Engineering Activity 4: Create a Remote Sensing Device

Educator Preview

Activity Overview

Youth work in groups to plan, create, and test remote sensing devices that use the different technologies from the previous activities to gather data from a distance.

Activity Timing		**Prep Snapshot**	**21st Century Skills**
Introduction	5 min	Prep Time 60 min	**Connection** • Collaboration • Critical Thinking
Imagine and Plan	10 min	If you have not yet done so, create model landscapes and (optional) Space Screens. Set up Materials Table.	**Habits of Mind** • Consider problems in context. • Weigh the implications of solutions.
Create and Test	30 min		
Reflect	10 min		
Total	**55 min**		

Guiding Question	**Youth Will *Do***	**Youth Will *Know***
How can we create remote sensing devices to gather different types of data from a distance?	• Design a technology that can help answer a scientific question. • Use an engineering design process to guide themselves to a successful solution.	• Engineers use what they learn while investigating to inform their design decisions. • Engineers often collaborate with scientists.

Connecting Across Activities

In the previous Activities, youth explored different methods of remote sensing. In this Activity, youth combine those methods and use their engineering design process to design and test remote sensing devices. In Engineering Activity 5, they use what they learned to improve their devices.

Educator Resources

Access Activity resources using link or QR code.

Activity Resources

QR code leads to resources available for this Activity.

https://planets-stem.org/**betars-activity-a4**/

Family Connection

If time permits, have youth ask the following questions to their Elders, families, or mentors before the Activity:

Q: Can you tell me about an animal that was able to sense something you could not?

Q: Can you tell me a story about building something that was inspired by nature?

Materials and Preparation

Materials

For the model landscape sites and Space Screens

- *Mineral Paper*
- 4 boards, tri-fold
- 1 bottle of glue, white
- 20 cups, paper, 3 oz. (approx. 90 mL)
- 1 sheet of felt
- 1 sheet of foam, craft
- 1 knife, utility
- 1 sheet of paper, construction
- 4 shoeboxes, with lids, 7″ × 5″ × 12″ (approx. 18 cm × 13 cm × 30 cm)
- 6 sheets of Styrofoam, 12″ × 12″ × 1″ (approx. 30 cm × 30 cm × 3 cm)
- 1 roll of tape, masking
- 1 set of pattern blocks (optional)

Teaching Tip

Stores that display and sell shoes without boxes may have the shoeboxes in storage and may donate them if asked.

For the whole group

- engineering design process depiction created in the Engineering Prep Activity
- *Remote Sensing Definition* chart paper created in the Engineering Prep Activity
- *Filter Investigations* chart from Engineering Activity 2
- *Scraper Investigations* chart from Engineering Activity 2
- 12 sheets of cellophane, blue
- 12 sheets of cellophane, red
- 60 clips, binder, medium
- 25 cups, paper, 8 oz. (approx. 240 mL)
- 25 sheets of felt
- 25 sheets of foam, craft
- 25 folders, manila
- 20 mirrors
- 100 rubber bands
- 25 sheets of paper, construction
- 50 sticks, craft
- 50 sticks, fuzzy
- 2000 straws, regular
- 2000 straws, thin

For each group of 4

- 1 ruler
- 1 pair of scissors
- 1 roll of tape, masking
- light redirection system from Engineering Activity 1
- 2 *Data Collection Grids*
- *Test Sites* from Engineering Activity 2

For each youth

- Engineering Notebook

Activity 4 Materials Preparation (60 min)

1. If you have not yet done so, read through the instructions for *Model Landscape Assembly* (pages 99 – 101) and *Space Screen Assembly* (pages 103 – 105). Then decide whether to use the Space Screens. This activity should be safe and inclusive. Use the Space Screens only if youth can reach through them safely. Make the choice that is best for your group but still allows all youth to gather data "remotely."

2. Before beginning this activity, make sure you have finished preparing the model landscapes and, if appropriate for your group, the Space Screens. There should be two models each of Site A and Site B, one behind each Space Screen, so multiple groups can access them during testing.

3. Set up the model landscape sites and Space Screens.

4. Create a Materials Table with the materials listed above for the whole group and for each group of four.

5. Post youth's engineering design process depiction.

6. Post the *Remote Sensing Definition* chart paper and *Filter* and *Scraper Investigations* charts from Engineering Activity 2.

Activity Guide

Guiding Question: How can we create remote sensing devices to gather different types of data from a distance?

Post the question somewhere accessible, such as on chart paper or a shared document, so that youth can refer to it throughout the activity.

Introduction (5 min)

1. If you sent youth home with the Family Connection questions, ask:

   Q: If anyone talked to their families about animals or about building something, would you like to share about it?

   A: Accept all responses.

2. Have youth think back to the previous activities. Ask:

   Q: What remote sensing technologies have we designed to help us gather data from a distance?

   A: Accept all responses. Possible responses include that we have designed light redirection systems so we can get light from the planet using mirrors, we have designed filters so that we can learn about the minerals on the planet by looking at only certain colors of light, and we have designed LiDAR so we can learn about the topography of the planet.

