



LET'S INVESTIGATE MARS

Activity topic selected from NASA's KSNNTM 21st Century Explorer newsbreak "Why do we want to study and travel to Mars?"

Educator Section

Introduction

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.

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.

Lesson Objective

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

Problem

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

Learning Objectives

The students 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.

Materials

- NASA's KSNNTM 21st Century Explorer 30-second newsbreak, "Why do we want to study and travel to Mars?" (Download the newsbreak at <http://ksnn.larc.nasa.gov>.)
- computer with Internet access
 - A suggested list of web sites to use for research is located in the Lesson Development Section.
 - It is recommended that you bookmark research web sites on student computers for quicker access during this activity.
- printed materials for research (books, periodicals, printed research from the Internet)

Grade Level: 3-5

Connections to Curriculum: Science

Science Process Skills: observing, classifying, inferring, predicting, communicating
(Association for the Advancement of Science)

Teacher Preparation Time: 30 minutes

Lesson Duration: 2 class periods of 60 minutes each

Prerequisite: none

National Education Standards

addressed in this activity include Science (NSES), Health (NHES), Geography (NCGE), and Language Arts (NCTE) For an alignment to standards in this activity, see page 8.

Materials Required

printed research materials such as current books and magazines or computers with Internet access

Scientific Inquiry Investigation Chart (Appendix B)

NASA's KSNNTM 21st Century Explorer 30-second newsbreak , "Why do we want to study and travel to Mars?"

- Designing a Mars Inquiry Investigation (Appendix A)

Per group (3 or 4 students per group)

- research from Mars resources (provided by the instructor)
 - These resources can be accessed via the Internet on a computer in the classroom or printed out and available for student use.
 - URLs for research web sites are located in the Lesson Development Section.
- Let's Investigate Mars Student Section
- Scientific Inquiry Investigation Chart (Appendix B)

Safety

Remind students about the importance of classroom, Internet and lab safety. Please use Internet Acceptable Use Agreement guidelines as directed by your school.

Pre-lesson Instructions

- Students should work in groups of 3 or 4. Each group will be called a “crew”.
- Create bookmarks for URLs on student computers or print web pages for student use. (URLs are listed in the Lesson Development Section.)
- Print the Designing a Mars Inquiry Investigation (Appendix A) and post in several places around the room for crew use.
- Print copies of the Feedback Form for Crew Presentation (Appendix E) so that each student has one form per crew presentation. (Only one form is included in the Let's Investigate Mars Student Section.)

Lesson Development

To prepare for this activity, the following background information is recommended:

- Read NASA's KSNN™ 21st Century Explorer Web Text Explanation titled “Why do we want to study and travel to Mars?” at <http://ksnn.larc.nasa.gov>.
- Read the following text taken from the Observation Section of the Let's Investigate Mars Student Section.

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.

- To understand how to instruct your class using inquiry education, read the following text. During this activity, your students will formulate questions and an inquiry based, collaborative

investigation using the following guideline on inquiry education from the National Science Education Standards:

What is inquiry in education? The National Science Standards note:

Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.

- The following URL's provide additional information on Mars. These web sites will be used later in the inquiry investigation for student research.
 - To see pictures from Mars: <http://marsrovers.nasa.gov/home/index.html>
 - To find out about a futuristic Mars base: <http://www.exploremarsnow.org/>
 - To play games about Mars, learn more facts about Mars, do fun activities, and find out about special events: http://marsprogram.jpl.nasa.gov/funzone_flash.html
 - To find out what other students are doing with Mars: <http://marsrovers.nasa.gov/classroom/students.html>
 - To participate in a Mars rock program: <http://marsprogram.jpl.nasa.gov/rockworld/>
 - To find out more about the Mars rovers: <http://marsrovers.nasa.gov/classroom/>
- You may want to do research on testing environments. If so, find out more about ground analogs at: <http://www.nasa.gov/centers/ames/research/factsheets/FS-100103.1ARC.html>
- If needed, additional research can be done on the following science topics:
 - Viking Mars Missions
 - Mars rovers: Spirit and Opportunity
 - Mars future habitat
 - ground analogs

Instructional Procedure

Throughout this lesson, emphasize the steps involved in an inquiry based, collaborative investigation. This lesson should be led and monitored by the instructor in order to keep the lesson on time.

This educator section is numbered and correlated to the Student Section and to the Scientific Inquiry Investigation Chart (Appendix B) for instructional purposes. *Educator specific notes appear in italics.*

Use the Scientific Inquiry Investigation Chart (Appendix B) to guide the instructional procedure throughout the lesson. Each student will complete their own chart as the crew designs their inquiry investigation.

