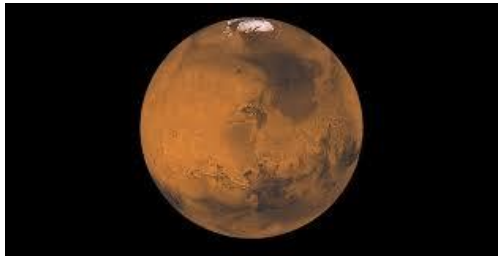
National Aeronautics and Space Administration



Planetary Magnetospheres: Mars, Jupiter, and Beyond

Heliophysics Investigations by Dr. Hilarie Davis

8/5/25 HEAT Community Meeting

NASA Heliophysics Education Activation Team

Studying Planetary Magnetospheres

NASA flies magnetometers to observe solar wind impacts on planets

- Scientists are trying to understand the magnetospheres, the near space environment at these planets.
- Magnetometers are one of the most commonly flown scientific instruments across NASA missions.
- Numerous heliophysics missions study magnetic fields in space.
- Planetary missions, too, study planetary magnetic fields whether intrinsic or induced.
- MAVEN has detected induced magnetic fields on Mars caused by solar events.
- JUNO is observing Jupiter's magnetic field, which is very different from other planets.

Framework for Heliophysics Education (FHE)

Developed by NASA HEAT in 2022

https://science.nasa.gov/learn/heat/big-ideas/

Structured around NASA's Big Heliophysics Questions

1. What are the impacts of the Sun on humanity?
2. How do the Earth, the solar system, and heliosphere respond to changes on the Sun?
3. What causes the Sun to vary?

FHE has Developed Big Ideas for the NASA Questions

1. What are the impacts of the Sun on humanity?

1.1 The Sun is really big and its gravity influences all objects in the solar system. (PS2, ESS1)

1.2 The Sun is active and can impact technology on Earth via space weather. (PS1, PS2, PS4, ESS2, ESS3)

1.3 The Sun's energy drives Earth's climate, but the climate is in a delicate balance and is changing due to human activity. (PS1, PS2, PS3, LS4, ESS2, ESS3)

2. How do the Earth, the solar system, and heliosphere respond to changes on the Sun?

2.1 Life on Earth has evolved with complex diversity because of our location near the Sun. It is just right! (PS3, PS4, LS1, LS2, ESS2)

2.2 The Sun defines the space around it, which is different from interstellar space. (PS2, ESS1, ESS2)

2.3 The Sun is the primary source of light in our solar system. (PS1, PS2, PS3,PS4, ESS1)

3. What causes the Sun to vary?

3.1 The Sun is made of churning plasma, causing the surface to be made of complex, tangled magnetic fields. (PS1, PS2, ESS1, ESS2)

3.2 Energy from the Sun is created in the core and travels outward through the Sun and into the heliosphere. (PS1, PS3, PS4, ESS1, ESS2, ESS3)

Studying Planetary Magnetospheres in FHE with NGSS

Question 1: What are the impacts of the Sun on humanity?

1.2 The Sun is active and can impact technology on Earth via space weather. (PS1, PS2, PS4, ESS2, ESS3)

Question 2: How do the Earth, the solar system, and heliosphere respond to changes on the Sun?

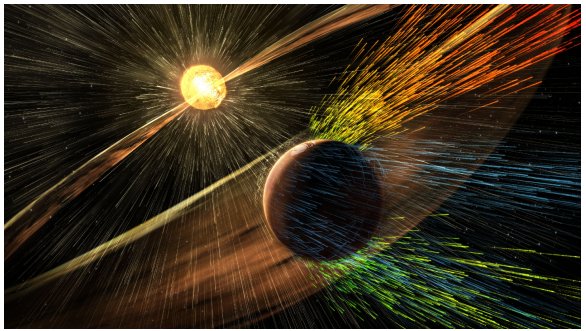
2.1 Life on Earth has evolved with complex diversity because of our location near the Sun. It is just right! (PS3, PS4, LS1, LS2, ESS2)

Question 3: What causes the Sun to vary?

3.1 The Sun is made of churning plasma, causing the surface to be made of complex, tangled magnetic fields. (PS1, PS2, ESS1, ESS2)

Introductory Level Investigation

Does Mars have a magnetic field like Earth? How do the differences affect if/how we could live there?



NASA's MAVEN mission has learned that

- Mars' magnetosphere is different from Earth's How does this affect its atmosphere?
- Mars has a twisted magnetosphere tail How does this affect the surface?
- Mars activities to learn more

Intermediate Level Investigation

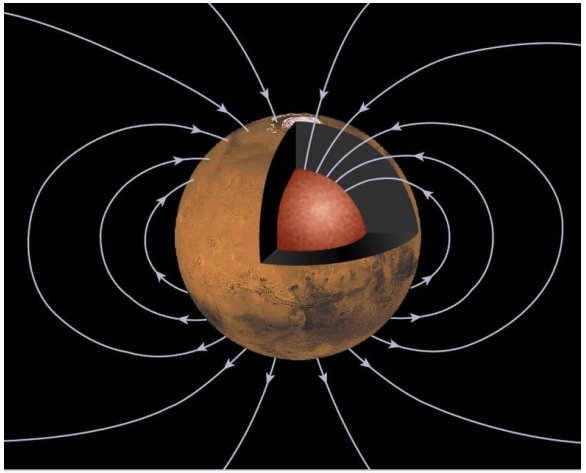
When was Mars habitable? How did it lose its water? Could we lose ours? What is the role of the magnetosphere in a planet being habitable?

Explore Mars in Eyes on the Solar System

Mars could have supported life (simulation results)

Mars Global Explorer studied the magnetic fields of Mars

Mars activities to learn more



Martian Dynamo. The schematic illustration of the ancient dipolar magnetic field of Mars generated by a core dynamo process.

Advanced Level Investigation

How do the magnetospheres of Mars and Jupiter compare? Is one more habitable than the other due to its magnetosphere?

Magnetospheres of our Solar System
Animation depicts the unique magnetospheres around Earth, Mars, and Jupiter

NASA's JUNO mission has been in orbit around Jupiter since 2016

Explore Jupiter site

For more information

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