Activity 1 Looking Beyond

Educator Preview

Overview

Youth *investigate* technologies that use mirrors to change the way light travels in order to collect information from a distance.

Note to Educator:

The periscopes youth create in this activity do not use curved mirrors or lenses, so they will not make objects appear closer, like a telescope would. You can add these specialized materials to the challenge if time allows. Providing recycled containers like juice cartons can help youth quickly change the shape of their periscopes as they improve. Bring in a few of these items for youth to use, if available.

Review the preparation for Activities 4, 5, and 6 on p. 26 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
Investigating Mirrors:	15 min
Periscopes:	30 min
Reflect:	10 min
	60 min

21st Century Skill Highlight

Critical Thinking
Collaboration

Activity 1 Materials

For the whole group

- ☐ *Engineering Design Process* poster
- ☐ *Remote Sensing Definition* chart paper
- ☐ 1 box or other obstacle, 7” x 5” x 3” or larger
- ☐ 1 index card
- ☐ 1 pipe cleaner

For the Materials Table

- ☐ 8 packs of crayons
- ☐ 8 packs of markers
- ☐ 25 sheets of construction paper
- ☐ 25 straws
- ☐ optional: curved mirrors or lenses
- ☐ optional: recycled containers

For each group of 3

- ☐ 1 index card
- ☐ 1 manila folder
- ☐ 1 pair of scissors
- ☐ 1 pipe cleaner
- ☐ 1 roll of masking tape
- ☐ 1 small box or other obstacle
- ☐ 6 mirrors
- ☐ 12 binder clips, medium

For each youth

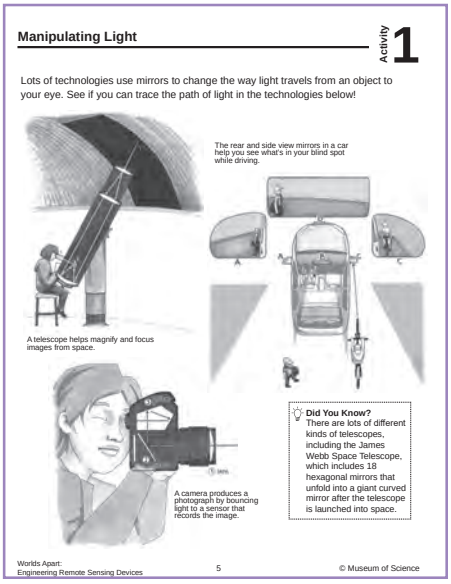
- ☐ Engineering Notebook

Activity 1 Materials Preparation (15 min)

1. Post the *Engineering Design Process* poster and *Remote Sensing Definition* chart paper.
2. Set up a sample obstacle course according to *Obstacle Course Setup*, p. 31 in this guide.
3. Create a Materials Table with the materials listed above.

Notebook Pages for Activity 1

Manipulating Light, p. 5



Manipulating Light — Activity 1

Lots of technologies use mirrors to change the way light travels from an object to your eye. See if you can trace the path of light in the technologies below!

The rear and side view mirrors in a car help you see what's in your blind spot while driving.

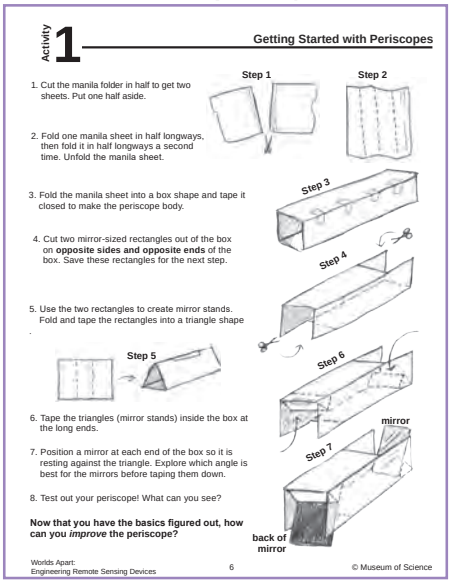
A telescope helps magnify and focus images from space.

A camera produces a photograph by bouncing light to a sensor that records the image.

Did You Know? There are lots of different kinds of telescopes, including the James Webb Space Telescope, which includes 18 hexagonal mirrors that unfold into a giant curved mirror after the telescope is launched into space.

Worlds Apart: Engineering Remote Sensing Devices 5 © Museum of Science

Getting Started With Periscopes, p. 6



Activity 1 — Getting Started with Periscopes

1. Cut the manila folder in half to get two sheets. Put one half aside.
2. Fold one manila sheet in half longways, then fold it in half longways a second time. Unfold the manila sheet.
3. Fold the manila sheet into a box shape and tape it closed to make the periscope body.
4. 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.
5. Use the two rectangles to create mirror stands. Fold and tape the rectangles into a triangle shape.
6. Tape the triangles (mirror stands) inside the box at the long ends.
7. 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.
8. Test out your periscope! What can you see?

