MARS: TEACHER GUIDE

Subject: Earth & physical sciences
Grade Level: Middle School
Last Updated: February 22, 2008

Case Summary

Marc and Margarite are approached by NASA to help in the creation of a Mars space station, complete with working electricity from sources available on Mars, electrical wiring plan, and electrical safety and energy conservation advice.

Credits

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Learning Objectives

At the end of the case, students will be able to:

1. Describe different forms of energy (ex. Mechanical, electrical, nuclear, radiant, etc.)
2. Describe how energy and power are related
3. Describe electrical currents, fuses and circuits, how they are related & how they function
4. Contrast alternating and direct currents
5. Identify safety measures concerning electricity and lighting
6. Define and explain "alternate" sources of energy (ex. Solar, wind, hydroelectric) versus nonrenewable sources (ex. Fossil fuels)
7. List ways that energy can be pragmatically conserved.

Georgia Performance Standards

S8CS1. Students will explore the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

S8CS2. Students will use standard safety practices for all classroom laboratory and field investigations. (NSES Content Standard F)

S8CS3. Students will use computation and estimation skills necessary for analyzing data and following scientific explanations. (NSES Content Standard A)

S8CS4. Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities. (NSES Content Standard A)

S8CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters. (NSES Content Standards A, F, & G)

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S8CS6. Students will communicate scientific ideas and activities clearly. (NSES Content Standards A & E)
S8CS9. Students will understand the features of the process of scientific inquiry. (NSES Content Standard A)
SCS10. Students will enhance reading in all curriculum areas (NSES Content Standards A, D, F, & G):
a. reading in all curriculum areas (e.g. technical texts in science)
c. building vocabulary knowledge
d. establishing context
S8P2. Students will be familiar with the forms and transformations of energy. (NSES Content Standard B)
S8P5. Students will recognize characteristics of gravity, electricity, and magnetism as major kinds of forces acting in nature. (NSES Content Standards B & D)

Assessment

Boxcharts (individual assessment)
Learning Issue Research Reports with proper citation (individual assessment)
Completed Dream Home packet with constructed prototype home

Implementation Strategy

This is a Problem-Based Learning (PBL) case, designed for use in standard public school classrooms of about 30 students. Subgroups of about 4-5 students were ideal for small group (team) work, such as reading the scenes, breaking down the data, questions, hypotheses, and learning issues, and assuming research responsibilities. Small groups were facilitated by at least one adult (teacher, parent, or PRISM graduate or undergraduate student). It was good to set as a goal, before any scenes were read, the minimum number of learning issues that the group wanted to create (at least 6). Students researched learning issues individually and in pairs and reported findings to the small group. Small groups reconvened with the whole class and their teacher frequently to review separate findings and summarize data and new directions. To design and build the prototype home, students worked in pairs.

<u>Day 1: Class and small groups</u>

- Students will read scene 1
- Students will generate initial boxplots of facts, hypotheses, interview questions, and learning issues.
- Students will read scene 2
- Students will add to their existing boxplot with more emphasis being spent on generating hypotheses and learning issues in the latter part of the class.
- Students will choose learning issues: Students will pick two learning issues. Facilitators will record the full name of the student on the learning issue assignment sheet so that teachers can have enough webquests to hand out the next day.
- Reflection (5-7 minutes): students will discuss how they worked in a group and how they hope to work during learning issue research (in future students assess how well they researched and presented their research, how they could improve in researching, and how their group did well or could improve in their discussion)

Day 2 (small groups)	
Individuals & pairs research with laptops, & discuss with group	50 min
Day 3 (small groups)	
Individuals & pairs research with laptops, & discuss with group	50 min
Day 4 (small groups with facilitators)	
Students discuss learning issue research and how it relates to the case	25 min
Students try to eliminate and generate new hypotheses	
Students read next scene and discuss what is known and what they Need to know	15 min
Reflection	10 min
Day 5 (large group→small groups)	
Students receive their prototype packets, break into pairs, and begin working on house design	50 min
Day 6 (pairs)	
Students work on prototype homes	50 min
Day 7 (pairs)	
Students work on prototype homes	50 min
Day 8 (pairs)	
Students work on prototype homes	50 min
Day 9 (facilitator working with pairs)	
Home inspection and student quizzes / Evaluations (See ***Student Mateirals***)	50 min

