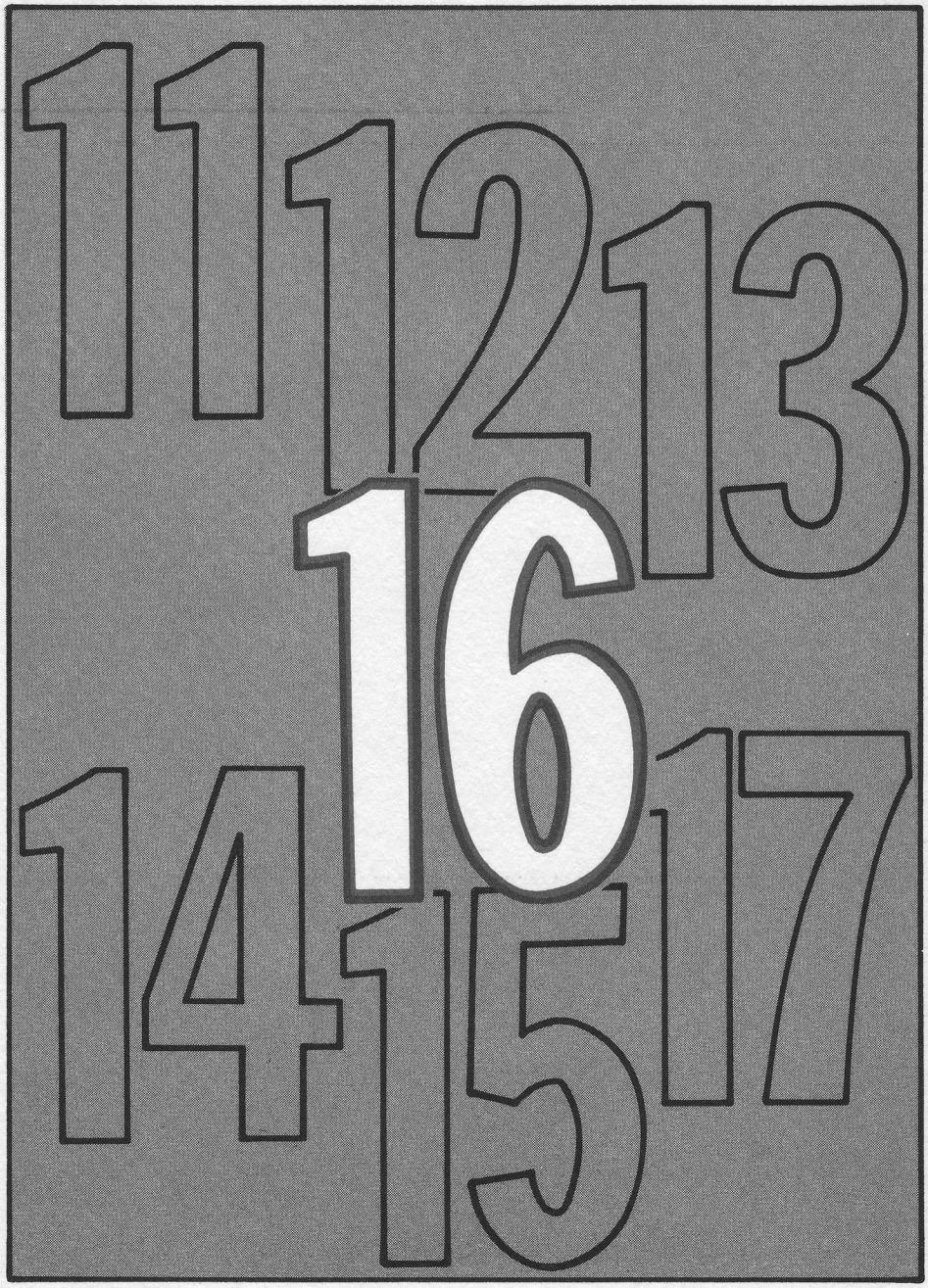
Mission Assignments

APOLLO LUNAR SURFACE EXPERIMENTS PACKAGE (ALSEP)



Bendix

Apollo Lunar Surface Experiments Package (ALSEP)

