National Aeronautics and Space Administration



Exploring the Solar System with NASA

Presented by:

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NASA STEM Pathway Activities Consortium for Education *activities*



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NSPACE



High School Students United with NASA to Create Hardware







Minority University Research & Education Program



MUREP Innovation & Tech Transfer Idea Competition



NASA Community College Aerospace Scholars



NASA Spacesuit User Interface Technologies for Students







HISD Aerospace Academies

- HISD is the recipient of the Magnet
 School Assistance Program (MSAP) grant
 from the U.S. Department of Education
- HISD, with NASA involvement, launched five Aerospace Academies with the intent of attracting and retaining underrepresented and underserved students to STEM disciplines

Elementary Campuses



Wesley Elementary School Grades: PreK-5 Where Inspired Instruction Incites Imagination and Innovation Students: 549



Grades: PreK-5 Students: 404

Middle School Campus



Grades: 6-8 Students: 719

High School Campuses



Charles H. Milby High School Houston East End's School of Choice since 1925



hoice Students: 1,903

Grades: 9-12 Students: 758

Grades: 9-12

Agenda

- Padlet
- Solar System Lessons
- Tips and Tricks for Effective Virtual Learning
- Current NASA Missions



Padlet



<u>https://padlet.com/debramderham/4l4pfk868ixfytgi</u>

Solar System Scroll and Solar System Beads



- Science Topics
 - Scaled distances of orbits in the Solar System
 - Types of objects in the Solar System
 - Usefulness of models

• TEKs

- 5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth
- **MS-ETS1-4** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system.
- MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.



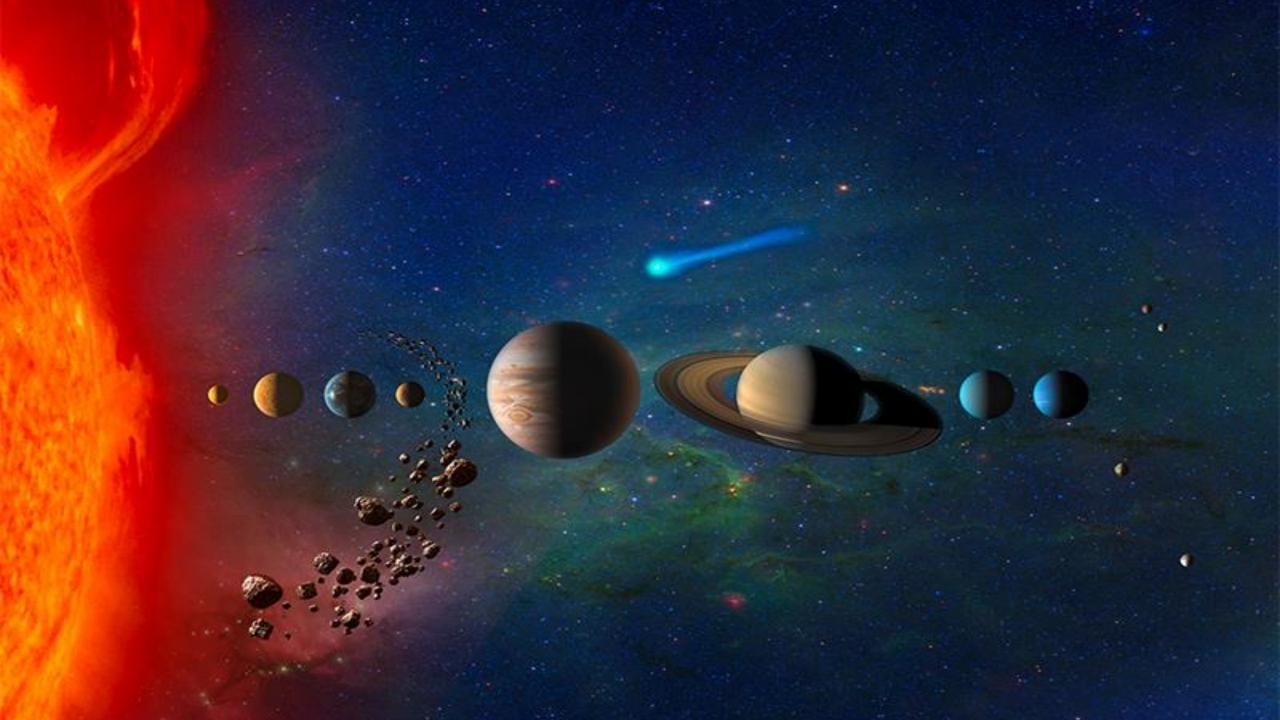
Solar System Scroll and Solar System Beads

