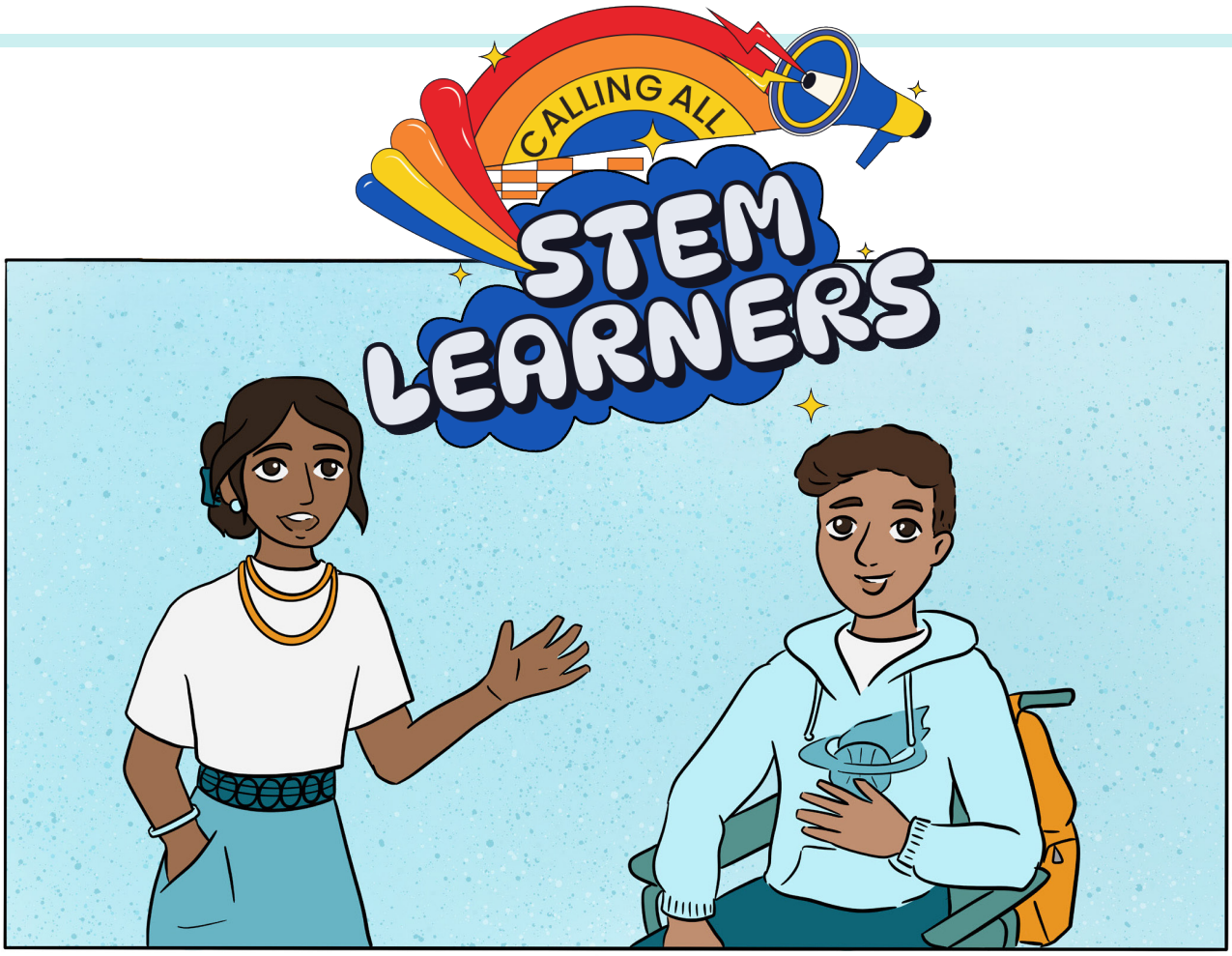


Your PLANETS
Engineering Notebook

for:

Worlds Apart! Engineering Remote Sensing Devices

Name: _____

PLANETS

Ready, S.E.T., Go!

