

Key Questions:

- How will humans get to the Moon and back to Earth?
- How will supplies be carried?
- What type of transportation is possible on the Moon?
- As weight goes up, so do cost and propulsion requirements. How does this impact shelter design?

Transportation Overview:



Moving equipment, resources, materials, and humans are critical to the success of the lunar colonization mission. Factors that need to be considered include cost, time, weight, propulsion, and most importantly – safety. You need to consider transportation in three different realms. These include:

- Transportation from the Earth to the Moon.
- Transportation on the Moon.
- Transportation from the Moon to the Earth.

The following information is provided by Wikipedia and can be found at:

Wikimedia Foundation, Inc. (May, 2007). *Wikipedia: The Free Encyclopedia*. Retrieved May 10, 2007, from <http://en.wikipedia.org/wiki/Lunar_base#Transport>.

Transportation on the Surface

Lunar colonists will want the ability to move over long distances, to transport cargo and people to and from modules and spacecraft, and to be able to carry out scientific study of a larger area of the lunar surface for long periods of time. Proposed concepts include a variety of vehicle designs, from small open rovers to large pressurized modules with lab equipment, and also a few flying or hopping vehicles.

Rovers could be useful if the terrain is not too steep or hilly. The only rovers that operated on the surface of the Moon as of 2004 were the Apollo Lunar Roving Vehicle (LRV), developed by Boeing and the unmanned Soviet Lunokhod. The LRV was an open rover for a crew of two, with a range of 92 km during one lunar day. One NASA study resulted in the Mobile Lunar Laboratory concept, a manned pressurized rover for a crew of two, with a range of 396 km. The Soviet Union developed different rover concepts in the Lunokhod series (DLB Lunokhod 1-3/LEK and the L5) for possible use on future manned missions to the Moon or Mars. These rover designs were all pressurized for longer missions.

Once multiple bases have been established on the lunar surface, they can be linked together by permanent railway systems. Both conventional and magnetic levitation (Mag-Lev) systems have been proposed for the transport lines. Mag-Lev systems are particularly attractive, as there is no atmosphere on the surface to slow down the train, so the vehicles could achieve velocities comparable to aircraft on the Earth. One significant difference with lunar trains, however, is that the cars will need to be individually sealed and possess their own life support systems. The trains will also need to be highly resistant to derailment, as a punctured car can lead to rapid loss of life.

Transportation on the Moon

A lunar base will need efficient ways to transport people and goods of various kinds between Earth and the Moon and, later, to and from various locations in interplanetary space. One advantage of the Moon is its relatively weak gravity field, making it easier to launch goods from the Moon than from Earth. The lack of a lunar atmosphere is both an advantage and a disadvantage; while it's easier to launch from the Moon because there is no drag, aerob-

raking is not possible, which makes it necessary to bring extra fuel in order to land. An alternative that may work for supplies is to surround the payload with impact-absorbing materials, something that was tried in the Ranger program. This can be efficient if the impact protection is made of needed lighter elements that are absent from the Moon (Ranger used balsa wood).

One way to get materials and products from the Moon to an interplanetary way station might be with a mass driver, a magnetically accelerated rail. Cargo would be picked up from orbit or an Earth-Moon Lagrangian point by a shuttle craft using ion propulsion, solar sails, or other means and delivered to Earth orbit or other destinations such as near-Earth asteroids, Mars, or other planets—perhaps using an Interplanetary Superhighway. If a lunar space elevator ever proves practical, it could transport people, raw materials, and products to an orbital station. A “Pop Gun” concept has also been proposed, using heated gas to launch packets of material to orbit.



Lunar Flight Plan

NASA & Frassinito, John and Associates. (n.d.) *Lunar flight plan*. Retrieved May 10, 2007, from <http://www.nasa.gov/images/content/125171main_flight_plan_graphic.jpg>.

- This diagram shows how a lunar flight plan may look and could be used for lunar colony transportation.

Lunar Transport Vehicles

Dismukes, Kim (Curator) & Petty, John Ira (NASA Official). (April 9, 2007). *Human space flight*. National Aeronautics and Space Administration. Retrieved May 14, 2007, from <<http://www.spaceflight.nasa.gov/gallery/images/mars/lunarvehicles/ndxpage3.html>>.

- On this site there are a variety of NASA concept drawings of lunar vehicles. Explore them to gain some ideas.