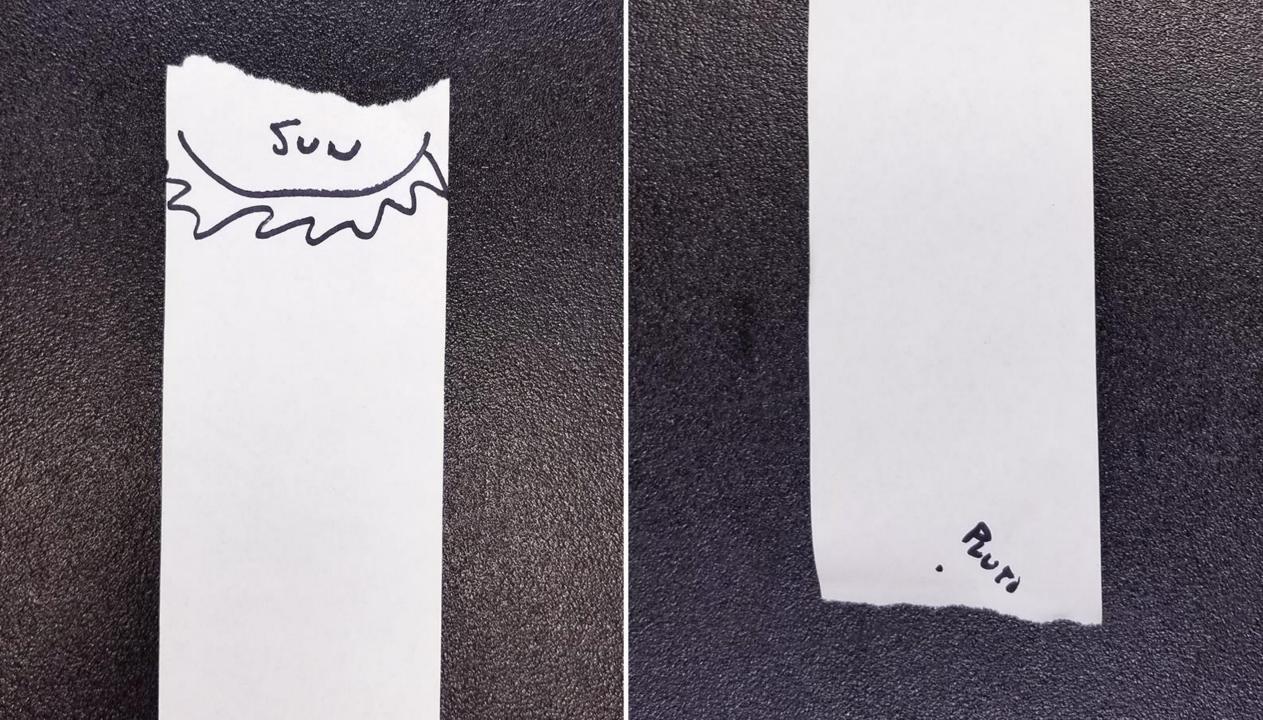
- Materials Needed:
 - Solar System Scroll:
 - Strip of paper the length of a wingspan
 - Colored Pencils
 - Markers or crayons
 - Solar System Beads:
 - Large craft pony beads 11 colors
 - String 5 meters
 - Meter stick or ruler

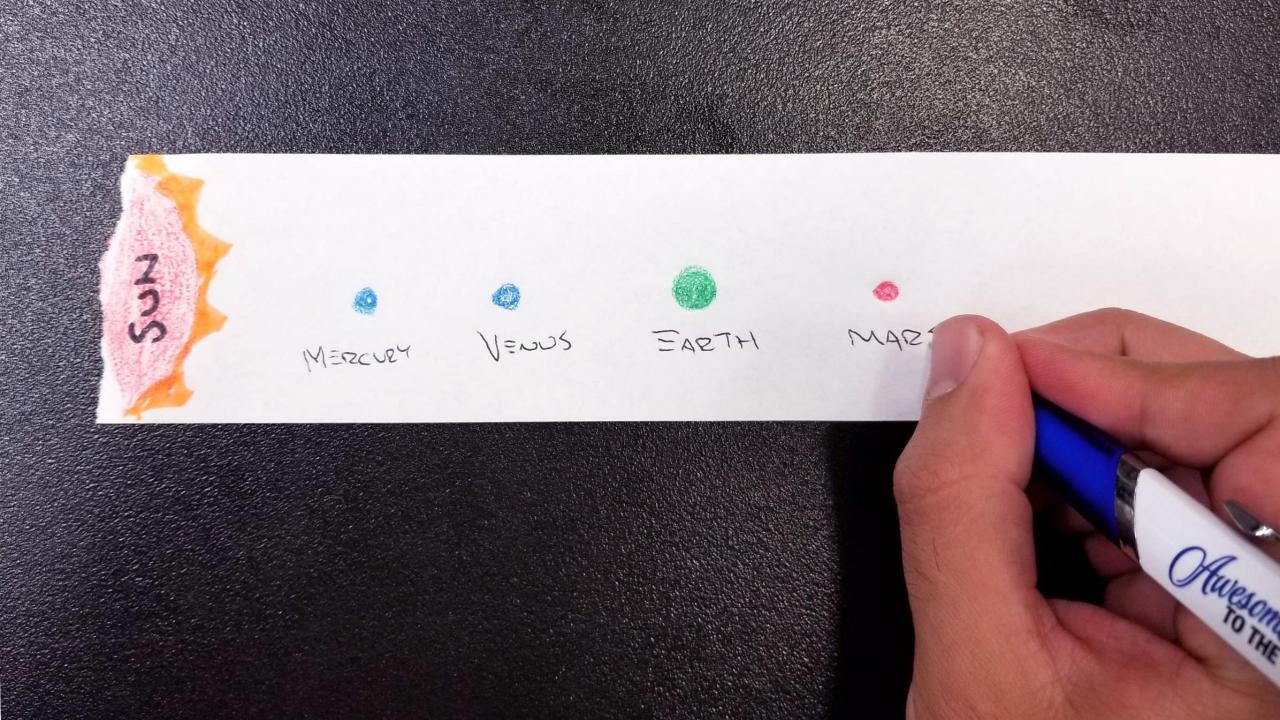
Solar System Scroll: https://www.jpl.nasa.gov/edu/teach/activity/solar-system-scroll/ Solar System Beads: https://www.jpl.nasa.gov/edu/teach/activity/solar-system-bead-activity/

