e::MISSION
SPACE STATION ALPHA

Lesson 12: Life Support

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: Entry from *Mission Specialist's Log*

Subject

Life Support Systems on Space Station Alpha must maintain earth-like atmospheric conditions to ensure the astronauts' safety.

Description of Student Activities

This class is a modified Article Review activity with 8 student groups. Four groups of students answer a question and report their "findings" to the rest of the class. Four groups try to find errors in the reports.

Duration

35 Min *Article Review* activity
10 Min Homework preparation

Materials

Articles

Main Topics

1. The atmosphere within the space station must be the same as the earth's atmosphere in terms of the mix of gases and their combined pressure.
2. The astronauts pollute their own environment by simply breathing and performing other vital human functions.
3. The astronauts are 100% dependent upon technology for their well being.
4. Solar weather can jeopardize the atmospheric balance within the space station by disturbing its electrical power supply and computer systems. The life support system is dependent upon these other systems.
5. The atmosphere on earth is composed of a complex blend of gases to which the human body has become specifically attuned.

Outcomes

1. Students will describe the atmospheric balance of pressures and gases that must be maintained on the space station.
2. Students will explain the astronauts' needs in terms of atmospheric conditions.
3. Students will explain the space station as a technologically-sustained environment in which the astronauts themselves are a source of pollution.

Special Comments:

Two interesting ideas should be considered regarding the space station's life support systems.

(1) The space station is, in some ways, an inverted metaphor for the earth. The earth's atmosphere is polluted by many of man's technological advances. Outside of the earth's atmosphere is a vacuum, wholly uninhabitable without sophisticated technology. On the space station, humans are the polluters of their environment that is wholly sustained by technology.

(2) The human body has adapted to its environment and depends upon the 78% / 21% nitrogen-oxygen mix and constant air pressure.

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Procedure:

(35 minutes)

Article Review activity (modified): Students should have read these articles before this class. Organize 4 or 8 groups of students. Assign one question to each group. If you have eight groups, assign one question to two groups. Each group will prepare reports on the following questions. Each group also needs to be assigned to stump another group. They will review the question another group has and prepare questions to stump the presenters. For example, Group A would answer question #1 and then review Question #2 to stump Group B.

Group	Answers Question Number	Reviews Question Number (to stump another group)
A	1	2
B	2	3
C	3	4
D	4	1
E	1	2
F	2	3
G	3	4
H	4	1

This approach is being suggested to both save time and still permit the students to fully grasp the four basic topics in this unit.

Allow 15 minutes for the teams to prepare reports and questions. Suggest that as many students as possible on the reporting teams be given a part of the question to present and that they use sketches to illustrate their ideas.

Spend the remaining time for team answers and stumpers from other groups. Leave enough time to discuss homework and assign e-Mission teams.

(10 Minutes)

Homework for Lesson 13

Complete entry in *Mission Specialist's Log*

Assign e-Mission teams and hand out copies of the assigned team readings
When students report to the next class they will be seated by teams according to the Classroom Setup chart in Pre-Mission Preparation. They will learn and practice their e-Mission tasks. They should bring with them the equipment (calculators, etc.) they will need as described in their Team Preparation Materials. They should also try to answer the questions asked of them in their Team Preparation, …Your Task articles.

Read

Pre-Mission Preparation
Overview of Teams
Mission Directives
Specialist Team Preparation Introductions (Students read only ONE of below)

- *STORM Team*
- *Radiation Team*
- *Power Team*
- *Life Support Team*

(Don't assign Communications Team or Crisis Management Team yet. Have all students work on one of 4 specialist teams listed.)

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Article Review

Life Support Systems

Time	Questions
15 minutes	

1. In the article "How I Discovered Air," what are the five most important facts that the author learns about air? What is the main idea or thesis of this article?

2. Describe how Torricelli discovered air pressure and how his discovery affects our lives today.

3. What is STP? What technology is used to measure STP? How are the two components of STP written? Compute the following: The air pressure at any given moment is a total pressure of all of the gasses in the air. Each gas "owns" a part of that pressure based upon the percentage of that gas in the air. The part of the gas pressure "belonging" to one gas is called that gas' partial pressure (pp). If the air pressure is 760 mmHg. What is the partial pressure of oxygen (ppO_2 = 21% x air pressure) and nitrogen (ppN_2= 78% x total air pressure.) at STP

4. On earth, how is the atmosphere created and changed? On the space station, how is the atmosphere created and changed? Give examples. Of all the parts of the ECLS system, what do you believe are the most critical components and why?

Article Review

Life Support Systems

Time

15 minutes

Questions

1. (Easy question) In the article "How I Discovered Air," what are the five most important facts that the author learns about air? What is the main idea or thesis of this article?

A: The five most important facts are: 1. We can't see air. 2. A cubic centimeter of air contains many molecules. 3. Air is a mix of 10 basic gasses –unless there dust and toxins are present. 4. Three main gasses in the air are N, O, CO_2. 5. We breathe in many molecules of gas when we inhale. The main idea or thesis of the article is that air is precious and we must take care of it and not take it for granted.

2. (Medium difficulty) Describe how Torricelli discovered air pressure and how his discovery affects our lives today.

A. He used a glass tube, closed on one end, full of mercury. He placed the open end of the tube in a bowl of mercury. He discovered that air's pressure supported a 760 mm column of mercury in the tube. Toricelli's discovery led to the creation of the barometer that is instrumental in helping us predict weather patterns.

3. (Medium difficulty) What is STP? What technology is used to measure STP? How are the two components of STP written? Compute the following information. The air pressure at any given moment is a total pressure of all of the gasses in the air. Each gas "owns" a part of that pressure based upon the percentage of that gas in the air. The part of the gas pressure "belonging" to one gas is called that gas' partial pressure (pp). If the air pressure is 760 mmHg. What is the partial pressure of oxygen (ppO_2 = 21% x air pressure) and nitrogen (ppN_2= 78% x total air pressure.) at STP?

A: STP is standard temperature (59 degrees Fahrenheit) and pressure (760 mmHg). Barometers and thermometers measure air pressure and air temperature. Partial pressure of oxygen is ppO_2= .21 X 760mmHg = 159.6 mmHg. Partial pressure of nitrogen is ppN_2= .78 X 760 mmHg = 591.8 mmHg.)

4. (Difficult) On earth, how is the atmosphere created and changed? On the space station, how is the atmosphere created and changed? Give examples. Of all the parts of the ECLSS, what do you believe are the most critical components and why?

A: The earth's atmosphere is created and changed by both natural and man-made causes. On the space station the atmosphere is created by technology and unbalanced by nature (astronauts) and solar weather. The astronauts pollute their own atmosphere by using up oxygen and adding carbon dioxide, methane, and water vapor to the air.
(This next part is tricky) All the parts of the life support system work together to maintain a healthy environment, but the most critical parts of the ECLS system are the computers that monitor the atmospheric content of the air. Most dangerous atmospheric conditions go unnoticed by humans until it is too late. After that there are the carbon dioxide removers, the oxygen generators, the oxygen and nitrogen gas tanks, etc.