MISSE-X

Materials International
Space Station Experiment-X

For the Teacher

Challenge

In this challenge, students recreate the MISSE-X mission and test a variety of materials for properties and abilities to stand up to wear-and-tear.

Materials

Variety of plastic recyclable materials that are used in other challenges (food storage tubs, small medicine cups, film canisters, bubble wrap, tin foil, clear wrap, insulated cups, wire mesh, large lightweight fabric scraps, wrapping paper, tissue paper, plastic trash/grocery bags, or plastic tablecloths).

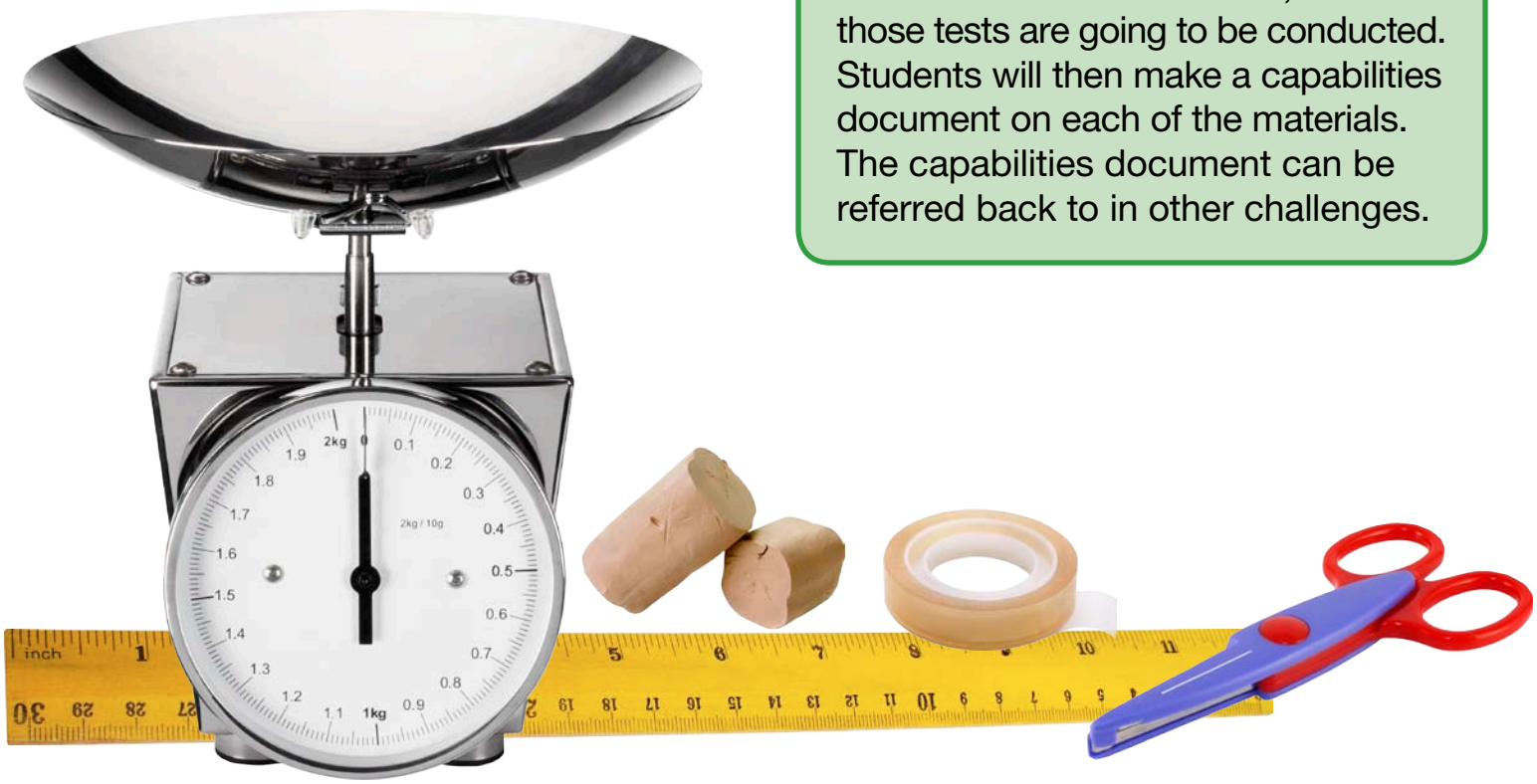
Other materials may be suggested by the students (and subject to teacher approval) such as effervescent tablets, hand sanitizer, etc.

