prepare badges for the role of sound engineer.

Activity

Introduction

Introduce the children to the star TRAPPIST-1 and its seven planets, revealed by the Spitzer Space Telescope. (Show image of TRAPPIST-1)

http://cdn.sci-news.com/images/enlarge3image_4728e-TRAPPIST-1.jpg

Watch the animation of the TRAPPIST transits. The orbits have been speeded up to fit into a one-minute video.

http://www.spitzer.caltech.edu/explore/blog/371-Making-Music-from-Exoplanets

Explain that using the transit patterns of these seven Earth-like planets, a musician has composed some music based on the timing of these transits. He accompanied each planet transit with a musical note of the same name and added some simple background instruments and a drum track.

Give examples of some other exoplanet systems such as Gliese or Kepler, involving different numbers of orbiting planets.

https://exoplanets.nasa.gov/resources/174/

https://www.nasa.gov/ames/kepler/kepler-186-and-the-solar-system

The children cut the straws to make seven 'pan pipes' of different lengths, each having one pointed flattened end, producing a different note or vibration when blown through the flattened end. Can the children blow them in turn to make a melody? In groups, the children use the seven notes as a basic tune and add music of their own.

We have made music based on the TRAPPIST transit. Can they make a melody based on the other systems? They could try tapping bottles or jars filled with water to different levels, drumming, twanging rulers extending over the edge of a table or elastic bands stretched across an empty tissue box.

Can the groups compose a rap to accompany their rhythms?

Plenary

Each group performs its composition for the class. Can they suggest any improvements to the musical pieces?

In Lesson 7, the children learned that planets with a magnetic field produce signals that are detected by using radio telescopes. An alien race picking up Earth's natural radio signals will hear a series of chirps and whistles, a bit like listening to R2-D2, the robot from Star Wars!

Listen again to Earth's chirps and whistles on ESA Kids: http://www.esa.int/esaKIDSen/SEM5QPSHKHF_LifeinSpace_0.html

Listen to a clip from Star Wars, the five-note signature from the film Close Encounters of the Third Kind, or other space-themed music.

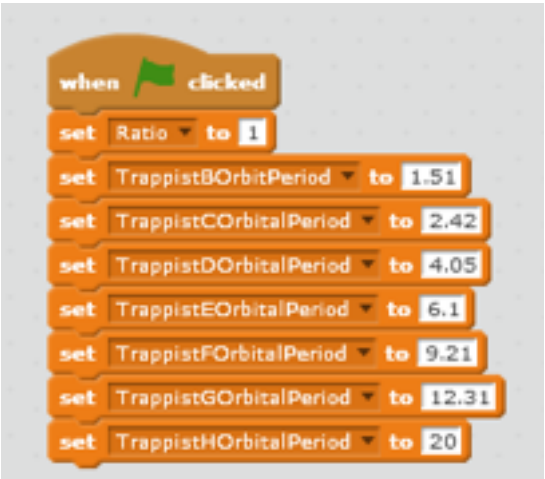
Extension

The children could be introduced to a computer program to produce their own musical compositions based on the TRAPPIST-1 orbiting pattern. Beatwave is an interesting app that can be used on the iPad. The app provides opportunities for composing simple rhythms, melodies, parallel melodies and adding background instruments.

Scratch program

Each of the Trappist-1 planets takes a different time to orbit its parent star. Kepler's Law tells us that the further away a planet is from the star, the longer the duration of the orbit.

In this Scratch project, the period of each orbit is proportional to the real orbital periods of the Trappist exoplanets. Each time a planet completes one orbit, the model makes a different sound.
https://scratch.mit.edu/projects/153216618/



The sounds are allocated as follows but are easily changed within the model:

B – Chomp
C – Boing
D – Cricket (chirp)
E – Meow
F – Alien Creak2
G – Bass beatbox
H – Goose

The time taken for each orbit can be found in the Scratch model and is given in seconds.

The ratio slider on the model can be used to give multiples of each orbital period. For example, if the ratio is set to 2, then the period for Trappist-1b will be 3.02 seconds, and for Trappist-1h will be 40 seconds.

Lesson 8

Making music 'exoplanet style'

Activities

Click the arrow: Identify the different noises being played. Put them in order (from shortest period to longest). Click stop to end the sounds.

Time each one: Create a table of orbital period (seconds). Check by clicking on each planet to play each sound on its own. The actual planet data can be found on Wikipedia here: https://en.wikipedia.org/wiki/TRAPPIST-1#/media/File:PIA21425_-_TRAPPIST-1_Statistics_Table.jpg

Children could model the orbits by walking around a 'star' and trying to time their orbits so that they pass by the same point when the sound of their planet is made. Physically modelling the orbits, each child representing a planet walking or running around a central star, might help them understand the planet's distance away from the star and the speed at which it is travelling in relation to the other planets. It may also help them to understand what they are actually doing with the Scratch programming activity – that the different noises represent a complete orbit. They would need to scale the distance of the orbits, otherwise some might take days to orbit, so a useful maths activity would be to create a suitable scale that could be represented in class. This would have to assume that they are all circular orbits. By playing with the ratio slider, the children can find the best option to enable all planets to safely complete their orbits. They calculate how long the period of their particular sound will be, then check.

Keen programmers could take this further by adding the orbits of the planets to the model. An example of circular motion in Scratch can be found here: https://scratch.mit.edu/projects/11439426/

Extension activities

Use the orbital period data to create a similar musical composition for our solar system and compare the two systems.

Create a Scratch animation of the exoplanets rotating around TRAPPIST-1.