Now that you have the basics figured out, how can you *improve* the periscope?

Step 1 Step 2 Step 3 Step 4 Step 5 Step 6 Step 7 mirror back of mirror

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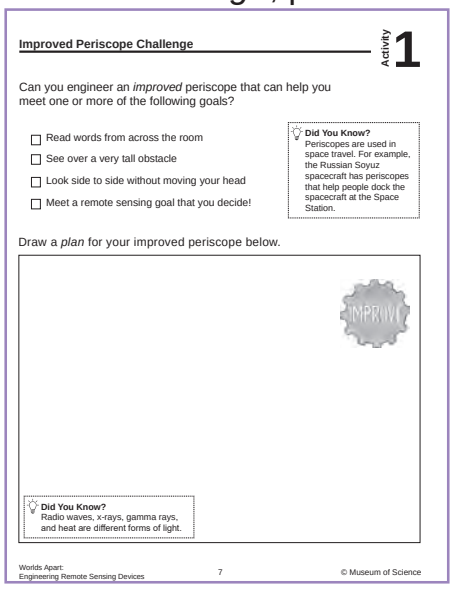
Improved Periscope Challenge, p. 7



Improved Periscope Challenge — Activity 1

Can you engineer an *improved* periscope that can help you meet one or more of the following goals?

- ☐ Read words from across the room
- ☐ See over a very tall obstacle
- ☐ Look side to side without moving your head
- ☐ Meet a remote sensing goal that you decide!

Did You Know? Periscopes are used in space travel. For example, the Russian Soyuz spacecraft has periscopes that help people dock the spacecraft at the Space Station.

Draw a *plan* for your improved periscope below.

IMPROVE

Did You Know? Radio waves, x-rays, gamma rays, and heat are different forms of light.

Worlds Apart: Engineering Remote Sensing Devices 7 © Museum of Science

Activity Preparation (continued from p. 25)

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.

Activity 1 Looking Beyond

Activity Guide

Youth will learn:
- They can use mirrors to collect information from a distance by changing the way light travels.
- *Investigate* is an important step of the Engineering Design Process.

Tip

Replay the *Special Report* video from (3:07-3:28) to remind youth how scientists and engineers at NASA's Jet Propulsion Laboratory use technologies that change the path of light to collect information from a distance.

Tip

If youth already have a basic understanding of how light travels, consider running the Exploring Mirrors and Periscope portions of this activity as stations, and have youth choose where to spend their time.

Tip

Consider assigning roles for group members to keep everyone focused on the challenge.

Introduction (5 min)

1. Have youth think back to the video they watched in the last activity. Refer to the *Remote Sensing Definition* chart paper from Prep Activity 2 to remind youth of their challenge over the next few days. Ask:
   - **What kinds of problems can remote sensing help us solve?** *Remote sensing can help us solve problems where we need to collect information from a distance.*
   - **What problem do the scientists need help solving?** *They need to collect information about the surface of the Mystery Moon, before they send astronauts to explore it.*
2. Let youth know that today they will *investigate* how they can use mirrors to reveal objects that are difficult to see.
3. Have youth turn to *Manipulating Light*, p. 5 in their Engineering Notebooks, to see how technologies like cars and cameras use mirrors to change the way light travels from an object to your eye.
4. Let youth know that today, they will use mirrors to change the way light travels so they can see objects remotely, even if they are hidden from view.

Investigating Mirrors (15 min)

1. Gather youth around the sample obstacle course you prepared and explain:
   - Each group will build an obstacle course at their tables, similar to the one shown, by drawing on a folded index card, and placing it behind an obstacle.
   - Youth will look through the pipe cleaner hoop, or eyepiece, and *investigate* how to arrange the mirrors on the table to bring the drawing into view, even though it is completely hidden behind the obstacle.
2. Split youth into groups of 3 and have a volunteer collect mirrors and small binder clips for each group.
3. Give groups a few minutes to build their obstacle courses, and start positioning the mirrors to reflect light around the obstacle, until they can see the drawing through the

eyepiece. As they are working, check in and ask:

- **What was hard about using mirrors to try to see behind the obstacle?** *Youth may say it was difficult see the whole drawing right away, keep changing the angle of the mirrors, or adjust the mirrors to be very precise.*
- **What advice would you give to other groups?** *Youth may suggest that it helps to move the mirrors a little bit at a time and make sure they are secure in the mirror stands.*

Periscopes (30 min)

1. After groups practice manipulating light using mirrors, have them turn to *Getting Started With Periscopes*, p. 6 in their Engineering Notebooks. Let youth know they can use this page to *create* a technology that uses mirrors to collect information from a distance.
2. Give groups about 20 minutes to build a basic periscope and test it out on the optical obstacle course. As they work, circulate around to each group and ask:
   - **What is working well about your periscope design?**
   - **What can be *improved*?**
3. As groups find success, have them turn to *Improved Periscope Challenge*, p. 7 in their Engineering Notebooks and revisit the Materials Table for additional materials. Ask them to design a periscope that can help them meet one or more of the following goals:
   - See over a very tall obstacle
   - Look side to side without moving their heads
   - Meet another goal that youth decide
4. Let groups know when they have 10 and 5 minutes left.