Items required for this activity:

- Large plastic trays or copy paper box lids to hold the various materials
- Hair dryer
- Access to freezer
- Scissors
- Something to wear out the materials with—hammer, mallet, sandpaper, etc.
- Clear tape
- Rulers
- Digital scale or balance

Pre-Activity Set-up

In this challenge, students will set up their own scientific investigations. Students determine which materials will be tested, what types of tests should be conducted on the materials, and how those tests are going to be conducted. Students will then make a capabilities document on each of the materials. The capabilities document can be referred back to in other challenges.



For the Teacher

Motivate

- This challenge is about how NASA's research benefits not only the space program but life on Earth. Learning how materials react in space and on Earth can save time and money. In this activity, students will learn also about the material capabilities.
- Discuss the extreme environment of space and what types of elements materials would be exposed to over time. (Cold, heat, micrometeoroid impact, radiation exposure, etc.)
- Discuss the MISSE-X (see *Background*) and which materials have been tested on the International Space Station in previous missions.
- Videos and more information about MISSE-X available at *http://www.nasa.gov/mission_pages/tdm/missex/index.html* and *http://www.youtube.com/watch?v=YzAbGmc2fBc*
- Introduce the challenge.

Ask

- Have students ask, what can this material do? (stretch, fill up a space, provide strength, hold liquids, bend, remain rigid, etc.) Challenge them to think "outside the box." For example, a trash bag is not just for holding trash. It could be cut into smaller pieces or it could be crumpled to provide insulation.

Imagine

- Have students ask, in what ways can we test this material? (How can we see if it will be strong enough, durable enough: what are the limitations of the material, etc?) Can we pull it, puncture it, heat it, cool it, throw things at it, etc.? Students will also need to determine a scale for "grading" the material.

Plan

- Students will need to plan the proper steps to test the material. How long is the test going to take? Is it feasible to do in the classroom setting? If not, what are other solutions? What are the limitations? How are you going to measure results?

Create

- Is any prep or setup needed to conduct testing?

For the Teacher

Experiment

- Follow the directions and answer the questions on the *Experiment and Record* sheets.

Improve

- After completing the first round of testing, students make modifications to their tests to get better, clearer results, learning more about the capabilities and limitations of the materials.

Challenge Closure

Students write a one paragraph capabilities statement on each material tested. The capabilities statement should be factual and provide both the capabilities and the known limitations of the material

Engage the students in a discussion by reviewing all of the data and posing the following questions:

- What was challenging to you in this activity?
- If you had more time and/or resources, what would you have wanted to be able to do?
- What information could engineers working on this project learn from your team's findings?

Safety Concerns

In this activity, keep common sense safety in mind. Possible things to be aware of:

- Students using tools to damage various materials.
- Students need to use caution when heating materials.

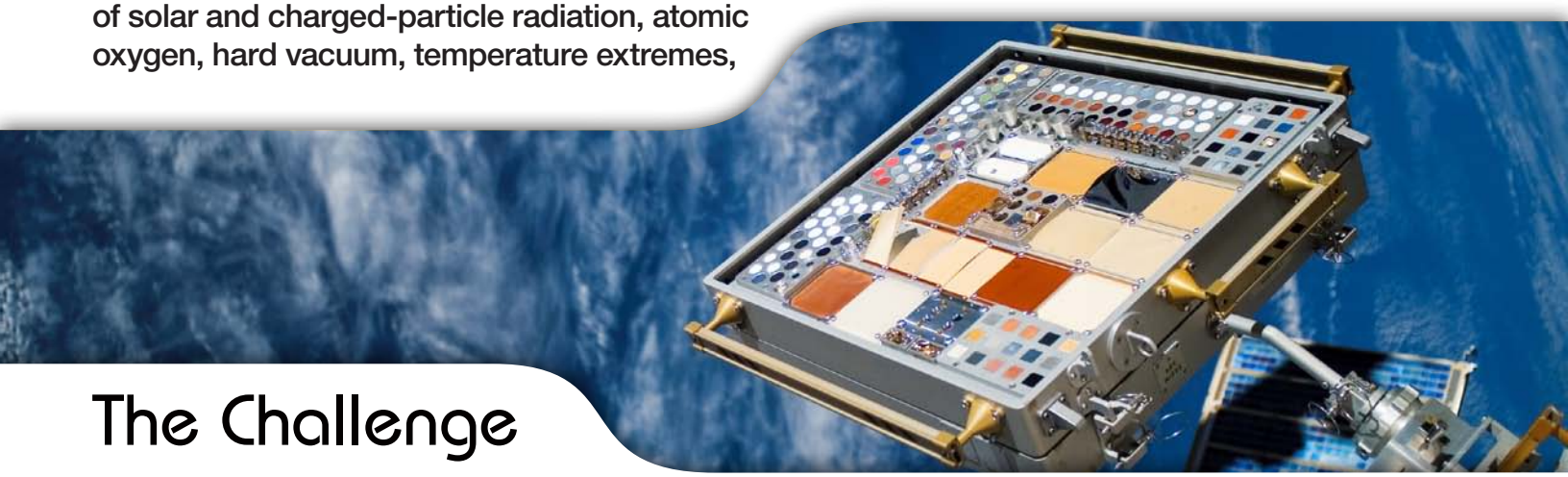
Background

MISSE-X

Since 2001, NASA's Materials International Space Station Experiment-X (MISSE-X) series has tested 4,000 material samples and specimens—from lubricants and paints to fabrics, container seals, and solar cell technologies—to demonstrate their durability in the punishing space environment.

Flown 220 miles above the Earth, fixed to the exterior of the International Space Station for periods of up to four years, these innovative experiments endure extreme levels of solar and charged-particle radiation, atomic oxygen, hard vacuum, temperature extremes, and contamination, giving researchers unprecedented insight into developing durable materials for spacecraft, flight hardware, and even astronaut clothing.

Find videos and more information about MISSE-X available at *http://www.nasa.gov/mission_pages/tdm/missex/index.html* and *http://www.youtube.com/watch?v=YzAbGmc2fBc*



The Challenge

Set up your own scientific investigations. Determine which 2–3 materials you will test, what types of tests should be conducted on the materials, and how those tests will be conducted. Obtain teacher approval before testing any materials. Follow the Engineering Design Process steps:

- Ask—What can this material do?
- Imagine—In what ways can we test this material?
- Plan—Plan the proper steps to test the material.
- Create—How is the test going to be set up?
- Experiment—Conduct the tests on the materials.
- Improve—Make modifications to test capabilities and limitations of the materials.
- Conclusion—Write a capabilities paragraph on each of the materials for other students to use as a reference in future challenges. Paragraph needs to be factual and state only known capabilities and limitations. Assumptions should not be made.

Reminder For All Challenges

- Be sure to document all testing results.
- Make any necessary design changes to improve your results and retest.
- Complete all conclusion questions.

Our Team's Plan

Name of Material _____

ASK

What can this material be used for?

IMAGINE

In what ways can we test this material?
Determine a scale for "grading" the material.

PLAN

Plan the proper steps to test the material. Why are you using this test for this material?

