# USC ASTE-523 -- Spring, 2023
# The Design of Low-Cost, Space Missions
# A Near-Term, Income-Generating, Lunar Settlement

## Homework Set #6 -- Due 3/30/23

1. We've mentioned several times that Nitrogen is one of the principle components that we will need lots of, but don't have in realistic quantities on the Moon. The weight of nitrogen is roughly 1 kg/$m^3$ and we're assuming a cost of getting there of $1,600/kg. We should probably initially bring about twice what we actually need to account for spills, leaks, or back-up. Given that our first structure will be about 100 m in diameter and 10 m high, what will be the cost of the nitrogen for our first structure?

2. Offering a prize is one of the ways often considered to encourage the development of new technology or to reduce the cost of various aspects of space missions. What is the principal advantage of doing so? What is the principal disadvantage? In your opinion, is a prize likely to be valuable in finding ways to reduce the cost of elements of a lunar settlement? Why?

3. In your own words, explain both the advantages and disadvantages of using industrial grade, non-space-qualified hardware for working inside a settlement on the Moon.

4. Much like cars, phones, and children's toys, space systems are becoming much more driven by software. What are the principal advantages of this happening? What are the principal disadvantages? Is it likely to make space systems cheaper or more expensive?

5. Explain the principal reasons that programs that take a long time to implement (say a decade or more) are more likely to get canceled along the way and are also much more likely to have cost and schedule overruns.

6. We have seen on many occasions that Attitude and Personnel Issues (i.e., culture) are among the most important factors in reducing cost. Explain why this is true and why it so hard to make these issues work successfully in traditionsl governmnet programs in either NASA or DoD.

7. Explain why *Concurrent Engineering* (i.e., developing solutions to two separate problems simultaneously) has the potential to significantly reduce cost and yet is rarely used in modern space programs.

8. Explain in your own words why "Having fun on the Moon" could be regarded as inappropriate for being one of the drivers for a lunar settlement design. Explain why it might be acceptable as an appropriate design characteristic.