

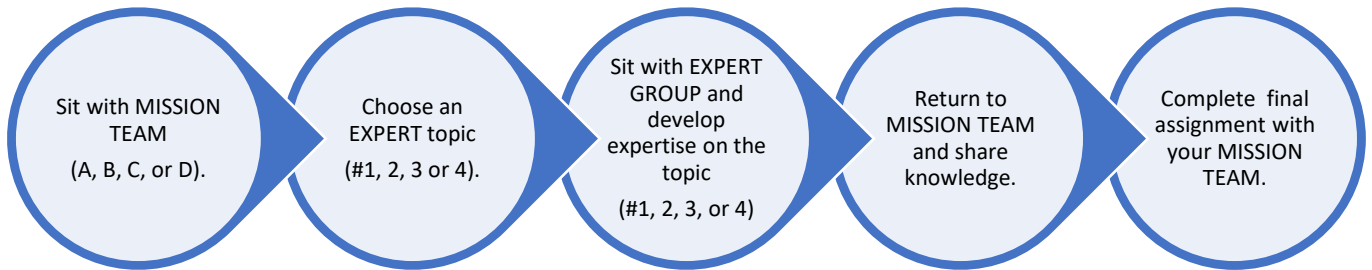
Mission Team Name: _____

MARCH TO MARS: STUDENT HANDOUT

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Instructions: Today you will perform a classroom jigsaw activity. During this exercise, you will become experts on a topic related to the Mars Science Laboratory (Curiosity) Mission and/or the Mars 2020 (Perseverance) Mission. After developing expertise with your Expert Group, you will teach your peers (Mission Team) what you have learned, and collaboratively synthesize the information to plan a manned mission to Mars. Your team's mission proposal will then be shared with the class, and in the end only one of the team's proposals will be "supported" through a class vote. Follow the procedure outlined below as indicated by your instructor.

Watch as a Whole Class: <https://www.youtube.com/watch?v=pwipxdQ74pU>



Expert Group Topics

- #1 – Curiosity Mission Overview & Rover
- #2 – Curiosity Landing Site, Findings, and Future
- #3 – Perseverance Mission Overview & Rover
- #4 – Perseverance Landing Site, Findings, and Future

March to Mars Products

- Each student will turn in their notes/images/answers to questions from their expert group work (there may be 1 or 2 students per submission, depending on team organization)
- Each Mission team will submit the following
 - o A report (summary) of the Curiosity and Perseverance Missions
 - o A written “Manned Mission Plan” (using the template provided)
 - o An oral “Manned Mission Proposal” (the class will vote which to support)

EXPERT GROUP 1 – CURIOSITY MISSION OVERVIEW & ROVER

Read and take notes on the following:

- *Curiosity Mission Overview*
<https://mars.nasa.gov/msl/mission/overview/>
- *Mission Timeline*
<https://mars.nasa.gov/msl/mission/timeline/>

Answer the following questions based upon what you have learned.

- What are the important dates for the Curiosity Mission (aka. launch, landing, mission end)?
- What are the overall goals of the Curiosity Mission?
- Does the Curiosity Mission represent the work of a single group of scientists at the NASA facility or a large group from various institutions around the country?
- Describe the major phases of the mission.
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

View the 3D-printed Curiosity Mars Rover. What observations can you make about the rover based on the 3D model?

Identify a few features that you want to know more about.

View and take notes on the following:

- *Curiosity Rover*
<https://mars.nasa.gov/msl/spacecraft/rover/summary/>
- *Building Curiosity: Mars Rover Goes from Shake to Bake*
https://www.youtube.com/watch?v=N7ibTj_wkkU
- *Building Curiosity: Rover at Kennedy Space Center*
<https://www.youtube.com/watch?v=R4lF5Wzl0ek>
- *How Does NASA's Curiosity Rover Work*
<https://www.youtube.com/watch?v=liypQHadr8>
- *The Launch Vehicle*
<https://mars.nasa.gov/msl/spacecraft/launch-vehicle/summary/>

Answer the following questions based upon what you have learned.