Missions to Mars

1. Choose one type of survey mission to design for:
   - **Global Survey**: a long-term mission to explore and map a new planet or moon
   - **Landing Site Selection Survey**: a short-term mission to choose the best place to land a robot or human on the surface

2. Figure out what your survey mission needs to do:
   - **Level of Detail for Images**:
     High Detail Low Detail
   - **Measuring Shape and Texture of Surface**:
     Required Optional
   - **Measuring What the Surface Is Made Of**:
     Required Optional

3. List the limits on your design:
   - **Space Required**: All instruments must fit inside the fairing without overlapping.
   - **Power Required**: _____
   - **Data Volume Required**:_____
   - **Weight Limit**:_____

Our Engineering Design Process

YES Middle School

NASA Career Spotlights

Photo Credit: N4 Solutions

Dr. Berhanu Bulcha

My job at NASA is to create advanced technology that collects images and data on planetary bodies, like Saturn's moon Enceladus, so that we can detect what molecules are there and look for potential life in space.

Mike Scott

My job at NASA is to make sure we always have enough power (and battery charge) on the space station.

Engineering Activity 1: My Technology Story: Sharing Experiences

Why is technology important?

My Technology Story

Think of a story about a technology or tool that made a big difference in your life.

- It can be a story you heard, watched, read, or experienced.

Then

- write or draw your story on this page, or
- build something to demonstrate it.

