What Protects the Astronauts From Extreme Temperature Change in Space?

Standard Statement:
3.4.7 B- Relate energy sources and transfer to heat and temperature**.**

Content Objectives:
Students will be able to:
1. Decide the effectiveness of Mylar, cotton fabric, and gortex for protecting the astronauts from extreme temperature variation in space.

Process Objectives:
Students will be able to:
1. Discuss the advantages and disadvantages of using various materials for the construction of tiles on the outside covering of the space shuttles.
2. Data collection and analysis.

Assessment Strategies:
1. Accurately measure and record thermometer readings to determine temperature changes.
2. Analysis of data collected.
3. Create a poster of a spacesuit design based on the information gathered in lab and information collected on the NASA website.

Procedures:
1. Discuss with students the extreme temperature variation encountered in space due to the lack of atmosphere
2. Have students assemble into lab groups and gather the necessary materials.

Suggested Level:
Intermediate/Secondary

Standard Category:
3.4—Physical Science, Chemistry and Physics

Materials:
Two inch square pieces of
Mylar, gortex, and
white cotton fabric
White paper
Four thermometers
Heat lamp

Instructional Strategies:
Experimentation
Cooperative learning
Research
Essay writing
Interpreting data

Related Concepts:
Understanding the space environment

What Protects Astronauts From Extreme Temperature Change in Space?

Thought question to begin:
What types of materials do you wear to keep cool in the summer? _____

Investigation:
To decide which materials would be best suited for the construction of space suits, conduct the following investigation.

1. Place the three pieces of material in a row on a sheet of white paper so they are evenly spaced.
2. Insert a thermometer behind each of the pieces of material.
3. Tape the edges of each material to the paper so they stay in place.
5. Record the initial temperature from each of the thermometers in the data table.
6. Turn on the heat lamp and begin evenly heating each of the material samples, recording the temperature of each every five minutes for thirty minutes.
7. Place all materials back in their proper locations and clear the lab area.

Data Table:

Time (minutes)	Temperature of Mylar (°C)	Temperature of Cotton (°C)	Temperature of gortex (°C)
0			
5			
10			
15			
20			
25			
30			

Questions to ponder:

1. Which material had the greatest change in temperature? Which had the least?
2. Which materials would be best suited for use in the fabric of a spacesuit? Why?
3. Which material if any would not be well suited for space suit fabric to reduce temperature change?
4. Would the color of the materials have any affect on their ability to protect the astronauts from extreme temperature change?
5. Do you think the astronauts need more protection from extreme temperature change than can be given from one layer of material in a spacesuit?
6. What other factors would NASA have to consider before deciding on materials for a spacesuit?
7. Do you think spacesuits are made from one material or layers of different materials that serve different purposes to protect the astronauts?
8. What other materials and devices would you add to a spacesuit to protect the astronauts from the harsh conditions they may encounter in outer space?

Follow up Activity:

1. Design a poster describing how you would construct a spacesuit for the astronauts to wear during their space walks outside the shuttle. Research information on the NASA website on other extreme conditions the astronauts face while in space. Take these factors into account when you design your suit. Present your poster to your class.

Poster

Name _____ Date _____ Course/Class _____

Task/Assignment _____

Performance Criteria	Assessment			
	Points	**Self**	**Teacher**	**Other(s)**
1. The poster contains a title that clearly reflects the topic or theme.				
2. The poster contains relevant and accurate information about the topic or theme.				
3. The format of the poster is appropriate to the content, purpose, and audience for which it is designed.				
4. Graphic elements, such as pictures, photographs, charts, tables, scientific drawings, diagrams, graphs, etc., add to the overall effectiveness of the poster				
5. There is a coherent, flowing organization to the poster with the various elements (text, graphics, etc.) working well together.				
6. The poster is aesthetically pleasing, with effective use of space, color, texture, and shape.				
7. The poster is skillfully designed and crafted using appropriate graphic design tools				
8. The poster effectively communicates its theme in convincing fashion to the intended audience.				
9. The poster is creative and draws attention.				
10. Language chosen for the poster is captivating, persuasive, informative, accurate, and concise.				

O Comments O Goals O Actions

Oral Presentation in Science

Name _____ Date _____ Course/Class _____

Task/Assignment _____

Performance Criteria	Assessment			
	Points	**Self**	**Teacher**	**Other(s)**
Content and Organization				
1. The purpose of the presentation (informing, persuading or both), the subject, and any position taken by the presenter are clearly defined at the outset.				
2. The presentation is made in an interesting, logical sequence – an introduction, an organized body, and a clear closure – that the audience can follow.				
3. The introduction has a strong purpose statement that serves to captivate the audience and narrow the topic.				
4. An abundance of accurate supporting scientific concepts, facts, figures, statistics, scenarios, stories, and analogies are used to support the key points and ideas.				
5. The vocabulary is appropriate to both the science content and the audience.				
Optional				
6. Interesting and colorful audiovisuals aids or multimedia materials are interwoven to explain and reinforce the screen text and presentation.				
7. The topic is developed completely and thoroughly.				

Oral Presentation in Science (continued)

Performance Criteria	Assessment			
	Points	**Self**	**Teacher**	**Other(s)**
Presentation				
8. The speaker maintains a proper volume, clear elocution, steady rate, effective inflections and enthusiasm throughout the presentation.				
9. Humor is used positively and in good taste, with consideration given to the composition of the audience.				
10. Stories and motivational scenarios are used appropriately.				
11. Body language such as eye contact, posture, gestures, and body movements are appropriate and are used to create effect.				
12. Delivery is well paced, flows naturally, has good transitions, and is coherent.				
13. The speaker is relaxed, self-confident and appropriately dressed for purpose or audience.				
Audience				
14. The audience's attention is maintained by involving them in the presentation.				
15. Information needed by audience to fully understand the presentation is provided.				
16. The speaker gives the audience time to think, reflect, and ask questions about points made in the presentation.				
17. The speaker answers all questions with clear explanations and further elaborations.				

Oral Presentation in Science (continued)

Performance Criteria	Assessment			
	Points	Self	Teacher	Other(s)
18. The topic and the length of the presentation is appropriate for the audience and within the allotted time limits.				

O Comments O Goals O Actions

Scientific Investigation

Name _____ Date _____ Course/Class _____

Task/Assignment _____

Expert 4	The question has been developed in such a way that it can be answered by conducting an experiment and reflects background research and previous observations. The hypothesis has been developed directly from the question and is expertly expressed in an "If-and-then" statement(s). The procedures are detailed, complete, follow a logical step by step order, and include a list of all necessary materials. The experimental design uses proper controls and tests for the effects of only one independent variable at a time. The collected data are organized and displayed in appropriate graphic formats. The data are manipulated through the use of appropriate statistical methods. The conclusions of the experiment are written in clear and complete statements, and are supported by the data. Language used is appropriate, purposeful, and written in complete sentences. Scientific content and terminology are accurate.
Proficient 3	The question provides general guidance to the design of an experiment. The hypothesis has been developed from the question and is expressed in an "If-and-then" statement(s). The procedures are complete, follow a somewhat logical step by step order, and include a list of materials. The experimental design uses proper controls and tests for the effects of only one independent variable at a time. The collected data are organized, displayed, and manipulated through the use of appropriate statistical methods. The conclusions of the experiment are written in clear and complete statements, and are mostly supported by the data. Language used is appropriate and purposeful. Scientific content and terminology may contain minor errors.
Emergent 2	The question provides some guidance to the design of an experiment. The hypothesis is loosely connected to the question and there is an attempt to express it in an "If-and-then" statement(s). The procedures are incomplete and follow a somewhat illogical step by step order. The experimental design does not completely identify nor control variables. The collected data are disorganized and there is limited manipulation through the use of appropriate statistical methods. The conclusions of the experiment are loosely supported by the data. Much of the language used is inappropriate. Scientific content and terminology contains major errors.
Novice 1	The question is ill defined and gives little to no direction for developing an experiment. The hypothesis bears little to no connection to the question. The design of the experiment is unclear. The procedures are confusing and difficult to follow. Variables have not been clearly identified, nor controlled. The conclusions of the experiment are vague, not written in clear and complete statements, and are not supported by the data.

O Comments O Goals O Actions