- What are the dimensions and major features/instruments of the Curiosity Mars Rover?
- What is meant by “Shake and Bake” testing and why is it important?
- What features can you clearly identify on the 3D Model?
- What was the launch vehicle for the Curiosity Rover and what specific features/characteristics of the spacecraft are critical in getting the rover to Mars?
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

EXPERT GROUP 2 – CURIOSITY LANDING SITE, FINDINGS, & FUTURE

Read/view and take notes on the following:

- *Landing Site Selection*
<https://mars.nasa.gov/msl/mission/timeline/prelaunch/landingsiteselection/>
- *Simulated View of Gale Crater Lake on Mars*
<https://www.nasa.gov/jpl/msl/pia19080>
- *A Guide to Gale Crater*
<https://www.youtube.com/watch?v=Q-uAz82sH-E&feature=youtu.be>
- View the 3D-printed Gale Crater

Answer the following questions based upon what you have learned.

- What were the final four candidates for Curiosity landing sites, and why was the Gale Crater chosen?
- What is the diameter of Gale Crater?
- How was the Gale Crater thought to have formed?
- Which aspects of the crater could have supported life?
- What general observations can you make about this site based on the 3D-printed model?
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

Read/view and take notes on the following:

- *Curiosity's Path to Mount Sharp*
<https://www.jpl.nasa.gov/video/details.php?id=1255>
- *Curiosity's Location*
<https://mars.nasa.gov/msl/mission/where-is-the-rover/>
- *NASA's Curiosity Mars Rover Looks Back on Murray Buttes (Interactive 360 View):*
<https://www.nasa.gov/feature/jpl/full-circle-vista-from-nasa-mars-rover-curiosity-shows-murray-buttes>
- *NASA's Curiosity Mars Rover at Ogunquit Beach (Interactive 360 View):*
https://www.youtube.com/watch?time_continue=1&v=V3qr9AqZyEI
<https://www.jpl.nasa.gov/spaceimages/details.php?id=pi11242>
- *Curiosity Mission Reports*
<https://mars.nasa.gov/msl/mission/mars-rover-curiosity-mission-updates/>
- *10 Years of Curiosity (watch the video)*
<https://mars.nasa.gov/news/9240/10-years-since-landing-nasas-curiosity-mars-rover-still-has-drive/>

Answer the following questions based upon what you have learned.

- How long has Curiosity been on Mars?
- What is the approximate distance that Curiosity has traveled to date?
- Describe the path (including landmarks) that the rover has passed since it landed on Mars.
- Why was this path chosen for the mission?
- What happened on the weekend of Sol 1600? What happened on the weekend of Sol 1831? What happened on Sols 3098-3100? What happened on Sol 3639?
- What are the major findings of the Curiosity mission to date?
- What is next for the Curiosity mission?
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

EXPERT GROUP 3 – PERSEVERANCE MISSION OVERVIEW & ROVER

Read and take notes on the following:

- *Perseverance Mission Overview*
<https://mars.nasa.gov/mars2020/mission/overview/>
- *Mission Timeline*
<https://mars.nasa.gov/mars2020/timeline/overview/>

Answer the following questions based upon what you have learned.

- What are the important dates for the Perseverance Mission (aka. launch, landing, mission end)?
- What are the overall goals of the Perseverance Mission?
- Does the Perseverance Mission represent the work of a single group of scientists at the NASA facility or a large group from various institutions around the country?
- Describe the major phases of the mission.
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

View and take notes on the following:

- *Perseverance Rover – Interactive 3D Visualization*
<https://mars.nasa.gov/mars2020/spacecraft/rover/>
- *Building Perseverance*
<https://mars.nasa.gov/mars2020/multimedia/videos/?v=420>
- *Test Driving Perseverance*
<https://mars.nasa.gov/mars2020/multimedia/videos/?v=422>
- *Ingenuity*
<https://mars.nasa.gov/technology/helicopter/#Overview>
- *Building the Spacecraft*
<https://mars.nasa.gov/mars2020/multimedia/videos/?v=413>
<https://mars.nasa.gov/mars2020/spacecraft/overview/>
- *The Launch Vehicle*
<https://mars.nasa.gov/mars2020/spacecraft/launch-vehicle/>

Answer the following questions based upon what you have learned.