NASA Career Spotlights

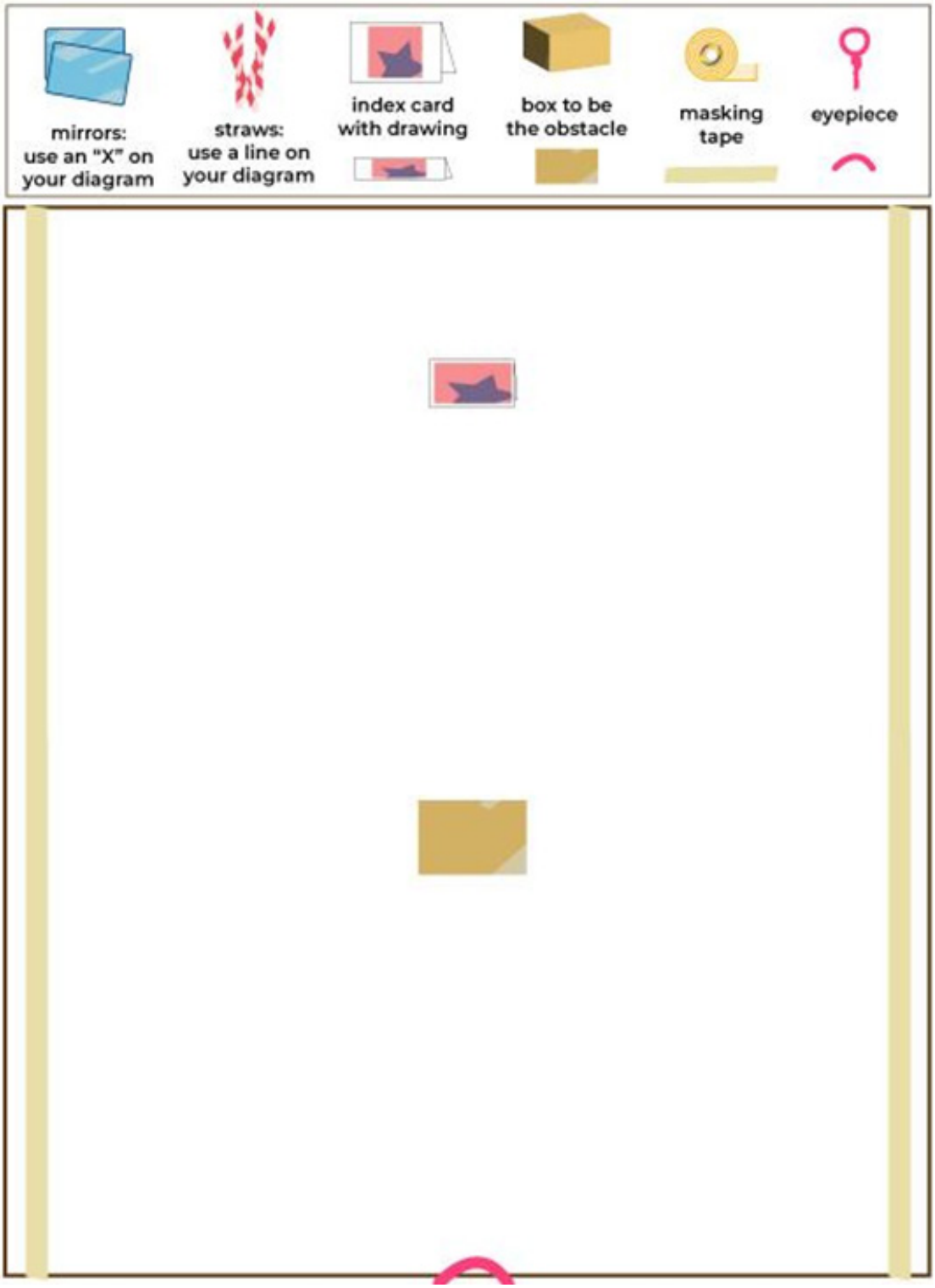
Photo Credit: Aubrey Gemignani/NASA

Dana Bolles

My job at NASA is to ensure all users can enjoy our science websites.

Engineering Activity 2: Lighten Up! Investigating Light

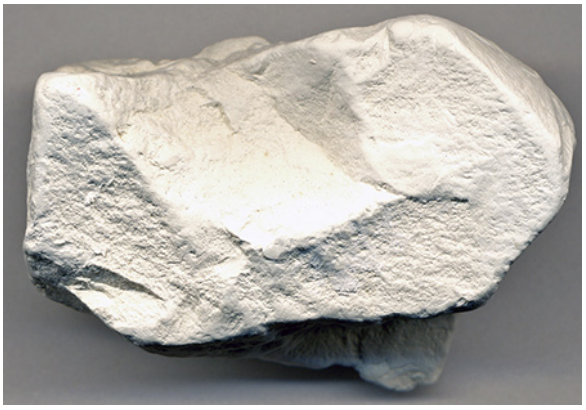
Obstacle Course Diagram



Engineering Activity 4: Hide and Seek: Finding Minerals

Data Detection Investigation–Sound

Felt represents clay minerals



Kaolinite. Image source: Wikipedia

Paper represents volcanic minerals

Olivine. Image source: NASA

Foam represents sulfate minerals

Gypsum. Image source: Wikipedia

Feel and scrape each material with a craft stick and different-sized straws.

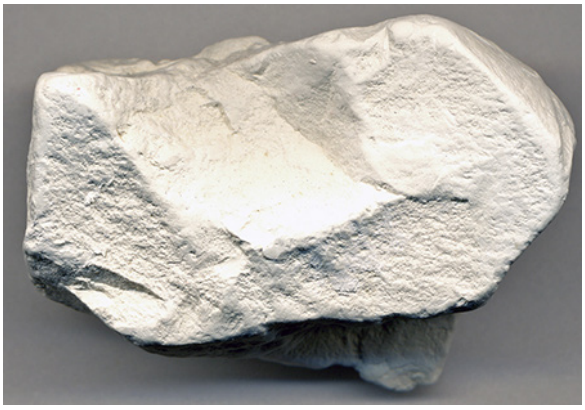
Feel and listen to the differences as you scrape.

Use this space to record your observations.

record your observations

Data Detection Investigation–Light

Triangles ▲ represent clay minerals



Kaolinite. Image source: Wikipedia

Circles ● represent volcanic minerals

Olivine. Image source: NASA

Stars ★ represent sulfate minerals

Gypsum. Image source: Wikipedia

Investigate how the colors on the red and blue test sites look in two ways:

