

15 Questions on Settling the Moon

The Moon has no air. How will settlers breath?

Settlers will live and work in airtight habitats. Initial air reserves brought from Earth will be kept fresh through green plants used to grow food. But as Moon rocks and soil contain as much as 45% oxygen bound up in various minerals, a first priority will be to extract oxygen from the soil. We can also harvest Nitrogen, needed as a buffer gas and for plant growth, from the loose top soil, just by heating it up.

The Moon has no water. So what will settlers drink, use for washing, and to grow food?

Water is 89% oxygen by weight. As we can produce plenty of that from the soil, the trick will be to get the other 11%, hydrogen. We can harvest hydrogen from the loose top soil also, by heating it in the same operation we use to extract nitrogen. In time, we'll be able to harvest water-ice reserves discovered by the Lunar Prospector probe in 1998 in craters near both north and south poles always in cold shadows.

The Moon's Gravity is only 1/6 as strong as Earth's. Won't that cause health problems?

Astronauts staying in orbit many months at a time experience a loss of bone calcium and muscle mass. But that is in "Zero-G". There is every reason to expect that in the Moon's 1/6 gravity, any initial deterioration will stabilize at an acceptable level for long term, even lifetime stays. Mass and momentum will be the same as on Earth, so isometric exercises will be more important than lifting, and musculature will be a little different. Children (and flowers!) may grow lithe and tall. Settlers will invent graceful new dances and interesting sports to suit the low gravity.

Doesn't the Moon become too hot during the long day and then get too cold during the long night?

Yes! It gets hot enough to boil water during the two week long Sun-up dayspan and quickly falls to more than -200° F during the two week long nightspan. This is because there is no atmosphere and ocean to hold heat and even out temperatures. But it is just a surface effect. A few feet below the surface, it stays the same temperature all the time, -4°F, easily handled as all life & work activities produce warmth, and the soil is a good insulator. Settlers will live below a 6-13 foot thick surface "blanket" of loose soil anyway - to protect themselves from cosmic rays, meteorites, and solar flares as well as hot and cold extremes. Earth's "blanket" of air does all this for us.

On the Moon, won't people have to wear clumsy, heavy spacesuits most of the time?

Only out on the surface, outside pressurized habitats and vehicles. We can engineer the need to go "out-vac" out of most living and working routines. All

underground pressurized living areas, workspaces and farming areas can be connected by pressurized shielded passages so that one might go most anywhere in the settlement without a spacesuit. Vehicles will be built with doors that "dock" (couple and lock) directly with the airlocks of the habitat areas so people can enter or leave "in shirtsleeves" much as we board planes these days through jetways. While prospectors and surface facility maintenance crews need spacesuits, most settlers will get to put them on only in emergency "decompression drills."

Won't settlers suffer from claustrophobia?

While future Moon folk or Lunans must live below the surface, that doesn't mean they can't enjoy sunshine! Sunlight gathered by sun-tracking mirrors can be channeled through sealed, mirrored ducts or by fiber optic bundles, preserving the needed protection. "Picture-windows" using the periscope principle will offer moonscape vistas. Homesteads can be built to provide all the sunny openness settlers may want. Once we can expand using building materials made on the Moon, quarters can be built to be "roomy."

The night spans are two weeks long. How will settlers get enough power during that stretch?

With no wind or waterfalls to harness, nor any rivers to dam, and no deposits of coal, gas, or oil to tap, settlers will rely heavily on Solar Power. Without a hazy, cloudy atmosphere, the Sun shines intensely for two weeks at a time. Solar collectors can be built of materials processed from the regolith (soil). To provide nighttime power, excess dayspan energy can be used to turn some of the water reserves back into hydrogen and oxygen. These gases can power fuel cells by nightspan, forming water again as well as power. Settlers can help matters by doing the more energy-intensive tasks during dayspan, saving the more labor-intensive tasks for the nightspan period.

Won't settlers have to import most everything?

At first, certainly. But the loose top soil blanket of regolith is rich in elements from which we can make useful alloys (iron and steel, aluminum, titanium, magnesium), glass, ceramics, even concrete. So the settlement can expand using mostly "made-on-Luna" materials. One exciting possibility being explored is glass-glass composites - on the analogy of familiar and fiberglass reinforced plastics. With "glax," settlers can do without wood and plastics in making their own furniture and many building products.

What about food? How can the Moon be farmed?

Experiments with the Apollo Moon Rocks showed that test plants can indeed grow in lunar soil. The fine powder that could clog drainage systems will be sifted out in the process of moving the soil into the inside planting beds. Sanitized human and waste plant matter compost will be worked into the soil to keep it productive. The savings to settlers will come from the 50% dry food weight and 89% of associated water that will come from oxygen produced locally.

What can settlers export to Earth, to help pay for things that they can't make for themselves?

The first export will be liquid oxygen to refuel Moon-bound rockets in low Earth orbit. Next will be building materials to make bigger, cheaper space stations, orbiting factories, orbiting hotels, and solar power satellites to provide abundant environment-saving clean power to Earth. Anything the settlers learn to manufacture for themselves can also be exported to Earth-orbit destinations more cheaply than anything brought up from Earth, as only 1/20th as much fuel is needed to launch to Earth orbit from the Moon as from Earth's surface. The Moon is also well-endowed with rare Helium-3, a gift of the Solar Wind and the ultimate waste-free fuel for ultra-clean nuclear FUSION (not dirty fission) plants. There is enough of it easily harvestable from the loose dust blanket to take care of Earth's needs and keep our homeworld "clean & green" for thousands of years.

Won't settling and mining pollute the Moon just as we have been polluting the Earth?

Our reputed ancestral relatives, apes and monkeys, can't be housebroken. And it seems that in chip-off-the-old-block fashion, humans "can't be planet-broken." We have a way of fouling our home world with everything we do. On the Moon, the difficulty of surviving in such hostile surroundings will impose no-alternatives do-or-die changes in our life style that will go a long way towards cleaning up our act. On the airless Moon we must live in sealed mini-biospheres in which we will quite literally live immediately "downwind" and "downstream" of our selves. Any environmental sins would haunt us immediately - leaving little time for repentance. In preparing for settlement, we will learn many tricks of good eco-sphere housekeeping that can help change our ways on Earth. As to mining, all the mineral wealth we need lies in the loose 2-5 yard thick "pre-mined" blanket of meteorite-pulverized rock and dust that lies everywhere. No open-pit mines. We'll extract what we need, leaving tailings in place. Only small craterlets, not visible from Earth, will be raked clean, as anything of size will be steered around. There is no ground water to pollute, nor atmosphere. Any wastes containing precious hydrogen, nitrogen, and carbon (the very things we find throw-away "dirt-cheap" on Earth) will be recycled religiously.

The Moon is gray, gray, gray! Wont any Moon settlement be just as drab inside as outside?

Many of the things we use to provide the colors we enjoy, such as plastics, bright coal tar-based dyes, and solvent-rich paints, will be either too expensive or too polluting or both to be of service on the Moon. A make-do paint of metal oxide pigments suspended in sodium silicate (waterglass), lime whitewash, stained glass, glazed ceramic tiles, and natural-dyed fabrics will provide ample color. Add abundant greenery and flowers and plenty of warm sunlight, and Lunan interiors should be anything but drab.

What about clothing and other fabric needs?

Modern synthetic fabrics are hydrocarbon-based. These will be much more expensive to produce on the Moon than organic fabrics that are about 50% oxygen by weight, like cotton and paper. Waste biomass from cotton production can be biodigested into a tofu like food product. Pioneers can use natural biodegradable plant-derived dye stuffs such as indigo, henna, etc. to color their cotton goods, so that worn clothing can be recycled as farm compost. Pre-tinted cotton is now being raised on Earth. For most other uses, fiberglass will make an inexpensive fabric. In the low gravity, form-fitting molded seating need not be padded or upholstered, nor will floor cushioning be needed. Fiberglass rugs, which would wear poorly underfoot, could be placed on wall surfaces instead to provide acoustical and visual softening.

Where would settlers go for a needed change of scenery, or simply "to get away from it all?"

The Moon's surface is much more monotonous than Earth's. Yet there are still enough differences to provide mining-based diversity for a number of scattered towns, plus outlying scientific outposts and observatories. There will be "must-see" craters, valleys, and overlooks of special scenic beauty. From above one settlement may look like any other, but there will be plenty of room for exterior and interior architecturally differences in both structures and layouts. Each town may develop its own styles of decorating and plantscaping and its own chosen interior climate. Each may develop distinctive arts and crafts and cultural festivities. Trade and travel between scattered lunar towns should be vigorous and add importantly to the spice of life.

How does opening up Mars fit into the picture?

If we only go to Mars to explore, the advantages of prior lunar settlement, while important, would not be critical. Moon "experience" would allow safe field-testing of vital equipment and life-support systems within "rescue distance" of Earth. Mars-bound ships could top off their fuel tanks with lunar oxygen and thus be able to carry more payload and passengers. The real advantages will come only if we open Mars to settlement. Nothing that can be manufactured on Mars will be of export value to Earth directly. But as things can be shipped from Mars to the Moon at one third the fuel cost of direct from Earth shipments, lunar settlements could provide Mars with a market for whatever Martians can produce that can't be made on the Moon from local resources. Mars does have great scenery and tourist experiences to sell, but at that distance there will be few takers.

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