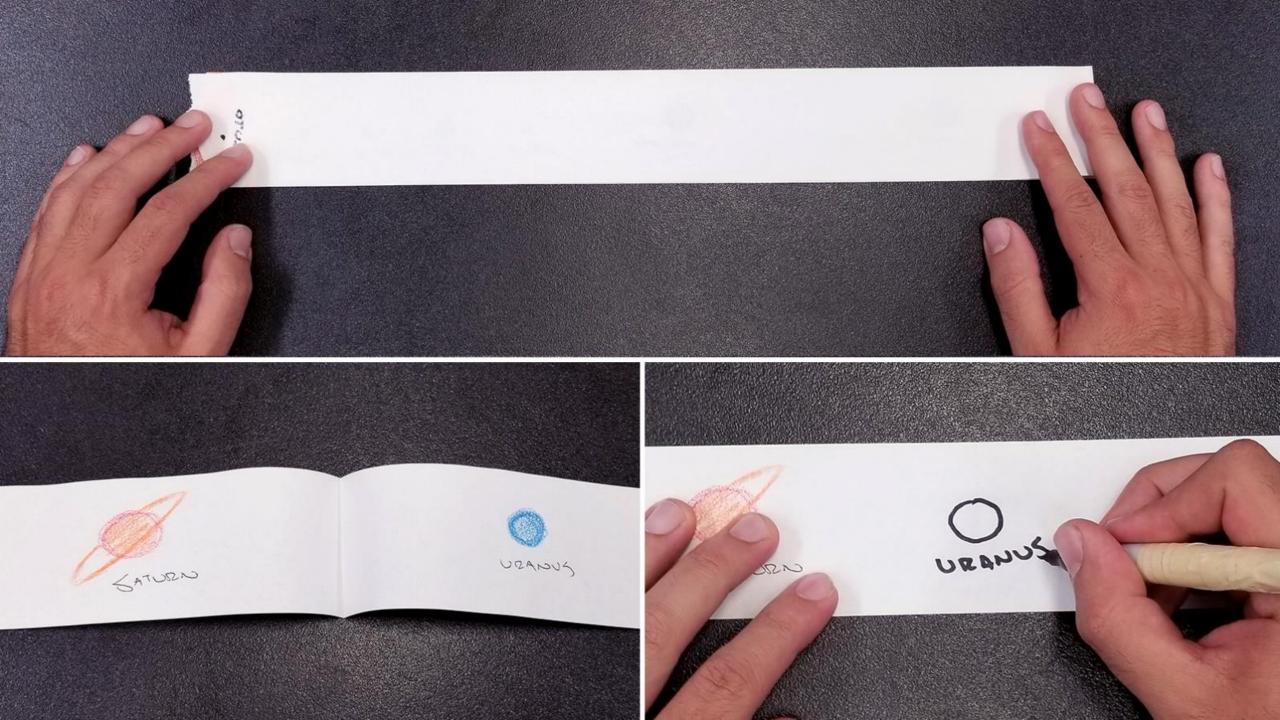


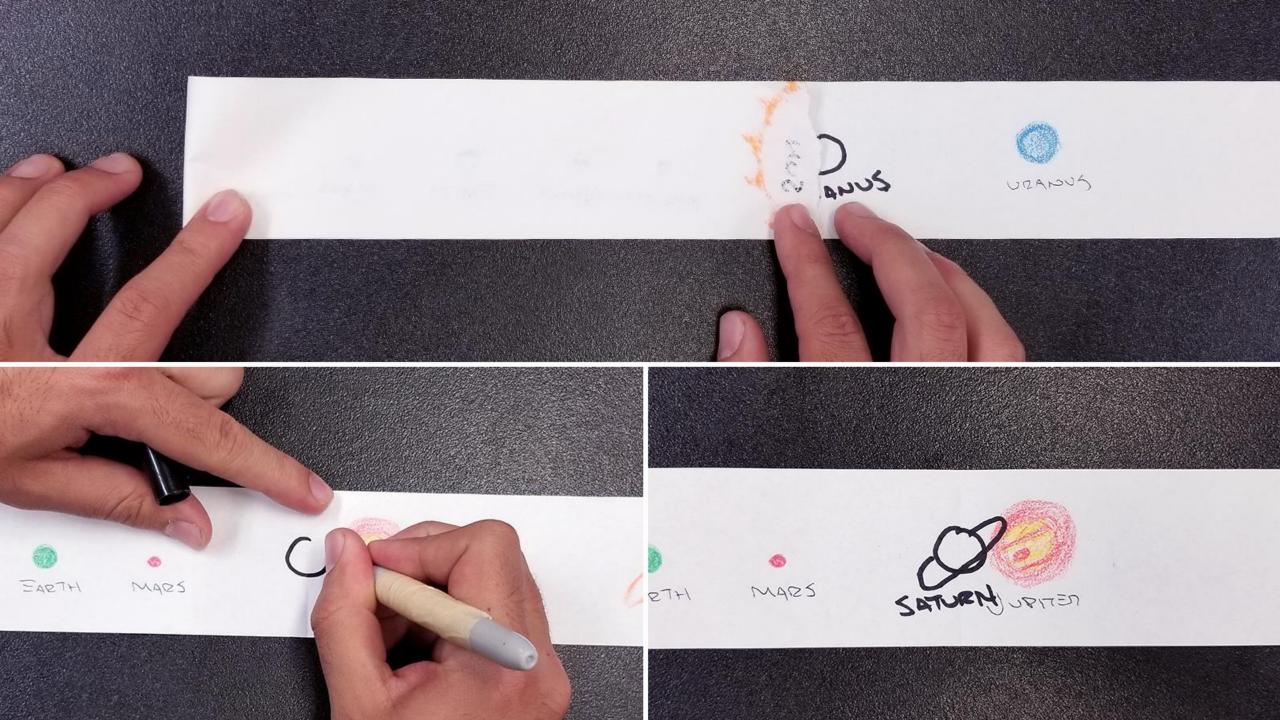
Solar System Scroll

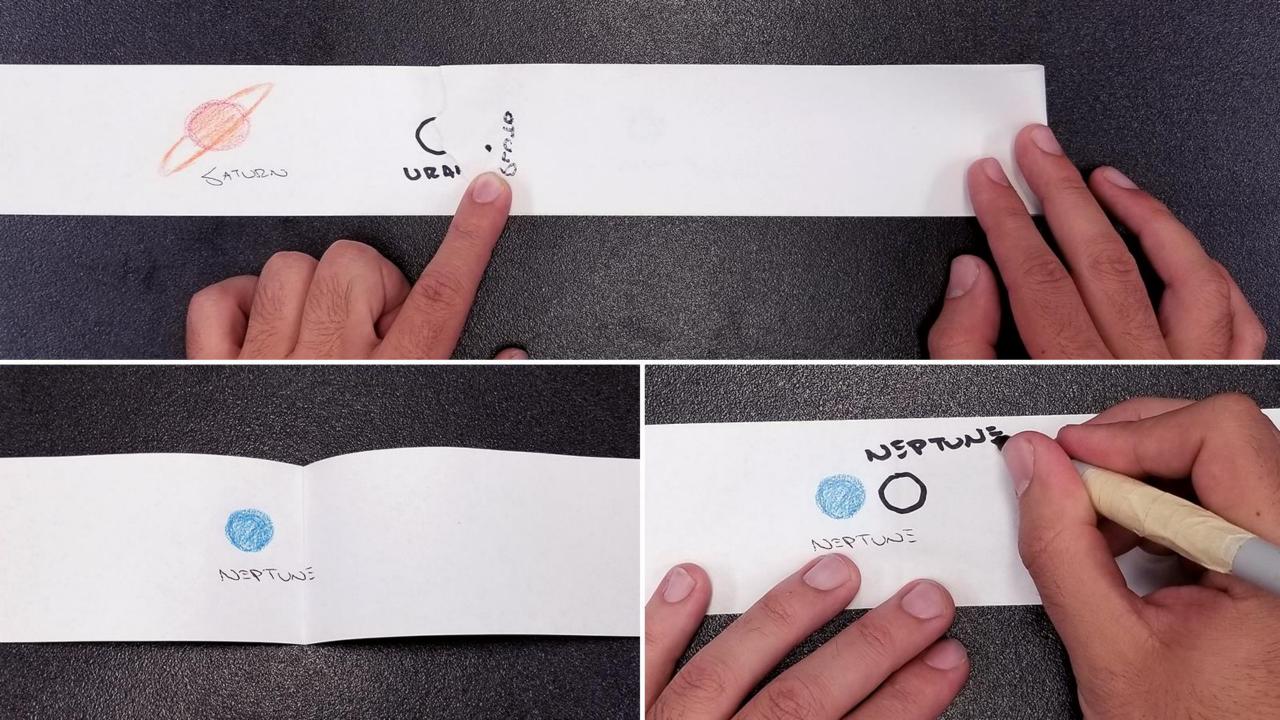


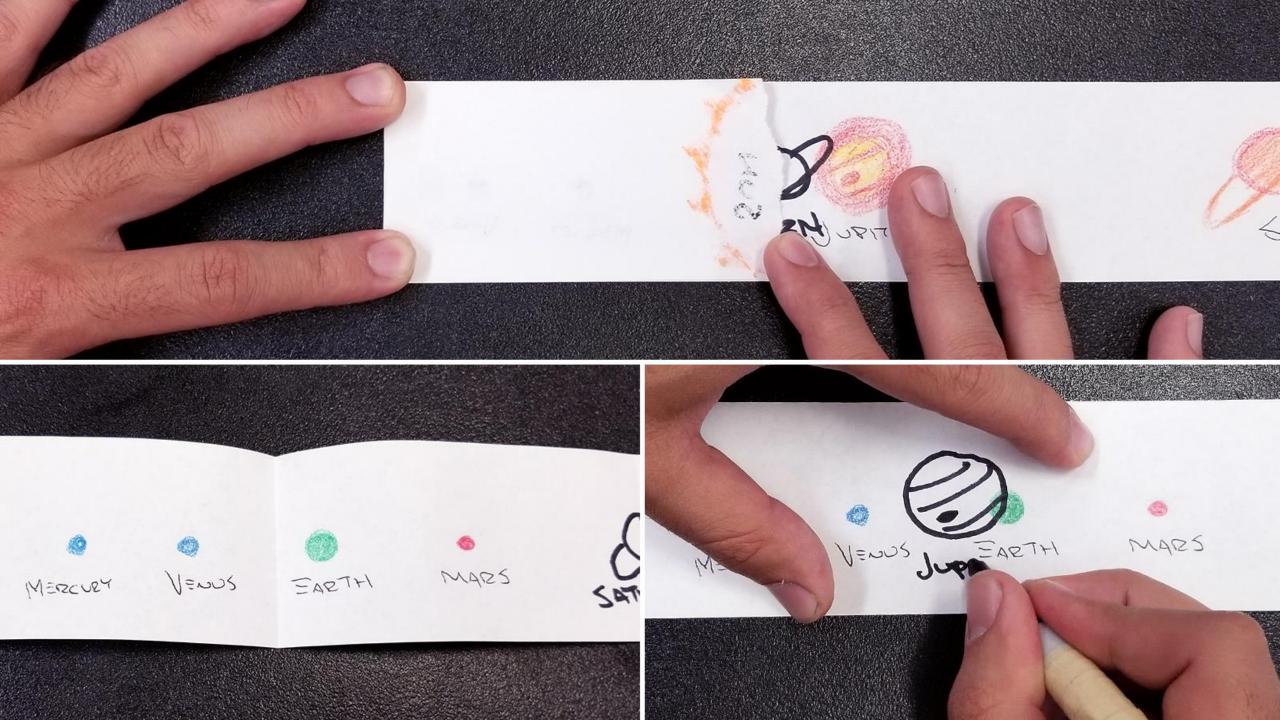


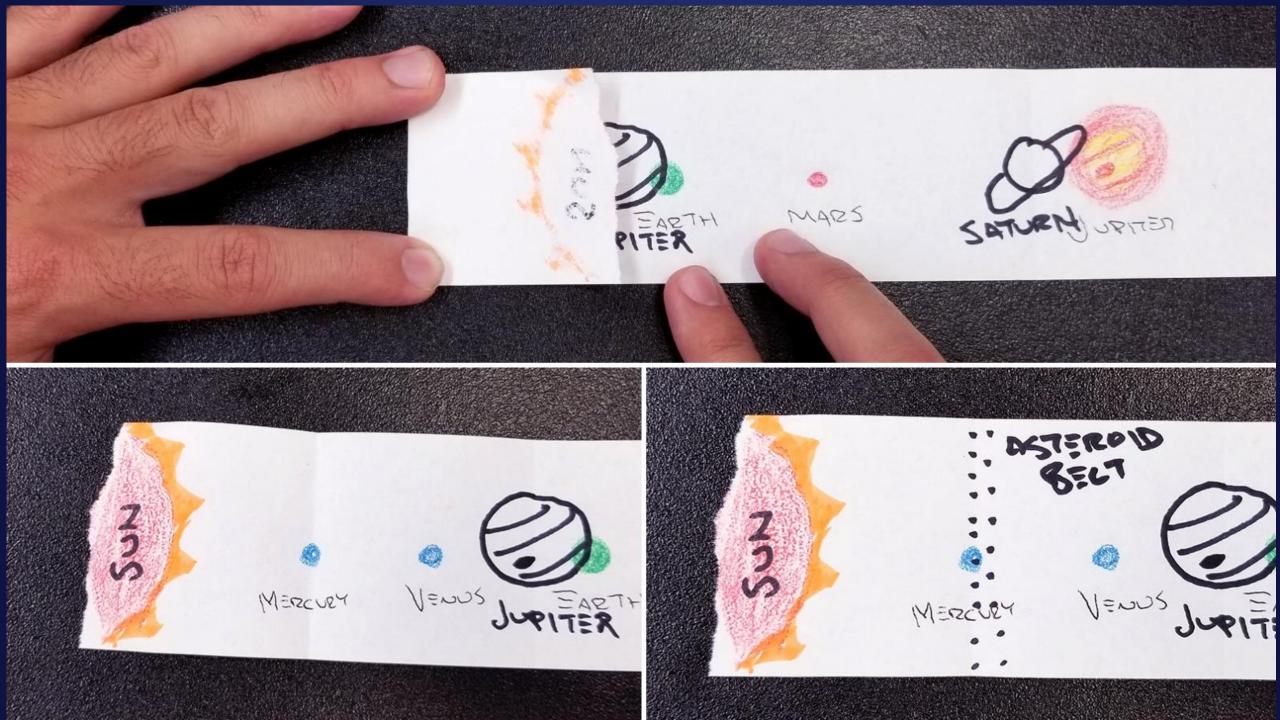


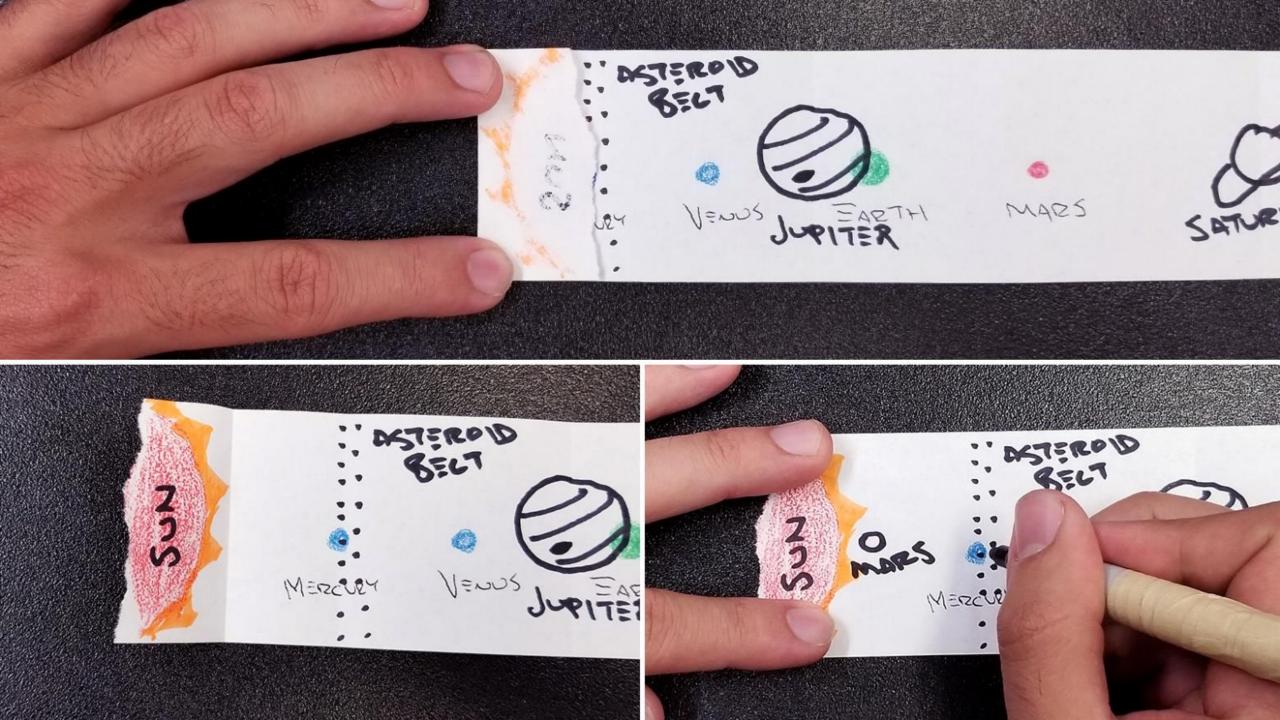














Jet Propulsion Laboratory California Institute of Technology SOLAR SYSTEM SCROLL

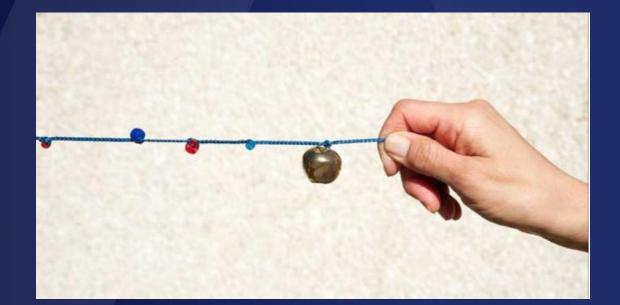




Solar System Scroll Flipped Lesson Video: https://screencast-o-matic.com/watch/cYf03zAulC

Solar system beads





Planet	AU	Scale Value (centimeters)	Bead Color
Sun	0.0 AU	0 cm	Yellow
Mercury	0.4 AU	4 cm	Solid Red
Venus	0.7 AU	7 cm	Cream
Earth	1.0 AU	10 cm	Clear Blue
Mars	1.5 AU	15 cm	Clear Red
Asteroid Belt	2.8 AU	28 cm	Black
Jupiter	5.2 AU	52 cm	Orange
Saturn	9.6 AU	96 cm	Clear Gold
Uranus	19.2 AU	192 cm	Dark Blue
Neptune	30.0 AU	300 cm	Light Blue
Pluto (closest)	29.7 AU	297 cm	Brown
Pluto (average)	39.5 AU	395 cm	Brown
