Lesson 22: The Issues and Future of Space Exploration

Summary
This learning module and related exercises will expose students the issues of space exploration and the other NASA-partnering agencies and institutions as well as private companies engaged in space-related technology. Students address socio-scientific issues and apply the nature of science to real-world decisions regarding human space flight.

Learning Goals

Students will be able to:
- Become aware of NASA partnering agencies and private companies engaged in space-related technology
- Design a mission and experience the panel review/decision process.

Context for Use
This particular module does not apply to any Earth analog approaches, but rather exposes students to the philosophy and ethics of privatized vs. government-funded research programs. Students practice with the realities of a cutting a budget in preparation for the Mission to Mars project.

Description and Teaching Materials

In-Class Activity
- In-Class Activity 1: Manned-Space Flight: Is it needed?
- In-Class Activity 2: Space flight going private

Homework/Lab
- Homework 1: Cut A Budget: An Ethical Debate

Teaching Notes and Tips

1. Homework 1 should be given prior to the Mission to Mars project due date to give students experience.
2. Become aware of the issues yourself before engaging in a discussion with students regarding privatization.

Assessment
Each In-Class Activity and Homework has its own measure of Assessment.
References and Resources

- Mission to Mars Rubric
- Space X Press Release
In-Class Activity 1
Space Issues_MFE
Manned Space-Flight: Is it needed?

**Purpose:** Discuss the issues surrounding manned-space flight and the future of space flight.

**Preparation:**
- Disseminate copies of news articles and/or NASA goals for students to discuss in groups or...
- Summarize points of each article in a PowerPoint presentation for discussion.

**Resources:**
- News Article (find a recent article such as): [http://www.science20.com/brinstorming/near_future_manned_spaceflight-93648](http://www.science20.com/brinstorming/near_future_manned_spaceflight-93648)
- NASA roadmap for Astrobiology: [https://astrobiology.nasa.gov/roadmap/](https://astrobiology.nasa.gov/roadmap/)
- Space-X CEO Interview: [http://www.youtube.com/watch?v=IiPjI8pl8Q&feature=related](http://www.youtube.com/watch?v=IiPjI8pl8Q&feature=related)

**Engage**
Engage students by asking what they think about space flight. Should the U.S. be involved in space exploration? What is the benefit? Should we do more than we are doing? What are the ethical questions? What is their knowledge about NASA missions?

Then Poll students on whether or not manned-space flight is a good idea
1. What is the reason for their choice?
2. What is the history of space flight? (utilize NASA interactive timelines on the history of spaceflight such as those below):
   - [http://nssdc.gsfc.nasa.gov/planetary/chronology.html](http://nssdc.gsfc.nasa.gov/planetary/chronology.html)
   - [http://history.nasa.gov/timeline.html](http://history.nasa.gov/timeline.html)
   - [http://www.nasa.gov/missions/timeline/](http://www.nasa.gov/missions/timeline/)

**Explore**
*Manned-Space Flight Discussion in the News*
2. Discuss the article and what the future might or should be.
Mars for Earthlings

Explain
   a. What points do students believe are important?
   b. What aspects did they not expect?

Elaborate
Space X Plans to put man on Mars in 10 years
- Interview with the CEO of Space-X (start interview at Time- 13:00-15:30) http://www.youtube.com/watch?v=IiPJsI8pl8Q&feature=related
- Discuss what students think of this venture.

Evaluate
Statement to a Congressman/woman
Ask students to prepare a 2-page statement to a Congressman/woman recommending or declining space flight using NASA published goals and/or other publicly announced space flight goals.
   a. Have students identify a real and acting member of Congress and write a letter/statement accordingly.
   b. Students must cite publications that support their recommendation.
   c. Review student recommendations to Congress for understanding of current NASA goals.
Mars for Earthlings

In-Class Activity 2
Space Issues_MFE
Space Flight going Private

**Purpose:** Become aware of private companies pursuing space flight and their role with our outside of NASA’s Mission directorate (government vs. private funding).

**Preparation**
Be ready to facilitate a discussion and have talking points outlined. Suggested questions are below.

**Engage**
*Dragon docking with the ISS*
Present students the following video of Space X's Dragon spacecraft docking with the ISS: [http://www.youtube.com/watch?v=QwDCWTqNceQ&feature=player_embedded](http://www.youtube.com/watch?v=QwDCWTqNceQ&feature=player_embedded)

a. Ask students what is significant about this event
b. Ask students what they think of this venture

**Explore**
Lead a discussion of Privatization vs. Government-funded research in Space

1. What is the history of privatization?
2. What are the pros and cons of private companies taking over the space program?
3. Share the Space X video of their award to continue on manned-space flight
   a. Video: [http://www.youtube.com/watch?v=MZJk4CrxtQ&feature=youtu.be](http://www.youtube.com/watch?v=MZJk4CrxtQ&feature=youtu.be)
   b. If the students had the money, would they buy a seat? Why or why not?
4. The Space X reusable Space Craft: [http://www.youtube.com/watch?v=sSF81yjVbJE&feature=related](http://www.youtube.com/watch?v=sSF81yjVbJE&feature=related)
   a. Why is the Space X craft remarkable?

**Explain**
Compare NASA’s budget with other federal government agencies and/or privately funded corporations using the following website: [http://www.richardb.us/nasa.html#table1](http://www.richardb.us/nasa.html#table1)

**Elaborate**
*Space X’s Mars Business Model*
[http://www.youtube.com/watch?v=4fS1FxBo64A&feature=relmfu](http://www.youtube.com/watch?v=4fS1FxBo64A&feature=relmfu)

1. What do the students think of Space X’s Mars Business Model?

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Mars for Earthlings

Evaluate
In a Group setting:

1. Decide as a group if privatization is a good route to pursue for space research and flight.
2. Groups should be ready to defend their position.
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Homework 1
Future Mars Missions & Societal Issues_MFE
Cut a Budget: An ethical debate?

Objective: Critique the viewpoint of a proponent of increased NASA funding and cut a theoretical mission budget to fit NASA cut backs.

A Viewpoint on NASA funding
Watch the following YouTube video, narrated by Neil deGrasse Tyson, concerning the national budget and NASA. Neil deGrasse Tyson is an astrophysicist and director of the Hayden Planetarium.
Video: http://www.youtube.com/watch?v=FI07UfRkPas&feature=youtu.be

1. Do you agree with any of Neil deGrasse Tyson’s points?

2. Similarly, do you disagree with any of his points?

3. Do you find Dr. Tyson’s line of argument flawed? If so, why?

A Proposed Budget
Below is a proposed hypothetical NASA budget with all budget elements compliant with NASA documentation:

4. Scrutinize the budget and make a 30% cut to your budget. NASA will approve this mission if you can cut your budget by 30%. For reference on what each budget item means see the above .pdf url link. (1) Show and justify all changes you make to achieve the 30% cut. (2) Attach an extra sheet of paper for justification if necessary. (3) Add items you think are necessary.
## Mars for Earthlings

Proposed Budget  
(Sample, direct costs)  
Mission: Orbit Europa  
Duration: 4 years

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<th>Category</th>
<th>Sub-Category (#)</th>
<th>Cost per Unit</th>
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**Mission Total**  
$478,519,280