Space Exploration Teacher Workshop: Ethical and Societal Implications

Dr. James S.J. Schwartz

Assistant Professor, Department of Philosophy

Wichita State University

My Background

- B.A., M.A., and Ph.D. in Philosophy
- 10+ years experience researching and teaching the ethics of space exploration and space policy, with numerous multidisciplinary collaborations (including with NASA researchers).
- Founding Coordinator of the Wichita Space Initiative (wichita.edu/space) and the Space & Society Virtual Working Group.
- Author of *The Value of Science in Space Exploration* (Oxford University Press, 2020) and editor of *The Ethics of Space Exploration* (Springer, 2016).

Outline

- Space Ethics in Context
- Tie-in to Education Standards
- “Grand Tour” of Space Ethics
  - Terraforming
  - Alien life
  - Space tourism
  - Space mining
  - Space settlement
- Ideas for the Classroom
  - To the Moon: Outline of a Case Study

Space Ethics in Context

Ethics is simply the rigorous study of *what we ought to do*.

Space ethics, in turn, is the rigorous study of *what we ought to do when it comes to space exploration*.

Space ethics is neither inherently “pro-space” nor inherently “anti-space”.

Space Ethics in Context

To-date, space ethics has been an *issue-driven* area of research, and it deals with ethical questions arising from spaceflight activities and from the spaceflight community and its culture.

In its brief history, space ethics has shown a responsiveness to real-life space exploration developments; it is no more concerned with "science fiction" than space exploration itself.

Space Ethics in Context

Space ethics is highly interdisciplinary.

My colleagues include scholars and professionals with backgrounds in: anthropology; astrobiology; astronomy; astrophysics; communications; dance; gender studies; history; human performance; ecology; engineering; fine art; law; literature; medicine; philosophy; planetary science; political science; sociology; and others.

(STE**A**M – not just STEM!)

Space Ethics in Context

Laura Delgado López
Policy Analyst, NASA Science Mission Directorate

Prof. Sheri Wells-Jensen
Xenolinguistics, Disability Studies
METI International
Currently organizing a zero-G flight for disabled passengers!

Wichita State University

Space Ethics in Context

Prof. Danielle Wood
MIT Media Lab
Space Enabled Research Group

Dr. Erika Nesvold
Astrophysicist, *Universe Sandbox* game dev
JustSpace Alliance
Making New Worlds podcast

Wichita State University

Space Ethics in Context

Daniela de Paulis
Dancer, media artist, radio telescope operator

Prof. Kathryn Denning
Anthropology of SETI and METI

An Important Proviso

"Space Exploration" is not just one thing. It is a term that refers to a great variety of possible activities, including:

- Crewed scientific exploration (*Apollo, ISS*)
- Remote scientific exploration (*InSight, Perseverance, JWST)*
- Space tourism (*Virgin Galactic, SpaceX)*
- Military/defense spaceflight activities (*ASAT, X-37B*)
- Telecommunications services (*GPS, satellite TV & Internet)*
- Space resource exploitation (*asteroid mining)*
- Space settlement (*orbital, lunar, planetary*)

An Important Proviso

Thus, when students offer “pro-space” and “anti-space” perspectives, it can sometimes be helpful to indicate that there are diverse ways to be both “pro” and “anti” space.

For instance, someone can support space settlement but be uninterested in space tourism – that is still a “pro space” position.

Similarly, someone can support robotic scientific exploration but oppose crewed scientific exploration – that is still a “pro space” position.

An Important Proviso

In my experience teaching college students, hardly anyone is *fully anti-space*; most students seem willing to agree that they value *at least some* kinds of space exploration (for instance, space-based environmental monitoring is something hardly anyone dislikes!).

This is important to keep in mind if you find yourself needing to guide your students through a discussion where differences of opinion about space are likely to arise.

Disliking of *all* of space exploration is a perfectly legitimate attitude to have; so look out for peer pressure!

Tie-in to Education Standards

Note: I am NOT an expert in K-12 education standards!