Mission Assignments

LUNAR SURFACE EXPERIMENTS	APOLLO DATE ON MOON Lunar Location - Long. - Lat.	11 July 20, 1969 Tranquillity Base 23.4°E 0.7°N	12 Nov 19, 1969 Oceanus Procellarum 23.5°W 3.0°S	13 - -	14 February 5, 1971 Fra Mauro 17.5°W 3.7°S	15 July 31, 1971 Hadley Rille 3.7°E 26.1°N	16 April 21 1972 Descartes 15.5°E 9.0°S	17 Dec. 10, 1972 Taurus Littrow 30.8°E 20.2°N
SEISMIC								
• Passive		—	—	—	—	—	—	-
• Active		-	-	-	—	-	—	-
• Seismic Profiling		-	-	-	-	-	-	—
MAGNETIC								
• 3-Axis Magnetic Field		-	—	-	-	—	—	-
PARTICLE								
• Solar Wind Spectrum		-	—	-	-	—	-	-
• Ionosphere Detection		-	—	-	—	—	-	-
• Atmosphere Detection		-	—	—	—	—	-	-
• Charged Particle Detection		-	-	—	—	-	-	-
• Mass Spectrum		-	-	-	-	-	-	—
• Ejecta and Micrometeoroids		-	-	-	-	-	-	—
SPECIAL								
• Heat Flow		-	-	—	-	—	—	—
• Laser Ranging								
- 100 Reflectors		—	-	-	—	-	-	-
- 300 Reflectors		-	-	-	-	—	-	-
• Gravity		-	-	-	-	-	-	—

ALSEP Instrument Data

Passive Seismic Experiment

Measures the seismic and tidal movements of the Moon, the approximate azimuth and distance to epicenters of lunar seismic activity as well as the location and frequency of meteorite impacts.

Short period 0.1- to 1.0-sec seismic signals, vertical axis displacement rate sensor, range: 1.0 to 10,000 mμ

Long period 0.7- to 15-sec seismic signals, 3 orthogonal axes displacement amplitude sensor, range: 1.0 to 10,000 mμ

Tidal signals: same three sensors as long period, but response peaked at 15 sec.

Range: 0.01 to 0.4 arc-sec horizontal, 8.0 to 320 mGal

Lunar Ionosphere Detector Experiment

Measures the energy, velocity, flux and mass of positive ions at the lunar surface.

Velocity range: 4.0 to 9,350,000 cm/sec
Low Energy Range: 0.2 to 48,6 ev
High Energy Range: 10 to 3500 ev
Ion Mass Range: 1 to 130 AMU (low energy range only)
Flux Range: 1 to 10^6 particles/sec

Principal Investigator: Dr. John Freeman
Rice University

Lunar Atmosphere Detector Experiment

Heat Flow Experiment

Measures the heat flow properties of the moon.
Conductivity Range: 5×10^{-6} to 1×10^{-3} cal/cm-sec-°C
Temperature Differential: Any $\pm 2^{\circ}$ K range between 200 and 250° K with sensors 50 centimeters apart.

Principal Investigator: Dr. Mark Langseth
Lamont Doherty Geological Observatory

Laser Ranging Retro-Reflector (LRRR)

A passive array of precise optical retro-reflectors aimed at the Earth to provide an efficient target for Earth-based laser-ranging equipment. Each retro-reflecting element is a

Range: 0.01 to 0.4 arc-sec horizontal, 8.0 to 320 mGal vertical.

Principal Investigator: Dr. Gary Latham
Lamont Doherty Geological Observatory

Active Seismic Experiment

Thumper Portion — Produces up to 227 gram-second impulses to lunar surface. The impulses are detected with geophones whose sensitivity is such that a 5 mμ zero-to-peak signal at 10 Hz will be 18 db above noise. The geophone bandpass between 6-db down points is 3 to 250 Hz. The experiment will measure elastic properties of the lunar subsurface to a depth of about 23 meters.

Mortar Portion — Launches four grenade rockets charged with 454, 272, 136 or 45.4 grams of HNS explosive, which detonates on impact with the lunar surface. The energy of HNS is approximately 0.9 that of TNT.

Principal Investigator: Dr. Robert Kovach
Stanford University

Lunar Seismic Profiling Experiment (LSPE)

Measures surface and near-surface response to artificially induced seismic energy. Physical characteristics of the near-surface materials can be inferred from this measured response.

Sensitivity:	3.0 millimicrons (mμ)
Dynamic Range:	0.5 to 250 mμ
Bandwidth:	3 to 20 Hz
Data Rate:	3533 or 1060 bits per second

Principal Investigator: Dr. Robert Kovach
Stanford University

Magnetometer Experiment

Measures the magnitude, direction and gradient of the lunar surface magnetic field.

Range: 0 to ± 400 gamma
Resolution : ± 0.2 gamma
Frequency Response: DC to 1 Hz
Gradient Range: 0.003 to 1 gamma/centimeter
Axes: 3 orthogonal

Principal Investigator: Dr. Palmer Dyal
Ames Research Center

Solar Wind Experiment

Measures the flux and particle energy of ions and electrons impinging on the lunar surface.

