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Objectives:

- Explore, support and challenge the technical, physiological, social and ethical issues around human space exploration.
- Evaluate the risks and rewards of spacefaring, and discuss why a manned mission to Mars is, or is not, appropriate for the human species.
- Determine motivation for, or against, traveling to Mars and justify this decision with information and logic.
- Gather information about the Red Planet, including average temperature patterns, atmospheric conditions, distance from the sun, and other factors that ultimately influence space travel design and preparation.

Background Information

Humans have dreamed of traveling into space for many years. The pursuit of exploring beyond our Earth has been persistent and enduring. Since the beginning of the 20th Century, space programs have worked diligently to develop the technology and information systems necessary to send explorers into space. Consequently forming a market of competition among participating countries (i.e, China, Germany, Russia and the United States), the desire to explore space initiated the engineering of rockets, and later, plans to send humans into space.

The United States, an active and accomplished contributor to space travel, successfully sent its first satellite, Explorer 1, into orbit on January 31, 1958. Several years later, in 1961, the U.S.'s Alan Shepard became the first American to fly into space. Continuing to send men into space, on February 20, 1962, John Glenn became the first American to reach Earth's orbit. Finally, on July 20, 1969, with sights on exploring new planets in our solar system, Neil Armstrong took "a giant step for mankind" as he stepped onto the Moon (source: Aerospace). Now, with increased attention on furthering our exploration to other planets, developing a detailed plan to complete the first manned mission to Mars is being pursued.

The first images of Mars were taken by the Mariner 4, a fly-by spacecraft sent into orbit in 1965. Since then, while dozens of orbiters, landers and rovers have been launched into space to study the Red Planet, only about one of every three missions has been a success. Yet, information and data received from these

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successful missions have provided an interesting insight into the topography, atmosphere, weather and geology of a planet yet to be explored by humans.

In 2016, President Barack Obama set a clear goal to send humans to Mars by the 2030s. President Donald Trump has also echoed the urgency of achieving this task. Currently, commercial partners are working to build new habitats that can sustain and transport astronauts on long-duration missions in deep space. These missions will teach us how humans can live far from Earth.

There are many documented and published reasons for sending humans to Mars. These include discovering information about Mars that cannot be achieved by robots, inspiring current and future scientists, building morale and prosperity for the United States, the growth of diplomacy, and arguably the most significant, the advancement and expansion of humanity.

Elon Musk, the CEO and founder of Tesla and SpaceX, explains the need for humans to expand past this planet (source: Nu Sci):

> I really think there's a fundamental difference, if you sort of look into the future, between a humanity that is a spacefaring civilization, that's out there exploring the stars, on multiple planets, and I think that's really exciting, compared with one where we are forever confined to Earth until some eventual extinction event.

While significant achievements have been made in planning and preparing for the first manned mission to Mars, educating the public about the risks and rewards of space travel is important. Information gained from space explorations provide an abundance of new ideas and ground-breaking technologies that are used in our day-to-day living.

Infographics, a resource growing in popularity, are often used to simplify a complicated or mundane subject into an interesting and attractive visual. A tool to educate and inform, infographics integrate words and graphics to reveal information, patterns or trends. Created with the understanding that humans receive input from all five sense, but significantly more information through vision, infographics balance visual content (colors, theme) with content (data, information) and knowledge (insight into the content).

Inquiry Overview

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In the following activity, students will be presented with a Request for Information which will set the stage for studying and planning a Mars mission to launch in 2033. After brainstorming a list of known characteristics about Mars, students will participate in Mars: Manifest Destiny, a board game designed to introduce basic information about the Red Planet while introducing several technical, social and ethical issues which surround space travel. Students will work collaboratively to share thoughts regarding the risks and rewards of traveling to Mars while summarizing the implications of this task.

Next, students will reflect on their knowledge of space travel, Mars, and information gained from the board game to evaluate three questions:

- **Should we, as a human species, go to Mars?**
- **Should we, the United States, go to Mars?**
- **Would you go to Mars?**

Then, after viewing a series of infographics, students will work with a partner to design their own infographic that answers the question, "What should a person know about traveling to Mars?" This visual resource will demonstrate a balance of informational content and images, and will be shared with the class as a tool to present complex information quickly and clearly.

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Activities

Activity 1: Mars: Manifest Destiny

Objectives:

- Explore, support and challenge the technical, physiological, social and ethical issues around human space exploration.
- Gather information about the Red Planet, including average temperature patterns, atmospheric conditions, distance from the sun, and other factors that ultimately influence space travel design and preparation.

