e::MISSION
SPACE STATION ALPHA

# Lesson 10: Power Systems II

## Preparatory Readings

| LP # | Unit 1: Mission Bfg/ App Process |
|---|---|
| Mission Briefing | |
| 1 | The Mission |
| 1 | We Need You |
| 1 | Space Station Alpha |
| opt | Verizon |
| How to Apply | |
| 2 | Apply Today |
| 2,3 | Personal Essay |
| 2,3 | Class Activity: Station Systems |
| opt | Mission Patch |

| LP # | Unit 2: Space Weather |
|---|---|
| 4 | Specialist Orientation |
| Chapter 1 | |
| 4 | Here Comes the Sun |
| 4 | Inside the Atom |
| 5 | Sheer Magnetism (Hands On) |
| 5 | Dr. Z: Inside the Sun |

| LP # | Unit 3: Radiation Health |
|---|---|
| Chapter 2 | |
| 7 | New Frontiers & New Dangers |
| 8 | Electromag Rad: Taming the Wild Energies |
| 7 | Do You Want the Recipe? |
| 7 | In the Kitchen with Poly |
| 7 | Measuring Exposure to Radiation |
| Enrichment Activities | |
| 7 | Ready, Aim, Mutate! (Hands On) |
| 7 | Sweet Dreams are Made of These (Hands On) |
| 7 | Are You Too Hot? (Hands On) |

| LP # | Unit 4: Power Systems |
|---|---|
| Chapter 3 | |
| 9 | The Energy Supply Problem |
| 9 | Rechargeable Batteries |
| 10 | All About Power |
| 10 | Emergency Procedures |
| 10 | Practice Ex: Power on the SS (Hands On) |
| Enrichment Activities | |
| 10 | Electrical Current Mag Field (Hands On) |
| 10 | Electrical Circuit: Quick Guide (Hands On) |
| 10 | Nailing Down Energy (Hands On) |
| 10 | A Shocking Discovery (Hands On) |
| 10 | Electrolysis (Hands On) |
| 10 | It's Electric (Hands On) |

| LP # | Unit 5: Life Support |
|---|---|
| Chapter 4 | |
| 12 | How I Discovered Air |
| 12 | A Weighty Discovery |
| 12 | Living in a Bubble |
| 12 | Breathing on the Space Station |

| LP # | Unit 6: Pre-Mission Prep |
|---|---|
| 13 | Overview of Teams |
| 13 | Mission Directives |
| 13 | Classroom Setup |
| Team Preparation Introductions | |
| 13 | STORM Team Overview |
| 13 | Radiation Team Overview |
| 13 | Power Team Overview |
| 13 | Life Support Team Overview |
| 13 | Communications Team Overview |

**Other Homework Due:** Answers to *The Practice Exercise: Power on the Space Station*

## Subject

Fundamentals of electricity, circuits, induction, magnetism, and solar cells.

## Duration

20 min. Debrief *Practice Exercise: Power on the Space Station*
20 min Electricity explorations
5 min. Homework preparation

## Materials

There are six explorations. Each one has its own set of materials and necessary preparation.

## Description of Student Activities

The first part of this class is a discussion of the students' homework assignment. This is followed by the electrical explorations.

## Main Topics

1. A piece of electrical equipment or a system consisting of an entire electrical circuit requires electrical power, measured in watts, in order to do work. Each piece of equipment creates a load when it is used. The load cannot exceed the available power.
2. Electricity and magnetism are closely related phenomena. Magnetism induces electricity in a wire. The flow of electricity through a conductor creates a magnetic field.
3. Photovoltaic cells may be more or less efficient depending on several factors—one of which is the angle of the light source.
4. Circuits have three components: source, conductors, and load. Some people include a switch in the definition.
5. Electrical currents create magnetic fields. A compass responds to the earth's magnetic field. Two magnetic fields, the earth's and that formed by an electrical current, can compete for a compass's "attention." This fact may be used to "measure" an electrical current. The compass becomes a type of galvanometer.
6. Water conducts electricity. Water's conductivity is enhanced by the presence of an electrolyte in solution.
7. $H_2O$ may be converted to $O_2$ and $H_2$ through the process of electrolysis. Electrolysis is used on board the space station and provides oxygen for breathing.