   To prompt youth's memories, allow them to examine each type of technology that they designed as they describe it.

3. Let youth know that today they will start the final design challenge with their groups. Share the Guiding Question:

   Q: How can we create remote sensing devices to gather different types of data from a distance?

4. Have youth turn to *Remote Sensing Engineering Challenge*, page 26 in their Engineering Notebooks, to learn about the challenge. Explain that when planning for missions, NASA scientists choose sites on Earth that are similar to the planets they want to investigate, so engineers can design and test devices before sending them into space. Gather youth around the Space Screen setups and explain that the closed shoeboxes behind the screens contain model landscapes that represent sites on Earth that are similar to the areas on Mars that NASA scientists want to explore, Site A and Site B. Ask:

   Q: Why do you think these Space Screens are here? What might they represent?

   A: Accept all responses. Possible responses include that the Space Screens represent space or the difficulty of getting information about things that are far away.

   Remind youth that remote sensing allows people to gather data from places that are far away or inaccessible. The Space Screen represents the distance between the engineers and the model landscape testing site on Earth because, like distance in outer space, the Screen makes it difficult to learn about the landscape. Youth will be on one side of the Space Screen, while Site A and Site B will be on the other side. Youth will use the remote sensing devices they design to explore the sites through the Screen.

Imagine and Plan (10 min)

1. Arrange youth into groups of four. Youth will stay in these groups for Activities 5 and 6. Explain that for their missions, youth will use their remote sensing devices to help scientists learn about other planets. Give groups a chance to read the *NASA Scientist Cards*, pages 27 – 30 in their Engineering Notebooks. Point out the different criteria for the designs based on the scientists' questions. Have each group choose a scientist whose mission sounds interesting to work with.

Teaching Tip

If you have enough materials, encourage youth to work in pairs. You may want to consider strategic pairing and groups that place together learners who complement each other's strengths and areas where they are growing.

Supporting Learner Differences

If youth have struggled with previous activities or concepts, consider starting them with Caris, the scientist who has the simplest mission (landforms). Once successful, youth can select a more challenging mission to engineer for.

2. Have youth turn to *Guidelines for Testing Devices*, pages 31 – 32 in their Engineering Notebooks, to imagine how they might use their remote sensing devices before they plan. If youth are working with a scientist who is going to need information about minerals, point out the key for interpreting minerals on this page.

   Remind youth about the materials they can use in their designs and the types of technologies they learned about: light redirection systems, optical filters, scrapers, and LiDAR. Let them know that NASA scientists often send multiple remote sensing technologies on a single spacecraft to collect all the information they need. Similarly, youth should use multiple technologies to get the information the scientist needs.

3. Give each group a few minutes to imagine and plan their design, keeping their scientist's criteria and constraints in mind. It may be useful for youth to come up with ideas individually or in pairs, then combine those ideas into a single plan as a group. Youth can record their ideas on *Remote Sensing Plan*, page 33 in their Engineering Notebooks.

4. As groups are planning, circulate around the room and ask:

   Q: Which remote sensing technologies will help you gather the information your scientist needs?

   A: Accept all responses. Possible responses include light redirection systems and LiDAR to learn about topography and light redirection systems, optical filters, and scrapers to search for minerals.

Create and Test (30 min)

1. After groups have finished planning, have them gather materials from the Materials Table and begin creating their remote sensing devices. Make sure youth know their devices should be able to fit through the opening in the Space Screen to reach the model landscapes.

Teaching Tip

Have youth gather small amounts of materials at a time to avoid running out of materials.

2. Give youth an opportunity to test their remote sensing devices as they build using the *Test Sites* and *Data Collection Grids* from Engineering Activities 2 and 3.

3. When groups are ready to test their remote sensing devices on the model landscapes (Sites A and B), remove the lids from the shoeboxes that are behind the Space Screens so that they can collect information.

4. Have groups record what they learn on *Data Collection Grids*. While they work, ask:

   Q: What types of information can you collect?

   A: Responses will vary. Possible responses include information about the topography and information about the minerals.

   Q: Are you meeting your scientist's criteria?

   A: Accept all responses.

   Q: Are your remote sensing devices working the way you imagined they would?

   A: Accept all responses.

Supporting Youth Thinking

Youth may say that they have failed. Explain that although particular designs may fail, youth themselves are not failures, and that failure is an important way in which engineers gather information to improve their designs. Remind youth how engineers and scientists learn from failure (*Special Report* video, 7:47 – 8:09). Ask:

Q: What did you learn from the failure of this design?

A: Accept all responses. Possible responses include that the light redirection system needs to be a different size or that the model LiDAR needs more straws.

5. Let groups know when they have ten and five minutes remaining. If they need more time, inform them they will continue working on their designs during the next session.

Reflect (10 min)

1. Have youth reflect on the Guiding Question:

   Q: How can we create remote sensing devices to gather different types of data from a distance?

   A: Possible responses include that we used a light redirection system with optical filters to learn about the landscape and identify some minerals, we used a scraper to identify additional minerals, and we used LiDAR to learn about the topography of the planet and to locate safe landing sites.