- What are the dimensions of the Perseverance Mars Rover?
- Describe five important features/instruments on the Perseverance rover (and their purposes) from examining the interactive 3D visualization.
- What is “Ingenuity” related to this mission, and what are some of its key features?
- Is the spacecraft built linearly from beginning to end, or are different parts built simultaneously and then assembled?
- What specific features/characteristics of the spacecraft are critical in getting the rover to Mars?
- What was the launch vehicle for the Perseverance rover?
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

EXPERT GROUP 4 – PERSEVERANCE LANDING SITE, FINDINGS, & FUTURE

Read/view and take notes on the following:

- *Landing Site Selection Process*
<https://mars.nasa.gov/mars2020/mission/science/for-scientists/landing-site-selection/>
- *The Landing Site*
<https://mars.nasa.gov/mars2020/mission/science/landing-site/>

Answer the following questions based upon what you have learned.

- What were the final three candidates for Perseverance landing sites, and when was Jezero Crater finally chosen?
- What is the diameter of Jezero Crater?
- How was the Jezero Crater thought to have formed?
- Which aspects of the crater could have supported life?
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

Read/view and take notes on the following:

- *Perseverance Surface Operations*
<https://mars.nasa.gov/mars2020/timeline/surface-operations/>
- *The Interactive Jezero “Hiking” Map*
<https://phys.org/news/2022-09-virtual-hiking-jezero-crater-mars.html>
<https://maps.planet.fu-berlin.de/jezero/>
- *Perseverance’s Location*
<https://mars.nasa.gov/mars2020/mission/where-is-the-rover/>
- *Explore with Perseverance*
<https://mars.nasa.gov/mars2020/surface-experience/?drive=1222&site=26>
- *Perseverance Rock Sampling*
<https://mars.nasa.gov/mars-rock-samples/>
- *Ingenuity Flight Log*
<https://mars.nasa.gov/technology/helicopter/#Flight-Log>

Answer the following questions based upon what you have learned.

- How long has Perseverance been on Mars?
- What is the approximate distance that Perseverance has traveled to date?
- Describe the path (including landmarks) that the rover has passed since it landed on Mars.
- How many rock and atmospheric samples have been collected to date? Choose one sample and indicate its Sample number, type, date of collection, and rock/outcrop of origin.
- What happened on of Sols 1-12? What happened on Sols 34-47? What happened on Sol 3639? Include your favorite image from each event.
- How many flights has Ingenuity taken to date? What have been the maximum altitude, horizontal distance, and duration for a flight? Choose and include your favorite image captured by Ingenuity.
- What would you consider the major findings of Perseverance to date?
- What information that you have learned above might be important to know in order to plan a manned-mission to Mars? What more would you want to know? Seek out answers to your questions.

FINAL ASSIGNMENT: PLANNING A MANNED MISSION TO MARS (MISSION TEAMS)

Return to your Mission Team. Each expert should share with their team what they have learned about their rover and missions for about 2-3 minutes each. Be sure to pass around any 3D printed models.

Complete the following using the template provided. Synthesize the expertise that your group has gained describe the critical aspects of the Curiosity and Perseverance Missions in 1-2 paragraphs (Mission Reports). Then, using the knowledge gained, supportive evidence from your Expert Groups, and critical thinking, plan a manned mission to Mars that would be focused in the one of the regions of the planet that these missions explored and expand/extend/confirm its findings (Manned-Mission Proposal). Include images/visuals in each document where beneficial.

Wrap Up

Choose a spokesperson (or two) who will share your team's Manned-Mission Proposal with the class. After all Manned-Mission Proposals are shared, the class will vote on which to support. At the end of class, turn in your group's Mission Reports and Manned-Mission Proposal documents to your instructor.

Mission Name:

Team Members:

The Curiosity & Perseverance Mission Reports (1-2 paragraphs summarizing key points)

Manned-Mission Proposal

Address each of the topics below, including your team's reasoning for each decision.

Mission Goals:

Personnel (Number, Demographics, Expertise):

Landing Site:

Base Camp Site:

Studies to Conduct:

Sites for Sampling/Exploration:

Expectation of Findings:

Duration of Mission:

Impact for Human Colonization:

Other Aspects/Features: