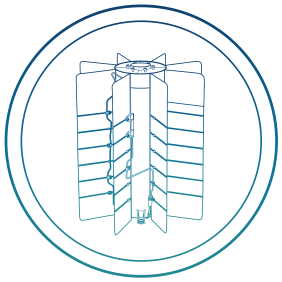
POWER TO EXPLORE CHALLENGE



SCIENCE LESSON WORKSHEET

DIGITAL SCAVENGER HUNT

It takes a special kind of power to explore the extremes of our solar system, and NASA wants to hear how it would energize your lunar exploration dreams! But before you plan your nuclear-powered lunar base, you need to know about where you're going (the Moon) and what RPS and fission power systems can do. Follow the trail and pick up all the know-how you need on this scavenger hunt to help you design a lunar base.
The hunt is on!

VOCABULARY

- Lunar
- Lunar South Pole
- Lunar regolith
- Apollo
- Artemis
- Nuclear energy
- Plutonium-238
- RPS
- RHU
- MMRTG
- Fission power systems
- Uranium

SCAVENGER HUNT

You have been given this list of questions and tasks. You will notice that your scavenger missions are split into sections, and each section has a handy QR code after the introduction that you can use to navigate your way to the answers and see how much you can discover before time runs out!

THE POWER TO EXPLORE CHALLENGE

Knowledge is power! This scavenger hunt will lead you on a deep dive into the world of lunar exploration and nuclear power, which will, in turn, prepare you to submit an entry for the Power to Explore Challenge!

CLICK OR SCAN

1. Briefly explain what the Power to Explore Challenge wants you to do.

_____

_____

_____

2. What is required to submit for a Power to Explore Challenge entry?

a. An illustration of a nuclear-powered lunar base and a written submission about my superpower
b. Only an essay
c. A picture found online

POWER TO EXPLORE CHALLENGE

THE MOON

What is the Moon made up of? Scientists have had decades to investigate lunar samples and data from the Apollo missions, but it also led to many new questions. Lunar scientists look forward to using new research equipment to support new investigations. Scan the QR code to answer the following questions about the Moon.

Click or Scan

3. What is Lunar regolith?

a. A moon lander
b. An air filter system
c. A historic monument on the Moon
d. Lunar soil

4. A seismometer is a scientific instrument used on the Moon to study which of the following?

a. The Moon's temperature
b. Moonquakes
c. How much sunlight the Moon gets
d. How many astronauts have been on the Moon

5. Is the following statement true or false?

The Moon is an active world, and its underlying structure is a mystery that scientists are still trying to unravel.

a. True
b. False

WATER ICE ON THE MOON

Is there water on the Moon? Watch this short video and answer the questions below.

Click or Scan

6. What do we call the areas at the poles of the Moon that never receive any sunlight and are extremely cold?

_____

7. Which of the following is NOT a form of water on the Moon?

a. Ice buried deep below the surface
b. Ice mixed with lunar soil
c. Sheets of ice
d. Liquid pools of water

8. Briefly explain what the video says about the potential uses of harvested water ice.

_____

_____

_____

EXPLORING THE MOON

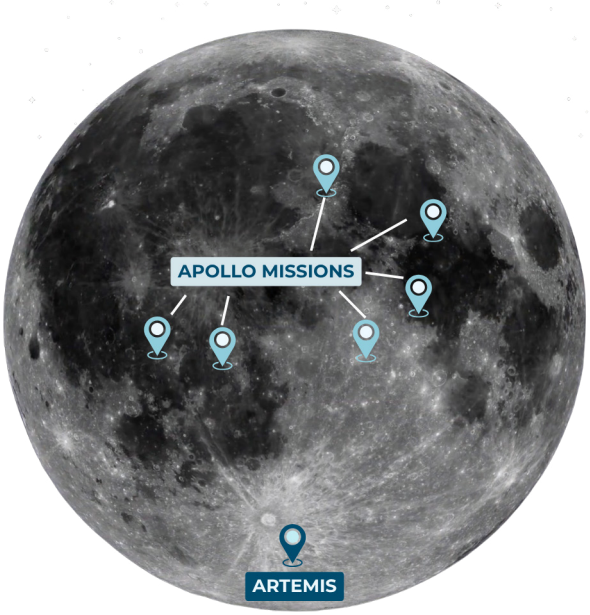
We bet you were inspired by the Artemis II mission – we were too! Now, imagine what it would be like to live and work on the Moon. NASA is building a Moon Base to unlock scientific discovery and prepare humanity for missions to Mars. Scan the QR code to find the answers below:

CLICK OR SCAN

9. NASA has been to the Moon before. Apollo astronauts first set foot on the Moon on July 20, 1969. Now with the Artemis program, NASA is returning to the Moon, and this time to stay.

Which part of the Moon is NASA planning to set up their lunar base?

a. Lunar North Pole
b. Lunar South Pole
c. Lunar West Side
d. Lunar East End



Which of the following is **NOT** one of the resources the Moon contains that could one day help support future explorers?

a. Water Ice
b. Lunar regolith
c. Fresh air to breathe
d. Other frozen materials

Select the following statement that is **TRUE** about the Moon's environment:

a. On the Moon, there is rugged terrain, long periods of darkness, dramatic temperatures, and lunar dust.
b. The Moon has an extremely flat surface, with elevation remaining the same almost everywhere.
c. On the Moon, it is hot at all times.
d. The Moon has the exact same environmental conditions as Earth.

10. What future uses of lunar regolith are researchers currently studying?

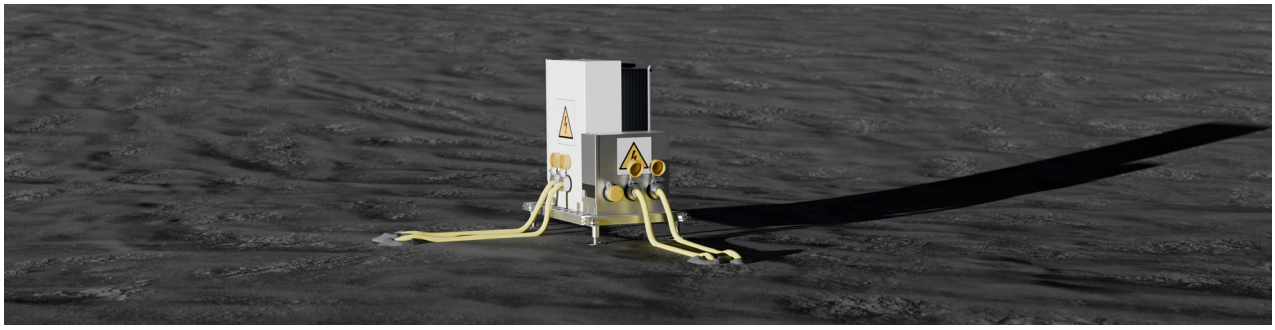
MOON BASE POWER SYSTEMS

Click or Scan

A lunar base will need to withstand some of the harshest, darkest, and/or coldest conditions. Solar energy (energy from the sun) can only be used if there is enough sunlight to power them. In dark, dusty conditions, nuclear energy (energy released from the nucleus of an atom) is the best option for providing continual power. On the Moon, nuclear power systems will work during long lunar nights, in permanently dark craters with water ice, or in dusty conditions. Scan the QR code to learn about Moon Base power systems and find the answers below.]

11. Read about power systems on the Moon. Underline any power system type that NASA plans to use on the Moon. Additionally, circle the nuclear power systems.

radioisotope heater units (RHUs)	**gas generators**
diesel generators	**radioisotope thermoelectric generators (RTGs)**
solar arrays	**propane burners**
hydroelectric power stations	**wind turbines**
AAA batteries	**geothermal power**
coal-fired power station	**fission surface power systems**



RADIOISOTOPE POWER SYSTEMS

An RPS is a small but mighty type of nuclear technology—able to power exploration of the coldest, darkest and dustiest corners of space for decades! RPS relies on the natural heat of plutonium-238. Let's dig a little deeper to give you a head start on planning your nuclear-powered Moon base entry.