## Outcomes

1. The students will explain some of the uses of electricity on the space station.
2. The students will be able to compare and contrast the electrical circuits on the space station with those in their homes.
3. Students will explain to each other the relationships between the manipulatives used in the explorations and the fundamentals of electricity, circuits, induction, magnetism, electricity, and solar cells.

## Special Comments:

The electrical explorations for Lesson 9 & 10 require a good deal of teacher preparation, particularly the electrolysis exploration. We suggest that the students focus on the main idea behind their exploration in order to be ready to describe the importance of that idea to the rest of the class.

Students often benefit from structure. Help them structure the reports they will present to the rest of the class. Have them assign different students to make different parts of the report. Counsel them that the reports should be very brief and to the point and that at the end they should invite questions.

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## *Lesson 10: Power Systems II*

### Procedure:

(10 minutes) Debrief *Practice Exercise: Power on the Space Station*
Have students discuss the wattage requirements of various appliances, the local cost of electricity, and what it would cost to run different appliances for an hour (kWh). They should list items like washing machines, dishwashers, and toasters. A representative list of wattages and appliances is below.

| Equipment | kW | Equipment | kW |
|---|---|---|---|
| Air Conditioner | 1400-2400 | Electric Water Heater | 1000-1500 |
| Blender | 600 | Hair Dryer | 350-1500 |
| Coffee Maker | 550-1000 | Iron | 500-1200 |
| CD Player & Speaker | 50-100 | Microwave | 700-1500 |
| Computer | 50-100 | Radio | 50-200 |
| Curling Iron | 20-50 | Refrigerator | 400-1000 |
| Dishwasher | 1400 | Space Heater | 100-1500 |
| Electric Broom/Vacuum | 200-500 | Television | 200-600 |
| Electric Drill | 250-750 | Toaster | 750-1200 |
| Fan | 25-100 | Washer/Dryer | 2000-2250 |
| Stove (Per Element) | 350-1000 | VCR | 150-200 |

(10-15 minutes) Power systems hands-on explorations
Have the students meet in their 6 student groups and finish their explorations. Explain that the students will describe and explain what they observe to the rest of the class. Students complete all the steps in their explorations and address the closure questions. As the students are conducting their explorations they should be trying to explain what is happening in terms of atoms, molecules, electricity, and magnetism (technical terms they have learned). They should make sketches of what is happening to help them present the exploration to the rest of the class.

(10 minutes) Explain that each exploration is directly related to the space station. Each group should realize that it is responsible for making sure that at the end of the next class the rest of the students will be familiar with their group's exploration. Take 10 minutes and have students develop answers to the following questions. Explain that these will be turned in at the beginning of next class. The quality of the students' reports depends upon clear directions. And finally, they should decide in what way and under what conditions this exploration may be relevant to life on board Space Station Alpha.

Copy the following on paper for each group as a guide to their presentations.
Report Guide: Answer these Questions in your Report:

1. Describe the phenomena that you observe and explain what this has to do with fundamentals of electricity, circuits, induction, magnetism and electricity, or PV power generation
2. Describe what happens in your exploration in terms of atoms and electrons and molecules.
3. Describe why this happens.
4. If scientists were conducting this exploration as an experiment, what might they be measuring?
5. Describe how your exploration applies to the space station and hypothesize how it might be affected during a coronal mass ejection.

(Remaining time, about 10 minutes)
Begin with two student presentations at five minutes apiece. Tell the students you will finish the rest during the next class.

### Homework for Lesson 11

- Prepare for their presentation. Answers to the five questions above will be turned in.
- Complete Closure questions from their hands-on exploration
- Read
  *How I Discovered Air*