Exploring Other Worlds: a Project in Planetary Science Class

Attention!! It will be very useful but not mandatory for participants of this workshop to have internet access!!

General materials - Read only

https://drive.google.com/drive/folders/17JNYwJUVxhe057tlc2nyrzDgJSeUu5JD?usp=sharing

Exploring Other Worlds: a Project in Planetary Science Class

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Planetary Science

- Planets are incredibly complicated and dynamic systems.
- The study of planets is often very interdisciplinary including subjects such as…
  - Geology
  - Atmospheric sciences
  - Magnetohydrodynamics
  - Thermodynamics
  - Chemistry
  - Biology
  - Etc…

Planetary Science Missions

- Robotic missions that explore other planets are also very complicated and interdisciplinary.
- They often have several advanced instruments in order to do a wide array of different measurements.
- They utilize very complicated and advanced engineering designs and testing procedures.
- But they still follow some simple general scientific and engineering principles.

Planetary Science Missions

Just like many science experiments…

- there are theories about planets and moons
- scientists propose experiments (missions) to test these theories
- scientists determine what evidence or data need to be collected
- scientists use specific instruments on these missions to collect the evidence or data
- scientists analyze the data to either prove or disprove theories.

Planetary Science Missions

Just like many engineering projects …

- there are specific problems that must be identified
- there are specific criteria and constraints that must be taken into account
- these problems and criteria can be broken down to simpler ones that can be approached systematically
- solutions must be developed and evaluated

Planetary Science Missions

These scientific and engineering practices are highlighted in several different areas of the NGSS Core ideas, Practices, and Cross Cutting Concepts

- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Asking Questions and Defining Problems
- Constructing Explanations and Designing Solutions
- Systems and System Models

Planetary Science Missions

How to replicate this in a classroom?

Have the students play the role of planetary scientists!

The students…..

- Work in groups to share information and discuss ideas
- Learn about their destinations
- Develop goals for their missions
- Decide what data or evidence they need to collect to achieve their goals
- Determine what instruments are needed to collect the data they need
- Design the mission and write a proposal

Planetary Science Missions

Each participant will get the chance to play the part of a student and teacher.

The first step is to choose your mission!!

Five Mission Destinations

Mars H_2O

We believe that Mars used to have liquid water and therefore may have had life at one point in time.

Regions of Mars that we know used to have water might have evidence that life once existed.

Mars CH_4

We have discovered methane in the Martian atmosphere.

Since methane can come from biological processes, the source of the methane might have evidence that life once existed.

Europa

A large moon of Jupiter.

We believe there is a deep liquid water ocean beneath a thick ice crust.

This liquid water could contain life, or evidence that life existed in the past.

Enceladus

A small moon of Saturn.

Enceladus has many geysers spraying water ice into space.

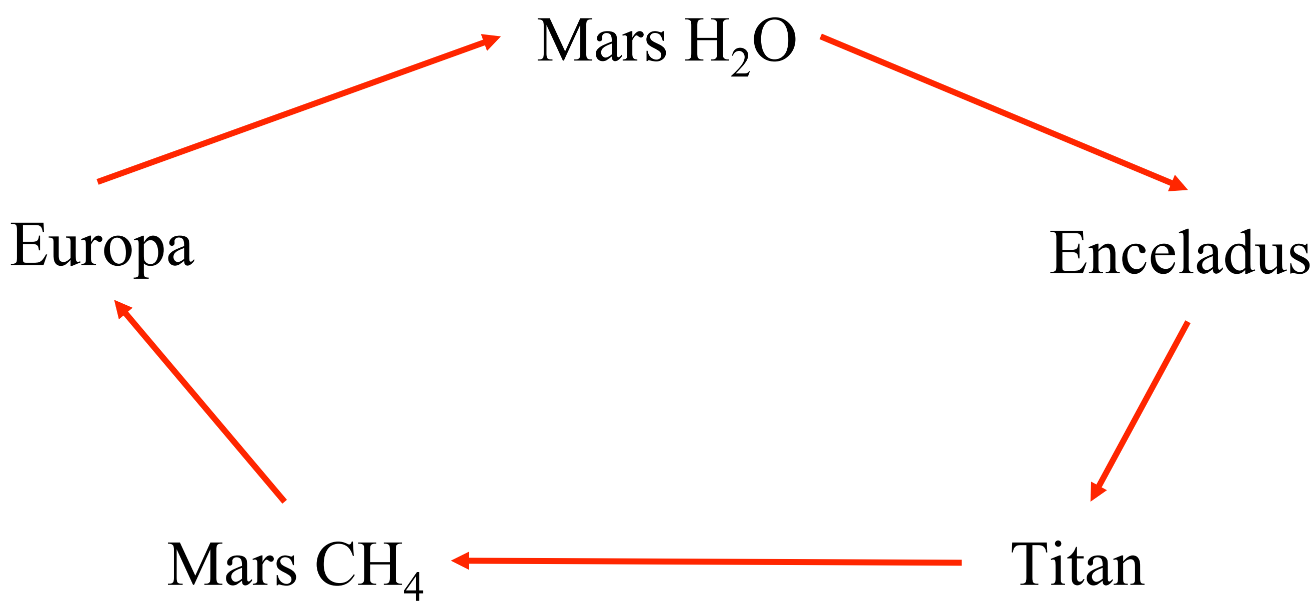
We believe that a liquid water reservoir is beneath the surface, and could contain life.

Titan

A Large moon of Saturn.

Has a thick N_2 atmosphere with rain, rivers, and lakes of liquid ethane and methane, most likely full of organic molecules thought possibly to be similar to organics on a pre-life Earth.

Five Mission Destinations



This shows who will act as the "teachers"
for each mission

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Europa - read and edit

https://drive.google.com/drive/folders/1HeF_hdX4VHf1p_6gWMuhJu1HTCVZdI2r?usp=sharing

Enceladus - read and edit

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Mars CH_4 - read and edit

https://drive.google.com/drive/folders/1DKxtlQ1IOEHEKojdbJ_h8cp6B29Y8JHv?usp=sharing

Titan - read and edit

https://drive.google.com/drive/folders/1KVrodCy68Z3mIiv5Qb9Qqa_hKV2MD1C8?usp=sharing

Planetary Science Missions
Basic Steps

- Learn about your destination
- Develop goals for your mission
- Decide what evidence you need to collect to achieve your goals
- Determine what instruments are needed to collect the evidence you need
- Other design aspects include...
    - Where and how will you land?
    - What activities will you need to do in order to collect your evidence
    - How will you power your probe?
    - Budget
    - Other?

Planetary Science Missions Basic Steps - Teachers

- Learn about the destination of the group you are "teaching"
- Discuss the goals, evidence, and instruments with the group you are "teaching"
- After the design of the mission is complete, write a "mission report" telling the group you are "teaching" what data their mission has collected at their destination.

Planetary Science Missions Conclusions

- Feedback on the workshop and the project.
- Could you use this project or something similar in your classes?
- What changes would you make to this project to better fit your classes and students?