NGSS Cross-Cutting: "Influence of Science, Engineering, and Technology on Society and the Natural World:

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4)
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MSESS3-3)"

Tie-in to Education Standards

HGSS Standards

Standard 1: Choices have consequences. History, government, economics, and geography are affected by human choice. Choices made by individuals and groups have consequences, and the desirability of the choices are dependent on the perceived positive and negative consequences. Often choices are built and dependent upon earlier choices and consequences.

Standard 4: Societies experience continuity and change over time. People and communities have aspects of continuity but experience some degree of change over time. Continuity refers to a society's ability to hold on to what is important, to remain stable, anchored. Change refers to a society's ability to adapt and make the adjustments necessary to protect and advance the society.

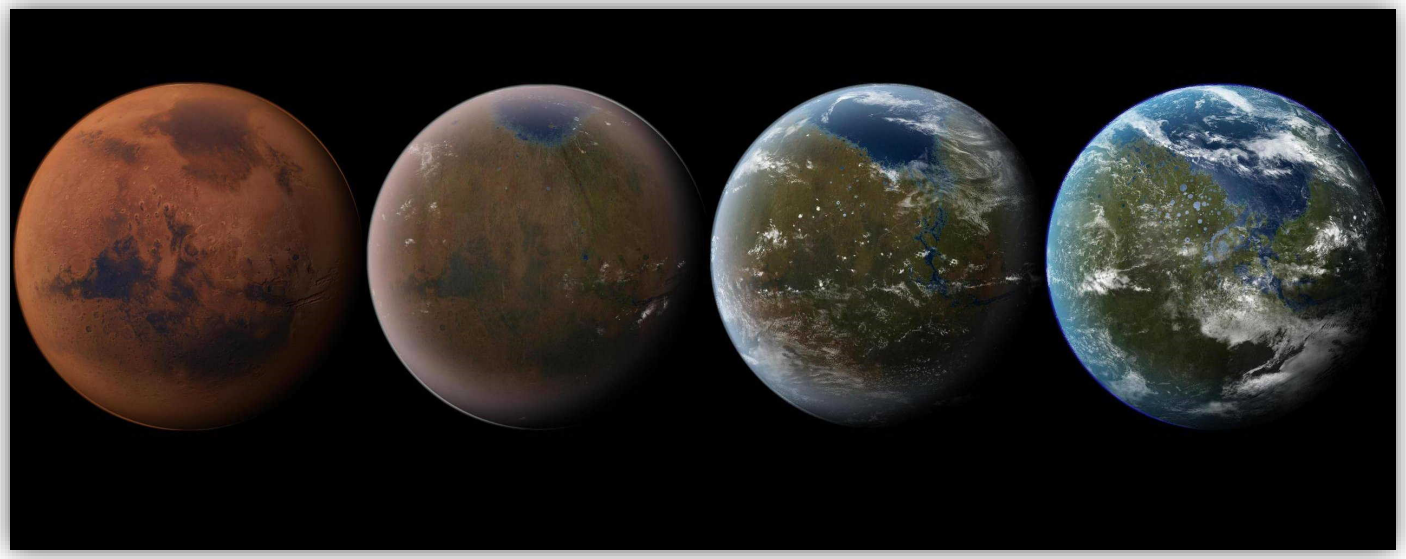
Tie-in to Education Standards

HGSS Standards

Standard 5: Relationships among people, places, ideas, and environments are dynamic. People, places, ideas, and environments experience change, activity, progress, or regression. All relationships are in a constant state of adjustment. These adjustments may also result in additional change, activity, progress, or regression.

Grand Tour Stop 1: Terraforming

In the 1980s, researchers, including NASA astrobiologist Chris McKay, demonstrated that, in principle, it would be possible to *terraform Mars!*