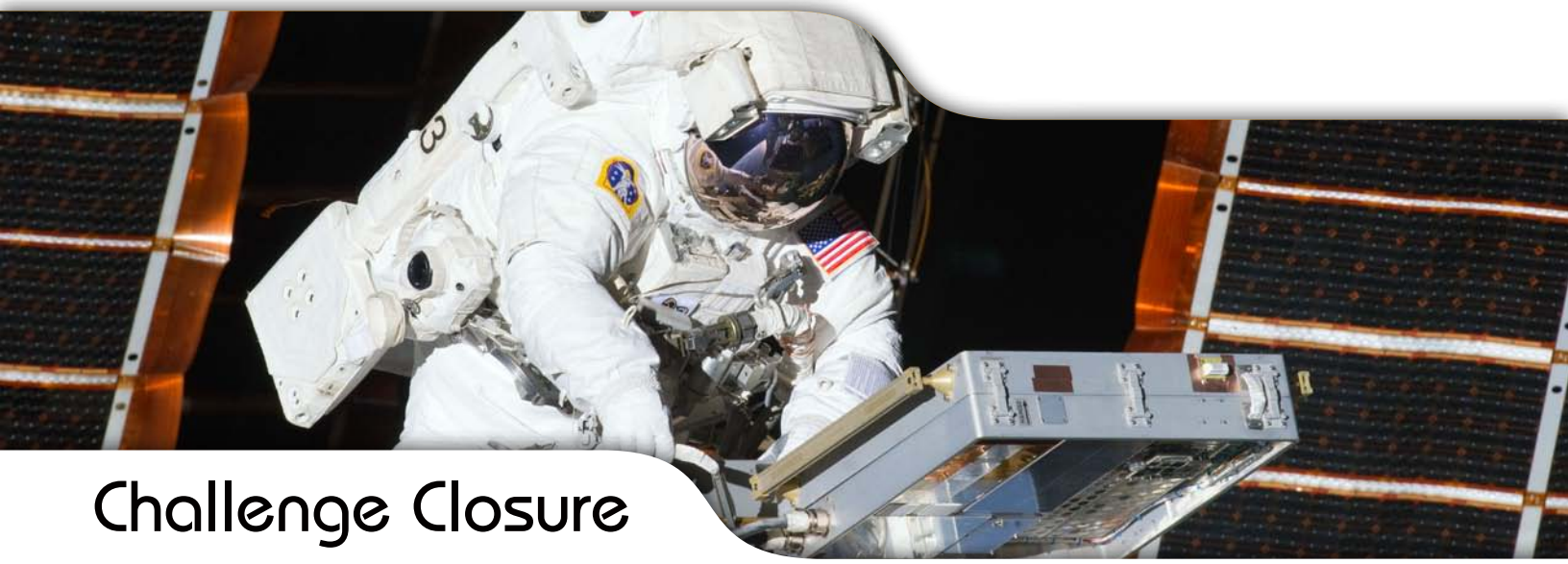
Be sure to include measurements!

Experiment & Record

Team Name_____

Create charts, diagrams, and graphs to collect your data. Include the information about the review criteria you will use. Please use additional sheets of paper as needed.

After you have concluded your first round of testing, what changes are you going to make to collect more accurate data?



Challenge Closure

1. Write a one paragraph capabilities statement on each material tested. The capabilities statement should be factual and provide both the capabilities and the known limitations of the material. Use additional paper or complete in a word processing or presentation document.

2. What was challenging to you in this activity?

3. If you had more time and/or resources, what would you have wanted to be able to do?

4. What information could NASA engineers working on the MISSE-X project learn from your team's findings?

More Fun With Engineering

MISSE-X

Activity One:

NASA Spinoffs—There have been over 1,800 documented technologies, materials, and procedures that have resulted from NASA research since it created the Technology Utilzation Progam in 1962 by congressional mandate. An annual report is published each year highlighting the ingenuity of American inventors, entrepreneurs, and application engineers, along with the willingness of a government agency to assist them. This program continues to ensure a global competiveness and technological leadership by the United States.

Go to the NASA Spinoffs Website and research about three different Spinoffs of your choice. *http://spinoff.nasa.gov/* You can just look for highlighted Spinoffs or search under a specific topic. Then answer the following questions.

What three Spinoffs did you research today?

Did you know this was a NASA Spinoff before you learned about it today?

Which of these Spinoffs are applicable to your life?

What other items do you think are NASA Spinoffs? Did you try to research them?