

How Do We Generate Energy for Human Outposts?

Project Introduction

Space engineers know that one of the most important resources for human survival in space is electrical power. High above Earth is the International Space Station (the ISS). It relies on electrical power for heating and cooling, as well as air flow, lighting, and (most important of all) the life-support systems that make it possible to live there.

Since the ISS is in space and outside Earth's atmosphere, one of the best resources available is solar power. Stored in specially designed rechargeable batteries (just like much bigger versions of the one in your mobile phone) the electrical energy is vital if the astronauts are going to survive and carry out all their tasks.

As humans begin to plan missions to Mars or even to nearby asteroids, we need to work out how power can be used economically to support life. The solar arrays used on the ISS are still very fragile and may not work so well as we travel further away from the Sun. What are our options?

Topics to Be Covered

- Energy production
- Energy transfer
- Energy consumption
- Designing energy-efficient systems
- Types of energy

Objective

Students will learn about transfer of energy and how energy availability regulates the capability of a human outpost in space. Students will identify and explain the advantages and disadvantages of various energy-generation methods in a space-based application.

Classroom Time

Three to four hours, depending on the number of groups presenting.

Materials Required

Computers with Internet and printer access will also be helpful, as well as a poster board and access to computer-based presentation tools such as PowerPoint.

Lesson Starter

You could start by asking your class why energy is essential for surviving in space. Listen to their ideas. Introduce the idea that energy runs all of the systems on the International Space Station. Is that something that they had thought about before? What are their opinions?

Ask them what they think is needed to survive in extreme environments such as an outpost on the Moon, on Mars, or on an asteroid, and how electricity may fit within this. You could also get them to think about all of the electrical equipment in their lives. Which ones are luxuries and which ones would be hard to live without?

There are other questions that you might like to consider. How would the change from being a one-planet species to one that lives away from Earth, change the way we produce energy? How would we stay warm in space? How would we warm water for eating or showering? How would we store our food? Explore with your class what resources could be used in a given environment to provide a space base with energy.

Lesson Development

The objective is for each group to decide where to locate their own space outpost and to think about its energy needs.

Each group should first discuss some of the issues involved and be encouraged to do further research on the issues involved in a space outpost, by using the library or the Internet. You may also want to invite locally based engineers or scientists to talk about the subject.

Students should choose their outpost location and then analyse, plan, and choose the power generation appropriate for their outpost location. They need to think about which power source would be most beneficial in the unique environment of each destination.

The students can then design an outpost that includes elements such as living quarters, work areas, storage, and locations for their power supply. They can then decide which items they would take with them.

Final Presentation

Your students should develop a poster and oral presentation explaining their research, providing potential solutions and challenges within the topic the group has chosen. Students need to make their presentation as a team, making sure each team member has a role. The presentation should include an explanation of how their solution can solve the challenge of generating energy for a human outpost in space.

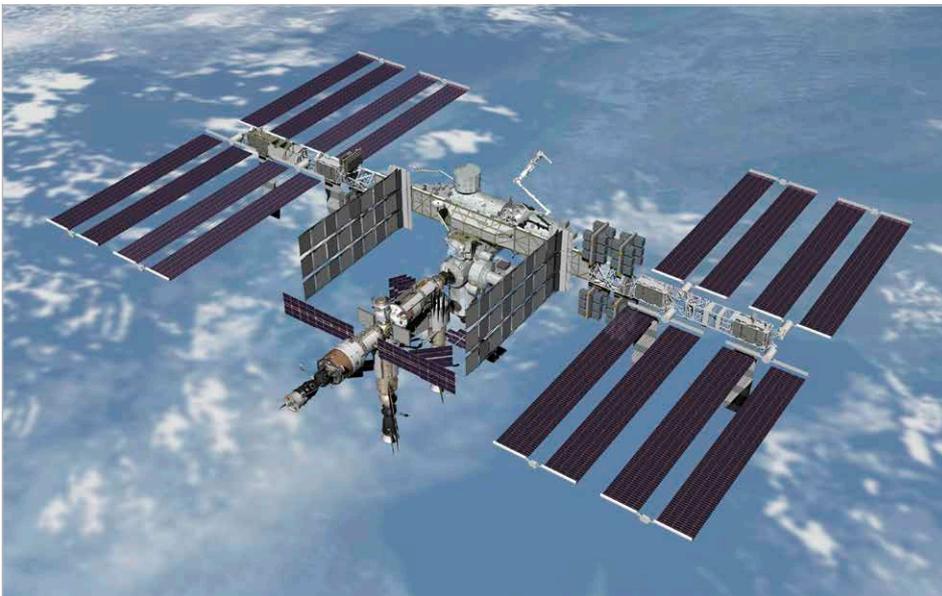
Wrap-Up Discussion

Students should be encouraged to participate with their classmates in a group discussion about managing in-space resources, including which of their solutions were most feasible in addressing the challenge of creating energy for an outpost in space.

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The International Space Station has solar panels that generate around 120 kW of energy. This might not sound like much, but it could probably power a small city. All of the energy is collected from the Sun and stored in batteries for moments when the solar panels aren't in use.



In this project, you need to think about how we can make energy in space. On Earth, we rely on power stations and other sources of energy like wind farms or hydroelectric power to provide us with energy. In space, we can't do that, so what are the options? And more importantly, if you were in charge of deciding where to put a new space base, where would it go and how would you get power?

Discussion #1

Have a discussion to find out what you already know. Your teacher will lead this by asking questions. After the discussion, get into your group to find an area of power generation that interests you and then research it.

Perhaps you want to know more about solar panels, or maybe you can think of a new way to harness energy. What would happen if there wasn't any solar power at all? Perhaps you are exploring the dark side of a distant planet where there is no light, or the light is very weak.

Asking one of these questions might help you:

- In space, what do we need energy for?
- How do we heat our houses and which methods can we use in space?
- How do we store food and which methods can we use in space?

When you've had the discussion, present your findings to the other groups. You'll have to face questions about what you've decided and how you could generate energy, so make sure you do your research properly!

Discussion #2

Choose a space destination you might want to visit. Perhaps you want to go to Mars, the Moon, or a nearby asteroid like Vesta. Find out about your destination. Is there wind or an atmosphere? Is there any warmth there? And what is the ground made of? When you've finished researching these questions, you're ready for the next stage of the task.

Explain how a space station in this location could be powered. Think of how to create energy and how you could use it at your chosen destination. Analyse, plan, and choose the power generation. Remember to consider what power source might be needed in this environment.

Final Discussion

Talk about your findings. Discuss what you have learned about power generation and, in particular, about power generation in space. What are the challenges that we face if we need the kind of power that runs the International Space Station and makes it possible to support human life? Did you think of ways to provide it? And more importantly, how about your space base? What did you take into account when you decided where to locate it?