


Today's Class: **Project Artemis – Guest lecture by Lockheed Martin Chief Exploration Architect T. Cichan & Deputy Dr. Christine Edwards**

- Continue to read about Artemis & Science on the Moon using NASA report referenced on class website for Oct. 11.
- Homework #4 will be handed out next week.



ARTEMIS PLAN
NASA's Lunar Exploration Program Overview
September 2020

Astronomy 2020 – Space Astronomy & Exploration

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Poem by 2020 Literature Nobel Laureate

Telescope by Louise Glück

There is a moment after you move your eye away when you forget where you are because you've been living, it seems, somewhere else, in the silence of the night sky. You've stopped being here in the world. You're in a different place, a place where human life has no meaning. You're not a creature in body. You exist as the stars exist, participating in their stillness, their immensity.

Then you're in the world again. At night, on the cold hill, taking the telescope apart. You realize afterward not that the image is false but the relation is false. You see again how far away everything is from every other thing.

Astronomy 2020 – Space Astronomy & Exploration

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Elements of Project Artemis: Orion, Gateway, and HLS

Timothy Cichan
Space Exploration Architect

Dr. Christine Edwards
Deputy Space Exploration Architect

October 9, 2020

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ARTEMIS : Landing Humans On the Moon in 2024



Lunar Reconnaissance Orbiter: Continued surface and landing site investigation

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 Power and Propulsion Element and Habitation and Logistics Outpost

Initial human landing system delivered to lunar orbit

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

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

Human Investigating Polar Exploration Rover: First mobility-enhanced lunar vehicles arrive

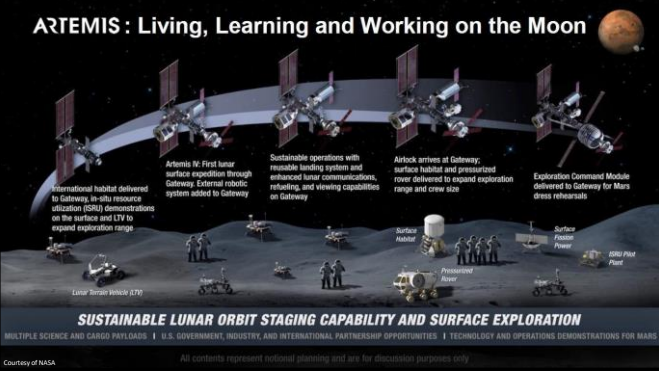
Humans on the Moon - 21st Century: First crew arrives. Infrastructure left behind by previous missions

LUNAR SOUTH POLE TARGET SITE

Courtesy of NASA

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ARTEMIS : Living, Learning and Working on the Moon



International habitat delivered to Gateway, in-situ resource utilization (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

Sustainable operations with enhanced lunar communications, relaying and viewing capabilities on Gateway

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

Exploration Command Module delivered to Gateway for Mars dress rehearsal

Lunar Terrain Vehicle (LTV)

Surface Habitat

Pressurized Rover

Surface Power

ISRU Plant

SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

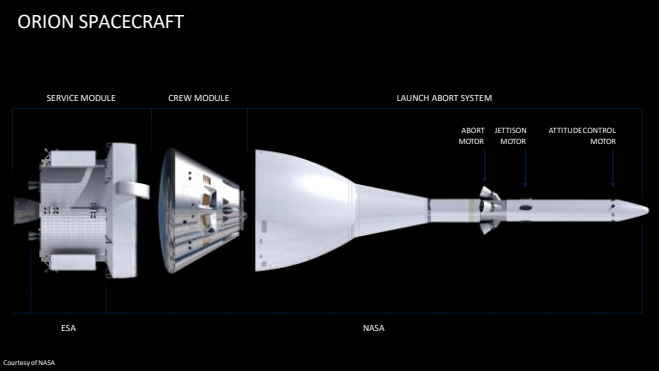
MULTIPLE SCIENCE AND CARGO PAYLOADS | U.S. GOVERNMENT, INDUSTRY, AND INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

All contents represent notional planning and are for discussion purposes only

Courtesy of NASA

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ORION SPACECRAFT



SERVICE MODULE (ESA)

CREW MODULE (NASA)


LAUNCH ABORT SYSTEM

ABORT MOTOR, JETTISON MOTOR, ATTITUDE CONTROL MOTOR

Courtesy of NASA

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THE SPACECRAFT Orion

Apollo		Orion
3 crew members		4 crew members
~39 crew days consumable		~84 crew days consumables
Fuel Cell Powered (~14day max lifetime)		Solar Array Powered
Command Module	Height: 107'7" (3.2m) Diameter: 12'10" (3.8m) Habitable Volume: 11,000 ft ³ (3.1m ³) Launch Weight: 12,800 lbm (5,823 kg) Landing Weight: 16,577 lbm (7,529 kg)	Crew Module
Service Module	Height: 22'7" (6.9m) Diameter: 12'10" (3.8m) Launch Weight: 11,258 lbm (5,120 kg)	Height: 107'10" (3.3m) Diameter: 12'10" (3.8m) Habitable Volume: 11,000 ft ³ (3.1m ³) Launch Weight: 22,900 lbm (10,387 kg) Landing Weight: 20,400 lbm (9,253 kg)
Performance	Crew: 3 Habitable Volume: 70 ft ³ /person (2.0m ³) Mission Support: 14 day/12 crew Power Source: Fuel Cells	Crew: 4 Habitable Volume: 75.5 ft ³ /person (2.2m ³) Mission Support: 21 day/14 crew Power Source: Solar Array

Transition from minimal mission durations to long-duration and flexibility in cislunar operations


Courtesy of NASA

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Moon to Mars: Artemis and Beyond

ARTEMIS I


Uncrewed flight test around the Moon and back to Earth.



