



THE MARS SOCIETY

*“Don't let anyone rob you of your imagination, your creativity, or your curiosity.
It's your place in the world; it's your life.*

Go on and do all you can with it, and make it the life you want to live.”

- Mae Jemison, first African-American female astronaut in space

Dear Friends of the Mars Society:

One objective of publishing grade-specific Mars curricula is to allow any educator, student, or Mars enthusiast to follow consistent and specific learning standards, lesson plans, assignments, and materials that will allow educators to teach STEM concepts that relate to the planet Mars. Our proposed curriculum is intended to serve as a guide to educators worldwide, thus allowing educators across the globe to have a common resource from which to draw instructional materials. We believe you will find it to be a versatile, scaffolded design enabling each grade level to build upon the previous. It is student-friendly and administrator-friendly.

As a global collaborative effort to educate and inspire, we believe it is essential to teach specific subject matter at the grade levels suggested below. If this is done successfully, then students from around the world will be receiving daily instruction that will allow them to move seamlessly from school to school. How this material is taught will be a matter of personal style, experience, and daily classroom opportunities, but we assert that the framework must be the same to promote the desired learning outcomes.

Mars is the next step in human exploration. Therefore, we must be committed to providing our children with as much information as is relevant to their age group. Knowledge is power, and our success is dependent on information sharing. We must also have the willingness as a global society to do so.

The Mars Society aims to profoundly impact STEM education in America and around the world. For students in the United States, our goal is to institute a national educational effort that will become the STEM standard at all grade levels. If we can present coordinated, internationally curated curricula to schools, administrators may be more willing to accept it. We ask all educators or please adopt it and promote it widely.

Our ultimate goal is to inspire and prepare the next generation for human space exploration and settlement. We invite you to join us on this important educational journey.

On To Mars,

James Burk
Executive Director
The Mars Society

Special thanks to Tom Becker, Erv Baumann, Adrian Hon, Michael Foster, Jorge Mermoz, and Nicole Willet for organizing the original draft of this curricula.

Mars Curriculum 1

Elementary School Level: Grades K-6

Objectives:

- To describe Mars as a unique planet and a possible future home for humanity
- To learn how humans will explore and settle on Mars with colonies
- To instill in young people a vision of being pioneers to Mars

Student Learning Paths in K-6 Science/Geography Setting:

Kindergarten - Emphasize solar system and Requirements for Human Life

- Understand the Earth as a sphere
- Learn about the solar system as humankind's "neighborhood"
- Identify Earth as a planet in the solar system
- Describe Mars as the fourth planet in the solar system
- Identify Mars as "The Red Planet"
- Relate the distance of Mars from Earth
- Identify requirements for human life on Earth and how each is met on Earth
- Understand travel in a spaceship
- Understand travel to Mars in terms of time and distance

Grade 1 - Emphasize Space Travel and Comparative Planetology

- Name the planets in the solar system; discuss gravity
- Identify Mars as a neighbor to Earth
- Compare the size of Earth and Mars, noting Mars is slightly more than half the size of Earth
- Learn how Mars is different from Earth as an environment, ex: geology, temperature
- Describe Mars' polar regions; compare them to Earth's polar regions
- Learn about the difficulties in reaching Mars
- Learn about the requirements to survive in space
- Identify the requirements for human life to survive on Mars

Grade 2 - Emphasize Mars Topography and Major Features

- Examine Mars as the source of “Martians” in Earth’s mythology
- Discuss science fiction novels such as: *War of the Worlds* by H.G. Wells and *A Princess of Mars* by Edgar Rice Burroughs and their impact on science
- Discuss science fiction movies such as: *John Carter*, *Star Wars*, and others and their impact on people entering the field of science as a career
- Discuss the Martian landscape, including the scattered rocks, ancient riverbeds, and regolith
- Identify the major features of Mars topography in general terms: craters, extinct volcanoes, canyons, valleys, ridges/plateaus
- Identify Mars’ unique atmosphere, presence of liquid water on or beneath the surface, now and in the past
- Name and locate the following major features, and compare to similar Earth features: Olympus Mons, Tharsis Dome, Tharsis Mountains, Mariner Valley, Elysium Mons, Hellas Basin, Argyre Plain/Basin, North and South Poles