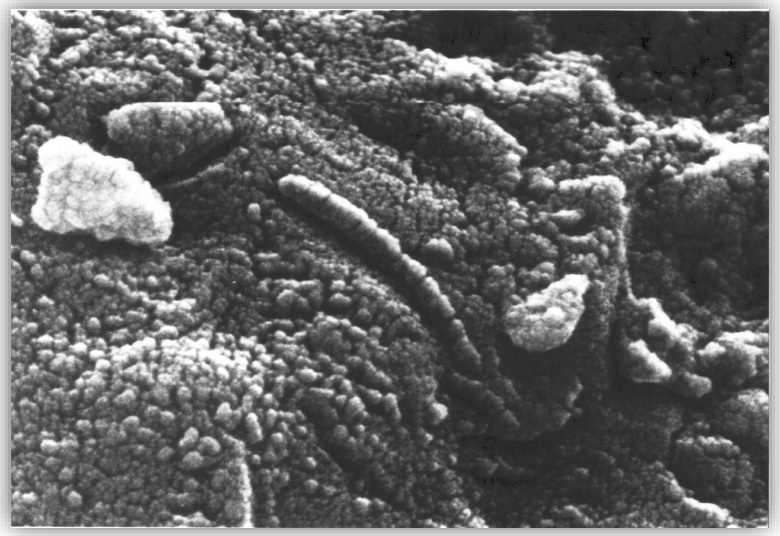


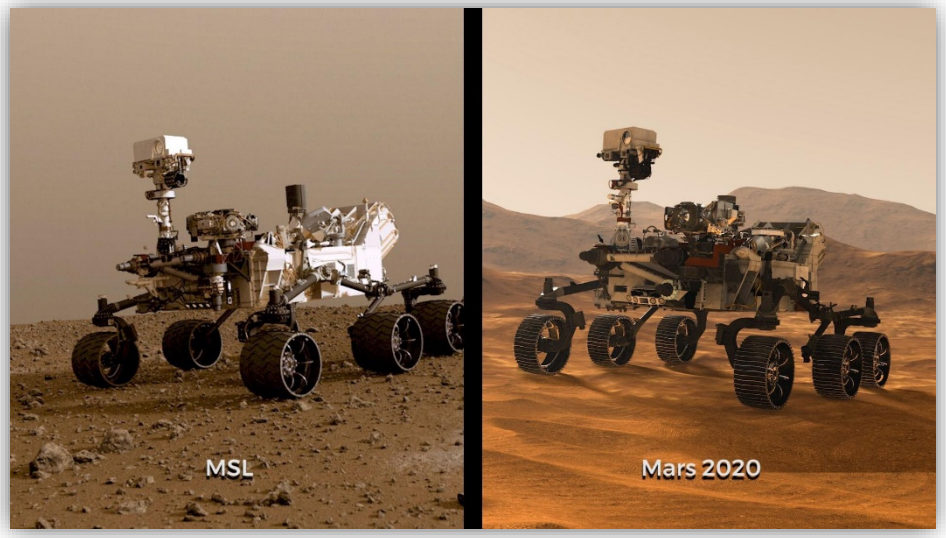
Grand Tour Stop 1: Terraforming

- Is Mars *ours* to remake in this way? Who owns Mars?
- What is the *cost* of terraforming Mars – both in terms of economic costs but also opportunity costs?
- If Mars is home to native life, would that mean we shouldn't try to terraform Mars?
- Should we protect Mars to preserve its natural beauty? Or would a post-terraformed Mars be even more beautiful?
- Will terraforming Mars provide humanity with a second home? If not, is there any other reason to try it?

Grand Tour Stop 2: Alien Life

In the 1990s, there was excitement about a potential discovery of Martian life. While *Curiosity* and *Perseverance* aren't looking for life, they are searching for evidence about Mars's past habitability.



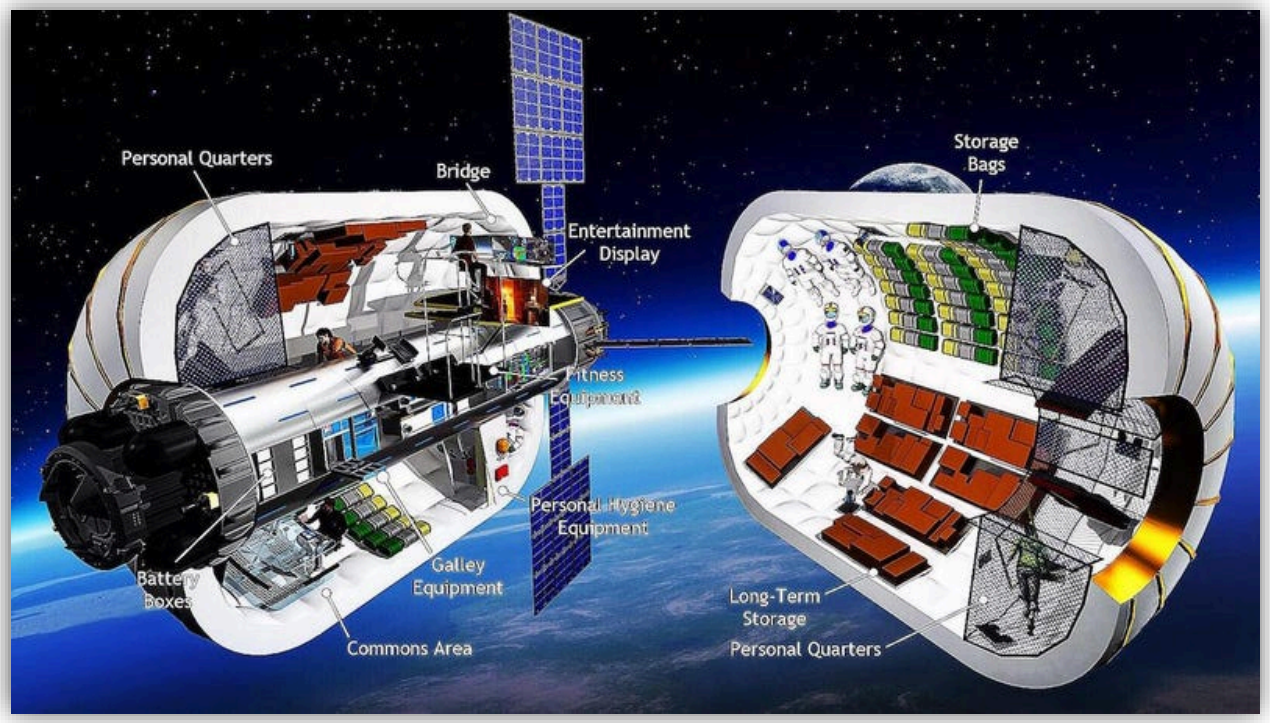


Grand Tour Stop 2: Alien Life

- If we find life on Mars, even if it is only microbial life, would it have rights? Moral status?
- Would we have an obligation to protect Martian life? What could we do to protect it? Are existing “Planetary Protection Policies” enough?
- Can humans visit without contaminating Mars, making it even more difficult to search for Martian life?
- If there is no life on Mars, does that mean that it is “anything goes” on Mars?

Grand Tour Stop 3: Space Tourism

Companies like Virgin Galactic are soon to offer regular (?) access to spaceflight for private citizens. Other space-based hospitality services are likely to follow, possibly including orbital hotels (Bigelow Aerospace).

