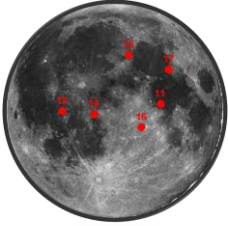


## Today's Class: Project Apollo

**Exam #1 on Monday!**

- All the reading since Aug. 24th through Sep 18th.
- All homework assignments.
- Space in the News* articles/discussions.
- All material discussed in class including in-class group exercises.
- One page (front + back) of notes allowed. **Bring a calculator not on your phone.**
- Study with another member in the class, if possible.



6 Apollo landing sites on the Moon

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## Artemis Accords: Repeating the Mistakes of the Age of Exploration

Presentation by David W. Barker

Artemis Accords:

- Created by NASA and US Government
- No International cooperation
- Amends international treaties, allowing mining on moon
- Allows defense of resources for "safety"

Would you consent to the United States having legal dominance in space if it meant getting to Mars more quickly?



2

## Last Class

- Why was Apollo important in learning how to explore another planetary body?

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## Today's Class

- Kennedy's Challenge to go to the Moon
- Goals of Apollo
- Saturn V rocket and Spacecraft
- Apollo 11 – first landing on the Moon
- Apollo 17 – Science-driven mission
- The meaning of Apollo

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## John Kennedy's Vision for Space Exploration

May 25, 1961



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## Class Exercise: What was the principal motivation for the U.S. investment in missions to the Moon?

- To develop new technologies such as medical devices and computers.
- To boldly go where no one has gone before.
- To beat the Russians & advance U.S. political goals.
- To build a monument to human innovation & ingenuity.
- To gather lunar samples & help us understand how the Moon formed.

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Class Exercise: **What was the principal motivation for the U.S. investment in missions to the Moon?**

- a) To develop new technologies such as medical devices and computers.
- b) To boldly go where no one has gone before.
- c) To beat the Russians & advance U.S. political goals.**
- d) To build a monument to human innovation & ingenuity.
- e) To gather lunar samples & help us understand how the Moon formed.

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## Goals of Apollo

- Establishing the technology to meet other national interests in space.
- Achieving preeminence in space for the United States.
- Carrying out a program of scientific exploration of the Moon.
- Developing humankind's capability to work in the lunar environment.

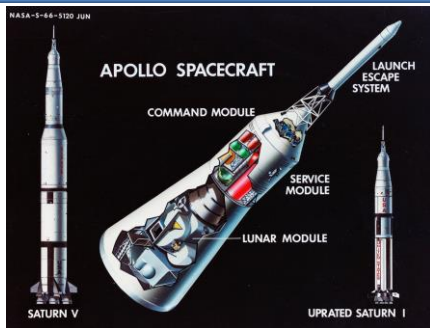


*"That's one small step for a man. One giant leap for mankind."*  
- Neil Armstrong

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## Rocket and Spacecraft



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## Apollo 11 – First Manned Landing

Launch: July 16, 1969



Armstrong, Collins, Aldrin video



Music in July 1969

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## Getting “Buzz’ed” in Boulder



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## New Images of Apollo 11 site from NASA’s Lunar Reconnaissance Orbiter



You can see the remnants of their first steps as dark regions around the Lunar Module (LM) and in dark tracks that lead to the scientific experiments the astronauts set up on the surface. The Passive Seismic Experiment Package (PSEP) provided the first lunar seismic data, returning data for three weeks after the astronauts left, and the Laser Ranging RetroReflector (LRRR) allows precise measurements to be collected to this day. You can even spot the discarded cover of the LRRR.



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## Apollo 17 – NASA’s last trip to the Moon

Launch: December 7, 1972

- Larger scientific payload capacity enabled by the use of the battery-powered *Lunar Roving Vehicle*.
- **Goals for Apollo 17:**
  - deployed heat flow experiment;
  - lunar seismic profiling;
  - lunar surface gravimeter;
  - lunar atmospheric composition experiment;
  - lunar ejecta and meteorites;
  - lunar sampling and lunar orbital experiments;
  - biomedical experiments.

Gene Cernan & Jack Schmitt

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## With Apollo 17 astronaut Dr. Jack Schmitt – July 2019




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## The Meaning of Apollo

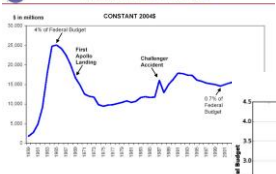
- Demonstrated technology & economic virtuosity of U.S. and established technological pre-eminence in the world. **Total cost = ~\$220 billion in FY20 dollars!** (For comparison, U.S. has spent \$2 trillion in Iraq.)
- Apollo accomplished political goals for which it had been created.
- Triumph of NASA’s management strategy in difficult engineering, technological, and organizational requirements (systems engineering).



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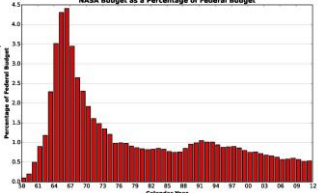
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## Historical NASA Funding



CONSTANT 2008

NASA currently receives 0.4% of the \$4.15 Trillion federal budget compared to over 4% during Apollo



NASA Budget as a Percentage of Federal Budget

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## What we learned today

- Goals of Apollo
- Saturn V rocket and Spacecraft
- Apollo 11 – first landing on the Moon
- Apollo 17 – Science-driven mission
- The meaning of Apollo

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