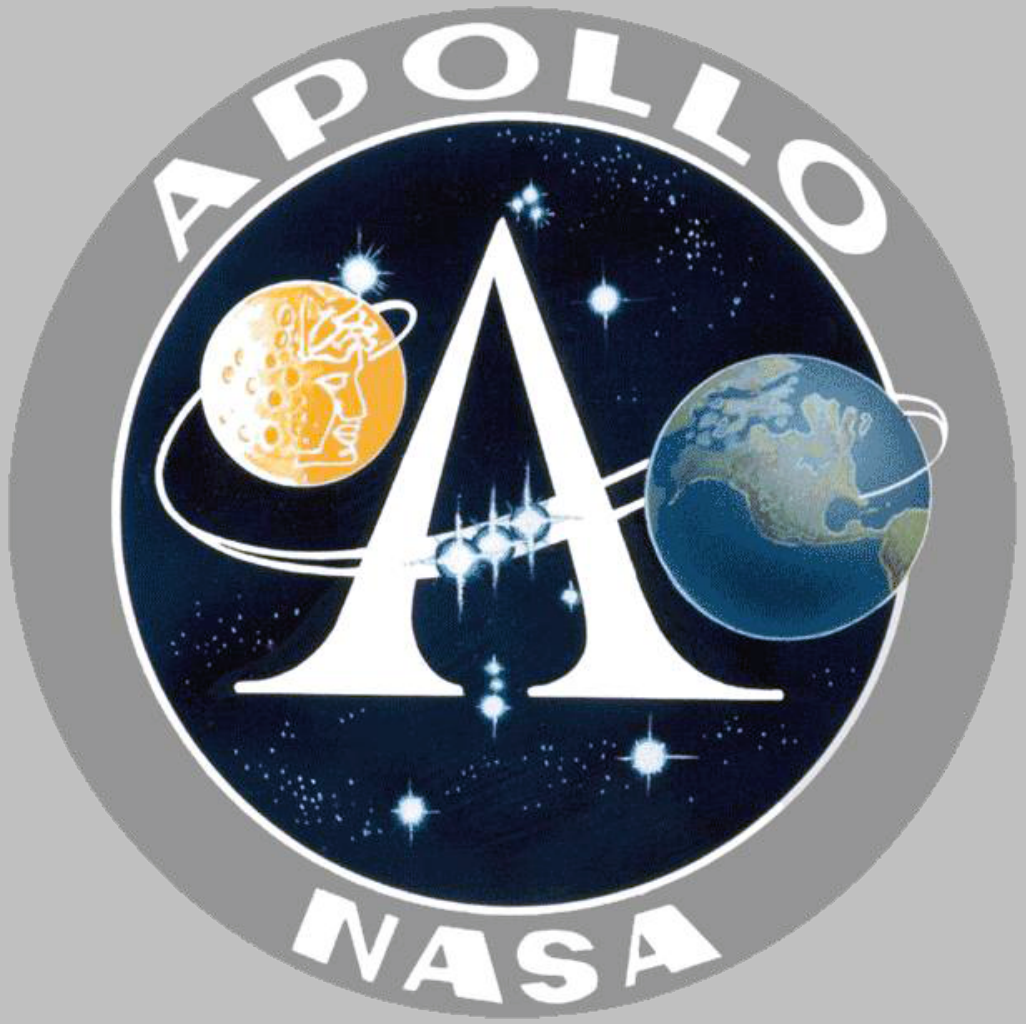
The Apollo Program

PTYS 395
October 9, 2008
Sarah Mattson

May 25, 1961
President Kennedy announces the Apollo Program.
The goal was to put a man on the Moon, and return him safely to Earth, by the end of the decade.

