ScienceNews

Activity Guide for Students: Mission to Mars

Directions:
During this activity, you are going to be acting as engineers and scientists working for NASA. You will determine which scientific questions NASA wants to study and then design a mission to Mars that will answer those questions. The data your mission collects will be used toward designing a future human-crewed mission to Mars.

Your team will design your mission around collecting data to answer a central question or group of questions. Based on the central question, you will then need to consider what types of data you will need to collect to answer this question, what instruments you will need to make these measurements and what experts you will need to design the experiments and interpret the data. For instance, you might ask "Is there enough sunlight on Mars' surface to grow food?" You might decide that to answer this question you will need to determine how often dust storms block sunlight from reaching the planet's surface. To measure this, you could use solar panels to measure the intensity of the sunlight, and cameras to verify what is blocking the sunlight when it is less intense. Finally, you might decide that to complete this mission you would need engineers and physicists to build your equipment, as well as physicists, biologists and meteorologists to analyze the data collected.

This activity could take place in the classroom or in a virtual environment. If the activity takes place virtually, your teacher will make arrangements for you to participate in classroom discussions and share your data. Follow your teacher's instructions for getting set up to discuss and share remotely.

Background questions
Before designing and planning a mission to Mars, you need to understand some of the properties of the planet. Use reputable sources such as NASA to answer the following questions before class to gather some background information about Mars. Then use this information to consider what astronauts will need while on Mars.

1. Research the following properties of Mars:

Mass	
Radius	
Day length (in Earth hours)	
Year length (in Earth days)	
Average distance from the sun	
Surface gravity	

Temperature range	
Moons (number and their names)	
Atmospheric composition	

2. What are some key geographic features on Mars?

3. What is the surface gravity on Earth? How does that compare with the surface gravity on Mars?

4. How does Mars' atmospheric composition compare with Earth's? How would this affect astronauts living on Mars?

5. Like Earth, Mars also experiences seasons due to its ~25 degree axial tilt. How do the seasons compare between Earth and Mars?

6. Based on what you researched about Mars, do you think Mars can support human life using only the natural resources available on the planet? Explain why or why not.

7. What natural hazards on Mars do you think pose risks for future astronauts?

Mission research

Like any good scientist, you will want to perform some research on other Mars missions before meeting with your group to discuss your plans. Start by looking through old articles at *Science News* and *Science News for Students*, including "To rehearse Perseverance's mission, scientists pretended to be a Mars rover" and "The Perseverance rover caps off a month of Mars launches," to learn more about current and past Mars missions. Use additional sources such as NASA for more information.

1. Write some notes about previous and current Mars missions. Include details about the purpose of the missions, the scientific instruments, equipment and spacecraft (rover, lander, orbiter or flyby) used and key discoveries from the missions.

2. What are some key details from past and current Mars missions that can be used to help design human-crewed missions to Mars?

3. Based on your research, what would you be interested in studying about Mars during your Mars mission?

4. If no data existed for what you want to study on Mars, what other types of existing data could you use to help plan your part of the mission and understand what you are looking for?

5. Astronomers are not the only ones who study other planets in the solar system. For example, geologists, mineralogists, biologists, meteorologists and engineers are some other types of scientists who work together to design, plan and build missions to Mars. What are some examples of what these scientists study that will benefit the missions?

Group discussion

Your teacher will lead your class or small groups in discussions about what you learned from the research about Mars missions that you completed before class. Remember to include insights from missions that "failed."

1. What were the primary purposes of past and current missions to Mars?

2. What do you notice about the number of mission failures versus the number of successes? How are the failed exploratory missions valuable to teams studying Mars?

3. Discuss a successful Mars mission. What was the goal of the mission? What area of Mars was researched? What spacecraft and instrumentation did the mission require?

4. Discuss a failed Mars mission. What was the intended mission? Why did it fail?

5. Do the Mars missions focus on answering one specific question or lots of different questions? Why do you think this is?

Planning your mission

Every mission starts out with a solid plan. With your group, think about what you would want to study about Mars and what your mission to Mars would need to include to be successful. Discuss past and current missions to Mars and what was learned from the missions. Use this discussion to determine what your team thinks would be valuable to research about the planet before sending astronauts to Mars, then answer the questions below.

1. What is the primary question or goal of your team's mission to Mars?

2. How will the data from your mission benefit planning for human missions to Mars?

3. What measurements will your mission need to make in order to answer your team's question?

4. Based on the measurements your team is interested in taking on Mars, what types of scientific instruments and equipment will you need? Use your research on past and current Mars missions to guide your thinking.

5. Select the kinds of experts you will need for your team's mission. Feel free to add more types of experts if your team thinks they will be needed.

Computer scientist	Biologist	Chemist	Physicist
Astronomer	Mathematician	Geologist	Biochemist
Statistician	Microbiologist	Volcanologist	Meteorologist
Mechanical engineer	Chemical engineer	Medical doctor	Virologist

6. Why will you need these particular experts? What will they do?

7. Select the type of spacecraft your study will require.

Lander	Rover	Orbiter	Flyby

8. Why will this type of spacecraft be best for your team's mission?

9. What are the potential challenges your team will need to overcome to measure useful data?

Bonus

As a bonus activity, your group may want to create a team presentation to deliver to NASA. You may want to research other publicly available presentations from past, current and future missions to determine what you may need to include. Your presentation could be a slideshow or a poster. Include any images that could be useful in describing your mission or instruments. Add any relevant data, graphs or tables that help explain the question you want to research.