Science Homework – Week of 3/31st – Due BEFORE CLASS on Friday 4/3

Directions: Read the articles included in this packet. Find 3 pieces of evidence/ quotes to answer each question below (3 quotes per question):

1. **Why should we send astronauts back to the moon?**
   Evidence #1:
   ____
   ____
   Evidence #2:
   ____
   ____
   Evidence #3:
   ____
   ____

2. **Why should we send astronauts to Mars?**
   Evidence #1:
   ____
   ____
   Evidence #2:
   ____
   ____
   Evidence #3:
   ____
   ____

3. **Should we go to the Moon before Mars?**
   Evidence #1:
   ____
   ____
   Evidence #2:
   ____
   ____
   Evidence #3:
   ____
   ____

Article 1:

July 25, 2019

What is Artemis?

Artist's concept of the Space Launch System rocket and Orion capsule prepared for launch.
Credits: NASA

NASA is committed to landing American astronauts, including the first woman and the next man, on the Moon by 2024. Through the agency's Artemis lunar exploration program, we will use innovative new technologies and systems to explore more of the Moon than ever before. We will collaborate with our commercial and international partners to establish sustainable missions by 2028. And then we will use what we learn on and around the Moon to take the next giant leap – sending astronauts to Mars.

Why Go to the Moon?

With the Artemis program we will:

- Demonstrate new technologies, capabilities, and business approaches needed for future exploration including Mars
- Establish American leadership and a strategic presence on the Moon while expanding our U.S. global economic impact
- Broaden our commercial and international partnerships
- Inspire a new generation and encourage careers in STEM

How Do We Get There?

NASA's powerful new rocket, the Space Launch System (SLS), will send astronauts aboard the Orion spacecraft nearly a quarter million miles from Earth to lunar orbit. Astronauts will dock Orion at the Gateway and transfer to a human landing system for expeditions to the surface of the Moon. They will return to the orbital outpost to board Orion again before returning safely to Earth.

When Will We Get There?

Ahead of the human return, we will send a suite of science instruments and technology demonstrations to the lunar surface through commercial Moon deliveries beginning in 2021.

The agency will fly two missions around the Moon to test its deep space exploration systems. NASA is working toward launching Artemis I, an uncrewed flight to test the SLS and Orion spacecraft together, followed by the Artemis II mission, the first SLS and Orion test flight with crew. NASA will land astronauts on the Moon by 2024 on the Artemis III mission and about once a year thereafter.

Artist's concept of the Phase 1 Gateway in lunar orbit with Orion and the human landing system docked to the orbital outpost.
Credits: NASA

What Will We Do There?

While Mars remains our horizon goal, we have set our sights first on exploring the entire surface of the Moon with human and robotic explorers. We will send astronauts to new locations, starting with the lunar South Pole. At the Moon, we will:

- Find and use water and other critical resources needed for long-term exploration
- Investigate the Moon's mysteries and learn more about our home planet and the universe
- Learn how to live and operate on the surface of another celestial body where astronauts are just three days from home
- Prove the technologies we need before sending astronauts on missions to Mars, which can take up to three years roundtrip

Going forward to the Moon will be the shining moment of our generation. This moment will belong to you – the Artemis Generation. Are you ready?

Article 2: https://mars.nasa.gov/

Mission Name	Mars 2020
Rover Name	Perseverance
Main Job	The Perseverance rover will seek signs of ancient life and collect rock and soil samples for possible re
Launch Window	July 17 - Aug. 5, 2020
Launch Location	Cape Canaveral Air Force Station, Florida
Landing	Feb. 18, 2021
Landing Site	Jezero Crater, Mars
Mission Duration	At least one Mars year (about 687 Earth days)

NEXT STEPS

In 2020, NASA will send the next Mars rover to continue seeking the signs of life on Mars. The Mars 2020 rover mission will collect rocks and soil samples that a future mission could return to Earth for study.

NASA is also planning to send humans to Mars sometime in the future. Preparations are being made, primarily through robotic exploration in collaboration with the Human Exploration and Operations Mission Directorate and the Space Technology Mission Directorate. The Mars 2020 rover will help us understand the current weather, winds, radiation, and dust environment, and will demonstrate technologies that will help humans once there.

WHY MARS?

There are several strategic, practical and scientific reasons for humans to explore Mars. Among them we know that Mars is the most accessible place in the solar system. Additionally, exploring Mars provides the opportunity to possibly answer origin and evolution of life questions, and could someday be a destination for survival of humankind.

In the strategic sense, exploring Mars demonstrates our political and economic leadership as a nation, improves the quality of life on Earth, helps us learn about our home planet, and expands US leadership in the peaceful, international exploration of space.