Standards:

CCSS ELA/Literacy: 6.RI.7, 6-8.W.2, 6-8.SL.1

***Estimated Time* (60 minutes total):**

- **15 Minutes – Presentation of Letter**
- **35 Minutes – Board Game**
- **10 Minutes – Debrief**

Materials:

for each student:

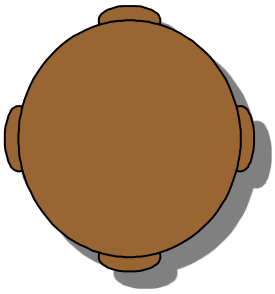
- *Student Pages*

for each team of four:

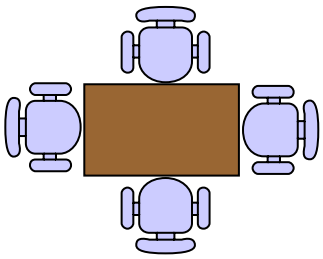
- 1 Mars: Manifest Destiny Game Board
- 1 Die
- 1 set of Game Cards
- 4 Playing Pawns (four separate colors)

for the teacher:

- Game Directions PowerPoint
- Request for Information PowerPoint
- 1 piece of Chart Paper
- 1 Chart Marker



Seating Arrangement



Suggested Inquiry Approach:

Arrange students in groups of four. It is important that students are seated around a circular or rectangular table so they are directly across from one another. Please rearrange the classroom, if necessary.

Begin by displaying the Request for Information PowerPoint. This document can be located in the Teacher Resources file of this unit in the Content Classroom at learning.imsa.edu.

Allow several minutes for students to read the document. Then, pose the following questions to the whole class and select individual students to share their thoughts:

- **Why do you think people are so interested in traveling to Mars?**
- **The letter says that you will "study a Mars mission to be launched in 2033." What do you think is involved in planning a space mission?**

- **How old will you be in 2033?**

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Then, ask students:

- **What do you know about Mars?**

As students share their ideas, record their thoughts on the provided chart paper. It is suggested that this visual remains in a location within the classroom to reference throughout the entirety of this curriculum. This record serves as evidence of students' prior knowledge and will evolve as they experience new learning opportunities and challenges.

Next, distribute student pages, the Mars: Manifest Destiny Game Board, number die, game cards and four playing pawns. Refer to the directions as provided on the student pages. A PowerPoint slide is also available to display for the students. This can be found in the Teacher Resources file of the Content Classroom at learning.imsa.edu. Take several minutes to answer any questions that students may have about playing the game. Allow 30-40 minutes for students to complete the game. Once each team has finished, they should discuss and answer the reflection questions on their student pages.

Debrief Activity 1:

Following completion of the game, ask students to talk among their teams and summarize the information they learned while playing the game. Suggested questions for discussion include:

- ***What information presented in the game surprised you the most? Why?***
- ***Why do you believe people are so interested in going to Mars?***
- ***What do you think would be the first step in preparing to travel to Mars? Why do you think this?***
- ***Who do you think is involved in planning a manned mission to Mars? What is their role?***
- ***What do you think the title of the game,* Mars: Manifest Destiny, *means?***

Students may wish to return to the game at any time throughout the curriculum.

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Activity 2: Visualizing the Information

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Objectives:

- Explore, support and challenge the technical, physiological, social and ethical issues around human space exploration.
- Evaluate the risks and rewards of spacefaring, and discuss why a manned mission to Mars is, or is not, appropriate for the human species.
- Determine motivation for, or against, traveling to Mars and justify this decision with information and logic.

Standards:

CCSS ELA/Literacy: 6-8.W.2, 6-8.SL.1, 6-8.SL.5

***Estimated Time* (90 minutes total):**

- **15 Minutes – Introduction**
- **45 Minutes – Infographic Design**
- **15 Minutes – Share and Debrief**

Materials:

for each student:

- *Student Pages*

for each group of two:

- 9”x12” Colored Construction Paper
- 12”x18” White Construction Paper
- 9”x12” Neon Construction Paper
- 1 pack of Colored Markers (to be shared)
- 1 set of Game Cards from Activity 1
- *Computer with Internet Access (optional)*

for the teacher:

- Infographics PowerPoint

Suggested Inquiry Approach:

Students will begin this activity by reforming the small groups from Activity 1. Each group should be provided with the appropriate student pages and game cards from the *Mars: Manifest Destiny* board game.

