Building a Spacecraft

Grade Level:
9-12

Duration:
250 - 300 minutes

Materials:
AnaSonde Buzz-E or Blink-E Kit, computer with internet access, Morse code key, acrylic paints, Microsoft Excel or similar program, white out (correction fluid), cardstock, tape/glue, utility knife, scissors, various types ofinsulators/conductors (Styrofoam, cotton, foil, spray foam, etc.), heat lamp, and freezer.

Learning Objectives:

Concepts: Students will understand light absorption/reflection and heat transfer due to an object's insulation and covering.

Skills: Students will create a spacecraft well-insulated and well-protected so that there is a minimal effect on the temperature sensor inside the spacecraft.

Affect: Students will appreciate the importance of insulators and coverings in preventing heat transfer (whether it is trying to keep heat in or out of a specific object). Students will appreciate the importance of keeping a spacecraft at a specific temperature and be able to apply the concepts learned from the spacecraft to other things (such as a home or clothing).

Content Background:
Man's amazement of the world has always existed. In the quest for knowledge about the world, man stumbled upon what has been labeled the "Final Frontier". The skies have always been fascinating, but now we have the technology to take a closer look at it all.

Spacecrafts are very important in obtaining information about the universe. From these instruments and robots, we can take measurements of atmosphere, soil, and much more on other planets and moons to give scientists an idea of its environment. This can allow scientists to eventually visit the planet and collect even more data and samples. However, in order for these instruments to function properly or man to be able to travel to far-off planets, these spacecrafts must obtain and maintain appropriate conditions. This means that temperature must be regulated inside the craft by means of effective insulators and the use of reflective materials to prevent radiation from penetrating into the spacecraft.

Colors are created by materials reflecting the different wavelengths of light to our eye. Sunlight is pure white light. When sunlight meets something, it is either ***absorbed*** or ***reflected***. The ***absorbed*** light can be felt as heat. Since some the wavelengths of colors in white light differ, those that are not absorbed are ***reflected***. This light is reflected to the eye and the eye, based on intricate biology, sees different colors.

These concepts can be applied to several everyday situations (such as what shirt to wear on a hot summer day; black or white) or what color to paint something (such as the spacecraft).

A good ***thermal insulator*** will prevent the transfer of heat from one place to another. In other words, it can prevent an object (such as a spacecraft or a house) from gaining too much heat from its surroundings, but also prevent heat loss when it is cooler outside than inside the object.

Good insulators include things that are not very dense. This is because something that is denser has particles in it that are closer together, allowing for an easier transfer of energy by heat (which is what we are trying to prevent with an insulator). Some examples of good insulators include air (unless there is room for ***convection***, or for the air to move around), Styrofoam, fiberglass, and cotton. Another thing to consider is that some metallic materials can help reduce radiative heat transfer by reflecting the radiation back to the source of the heat (like a thermos).

Instructional Procedures:
During the first class periods, introduce students to the concepts of color and the different wavelengths of light. This will include which colors can absorb/reflect the most light. Explain what insulators are as well. These things will be helpful in getting the students ready to build their model spacecraft.

On the second day, divide the students into groups of 2 or 3 and give them information on the space program and what types of insulation are used on spacecrafts. Also, give them information on the Sun and Pluto and their different climate types as they will be "traveling" to one of these places. The students will then choose their mission (to the Sun or to Pluto). Inform the students that they will need their spacecraft to be able to maintain the starting temperature of their spacecraft, within a range of 25 degrees Celsius, for 10 minutes to get full credit on this project. Give the students materials that they can test and the Buzz-E or Blink-E AnaSonde. They should decide what they are going to use for their insulator and for the outside color and then hypothesize about what will happen by using those materials on their spacecraft. Once they have decided on this, students should begin assembling their spacecraft.

The following two to three class periods should be used to assemble and protect (with colors and insulators) the spacecraft (a model taken from the website listed at the end of the lesson printed on cardstock for strength). To create their spacecraft students should follow the instructions and use the templates included in the kit, along with the instructions to build. If more copies are needed, a copier can be used to copy onto cardstock paper.

Once students have finished building their spacecraft, most likely during the fifth or sixth class period it will be put in the appropriate environmental conditions for the mission chosen by the student. The two environments will be simulated by placing the spacecraft in a freezer or under a heat lamp. If they are able to maintain the temperature of their spacecraft within a range of 25 degrees Celsius of their original starting value for 10 minutes they can receive full credit. If they make it past 8 minutes of time they will have completed their mission and be graded accordingly. If not, students must redo the experiment or explain why the temperature did not remain constant enough to complete the "mission". Students should be told these guidelines several times to ensure they know what is expected of them.

Students will share with the class their methods and materials used in the creation of their "spacecraft" and how well it performed in the temperature test. They will then write a short summary of why they think they finished/did not finish their particular mission.

Suggested Evaluation Procedures:

Students will write a short lab report on what the results of their experiment were and compare their results with the rest of the class. Students should decide whether they can confirm or reject their hypotheses and discuss the practical applications of the study. Students will be able to predict (given a color) what wavelengths of light will be absorbed and which will be reflected. Students will also be able to write a short explanation of why those colors would be reflected/absorbed and what that will do to temperature and how it affects their mission.

Suggested Spacecraft Templates

There are lots of free templates on the internet for building spacecrafts. Look on any search engine and you will find many results! ***Be careful*** as to which models you let students choose from as some can take a very long time to build. SpacecraftKits.com offers some free templates that you can download and print (and copy) on cardstock for building the spacecrafts. From experience, we can say that some of the kits are much less time consuming to build than others. NEAR is a fairly simple model to build, so is the quick version of Cassini. **http://www.spacecraftkits.com/free.html**