IMSA Fusion

IMSA Fusion is a teacher professional development and student STEM enrichment program for Illinois students who are talented, interested and motivated in mathematics and science. IMSA Fusion places a special emphasis on students who are historically underrepresented in those areas. Fusion works with teachers and students in grades 4-8.

In brief, the program goals are:

- Maintain or increase students interest, involvement and literacy in science and mathematics
- Enhance the knowledge and skills of teachers in science, mathematics, and technology; stimulate excellence in schools
- Stimulate excellence in schools' science and mathematics programs
- Help increase access to programming for students who are historically under-resourced in science, mathematics and technology and for all areas of the state

By design, the IMSA Fusion curriculum is inquiry based, problem centered and integrative. The learning experiences focus on helping students "learn how to learn" and emphasize logic, mathematical thinking and experimental scientific thinking. Topics relate to the students' lives, thereby arousing their curiosity and increasing their motivation to learn.. Teachers from each participating school are supported with on-going professional development for the delivery of the curriculum and use of appropriate pedagogy.

Mars: Manifest Destiny

Designed for Grades 6-8

From the earliest days of space exploration, no other object has excited the imagination of writers, scientists, engineers, and the public more than Mars. A neighbor in space, and visible to the naked eye on many clear evenings, the Red Planet beckons.

The development of modern rocketry was advanced by visionaries such as Robert Goddard and Werner von Braun, who always considered Mars to be their true destination. Today, we have the technology to make that dream a reality. What's more, there is a compelling reason to go, beyond the human instinct for exploration. Life on Earth has suffered a series of extinction events over its long history and there is no reason to expect the future to be uneventful. Becoming a multi-planetary species is the surest means of securing a long and prosperous future for humanity.

If Mars proves to be without native life, as seems likely given our current understanding, then human colonists will one day become "the Martians". There is, however, another possibility. Although no evidence for life of Mars has yet been discovered, much research in this area continues. If native life, even microscopic, is discovered on Mars, then the moral equation changes completely. Past campaigns of colonization in the name of Manifest Destiny have had catastrophic results for native populations in the Americas and elsewhere. What would it mean for life on Mars? Could humans colonize Mars without driving the native ecology to extinction?

Such questions cannot be answered without a more complete understanding of the Red Planet. Humans may go to Mars in the 2030's, as currently planned. Most likely, they will find no Martian organisms to worry about. Even if they should, and governments decide against colonization, the discovery and in-situ study of Martian organisms would be the most astounding achievement of the century. There is no reason not to begin planning the first manned mission to Mars immediately. Your students begin today!

Students completing this curriculum will understand that:

- Mars is a hostile environment. Although conditions there are quite different from Earth, both landscapes were shaped by many of the same physical processes. Certain unique features of Mars, however, are being studied closely. Citizen scientists can make a contribution to this effort.
- Designing a manned mission to Mars will be one of the greatest technical challenges ever undertaken by mankind. Yet, the challenge is largely one of complexity and cost. There are no hurdles which are beyond current scientific understanding.
- The ultimate goal of establishing a permanent colony on Mars will depend on finding ways to utilize Martian resources to attain complete self-sufficiency.

Mars: Manifest Destiny
Unit Summaries

Spacefaring or Extinct

This unit introduces the problem-centered challenge of designing the first manned mission to Mars. The first activity activates prior knowledge and allows students to play a board game. The game introduces many of the social and ethical issues involved in sending humans to Mars, as well as the hazards those astronauts will face. Student groups will then create infographics depicting their views on “What should a person know about travelling to Mars?”.

Environmental Conditions

Students compare the environments and landscapes of Earth and Mars. Using actual data from spacecraft orbiting Mars, students will construct multi-layer maps of the for the purpose of selecting the most advantageous landing site for their mission. Using an online tool called Mars Trek, students can virtually explore their chosen landing site as well as other interesting features on the surface of the Red Planet.

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Unit Summaries

Citizen Science

Students will study photographs of interesting features on the south polar ice caps. Using materials to simulate Martian soil and ice, students will conduct experiments in an effort to model the observed features. Finally, they will use an online website to classify the features as part of an ongoing research project called Planet Four, involving citizen scientists across the globe.

Orbital Mechanics

This unit addresses some of the misconceptions students are likely to have about space travel. They will study elliptical orbits and learn how to shift from one orbit to another using the least possible amount of energy and fuel. Finally, they will chart a transfer orbit to Mars and calculate the critical factors which will drive the subsequent design of their spacecraft.

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Unit Summaries

To Boldly Go

Students begin by observing a video of a rocket launch before using a set of materials to test an idea they have about how a multi-stage rocket works. They will learn the role of the Space Launch System in getting heavy payloads into orbit. As they continue planning their first mission to Mars, students will determine how many astronauts are needed as well as the mass and volume of consumable supplies which those astronauts will need to complete the mission objectives selected by the class.

Mars Transit Vehicle

In this unit, students will design a Mars Transit Vehicle capable of taking their crew to Mars and returning them safely to Earth. Using realistic design constraints and decisions made in previous units, students will calculate everything from the size of the storage lockers to the size of solar panels and thermal radiators. As they design, they will assemble a 1/100 scale prototype of their vehicle.

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Unit Summaries

Mission Architecture

Students will learn to construct Gantt charts and apply this knowledge to plan their mission. Once they have their plan charted, it will be used to help them make rapid decisions in the face of unexpected system failures. Go or abort? Students must decide.

Ice Truckers

Students will consider the requirements for a Martian cargo rover. After seeing examples of other rovers, students will design, build, and test a prototype of their own. The emphasis will be on communications and cooperation between small teams as students are introduced to the concept of Systems Engineering.

Mars: Manifest Destiny
Unit Summaries

We are Martians

Students will consider the practical difficulties of constructing a permanent colony on Mars. First, they will experiment with construction techniques and materials by building and testing domes of simulated Martian concrete. Next, they will examine what it means for a community to be self-sufficient by looking at their own communities on Earth. Finally, they will design the physical layout of a colony for 500 Martian settlers.