From a practical perspective we know that Mars is unique across the entire solar system in that it is a terrestrial planet with an atmosphere and climate, its geology is known to be very diverse and complex (like Earth), and it appears that the climate of Mars has changed over its history (like Earth).

Overall, many of the key questions in ***solar system science*** can be addressed effectively by exploring Mars. This endeavor also serves to inspire the next generation of explorers and dramatically expand human knowledge.

Article 3:

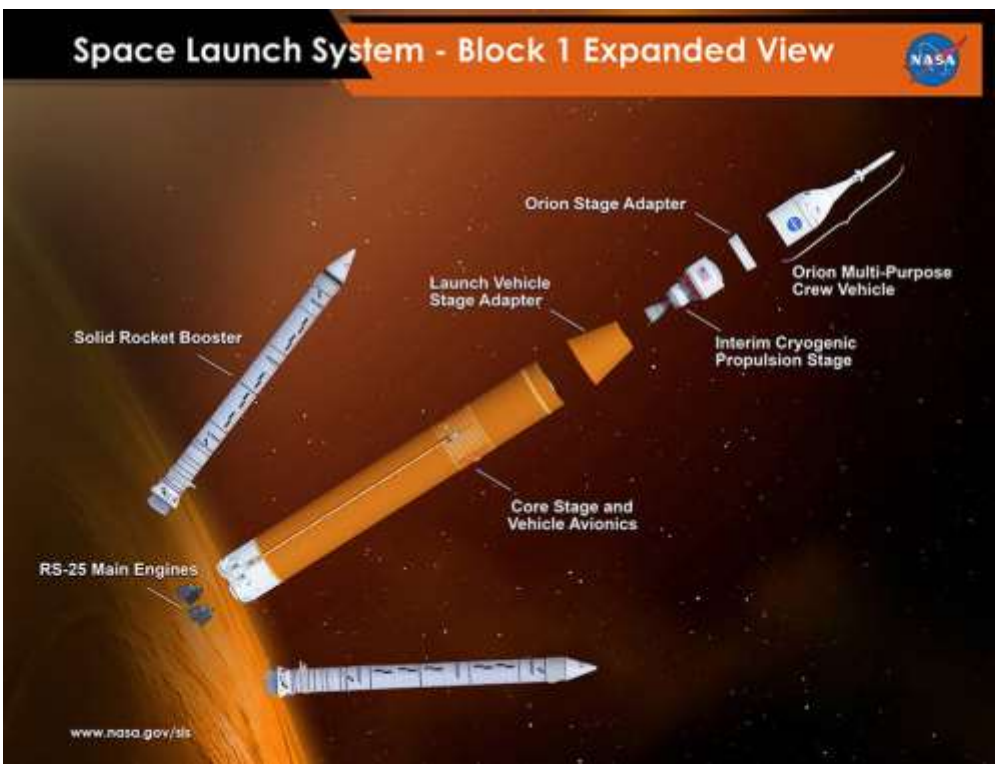
The Great Escape: SLS Provides Power for Missions to the Moon

Getting to the Moon requires a powerful rocket ship to accelerate a spacecraft fast enough to overcome the pull of Earth's gravity and set it on a precise trajectory to its destination. When NASA's deep space rocket, the Space Launch System, takes off on its first flight, Artemis I, it will produce a maximum 8.8 million pounds of thrust, exerting more power than any rocket ever. Like many rockets, the rocket's propulsion is delivered in stages.

Liftoff: Core Stage & Boosters

At liftoff, the SLS core stage and twin solid rocket boosters fire to propel the 5.75 million pound rocket off the launch pad at Kennedy Space Center in Florida and send it into orbit, carrying an uncrewed Orion spacecraft. To do this, in a mere eight minutes, SLS's four RS-25 engines burn 735,000 gallons of liquid propellant to create two million pounds of thrust and the twin rocket boosters burn more than two million pounds of solid propellant to create more than seven million pounds of thrust. During ascent, rocket engineers often say the rocket is going uphill, likening this phase of launch to carrying a huge weight up a mountain with Earth's gravity pushing back the whole time.

After the rocket burns through the fuel in the boosters and core stage, it drops them, much like a hiker might drop a heavy backpack to climb the last few miles to a mountain's peak. SLS uses its power to maximize the cargo the rocket can send to the Moon. That's why SLS does not carry extra fuel or propulsion systems necessary to return any stages to Earth for reuse. The solid rocket boosters separate two minutes into the flight, and the core stage falls away around eight minutes after launch.



The Space Launch System reaches Earth orbit with the power of two solid rocket boosters and a core stage with four RS-25 engines. From here, the interim cryogenic propulsion stage fires its RL10 engine to send the uncrewed Orion to the Moon for Artemis 1.

Credits: NASA/MSFC

The Big Move to the Moon: Trans-Lunar Injection

After SLS loses the weight of its first stage propulsion systems and fuel, more power is still needed to send Orion to the Moon. At this point, the upper part of the rocket and Orion are soaring almost 100 miles above Earth, accelerating at more than 17,500 miles per hour, and beginning a circular orbit around Earth. This is low-Earth orbit, often referred to as LEO. SLS can deliver more than 95 metric tons (209,439 pounds) to this orbit with a Block I configuration. However, a deep space mission requires a rocket that can travel beyond LEO with enough power and speed to overcome the pull of Earth's gravity and send the spacecraft even farther to reach the Moon. The upper part of rocket prepares for the next big move to send Orion out of LEO without even completing a full orbit of Earth.

This big move is called a trans-lunar injection, or TLI, and is the key maneuver that makes it possible to send Orion 280,000 miles beyond Earth and 40,000 miles beyond the Moon, farther than any spaceship qualified to safely carry humans has ever ventured. The amount of mass a rocket can send to the Moon is determined by its performance at TLI. The initial configuration of SLS can send more than 26 metric tons (57,000 pounds) to lunar orbits and future upgrades will enable the rocket to send at least 45 metric tons (99,000 pounds).

For Artemis 1, the TLI maneuver will begin as the upper part of the rocket, officially named the interim cryogenic propulsion stage, fires one RL10 engine producing 24,750 pounds of thrust to accelerate the vehicle to more than 24,500 miles per hour, a velocity fast enough to overcome the pull of Earth's gravity and propel Orion out of low-Earth orbit to send the spacecraft to the Moon. The TLI maneuver precisely targets a point about the Moon that will guide Orion close enough to be captured by the Moon's gravity.

Right after the TLI burn, the interim cryogenic propulsion stage separates from Orion. Orion heads to the Moon for its three-week mission, and the stage continues on a similar path, deploying several CubeSats along the way to study the Moon or head father out to deep space. The stage continues to an orbit around the Sun, which will eventually consume it. The 13 small satellites continue their various missions, gathering information to help NASA in the future exploration of deep space.

Meanwhile, Orion fires the maneuvering engines on its service module provided by ESA (the European Space Agency) to bring the spaceship around the far side of the Moon. On this flight, NASA is testing critical systems in the environment of deep space, especially elements of its crew life support system and navigation system. These tests take place so far from Earth that the global positioning system, or GPS, that many people use every day, doesn't work. Instead, Orion will communicate through the Deep Space Network. Later, as Orion heads home, one of the most crucial tests occurs when its heat shield endures temperatures as high as 5,000 degrees Fahrenheit, half as hot as the surface of the Sun, during re-entry to arrive safely back on Earth. With the help of the Navy, NASA recovers Orion from the Pacific Ocean off the coast of California.

For Artemis 1, the interim cryogenic propulsion stage provides the power to send Orion 280,000 miles from Earth and 40,000 miles beyond the Moon, farther than any spacecraft built for humans as ever traveled. ***Credits: ULA***

What comes next? People Traveling Farther from Earth than Ever Before

After the first flight, the next step is to start sending people on bold missions to the Moon and beyond. As SLS evolves over future missions to unprecedented accommodation of payload mass and volume and unrivaled performance, the rocket will allow NASA to send missions to deep space and reach distant destinations faster than ever before. On its second mission carrying Orion and astronauts, Artemis II, SLS will send Orion and its crew farther than people have traveled before around 250,000 miles from Earth, 10,000 miles beyond the Moon. Like Artemis I, the second flight will use a Block I version of the SLS. On the third flight, Artemis III, SLS will send Orion an astronauts on a mission in 2024 that will land on the Moon. Americans along with their international and commercial partners will use the Moon as a proving ground to test technologies and prepare for missions to Mars.

To land larger cargos on the Moon and to send people to Mars, SLS will evolve to a configuration called Block 1B. This rocket configuration will use a powerful Exploration Upper stage instead of the interim cryogenic propulsion stage and be capable of sending 37 metric tons (88,000 pounds) to the Moon. One feature that will help the rocket haul payload to space along with Orion is the universal stage adapter. It acts like the trunk in a large van and allows SLS to send both astronauts and large cargo that take up more than 10,000 cubic feet and weigh up to 10,000 pounds. Carrying only cargo, the rocket's 8.4-meter shroud could hold three fully loaded school buses or the equivalent of 30 Mars Curiosity rovers that are about the size of a small car. Large parts of NASA's Gateway can be launched along with the Orion spacecraft or on separate flights.

The ultimate evolution of SLS is the Block 2 rocket that can carry either crew and cargo or just cargo needed for Mars exploration or for planetary missions headed to the outer solar system. The Block 2 launch vehicle reaches orbit with the same core stage used by smaller versions of the rocket, but more powerful boosters will increase thrust to 11.9 million pounds. This will allow it to launch up to 45 metric tons (99,000 pounds) to deep space.

Peaceful Exploration for Humanity

SLS and Orion are America's space vehicles and the foundation for missions carrying explorers to deep space. This new era of discovery requires all of humanity, including international and commercial partners, to help make these ventures possible and sustainable. Partners can help provide routine delivery of supplies and equipment needed to live and work on the Moon and in deep space. SLS and Orion are planned to fly once or twice a year and will focus on dependable, safe flights for humans and large cargo.

America and the world are ready for this new era of space exploration. The Apollo Program gave humanity its first experience traveling to a foreign world. NASA's planetary probes and great observatories have revealed the Universe in all its mystery. One hundred and thirty-five NASA space shuttle missions, 20 years building the International Space Station, the largest structure ever constructed in orbit, and 18 years of continuous human presence in space have helped us learn to live and work in space. Our next adventure, the Artemis program, starts when SLS roars off the launch pad, opening a new era of human exploration and discovery.

Article 4:

Why is NASA Going Back to the Moon Before Heading to Mars?

May 24, 2018

Written by Elizabeth Howell

NASA's new space plan sounds a bit like a time warp. The agency wants to bring humans back to the moon, a place that twelve people already walked upon between 1969 and 1972. Why are we going back again nearly 50 years later? As NASA's new administrator Jim Bridenstine said in a major speech in Washington, D.C. last week, the moon will help us prepare for Mars. "We are doing both the moon and Mars in tandem, and the missions are supportive of each other," he said at the annual Humans to Mars Summit.

The Moon Is a Different Place to Us Now

Fifty years is a really long time, and in those five decades we've discovered the moon is not the dry, barren, nearly unchanging place we thought it was. The biggest discovery in recent decades? Finding water. Yes, there does appear to be water ice in permanently shadowed craters on the moon's surface. This means that future explorers may not need to bring all their water with them. We could build a moon colony near the ice and, in theory, extract the water for drinking, showering, or cleaning.

There are other weird features worth exploring as well. Ancient underground lava tubes could serve as great spots for humans to take shelter against the radiation bathing the moon's surface. The moon has bizarre levitating dust that, through electrostatic charges, dances on the surface during lunar sunrises and sunsets. And we've also come to appreciate the moon as a time capsule. All those craters and divots on the surface are scars of our solar system's history, scars that Earth would have too if they weren't erased by wind, water, and earthquakes. So by studying the moon, we can actually learn a little bit about how Earth formed. Talk about a cosmic origin story.

We Can Prepare for Mars

The moon is relatively close to us; the Apollo astronauts were able to reach it only two days after they lifted off from Earth. That's really convenient if an emergency occurs. When the Apollo 13 spacecraft suffered an oxygen tank explosion in 1970 while the astronauts were still going to the moon, all NASA had to do was have the astronauts loop around the moon and zip back to Earth for a safe landing. So the moon serves as a handy testbed for exploring deep space — with the safety net of knowing that if something goes terribly wrong, the astronauts can still get home relatively quickly.

We can also test out technologies on the lunar surface that would be useful on Mars. How do we build a habitat where astronauts can stay safe and productive for months at a time? What spacesuits can we use again and again, even with corrosive lunar dust eating away at the protective layers of the suit? Astronauts can test all sorts of things on the lunar surface, from rovers to mining tools to science techniques.

Mars and the moon aren't perfect twins, of course, but any practice for living in space will be useful for the Red Planet. Mars will present even more challenges to astronauts because it's further away and it's a planet with dust storms and other weather. But it might be easier in some senses, too. Mars has a day that's close to our 24-hour day. And as humans, we may feel psychologically better looking around at a ruddy, wind-swept landscape that resembles some desert zones on Earth.

Article 5:

The Case Against the Moon: Why We Shouldn't Go Straight Back

By Denise Chow January 13, 2011

After Apollo 12 left lunar orbit this image of the moon was taken from the command module on Nov. 24, 1969.
(Image: © NASA)

This story is part of a week-long SPACE.com series on what it would take for humanity to return to the moon to stay. Also coming on Friday on SPACE.com: Mining the moon.