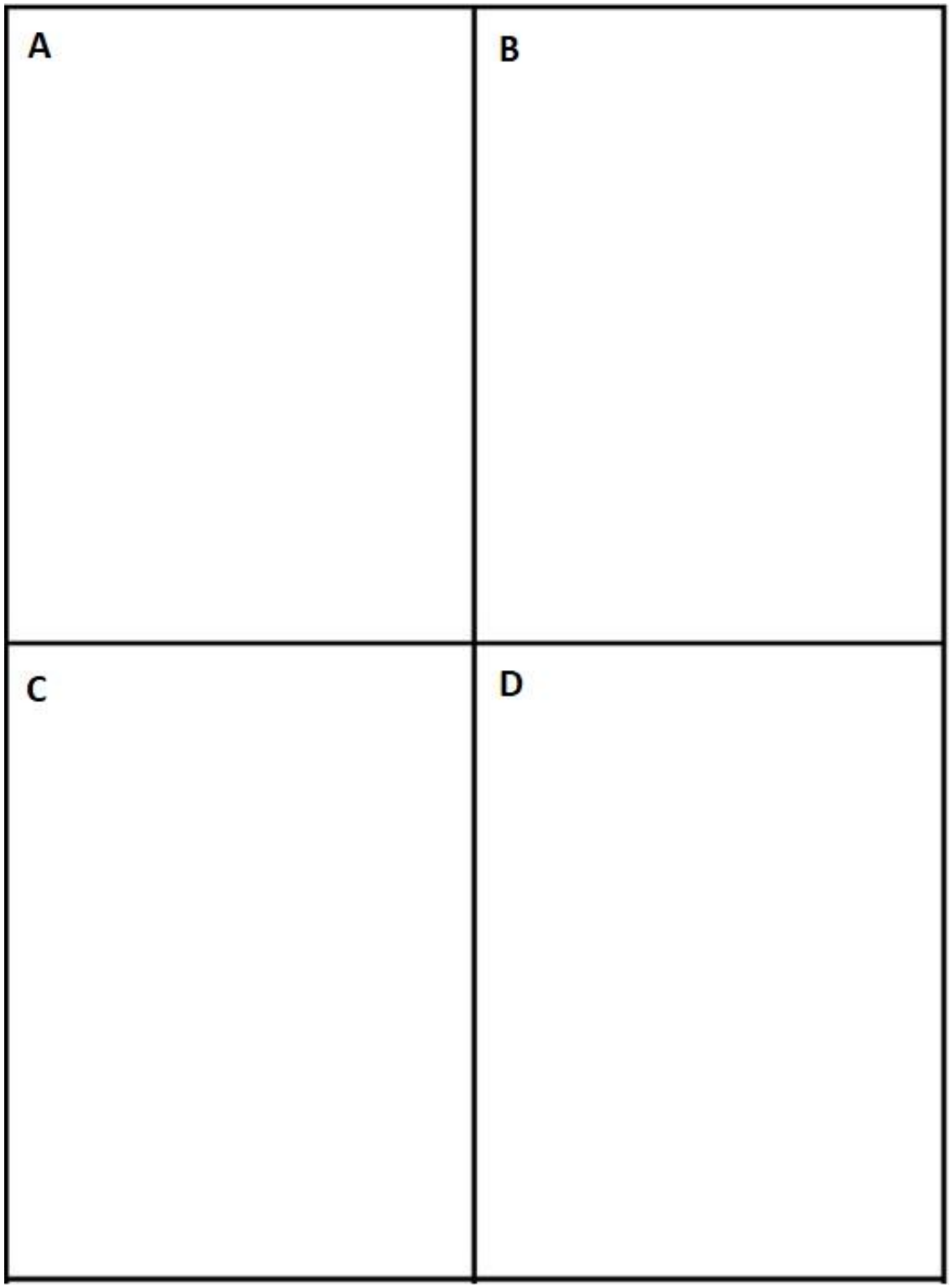
- with cellophane filters placed over them
- without cellophane filters placed over them

Use this space to record your observations.