Pluto (most distant)	49.3 AU	493 cm	Brown



Tips and Tricks for Effective Virtual Learning

- Communication is key
- Make all instructions very clear
- Multiple ways to complete activities
- Interactive-Padlet, Pronto, Goosechase
- Gamify your activities- Badger
- Multi-media
- Flipped lesson videos-Asynchronous

NASA STEM Engagement Resources and Opportunities



- NASA STEM@home
- NASA Express
- Informal Education Resources
- Speaker's Bureau
- Citizen Science
- Opportunities and Challenges

- <u>STEM on Station Resources and</u>
 <u>Downlinks</u>
- <u>Commercial Crew Mission Toolkit</u>
- Museum Alliance
- Imagine the Universe
- SMD Toolkits



NASA 2021







The Artemis Program

Artemis is the twin sister of Apollo and goddess of the Moon in Greek mythology. Now, she personifies our path to the Moon as the name of NASA's program to return astronauts to the lunar surface by 2024.

When they land, Artemis astronauts will step foot where no human has ever been before: the Moon's South Pole.

With the horizon goal of sending humans to Mars, Artemis begins the next era of exploration.



Artemis I-III

LRO: Continued surface and landing site investigation



Early South Pole Robotic Landings Science and technology payloads delivered by Commercial Lunar Payload Services providers

Artemis I: First human spacecraft to the Moon in the

Artemis II: First humans to orbit the Moon and rendezvous in deep space in the 21st Century

Gateway begins science operations in lunar orbit with launch of PPE and HALO

Initial human landing system delivered to lunar orbit

Artemis III: Orion and crew dock to human landing system for crew expedition to the surface

21st century

Volatiles Investigating Polar Exploration Rover First mobility-enhanced lunar volatiles survey

Humans on the Moon - 21st Century First crew leverages infrastructure left behind by previous missions

LUNAR SOUTH POLE TARGET SITE

Artemis IV



International habitat delivered to Gateway, in-situ resource utiization (ISRU) demonstrations on the surface and LTV to expand exploration range Artemis IV: First lunar surface expedition through Gateway. External robotic system added to Gateway

Lunar Terrain Vehicle (LTV)

st lunar ition through irnal robotic to Gateway Sustainable reusable lan enhanced lu refueling, an on Gateway

Sustainable operations with reusable landing system and enhanced lunar communications, refueling, and viewing capabilities on Gateway

Airlock arrives at Gateway; surface habitat and pressurized rover delivered to expand exploration range and crew size

> Pressurized Rover

Surface

Habitat

Enhanced habitation capability delivered to Gateway for Mars dress rehearsals

Fission

Surface

Power

ISRU Pilot Plant

SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS | U.S. GOVERNMENT, INDUSTRY, AND INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

All contents represent notional planning and are for discussion purposes only



3 HOURS 3,000^oF 17,500 MPH 250 MILES

LOW EARTH RETURN

LUNAR RETURN

3 DAYS 5,200°F 24,700 MPH 240,000 MILES 9 MONTHS 6,200°F 26,800 MPH 39,000,000 MILES

MARS RETURN



Artemis Astronauts





Joseph Acaba





Kayla Barron



Raja Chari







Nicole A. Mann

Anne McClain

Jessica Meir



Matthew Dominick



Victor Glover



Warren Hoburg



Jasmin Moghbeli



Kate Rubins



Frank Rubio



Jonny Kim



Christina H. Koch



Kjell Lindgren



Scott Tingle



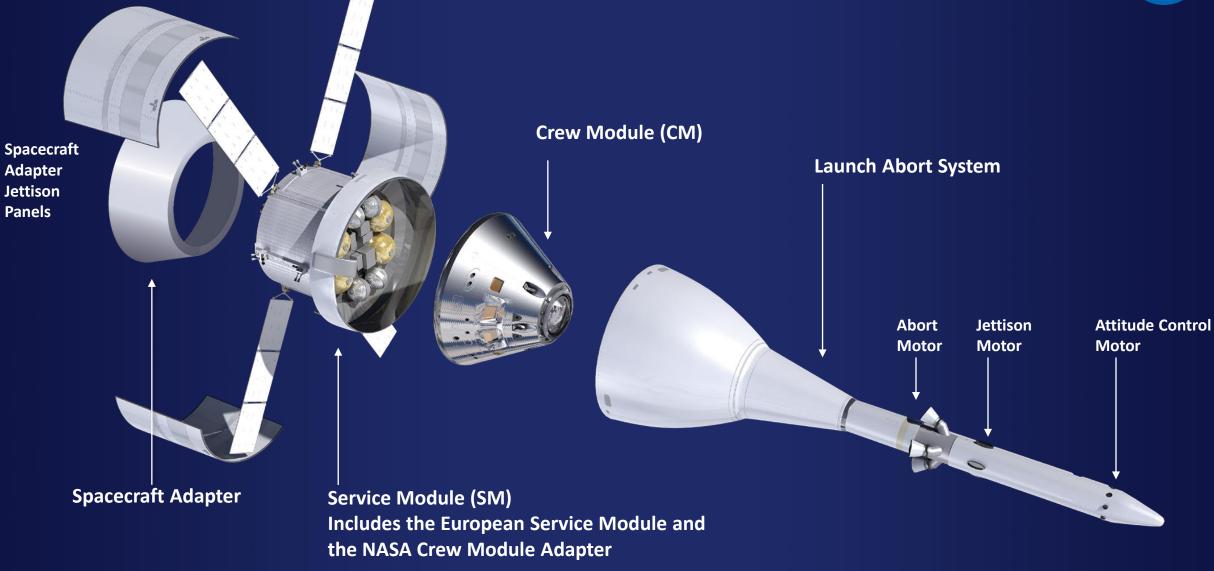


Space Launch System

Orion Spacecraft

ORION SPACECRAFT OVERVIEW





The Gateway

A platform to establish a sustained human presence on and around the Moon in this decade

Includes living quarters for astronauts, a lab for science and research and more

 Components will be from U.S. companies, as well as international partners

First Gateway Components Integrated for Launch in 2023

MAXAR POWER AND PROPULSION ELEMENT (PPE)

NORTHROP GRUMMAN

HABITATION AND LOGISTICS OUTPOST (HALO)

Gateway Logistics Services(GLS)

SPACEX

NASA selected SpaceX as the first U.S. commercial provider under the Gateway Logistics Services contract to deliver cargo, experiments and other supplies to the Gateway in lunar orbit.

Gateway International Partners Building on ISS partnerships to expand deep space capabilities



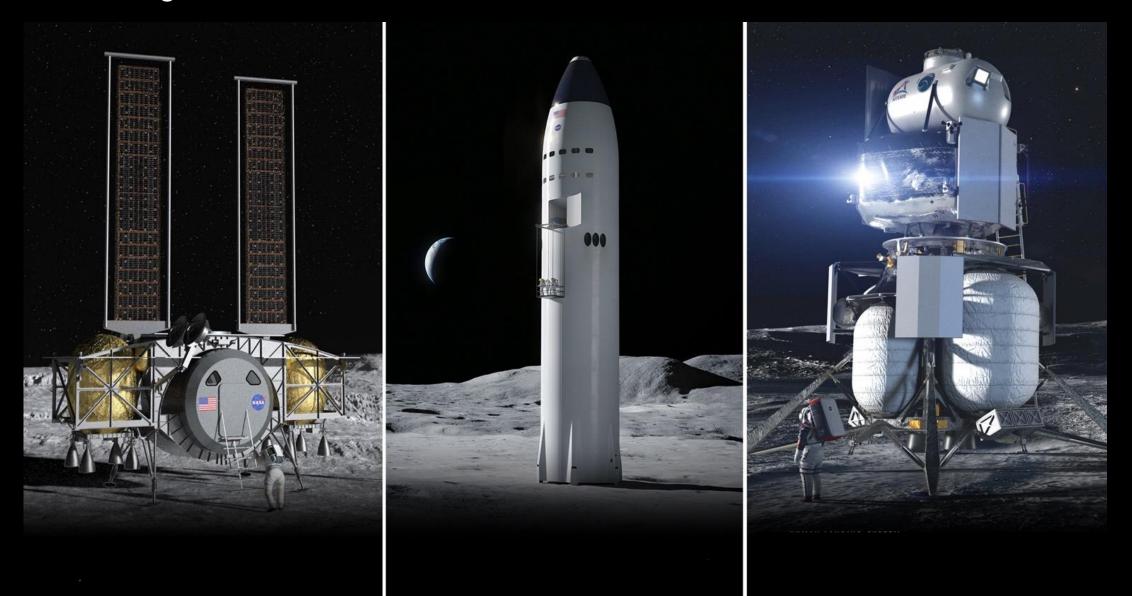


European Space Agency



HUMAN LANDING SYSTEM SELECTIONS

Providing crew access to the lunar surface



VALUABLE LUNAR SCIENCE



Study of Planetary Processes



Understanding Volatile Cycles



Impact History of Earth-Moon System



Record of the Ancient Sun



Fundamental Lunar Science

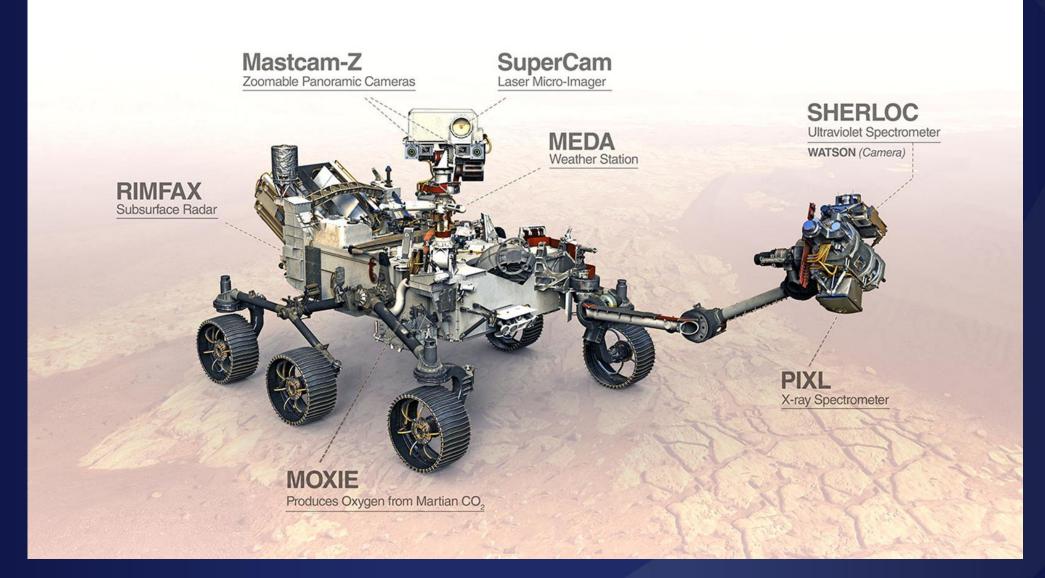


Platform to Study the Universe

LUNAR SURFACE SCIENCE OBJECTIVES

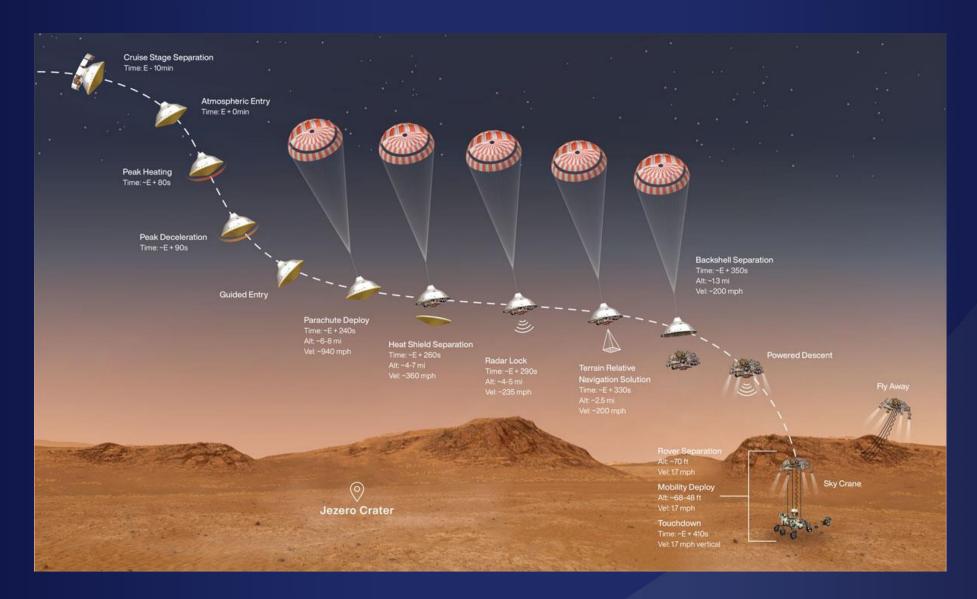
Perseverance Landing on Mars





Entry, Descent, and Landing





Ingenuity Mars Helicopter



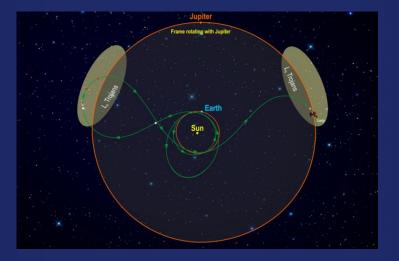


Other NASA Level I Events





James Webb Telescope





Lucy

Landsat 9



Let's go. The time is now.