Case Notes

This Problem-Based Learning (PBL) case, entitled *"Mars!!"* was designed to be the fourth in a series of four cases addressing physical science concepts in two sixth-grade classes at Renfroe Middle School, in the city of Decatur, Georgia (*see Resources section for other cases in this series*). This fifth case continues with two of the characters introduced in the first case, "Vortex." The two main characters are approached by NASA scientists to help design a station that would support life on Mars. Students will investigate the science of electricity and circuits, sources of energy, energy production and conservation, and renewable and nonrenewable resources as they design and build a model of a home for the Mars station.

Differences from previous cases:

This case was implemented over the course of two weeks rather than one and involved additional small group facilitation and reduced dependency on directive research guides.

Student research was not as adequate as the case in which specifically directed research guides were used (see for example "The Day After Tomorrow"). Group facilitators noted reduced research and on-task behavior, though students still performed better than in earlier cases. We would recommend the creation of directed learning guides that allowed overlap between learning issues to guide students' depth and breadth of knowledge. In some classes larger student groups were implemented (6 instead of the normal 4-5). Facilitators noted increased behavior problems, disinterest, and disengagement. As such we recommend that this case be run with small groups of no more than 5 students per group, though we feel 4 is optimal.

Facilitator Guide

Example of Possible Box Chart for Day 1

FACTS	**HYPOTHESES**
From Scene 1: Marc and Margarite are watching a movie together Two scientists from NASA show up and want to talk to them Scientists know about the rocket launch The information is highly classified (secret) ***From Scene 2:*** Scientists want Marc and Margarite to help them design and build a Mars station There is a water source on Mars (underground ice reservoir) The Pentagon wants the world to be prepared in case they can't stop climate change they will have limited battery power on mars and will need to create electricity while on mars from other sources	***From Scene 1:*** Scientists want them to build another rocket (a whole range of hypotheses about what information the scientists want to tell them) Marc and Margarite are dating ***From Scene 2:*** The pentagon wants to build the station for security reasons
QUESTIONS	**LEARNING ISSUES**
From Scene 1: What do the scientists want with Marc and Margarite? ***From Scene 2:*** Why is the Pentagon concerned? Why do the scientists want Marc and Margarite when there are other qualified persons to do the job (the answer is in this scene but it might be good to have students reinforce the reasoning behind NASA's choices) where on mars are they going	***From Scene 1:*** What does "highly classified" mean? ***From Scene 2:*** What is the "red planet"? What are the potential energy sources on Mars What are fossil fuels? What can they use on Mars in place of fossil fuels? What would be renewable ways to make electricity and what types of these renewable ways are available to them on mars? What's Mars like? How do you make Mars livable for humans? *STUDENTS MAY COME UP WITH ADDITIONAL LEARNING ISSUES RELATED TO SPECIFIC RENEWABLE RESOURCES THAT THEY HAVE HEARD ABOUT (WIND ENERGY, SOLAR POWER, HYDROGEN FUEL CELLS)*

Resources

Other Marc & Margarite Cases

1. **Vortex**
   Embree, M., & McMahon, K. M., Price, C. J., & Webb, A. L. (2005). Vortex. Retrieved May 25, 2006 from Emory University, CASES Online Web site: http://www.cse.emory.edu/cases/casedisplay.cfm?case_id=243

2. **The Day After Tomorrow**
   Webb, A. L., & McMahon, K. M. (2005). *The day after tomorrow*. Retrieved May 25, 2006 from Emory University, CASES Online Web site: http://www.cse.emory.edu/cases/casedisplay.cfm?case_id=245

3. **Liftoff!**
   Price, C. J., & Webb, A. L., McMahon, K. M., & Embree, M. (2005). *Liftoff!* Retrieved May 25, 2006 from Emory University, CASES Online Web site: http://www.cse.emory.edu/cases/casedisplay.cfm?case_id=244

4. **Mars**
   Embree, M., & McMahon, K. M., Price, C. J., & Webb, A. L. (2005). *Mars*. Retrieved May 25, 2006 from Emory University, CASES Online Web site: http://www.cse.emory.edu/cases/casedisplay.cfm?case_id=246