Final pre-flight testing and mission operations

ARTEMIS II

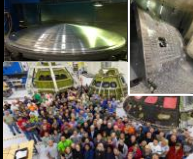
Crewed flight test to lunar orbit and back carrying humans farther from Earth than ever before.



Completion of crew module and life support system development

ARTEMIS III - V

Carrying astronauts to the lunar surface in preparation for Mars.



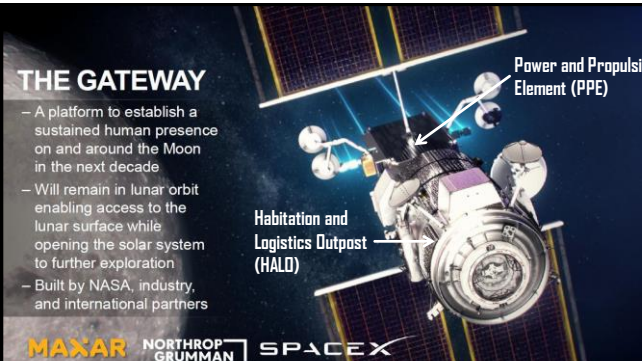
Beginning of production work and purchase of long-lead items for three shipset buy

Designed from the ground up for deep space. Orion is the most capable and reliable spacecraft in human history.

LAUREN WATSON

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THE GATEWAY



- A platform to establish a sustained human presence on and around the Moon in the next decade
- Will remain in lunar orbit enabling access to the lunar surface while opening the solar system to further exploration
- Built by NASA, industry, and international partners

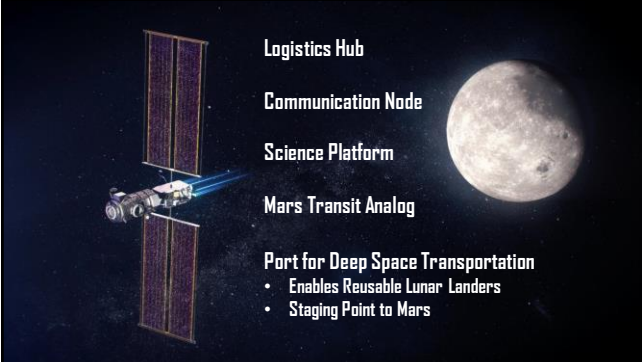
Power and Propulsion Element (PPE)

Habitation and Logistics Outpost (HALO)

MAXAR NORTHROP GRUMMAN SPACE X

Courtesy of NASA

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- Logistics Hub
- Communication Node
- Science Platform
- Mars Transit Analog
- Port for Deep Space Transportation
 - Enables Reusable Lunar Landers
 - Staging Point to Mars

Courtesy of NASA

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Human Landing System (HLS)





Three contracts awarded April 30, 2020

Complete lander systems were proposed including launch vehicles for an end to end solution for 2024 and sustaining

Base Period: May 2020 – February 2021

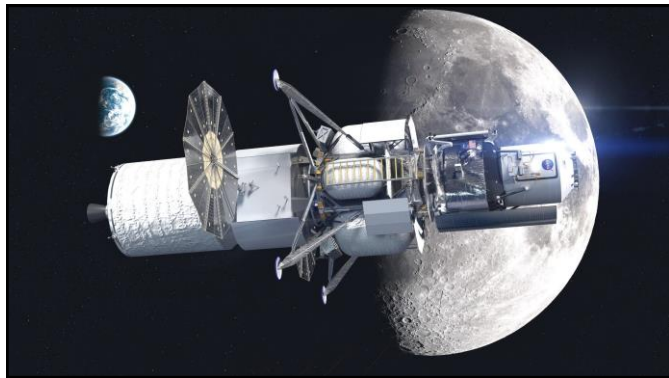
The Broad Agency Announcement catalyzed the innovation in U.S. Industry it was designed to do.

Courtesy of NASA

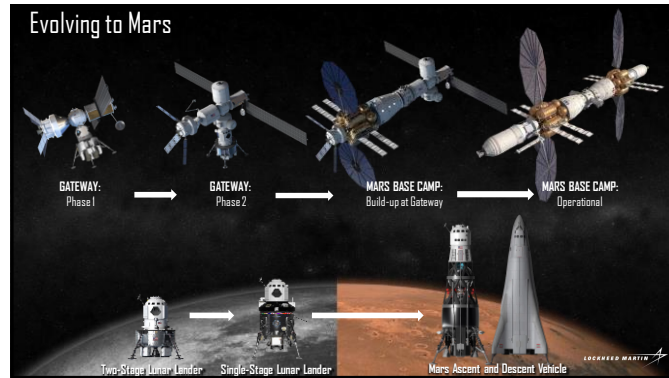
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