Grade 3 - Emphasize Geology and Findings of Major Robotic Missions To Mars

- Identify the revolution and rotation for Earth and Mars both
- Identify the major missions to Mars and (in general terms) their results
 - Mariners 4, 6&7, 9, Vikings 1&2, Soviet Phobos, Pathfinder/Sojourner, and Mars Global Surveyor, ESA’s Mars Express, MER Spirit and Opportunity Rover, the Phoenix Lander, MSL Curiosity Rover, Insight Lander, Mars 2020/Perseverance Rover, etc.
 - Use photographs from the missions
- Describe what Mars might have been like in the distant past based on geological clues, and compare with Earth
- Identify the cause and results of seasons on Earth and Mars (axial tilt)
- Discuss the concept of “canals” conceived by Lowell and Schiaparelli

Grade 4 - Emphasize Colonization Requirements and Hostile Factors

- Identify comets, meteorites/micrometeoroids and asteroids, including Heat Shield Rock, which was the first meteorite discovered on another planet (Mars)
- Examine factors on Earth that encouraged colonization at (Plymouth, Jamestown, etc.)
- Examine factors on Mars that would encourage colonization, determine what kind of landing site would be appropriate
- Examine atmospheric and geological conditions hostile to human life
 - Volcanism, dust storms, dryness, perchlorate in regolith, radiation, lack of rainwater, etc.
- Learn about the Greenhouse Effect on Earth and Venus in terms of clouds and radiation
- Search maps of Mars for suitable colonization sites in terms of limits for human survival

Grade 5 - Emphasize Factors Of Everyday Life In A Mars Colony

- Relate current Martian expeditions and goals to exploration/settlement of Mars
- Determine details of what early human colonization on Mars might be like
 - Domed cities, inflatables, living inside craters, valleys, caves
- Discuss methods of communication and transportation on Mars
- Determine methods of farming, mining, manufacturing in a Mars colony
- Identify specific factors in artificially creating a Mars hospitable environment
- Identify and discuss the concept of terraforming
- Identify the use of law (exopolitics), religion, creative arts (music-paintings-movies)

Grade 6 - Emphasize Real-Life Careers And Colonization Factors

- Examine and discuss possible careers in Martian colonies
- Identify the role of the Mars Society Flashline Mars Arctic Research Station and how the research station was created
- Identify and describe commitments of Earth inhabitants in colonizing Mars as a future permanent home
- Relate the efforts of The Mars Society to encourage the exploration and colonization of Mars

Mars Curriculum 2

Middle School Level Grades 7 & 8

Objectives:

- Provide group and individual hands-on learning experiences in Mars studies and rocketry
 - Permit students to construct flyable and static spacecraft models
 - Create original drawings and three-dimensional representations of Mars features
 - Construct table-top models of Mars on-site structures such as habitats, rovers, living quarters, mining sites, enclosed farms
- Improve computer skills using space-oriented websites, especially NASA, ESA, ISAS, Planetary Photojournal, PDS, Malin Space Science Systems, JPL, ASU, and USGS

Student Learning Paths In Grades 7 & 8 in Mars landscapes, reality-oriented spacecraft, and colony structures.

Grade 7 - Emphasize Mars Geology, Major Features, Model Rocketry

- Build and launch a number of different-sized model rockets and make records of their flights using standard terminology and measurements
- Build table-top models of Mars major features: (clay, paper mache, etc.)
 - Olympus Mons, Ascræus Mons, Hellas Basin, etc.
- Make blueprint type drawings
 - Possible Mars colony structures
 - Mars Arctic Research Station
- Improve personal computer skills

Grade 8 - Emphasize Improvement of Model Building, Blueprinting, Computer Skills

- Provide students with accurate maps of Mars and help them identify unusual or lesser-known features
- Continue to encourage the building of more detailed table-top models of features
- Assist students with more mature blueprint-type drawing concepts (Mars features, spacecraft for travel to Mars, colony structures)
- Continue to improve personal computer skills utilizing Mars-related websites such as Google Mars, The Mars Society, The Mars Society Education Page, etc.
- Invite planetary scientists or Mars Society representatives to the classroom for dialogue between professionals and students
- Encourage students to interview scientists either in person or via the Internet (Skype, WebEx, Google Meet, Zoom, E-mail)

