Engineering Activity 3: Looking Beyond: Portable Light Redirection

Educator Preview

Activity Snapshot

Learners design portable light redirection systems to gather data from a distance.

Timing | 45 minutes

Get Ready and Team Up	10 min.
Create a Light Redirection System	25 min.
Reflect	10 min.
Total	**45 min.**
Level Up Activities	5 min. each

Prep Snapshot*

Prep Time 30 min.

- Create a sample light redirection system.
- Create a tactile light redirection system model.
- Set up a Materials Table.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Critical Thinking

Habits of Mind

- Use systems thinking.
- Investigate properties and uses of materials.

Guiding Question

How can we use a system to redirect light to gather data from a distance?

Learners Will Do

Design portable mirror systems and use the systems to see around obstacles.

Learners Will Know

Engineers can combine technologies into a system.

Connecting Across Activities

Activity 2: Investigating Light	Activity 3: Redirecting Light	Activity 4: Finding Minerals
Last time, learners investigated how light travels and how mirrors can redirect light to gather data from a distance.	**Today**, they design portable light redirection systems. These systems are one technology they can use when designing their complete remote sensing technologies.	**Next time,** they will explore the properties of filters and scrapers to gather more data, specifically about minerals.

Activity Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction, pgs. iii-xxvi. Access more PLANETS units, research, and pathways at https://planets-stem.org/.

QR Code for Activity Resources

weblink: https://hov.to/9cf7a44c

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document). See Prep & Setup Guide (PDF)
  Examples | Templates
- sample portable light redirection system
- Tactile light redirection system model, pg. 47

For each pair

- Create a Light Redirection System, pg. 42
- 1 folder, manila
- 2 mirrors
- 1 pair of scissors
- 1 roll of tape, masking

For each learner

- Engineering Notebook (PDF)

Activity 3 Materials Preparation (30 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
2. Print out one copy of Create a Light Redirection System Handout, pgs. 45-46, per group.
3. Create a sample portable light redirection system following the instructions on *Create a Light Redirection System*, pgs. 42-43. See the video How to Build a Light Redirection System for additional support.
4. Create one or more Tactile Light Redirection System models, pg. 47, to support learner understanding of the portable light redirection systems they will create.

In Your Space

5. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
6. Create a Materials Table with the materials listed above as *For each pair*.
7. Place the tactile light redirection system model at a station for learners to access.

Preparation for Engineering Activities 6–9 (60 min.)

The final design challenge for this unit requires the educator to prepare a multi-part model so learners can test their remote sensing devices. Read Activity 6 Materials Preparation on pg. 80 and decide whether to use the Space Screens with learners. **Then 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)
- Optional: Space Screens that prevent learners from looking at the model landscapes on the opposite side and represent the distance between the Earth and other planets

The complete instructions for building Site A and B, pgs. 85-87 and the Space Screens, pg. 88-89 are outlined in this guide, and a video that shows the process of how to build a model landscape is available. Since remote sensing engineers cannot see the surface of a planet up close, it is important that learners use only the remote sensing devices they create to gather information about each site and that they do not look at the models directly. Keep the model landscapes covered when not in use until groups complete their tests in Activity 9.

Supporting Learner Differences

Learners will leave this activity with a tool to hold mirrors they can use in Activities 6–9 for viewing sites obscured by space screens. Learners with little to no vision might not find this activity engaging. Consider making it a group activity, encouraging blind/low vision learners to feel and help predict the angles, but have sighted peers perform the actual construction of the redirection systems. Allow blind/low vision learners extra time to explore the sample portable light redirection system.

Cutting and folding the manila folders can be tricky, even with demonstration. Consider pre-folding the manila folders and marking where to cut and/or showing them the video How to Build a Light Redirection System.

Activity Guide

Get Ready and Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** *(We used straws and mirrors to investigate how light travels. We learned light moves in a straight line and we can use a system of mirrors to redirect its path to answer "How can we redirect light to gather data from a distance?")* Draw learners' attention to their work on the *Our Ideas* poster about light and mirrors.

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx-xxi) and use other engagement strategies as necessary (pgs. viii-xvi).

2. Say: **Our challenge is to figure out how to gather information about Mars from far away.**
3. Say: **Today, we'll continue answering questions about how we gather information from a distance. We know now that the technologies we are designing will be systems–in other words, they will have multiple parts.** Modify the previous Guiding Question to create the new Guiding Question or a similar new question from the *Our Ideas* poster with learners aloud and in writing *(using multiple languages as needed)*: **How can we use a system to redirect light to gather data from a distance?**
4. Organize learners into pairs.

Create a Light Redirection System (25 min.)