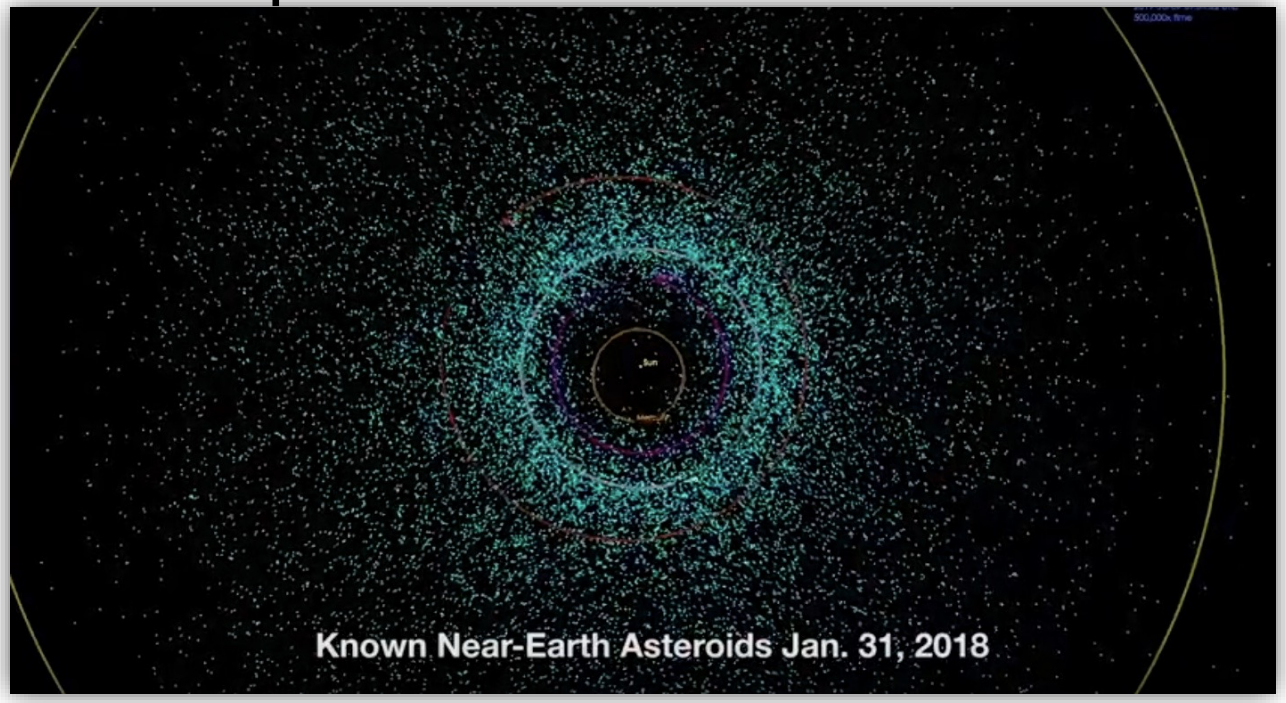


Grand Tour Stop 3: Space Tourism

- Is spaceflight “safe enough” for commercial passengers?
- Should “spaceflight participants” go through the same training as professional astronauts?
- Under international law, *astronauts* have legal obligations to render assistance to those needing help in space. Should “spaceflight participants” have the same legal responsibilities?
- Should space tourism businesses be required to provide accommodations for disabled passengers?

Grand Tour Stop 4: Space Mining

Some asteroids contain enough platinum-group metals to be worth *trillions* of dollars at current prices. Many hope to exploit these metals and other asteroidal resources for profit and to enable human expansion into space.



Grand Tour Stop 4: Space Mining

- International law prohibits any owning of territory in space. What does that mean for who is allowed to "own" space resources?
- Are space resources truly *ours* to extract and commodify?
- What are the costs and benefits of space mining?
- Will space resources be consumed on Earth, or only in space?
- Can using space resources help us consume less on Earth and protect Earth's environment?
- Does it matter how quickly we consume space resources? Will any of them ever run out? If so, how quickly?

Grand Tour Stop 5: Space Settlement

Whether it is Mars One (now defunct), Mars Direct, or Musk/SpaceX's plans to make humanity a "multiplanetary species", never before has there been this much apparent momentum behind human space settlement.

N.B.: *Space colonization* is a common term, but many regard it as too problematic. *Space settlement* tends to be preferred, but some argue that the term "settlement" is still problematic. *Space expansion* may be the best "neutral" term for the moment.

Grand Tour Stop 5: Space Settlement

Despite the recent increased interest in crewed visits to Mars, a crewed return to the Moon, possibly including lunar settlement, is comparatively more likely to happen as a first step in humanity's expansion into space.

Why the Moon? It is "close", *and it has water* (and *most* things needed to support human life).

So, let's see what a "case study" about lunar settlement could be like.

To the Moon: An Outline of a Case Study

A way to get students to think about the wider ethical and societal implications of space settlement is to get them to think about the issue from a planning/design perspective. "Zooming out" is just as important as "zooming in".

Step 1: Define Goals

- What's the "objective" of space settlement? Commerce? Science? Human expansion? National prestige? Security?
- What are the criteria of success for space settlement? Sheer survival? Comfortable lives for spacedwellers? Profits back on Earth? Geopolitical power?

To the Moon: An Outline of a Case Study

Step 2: Pick a Place to Live

The Moon is geologically heterogeneous; some “places” on it are easier places for humans to live. You might teach your students a bit about lunar geography before having them pick a destination.

