

Activity 4: Light and What it can tell Astronomers

Introduction:

What is light?

[Light](#) is a source of energy called electromagnetic radiation. The light that we see is called visible light, but visible light is only one small portion of a family of waves called electromagnetic (EM) radiation. X-rays, Gamma-rays, Infrared, and UV light are all examples of other types of light- or waves that humans cannot see with their eyes. Scientists use special instruments to “see” these other types of waves. Light waves travel in straight paths, and at very fast speeds- in fact, nothing can travel faster than light! The speed of light in a vacuum, like in space, is 300 million meters per second! What we are seeing when we see an object is reflected light. When light hits an object some wavelengths are absorbed by that object and some are reflected. Light of different wavelengths looks like different colors to us. When we see an object of a certain color that means that light of that color's wavelength is being reflected off the object. For example, when you see a red shirt, the shirt is absorbing all the colors of light except for the red color. The frequency of light that we see as red is being reflected and we see that shirt as red. Black and white are a bit different from other colors. White is a combination of all colors, so when we see white, the object is reflecting all the colors of light the same. Black is the opposite. When we see a black object that means almost all the colors of light are being absorbed.

How do astronomers use light?

Astronomers study the light of celestial objects to learn about their key characteristics such as what something is made of, how fast it is moving, or how an object is interacting with other things.

Telescopes have been an important tool for astronomers since the 17th century when Galileo first built one. Telescopes use lenses and/or mirrors to gather the light from far away celestial bodies, magnifying and focusing their image so that we can see them more clearly. Today, there are telescopes as big as 8 meters across, and even some telescopes in space!

Objectives:

- Recognize how astronomers and scientists use light in their research and to advance scientific knowledge
- Illustrate that visible light is made up of various wavelengths that relate to different colors
- Explain the components of a telescope and the effects they have in the tool

Vocabulary:

- light
- X-Rays
- Gamma-Rays
- Infrared
- UV Light
- Electromagnetic Radiation
- visible light
- Wavelength
- telescope
- objective lens
- eyepiece lens
- spectrometer
- prism
- spectrum

Activity A: Building cardboard telescopes

Materials (per group):

- paper towel roll
- toilet paper roll
- an objective lens
- an eyepiece lens
- tape
- cardboard scraps

Procedure:

1. Have students work in small groups to build their cardboard tube telescopes. Each group is given a paper towel roll (the telescope tube), a short cardboard toilet paper roll (the eyepiece tube), an objective lens, and eyepiece lens. Materials required to assemble the telescopes include tape and cardboard scraps.
2. Before building the telescopes, tell students **never to point their telescopes or lens at the Sun!!**
3. Instruct the students on how to assemble their telescopes:
 1. Tape the objective lens to one end of the long cardboard tube.
 2. Use cardboard scraps (or other available materials) as a support for the eyepiece lens inside of the smaller cardboard tube.
 3. Tape the eyepiece lens to the smaller cardboard tube, making sure that it's supported by something inside of the tube.
 4. Insert the smaller tube into the larger one and slide in and out until the image is focused.
 5. Older students can be asked figure out the magnification of their telescopes based on the focal lengths of their lenses.
 6. Let students observe objects through their telescopes and explain why the images are upside down, etc.

Activity B: Building cardboard spectrometers

materials (per group):

- Introduction:pre-cut CD/DVD (approx. 1/6 that has been stripped of any designs or content)
- cardboard tube
- 1/2 index card x 1/2
- tape/glue
- different types of flashlights

A spectrometer is a tool commonly used by astronomers which splits the light collected by a telescope into its colors. This allows astronomers see the details in the light from space. Astronomers know how to get a lot of special information about a space object by studying its light. By using spectrometers, we can find out the temperature of an object in space, learn which direction it is traveling, find out how fast it is

going, figure out its weight and even find out what it is made of. Spectrometers help us learn all of this from light!

Show students how the glass prisms disperse light into its constituent colors before starting the building activity.

Procedure:

1. Have the students form small groups, giving each group a cardboard tube, pre-cut CD or DVD piece, an index card, and tape.
2. Instruct them on how to build their spectrometers:
 1. Tape the CD/DVD piece to one end of the cardboard tube.
 2. Place the two pieces of index cards over the other end of the tube to cover the opening, but leave a small space between them for light to pass through. (This is the slit)
 3. Glue or tape the index cards in place
 4. Look through the end of the tube with the CD/DVD piece and observe different light sources and what their spectra look like. We will bring a few different types of flashlight to use for the comparison.