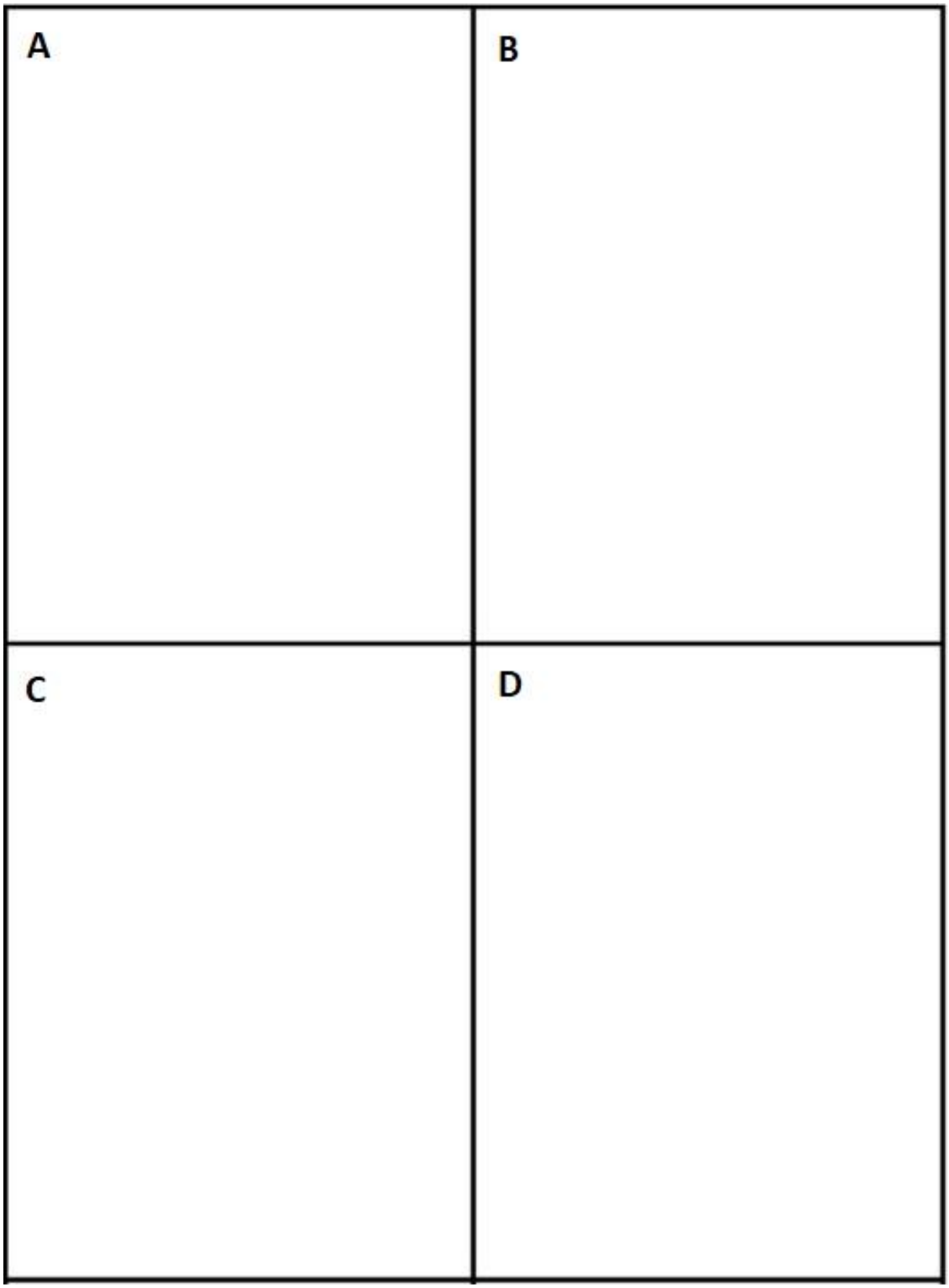
Engineering Activity 5: Taking Shape: Finding the Shape of the Land

Test Surface Heights

Side View (label height and width)



Bird's-Eye View (add labels as needed)



Engineering Activity 6: Put It Together: Creating a Remote Sensing Device

Remote Sensing Engineering Challenge

Your final design challenge is to engineer technologies that can collect information about the surface of Mars from a distance. Humans have never been to Mars, so it's important to learn as much as we can about it before astronauts go there. You will work with one of three NASA scientists to determine what information is needed. You will test your technologies on multiple sites on Earth to make sure it works before launching to Mars.

NASA Career Spotlights

Photo Credit: David Tuman

Aaron Yazzie

My job at NASA is to design robotic mechanisms and tools that allow us to gather rock samples from Mars and beyond.

NASA Scientist Cards

NASA Scientist: Jaime, planetary geologist

> ***"I am interested in how Mars was formed. Minerals can tell me a lot about the planet's history. What minerals are on the surface?"***

Criteria

- The device must be able to identify the minerals that form in water like clays (triangle ▲ and felt) and sulfates (star ★ and foam). It should also be able to identify volcanic minerals (circle ● and paper).
- The device must be able to fit through the opening in the Space Screen, which is 12" × 22" (31 cm × 56 cm) for testing.

Constraints

- You may only use the available materials to complete your design.
- You will have two sessions to engineer your remote sensing device(s).

NASA Scientist Cards

NASA Scientist: Caris, planetary geologist

> ***"I am interested in landing a rover on Mars. Is there a flat, open space where the rover could land safely?"***

Criteria

- Design a device to identify safe areas for the rover to land.
- The device must be able to determine the size of the area. To land safely, a rover needs an area of 3" × 4" (7.5 cm × 10 cm)
- The device must be able to fit through the opening in the Space Screen, which is 12" × 22" (31 cm × 56 cm), for testing.

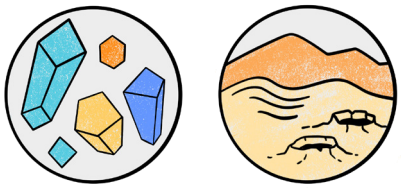
Constraints

- You may only use the available materials to complete your design.
- You will have two sessions to engineer your remote sensing device(s).

NASA Scientist Cards

NASA Scientist: Alex, astrobiologist

> ***"I want to know if Mars can support life. One of the most important materials to support life is water. Are there any sites that show evidence of water?"***



Criteria

- Design a device to identify places where water may have been present. Your device should identify landforms, like canyons, that may have been created by water. Your device should also identify minerals that form in water, like clays (triangle ▲ and felt) and sulfates (star ★ and foam).
- The device must be able to fit through the opening in the Space Screen, which is 12" × 22" (31 cm × 56 cm), for testing.

Constraints

- You may only use the available materials to complete your design.
- You will have two sessions to engineer your remote sensing device(s).

Remote Sensing Plan

Record a plan for your remote sensing device(s). After you test, choose areas of your design that you would like to improve.

Circle the scientist you are working with.

Jaime	**Caris**	**Alex**

Circle all the things your scientist is searching for.

open spaces

canyons

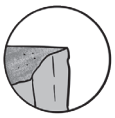
clay minerals (triangle ▲ and felt)

sulfate minerals (star ★ and foam)

volcanic minerals (circle ● and paper)

Data Collection

Site A

Topography:  flat  hilly  steep

Landforms: canyons valleys mountains

Minerals: _____

clay (triangle ▲ and felt)
sulfate minerals (star ★ and foam)
volcanic minerals (circle ● and paper)

Site A Side View (label height and width)

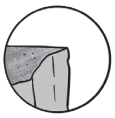
A	**B**
C	**D**

Site A Bird's-Eye View (label as needed)

A	**B**
C	**D**

Data Collection

Site B

Topography:  flat  hilly  steep

Landforms: canyons valleys mountains

Minerals: _____

clay (triangle ▲ and felt)
sulfate minerals (star ★ and foam)
volcanic minerals (circle ● and paper)

Site B Side View (label height and width)

A	**B**
C	**D**

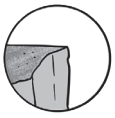
Site B Bird's-Eye View (label as needed)

A	**B**
C	**D**

Engineering Activity 7: Data Collection: Improve

Record any data that you collect using your improved remote sensing device(s).

Site A

Topography:  flat  hilly  steep

Landforms: canyons valleys mountains

Minerals:

clay (triangle ▲ and felt)

sulfate minerals (star ★ and foam)

volcanic minerals (circle ● and paper)

Site A Side View (label height and width)

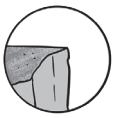
A	**B**
C	**D**

Site A Bird's-Eye View (label as needed)

A	**B**
C	**D**

Data Collection

Site B

Topography:  flat  hilly  steep

Landforms: canyons valleys mountains

Minerals: clay (triangle ▲ and felt)
sulfate minerals (star ★ and foam)
volcanic minerals (circle ● and paper)

Site B Side View (label height and width)

A	**B**
C	**D**

Site B Bird's-Eye View (label as needed)

A	**B**
C	**D**

Draw Pictures

Draw pictures of your technology before and after you improved it.