Click or Scan

12. Where does the heat for RPS come from?

13. How sharp are your eyes? Find these paragraphs and fill in the missing words.

RPS offer several important benefits. They are _____, rugged and provide reliable power in harsh environments where _____ arrays are not practical.

RPS offer the key advantage of operating _____over long-duration space missions, largely independent of changes in sunlight, temperature, charged particle radiation, or surface conditions like thick clouds or dust.

In addition, some of the excess _____produced by some radioisotope power systems can be used to enable spacecraft _____and on-board systems to continue to operate effectively in extremely cold environments.

In the future, radioisotope power systems could continue to support missions to some of the most extreme environments in the_____, probing the secrets of Jupiter's ocean moon Europa, floating in the _____of Saturn's moon Titan or touring the rings and moons of the ice giant planet _____. With this vital technological capability, the possibilities for exploration and discovery are limited only by our imaginations.

RHUs

Now let's dig a little deeper into different types of RPS. NASA uses radioisotope heater units (RHUs) to warm spacecraft in the cold environments of deep space. They do not generate electricity, but they do keep things warm!

Click or Scan

14. What are RHUs?

15. A radioisotope heater unit (RHU) contains a single Pu-238 fuel pellet about the size of a..

a. School bus
b. Lunch Box
c. Pen
d. Pencil eraser

16. Watch the RHU explainer video by scanning the QR code. How has NASA used RHUs?

Click or Scan

17. List at least one way that you think RHUs could be used on a lunar base.

MMRTGs

RHUs are just one type of RPS. Another important type of radioisotope power system is called a Multi-Mission Radioisotope Thermoelectric Generator (MMRTG). A MMRTG generates small amounts of electricity. It is the perfect, ultra-reliable power system for remote observation equipment or robotic explorers and is currently used to power the Mars Curiosity and Perseverance rovers. Scan the QR code to answer the following questions about MMRTGs.

Click or Scan

18. What do these acronyms stand for?

a. RTG _____

b. MMRTG _____

19. This piece of text is located somewhere in the section. Fill in the blanks.

> The principle of a thermocouple involves _____, each made of a different metal that conducts electricity. Joining these two plates to form a _____ while keeping the two junctions at different temperatures produces an electric current. Each of these pairs of junctions forms an individual thermocouple. In an RTG, the _____ heats one of these junctions while the other junction remains unheated and is cooled by the space environment or a planetary atmosphere.

20. Watch the MMRTG explainer video by scanning the QR code. How does an MMRTG work?

Click or Scan

_____

_____

_____

21. List at least one way that you think MMRTGs could be used on a lunar base.

_____

_____

_____

FISSION POWER SYSTEMS

Fission power systems will generate great amounts of energy by converting heat to electricity. This technology would make an ideal, robust energy source for living, working, and building things on the Moon. Watch the video to answer the questions below:

Click or Scan

22. How do fission power systems work?

23. What do fission power systems use to produce heat and generate electricity?

a. Plutonium
b. Uranium
c. Coal
d. Copper

24. Even a small amount of uranium could produce enough energy to power...

25. List at least one way you think fission power systems could be used on a lunar base.

FUTURE EXPLORATION

Through a series of crewed and uncrewed Artemis missions, NASA and its partners will build the infrastructure needed to support an enduring human presence on the lunar surface. As Earth's nearest planetary neighbor, the Moon has profound potential to be a source of new scientific advances.

CLICK OR SCAN

26. The Moon is the best place for NASA to test deep space systems and operations in preparation for the first human mission to which planet?

a. Saturn
b. Mars
c. Venus
d. Mercury

BONUS QUESTION

Every NASA mission is a massive achievement, a unique testament to what humankind can accomplish with collaboration and an unquenchable thirst to discover what lies beyond our planet. NASA's groundbreaking work ignites a global passion for space exploration, generation after generation. You are the Artemis generation.

27. What excites you most about exploring the Moon?