Reflect (10 min)

1. As youth finish engineering their periscopes, have each group share their design and the challenge they chose with the full group. Encourage groups to explain how they modified the basic periscope to meet their specific challenge.
2. After all groups have shared, let youth know that in the activities ahead, they will get to combine their periscopes with other technologies to create a detailed picture of the distant landscapes on the Mystery Moon.
3. Gather youth in front of the Engineering Design Process poster. Ask:
   - **What steps of the Engineering Design Process did you use today?** *All groups* investigated*. Some groups* planned, created, tested *and* communicated *if they completed the periscope challenge.*
4. Remind youth that remote sensing technologies that use

Tip

Youth may choose to improve on the basic periscope in a number of ways, such as changing the shape of the periscope body or adding handles to easily change the angle of the mirrors inside.

Tip

While youth may find it easy to move around the room to see around obstacles, remind them that working from behind the controls of a spacecraft or telescope would be much harder!

Tip

If there is not enough time to discuss each periscope design with the full group, consider having groups pair up and share with each other.

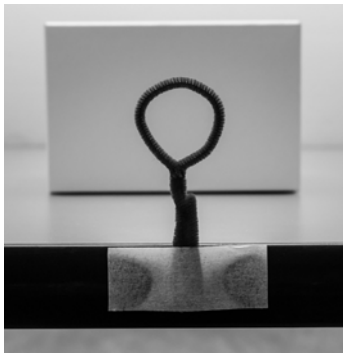
mirrors are just one way scientists and engineers collect information from a distance. Youth will learn about another type of technology that can reveal information in the next activity.

5. Congratulate youth on their excellent engineering work today.
6. Remind youth to disassemble their periscopes and return the mirrors and binder clips to the Materials Table for use in later activities.

Activity 1 Obstacle Course Setup

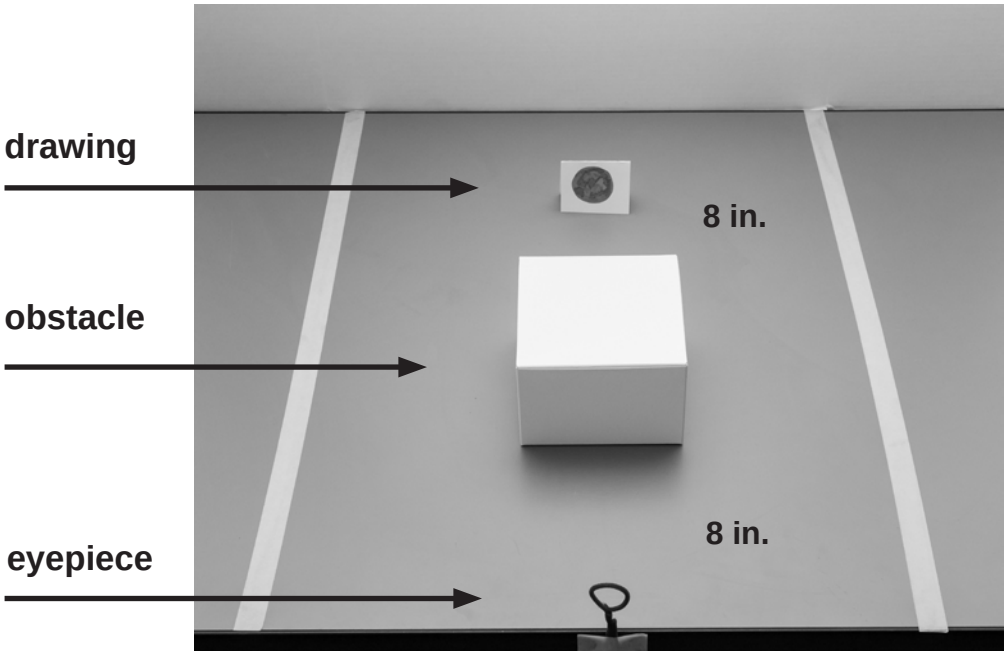
Make an eyepiece

- Take a pipe cleaner and twist a loop about 1 inch in diameter, curling the pipe cleaner around itself to close the loop.
- Bend the excess back.
- Tape the eyepiece to the edge of a table.