Electron Energy Range: 6.0 to 1330 ev
Positive Ion Energy Range: 18 to 9780 ev
Particle Flux Range: 2.5×20^6 to 10^{10} particles/cm^2-sec
Field of View: 2 π steradians
Angular Resolution: ± 30 degrees

Principal Investigator: Dr. Conway W. Snyder
Jet Propulsion Laboratory

Lunar Atmosphere Detector Experiment

Measures the pressure of neutral particles to indicate the pressure of the lunar atmosphere.

Range: 10^{-6} to 10^{-12} torr
Accuracy: ± 50% $< 10^{-10}$ torr $<$ ± 30%

Principal Investigator: Dr. Francis Johnson
University of Texas

Charged Particle Lunar Environment Experiment

Measures the energy of positive and negative charged particles impinging on the Moon's surface and counts the number of such particles.

Ion Energy Range: 40 to 80,000 ev
Flux Range: 10^5 to 10^{10} particles/cm^2-sec-steradian

Principal Investigator: Dr. B. J. O'Brien
University of Sidney
Sidney, Australia

Dust, Thermal, Radiation Engineering Measurements (DTREM)

Measures long-term changes in response of specially treated solar cells to ambient solar radiation and thus provides an indication of the rate of dust deposition. Proton radiation dosage is also indicated in three ranges (Mev): >0, >4.5, >9. From associated temperature measurements, the lunar surface brightness temperature may be derived.

Lunar Mass Spectrometer (LMS)

This instrument will identify and determine the density of constituents of the lunar atmosphere. Basic sensor is a magnetic sector mass spectrometer with a thermionic emission ion source.

Mass ranges:	1 to 4, 12 to 48, 27.4 to 110 amu.

Principal Investigator: Dr. John H. Hoffman
University of Texas

Lunar Ejecta and Meteorites Experiment (LEAM)

An experiment that measures: (1) long-term variations in cosmic dust influx rates, (2) extent and nature of lunar ejecta, and (3) radiant, flux density, and speed of particles in meteor streams.

Particle Velocity Range:	1 to 75 km/sec
Particle Energy Range:	1 to 1000 ergs
Particle Momentum Range:	$2.5(10)^{-5}$ to $7(10)^{-4}$ dyne-sec
Minimum Frequency of Detected Particles:	10^{-4} impacts/m^2/sec
Angular Resolution of Radiant:	± 26°
Sensor Field of View:	± 60°

Principal Investigator: Otto Berg
Goddard Space Flight Center

laser-ranging equipment. Each retro-reflecting element is a 1.5-in.-diameter fused quartz corner. 100-element arrays were emplaced by crews of Apollo 11 and 14. The 300-element array of Apollo 15 will (a) increase ranging accuracy and dependability (b) permit smaller telescopes (40") to detect useful signals. Signals from 3 reflectors permit measurement of the moon's libration components.

Use of the LRRR permits measuring the 1/4-million-mile separation of Earth and Moon to ± 15 cm.

Principal Investigator: Dr. J. E. Faller
Wesleyan University

Lunar Surface Gravimeter (LSG)

An experiment that measures the vertical component of gravity in three band pass ranges: tidal variations, (dc to 1 cycle/minute) seismic activity (0.05 Hz to 16 Hz) and lunar free mode oscillations (1 cycle/20 min. to 2 cycles/min). The ratio of lunar 'g' to earth 'g' is measured to 1 part in 10^5. The lunar free mode oscillation data is processed and used to detect gravitational waves from cosmic sources:

Range:	Earth, 980.7 ± 3.8 gal Lunar, 162.8 ± 1.9 gal
Resolution:	2 microgal for tidal variations 0.001 micron for seismic activity 0.008 microgal for free mode oscillations

Principal Investigator: Dr. Joseph Weber
University of Maryland

Central Station

Focal point of the ALSEP which provides power and command control, data processing, and data transmission relative to measurements of lunar characteristics. Key functions are:

- Transmits 106 ten-bit measurements per second with 1.0 w carrier output
- Formats and processes all digital science data
- Provides 90 additional channels of analog engineering measurements
- Receives, decodes, and channels up to 100 different ground commands throughout the system to implement complex functional mode changes.

Radiosiotope Thermoelectric Generator (RTG)

A SNAP-27 power supply provides all electrical power for the ALSEP deployed on the Apollo 12 mission. Similar RTGs will be used with future ALSEPs. The Apollo 11 system (EASEP) was solar-powered.

Fuel:	Radioisotope capsule
Thermocouples:	442
Output:	68 to 80 w at 16 v

Bendix