

Activity 2 Secret Messages

Overview

Youth manipulate light and color to reveal visual information.

Note to Educator:

Remote sensing technologies can be combined with other technologies, like optical filters, to enhance the information they receive. While the filters themselves are not a remote sensing technology, youth will explore how these tools can work together to reveal and help make sense of information from a distance.

Youth will work in groups of 4 for this activity so they can easily split into pairs to test their secret messages.

Review the preparation for Activities 4, 5, and 6 on p. 36 in this guide. Consider preparing the Space Screens and model landscapes in parts, or set aside at least an hour to assemble them in one session.

Activity Timing

Introduction:	5 min
Investigate:	25 min
Secret Messages:	20 min
Reflect:	5 min

55 min

21st Century Skill Highlight

Critical Thinking
Communication

Activity 2 Materials

For the whole group

- Engineering Design Process* poster
- Remote Sensing Definition* chart paper
- chart paper and markers
- 50 sheets of copy paper
- 1 pair of scissors
- 1 roll of masking tape
- 2 sheets of cellophane, blue
- 2 sheets of cellophane, red

For each youth

- Engineering Notebook

For each group of 4

- 1 box of crayons
- 1 pack of highlighters, assorted colors

Activity 2 Materials Preparation (10 min)

1. Post the *Engineering Design Process* poster and the *Remote Sensing Definition* chart paper.
2. Draw the *Optical Filter Investigations* chart, p. 36 in this guide, on the chart paper and post it near the *Engineering Design Process* poster.
3. Prepare a Materials Table with the materials listed above.

Notebook Pages for Activity 2

Optical Filters, p. 8

Activity 2 Optical Filters

Use a different color crayon to fill in each piece of the Mystery Moon image.

What happens when you look at these colors under the red filter?

How do the colors change under the blue filter? Why do you think so?

Try layering different colors, patterns, and writing materials to explore the effects of red and blue filters. Circle the combinations that work best to reveal information.

You might try: Yellow highlighter cross-hatching and pink highlighter squiggles

Cross-hatching

Squiggles

Worlds Apart: Engineering Remote Sensing Devices
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Hidden Messages, p. 9

Activity 2 Hidden Messages

Use what you found out about colors, patterns, and optical filters to hide and reveal a hidden message in the following challenges:

Criteria <small>The requirements of a design</small>	Constraints <small>Factors that limit how you can solve a problem</small>
Create a hidden message that can be read from across the room.	The entire message must fit on one sheet of copy paper.

Make up your own challenge

Criteria	Constraints

What types of information do you think you could reveal by combining optical filters with remote sensing devices, like cameras or periscopes?

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Chart for Activity 2

Optical Filter Investigations

Colors and Writing Materials	Filter

Activity Preparation (continued from p. 35)

Preparation for Activities 4, 5, and 6 (60 min)

The final design challenge for this unit requires the educator to prepare a multi-part model so youth can test their remote sensing devices on the surface of a Mystery Moon. **Consider preparing the following models in parts, or set aside at least an hour to assemble them in one session.**

- Model Landscapes for Site A (2 copies) and Site B (2 copies) on the Mystery Moon
- Space Screens that prevent youth from looking at the model landscapes on the opposite side and represent the distance between the Earth and the Mystery Moon

The complete instructions for building Sites A and B and the Space Screens are outlined on pp. 51–53 in this guide. Since remote sensing engineers would not be able to see the surface of the Mystery Moon up close, it is important that youth use only the remote sensing devices they create to gather information about each site. Keep the model landscapes covered when not in use until groups complete their tests in Activity 5.

Youth will learn:

- They can combine technologies, like optical filters, with remote sensing devices to reveal information.
- Manipulating colors can help them make sense of complex visual data.

Tip

Replay the *Special Report* video from (2:14-3:54) to remind youth how scientists and engineers at NASA's Jet Propulsion Laboratory combine remote sensing technologies in spacecraft like the Mars Reconnaissance Orbiter.

Tip

Youth may be familiar with photo-editing filters that use light and color to highlight certain aspects of a photo. Other types of image filters operate inside a camera, and collect specialized information about a subject before the photo is snapped.

