NISE Network Online Workshop

Find Your Place in Space - Engaging the Artemis Generation with Activities, Apps and More

Tuesday, May 7, 2024

Today's Presenters:

Caitlin Ahrens, PhD, NASA Goddard Space Flight Center, Greenbelt, MD

Ali Jackson, Sciencenter, Ithaca, NY

Darrell Porcello, Children's Creativity Museum, San Francisco, CA

David Knudsen, Museum of Life + Science, Durham, NC

Peregrine Bratschi, Museum of Life + Science, Durham, NC

Welcome! As we wait to get started with today's discussion, please:

Introduce yourself! Type your name, institution, and location into the Chat Box

Questions? Feel free to type your questions into the Chat Box at any time throughout the webinar or use the raise your hand function in the participants list and we'll unmute your microphone.

Today's discussion will be recorded and shared on nisenet.org at: nisenet.org/events/online-workshop

EXCITING TIMES FOR ARTEMIS II TO PREPARE FOR BEYOND!

DR. CAITLIN AHRENS

NASA GODDARD SPACE FLIGHT CENTER

UNIVERSITY OF MARYLAND COLLEGE PARK

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PLANETARY SCIENCE

PLANETARY SCIENCE

CHEMISTRY

BIOLOGY

GEOLOGY

ENGINEERING

PHYSICS

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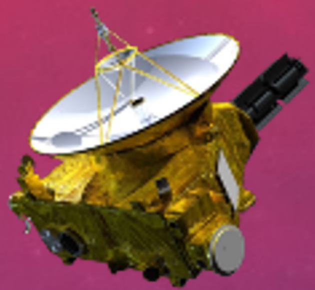
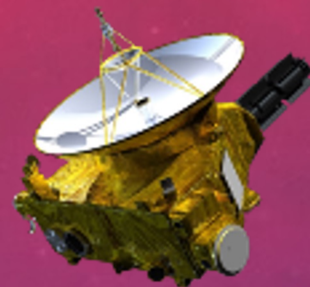
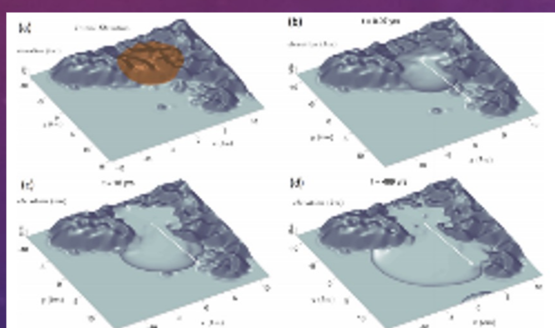


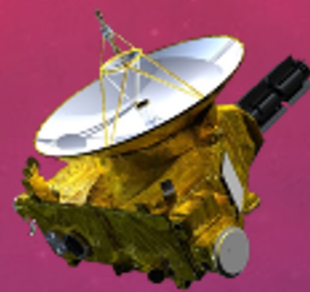
Ground-based, Fly-by, Orbiter Mission Data



Ground-based, Fly-by, Orbiter Mission Data

Modeling Simulations





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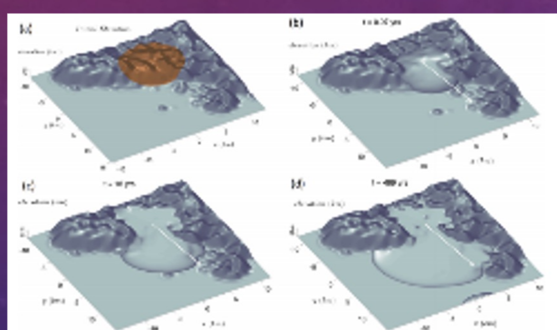
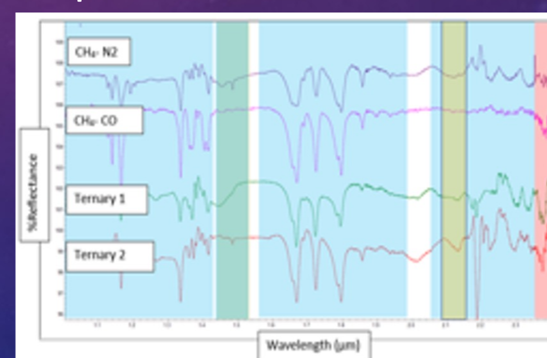
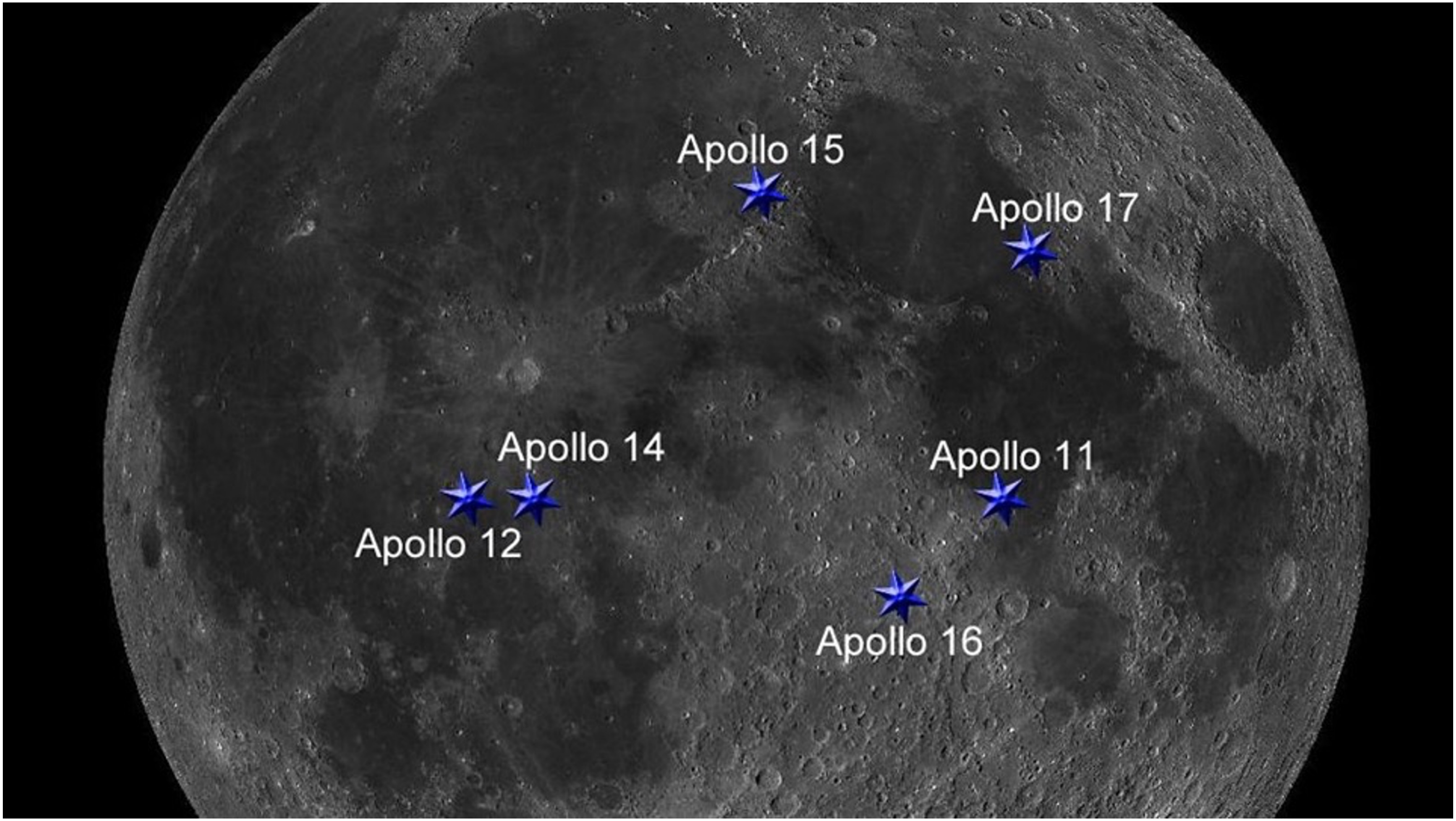
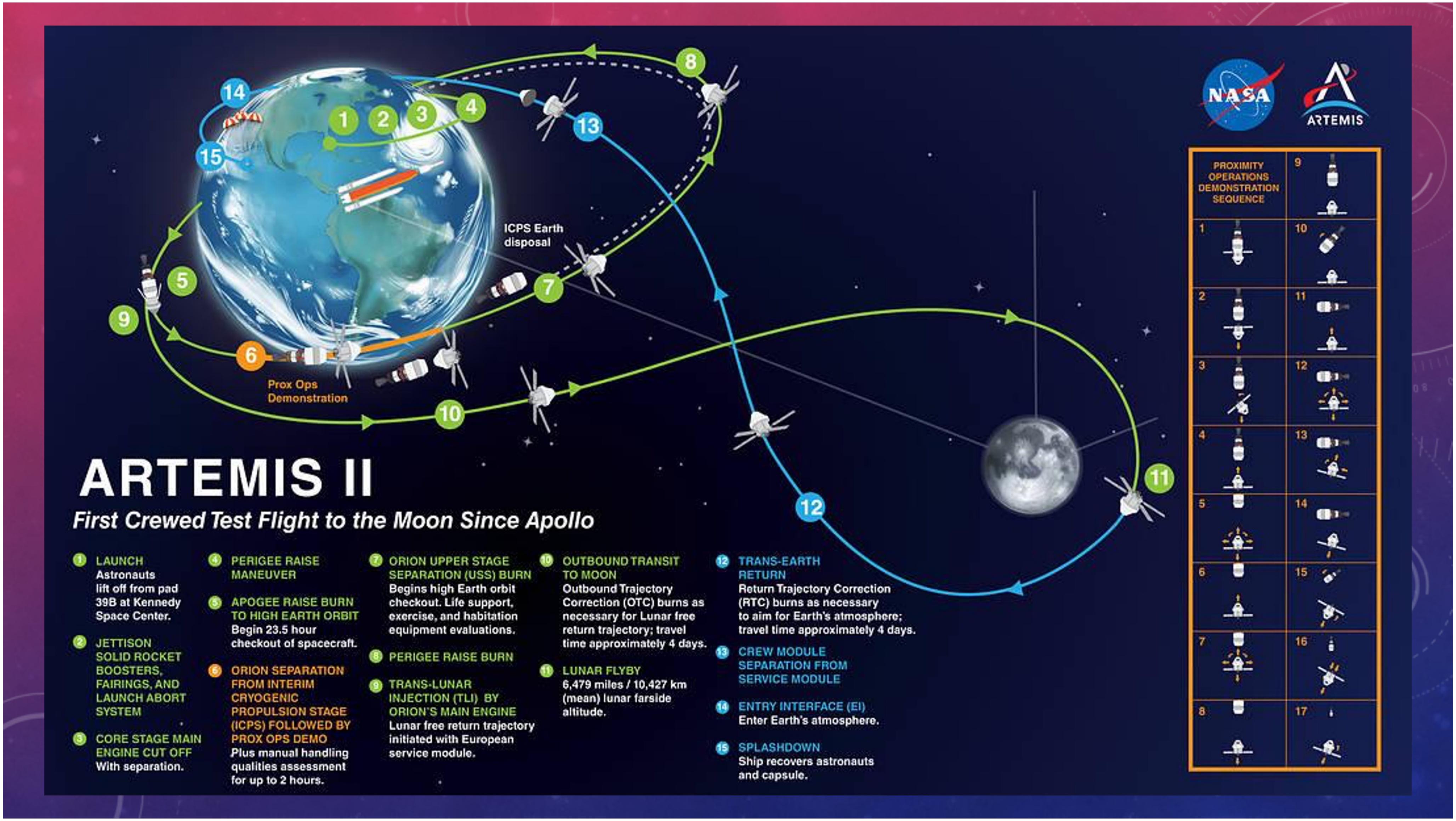