2. Have groups come together to share their remote sensing devices. Ask each group:

   Q: Did anything surprise you about collecting data with your remote sensing devices?

   A: Accept all responses. Possible responses include that it was difficult to use certain technologies and that different technologies were better at different tasks.

   Q: How might you improve your designs?

   A: Accept all responses.

3. Let youth know that they will have time to improve their remote sensing devices in the next session.

4. Have groups gather around the engineering design process poster and ask:

   Q: Which steps of our engineering design process did we use today?

   A: Responses will vary. A possible response is that we imagined, planned, created, and tested our designs to collect information about the landscapes.

5. Congratulate youth on their excellent engineering work! Emphasize that the information their designs are able to gather will help their scientists learn more about Mars and possibly expand our understanding of life and the solar system.

After the Activity

1. Label groups' designs and store them in a safe location. Save any remaining materials for the next activity.

2. Plan ahead for Engineering Activity 5. See Activity 5 Materials Preparation on page 110.

3. Take time to reflect on the following educator prompt.

   Q: How did you help youth embrace and learn from failure during this activity?

Remote Sensing Unit Resources

QR code leads to resources available for this unit.

https://planets-stem.org/**betars-unit-landing-page**/

Engineering Activity 4

Model Landscape Assembly

The final design challenge requires the educator to prepare model landscapes so youth can test their remote sensing devices.

Materials for each Model Landscape:

- *Mineral Paper*
- glue
- paper cups
- felt
- craft foam
- utility knife
- construction paper
- shoeboxes
- Styrofoam
- masking tape

Site A

Prepare two shoeboxes for Site A, each with the following features:

Must Have

- Lots of *Mineral Paper* printed with triangles, the symbol for clay minerals, and stars, the symbol for sulfate minerals that form in water.
- At least one triangle on the *Mineral Paper* covered in felt, which also represents clay minerals. To do this, cut felt into a triangle shape and glue it over a triangle on the *Mineral Paper*.
- Mountains or varied terrain made from Styrofoam sheets and cups.
- No flat, open spaces.

Consider Adding

- At least one star on the *Mineral Paper* covered with foam. To do this, cut a piece of foam into a star shape and glue it over a star on the mineral paper. The star and foam both represent sulfate minerals, which form in water.
- At least one circle on each *Mineral Paper* covered with construction paper. To do this, cut a scrap of construction paper into a circle and glue it over a circle on the *Mineral Paper*. The circle and the construction paper represent volcanic minerals.
- Paper cups to create landforms.

5. An example of Test Site A, which features a low area on the left with two cups providing elevation and more elevated areas on the right. The left part of the lowlands is covered with blue Mineral Paper, while red Mineral Paper appears in the center lowlands and blue Mineral paper on the highland at the right side of the box.

Site B

Prepare two shoeboxes for Site B, each with the following features:

Must Have

- Flat, open space, at least 3″ × 4″ (8 cm × 10 cm).
- *Mineral Paper*, different colors.
- Craters, dips in terrain using Styrofoam sheets.

Consider Adding

- At least one star on the mineral paper covered in foam, which represents sulfate minerals.
- At least one circle on each mineral paper is covered in construction paper, which represents volcanic minerals.
- Craters, dips in terrain using Styrofoam sheets.

Use a utility knife to cut foam sheets and build layers, or stack objects from around the room.

6. An example of Test Site B, which features a low area covered in blue Mineral Paper on the left. On the right, progressively more elevated areas appear like stair steps, all of which are covered with red Mineral Paper.

Engineering Activity 4

Space Screen Assembly

You will need to assemble four Space Screens in total, one for each model of Site A and one for each model of Site B. Before assembling Space Screens, determine whether the youth in your group can reach through them safely. Make the choice that is best for your group but still allows all youth to gather information "remotely."

Materials for each Space Screen:

- tri-fold board
- ruler
- utility knife
- felt
- scissors
- duct tape

1. Use a utility knife to cut a 9″ × 20″ (23 cm × 50 cm) rectangle approximately 10″ (25 cm) from the bottom of the trifold board.

2. Cut a 1″ (2.5 cm) wide fringe across four pieces of felt, leaving enough space around the edges to tape each piece to the board.

3. Tape the two pieces of felt to each side of the board so the hole is completely covered.

4. Label two of the screens “Site A” and two of the screens “Site B.” If time allows, decorate all screens using paint or stickers. Decorating the screens provides a visual reminder that they represent a significant distance between the engineers and the landscape site.

5. Position the Space Screen at the edge of a table so youth can easily access it and reach inside.

6. Tape one of the model landscapes to the table directly underneath the hole in the Space Screen. The model landscapes are positioned correctly if youth can reach through the Space Screen and collect data from the surface of each site. Keep the lid on the shoebox until groups are ready to test.

7. Tape the Space Screen to the table for extra stability.

8. Repeat to complete the remaining three Space Screens.

9. Position the Space Screens back-to-back or against a wall, so the model landscapes remain hidden as much as possible.