5. Give each pair a copy of Create a Light Redirection System, pgs. 42-43. Say: **You will work in pairs and use these instructions to create a system of mirrors to get light where you need it to be in a compact space. This system should be easy to move.**
6. Draw learners' attention to the tactile light redirection system model. Say: **Here is a model that you can feel. It demonstrates how light will move through the system you make**.
7. Give learners about 20 minutes to build their light redirection systems. As they work, circulate to each group and ask one or more of the following questions: **How is this technology working as a remote sensing device?** *(The mirrors redirect light from objects in the room to a person's eye, so that person can gather information from a distance.)* **Why must the mirrors be placed in this way?** *(The mirrors need to be at certain angles for the light to be reflected in the right direction.)*

Support Thinking

To help learners follow the process, you can demonstrate each step for the whole group before having pairs complete it and/or show the video How to Build a Light Redirection System.

Support Learner Differences

As needed, provide groups with a tub or other container to hold their materials. Give them time to explore the materials before they begin working.

8. Say: **Spacecraft rely on remote sensing technologies to gather information. Take five minutes to practice gathering information through your remote sensing technologies. Test your systems to search for items in the room.** Allow learners about 5 minutes to gather information.

9. Say: **These systems are easy to move around. Another word for this is portable. How are these portable systems an improvement from the mirrors on the table?** *(They can be used in many places.)* Write the word *portable* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.

Reflect (10 min.)

10. Say: **How did you use what you learned about the way light travels to redirect the light around obstacles?** *(We made sure that light could get through our system by traveling in straight lines because that is how light travels, etc.)*

11. Revisit the Guiding Question on the *Our Ideas* poster. Ask: **How can we use a system to redirect light to gather data from a distance?** *(Accept all responses that learners can support by referring to their light redirection systems.)* Remind learners of the terms portable and remote sensing.

12. Ask: **What questions do you still/now have?** *(How might we collect other types of data besides visual data?, etc.).* Record any new ideas.

13. Say: **Engineers call what you have been doing–gathering data from a distance–remote sensing. They call technologies to gather that data, like the ones you designed today, remote sensing technologies.** Write these terms on the *Our Ideas* poster.

14. Invite learners to turn and talk to a partner about the question, **How might someone use remote sensing technologies in everyday life?** *(Using mirrors on roads to see around corners to prevent collisions, aerial images, etc.).* Have them record ideas on the *Our Ideas* poster. Consider returning to learners' ideas at the start of the next activity.

15. Say: **Good job working as engineers today! The images our light redirection systems can collect will provide only some information about Mars for the scientists. Next time, you will learn about a way to gather evidence of water on Mars. Later you will combine your light redirection systems with other technologies to gather even more types of information.**

Support Thinking

Help learners understand the concept of remote sensing technologies by showing the videos Remote Sensing and How Light Is Used in Remote Sensing.

Level Up!

- Have learners explore the inside of their light redirection systems by dropping a small ball in one end and noticing what they see, hear, or feel as it travels through the system and comes out the other end. (5 min.)
- Refer to the *Engineering Design Process* poster. Ask: **What phases of the** *Engineering Design Process* **did you use today?** *(Frame and Investigate. Learners may also describe how they iterated on their first mirror setup to create a connected light redirection system.)* (5 min.)

After the Activity

1. Clean up:
   - Keep the *Our Ideas* poster for Activity 4.
   - Save pairs' light redirection systems for use in Activity 4.
2. Plan ahead for Engineering Activity 4. See Activity 4 Materials Preparation on pg. 50.
3. Take time to reflect on the following educator prompt: How did you activate learners' knowledge about light from Activity 2?

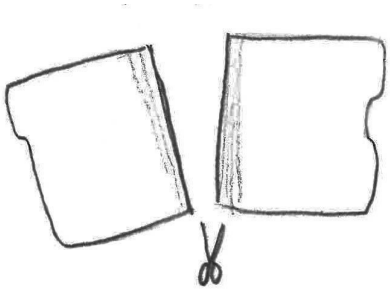
Remote Sensing Additional Resources

QR code leads to resources available for this unit.

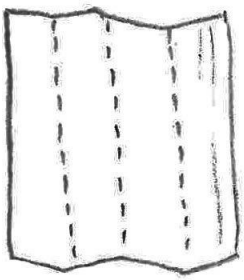
weblink: https://hov.to/248cf0d9

Create a Light Redirection System

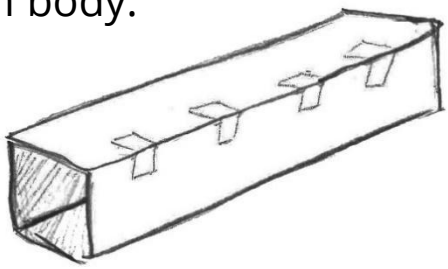
1. Cut the manila folder in half to get two sheets. Put one half aside.