Apollo Program 1961-1972



Goals

Political

Technological

Scientific

Inspiration

NASA Space Program

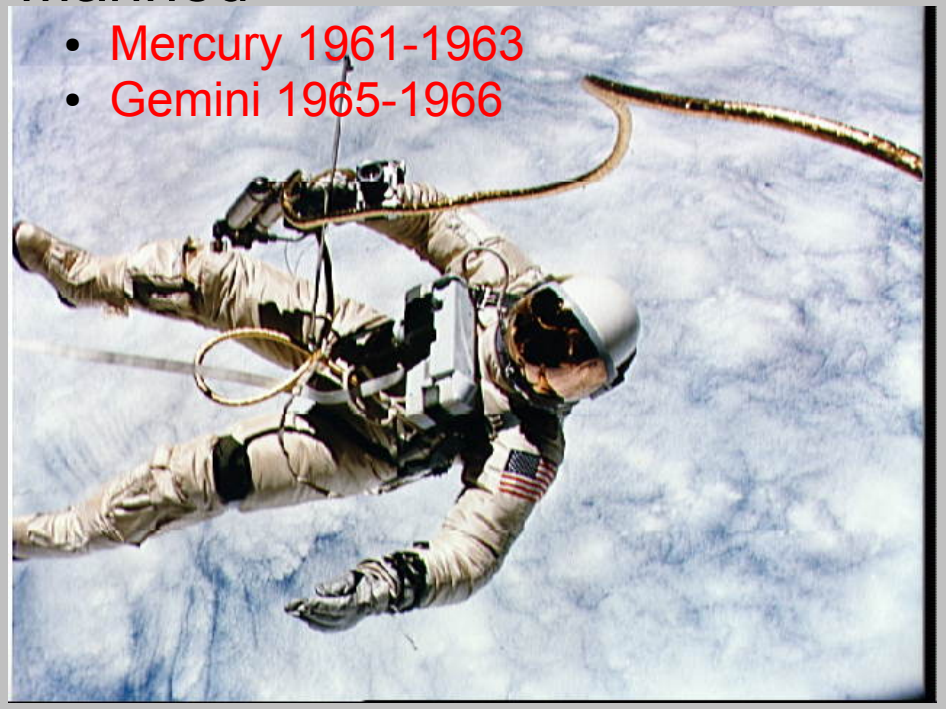
Supporting Missions

Robotic

- Ranger 1961-1965
- Surveyor 1966-1968
- Lunar Orbiter 1966-1967

Manned

- Mercury 1961-1963
- Gemini 1965-1966



Gemini IV astronaut Edward White on first U.S. spacewalk, June 1965

NATIONAL AERONAUTICS AND SPACE ACT, AS AMENDED

AN ACT

To provide for research into problems of flight within and outside the earth's atmosphere, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—SHORT TITLE, DECLARATION OF POLICY, AND DEFINITIONS

National Aeronautics and Space Act of 1958.

SHORT TITLE

SEC. 101. This Act may be cited as the "National Aeronautics and Space Act of 1958".

DECLARATION OF POLICY AND PURPOSE

SEC. 102. (a) The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind. 42 U.S.C. 2451.

(b) The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense; and that determination as to which such agency has responsibility for and direction of any such activity shall be made by the President in conformity with section 201(e). 72 Stat. 426.

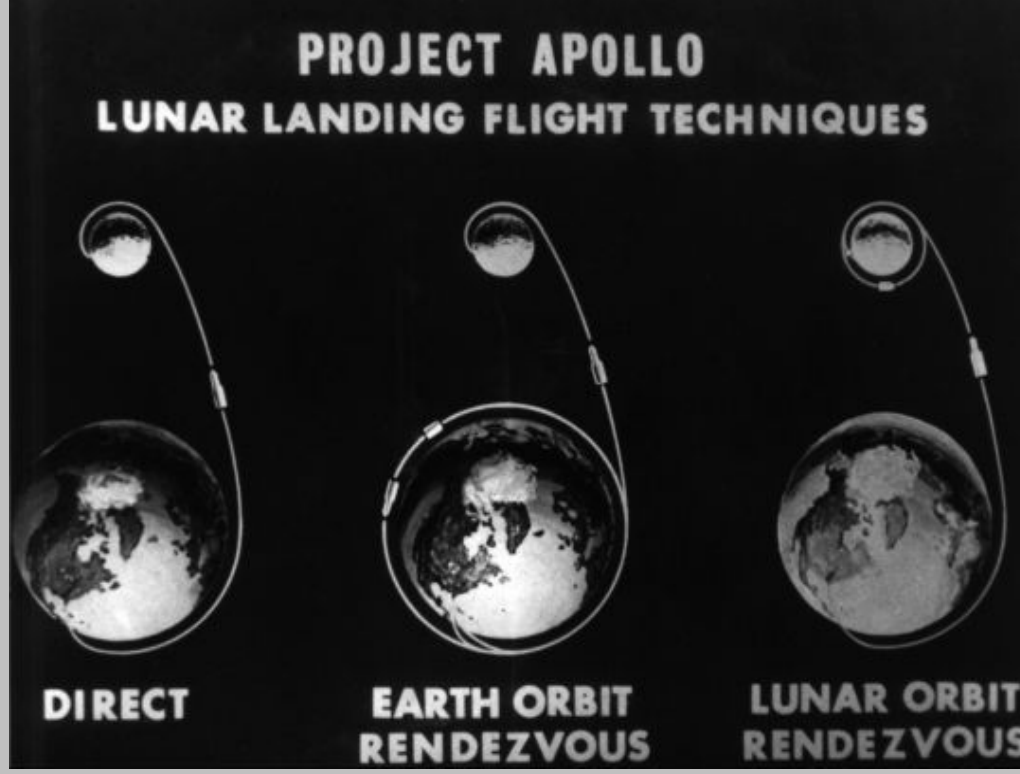
1958 Act creating NASA
Under President Eisenhower