Keep the investigations simple.

In order for the students to know how they will be graded, review with the class the performance indicators on the Scientific Investigation Rubric (Appendix F).

Students will form their inquiry based, collaborative investigation using the following procedure. (The following steps are taken from the Student Section. Educator specific comments are in italics.)

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).

Review the problem with the students. Refer students to the Scientific Inquiry Investigation chart where they will see that this has been pre-recorded. Tell the students that they will be using this chart to record their inquiry investigation as they proceed through the steps.

2. Observation

Have the crews make general observations about Mars by doing the following:

- *Show NASA's KSNNTM 21st Century Explorer newsbreak "Why travel to Mars?" to engage students and increase student knowledge about this topic.*
- *Have the students read the Observation Section in the Let's Investigate Mars Student Section and discuss in their crews.*

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).

- *Encourage your students to make notes in the Observation Section 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).

You may want to discuss these sample questions to get them started on a brainstorming session:

- *What is there on Mars for my crew to use to sustain life?*

- *What must my crew take with us to survive?*
- *Is there a fuel source, and an alternative fuel source?*
- *Were will your crew live?*
- *Will your crew grow some of your food in crops?*
- *Will your crew recycle water, air, waste?*
- *Who will you bring with you to Mars?*
- *What is the layout of your community?*
- *Will you and your crew ever leave Mars? If so, when will you leave?*

Make sure the students keep their questions simple.

After brainstorming, the crews will write their question 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: "Were 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."

Encourage crews to refine their hypothesis as needed. After developing their hypothesis, the crews will write their hypothesis on the Scientific Inquiry Investigation Chart (Appendix B).

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>.

You may print the web text for students to read, read the text aloud to the class, or have students visit the web site.

- Conduct research on Mars by using the teacher provided information.

These web sites were provided in the Lesson Development Section. You should have each crew investigate the URL's that are pertinent to their investigation only, in order to keep the lesson on time. You may want to set a time limit for the crews during this Internet research. If computer access is not available to students, material from these web sites can be printed and copied.

- 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).

Remind the crews that the purpose of their investigation is directly tied to the question and their hypothesis.

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).

Ask the crews to think about the following:

- *Where will the crew do the testing? On Earth, as a ground analog? Or, will they conduct their test on Mars?*
- *How will crews get the inquiry investigation to that location?*
- *Who or what will do the testing on Mars?*

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.

The crews will not actually conduct this test; they only need to think of “how” they would test it if they could conduct the test.

This may take longer for some groups. Make sure assistance and ideas are given to each crew to jump start their thinking process. You may want to ask the students to think about the following:

- *What, how, and why are the crews testing?*
- *What is your crew trying to find out?*
- *What are the desired results of your crew’s inquiry investigation?*

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.

Make sure the crews think about their data before designing their data sheet. With the sample, blank data sheet, they can fill in the column and row headers, and use as many or as few rows and columns as needed. Additional rows and columns may be drawn if necessary. A redesigned sheet may have to be made on the back of the paper.

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).

On the Scientific Inquiry Investigation Chart (Appendix B), the crews will circle which graphical organizer they will use, or they can write in their own.

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).

-- SUGGESTED PLACE TO STOP ACTIVITY. RESUME AT NEXT CLASS PERIOD. --

Homework: Assign the class homework to invent a crew name.

Tell your students that they will be presenting their investigations in class. Have them bring from home items that would enhance their presentation. Remind them to keep it simple.

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.

Give the crews time to organize their demonstrations. Then, have each crew present their inquiry investigation to the class.

Make sure to conduct evaluations during each presentation – see Step 12. Evaluation.

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.

Make enough copies of the Feedback Form for Crew Presentation (Appendix E) so that each student has one form per crew presentation.

Each student who is evaluating an inquiry investigation should provide alternative explanations for testing the crew's hypothesis on the evaluation form.

After evaluations are complete, collect and redistribute the feedback forms to the correct crews.

NOTE: If time does not allow for this presentation, the teacher may provide individual crew feedback using the same form.

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?

Lead the class in a discussion to the answers of these questions.

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?

Crews should reflect on their inquiry investigation and revise it according to the written evaluation of their presentation to the class.

Assessment

- Assess student knowledge through questioning.
- Observe and assess student performance throughout the activity using the Scientific Investigation Rubric (Appendix F).
- Assess student knowledge based on written comments from the class on the Feedback Form for Crew Presentation (Appendix E).
- Objective assessment may be given to the Scientific Inquiry Investigation Chart (Appendix B).

Activity Alignment to National Education Standards

National Science Education Standards (NSES):

Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry (K-8)
- Understandings about scientific inquiry (K-8)

Content Standard B: Physical Science

- Properties of objects and materials (K-8)

Content Standard C: Life Science

- Organisms and their environment (K-4)
- Populations and ecosystems (5-8)
- Diversity and adaptations of organisms (5-8)

Content Standard D: Earth and Space Science

- Properties of Earth materials (K-4)
- Earth in the solar system (5-8)

Content Standard E: Science and Technology

- Abilities of technological design (K-8)

Content Standard F: Science in Personal and Social Perspectives

- Types of resources (K-4)
- Changes in the environment (K-4)

National Health Education Standards (NHES):

Health Education Standard 3: Students will demonstrate the ability to practice health-enhancing behaviors and reduce health risks.

- 4: demonstrate strategies to improve or maintain personal health

National Mathematics Education Standards (NCTM):

Representation Standard:

- Create and use representations to organize, record, and communicate mathematical ideas

- Select, apply, and translate among mathematical representations to solve problems

Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others

U.S. National Geography Standards (NCGE):

- Standard 14: How human actions modify the physical environment
- Standard 15: How physical systems affect human systems
- Standard 18: How to apply geography to interpret the present and plan for the future

National Language Arts Standards (NCTE):

- Standard 1: Students read a wide range of print and non-print texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.
- Standard 4: Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Standard 8: Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Standard 12: Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

Curriculum Explorations

To extend the concepts in this activity, the following explorations can be conducted:

Mathematics

Discuss the different types of graphic organizers the crews used, and the type of data represented. Discuss the reasoning for selecting the graphic organizers and the pros and cons of each type.

National Mathematics Education Standards (NCTM):

Representation Standard:

- Create and use representations to organize, record, and communicate mathematical ideas
- Select, apply, and translate among mathematical representations to solve problems

Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others

Language Arts

Crews can look at similar questions and inquiry investigations from the class presentations and write descriptions of how these inquiry investigations would benefit NASA in developing a Mars habitat in the future.

National Council of Teachers of English Standards (NCTE):

- Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

History

Are there laws in space? If so, how do they govern space travel, other planets, and heavenly bodies? Who makes the space laws? What is in store for the future of space law? Do research to answer the questions, and prepare a timeline of the development of laws in space.

National Council for Geographic Education (NCGE):

- Standard 18: To apply geography to interpret the present and plan for the future.

Liberal Arts

Design a new crew patch to represent your crew on their investigation to Mars. This URL may be helpful in creating your crew patch:

<http://schools.spsd.sk.ca/victo/projects/Grassroots/Planet%20WebQuest/crewpatch.html>. Visit this web site to view mission patches from previous NASA spaceflights:

http://www.hq.nasa.gov/office/pao/History/mission_patches.html.

National Visual Arts Standards:

- Content Standard 3: Choosing and evaluating a range of subject matter, symbols and ideas
- Achievement Standard: Students
 - explore and understand prospective content for works of art
 - select and use subject matter, symbols, and ideas to communicate meaning

Sources and Career Links

Thanks to subject matter experts John Connolly and Kurt Klaus for their contributions to KSNNTM and Noticias NASA™ on the development of this education material.

John F. Connolly is currently assigned to NASA Headquarters' Exploration Systems Mission Directorate as a Special Assistant to the Associate Administrator. He leads the Agency's effort to design the lunar architecture that will return humans to the moon. You can find out more about Mr. Connolly at <http://exploration.jsc.nasa.gov/marsref/toc.pdf>.

Kurt Klaus is a planetary geologist, formerly an exploration geophysicist. He currently works with The Boeing Company. He has been involved in special projects such as the Mars Society's Mars Desert Research Station, and the Crew Exploration Vehicle Program. He has a B.S in Geology, a Master's Degree in Planetary Geology, and is an alumnus of the International Space University.

Original lesson development by the NASA Johnson Space Center Human Health and Performance Education Outreach team.

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.					

Appendix F

Scientific Investigation Rubric

Experiment: LET'S INVESTIGATE MARS

Student Name _____

Date _____

Performance Indicator	0	1	2	3	4
The student developed a clear and complete question and hypothesis.					
The student followed all directions and safety rules.					
The student followed the steps in the formulation of a scientific inquiry.					
The student completed the Scientific Inquiry Investigation Chart.					
The student participated in preparing the presentation.					
The student revised their investigation according to the written class feedback on the Feedback Form for Group Presentation.					
Point Total					

Point total from above: _____ / (24 possible)

Grade for this investigation _____

Grading Scale:

A = 22 - 24 points

B = 19 - 21 points

C = 16 - 18 points

D = 13 - 15 points

F = 0 - 12 points