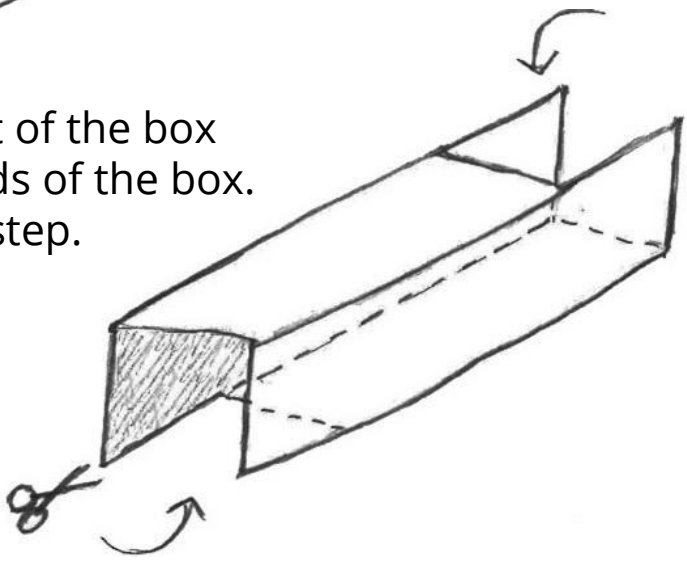
2. Cut the tabs off the manila folder sheets.
3. Fold one manila sheet in half longways, then fold it in half longways a second time. Unfold the manila sheet.



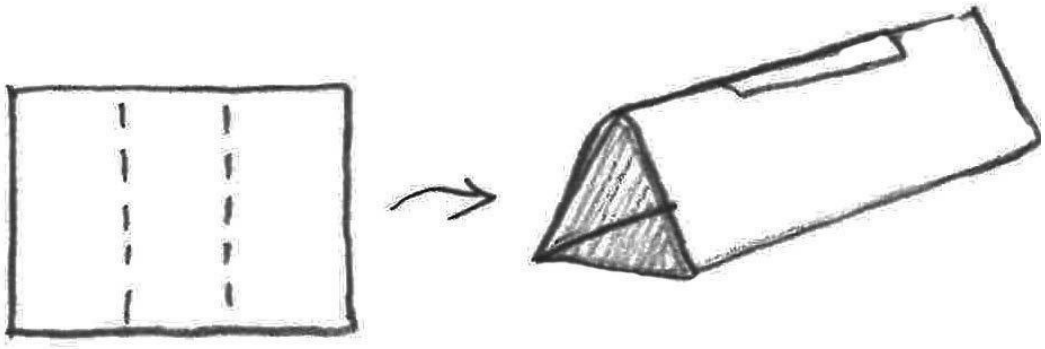
4. Fold the manila sheet into a box shape and tape it closed to make the light redirection system body.



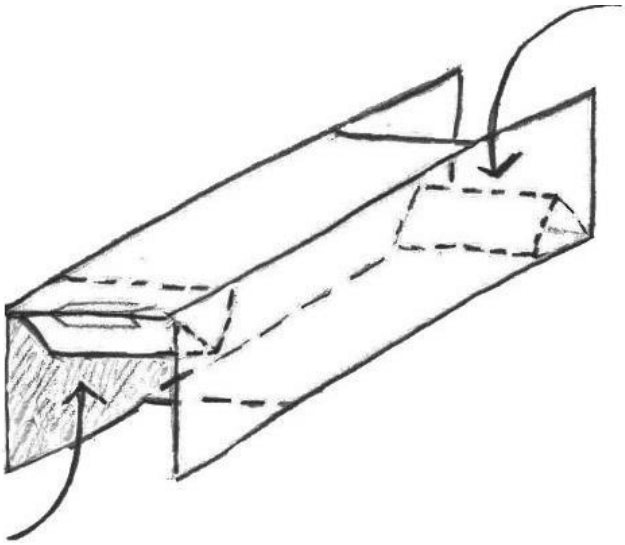
5. Cut two mirror-sized rectangles out of the box on opposite sides and opposite ends of the box. Save these rectangles for the next step.