Select one volunteer to read the Background Information aloud. Then, provide several minutes for the students to read and discuss the three focus questions:

- **Should we, as a human species, go to Mars?**
- **Should we, the United States, go to Mars?**
- **Would you go to Mars?**

To answer these questions, students may refer to the information provided on the game cards, in addition to prior knowledge and insights gained from their peers, to provide a rationale for their answers. Students should record their responses and opinions in the provided space on the student pages. Encourage students to justify their reasoning with appropriate information.

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Once all small groups have completed their work, allow students to share their thoughts as a whole class. During this conversation, reiterate to students that there is no one, correct answer to the preceding questions. When discussing social and ethical issues, all ideas and thoughts are to be respected and welcome.

The Content Classroom can be located at imsa.learning.edu

At this time, display the Infographics PowerPoint, located in the Teacher Resource folder of the Content Classroom for this unit. Explain to the students that infographics are visual representations that are used to share information. Students will use this resource to present information that would be important for a person to know if they were to consider traveling to Mars.

For each infographic included in the PowerPoint, allow students to discuss the information or data illustrated and make simple observations about how the visual content is displayed. At the end of the PowerPoint, pose the following questions to the whole class:

- **What do you notice about the information presented in the infographics?**
- **What do you notice about the visual characteristics of the infographics, such as the colors, shapes, amount of content on the page, etc.?**
- **How long did it take you to understand the "message" of each infographic?**

Inform students that they will now create an infographic to organize and display information that would be useful to someone that is considering traveling to Mars.

After dividing each small group into partner teams, students should sort the *Mars: Manifest Destiny* game cards into two piles according to color: blue and yellow. Each partner team should then take a pile of cards. Information presented on the cards may be used as content for the infographic.

Students may also refer to their own knowledge of Mars and space exploration to construct their infographic. Alternatively, students could further investigate a facet of traveling to Mars by completing their own research.

<u>Note:</u> If resources allow, students may also create their infographic online using design software such as Piktochart. This website requires students to login with a pre-established email address. Once an infographic has been completed,

students may share or print their document.

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Once students have completed their infographic, allow several minutes for volunteers to share their image with the class. Encourage students to elaborate on the information they chose to represent and how they constructed their graphics. Once each partner team has presented their visual, reconvene for a whole class debriefing session.

Debriefing Activity 2:

- ***What do you believe are the most significant rewards of completing a manned mission to Mars?***
- ***What do you believe are the most significant risks of attempting a manned mission to Mars?***
- ***Why do you believe people are so interested in space travel?***
- ***On October 4, 1957, the Soviets launched the first artificial satellite, Sputnik 1, into space. Since then, hundreds of astronauts, rockets, rovers and satellites have been sent into space. How do you think space exploration has benefited our population?***

Extension

Students may choose to display their infographics outside of the classroom to provide classmates outside of IMSA Fusion with information about traveling to Mars. This would also provide students an opportunity to ask the question, "Would You Go to Mars?" and poll classmates during the regular school day. Students may also choose to ask, "Why or why not?" to survey explanations in response to their initial question. IMSA Fusion students could then use this information to predict what aspects of traveling to Mars are attractive, or worrisome, to their peers.

Prepare an area for students to exhibit this information. A bulletin board or whiteboard is recommended.

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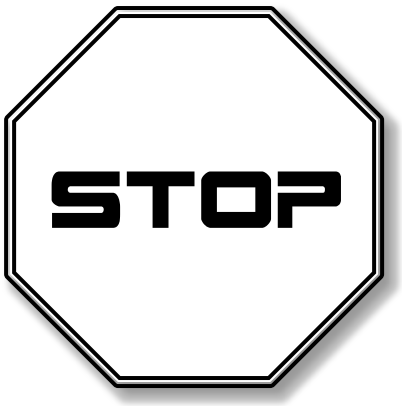

Before moving on to the next unit, be sure to submit your feedback to the Content Classroom at https://learning.imsa.edu/

Mars: Manifest Destiny

Request for Information:
From the office of Professional Field Services of the Illinois Mathematics and Science Academy

On March 21st, 2017, President Trump signed into law bill S.422, the NASA Transition Authorization Act of 2017. In this law, NASA is directed to contract with an independent organization to study a Mars mission to be launched in 2033.

The Illinois Mathematics and Science Academy (IMSA) plans to be the organization which develops that study for NASA.

By reaching out to Fusion students for ideas, IMSA can directly involve the very generation which will be building the spacecraft and making the voyage of exploration to Mars.