Set up a sample optical obstacle course

- Fold an index card in half so it stands upright and make a drawing that youth will try to see using the mirrors.
- Place an obstacle, like a box or stacked textbooks, between the eyepiece and the drawing. The obstacle should be about 8 inches away from the drawing and 8 inches away from the eyepiece.
- Use masking tape to make boundary lines around the obstacle course. Youth can arrange their mirrors anywhere inside these lines.



Activity 1 Getting Started with Periscopes

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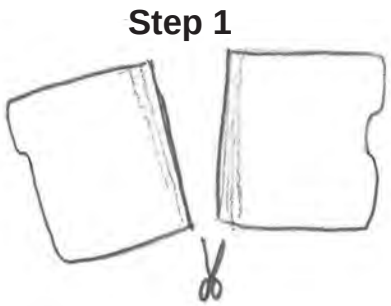

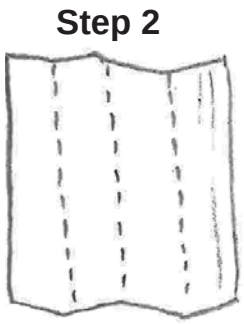

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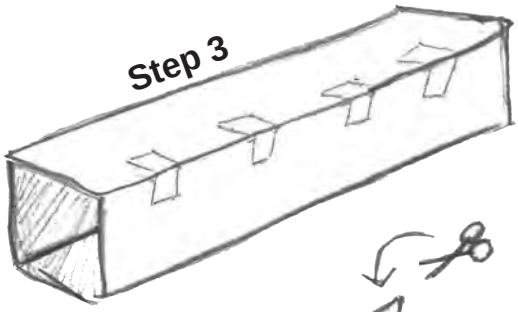
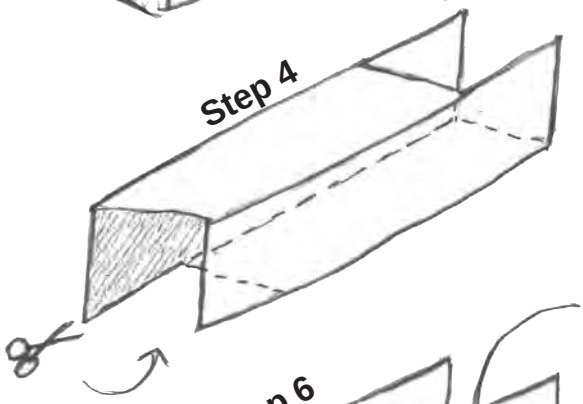


3. Fold the manila sheet into a box shape and tape it closed to make the periscope body.

4. 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.



5. Use the two rectangles to create mirror stands. Fold and tape the rectangles into a triangle shape
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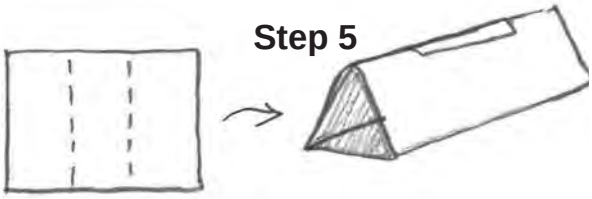
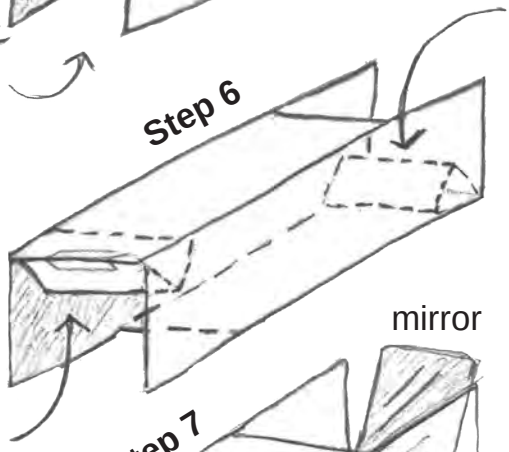
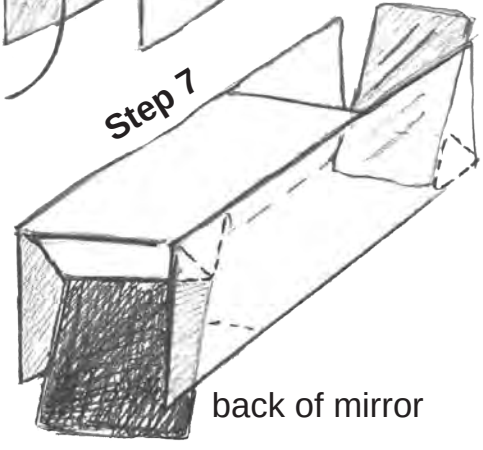




6. Tape the triangles (mirror stands) inside the box at the long ends.

7. 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.



8. Test out your periscope! What can you see?

Now that you have the basics figured out, how can you *improve* your periscope?