e::MISSION SPACE STATION ALPHA

Lesson 4: Space Weather 1

Preparatory Readings

Unit 1: Mission Bfg/ App Process		Unit 2: Space Weather		Unit 3: Radiation Health		Unit 4: Power Systems		Unit 5: Life Support		Unit 6: Pre-Mission Prep	
LP#		LP#		LP#		LP#		LP#		LP#	
Mission Briefing		4	Specialist Orientation	**Chapter 2**		**Chapter 3**		**Chapter 4**		13	Overview of Teams
1	The Mission	**Chapter 1**		7	New Frontiers & New Dangers	9	The Energy Supply Problem	12	How I Discovered Air	13	Mission Directives
1	We Need You	4	Here Comes the Sun	8	Electromag Rad: Taming the Wild Energies	9	Rechargeable Batteries	12	A Weighty Discovery	13	Classroom Setup
1	Space Station Alpha	4	Inside the Atom	7	Do You Want the Recipe?	10	All About Power	12	Living in a Bubble	**Team Preparation Introductions**	
opt	Verizon	5	Sheer Magnetism (Hands On)	7	In the Kitchen with Poly	10	Emergency Procedures	12	Breathing on the Space Station	13	STORM Team Overview
How to Apply		5	Dr. Z: Inside the Sun	7	Measuring Exposure to Radiation	10	Practice Ex: Power on the SS (Hands On)			13	Radiation Team Overview
2	Apply Today			**Enrichment Activities**		**Enrichment Activities**				13	Power Team Overview
2,3	Personal Essay			7	Ready, Aim, Mutate! (Hands On)	10	Electrical Current Mag Field (Hands On)			13	Life Support Team Overview
2,3	Class Activity: Station Systems			7	Sweet Dreams are Made of These (Hands On)	10	Electrical Circuit: Quick Guide (Hands On)			13	Communications Team Overview
opt	Mission Patch			7	Are You Too Hot? (Hands On)	10	Nailing Down Energy (Hands On)				
						10	A Shocking Discovery (Hands On)				
						10	Electrolysis (Hands On)				
						10	It's Electric (Hands On)				

Other Homework Due: Final draft of *Personal Essay*

Subject

Fundamentals of atoms and magnetism

Duration

15 min. *Space Station Stumpers*
25 min. *Sheer Magnetism*
5 min. Homework assigned

Materials

Space Station Stumpers: You may or may not choose to print out the questions in the Space Station Stumpers quiz.

Sheer Magnetism Hands-On: Prepare the materials listed in the activity for groups of 3 or 4 students.

Description of Student Activities

Students will take part in a quiz on *Inside the Atom,* called *Space Station Stumpers*. You might model the quiz like a team-based Weakest Link™. The competition will make it fun. The quiz reviews the materials in the articles assigned as homework. After the quiz, the students begin the hands-on exploration called *Sheer Magnetism*.

Main Topics

1) Creativity, imagination, and a good knowledge base are all required in the work of science, engineering, and technology.

2) Hazards and the potential for accidents exist. Regardless of the environment, the possibility of injury, illness, disability, or death may be present. Natural and human-induced hazards present the need for humans to assess potential danger and risk. Students should understand the costs and trade-offs of various hazardous situations. The importance of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations.

3) Atoms and atomic processes:
   - Matter is made of minute particles called atoms, and atoms are composed of even smaller components. Sub-atomic particles have no spatial dimensions but do have mass and electrical properties. Every atom has a positively charged nucleus surrounded by negatively charged electrons. The properties of the nucleus and electrons (electrical charges and the Strong Force) hold the atom together.
   - An atom's nucleus is composed of protons and neutrons, which are much more massive than electrons. (Except for Hydrogen atoms. They have a nucleus consisting of only one proton.)
   - Nuclear reactions convert a fraction of the mass of interacting particles into energy. Fission is the splitting of a nucleus. Fusion is the joining of two nuclei. Thermonuclear reactions take place under extremely high temperature and pressure. Fusion is the thermonuclear reaction that is responsible for the energy of the sun and other stars.
   - A substance composed of a single kind of atom is called an element.
   - The distances and angles between molecules or atoms differ between the various phases of matter: solid, liquid, plasma, and gas. In the solid phase, the atomic structure is nearly rigid. In the liquid phase, molecules or atoms move around each other but do not move apart. Plasma is the main ingredient of our sun. It constitutes almost 98+% of all the matter in our solar system. Plasma consists of wholly independent atoms and atomic particles that collide and fuse in conditions characterized by extreme heat and pressure. In the gas phase, molecules move independently of each other. In all phases of matter the movement of atoms and their particles is dependent upon both temperature and pressure.

4) Magnetism, magnetic fields, and magnetic field lines are fundamental forces on the earth and the sun. They play a significant role in the earth-sun relationship.

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Outcomes

1. Students will be able to describe what a specialist is and what is required of a specialist.
2. Students will answer questions related to their readings about atoms.
3. Students will use hands-on materials to explore the concepts of magnetism, magnetic poles, the magnetic force, atoms and molecules, magnetic field lines, and the similarities between the magnetic fields of the earth and a bar magnet.

Special Comments:

Space Station Stumpers
The quiz should take no more than 15 minutes of class time. There are more *Space Station Stumper* quizzes later, so how you conduct this quiz will set the stage for later ones. We suggest a rapid-fire, no-holds-barred approach.

Sheer Magnetism (Lesson 4/5)
Are your students familiar with magnetism? Have they ever had a chance to "play" with magnets? During field testing of this unit, as the *Sheer Magnetism* explorations were introduced, the students felt a need to "play" with the magnets. This appears to be a natural reaction to the mystery of the magnetic qualities of bar magnets and should be permitted, up to a point.

At an appropriate moment, it is worth pointing out that magnetism is a fundamental force of nature, one source of solar weather, and very important to the space station. The students' serious efforts to discover how it "works" will help them not only relate to the magnetic properties of the earth and the sun, but also help them appreciate, eventually, the intimate relationship between magnetism and the electrical systems on Space Station Alpha.

Procedure:

Space Station Stumpers (15 minutes)

Students will take part in a quiz (attached) called *Space Station Stumpers* based on the article *Inside the Atom*. You might model the quiz like a team-based Weakest Link™. The competition will make it fun. The quiz is meant as a review of the homework materials.

We suggest that the quiz be an "open book" quiz. Finding the correct answers to the questions is a way of repeating the materials and helping the students put the facts into context. The quiz should take no more than 15 minutes of class time.

You may choose to conduct this activity in a variety of ways:

1. Divide class into two or more teams and hold a competition. (You might divide the class into teams and conduct a quiz show such as the Weakest Link). Incorrect answers can be challenged.
2. Divide class into groups and score the quiz as a function of time and correct answers
3. Have entire class compete with teacher. Students answer question in time allotted (5 seconds), 1 point for students. Incorrect answers, or no response in time allotted, 1 point for teacher.

Sheer Magnetism (30 minutes)
Divide the class into groups of 2, 3, or 4 students and conduct the *Sheer Magnetism* exploration.

Homework for Lesson 5

- Read
  Dr. Z: Inside the Sun
- Prepare for article review activity
- Complete Closure questions in *Sheer Magnetism*

Space Station Stumpers

A Quiz on All Things Atomic

Time
15 minutes

Questions

1) All matter is composed of _____.

2) The four phases of matter are _____, _____, _____, _____.

3) One Greek philosopher that first used the word “atom” is _____.

4) Early scientists believed that everything around them consisted of what 4 elements?

5) With one exception, what are the three main components of all atoms?

6) Which atom is the exception to the last question? Which component is missing?

7) What is an ion?

8) Heat is created by submitting an atom or a group of atoms to what mechanical process?

9) Neutrons and protons bind together to form the atom’s _____.

10) An electron is how large compared to a proton?

11) An electron resides in one of the atom’s _____.

12) If you increased the hydrogen atom’s nucleus to a circumference of 3mm, how large is the new hydrogen atom?

13) The sun’s plasma consists mostly of the ions of what two elements?

14) When we touch something, what actually comes into contact with what?

15) What scientist discovered that atoms consisted mainly of a perfect vacuum?

16) What is a molecule?

17) Name one example of a molecule and state how many atoms are in it.

18) How fast does light travel through a vacuum?

19) Name two forms of electromagnetic radiation that are capable of ionizing the atoms in a human cell.

20) What was Einstein's famous formula?

21) What do the symbols in Einstein's formula stand for?

22) How is light created?

23) What thermonuclear force creates the tremendous heat in the core of the sun?

24) What is fusion?

25) What thermonuclear reaction is the opposite of fusion?

Bonus question: The sun produces what two things that threaten the astronauts?

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Space Station Stumpers

A Quiz on All Things Atomic

Time

15 minutes

Questions and Answers

1) All matter is composed of _____. **A: Atoms or parts of atoms or molecules**

2) The four phases of matter are _____, _____, _____, _____.
A: liquids, solids, gases, plasma

3) One Greek philosopher that first used the word "atom" is _____.
A: Democritus or Leucippus

4) Early scientists believed that everything around them consisted of what 4 elements?
A: Fire, water, earth, ether

5) With one exception, what are the three main components of all atoms?
A: electrons, protons, neutrons

6) Which atom is the exception to the last question? Which component is missing?
A: Hydrogen has one proton and one electron. It has no neutrons.

7) What is an ion?
A: An ion is an atom with an electrical charge because it has one less or one more electron than normal.

8) Heat is created by submitting an atom or a group of atoms to what mechanical process? **A: "rubbing it" or applying friction.**

9) Neutrons and protons bind together to form the atom's _____.
A: nucleus.

10) An electron is how large compared to a proton?
A: 1/1836

11) An electron resides in an _____.
A: orbit (Bohr model), energy level, or electron cloud

12) If you increased the hydrogen atom's nucleus to a circumference of 3mm, how large is the new hydrogen atom?
A: 3 ¼ football fields.

13 The sun's plasma consists mostly of the ions of what two elements?
A: hydrogen and helium.

14) When we touch something, what actually comes into contact with what?
A: Magnetic fields come into contact with each other.

15) What scientist discovered that atoms consisted mainly of a perfect vacuum?
A: Dr. J.J. Rutherford

16) What is a molecule?
A: two or more atoms bound together

17) Name one example of a molecule and state how many atoms are in it.
A: water (3), carbon dioxide (3), hydrogen molecule (2), etc.

18) How fast does light travel through a vacuum? **A: 186,000 miles per second.**

19) Name two forms of electromagnetic radiation that are capable of ionizing the atoms in a human cell.
A: X-rays, gamma rays, and in some cases high-energy ultraviolet rays.

20) What was Einstein's famous formula? **A: $E=mc^2$**

21) What do the symbols in Einstein's formula stand for? **A: E=energy, m=mass, c=speed of light.**

22) How is light created? **A: Electrons are energized and move to higher energy levels. When they return to their original energy level, they emit photons of light.**

23) What thermonuclear force creates the tremendous heat in the core of the sun? **A: fusion**

24) What is fusion? **A: The bonding of hydrogen nuclei to form a new nucleus. (four hydrogen protons become one helium nucleus)**

25) What thermonuclear reaction is the opposite of fusion? **A: fission.**

Bonus question: The sun produces what two things that threaten the astronauts? **A: Ionizing radiation (gamma rays and X-rays) and radioactive particles (protons and positrons)**