To the Moon: An Outline of a Case Study

Step 3: Congratulate them for going to the poles

Or, steer them towards this choice. The poles are where everyone wants to go, because that's where the water is (and everybody who is on the Moon needs water!).

You can guide them to this choice in what you share with them about lunar geography, or you can reveal this "along the way".

But the poles are also where the controversies reside!

To the Moon: An Outline of a Case Study

Step 4: Overcoming Likely Challenges

There is *a lot* standing in the way of getting a sustainable lunar settlement up and running, and I can only provide a brief and incomplete window into what has been discussed by the space ethics research community.

But the good news is there enough here for you to pick and choose which kinds of challenges to introduce to your students, based on your other lesson goals. Each will require students to engage in cross-disciplinary problem solving.

To the Moon: An Outline of a Case Study

Step 4a: The Outer Space Treaty (OST)

The OST forms the core of internationally binding space law. Article II poses a potentially thorny legal problem:

"Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

So, is space settlement even legally permissible? If not, do we need to form new international treaties? How well do the recent *Artemis Accords* resolve this problem?

To the Moon: An Outline of a Case Study

Step 4b: Who goes?

- How representative of all of humanity should a lunar settlement be? Does it matter, for instance, which nationality of people attempt to settle the Moon?
- Will disabled people be welcome on the Moon? Why or why not?
- If more people want to go to the Moon than can, how do we pick who goes?
- What skill sets might be needed to live on the Moon? How many people, and with what skill sets, will be needed?

To the Moon: An Outline of a Case Study

Step 4c: Actually Living on the Moon

Life on the Moon will likely consist of living in small enclosed environments that offer little privacy, freedom of movement, choice of vocation, or choice of romantic companion. "Everyone works or everyone dies" may be a fact of life.

- How can we build safe and reliable habitats on the Moon?
- What laws and government and economic systems should be used? Where do food and water and air come from?
- What will be taught in schools on the Moon?
- What about hobbies and recreation?

To the Moon: An Outline of a Case Study

Step 4d: Scarcity of Lunar Resources

The Moon contains significant quantities of metals like aluminum, iron, and titanium, as well as plenty of minerals containing oxygen.

Meanwhile, the best sites for water-ice extraction and solar energy collection are concentrated in a few small areas in the north and south poles.

- The water-ice totals to somewhere between 3 and 4 km^3.
- Land suitable for *uninterrupted* solar energy collection is on the order of hundreds of square meters.
- Who decides how these scarce resources are used?

To the Moon: An Outline of a Case Study

Step 5: Reviewing the Plan

After the students have done some “design work” around the constraints you’ve introduced, now it’s time to have them synthesize what they’ve come up with. There are many grade-appropriate ways to do this, from drawings to schematics to write-ups. **Look out for related NASA competitions for students!**

Once the class’s/group’s “vision” for lunar settlement has been completed, you can engage with questions like “So which of you would actually like to move there?” “What changes would you need to see before you’d want to go? How could we meet them?”

To the Moon: An Outline of a Case Study

Step 6: Comparing to Other Attempts

There is no shortage of accessible articles, books, and videos about space settlement. If desired, you can compare your students' space settlement designs against those promoted by well-known individuals like Elon Musk and Robert Zubrin, or even Scottish prisoners!

While you likely will discover Musk and Zubrin have thought of many things your students did not, you will also discover your students have thought of many things that Musk and Zubrin did not (and if you spot them, point them out to your students!).

To the Moon: An Outline of a Case Study

Step 7: Wrapping up

Here would be a good time to have a more general discussion about the importance (or not) of space settlement, how soon we should try, etc.

You might conduct small pre- and post-surveys to see if the project has changed students' perceptions of space settlement in any way.

Don’t Like the Moon?

You should have access to a reference list that will help you construct similar projects for Mars settlement and for asteroid mining, but each of these topics may require more advanced science knowledge (planetary science, astrobiology, orbital mechanics) compared to what is needed to discuss lunar settlement.

If you’re keen on another topic of those mentioned earlier, email me and I may be able to provide some additional references/suggestions: james.schwartz@wichita.edu

Questions?

Thank you for attending our workshop!

Email: james.schwartz@wichita.edu

www.thespacephilosopher.space (personal site)