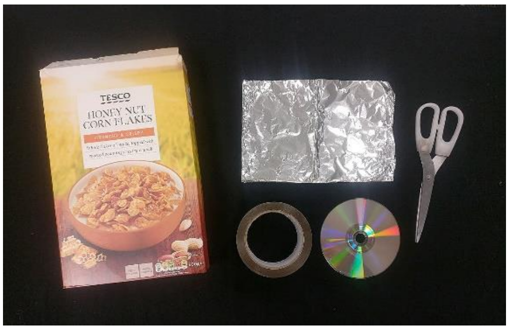
# USING SATELLITES TO STUDY EARTH: SPECTROMETER MASTER CLASS

SKYRORA

The following materials and tools will be required:

## MATERIALS AND TOOLS

A compact disc (CD or DVD)
Duct tape/parcel tape
4 to 6 light sources
Empty cereal box
Aluminium foil
Scissors



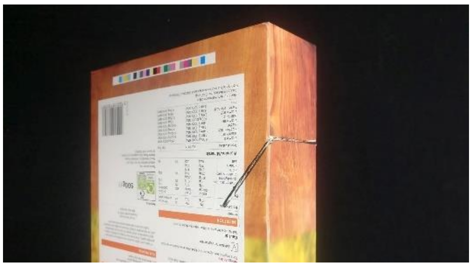

***This activity should be carried out under adult supervision***

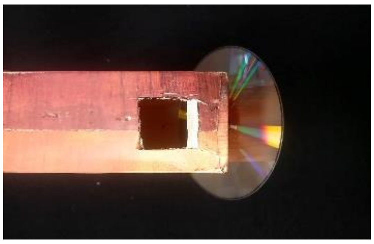
# ACTIVITY STEPS

SKYRORA

STEP 1

From the top corner of the cereal box, cut a line down each face of the box at a 30-degree angle. The CD serves as the diffraction grating, a device that splits coloured light into its individual wavelengths, much like a prism.





STEP 2

Cut out a small square on the top of the cereal box on the same side from where you cut the CD slits. This will be the viewing window.

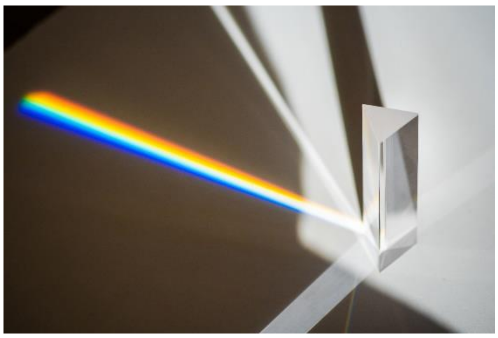
STEP 3

At the opposite end of where the CD sits, cut a small slit from left to right a few inches down from the top. This can be done lengthwise or widthwise on the box.

STEP 4

Use the aluminium foil to mend the slit as needed, leaving only 1 to 2 millimeters of open space for light to enter the slit. If the slit is too narrow, the spectra will appear dim. If the slit is too broad, the spectra will appear blurry.

Be sure the cereal box is sealed so that the only way light can enter is from the slit or the viewing window.



STEP 5

Point the slit toward the light sources to be explored – the closer the better. For sunlight, try reflecting the light off a white sheet of paper and changing the distance of the paper from the spectrometer. **Be certain not to point your device directly at the sun or put your eyes at risk!** There is enough light on a sunny day for the device to work indirectly.

# THE IMPORTANCE OF SPECTROMETERS IN SATELLITES

Technological innovations have made satellites an integral part of the climate change mission. Without precise data and other inputs provided by satellites, environmentalists and scientists would not be able to understand, analyse and predict the impact of climate change, and policymakers would not be able to formulate effective strategies for change.

A range of air pollutants can be inferred from satellite spectroscopy measurements by using the unique absorption signatures of gas species. Spectroscopy techniques greatly advance the comprehensive understanding of air pollution evolution, especially with the broad application of remote sensing.

Since the 1990s, spectrometers such as the Global Ozone Monitoring Experiment (GOME) and Ozone Monitoring Instrument (OMI), have achieved the global monitoring of atmospheric trace gases by using their unique absorption signatures. Methane is a prominent greenhouse gas and is responsible for about 20% of all atmospheric radiative forcing. As the planet continues to warm due to radiative forcing caused by greenhouse gases, understanding, monitoring, and reducing these emissions will become increasingly important.

In the coming decade, there is strong interest in a new generation of Earth observing satellites equipped with Visible and Shortwave Infrared (VSWIR) imaging spectrometers with finer spatial resolutions. These imaging spectrometers are sensitive to gas absorption features, which allows for the detection and quantitative mapping of methane, carbon dioxide, and water vapor. If these instruments can be used for methane mapping, the global monitoring of greenhouse gases will drastically improve.

Light plays an important role in aquatic ecosystems, both marine and freshwater. The penetration of light underwater influences various biogeochemical processes and influences activities and behavioural patterns of marine organisms. In addition, dissolved and particulate water constituents present in the water column absorb and scatter light, giving water its characteristic colour.

The concentration or abundance of these constituents, referred to as optically active constituents (OACs) also determine light availability underwater. Therefore, colour being an indicator of water column content, serves as a water quality parameter.

Monitoring of the ocean colour variables, such as the OAC concentrations and their optical properties, therefore, allows assessment of the health of an ecosystem. Advances in optical methodologies have improved the understanding of our ecosystems through spectrometry measurements and observations.

At Skyrora, the purpose behind the development of our launch vehicle suite is to enable the deployment of satellites into Earth's orbit to better benefit the environment and to meet societal needs. We understand the potential reach of using satellite technology in tackling the climate crisis and aim to facilitate this through the development of our rocket suite.

Skyrora aim to launch our orbital rocket from UK soil by 2023. The topic of launch within the UK since the Black Arrow programme ended in 1971 has been scarcely investigated. Since then, the UK space sector has almost entirely focused on satellite manufacture and development, with £200 million given to the European Space Agency every year from the government.

Satellite development provides an addressable market due to the vast number and quality of satellite manufacture in the UK compared to the lack of launch vehicles and government regulations that would enable launch from the UK. The satellite to launch vehicle market is currently rendered unequal, which Skyrora aim to rectify while assisting with the implementation of satellites for Earth observation and other beneficial purposes.