Future City Competition – Living on the Moon

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Apollo Lunar Exploration Program

Science-Engineering-Operations Synergism!
Apollo 11 Landing Site
Apollo Lunar Materials Keep in Curation Facility

The Oldest Earth Rock (4 Ga)
Was found on the Moon

Felsite clast (1027)

From Early Earth (~4 Ga)

Belucci, et.al. 2019
Earth’s Moon

Nearside

Farside
Earth’s Moon Altitude

Nearside

Farside

Topography (km)
Earth’s Moon Altitude

Nearside

Farside

SPA Basin

Topography (km)
Artemis Phase 1: To the Lunar Surface by 2024

Artemis 1: First Human Spacecraft to the Moon in the 21st Century

Artemis 2: First Humans to the Moon in the 21st Century

First High Power Solar Electric Propulsion (SEP) System

First Pressurized Crew Module Delivered to Gateway

Artemis 3: Crewed Mission to Gateway and Lunar Surface

Commercial Lunar Payload Services
- CLPS delivered science and technology payloads

Early South Pole Crater Rim Mission(s)
- First robotic landing on eventual human lunar return and ISRU site
- First ground truth of polar crater volatiles

Descent Element Test
- First large-scale lander on the Moon

Humans on the Moon - 21st Century
First crew leverages infrastructure left behind by previous missions

Lunar South Pole Crater Target Site

2019

2024
Future Moon

Science & Exploration
Living off the Land

Multi-planet Species

Fuel Depot
Mining
Manufacturing
What is Moon Trek?
https://trek.nasa.gov/moon
Solar System Treks (SST)

Web based interactive GIS portals

- Planetary surface Visualization
- Planetary Data Analysis
- Diverse User Base in Support of
  - Mission Planning
  - Scientific Research
  - Public Outreach/STEM

https://trek.nasa.gov
Other Worlds to Explore
Trek Portals

Publicly Available

• Moon Trek – https://trek.nasa.gov/moon
• Mars Trek – https://trek.nasa.gov/mars
• Vesta Trek – https://trek.nasa.gov/vesta
• Ceres Trek – https://trek.nasa.gov/ceres
• Titan Trek – https://trek.nasa.gov/titan
• IcyMoons Trek – https://trek.nasa.gov/icymoons
• Mercury Trek – https://trek.nasa.gov/mercury
• Bennu Trek – https://trek.nasa.gov/bennu
• Ryugu Trek – https://trek.nasa.gov/ryugu
Welcome to Moon Trek

Moon Trek is an application that allows you to view imagery and perform analysis on data from this celestial body.

- [x] Start Tutorial
- [ ] Skip Tutorial

☐ Do not show this dialog again
Tools

- Available without requiring login
- Visualization
- Measurement
- Sharing
Calculate Elevation Profile
3D Print File Generation
Virtual Reality Experience
Staking layers @ Marius Hills
Gravity of Marius Hills
Image Integration / Blending
Sharing

Moon Trek

- Calculate Distance
- Calculate Elevation Profile
- Calculate Sun Angle
- Experience Trek VR
- Generate 3D Print File

Share Link

Share Trek URL
https://trek.nasa.gov/moon/#v=0.1&x=-62.5231921930944457&y=-11.8961931374312641

Share Trek Lite URL
https://trek.nasa.gov/treklite/?f=LRO_WAC_Mosaic_Global_303ppd_v02,true,1&v=0.1&x=

Cancel
Future City Competition

Design a future lunar city and provide examples of how your city uses two Moon resources to keep your citizens safe and healthy.
Considerations

- Necessities to live on the Moon
  - E.g., Air, Water, Rocket Fuel, Manufacturing, Power
- Volatiles
  - E.g., Water, Hydrogen, Helium, Nitrogen, Carbon
- Minerals
  - E.g., Silicon, Titanium, Aluminum, Iron, Potassium, Thorium
- Geologic structures
  - E.g., Lava tube
- Line of Communication
  - Near Side vs Far Side
- Landing and approach
  - E.g., hazard, signal obstruction
Iron Concentration

Hydrogen Concentration

The half degree hydrogen abundance data product contains data from the LP neutron spectrometer [Feldman et al., 1999]. Hydrogen abundances are derived from epithermal neutron data that has been corrected by thermal neutron data [Feldman et al., 2001c]. Equations 3 and 4 of Feldman et al. (2001c) show how the corrected epithermal data is converted into hydrogen abundances as parts per million (ppm). Note, however, that these abundances are not necessarily reliable in regions of high thorium and rare-earth element abundances [Maurice et al., 2001a]. The map bin size is 0.5 deg by 0.5 deg. This Lunar Prospector (LP) gamma ray special product and associated documentation have been prepared by the LP Spectrometer Team as part of a NASA Lunar Data Analysis Program. These spectrometer data products integrate data collected between January 16, 1998 and July 31, 1999. The data file descriptions for these products were provided by: William C. Feldman, Tom H. Prettyman, Richard D. Belian, Richard C. Elphic, Olivier Bauduin, David J. Lawrence, Stefania I. Lawrence, and Kurt B. Moore all of LP.
Ice Exposures

M3 Ice Exposures, South Polar

This is a vector dataset depicting ice exposures for the south polar region of the Moon. Ice exposure detections are constrained by the Moon Mineralogy Mapper (M3), Lunar Orbiter Laser Altimeter (LOLA), Diviner Lunar Radiometer Experiment, and Lyman Alpha Mapping Project (LAMP) instruments. This data represents the distribution of water-ice-bearing pixels extending from approximately 75°S to 90°S. This data contains 1119 individual vector points, each associated with XY coordinates. Each vector point represents an M3 pixel, 280m x 280m. The XY coordinates were plotted using ArcGIS and then reprojected to a south polar stereographic projection. This data was provided by: Shuai Li from the Department of Geology and Geophysics at the University of Hawaii.
Maximum Temperature

Diviner will characterize temperature variations as a function of latitude, longitude, time of day and season. Diviner will have the capability to make accurate radiometric measurements for the warmest and coldest surfaces on the planet, as well as simultaneous measurements of broadband solar reflectance. The Diviner dataset should be sufficiently complete to allow confident prediction of lunar surface temperatures in daytime, nighttime and polar thermal environments.
Thank you