

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.

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References and Resources

- Mission to Mars Rubric
- [Space X Press Release](#)



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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
- NASA Human Space Flight Goals:
http://www.nasa.gov/pdf/626738main_HEOMD2012Goals.pdf
- NASA roadmap for Astrobiology: <https://astrobiology.nasa.gov/roadmap/>
- Space-X CEO Interview:
<http://www.youtube.com/watch?v=IiPJsI8pl8Q&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://history.nasa.gov/timeline.html>

<http://www.nasa.gov/missions/timeline/>

Explore

Manned-Space Flight Discussion in the News

1. "The Near Future of Manned Space Flight"
http://www.science20.com/brinstorming/near_future_manned_spaceflight-93648
2. Discuss the article and what the future might or should be.



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Explain

1. Review NASA Human Space Flight Goals:
http://www.nasa.gov/pdf/626738main_HEOMD2012Goals.pdf
2. Review NASA roadmap for Astrobiology: <https://astrobiology.nasa.gov/roadmap/>
 - 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=liPjSI8pl8Q&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.



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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

- 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=MZJk4CrxctQ&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>

 - 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>

Elaborate

Space X's Mars Business Model

<http://www.youtube.com/watch?v=4fS1FxBq64A&feature=relmfu>

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



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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=Fl07UfRkPas&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:

<http://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2013.pdf>

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.



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

<u>Category</u>	<u>Sub-Category (#)</u>	<u>Cost per Unit</u>	<u>Cost Total (4 years)</u>
Direct Labor	PI- Scientist (1) (1FTE)	\$112,000	\$448,000
	Co-I Scientist (3) (1/2 FTE))	\$55,000	\$660,000
	Co-I Engineer (5) (1FTE)	\$95,000	\$1,900,000
	Co-I Educator (1) (1/2 FTE)	\$40,000	\$160,000
	Post-Docs (3)	\$48,000	\$576,000
	Graduate Students (7)	\$24,000	\$672,000
	Undergraduate Students (3)	\$3,000	\$36,000
Other Labor	Consultant- Science (2)	\$15,000	\$120,000
	Consultant- Education (1)	\$10,000	\$40,000
Equipment	Orbiter (includes thermal, power, navigation, launch vehicle, etc)	\$425,000,000	\$425,000,000
	Cameras (1)	\$31,000,000	\$31,000,000
	Spectrometer (1)	\$17,600,000	\$17,600,000
	Website development	\$40,000	\$80,000
Supplies	Publications	\$2,000	\$10,000
	Software	\$20,000	\$20,000
	Computer Stations	\$50,000	\$50,000
Travel	LPSC Meeting Registration	\$100	\$800
	AGU Meeting Registration	\$350	\$2,800
	AAAS Meeting Registration	\$400	\$3,200
	Per Diems (\$40/day /person)	\$320	\$10,240
	Airfare (roundtrip/person)	\$600	\$4,800
	Lodging (night/person)	\$140	\$4,480
	Transportation (trip/person)	\$40	\$960
Facilities/Administration	Imaging lab (yearly)	\$15,000	\$60,000
	Imaging rendering lab (yearly)	\$15,000	\$60,000
		Mission Total	\$478,519,280