Introduction (5 min)

1. Have youth think back to the previous activities. Ask:
 - **What is the problem the scientists are trying to solve?** *They need to find out what the surface of the Mystery Moon is like, before astronauts can go there.*
2. Explain to youth that the scientists need help finding out about the minerals astronauts might find on the Mystery Moon. These minerals are difficult to identify just by looking at the surface. Ask:
 - **Why might scientists want to know which minerals are on the Mystery Moon?** *There might be water there, or signs of life. They might want to know how the moon was formed.*
 - **Has anyone seen or used a technology that helps reveal hidden information?** *Accept all answers. Youth may say X-rays, photographic filters, polarized sunglasses, infrared cameras, blacklight/UV light, etc.*
3. Explain that technologies that manipulate light and color, like the examples youth gave, can be combined with remote sensing devices to help the scientists find out even more about the Mystery Moon.
4. Hold up a piece of cellophane. Explain that youth will *investigate* optical filters like this cellophane, which hides certain colors and reveals others, to help them make sense of complex visual data.

Investigating Optical Filters (25 min)

1. Show youth the materials they will investigate today (crayons, highlighters, and different colors of cellophane).
2. Split youth into groups of 4 and assign one person from each group to gather paper, crayons, highlighters, and two sheets of red and blue cellophane from the Materials Table.
3. Explain that youth will share materials among their group but may work independently for this part of the activity.
4. Have youth turn to *Optical Filters*, p. 8 in their Engineering Notebooks and follow the instructions, using crayons to color

Tip

Since white reflects all colors, it creates a visual distraction with both red and blue cellophane. Patterns that use white space, like cross-hatching or squiggles, hide messages better than solid color.

Tip

Youth who are interested can learn more about another remote sensing technique that uses light and color, called spectrometry, in the Science Extension Activity for this unit.

Tip

If groups finish early, have them use extra manila folders and tape to combine their optical filters with familiar technologies, like glasses.

in the image of the Mystery Moon.

5. Have youth cut the cellophane into half sheets so each youth has one half sheet of each material and *investigate* how the colors in their drawing change, with and without cellophane filters placed over them.
6. As youth are working, circulate among the groups and ask:
 - **Which colors disappear under the red filter?** *Red, orange, yellow.*
 - **Which colors become easier to see under the red filter? Why do you think that is?** *Blue, green. The red cellophane blocked all the colors that are similar to red and enhanced the ones that are similar to blue.*
 - **Do you see a difference if you fold the filter in half? In quarters?** *Yes, the effect of the filter becomes stronger, making certain colors easier to see.*
7. Have youth continue their investigations by *creating* and *testing* their own combinations of colors and patterns on p. 8 in their Engineering Notebooks.

Hidden Messages (20 min)

1. Gather the group back together and let youth know they will now use what they learned about manipulating light and color to communicate a secret message to a partner.
2. Have youth turn to *Hidden Messages*, p. 9 in their Engineering Notebooks, to review the criteria and constraints of their challenge.
3. Give youth 5 minutes to write a message and hide it by scribbling over it with crayons and highlighters.
4. As groups finish, have partners trade messages and figure out what type of filter can help them read the hidden message clearly.
5. Have youth keep track of what they learn on *Hidden Messages*, p. 9 in their Engineering Notebooks.

Reflect (5 min)

1. Gather youth together in front of the *Engineering Design Process* poster and the *Optical Filter Investigations* chart. Ask:
 - **Which steps of the Engineering Design Process did we use today?** *Investigate, create, and test.*
2. Have a few volunteers share their secret messages with the rest of the group and record successful combinations on the *Optical Filter Investigations* chart. Ask:
 - **Which combinations of colors and filters worked well to reveal the hidden message?**
 - **How might you combine optical filters with remote**

sensing technologies, like periscopes, to help the scientists solve their problem? *We could add an optical filter to a periscope or camera to reveal information about the surface of the Mystery Moon.*

3. Save the *Optical Filter Investigations* chart for use in later activities.
4. Congratulate youth on their hard work and thorough investigations.
5. Let youth know that next time, they will learn about a remote sensing technology that uses lasers to map the shape of a surface.

