REPRESENTATIONAL COLOR

ACTIVITY INSTRUCTIONS

http://www.ncsciencefestival.org/starparty

OBJECTIVES

- Explore the use of representational color in images of Earth and space.
- Use representational color to present information outside the visible spectrum.
- Learn more about objects in space from their electromagnetic radiation.

SUGGESTED AGE RANGE

Ages 5 and up

ACTIVITY DURATION

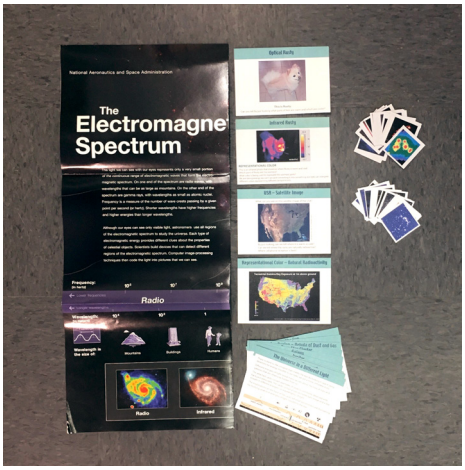
10-25 minutes

SETTING

Indoors or outdoors. Will need a well-lit space to see the cards. Choose a variation of the activity to fit your space and event needs.

MATERIALS

- Electromagnetic spectrum poster (https://www.sofia.usra.edu/sites/default/files/EMSPosterfinal.pdf)
- Rusty the Dog cards (optical and infrared)
- USA cards (satellite, radioactivity, cell phone reception, and temperature)
- “Universe in a Different Light” playing cards
- “Universe in a Different Light” postcard key on ring
- Optional, for large groups: computer and projector



PREPARATION

Display the electromagnetic spectrum poster near or on your table or workspace. Organize playing cards and other materials. If working with a large group, use the NotLikePhotos.ppt presentation with a computer and projector (refer to **VARIATION FOR LARGE GROUPS** and **MORE RESOURCES**).

PROCEDURE

1. Invite participants to the activity by showing them the card with the regular photo of Rusty the dog. Ask them: Can you tell—*only* by looking at the picture—which parts of Rusty are hot or cold? That is, don't use any other knowledge you might have about dogs. (No, you can't tell from the picture alone.)
2. Show the participants the infrared picture of Rusty. Ask: Now can you tell which parts of him are hot and cold? Which color is showing hot? Which color is showing cold?
3. Explain that the picture shows Rusty in infrared, a kind of energy that describes temperatures. The picture uses representational color to assign different temperatures a color, kind of like color coding or coloring by numbers. The photo could use colors other than purple, orange, and yellow, and we would still be able to tell which parts of Rusty are hot and cold.
4. Direct participants to the poster of the electromagnetic spectrum and explain there is energy all throughout the universe that we cannot observe with our eyes. Participants may have heard of or used some of these types of energy. Ask participants about their familiarity with the electromagnetic spectrum:
   - Have you ever used a microwave?
   - Have you ever had an X-ray?
   - Have you listened to the radio in the car?
   - Have you ever gotten a sunburn (ultraviolet waves)?
5. Explain that there are lots of types of energy that we cannot see, but we're still familiar with what these energies can do. Use the poster to point out the different kinds of energy waves, making sure to include the visible spectrum. Explain to participants that these kinds of energies can perform tasks (e.g., X-rays can tell us about broken bones in our bodies), but that they can also be emitted naturally, and we can use them to find out more about the world around us.
6. Show the participants the USA cards, and ask them what they think each card is telling us about. The cards display information about the USA through the visible spectrum, such as where we might be able to tell apart forests, deserts, and mountains; temperature information (infrared energy); natural radioactivity (gamma ray energy); and cell phone reception (radio waves).
7. Explain that the images are using representational color, just like the infrared picture of Rusty. The colors are a way to take information about energy we can't see and turn it into something our eyes can interpret.
8. Ask participants why they think representational color may be helpful for astronomers studying planets, stars, and distant galaxies. Can astronomers travel to all these places to collect more information? (No.) Do they think all the information astronomers can gather through a telescope is available to the eye alone (visible spectrum)? (No.)
9. Tell participants that, in fact, a lot of information about our solar system and universe can be revealed by examining the other parts of the electromagnetic spectrum, and then showing these findings through representational color. We know that Mars is red and has ice caps from our exploration of the visual spectrum information of Mars, but we can learn other interesting facts about the planet if we go beyond visual information. Explain that we'll do an activity to explore what information in other wavelengths can look like.
10. Explain to participants that we'll explore our universe using the different energies of light we were just discussing. Use the M51 postcard as an example, showing the participants how the different wavelengths of light give us different information to put together the story of the galaxy. Would they like to find out more stories about space, using what we can learn from different energies of light?
11. Show them one of the "Universe in a Different Light" playing cards and explain that each of the cards

PROCEDURE (CONTINUED)

shows an object in space displayed in a different kind of light. These images were taken using special telescopes to detect light outside of the visible spectrum.

