

# Activities—Designing Spacesuits for Mars

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Technology Education, Science, and Mathematics



## Introduction:

The steps spacesuit engineers and technicians followed in achieving a goal of creating reliable spacesuit systems for exploration of the surface of the Moon and for construction and maintenance work in Earth orbit were the same as those used in nearly every technological endeavor:

### Challenge

Design and construct a protective garment that will permit humans to venture safely into outer space and perform work.

### Research

Investigate the environment in which the garment will be worn and determine what protective measures must be employed.

### Management

Organize the effort into teams that design suit subsystems and investigate and select appropriate materials and technologies.

### Fabricate Prototypes

Construct and assemble suit subsystems into the completed garment.

### Evaluate

Test the garment in a simulated space environment and make modifications where needed.

### Manufacture

Construct operational spacesuits.

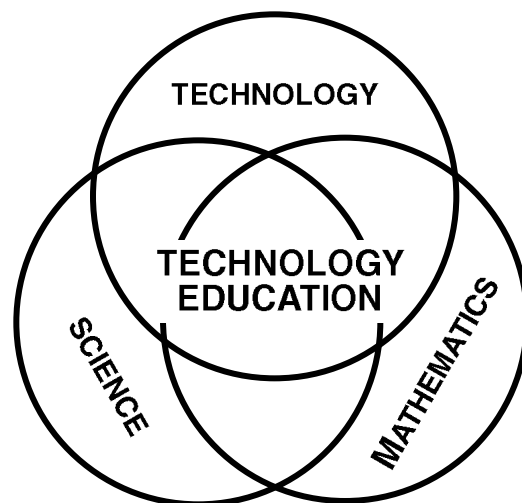
### Ongoing Evaluation

Continue refining spacesuit subsystems to improve efficiency, reliability, versatility, and safety while lowering costs.

The pages that follow outline a multifaceted technology education activity on spacesuits. This activity, designed for an entire class to work on as a

team, combines skills and content from science, mathematics, and technology. The challenge is to design and build a full-scale wearable model spacesuit to be used to explore the surface of Mars. Since no human expeditions to Mars are planned for many years, actual Martian spacesuits have not yet been built and there are no "right" answers. Consequently, this activity permits students to participate in "leading edge" research.

The overview of the activity is contained in a Design Brief format. It begins with a title and a context statement (introduction) and is followed by a challenge to create a Martian spacesuit. This is followed by information on materials, equipment, procedures, and evaluation. The success of the activity depends upon how well the students organize their work and communicate with each other. A computer with project software can be used to monitor the progress of the project or a flow chart can be constructed on a chalk or bulletin board. As an added aid to communication, Interface Control Documents (ICD) are created as systems are designed. (Reproducible master on page 49. Sample



*Technology Education is a multi-disciplinary subject combining mathematics, science, and technology.*



document on page 50.) These documents are completed by the teams. Critical details about systems, such as size, shape, and function, are recorded on the form. The form has a grid where diagrams can be made. ICD forms are then placed in a notebook and made available to all teams as a coordination tool. An ICD master is provided.

If desired, the project can be divided among several classes (or even several schools) which will each have to work together. This is the way major NASA projects are divided between contractors and sub-contractors located across the country.

To support the activity, a collection of Teacher Tech Briefs (TTB) are included. These briefs provide suggestions for your use when guiding students in accomplishing their tasks. For example, if student teams conclude that high-speed particles (micrometeoroids) are a problem in the Martian environment, plans are provided for a device that measures impact damage to materials. TTBs are not intended as "blue

prints" for students to use. Rather, they provide information on one of many ways in which the task can be accomplished. Students will build an impact test stand of their own design. TTBs aid you in facilitating the students' ideas. Following the TTBs is a section on spacesuit testing apparatus used at the NASA Johnson Space Center. The apparatus are "one of a kind" devices created by following the same design process students will use.

Exploration Briefs (EBs) are suggestions for activities that can be used to help students understand the nature of the environment for which they are designing a spacesuit. They provide background information and instructions for simple demonstrations and experiments that may be tried. A "bank" of additional ideas follow the EBs.

The guide concludes with appendices that list resources, such as NASA publications and Internet web sites, where students can obtain more information to help them in their research and development work.