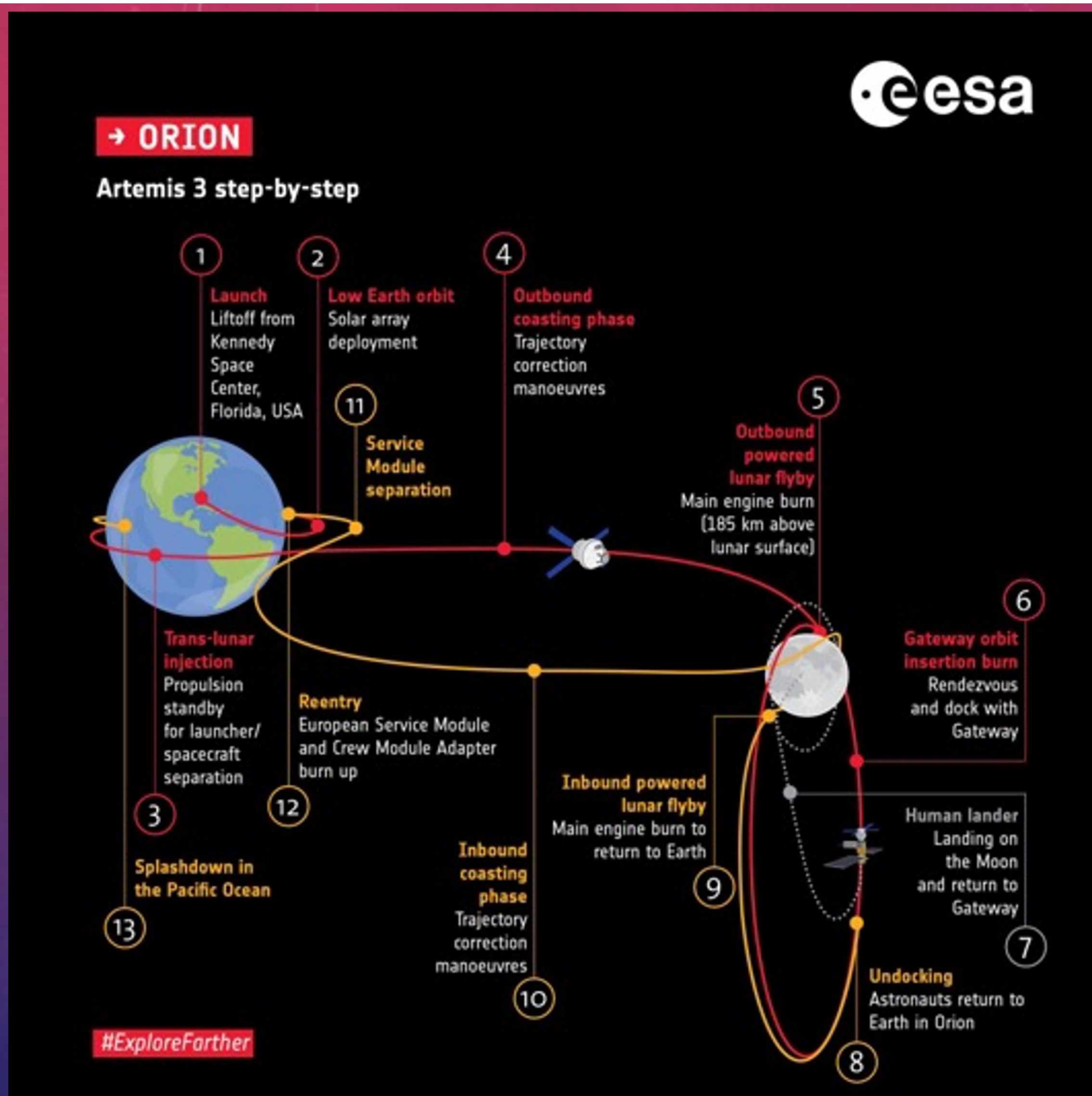
Experimental Research




Apollo 15
Apollo 17
Apollo 14
Apollo 11
Apollo 12
Apollo 16



ARTEMIS II
First Crewed Test Flight to the Moon Since Apollo
ARTEMIS
ICPS Earth disposal
Prox Ops Demonstration
1 LAUNCH
Astronauts lift off from pad 39B at Kennedy Space Center.
2 JETTISON SOLID ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM
3 CORE STAGE MAIN ENGINE CUT OFF
With separation.
4 PERIGEE RAISE MANEUVER
5 APOGEE RAISE BURN TO HIGH EARTH ORBIT
Begin 23.5 hour checkout of spacecraft.
6 ORION SEPARATION FROM INTERIM CRYOGENIC PROPULSION STAGE (ICPS) FOLLOWED BY PROX OPS DEMO
Plus manual handling qualities assessment for up to 2 hours.
7 ORION UPPER STAGE SEPARATION (USS) BURN
Begins high Earth orbit checkout. Life support, exercise, and habitation equipment evaluations.
8 PERIGEE RAISE BURN
9 TRANS-LUNAR INJECTION (TLI) BY ORION'S MAIN ENGINE
Lunar free return trajectory initiated with European service module.
10 OUTBOUND TRANSIT TO MOON
Outbound Trajectory Correction (OTC) burns as necessary for Lunar free return trajectory; travel time approximately 4 days.
11 LUNAR FLYBY
6,479 miles / 10,427 km (mean) lunar farside altitude.
12 TRANS-EARTH RETURN
Return Trajectory Correction (RTC) burns as necessary to aim for Earth's atmosphere; travel time approximately 4 days.
13 CREW MODULE SEPARATION FROM SERVICE MODULE
14 ENTRY INTERFACE (EI)
Enter Earth's atmosphere.
15 SPLASHDOWN
Ship recovers astronauts and capsule.
PROXIMITY OPERATIONS DEMONSTRATION SEQUENCE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17



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ARTEMIS OBJECTIVES

Regolith processes and weathering

Speciation of surface hydrogen

Understand surface hydrogen speciation spatial variability

Spatial distribution of subsurface hydrogen

ARTEMIS OBJECTIVES

Regolith processes and weathering

Establish the mechanisms, timing, and extent of volatile depletion in the Moon

Speciation of surface hydrogen

Understand surface hydrogen speciation spatial variability

Spatial distribution of subsurface hydrogen

Subsurface temperatures

Understand the impact of exploration on the lunar volatile record across the surface

ARTEMIS OBJECTIVES

Determine the compositional state (elemental, isotopic, mineralogic) and compositional distribution (lateral and with depth) of the volatile component in lunar polar regions

Identification of surface frost composition

Identification of surface frost locations in spatial context

Temporal variability of frost

Regolith processes and weathering

Establish the mechanisms, timing, and extent of volatile depletion in the Moon

Speciation of surface hydrogen

Understand surface hydrogen speciation spatial variability

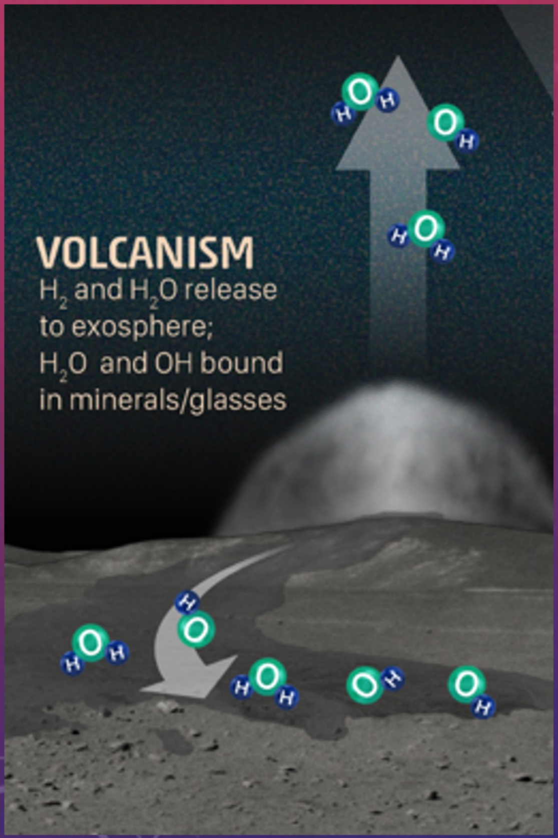
Spatial distribution of subsurface hydrogen