12. Tell the participants that we're going see if we can match the cards representing the same objects in space. This may be difficult, since the same object can look very different depending on the kind of energy shown in its picture.
13. Either pass the cards out evenly to your group, or display all cards face up on the table. Ask participants to match the cards representing the same object. Once they've made their decisions, discuss why they made certain choices, and talk about how the cards of the same object look similar or different from one another.
14. Double check the matching with the participants and explore together what information is represented on the cards by using the postcard key. This key will show the correct groupings of objects, as well as describe what the picture can tell us about the object. Encourage participants to continue exploring the objects on the cards, allowing them to read the postcard key and the information on the electromagnetic spectrum poster. For a reference to types of information found in different wavelengths, and an overview of telescopes used for this purpose, check out BACKGROUND INFORMATION below.

VARIATION FOR LARGE GROUPS

If you have a large group that will all be together in the activity setting for a set amount of time (that is, not wandering through a series of stations):

1. Use the Powerpoint presentation with a projector to introduce the electromagnetic spectrum and the use of representational color to show information outside the visible spectrum.
2. To explore astronomers' use of representational color, pass out one "Universe in a Different Light" card to each participant.
3. Tell your participants to find others in the room with the *same object* represented on their card. Once they do, they should compare pictures. Do the objects look the same?
4. Then they should find others with the same *kind of light* on their card. Is the information represented similar? Do they notice any patterns about the information presented by different kinds of light?
5. Explain, using the information on the postcard key (and summarized in **BACKGROUND INFORMATION**), about what information each type of light detected by the telescopes can tell us about objects in our universe.

BACKGROUND INFORMATION

Each type of light is used for different tasks on Earth and can tell us information about objects in space. Below the type of waves change from longest, lowest frequency, and lowest energy to shortest, highest frequency, and highest energy. This information is sourced from NASA's Tour of the Electromagnetic Spectrum, which you can find by following the link in MORE RESOURCES below.

Radio waves are the longest type of wave and so radio telescopes have to be very large to collect enough information to produce a clear image. Radios can be tuned to receive a certain frequency of radio wave so that you can listen to your favorite station while driving your car. For astronomy observations, radio waves are helpful because they can detect objects that are hidden by sunlight, clouds, or rain in Earth's atmosphere, or by dust in space.

Microwaves are shorter than radio waves, and can accomplish many tasks, from warming up our food to sending information to a GPS to monitoring conditions during a hurricane. Since microwaves can also see through clouds and rain, they are used by meteorologists in radar technologies. Microwaves also give us clues about the history of our universe and the Big Bang.

Infrared waves can be felt as heat but cannot be seen by human eyes alone. Infrared energy has many applications, from television remotes to heat-seeking goggles used by firefighters to satellite detection of wildfires. In space, infrared light has revealed auroras on Saturn and collections of stars hidden in the visible spectrum by the bright dust of the nebula.

Visible waves are detectable by the human eye and increase in energy through the rainbow from red (lower energy) to violet (higher energy). Visible light can tell us about the temperature of a star, and examining a spectrum of visible light, where the light is split into its component parts, can give information about the presence of chemical elements.

Ultraviolet waves are emitted by the Sun, but many of them are blocked from Earth's surface by the ozone layer in the atmosphere. Certain insects, like bumblebees, can detect ultraviolet waves. In astronomy, ultraviolet waves must be detected outside of our atmosphere, and can reveal the formation of young stars, which give off most of their energy in ultraviolet.

X-rays are very high energy and are used on Earth to examine bone structure. X-ray telescopes operate in space to collect X-rays from objects that are incredibly hot—millions of degrees! This can include exploded stars (supernovae) and the material surrounding a black hole.

Gamma rays are the smallest and most energetic type of light. In space, these types of waves are produced by very energetic objects such as neutron stars and pulsars. Scientists can also use gamma rays to explore the chemicals present on other planets. On Earth, gamma rays can result from nuclear explosions or radioactive decay.

MORE RESOURCES

1. Find the optional Powerpoint for large audiences, and watch a 6-minute video of this activity at https://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=395
2. NASA's Tour of the Electromagnetic Spectrum: https://science.nasa.gov/ems/

CREDIT

We are grateful to the NASA Night Sky Network (https://nightsky.jpl.nasa.gov/) and the Astronomical Society of the Pacific for granting permission to modify materials they created.

NORTH CAROLINA SPACE GRANT

The Statewide Star Party is made possible by the generous grant support of the North Carolina Space Grant.