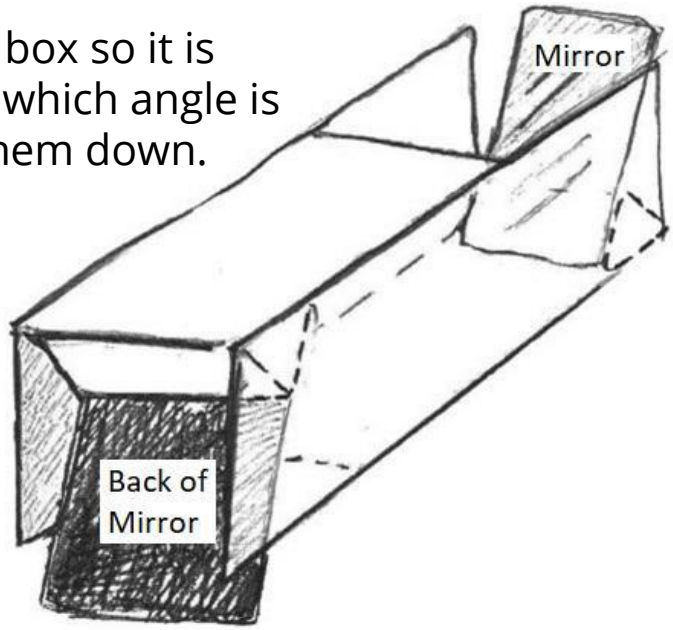
6. Fold and tape the rectangles into triangle shapes so they can be mirror stands.



7. Tape the triangles (mirror stands) inside the box at the long ends.



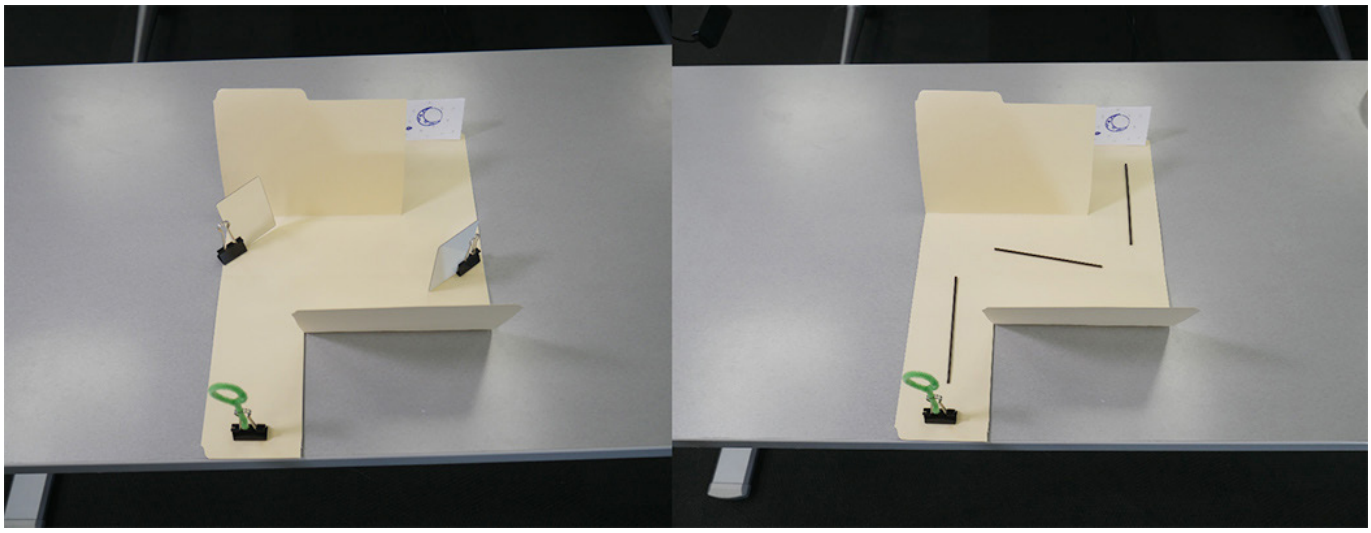
8. Position a mirror at each end of the box so it is resting against the triangle. Explore which angle is best for the mirrors before taping them down.



9. Test out your light redirection system!

Create a Tactile Light Redirection System Model

1. Cut the manila folder in half to get two sheets. Put one half aside.
2. Cut the tabs off the manila folder sheets.
3. Fold one manila folder sheet into thirds longways, then unfold it.
4. Make one cut from each outer long edge of the folder to the fold line. Position the cuts on opposite ends of the folder, each about 2" from the short edge.
5. Fold the large resulting flaps up. Keep the 2"-wide strips lying down. You now have the body of the tactile light redirection system model.
6. Attach two binder clips each to two mirrors and place them at opposite ends of the central third of the folder, oriented at 45° so they face both the central third and the 2"-wide strips.
7. To represent the path of light, tape coffee stirrers along the center of the 2"-wide strips and the central third of the folder. The coffee stirrers should connect at right angles at the mirrors.
8. Fold small pieces of paper or index cards to make triangular prisms. Attach a fuzzy stick loop to one. Place one at the end of each 2"-wide strip.



Tactile Light Redirection System Model