On July 21, 1969, Neil Armstrong became the first person to set foot on the moon, and in an instant, the world changed.

Eleven other American astronauts would follow in Armstrong's footsteps over the course of NASA's Apollo program, which produced six moon landings in all. Yet in the 38 years since the sixth landing, humans have not ventured back to their closest cosmic neighbor

And perhaps we should not. As NASA embarks on a new plan for space exploration amid political uncertainty and budgetary constraints, some experts are hoping the space agency will look beyond the moon for the future of human spaceflight, and instead push deeper into our solar system than ever before.

"We've done the moon – we understand it better than anything else," Buzz Aldrin, lunar module pilot on the Apollo 11 mission and second man to walk on the moon, told SPACE.com. "We've got to stop thinking of short-term hurrahs and start thinking of long-term investments."

With China and India aggressively moving forward with robotic and manned missions to the moon, some analysts envision a rehash of the 1960s moon race between the United States and the Soviet Union. And while some camps are calling for a return to the moon to expand lunar science and potentially construct moon bases, others are less thrilled at that prospect.

"As long as I've been involved in spaceflight, for about 20 years now, there has been this debate going on between the two groups," said Roger Launius, senior space history curator at the Smithsonian National Air and Space Museum in Washington. "I refer to them as the Martians and the Lunatics – the people who want to go to Mars, and the people who want to go back to the moon. No one side has the clear-cut answer. There are positives and negatives for both."

Moon vs. mars

Launius said returning to the moon could address important scientific questions, such as the existence of water ice, but with the objective of traveling to Mars on the horizon, he wonders whether it would cause NASA to be "sidetracked with years upon years of lunar exploration."

"I'm less excited about a human mission back to the moon," Launius said. "I remember the first ones – they were cool. I'd love to see us go to Mars, but it's much more complex and difficult. And I really question whether we're going to be able to develop the expertise to take a task like that on."

Others agree Mars is a more exciting destination and that a return to the moon should come eventually but should not top the space agency's list of priorities.

"A return to the moon should not be NASA's primary goal or focus in this decade," said Robert Zubrin, president of the Mars Society. "Rather, the proper goal of NASA's human spaceflight program should be human missions to Mars. From a technological point of view, we are much closer today to being able to send humans to Mars than we were to sending men to the moon in 1961, and we were there eight years later."

Political climate

NASA's now-canceled Constellation program, established during the administration of President George W. Bush, aimed to return American astronauts to the moon by 2020. As part of the roughly $9 billion program, NASA was charged with developing new Ares rockets and a space capsule called Orion that would act as a replacement for the agency's retiring space shuttle fleet.

But President Obama's 2011 budget request effectively shut down the moon-oriented Constellation program and shifted the focus of future U.S. space exploration toward asteroids and Mars.

On Oct. 11, 2010, Obama signed a major NASA act that turned these lofty goals into law. The signing officially scrapped the Constellation program and set the stage for a manned mission to an asteroid by 2025, followed by a manned mission to Mars, currently envisioned for some time in the 2030s.
The new space plan also opens the door for private spaceflight companies to create commercial vehicles to ferry astronauts into low-Earth orbit (LEO) while NASA sets its sights on targets deeper into the solar system.

One such commercial firm is Space Exploration Technologies, commonly called SpaceX. The Hawthorne, Calif., company's Dragon capsule is designed to transport cargo, and eventually humans, aboard the company's Falcon 9 rocket to the International Space Station.
"I think Mars, given that it holds the potential for making life multi-planetary, is much more important than the moon, and that should be the focus of future manned exploration," said Elon Musk, the chief executive of SpaceX. "However, if there turns out to be a market for traveling to the moon, SpaceX will support that just as we support LEO activity."

Maintaining a reputation of leadership

In addition to his concern that sending more Americans to the moon would tie up resources that could be used to develop Mars-bound technology, Aldrin said engaging in another moon race would jeopardize the legacy of U.S. dominance in space exploration.

"Manned missions to the moon should carefully consider U.S. leadership in space as we expand human presence outward into the solar system," Aldrin said. "If we go back to the moon and get there second or third, that is not U.S. leadership.

Activities going back to the moon should be led by the U.S. – but not at the expense of leading the world in space and expansion outward."

Arguments for human exploration of the Red Planet are no less politically charged.

"Given courageous leadership, we could be on Mars by 2020. That should be our goal," Zubrin said. "To say we cannot do it is to say we have become less than the kind of people we used to be, and that is something this country cannot accept and cannot afford."