Mars Curriculum 3

Upper High School Levels Grades 9-12

Objectives: (Throughout the 4 grades)

- Prepare students to host a Science Night at school (in spring), including the culmination of all sciences the students have learned
- Emphasis on individual skills development at a higher level
- Prepare for university-level instruction
- Scaffolded introduction of classic and theoretical physics, including astrophysics
- Use of local telescopes for individual or group project work
- Personal contact with scientists and the work of various scientists
- Mars project work leading to written papers with illustrations, triptychs, presentations, and dioramas (may be included in the school's Science Night)
- In-depth study of major and minor Mars features
- Continue keeping Mars news up-to-date at least weekly, including discoveries of Mars spacecraft (ex: Mars News Journal, Weekly Mars News, etc.)
- Original research work in Mars studies in grades 11 and 12
- Off-campus work in a science laboratory or university setting
- Reading professional literature: Science, Icarus, Scientific American, and other scientific journals
- Detailed improvement of computer skills, including using social media to contact professional scientists, astronauts, private space corporations, create school webpages, etc.

Grade 9 - Emphasize Improvement of All Personal/Pre-Professional Skills

- Detailed research of hostile environments in space and on the Martian surface
- Self-drawn inclusive full Mars maps with appropriate labeling
- Begin a concentrated program of detailed analysis of Mars regions to study possible landing/colony sites
- Study of research methods of classic astronomers and current astronomers: Kepler, Huygens, Brahe, Newton, Sagan, Dr. Chris McKay, et alia
- Introduction (NOT in-depth) of theoretical astronomy and physics concepts
- Hands-on familiarity with telescope usage and viewing
- Personal or class visit to a scientific laboratory and/or telescope observatory
- Utilizing the internet for research, including scientific journals and reputable websites
- Hands-on projects of building geological structures

Grade 10 - Emphasize Improvement of Individual Research and Concept Skills

- Use of local telescopes for individual or group project work
- Personal contact with scientists, local astronomy clubs, and local universities with planetariums and/or observatories
- In-depth study of major and minor Mars features including landscapes, poles, possible tectonics, atmospheric and magnetic properties
- Small group Mars data assembly projects: atmosphere, impact cratering
- Heavy emphasis on remote sensing technologies and data transmission
- Use of computer software to assemble facts and numerical data utilizing Excel activities
- Study of scientific films such as Pathfinder, Roving Mars, The Mars Underground, the Science Channel, YouTube, etc.
- Hands-on projects of dioramas of Martian habitats and science stations

Grade 11 - Emphasize Improvement of Individual Research and Concept Skills

- Use of space-related internet websites for tutorials and monitoring events
- Fine-tune drawing and writing skills by research activities and submitted science papers
- Analysis and/or critique activities: articles in scientific journals or magazines such as Science, Icarus, Scientific American
- Discussions and investigations of professional careers in science, including career preparation and daily work
- Monitor past, present, and future research findings and activities of the Flashline Mars Arctic Research Station
- Development of public speaking through student lectures utilizing PowerPoint, prez.com, sliderocket.com, or other slideshow websites which would include explanations to the class of various concepts and research results

Grade 12 - Emphasize Improvement of Individual Research, Concept Skills, and Leadership

- Off-campus research assignments in various Mars and astronomical studies
- Preparation of original research paper using journal articles, legitimate websites, books, and other pertinent sources, including direct contact with scientists
- Internship at a local science company, observatory, or university in order to study methods and instruments (if possible in your area)
- Use of original personal photography as part of research activities
- Close contact with science professionals to study methods and daily work
- Continued study of appropriate professional articles in science journals
- Study of books and ideas about space colonization, for example:
 - *The Case for Mars: Zubrin*
- Hands-on projects building robots, rovers, rockets, etc.
- Senior year should include the organization and implementation of a Science Night, which should be the culmination of all science that the students have learned
 - Subjects covered are physics, chemistry, biology, astronomy, astrobiology, geology, human factors research, etc.
 - Models, robotic rovers, dioramas, presentations, etc. should all be included