The scientists, engineers, managers, and astronauts who conquer Mars in 2033 are currently students in elementary and middle schools. Who else could be as motivated to take on this challenge?

Your IMSA Fusion class has been selected to participate. Your ideas are needed. Help us fulfil our destiny to be a nation of explorers and a spacefaring species.

Dr. Norman "Storm" Robinson III
Executive Director, Professional Field Services
Illinois Mathematics and Science Academy

Background Information: In the 19th Century, **manifest destiny** was the belief that the United States was destined to stretch from coast to coast, across North America. During this time, the American people viewed it as their virtue, mission and destiny to expand their society. In his 1776 pamphlet, *Common Sense*, Thomas Paine explained this opportunity, stating, "We have it in our power to begin the world over again. A situation, similar to the present, hath not happened since the days of Noah until now. The birthday of a new world is at hand…" Today, with an eye on Mars and plans to complete the first manned mission to the Red Planet, many have stated that our new destiny is to look beyond our Earth for resources to sustain mankind. Mars, a **terrestrial** planet considered Earth's analog in terms of hospitable environments, may serve as an option. However, the rewards of space travel, or **spacefaring**, do not come without risk.

Questions of Interest:

- Why do people want to go to Mars?
- What are the risks and rewards of completing a manned mission to Mars?

Materials:

- **1 Mars: Manifest Destiny Game Board**
- **1 set of Game Cards**
- **4 Playing Pawns (of different colors)**
- **1 Die**

Aim of the Game:

Be the first player to travel from Earth to Mars. Along the way, you will encounter obstacles and achievements as you experience the rewards of space exploration and the risks of the mission.

Preparation:

Begin by selecting a playing pawn and shuffling the deck of game cards. Position the game board so all players can easily move their pawns from circle to circle. Set up the game board placing each player's pawn on EARTH and the game cards in the rectangle labeled DRAW. Place the number die on the game board.

How to Play:

Each player will roll the die. The player that rolls the highest number will begin as *Player 1*. Play will continue in a **clockwise** manner (unless instructed otherwise!) for each player turn.

When it is your turn, roll the die and move your pawn, circle by circle, the number shown on the die. If at any time you can move, you must move, even if it's to your disadvantage. Two or more pawns may be on the same space at the same time.

If you land on  **,** draw a game card. Read the information on the card aloud and follow the instructions as written. If you are instructed to exchange game piece locations with an opponent but do not wish to do so, you may forfeit your move. After completing the instruction on the game card, place the card in the DISCARD pile. If all game cards in the DRAW pile have been used before the end of the game, shuffle the cards in the DISCARD pile and replace them back in the rectangle labeled DRAW. Continue play.

Winning the Game:

The first player to reach Mars wins the game. You must land there by exact count. If your roll would take you past Mars, you cannot move. Try again on your next turn.

Discuss:

- **What information present in the game surprised you the most?**

- **Why do you believe people are so interested in going to Mars?**

- **What do you think would be the first step in preparing to travel to Mars?**

- **What are the risks of traveling to Mars? What are the rewards?**

Background Information: While significant achievements have been made in planning and preparing for the first manned mission to Mars, educating the public about the risks and rewards of space travel is important. Historically, the idea of space exploration has excited and intrigued many people. However, for some, the risks of this feat outweigh the rewards. In the following activity, you will create an **infographic** to illustrate valuable information that people should know about traveling to Mars.

Headline: What should a person know about traveling to Mars?

Materials:

- **1 set of Mars: Manifest Destiny Game Cards**
- **Construction Paper**
- **Colored Markers**

Procedure:

1. Reflecting on your knowledge of space travel, Mars, and information you gained from playing *Mars: Manifest Destiny*, answer the following questions. Justify your reasoning.

Should we, as a human species, go to Mars?	Should we, the United States, go to Mars?	Would you go to Mars?

2. Take several minutes to view the Infographics PowerPoint with your instructor. In the space below, record any observations you notice about the information presented and visual characteristics of each infographic.

3. Working together, separate the *Mars: Manifest Destiny* game cards into two colors according to color (blue or yellow). Then, divide your small group into two partner teams. Each partner team will take one color.

4. You and your partner will now design an infographic, complete with content and visual images, to answer the question "**What should a person know about traveling to Mars?**"

5. Using the information written on the game cards, or your own knowledge of space travel and Mars, record data and information that you will include in your infographic. You may also make notes of any images, color schemes, symbols, or other characteristics that you will use to make your infographic: