

Ready, S.E.T. (Science, Engineering, Technology), Go!



Science



Engineering



Technology

Educator Preview

Activity Snapshot

Learners design spacecraft to gather data about Mars. As scientists, they choose a mission. As engineers, they figure out which instruments to send on the mission.



Timing | 45 minutes

Get Ready & Team Up 10 min.

Plan & Create (S.E.T.) 25 min.

Reflect (Go!) 10 min

Total 45 min.

Level Up Activities 5–30 min. each



Prep Snapshot*

Prep Time 60 min.

- Read front matter and activity.
- Print Notebooks.
- Cut out instruments.
- Make *Our Ideas* poster.

**See Materials & Preparation for full info.*



21st Century Skills

Connection

- Critical Thinking

Habits of Mind

- Use a structured problem-solving process.

Science Practices

- Planning and Conducting Investigations



Guiding Questions

Which survey mission should we send to Mars?

What instruments does a spacecraft need for it?

Learners Will Do

As scientists, choose a type of mission. As engineers, choose and arrange instruments for that mission.

Learners Will Know

Scientists and engineers can work together to solve problems.



Connecting Across Activities

Ready, S.E.T., Go!	Activity 1: Sharing Experiences
Today , learners design spacecraft to gather data about Mars. As scientists, they choose a mission. As engineers, they figure out which instruments to send on the mission.	Next time , learners share experiences with, and stories about, technology.

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/e7a7641c>

Materials and Preparation

Materials

For the educator

- *Our Ideas* poster (on paper or a shared digital document). See Prep & Setup Guide (PDF) [Examples](#) | [Templates](#)
- index cards
- markers
- scissors
- tape

For each group of 4–6

- Cutouts from [Science Ready, S.E.T., Go! Fairing and Instruments Sheets Handout, pgs. 16-18](#)
- [Science Ready, S.E.T., Go! Visual Instructions Handout, pg. 20](#)



Teaching Tip

If you think learners will benefit from having more space in the Notebook, print one-sided or add sheets of blank paper as you make the Notebooks.

For each learner

- [Science Notebook \(PDF\)](#)

Ready, S.E.T., Go! Materials Preparation (60 min.)

Ahead of Time

1. Read through the entire PLANETS [Science Pathway Educator Guide Introduction, pgs. iii-xxvi](#), to learn more about this unit.
2. Read the [Educator Science Background \(weblink\)](#) for context about the science and engineering in the unit.
3. Print and staple one *Science Notebook* for each learner, in color if possible. As needed, prepare to share the Notebook digitally.
4. Print a copy of the Science Notebook (PDF) for your own reference throughout the pathway.



Teaching Tip

This activity is the same in both the Science and Engineering Pathways. If you have already taught it in one pathway, you do not need to teach it again.

This activity can stand alone as a brief single-session program.



Support Learner Differences

The Science Notebook can be printed in large font and you can share a digital version that will work with screen readers. The Science Notebook is written in English, but you can translate the instructions into other languages; see translation guidance in our editable [Translatable Glossary \(DOCX\)](#).





5. Prepare an *Our Ideas* poster by following the online [Prep & Setup Guide \(PDF\)](#). Add the Guiding Question “Which survey mission should we send to Mars? What instruments does a spacecraft need for it?” so learners can refer to it throughout the activity.
6. Cut out one set of instruments from the *Science Ready, S.E.T., Go! Fairing and Instruments Sheets Handout*, pgs. 16-18 for each group of 4–6 learners, or prepare for learners to cut their own. (Cut around the edges of the instruments themselves, not around the edge of the rectangles.)
7. Print one [Science Ready, S.E.T., Go! Instruments Key Handout](#), pg. 19 for each group of 4–6 learners.
8. Print one [Science Ready, S.E.T., Go! Visual Instructions Handout](#), pg. 20 for each group of 4–6 learners.






Teaching Tip

You can begin the *Our Ideas* poster with several standard 23" × 32" pieces of chart paper. You may fill them up before the end of the pathway, in which case you can add additional pieces as needed. See the [Our Ideas poster example \(PDF\)](#).

The *Our Ideas* posters capture students’ authentic language and ideas as they emerge in real-time discussions. The posters are not meant to simply display and front-load vocabulary. The posters develop over time as the educator listens for and adds the language that learners use in the moment, thus validating their ideas, providing feedback and supporting sensemaking and language development.

Support Learner Differences

Different learners have different needs. Choose from the following tips to best support your learners:

- View the [Translanguaging Video](#) to support learners who speak multiple languages. 
- For those with low vision: add tactile elements, such as three-dimensional representations and Braille. Prepare a shared digital document all learners can access, ensuring that it supports text-to-speech for your learners. 
- Add learner questions to the *Our Ideas* poster to foster an interest-led approach. 



If it will support your learners, consider making the following modifications to each instrument:

- Punch out the white circle to indicate the top center.
- Attach dots to indicate the relevant levels of communication, weight, and power: one dot if the feature does not appear, two dots if it is a low value (e.g., low power, low weight), and three dots if it is a high value (e.g., high power, heavy).
- Attach a Braille sticker over the instrument number to indicate that number (e.g., “S4”).
- Print an extra *Science Ready, S.E.T., Go! Instruments Key Handout*, pg. 19, cut out the information for that item, and tape it to the back of that instrument.



In Your Space

9. Place the *Our Ideas* poster in a location all learners can access. Make a plan to store it between activities.

Consider also placing all the instruments for each group in a tub or other container.

Activity Guide

Get Ready & Team Up (10 min.)

1. Organize learners into groups of 4–6.
2. Say: **NASA wants to learn about Mars; one way they do that is by sending spacecraft to orbit the planet. Today, you are going to choose a mission to learn about Mars and design a spacecraft to complete it.** Share the Guiding Question with learners aloud and in writing (using multiple languages as needed): **Which survey mission should we send to Mars? What instruments does a spacecraft need for it?**

Plan & Create (S.E.T.) (25 min.)

Science: Choose a Mission

3. Ask: **What kinds of things do you think we should learn about Mars?** (*What it is made of, what mountains and other features it has, how big it is, where there is water, where a rover could land.*) Give groups five minutes to discuss and record their ideas on the *Our Ideas* poster. Say: **We will keep recording ideas on this poster.**
4. Say: **You've listed many possible things to study on Mars. It is not possible to study them all at once, so you will have to choose one mission to design for.**
5. Give each learner a Science Notebook. Say: **This Notebook is a place to record your observations and ideas.**



Support Learner Differences



If learners are new to you or each other, have them share their names, name pronunciations, and other important parts of their identities. These introductions are important for all learners and can be especially relevant for Indigenous learners, multilingual learners, and learners with different physical abilities. You can also distribute index cards and have learners write anything they want you to know but do not want to share with the whole group, such as resources that will help them learn. If everyone knows each other's names, ask if anyone has a middle name or nickname you could learn to pronounce. Invite them to share about it.



For more strategies to engage learners, refer to [Designing Instruction to Reach Diverse Learners, pg. xv](#).



Check out the [Intentional Grouping Strategies, pg. xxii](#).



Recording learners' ideas using words, diagrams, and pictures on the *Our Ideas* poster or shared digital document throughout the activities allows them to refer to the poster to remember words and build on past ideas. You can refer to an "In-Use Example" in the online [Prep & Setup Guide - Examples \(PDF\)](#).



If you have learners who speak multiple languages, encourage them to share in their preferred languages.



Teaching Tip

Throughout this guide, information for you to say to students appears in **bold**. You can say the bold sentences exactly as they are written or paraphrase them.



Support Thinking

To help learners understand what they will be doing during this activity, play the translatable video [Remote Sensing Instructional Read Aloud](#).

6. Have learners turn to [Missions to Mars, Science Notebook \(PDF\)](#). Say: **NASA designs different missions for different purposes. This page describes two different kinds of missions to Mars. Decide as a group which one you want to complete.**
 - **A global survey is a long-term mission to explore and map a new planet or moon.**
 - **A landing site selection survey is a short-term mission to choose the best place to land a robot or human on the surface.**
7. Allow each group to discuss, choose one mission, and mark it on the Science Notebook page.
8. Say: **Now that you've chosen a mission, you need to figure out what the mission needs to succeed.**
9. Say: **Survey missions need to make images. Which mission do you think needs more detailed images? Which mission needs less detailed images?** (*A global survey needs less detail because it is observing the entire planet. A landing site selection survey needs more detail because it is observing specific smaller locations.*)
10. Say: **The amount of detail in an image is called its *resolution*. A global survey can have lower-resolution images; a landing site selection survey needs higher-resolution images.** Write the word *resolution* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well. Have learners record the level of resolution their chosen mission needs in their Notebook.
11. Say: **Some missions need to know what the surface of a planet is made of, and some just need to know the planet's general shape and texture. Which do you think is needed for each mission?** (*A global survey needs to know about shape and texture, but not necessarily what the surface is made of, because nothing is landing on the surface. A landing site selection survey needs to know shape and texture as well as what the surface is made of, because that information is important when landing.*)
12. Say: **The shape and texture of a surface are called its *physical properties*. Knowing about these is required for all missions. What a surface is made of is called its *composition*. Knowing about this is required for a landing site selection survey and optional for a global survey.** Write the terms *physical properties* and *composition* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well. Have learners record information their chosen mission needs in their Notebook.
13. Explain that things a successful design needs to do are its **criteria**. Learners have just listed criteria for each mission. Have learners write this word after its definition in the Notebook, and add it to the *Our Ideas* poster.
14. Say: **Throughout history, people have figured out how to learn more about the world, from local plants and animals, to Earth, to other planets. Like these people, you have been using some practices of scientists. Scientists do many other things that we did not have time to do today, such as analyzing data.** Write the word *scientist* on the *Our Ideas* poster. Have learners work together to come up with a description of scientists and record it on the poster. (*For example:*

Scientists often ask questions, test things out, make observations and measurements, and gather evidence to answer the questions.) You can have learners add translations, drawings, or related images to the poster as well.

Engineering: Design a Spacecraft



Level Up!

Have learners sort the instruments by weight. Ask: **What do you notice about the weight of the instruments?** (*They have different weights. Some are light, some are moderate, and some are heavy.*) Set a limit for the maximum amount of weight on the spacecraft. (5 min.)

15. Ask: **Now that you have chosen a mission and figured out its criteria, what do you think you should do next?** (*Figure out how to complete the mission, design a spacecraft to do it.*)
16. Have learners discuss in their groups:
What kinds of things does a spacecraft need to work? What kinds of things does it need to study the surface of Mars? (*A spacecraft needs a source of power and a way to communicate with Earth. It needs technologies like cameras and sensors to study the surface of Mars.*)
17. Hand out one set of *Science Ready, S.E.T., Go! Fairing and Instruments Sheets Handout* cutouts, one *Science Ready, S.E.T., Go! Instruments Key Handout*, and one *Science Ready, S.E.T., Go! Visual Instructions Handout* to each group. Say: **You will design a spacecraft using these pieces of paper, which represent different instruments and parts of the spacecraft. This key explains what each instrument is.** Demonstrate how to use the key: for example, find the S1 instrument and look it up to determine it is the High Resolution Camera.
18. Ask: **What symbols are on these instruments? What do you think they mean?** (*The bars mean communication or signal. The weight means how much it weighs. The battery means power.*)
19. Have learners sort the instruments by how big they are. Ask: **What do you notice about the size of the instruments?** (*They are different sizes. Some are small, some are medium, and some are large.*) Say: **When NASA designs a spacecraft, they build it so it can fit on top of a rocket. The part that sits on top of the rocket and protects a spacecraft during launch is called the *fairing*. All the instruments need to fit into the cargo hold inside the fairing and not overlap.** Have learners find the piece of paper that represents the fairing.
20. Have learners sort the instruments by how much power they need or how much power they give. Ask: **What is needed to power these instruments?** (*Different instruments need different amounts of power. Some power sources give more power than others.*) Say: **Your spacecraft must have as much power as whichever instrument needs the most power. For example, if you have an instrument that needs a full battery, you need a source that provides a full battery of power.**
21. Have learners sort the instruments by how much data volume they need or how much data volume they can communicate. Ask: **How much data volume do these instruments need to communicate?** (*Different instruments need to send different amounts of data. Some communications relays can send more data than others.*) Say: **Your spacecraft must have as much communications relay as whichever instrument has the highest data signal needs. For example, if you have an instrument that needs more than two bars of signal, you need a relay that can transmit large data volumes.**

22. Explain that limits on a design are **constraints**. Learners have just listed constraints for their spacecraft. Have learners write this word after its definition in the Notebook, and add it to the *Our Ideas* poster.
23. Say: **Now it is time to choose instruments for your spacecraft. You will need to choose two types: instruments to help you learn about the planet for your mission (your criteria) and instruments to provide as much power and data volume as you need (your constraints).** Give groups 5 minutes to choose instruments.
24. Say: **Now it is time to arrange the instruments inside your fairing. They must fit without overlapping and without going past the edge of the fairing.** Give groups 5 minutes to arrange the instruments.
25. Say: **Humans often need to learn about things that are far away. Throughout history, people have done this in many ways, from telescopes to spacecraft. Like these people, you have been using the practices of engineers.** Write the word *engineer* on the *Our Ideas* poster. Have learners come up with a description of engineers together and record it on the poster. (For example: Engineers design things to solve problems.) You can have learners add translations, drawings, or related images to the poster as well.
26. Say: **Scientists start with a question and work to answer it. Engineers start with a problem and work to solve it. The objects, systems, and processes engineers design to solve problems are *technology*; for example, the spacecraft you designed are technologies. Engineers often design technologies that help scientists answer their questions. They depend on each other.** Write the word *technology* on the *Our Ideas* poster. You can have learners add translations, drawings, or related images to the poster as well.



Support Thinking

Help learners understand that this challenge does not have a single correct answer. Learners need to make tradeoffs in what they include on their spacecraft.



Level Up!

Learners may believe that *technology* refers only to devices powered by electricity. Explain that anything designed by people to solve a problem is technology. Have learners identify as many non-electrical technologies around them as they can. (10 min.)



Have learners create portrayals—through drawing, acting, or some other method of their choice—of scientists and engineers working together to plan missions and design spacecraft. (30 min.)

Reflect (Go!) (10 min.)

27. Have learners discuss the following questions in their small groups: **Where on Mars do you think it might be interesting to land your spacecraft? What would be useful to know about the place before it landed there?** Consider returning to learners' ideas at the start of the next activity.
28. Say: **You will be acting as scientists to think more about Mars. You will gather information about possible landing sites in order to choose one to land at.**

29. Say: **Next time, we will think about what we already know about technology and why it is important.**

After the Activity

1. Clean up:
 - Keep the *Our Ideas* poster for Activity 1.
 - Collect all paper cutouts. If possible, save them for reuse.
2. Plan ahead for Activity 1. See [Activity 1 Preparation on pg. 22](#).
3. Take time to reflect on the following educator prompt.
How did you create continuity between the science and engineering portions of the activity?



Level Up!

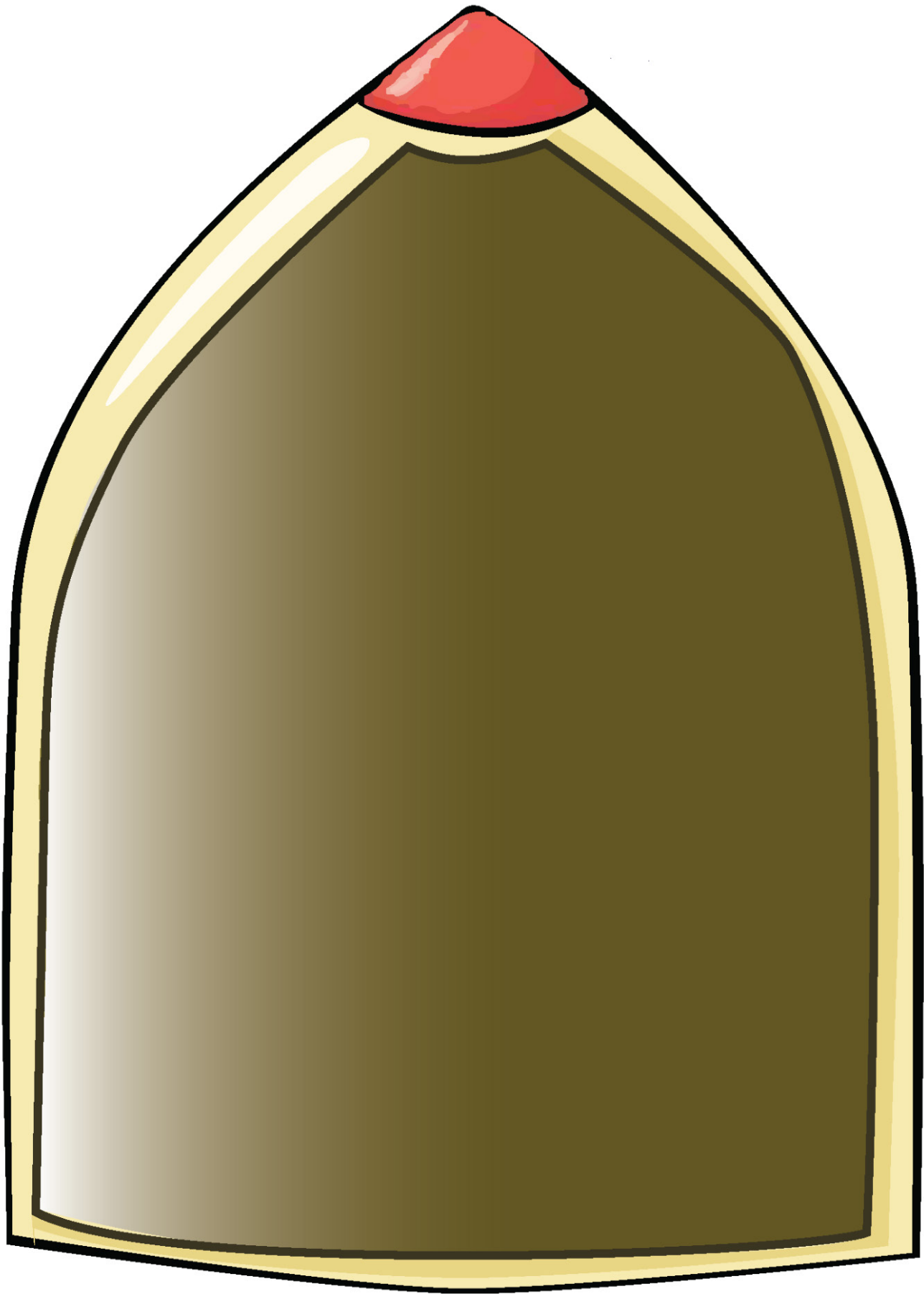
Watch this video about plans for sending humans to the Moon during the Artemis missions - [How We Are Going to the Moon - 4K](#). Discuss how spacecraft must be designed differently if they are carrying robots versus if they are carrying humans. (15 min.)

Remote Sensing Additional Resources

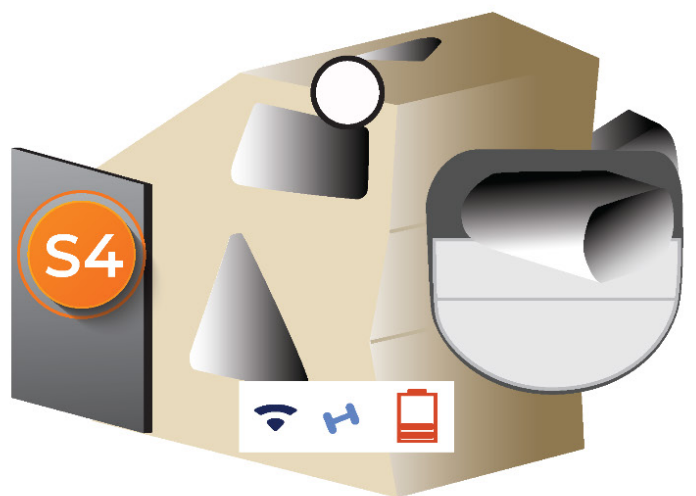
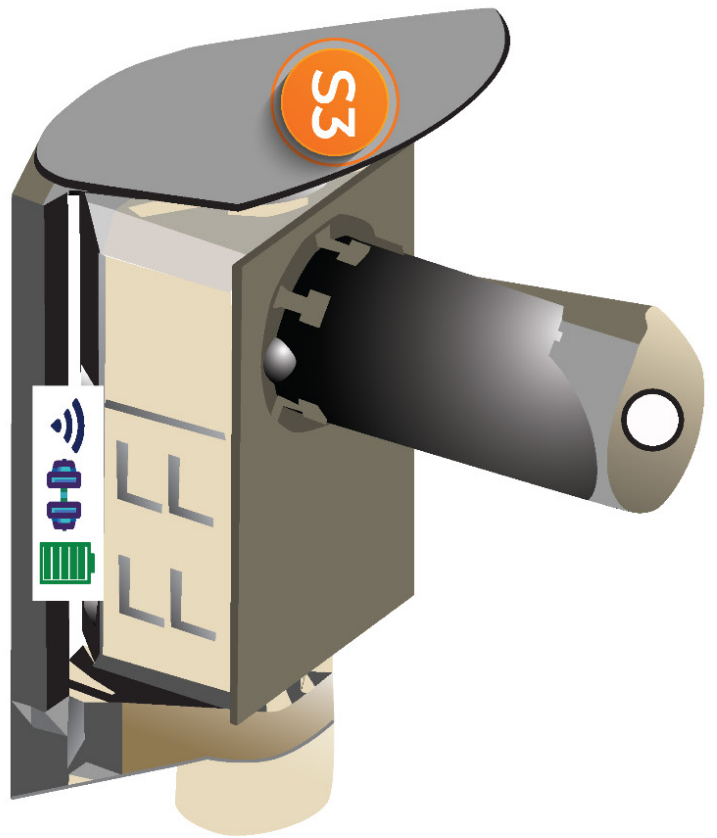
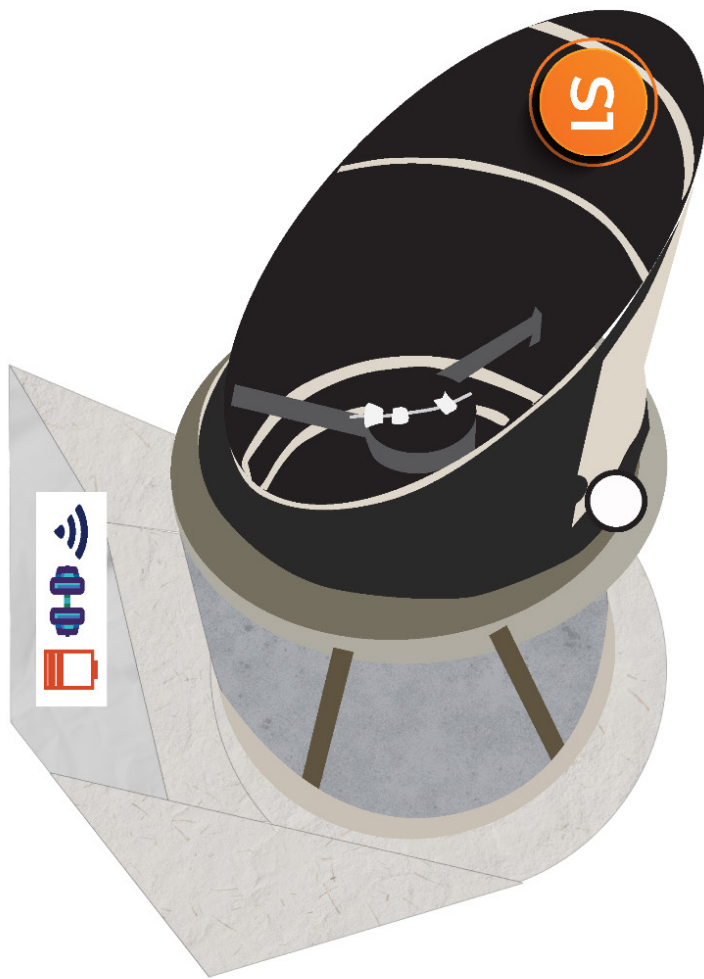
QR code leads to resources available for this unit.



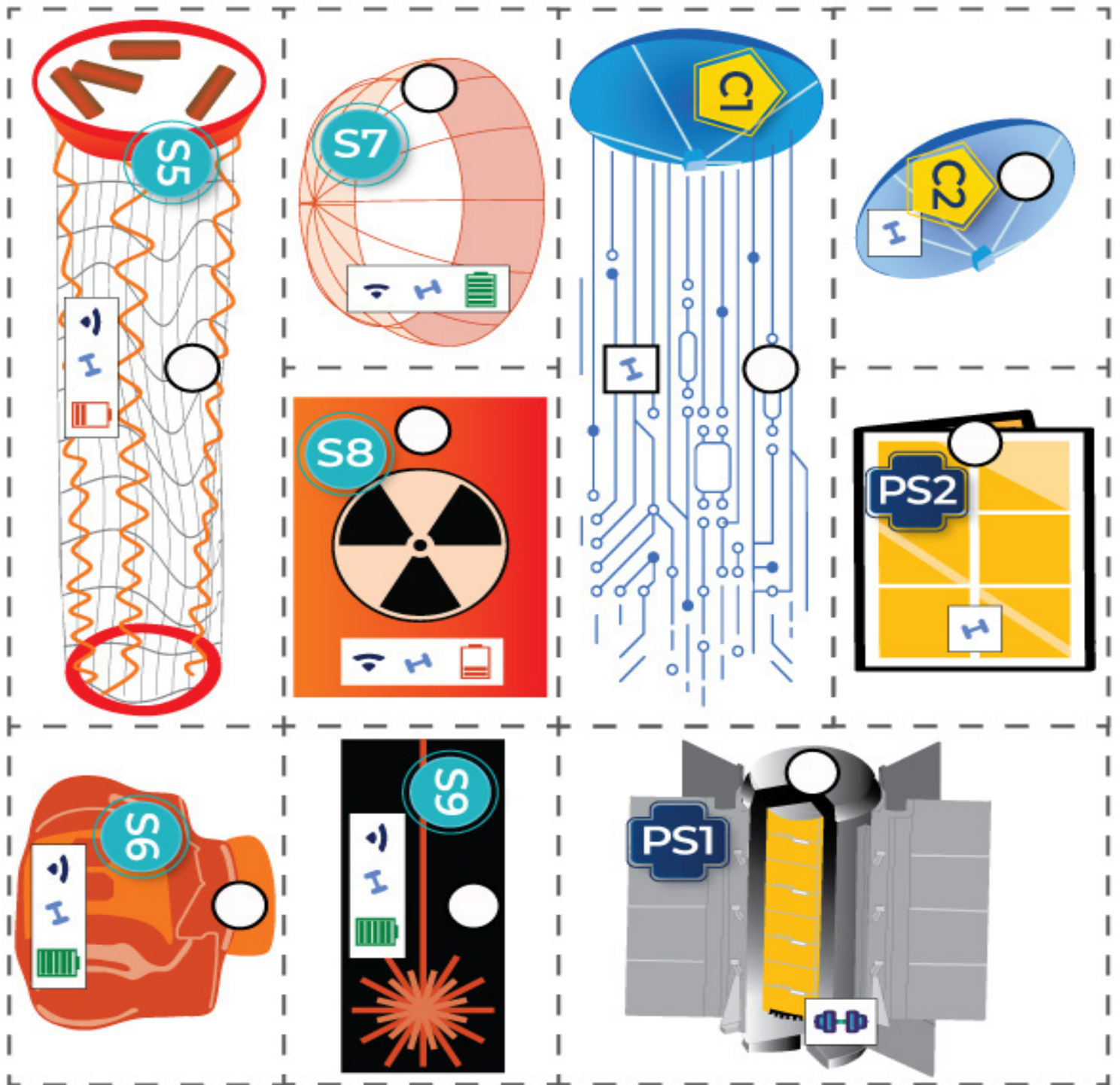
weblink: <https://hov.to/248cf0d9>



Instruments Sheet Handout – 1



Instruments Sheet Handout – 2



Instruments Key Handout



Science Instrument 1: High Resolution Camera

Can take 3D images of the surface and can take scientific measurements, which makes it great for making different kinds of maps.

high signal, heavy weight, low energy



Science Instrument 2: Low Resolution Camera

Can take good images of the surface, but has more limited scientific measurements.

low signal, light weight, low energy



Science Instrument 3: High Resolution Spectral Imager

Can take images of the surface and can take high resolution scientific measurements.

high signal, heavy weight, high energy



Science Instrument 4: Medium Resolution Spectral Imager

Takes good scientific measurements, but with reduced detail.

low signal, light weight, low energy



Science Instrument 5: Magnetometer

Measures the magnetic field of the planetary body.

low signal, light weight, low energy



Science Instrument 6: Thermal

Measures the temperatures of the surface, which can be used to figure out the grain size and where rocks are.

low signal, light weight, high energy



Science Instrument 7: Radar Instrument

Detects below the surface, showing us buried rocks, ice, and caverns.

low signal, light weight, high energy



Comms Instrument 1: High-Volume Communications Relay

Can transmit large data volumes.
light weight



Comms Instrument 2: Low-Volume Communications Relay

Can transmit small data volumes.
light weight



Power Source 1: High Power Source

Can last for a long-duration mission.
heavy weight



Power Source 2: Low Power Source

Can last for a short mission.
light weight



Science Instrument 8: Gamma Ray Spectrometer

Detects gamma rays on the surface, showing where different elements may be located.

low signal, light weight, low energy



Science Instrument 9: LiDAR

“Light Detection and Ranging” instruments can measure distances using light, which helps to understand the shape of the surface.

low signal, light weight, high energy

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Science Ready, S.E.T., Go! Visual Instructions Handout

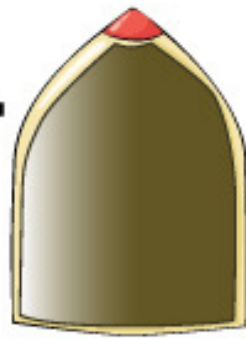
Prep for your Mission to Mars

1

Cut out all pieces



scissors

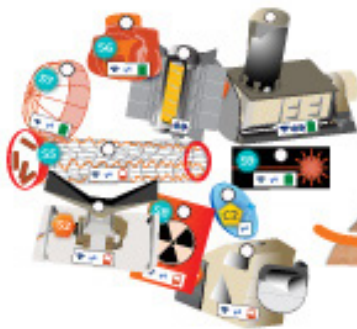


activity printout
cut outs



2

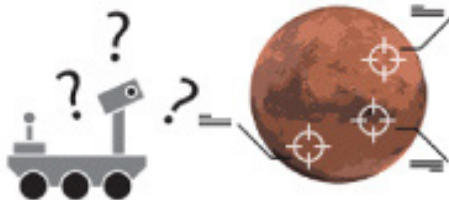
Sort the instruments



3

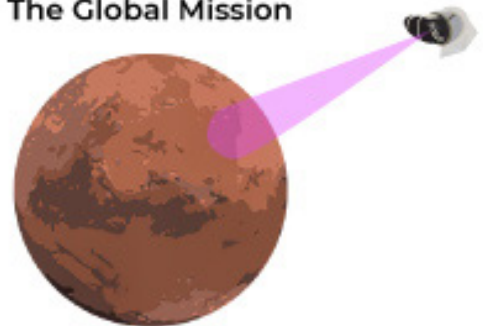
Choose your mission!

The Landing Site Mission



-or-

The Global Mission



Once you decide, you are on your way!

4

Guidelines

Can't overlap

**Can't go outside
of the faring**

Can't have
duplicates



Must have one of each type of instrument.

