



LET'S INVESTIGATE MARS

Student Section _____

Student Name _____

Lesson Objective

To formulate an original, collaborative, inquiry investigation based on recent Mars robotic investigations.

During this lesson, you will

- formulate an original question based on recent Mars robotic investigations.
- formulate an original, collaborative inquiry investigation.
- present their inquiry question and investigation to the class.
- revise the investigation based on feedback from the class.

Problem

What do I need to know about Mars in order to live there in the future?

Safety

Review your classroom, Internet and lab safety rules.

Test Procedure

1. Problem

What do I need to know about Mars in order to live there in the future?

The problem is pre-recorded on your Scientific Inquiry Investigation Chart (Appendix B).

2. Observation

The tests for life used by the Viking Mars missions in 1976 were based on the idea that life would cause changes in the air or soil in the same way that life on Earth does. However, the Viking tests did not detect the presence of life on Mars.

In 2004, NASA landed two robot rovers called Spirit and Opportunity on Mars. These rovers investigated rocks and soil, and took pictures of features that seem to prove Mars was very wet in the past.

Finding evidence that helps prove Mars had liquid water in the past supports the ideas and beliefs that life could have existed on Mars. Many questions about the history of water on Mars are likely to remain unanswered until samples are returned from the red planet for examination on Earth.

Mars is almost certain to have been warmer and wetter in its distant past, so the existence of simple life has been a tantalizing possibility for some time. The real search is just beginning. With robots helping humans explore, we will learn enough about Mars to help make it possible to live there safely.

Record any notes that you have from your observations on the Scientific Inquiry Investigation Chart (Appendix B).

3. Brainstorming, Question

With your crew, you will formulate a question to solve.

You are a mission specialist planning a mission to Mars with your crew. You will live off the land when you get to Mars, using the resources there for survival. To find out about Mars before you travel; you and your crew will plan and implement an investigation using the scientific method.

Keep this thought in mind when you are formulating the question for your investigation: What do I want to know about living and working on Mars?

With your crew, brainstorm and formulate a question for your investigation. Record the question formed from your brainstorming on the Scientific Inquiry Investigation Chart (Appendix B).

4. Hypothesis

On the Scientific Inquiry Investigation Chart (Appendix B), restate your question as a statement based upon your observations and predictions. Share your hypothesis with the class.

An example might be:

Question: "Where will we live on Mars?"

Hypothesis: "My team of mission specialists will live in the lava tubes that are found underneath the surface on Mars."

5. Further Investigation

Your crew should make further investigations about your question, by doing the following:

- Read the web text provided at NASA's KSNN™ 21st Century Explorer newsbreak "Why do we want to study and travel to Mars?" at <http://ksnn.larc.nasa.gov>.
- Conduct research on Mars by using the teacher provided information.
- Use the Further Mars Investigation Chart (Appendix C) as an additional resource for Mars facts.

Record the sources and your notes on the Scientific Inquiry Investigation Chart (Appendix B). Use a separate piece of paper if needed.

6. Title

Your crew should formulate a name for your inquiry investigation. Record your title on the Scientific Inquiry Investigation Chart (Appendix B).

7. Purpose

The purpose of an inquiry investigation is to find out more about something specific.

With your crew, decide on the purpose of your investigation of Mars. Ask yourselves "What is it that your crew wants to know more about?" Record the purpose of your inquiry on the Scientific Inquiry Investigation Chart (Appendix B).

8. Testing Environment

Decide whether or not your crew will be conducting the investigation on Earth or on Mars. If you are conducting the test on Earth, where will you perform your inquiry investigation? Who will do the testing? If you are conducting the test on Mars, how will you get the inquiry investigation there? Who will do the testing on Mars? Record the answers on the Scientific Inquiry Investigation Chart (Appendix B).

9. Materials

What materials will your crew need during the investigation? List your materials on the Scientific Inquiry Investigation Chart (Appendix B).

10. Test Procedure

Formulate the test procedure to answer the question your crew developed earlier. This should be a step by step procedure to test your crew's hypothesis. Keep your tests and the steps simple. On the Scientific Inquiry Investigation Chart (Appendix B), list the steps your crew will use to conduct the investigation. If you need more room for your steps, use the back of the sheet, and continue numbering the steps.

Record Data: Think about the important information you will collect during the test procedure of your inquiry investigation. Your crew will need to develop a data sheet for recording this information. A sample, blank data sheet is shown on Appendix D. What are you trying to find out? Will this data help you solve the problem question? If your data do not fit on this sample sheet, use the back of your paper to make your own. Remember, you will not actually record data, but need to think about how you will collect it. Some things you might want to include on your data sheet are units of measure, title, labels, and key or legend.

Study Data: If you had actually conducted your test, you would have data to study. Your crew will study the data by predicting if the data can be organized graphically. Your crew will then predict which graphic organizer you will use to display your data. It could be a bar graph, a pie chart, a Venn diagram, a pictograph, or something else. Decide on which graphical organizer your group will use and record this on the Scientific Inquiry Investigation Chart (Appendix B).

Conclusion: With your crew, predict what the conclusion might be, based upon your test procedure. Record your predicted conclusion on the Scientific Inquiry Investigation Chart (Appendix B).

11. Present Your Inquiry Investigation

With your crew, plan to present your investigation to the class. Prepare any items for the presentation that you have brought from home. Decide which section of the Scientific Inquiry Investigation Chart (Appendix B), each crew member will read.

12. Evaluation

Your classmates will evaluate you and your crew on your investigation so that you may improve your crew inquiry. You will also do a self-evaluation using the Feedback Form for Crew Presentation (Appendix E). Do not place your names on any of the feedback forms that you use during these presentations. Use the Feedback Form for Crew Presentation (Appendix E) for the evaluations. Use one form per crew presentation.

13. Reflect

After the presentations, answer the following questions with your crew about your investigation.

- How will the inquiry investigation you designed help make Mars more habitable for humans?
- How does your inquiry compare to other groups?
- Could we live on Mars in the future?

14. Revise

How can your crew change or improve your inquiry investigation using the comments from the feedback form? Use the class feedback forms to revise, edit and rewrite your inquiry investigation. How was this class feedback helpful? What changes did you make to your inquiry investigation that improved it, based on your critiques?

Designing a Mars Inquiry Investigation

1. State Problem
2. Make Observations
3. Design Question
4. Formulate Hypothesis
5. Conduct Further Research
6. Title Inquiry Investigation
7. State Purpose of Inquiry Investigation
8. Identify Testing Environment
9. Identify and Locate Materials
10. Formulate Test Procedure
 - Data Collection
 - Study Data
 - Conclusion
11. Present Inquiry Investigation
12. Evaluate Inquiry Investigation
13. Reflect on Presentation
14. Revise Presentation

Appendix B

Scientific Inquiry Investigation Chart

#	Step	Need to do	Crew Records
1	Problem	State the problem.	What do I need to know about Mars in order to live there in the future?
2	Observation	Take notes from observations about Mars.	Watched KSNN? <input type="checkbox"/> Yes <input type="checkbox"/> No Read Observation Section? <input type="checkbox"/> Yes <input type="checkbox"/> No Notes on my observations: (important facts) 1. 2. 3. 4. 5. 6.
3	Brainstorm, Question	Write the question my crew wants to answer.	QUESTION:
4	Hypothesis	Decide on a crew hypothesis.	HYPOTHESIS:

5	Further Investigation	<p>Do further research on your question.</p> <p>My question: _____</p> <p>_____</p> <p>_____</p>	<p>Printed sources:</p> <p>Web sources:</p> <p>My notes:</p>
6	Title	Decide on a title for your investigation	Title:
7	Purpose	Decide on the purpose of your investigation.	Purpose:
8	Testing Environment	<p>Decide where you will do your testing.</p> <p>(circle one)</p> <p>Mars Earth</p>	<p>How will the crew get the test to the test site?</p> <p>Who will do the testing?</p>
9	Materials	Make a materials list.	<p>Materials list:</p> <ol style="list-style-type: none"> 1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

10	<p>Test Procedure</p> <p>If more room is needed to complete the test procedure, you may use the back of these pages.</p>	<p>Write the test procedure (steps for conducting the test).</p>	<p>What, how, and why are the crews testing?</p> <p>What is your crew trying to find out?</p> <p>What are the crews desired results of the inquiry investigation?</p>
		<p>Test Procedure, Step 1 (What do I do first?)</p>	<p>1.</p>
		<p>Test Procedure, Step 2 (What do I do next?)</p>	<p>2.</p>
		<p>Test Procedure, Step 3 (Continue to explain how to test.)</p>	<p>3.</p>
		<p>Test Procedure, Step 4 (Continue to explain how to test.)</p>	<p>4.</p>
		<p>Test Procedure, Step 5 (Continue to explain how to test.)</p>	<p>5.</p>
		<p>Test Procedure, Step 6 (What is the last step in my testing?)</p>	<p>6.</p>
		<p>Collect Data</p>	<p>Make sure you design a data sheet for information you want to record and keep. Design your data sheet using Appendix D or the back of this page.</p>

		Study Data	<p>Will you be able to make your data into a graphic organizer? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Circle the graphic organizer you will use: Bar Graph Pie Chart Venn Diagram Pictograph Other _____</p>
		Conclusion	Predict: What will your conclusion be based on your testing?
11	Present your Investigation Inquiry	Presentation	<p>When? Where?</p> <p>Do we have items to enhance the presentation? List the items and why you chose them.</p> <p>Which section of the chart will each crew member read?</p>
12	Evaluation	Complete the Feedback Form for Crew Presentation (Appendix E).	Fill out one evaluation for each crew as well as for your own inquiry investigation.
13	Reflect	Reflection	What was the feedback from the class, and my crew, on our inquiry investigation?
14	Revise	Revision	How can I change/improve my investigation based on the class feedback?

Appendix C

Further Mars Investigation Chart

	Mars	Earth
Distance from Sun	228,526,848 kilometers (142 million miles)	149,668,992 kilometers (93 million miles)
Radius Distance from the core of the planet to the crust	3,397 kilometers (2,111 miles)	6,378 kilometers (3,963 miles)
Mass	0.11 of Earth's	1
Density	3.94 g/cm ³ (2.075 oz/in ³)	5.52 g/cm ³ (2.91 oz/in ³)
Surface Gravity	0.38 of Earth's	1
Rotation on axis (time it takes for the planet to spin around once on its axis)	24.6 hours	23.9 hours
Revolution around the Sun	687 days	365 days
Temperature at surface	-87°C (-125°F) Low 30°C (-22°F) High	-88°C (-126°F) Low 58°C (136°F) High
Natural Satellites	Phobos and Deimos	The Moon
Atmosphere	Carbon Dioxide	Nitrogen, Oxygen

Appendix D

Title of Data Sheet

Key:

Appendix E

Feedback Form for Crew Presentation

Name of Group: _____

Title of Investigation: _____

Rank the presentations from 1 to 5

1 2 3 4 5

Disagree

Agree

Circle the number 1 – 5

The question was clear.	1	2	3	4	5
The hypothesis was clear.	1	2	3	4	5
The title was consistent with the hypothesis.	1	2	3	4	5
The purpose fit the question.	1	2	3	4	5
I understood the test procedure.	1	2	3	4	5
The data collection chart is clear.	1	2	3	4	5
The group worked together well.	1	2	3	4	5
The presentation was clear.	1	2	3	4	5
Suggestions for improvement: 1. 2. 3.					
Explain how you could have conducted the test in a different way.					