Determine the source(s) for lunar polar volatile deposits

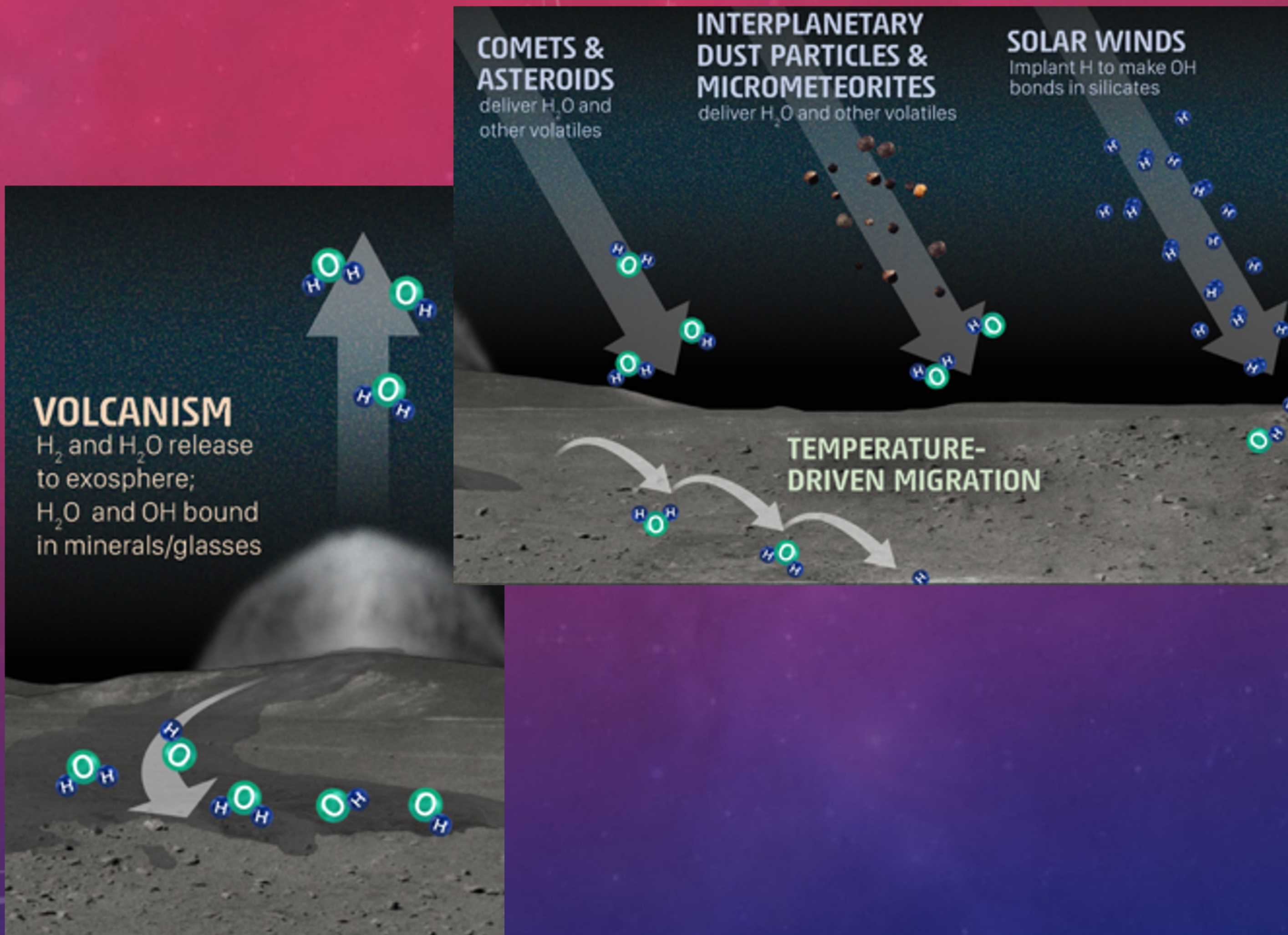
Understand the transport, retention, alteration, and loss processes that operate on volatile materials near and at permanently shaded lunar regions

Subsurface temperatures

Understand the impact of exploration on the lunar volatile record across the surface



- Credit: Sara Pooley (PCC/Caltech)



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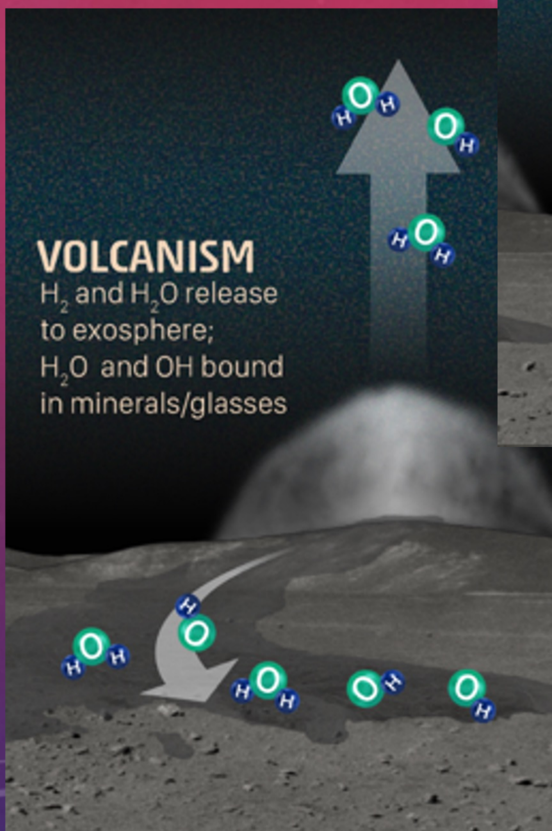
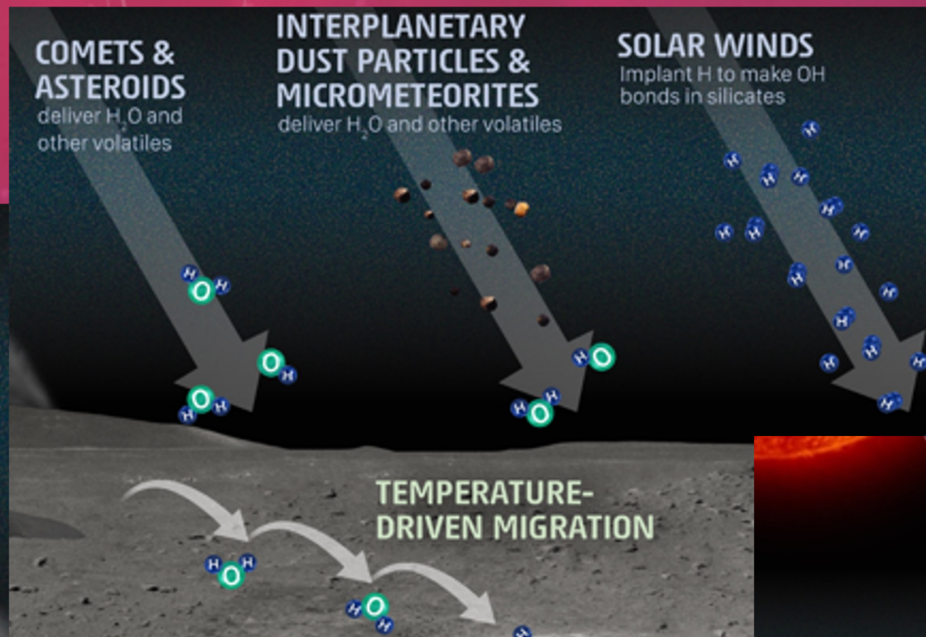
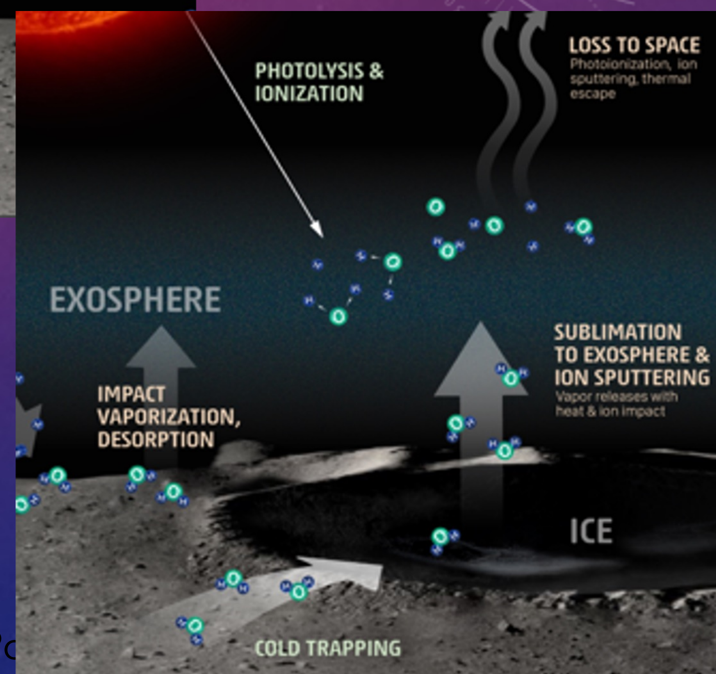
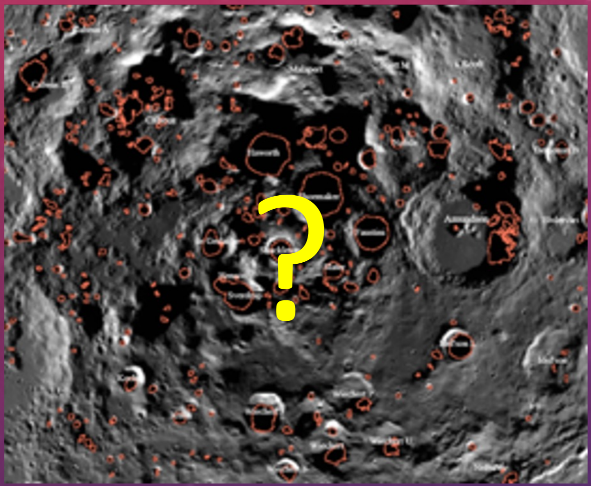






- Credit: Sara Pc

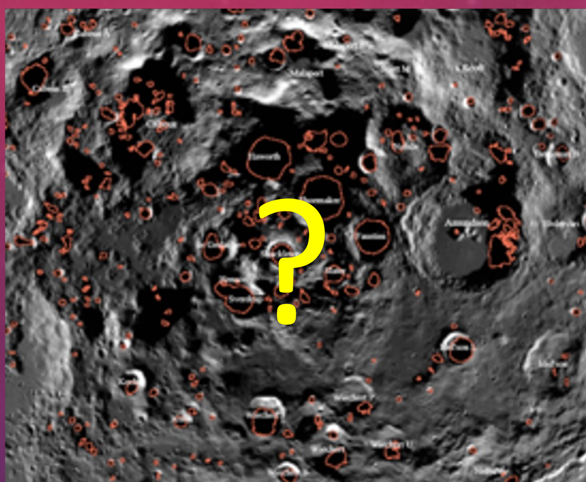
Science Themes



THEME 1:
Where are we going?!

Traverse planning

Science Themes



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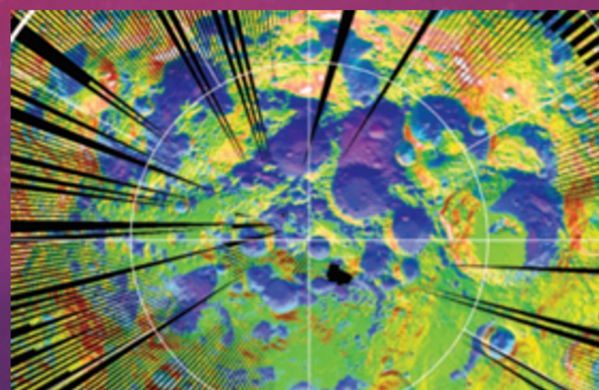
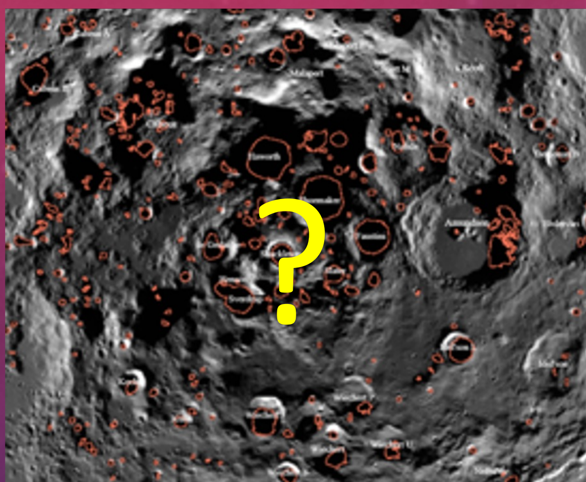


THEME 2:
Where is the water?!

Environmental learning

Science Themes



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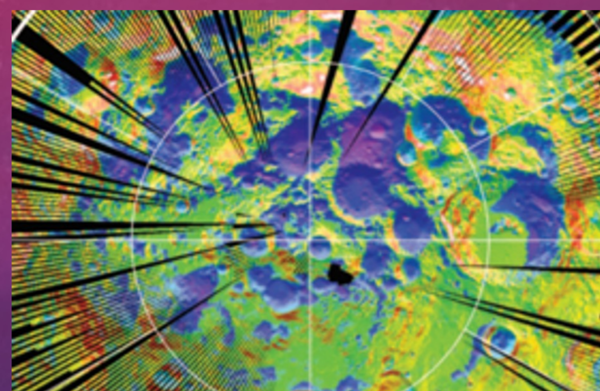
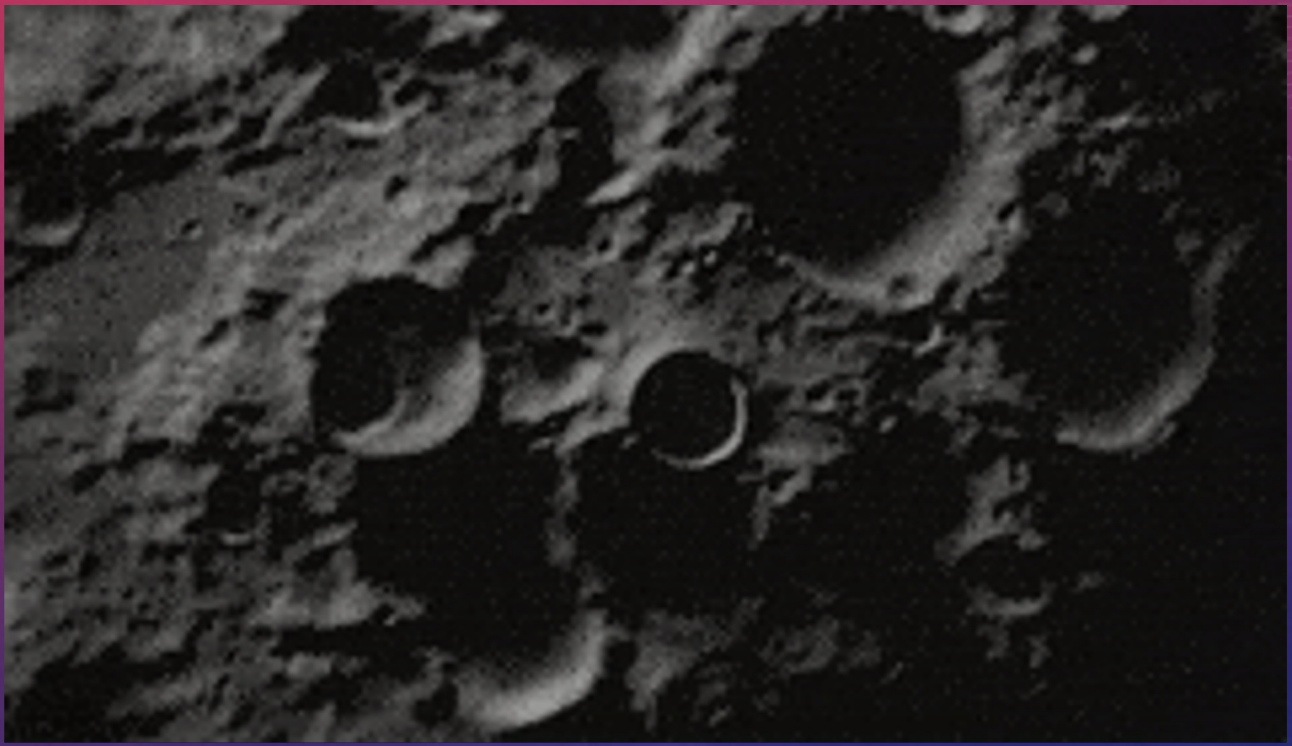


THEME 2:
Where is the water?!

Environmental learning

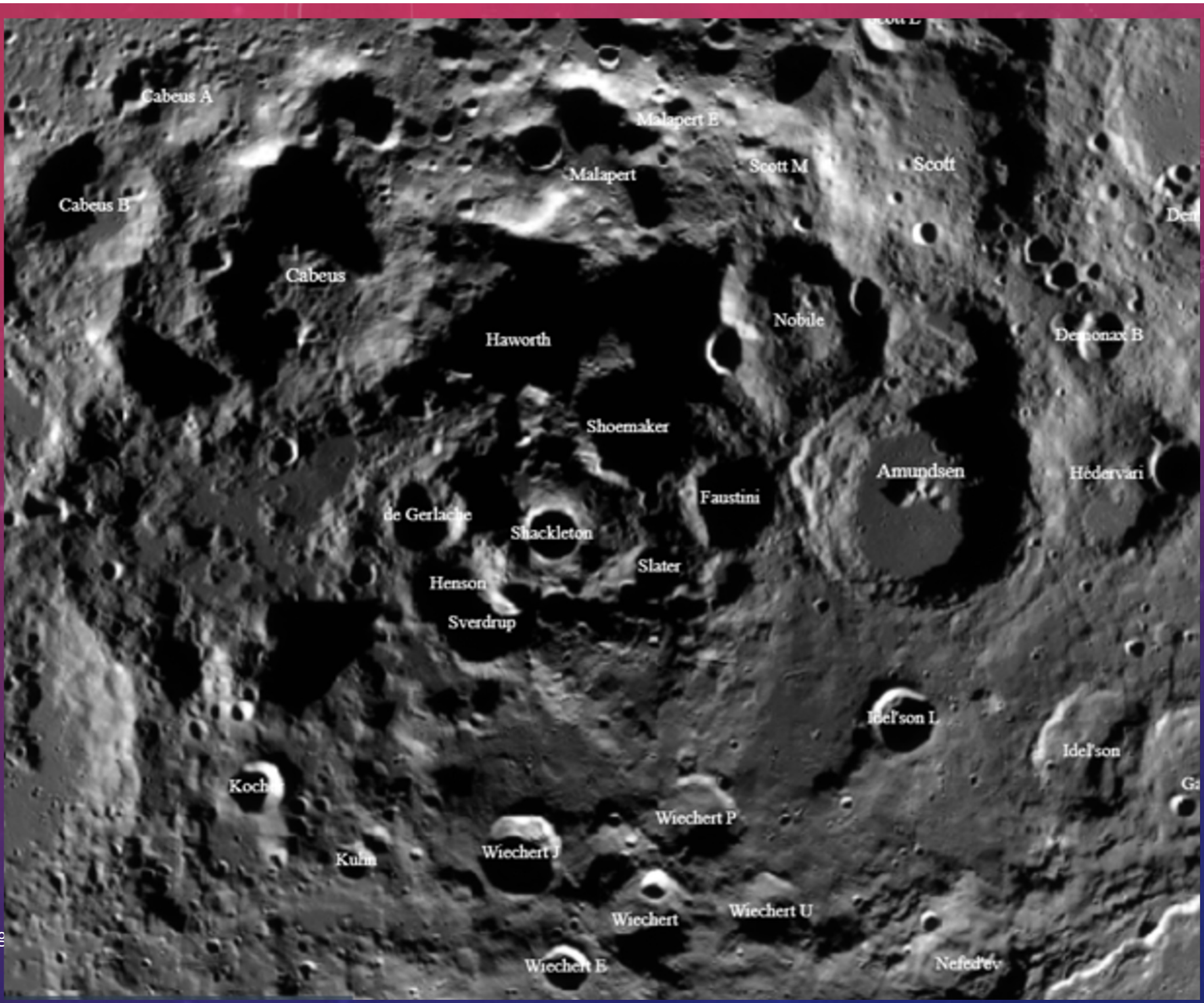
THEME 3:
Ok we found it,
now what?!

Sampling and safety



QUICK OVERVIEW OF PSRS

- Permanently Shadowed Regions
- Characterized by the variations in seasonal temperatures
- VERY COLD!!!!!
- VERY OLD???



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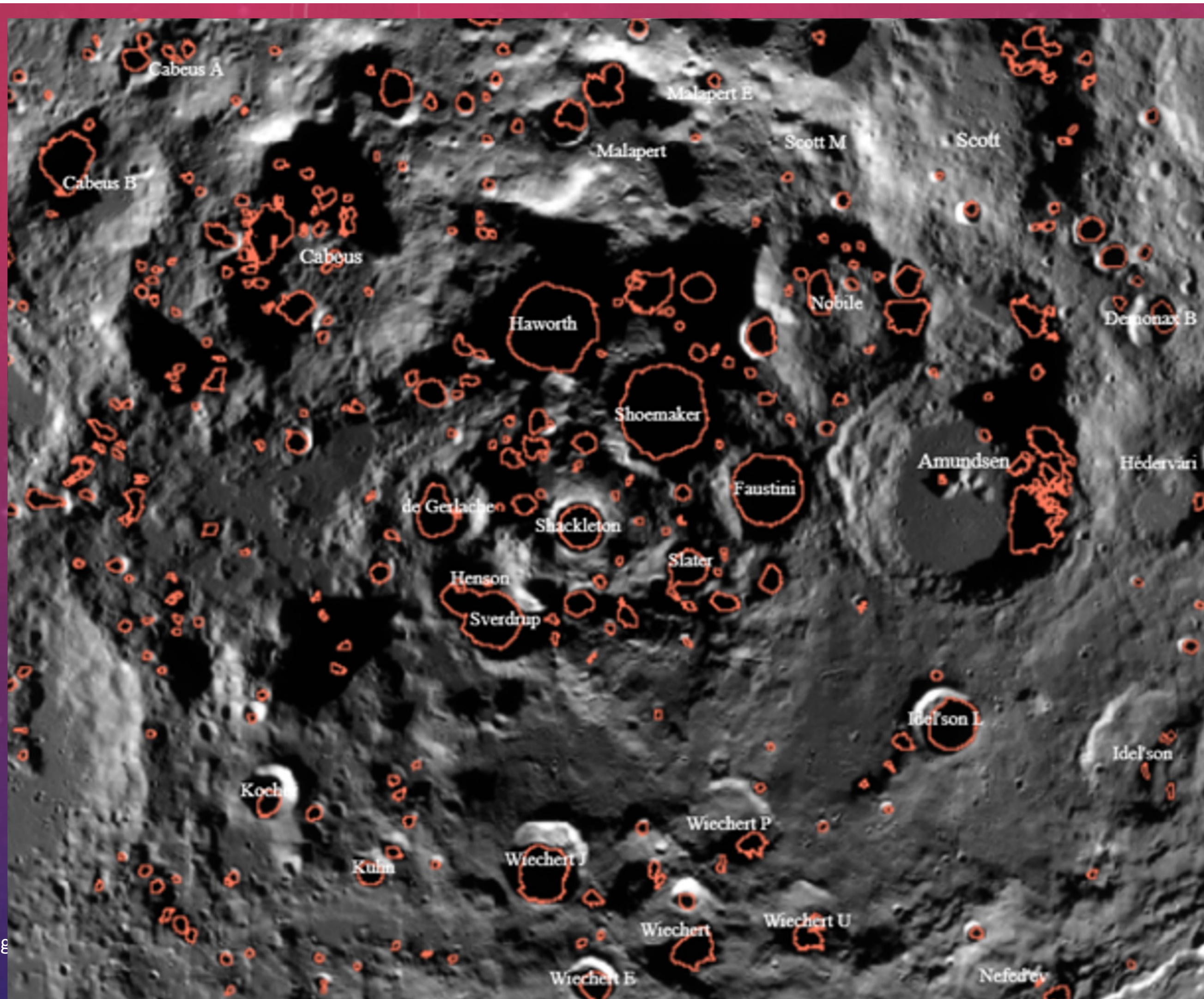

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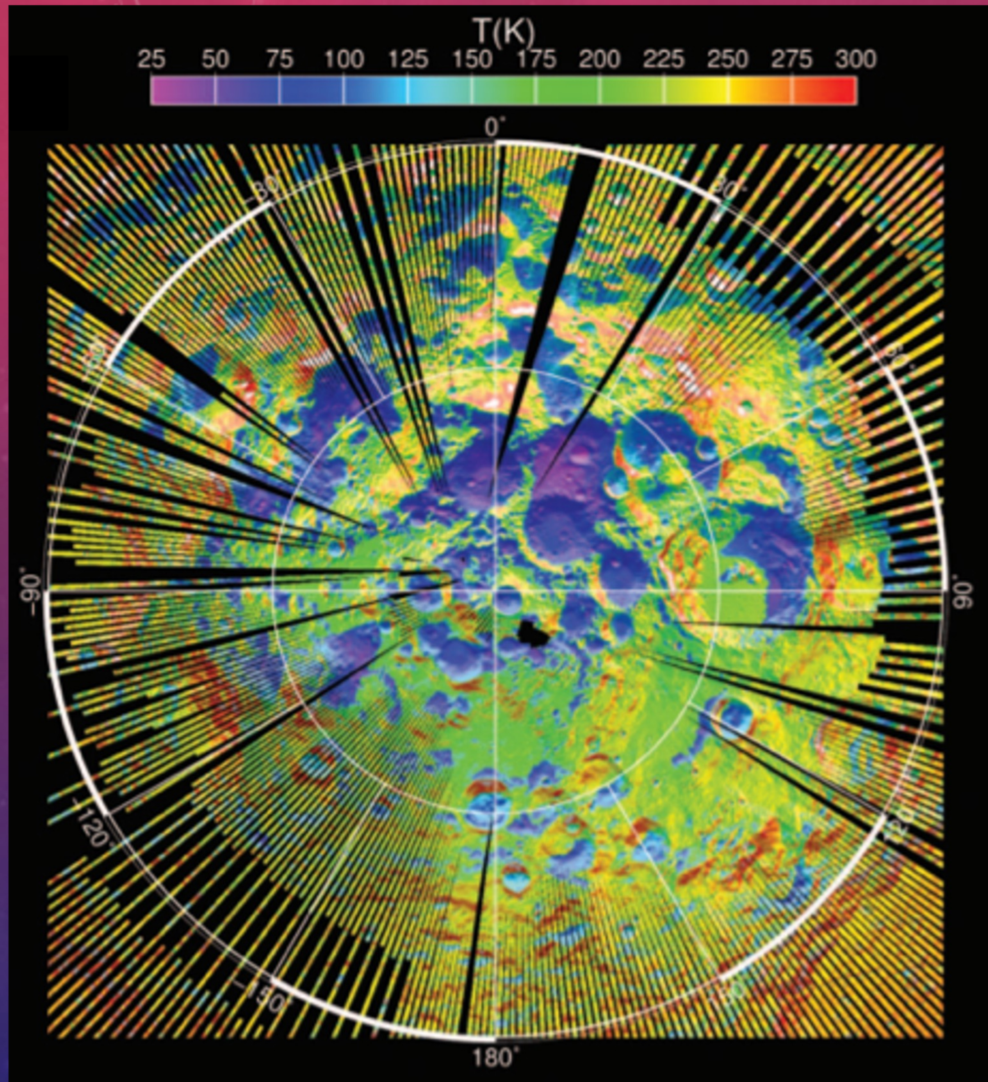
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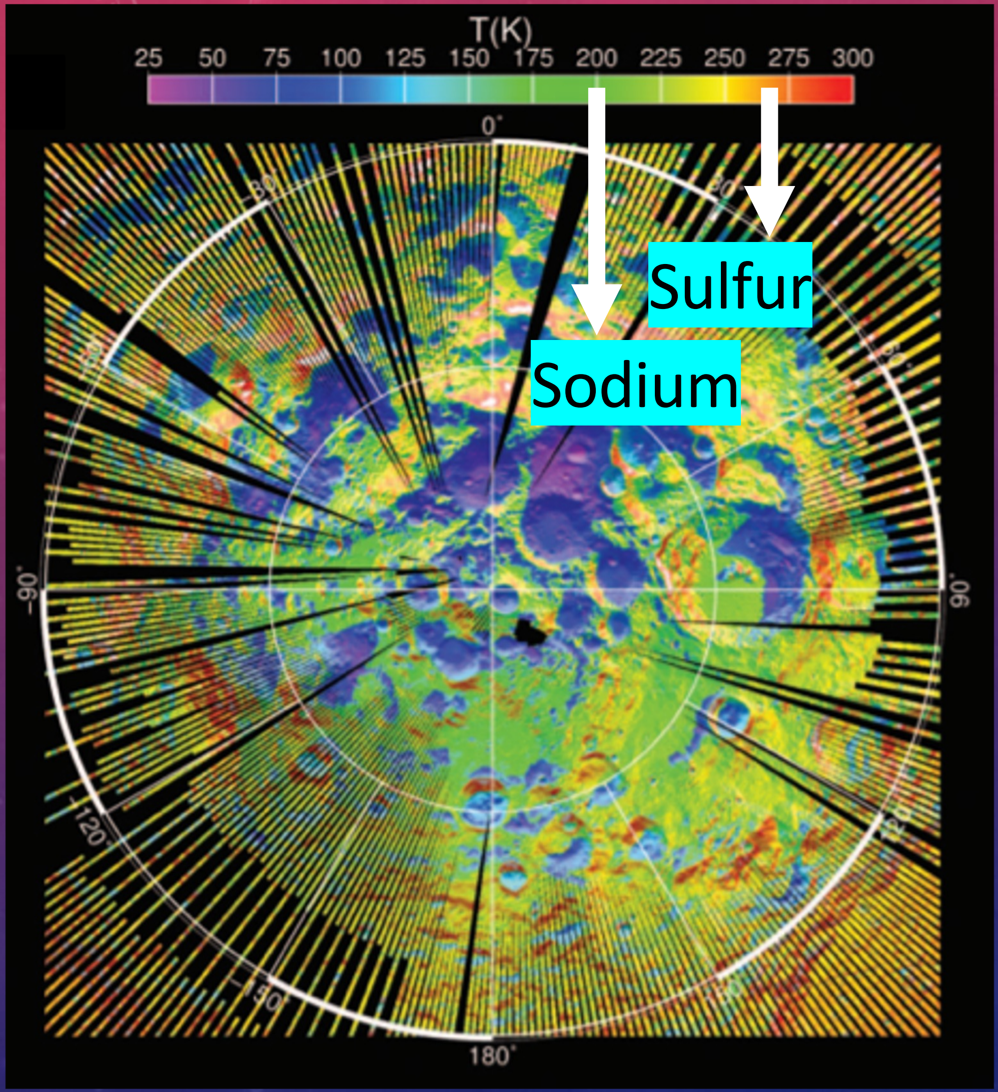
25 50 75 100 125 150 175 200 225 250 275 300
0°
30°
60°
90°
120°
150°
180°
-90°



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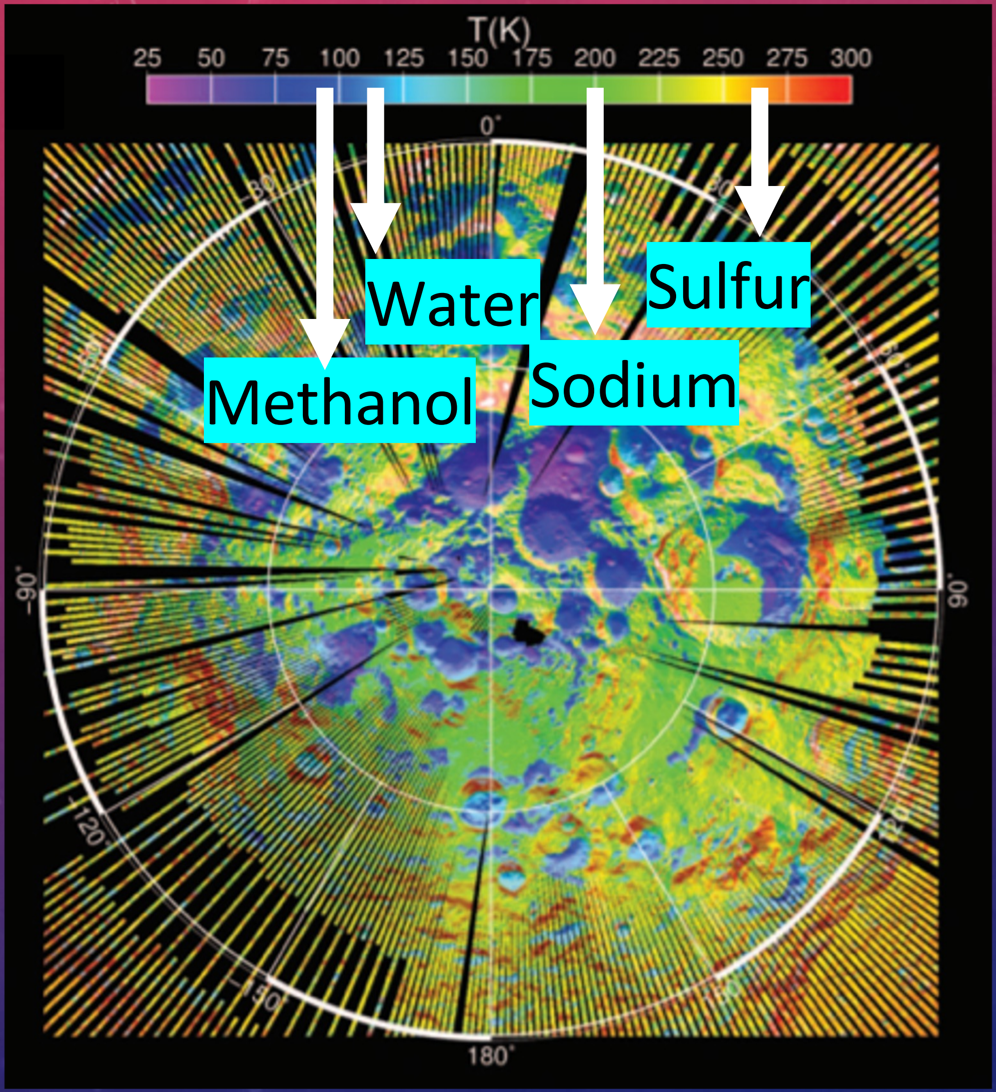
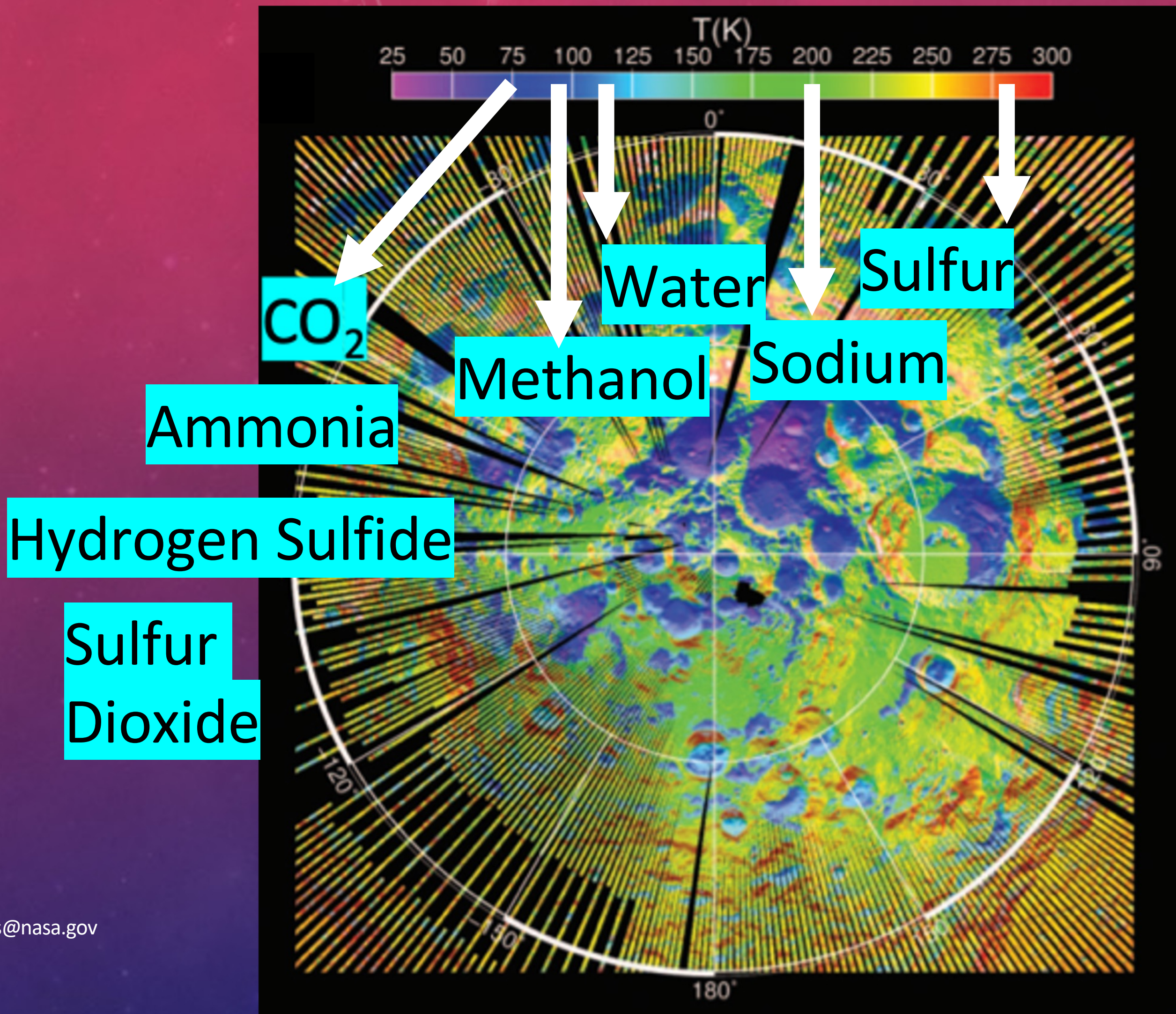

T(K)
25 50 75 100 125 150 175 200 225 250 275 300
0°
90°
-90°
180°
Water
Sulfur
Methanol
Sodium


T(K)
25 50 75 100 125 150 175 200 225 250 275 300
0°
90°
120
150
180°
CO2
Methanol
Water
Sodium
Sulfur
Ammonia
Hydrogen Sulfide
Sulfur Dioxide

CHALLENGES

- **We want to sample these PSRs!** ☺

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- VERY cold temperatures and low lighting conditions
- Tools can get hot
- Dust from rovers and astronauts may affect ice sampling

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- VERY cold temperatures and low lighting conditions
- Tools can get hot
- Dust from rovers and astronauts may affect ice sampling
- ***What to hold the samples in?***
- ***How will testing affect the ice?***

ARTEMIS

EHP

ACTIVITY RISK ASSESSMENTS

- Applies to **ALL** activity at the lunar surface
  - Ascent/descent vehicles
  - Astronauts (including suit risks)
  - Rovers & landers
  - Tools, instruments

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- DUST IS AWFUL ☹️

HAZARDS: NATURAL –VS – INDUCED

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- **Natural Hazards**
  - Dust
  - Radiation/Plasma
  - Illumination/shadows
  - Temperature

HAZARDS: NATURAL –VS – INDUCED

- **Induced Hazards**
  - Astronaut activity
  - Rover/lander activity
  - Tools
  - Power and batteries
  - Leaks
  - Astronaut suits

WHY BRING BACK SAMPLES?

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- Origins of the ice
- How has the ice formed? (*different chemistry?*)
- Different sampling techniques
- What can this ice tell us about other ice across the Solar System

EDUCATIONAL MATERIALS

K – 5 Activities/Presentations

- The role of the Moon
- Moon's evolution
- Moon rocks and ice
- Impact crater activity

6 – 8 Activities/Presentations

- Phases of ice
- Spectroscopy
- Traverse/mission planning
- Moon maps

9 – 12 Activities/Presentations

- PSRs, types of craters
- Spectroscopy
- Liquid nitrogen temperature
- Topography/mapping

General Public/Lifelong Learners Activities/Presentations

- Moon ice and chemistry, Moon Rocks 101
- Sampling techniques
- Apollo vs Artemis
- Mission planning

I tailor the presentation to what the educator needs and integrate into their lesson plans

EDUCATIONAL LABS AVAILABLE

Activity: Impact Cratering!

Info based from: Western Institute for Earth & Space Exploration https://space.uwo.ca/

Time: up to 60 minutes

Objective:

On Earth, many natural factors (wind, water, tectonic, and volcanic activity) play a role in shaping the landscapes we see. Elsewhere in our solar system, however, these processes are often destroyed or reshaped by one major process – impact cratering. This student-designed lab focuses on understanding the factors that play a role in the resulting crater formed after an impact.

Activity: Permanently Shadowed Craters

Time: up to 60 minutes

Objective:

On the Moon, there are impact craters at the north and south pole that are so deep and geometrically shaped that sunlight cannot reach the bottom. This lab focuses on understanding the geometry of sunlight at a crater and differences in sun angle to create a permanently shadowed crater.

Activity: Laser Altimetry

Time: up to 60 minutes

Objective:

We use lasers to learn about the topography of the lunar surface. While images and shadowing effects are useful in some ways, lasers can directly tell us information about different landforms. For example, learning about how deep and steep certain impact craters are on the surface of the Moon. Learning about the topography at the lunar surface can not only give us information about the geology, but also assists with mission planning. This lab focuses on understanding how laser altimetry works and how topography is important in mission planning.

EDUCATIONAL LABS AVAILABLE

Objetivo:

En la Luna, hay cráteres de impacto en los polos norte y sur que son tan profundos y de forma geométrica que la luz del sol no puede llegar al fondo. Este laboratorio se enfoca en comprender la geometría de la luz solar en un cráter y las diferencias en el ángulo del sol para crear un cráter en sombra permanente.

Descripción general:

Preparación del procedimiento

Presentación

Se puede diseñar una presentación de power-point para acompañar esta actividad. Antes de comenzar, entregue la hoja de trabajo de laboratorio e informe a los estudiantes que la primera página se utilizará durante la presentación. La presentación es una visión general de la formación de cráteres en nuestro sistema solar.

Se debe mostrar una serie de imágenes de cráteres de impacto. Para cada una de las imágenes (generalmente 4-5 imágenes), los estudiantes deben anotar de qué planeta creen que es el cráter o, si creen que es de cualquier luna planetaria (incluida la nuestra), deben escribir "luna".

Una vez hecho esto, las imágenes se muestran de nuevo. Pídales a los estudiantes, o vote, que determinen dónde creen que existen estos cráteres. Luego, diles la respuesta y pídeles que escriban esto en su hoja de trabajo.

Actividad: Altimetría láser

Tiempo: hasta 60 minutos

Objetivo:

Utilizamos láseres para conocer la topografía de la superficie lunar. Si bien las imágenes y los efectos de sombreado son útiles de alguna manera, los láseres pueden decirnos directamente información sobre diferentes formas de relieve. Por ejemplo, aprender sobre la profundidad y la pendiente de ciertos cráteres de impacto en la superficie de la Luna. Aprender sobre la topografía en la superficie lunar no solo puede darnos información sobre la geología, sino que también ayuda con la planificación de la misión. Este laboratorio se centra en comprender cómo funciona la altimetría láser y cómo la topografía es importante en la planificación de la misión.

LOOKING FORWARD

- *Still lots to do!*

Explore Science: Voyage through the Solar System

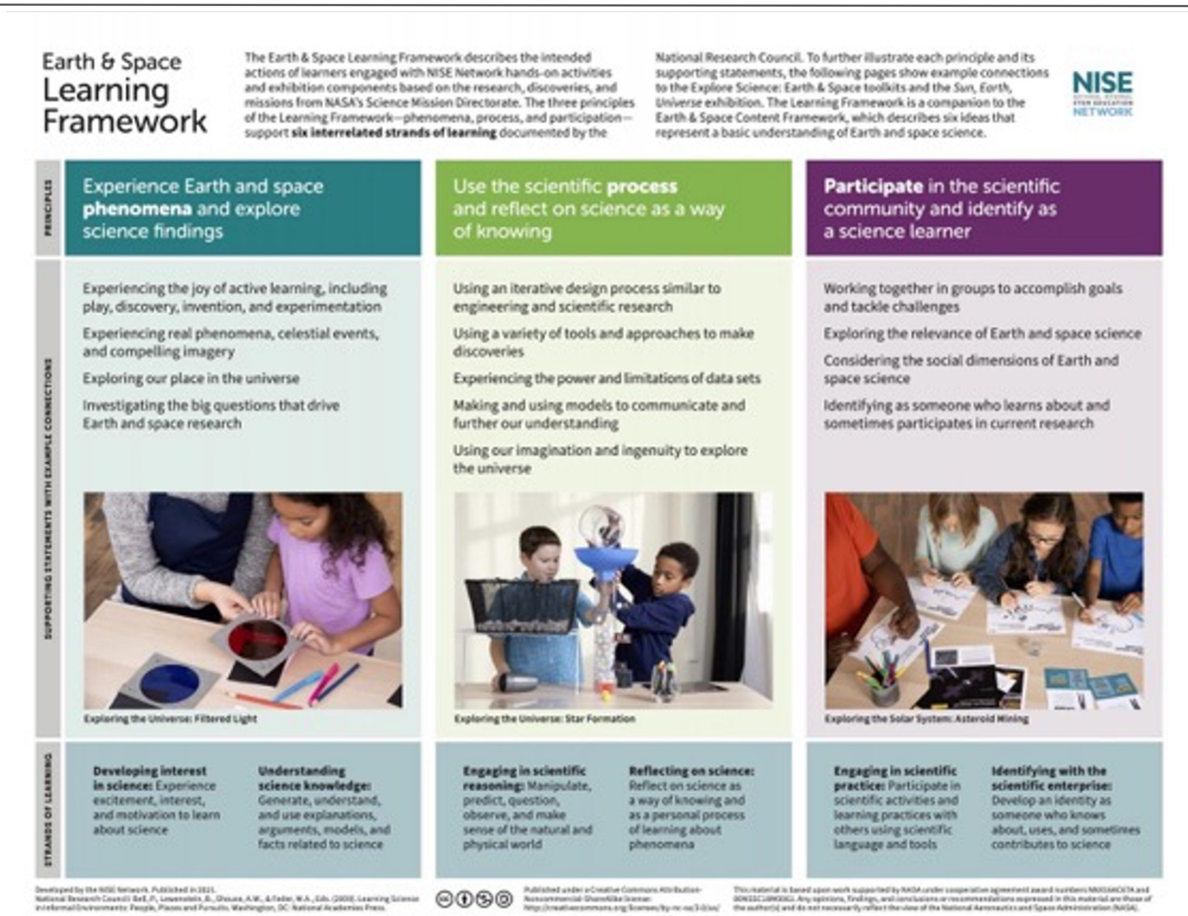
NISE
NATIONAL INFORMAL
STEM EDUCATION
NETWORK

EXPLORE SCIENCE
Voyage through the Solar System

Project Overview

- *New* physical toolkit of hands-on STEM (science, technology, engineering, and math) activities based on NASA's continuing pursuit of human exploration
- DIY Sun Science & DIY Solar System Apps **(available for free download through the iTunes app store and Google Play)**
- Disseminate resources to leverage NISE Network and local partnerships to engage diverse audiences and support at home STEM engagement—extending learning beyond museum walls.

Learning Frameworks + Human Exploration



Earth & Space Learning Framework

The Earth & Space Learning Framework describes the intended actions of learners engaged with NISE Network hands-on activities and exhibition components based on the research, discoveries, and missions from NASA's Science Mission Directorate. The three principles of the Learning Framework—phenomena, process, and participation—support **six interrelated strands of learning** documented by the National Research Council. To further illustrate each principle and its supporting statements, the following pages show example connections to the Explore Science: Earth & Space toolkits and the *Sun, Earth, Universe* exhibition. The Learning Framework is a companion to the Earth & Space Content Framework, which describes six ideas that represent a basic understanding of Earth and space science.

NISE NETWORK

PRINCIPLES	Experience Earth and space **phenomena** and explore science findings	Use the scientific **process** and reflect on science as a way of knowing	**Participate** in the scientific community and identify as a science learner
SUPPORTING STATEMENTS WITH EXAMPLE CONNECTIONS	Experiencing the joy of active learning, including play, discovery, invention, and experimentation Experiencing real phenomena, celestial events, and compelling imagery Exploring our place in the universe Investigating the big questions that drive Earth and space research Exploring the Universe: Filtered Light	Using an iterative design process similar to engineering and scientific research Using a variety of tools and approaches to make discoveries Experiencing the power and limitations of data sets Making and using models to communicate and further our understanding Using our imagination and ingenuity to explore the universe Exploring the Universe: Star Formation	Working together in groups to accomplish goals and tackle challenges Exploring the relevance of Earth and space science Considering the social dimensions of Earth and space science Identifying as someone who learns about and sometimes participates in current research Exploring the Solar System: Asteroid Mining
STRANDS OF LEARNING	**Developing interest in science:** Experience excitement, interest, and motivation to learn about science **Understanding science knowledge:** Generate, understand, and use explanations, arguments, models, and facts related to science	**Engaging in scientific reasoning:** Manipulate, predict, question, observe, and make sense of the natural and physical world **Reflecting on science:** Reflect on science as a way of knowing and as a personal process of learning about phenomena	**Engaging in scientific practice:** Participate in scientific activities and learning practices with others using scientific language and tools **Identifying with the scientific enterprise:** Develop an identity as someone who knows about, uses, and sometimes contributes to science

NISE Network Moon Resources

A compilation of educational resources to help engage the public in the Moon, as well as the Apollo and Artemis missions.

- Hands-on activities
- Apps, Imagery & Interactive Media
- Moon Observation Info
- Moon Cultural Stories
- And Much More!

nisenet.org/moon

Intended Audiences

The intended **public audiences** are **adults and children in museum settings and at home**

The project's intended **professional audiences** include **informal educators, subject matter experts, and volunteers**

Project Goals

- Youth and families will have access to high-quality, **authentic STEM** education resources with powerful connections to NASA that will inspire the next generation of explorers.
- Support **museums as strategic partners in their communities** and STEM ecosystems to increase the impact of NASA STEM engagement investments.
- **Engage groups historically underrepresented and underserved in STEM fields** through local partnerships, supported by a strong national network of informal education organizations.

EXPLORE SCIENCE
Voyage through the Solar System

Build a Moon Base Camp

EXPLORE SCIENCE
Voyage through the Solar System

Breath of Fresh Air

EXPLORE SCIENCE
Voyage through the Solar System

Space Souvenir

DIY Sun Science

- Over **500,000 downloads** since its launch
- We recently added two new activities
  - **Shadows on the Moon**
  - **Color Your Own Aurora**
- **Spanish version** now available

Available on the App Store

GET IT ON Google Play





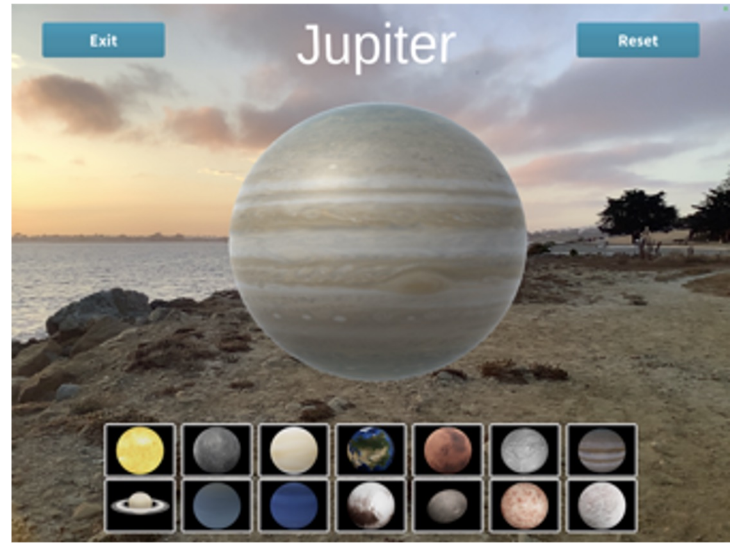

DIY Solar System

- NEW hands-on activities to extend learning beyond the museum walls
- All-digital activities including games and selfies
- New planets and solar system walk **augmented reality**

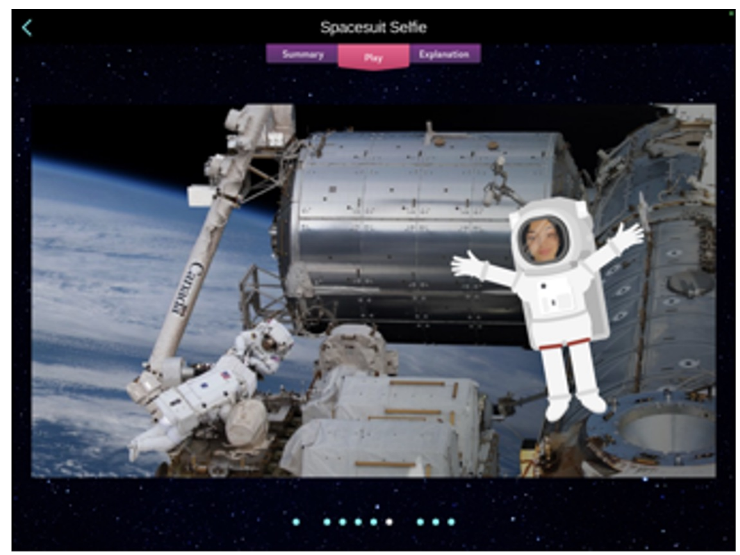
Available on the App Store

GET IT ON Google Play


DIY
SOLAR SYSTEM
Take a trip through the solar system! Launch the activities and games below to experience planets up close, prepare for space travel, and live like an astronaut.
ACTIVITIES
IN OR OUT GAME
PLANET WALK
rate | credits


Exit
Jupiter
Reset


VIDEO LOG


Spacesuit Selfie
Summary
Play
Explanation

Voyage Through the Solar System Activities
¡Celebremos las ciencias!

MUSEUM
of LIFE +
SCIENCE

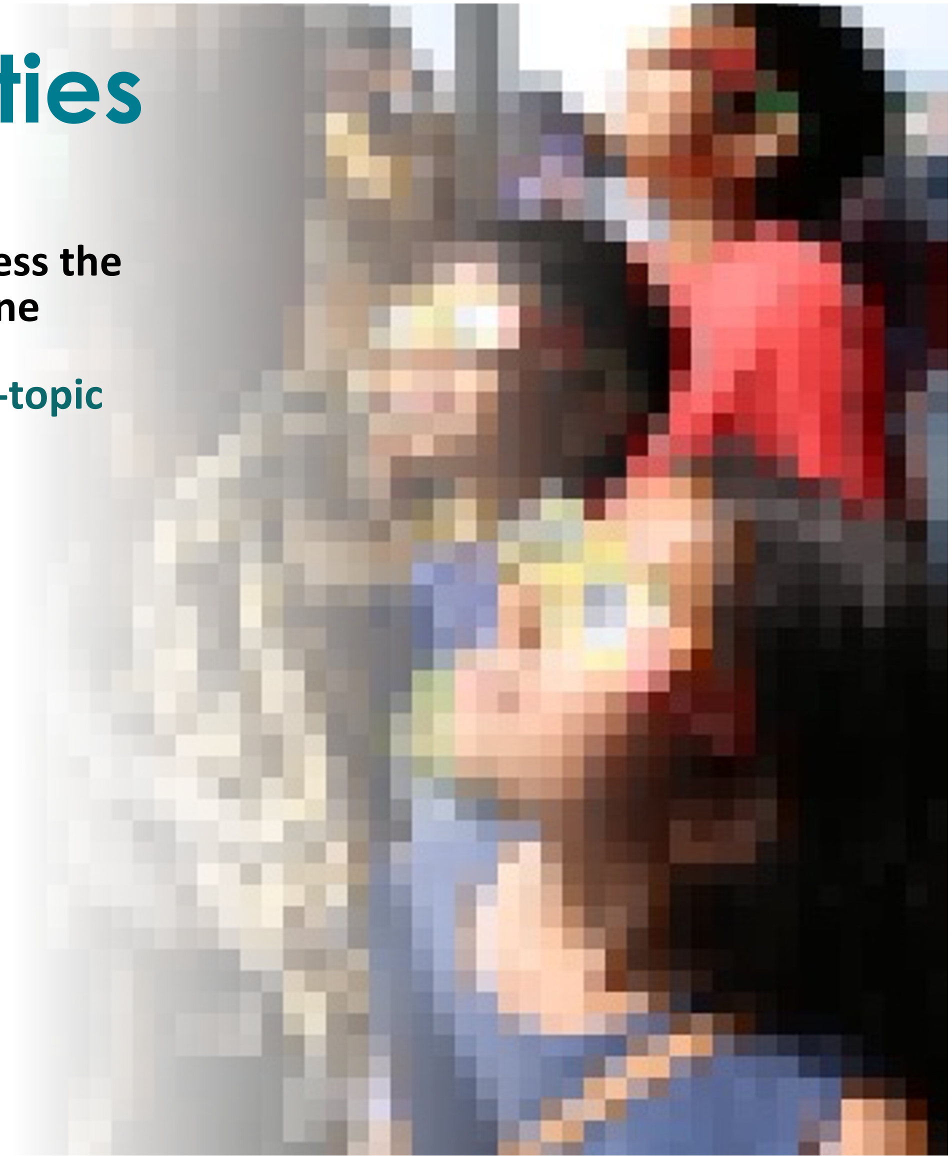
Resources & Opportunities

Learn more and access the NISE Network's online digital resources:
nisenet.org/browse-topic

Read our monthly newsletter
nisenet.org/newsletter

Past Recordings of Online Workshops
nisenet.org/online-workshop-recordings-list

Follow NISE Net on social networking
nisenet.org/social



Next Online Workshop…

Futures Thinking - Exploring Ideas and Developing Skills to Shape Our World

Tuesday, June 11, 2023
2pm-3pm Eastern / 11am-12pm Pacific

Register today:
https://nisenet.org/events/online-workshop/futures-thinking

NISE NETWORK
ONLINE WORKSHOPS

nisenet.org/events

Find the NISE Network at the 2024 ACM InterActivity Conference!

May 15-17, 2024 in Madison, WI

nisenet.org/acm2024

Thank You

NISE
NATIONAL INFORMAL STEM EDUCATION NETWORK

This material is based upon work supported by NASA under award number 80NSSC21M0082. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Aeronautics and Space Administration (NASA).

Q&A

Use the raise hand feature or type your question in the chat