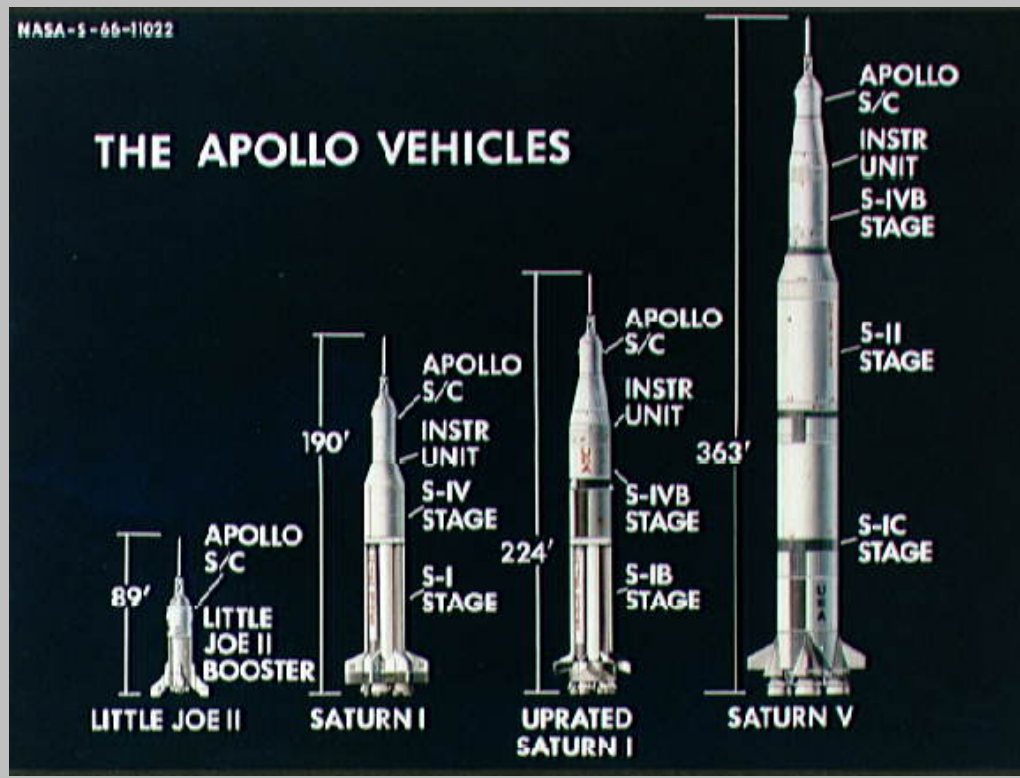
How to get there?

Direct Ascent
- Single large launch vehicle
- Rocket required not feasible

Earth Orbit Rendezvous (EOR)
- Launch parts of the s/c into orbit, assemble in space
- Several rockets required

Lunar Orbit Rendezvous (LOR)
- Several craft launched on one rocket
- Lander and orbiter separate in lunar orbit
- Part of lander lifts off from surface of Moon to rendezvous with orbiter
- Orbiter returns to Earth





Unmanned Missions

SA-1

SA-2

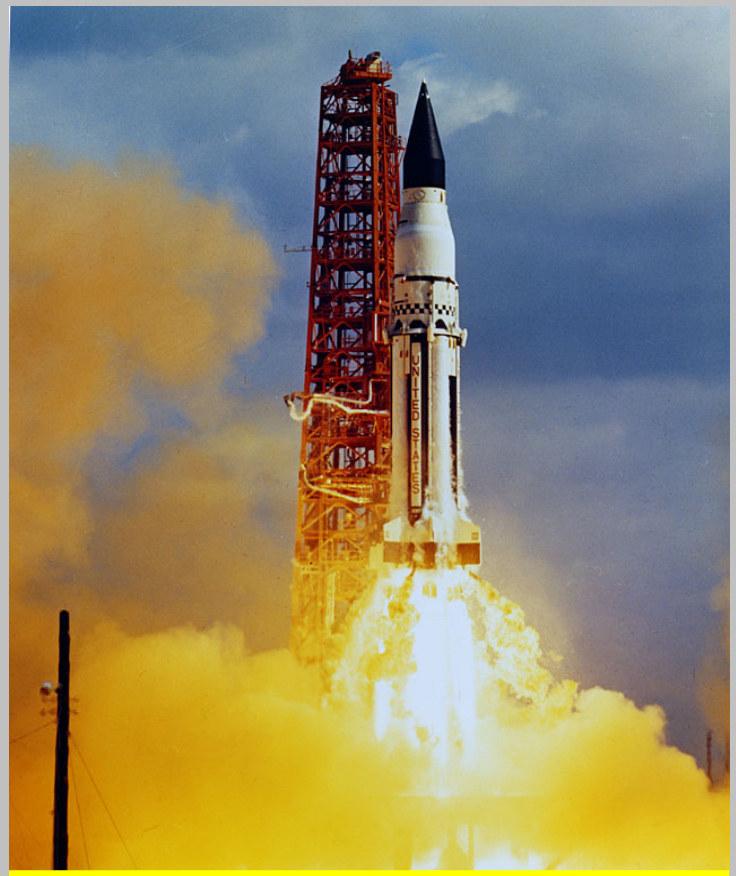
SA-3

SA-4

Apollo 4

Apollo 5

Apollo 6



SA-5 launch of the Saturn I rocket

Apollo 4 on the launch pad

Testing of the Saturn rockets and of the various components of the system.

Manned Missions Apollo 7 - 11

7 Schirra, Eisele, Cunningham Oct. 11-22, 1968
Orbited Earth 163 times

8 Borman, Lovell, Anders Dec. 21-27, 1968
Saturn V, Flew around Moon on Christmas eve

9 McDivitt, Scott, Schweikart Mar. 3-13, 1969
151 Orbits of Earth, 1st test of Lunar module

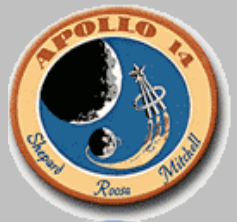
10 Stafford, Young, Cernan May 18-26, 1969
Orbited moon, lunar module got within 9 miles of lunar surface

11 Armstrong, Collins, Aldrin July 16-24, 1969
Moon landing, took core samples

Manned Missions Apollo 12 - 17

12 Conrad, Gordon, Bean Nov. 14-24, 1969
Landed near Surveyor 3 probe, returned parts of of Surveyor to study effects of space environment on equipment

13 Lovell, Haise, Swiegert April 11-17, 1970
Oxygen tank blew, had to abandon lunar landing, flew home in LM



14 Shepard, Roosa, Mitchell Jan. 13-Feb.9, '71
Science experiments, astronauts almost got disoriented in landscape

15 Scott, Irwin, Worden July 26 – Aug. 7, 1971
Lunar rover, 1st Apollo space walk, Hadley Rille, placed lunar satellite

16 Young, Mattingly, Duke April 16-27, 1972
Malfunction nearly scrubbed launch, took Lunar rover up to 18 km/h

17 Cernan, Evans, Schmitt Dec. 7-19, 1972 Last men on the Moon.
Taurus-Littrow

Training for Science

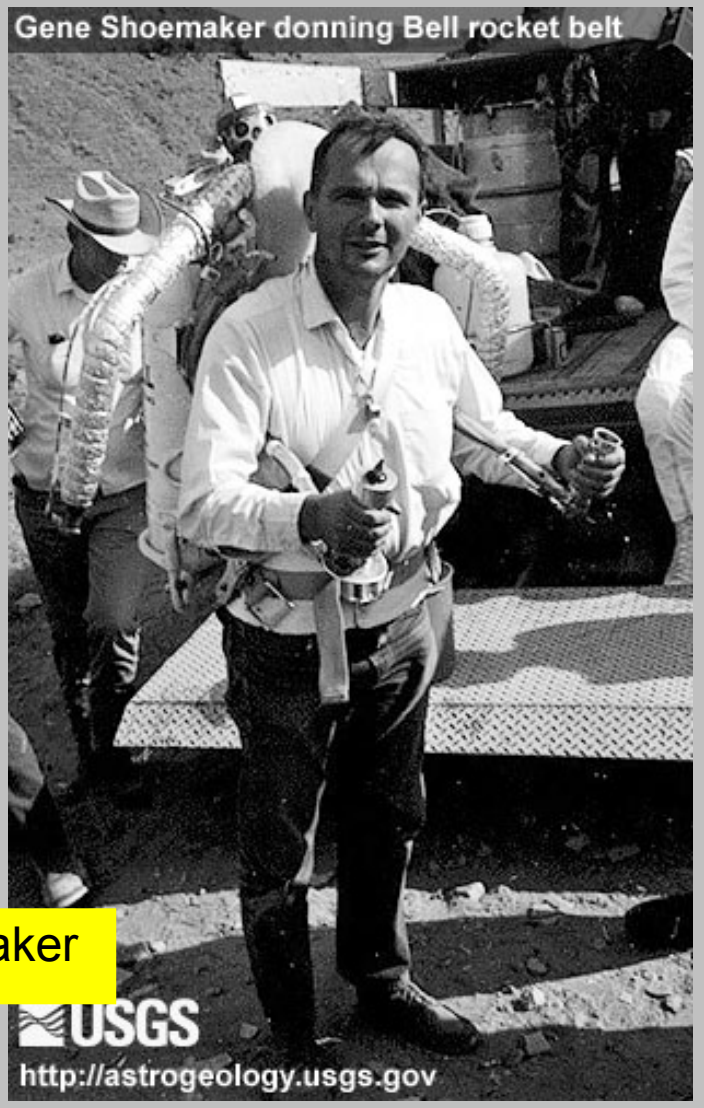
Test pilots, not scientists

Second class of astronauts trained in areas of science such as astrophysics and geology

Expanded recruitment guidelines to include scientists who were not pilots. Harrison “Jack” Schmitt was one of these – he flew on Apollo 17.

Eugene Shoemaker, Flagstaff, trained Apollo astronauts to do geology on the Moon

Used cameras, core samplers, retrival of rocks.



Eugene Shoemaker

Science Planning

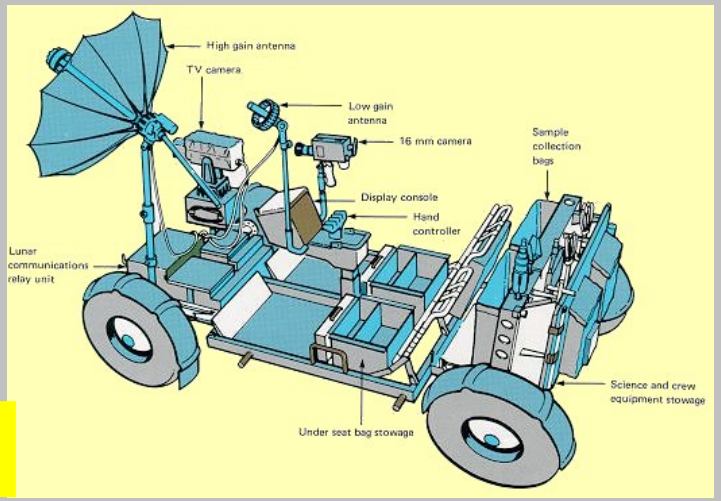
Really took effect post-Apollo 11

Landing site selection

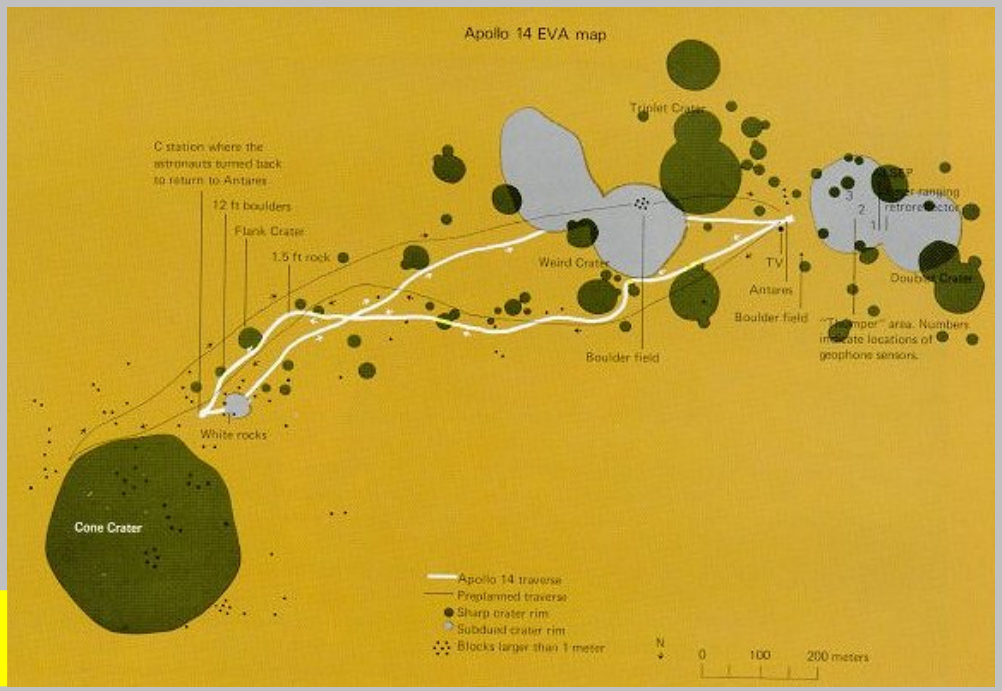
Training

Instruments
- Cameras
- ALSEP

Mapping



Lunar Rover



Apollo 13 EVA Map

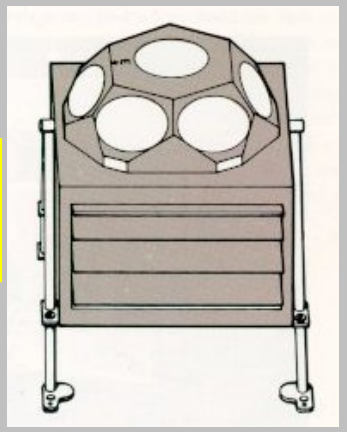
Lunar Sample Collection Sites

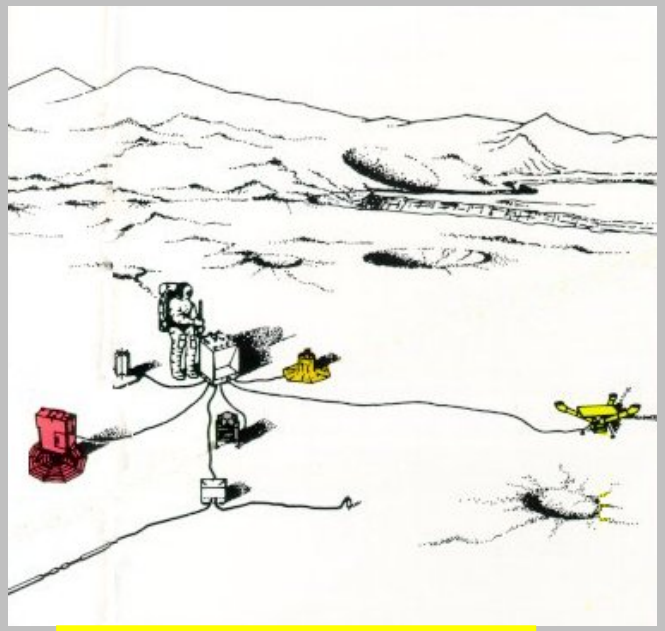
Apollo astronauts collected 381.69 kg of lunar rocks and regolith

ALSEP – Apollo Lunar Surface Experiments Package

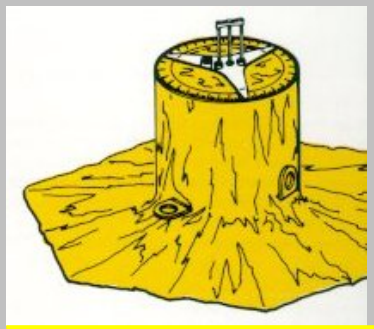
A set of experiments set up at each landing site from Apollo 12 on that would continue to relay information back to Earth.

Solar Wind Spectrometer



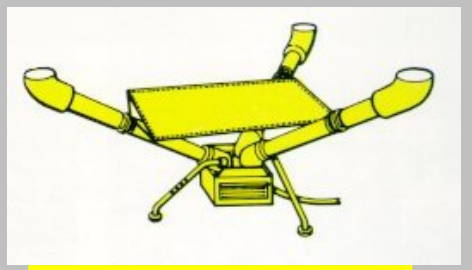


ALSEP setup



Passive Seismic Experiment

SIDE-Suprathermal Ion Detector (lunar atmosphere)



Lunar surface magnetometer

Science Return – in brief

Geology of the Moon
- Highlands
- Lowlands
- Composition

Magnetic field
- Varied spatially
- Estimated thermal conductivity

Gravitational
- Anomalies informed knowledge of interior

Lunar history
- Age of Moon ~4.6 Ga
- Attempted to explain origin

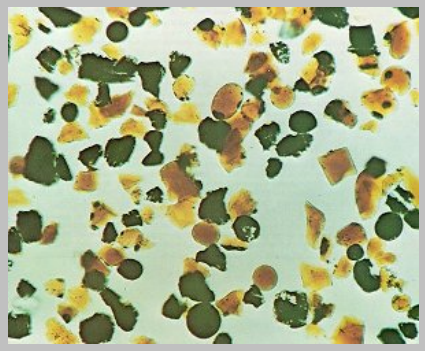
New perspective on Earth
- Influenced study of Earth

Radiation
- Effects on life and tech

Apollo 14, Alan Shepard taking a core sample

No evidence of life, either past or present
- Scarcity of Carbon

Analysis of Samples Yielded Geological History

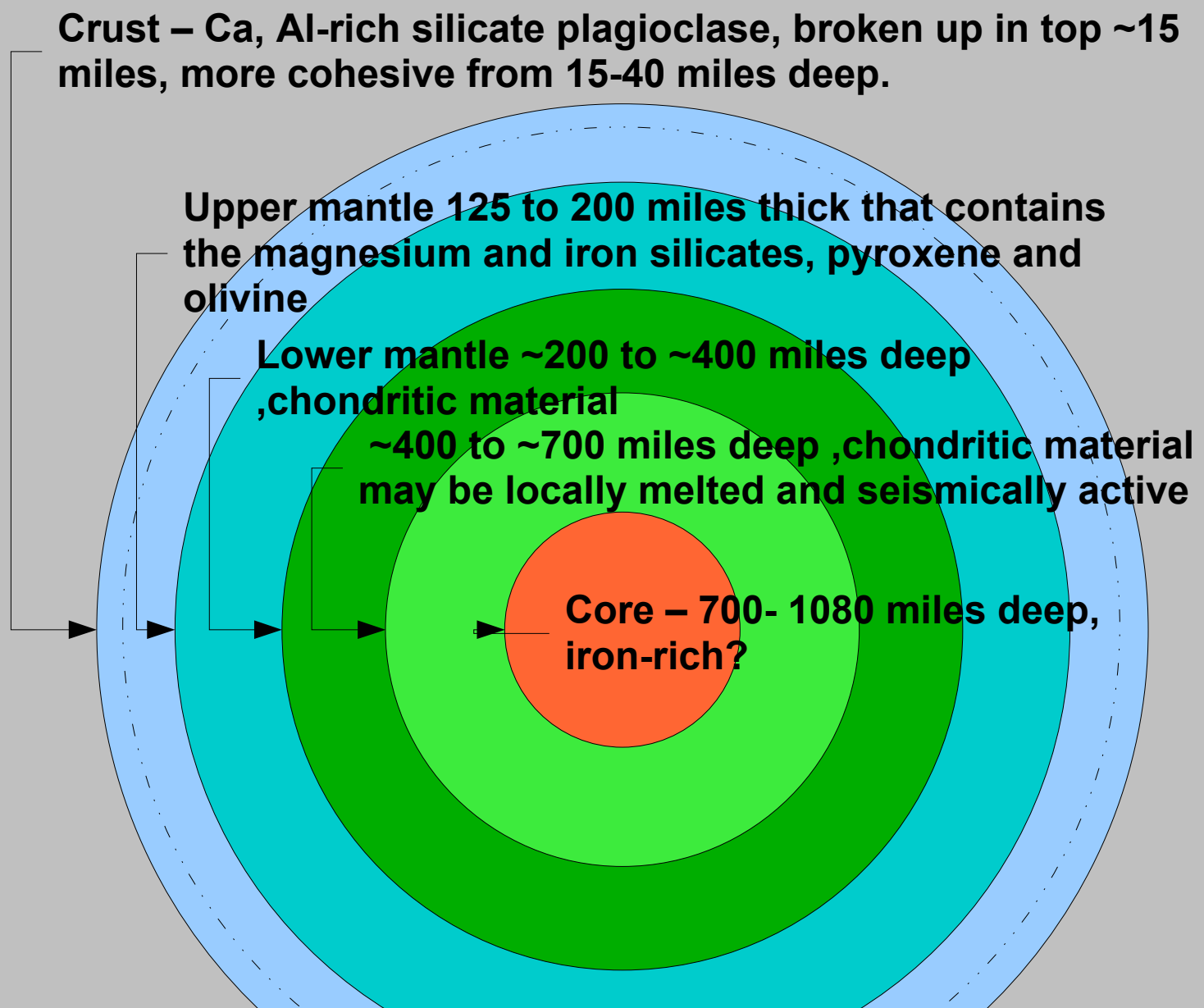


The known phases of lunar evolution are as follows:

1. The existence of a melted shell from about 4.6 to 4.4 billion years ago.
2. Bombardment to form the cratered highlands from about 4.4 to 4.1 billion years ago.
3. The creation of the large basins from about 4.1 to 3.9 billion years ago.
4. A brief period of formation of light-colored plains about 3.9 billion years ago.
5. The eruption of the basaltic maria from about 3.8 to about 3.1 billion years ago.
6. The gradual transition to a quiet crust from about 3.0 billion years ago until the present.

Excerpted from Harrison Schmitt, Apollo Expeditions to the Moon, Chapter 14
http://www.hq.nasa.gov/office/pao/History/SP-350/ch-14-2.html

Lunar Interior



Legacy

Planetary Science

- Learn about Earth by studying the formation of other planets

Skylab

- Made use of hardware left over from cancelled Apollo missions 18, 19 and 20

Apollo-Soyuz

- Political venture
- Docking of two disparate craft in orbit
- Used Apollo 18

Why did progress stop?

- Budget cuts
- NASA shifted focus to **Space Shuttle** program

Constellation program

- Return to the Moon
- Establish a lunar base

References

Project Apollo: A Retrospective Analysis
http://www.hq.nasa.gov/office/pao/History/Apollomon/Apollo.html

Apollo – Expeditions to the Moon
http://www.hq.nasa.gov/office/pao/History/SP-350/cover.html

Apollo – Manned mission chart
http://www.hq.nasa.gov/office/pao/History/apollo/welcome.html#chart

Sample Return
http://www.lpl.arizona.edu/SIC/moon/

“Where No Man Has Gone Before”
http://www.hq.nasa.gov/office/pao/History/SP-4214/ch6-1.html

Apollo and Skylab
http://www.hq.nasa.gov/office/pao/History/apollo/welcome.html#chart

Of course...
http://en.wikipedia.org/wiki/Project_Apollo