BRINGING MARS SCIENCE TO HAWAI’I’S STUDENTS:
MAKING SCIENCE CULTURALLY RELEVANT TO NATIVE HAWAIIAN AND
PACIFIC ISLANDERS

Michelle Lee Bradley
Department of Interdisciplinary Studies
University of Hawai‘i at Mānoa
Honolulu, HI 96822

ABSTRACT

The goal of this yearlong work was to develop standards-based, hands-on 6th-8th grade Mars science curriculum that is culturally relevant to Hawaii. The work was done as part of “Bringing Mars Science to Hawaii’s Students: An exercise in cultural adaptation, inclusivity and partnership”, which is a study being done by Dr. Barbara Bruno through NASA’s Education and Public Outreach program. I began my fellowship study by familiarizing myself with existing high-quality Mars science curriculum and I then adapted those lessons to make it more relevant to Hawai’i’s students (especially native Hawaiian and Pacific Islander students). By the end of the first semester as a fellow I developed an 8-lesson unit that linked Mars science and the Polynesian culture of exploration and Hawaiian sustainability. I was also able to pilot a few of the lessons at cooperating public schools to gain insight and feedback from the students and their in-service teachers. During the second semester of my fellowship I was able to pilot my entire 8-lesson unit, which was highly beneficial to the overall quality of the final lessons. During the second semester of work I was also able to test and finalize a board game that Dr. Bruno and I created. The eighth lesson of the unit is a board game called “Hawai‘i to Mars: A Voyage of Discovery,” which is an informal assessment tool for the teacher. The board game culminates all of the knowledge gained from the previous 7 lessons. This project is relevant to NASA’s Strategic Goal 6 on K-12 education in science, technology, education and mathematics

INTRODUCTION

I concentrated my efforts on adapting existing Mars science curriculum to (1) make both the content and teaching methodologies culturally relevant to Hawaiian and Pacific Islanders and (2) align them with Hawaii Science Content and Performance Standards (HCPS III) and national standards for inquiry. Although this new curricula will benefit all of Hawai‘i’s students, I was interested in helping Native Hawaiians and Pacific Islanders, who have among the poorest educational performance and are the least represented group among college graduates when compared to other ethnic and racial groups in Hawaii. In order to gain insight into Hawai‘i’s classrooms, I developed partnerships with Primary and Secondary school teachers at different public schools around the islands. The reason that I created these partnerships with in-service teachers was to be able to pilot my lessons to their class of students and in turn allow the teachers to critique and offer suggestions as to what worked and did not work in the lessons. The partner teachers were selected because they taught classes with a high number of Hawaiian and Pacific Islander students. The finalized 8-lesson unit is available to teachers as a resource online.
METHODS

The methods used to develop the curriculum and assess the students understanding of the materials covered were two separate endeavors. In order to obtain a real sense of how the students were retaining the information from the entire unit, a Pre-test and a Post-test was administered. The Pre and Post-tests were identical, having the exact same questions on both tests. The Pre-test was given before the start of the first lesson and the Post-test was given after the final 8th lesson of the unit was completed. In this way I could ascertain what was working in the 8-lesson unit and what the students were having a hard time understanding. The assessment of the students was integral in preparing quality lessons for publication and use by in-service teachers.

The second important facet to the methods I employed to create quality curriculum was critiquing and input from the in-service teachers. Their knowledge of the class dynamic and their experience as a working teacher was an important step in developing the 8-lesson unit. Upon completion of a day of teaching a lesson to 2-4 classes I would discuss the lesson with the teacher and ask them for suggestions on how to improve the lecture, the handouts, the visual aides or the laboratory experiment. In this way the students and the teachers that I worked with over the past year were very important to the success of the final 8-lesson unit.

RESULTS

The entire 8-lesson unit “Bringing Mars Science to Hawai’i’s Students: Making Science Culturally Relevant to Hawaiian and Pacific Islander Students” can be found at the website: Mikala.Bradley.googlepages.com. The eight lessons are summarized below:

1. Hawaiians as Space Explorers
   Students are asked to consider “Why people move?” and draw parallels between their personal experiences moving, Polynesian voyaging to Hawai’i, and modern day space exploration. Students then examine NASA data to determine which planet would be a good choice for human exploration and settlement. Typically, they choose Mars for its Earth-like temperature and rocky surface.

2. Life on Earth and Mars- The Role of Water
   Here we examine the essential requirements of life, including the role of water. First the students learn about how the Polynesian explorers brought water on their long ocean journeys and also how Polynesian sailors might have hypothesized about water existing on the far away islands that they were sailing towards (Hawai’i). Next the students look at NASA images of Mars to try to hypothesize, like the Polynesians, if there might be evidence of water on the far away planet. “Kitchen Science” laboratory experiments are conducted to see if students can use water to recreate features seen in the images (e.g., pouring water onto a ‘Martian surface’ to create channels). Typically they can recreate what they see in the NASA images of Mars, suggesting water existed-and may still exist-on Mars, which supports their choice of Mars as a reasonable planetary home.
3. **The Hawaiian Ahupua’a and Sustainable Development of Mars**

Students are asked to plan the first human settlement of Mars. Who would they take? What would they bring? How would they set up a sustainable living system on their new planetary home? To help answer these questions, they turn to Hawaiian history. When the Polynesians traveled to Hawai’i in voyaging canoes, they similarly had to make difficult decisions (e.g., what to bring in highly limited space, what would be needed to live sustainably in their new island home). Students review the Ahupua’a system (traditional Hawaiian system of land-division which maximized self-sufficiency and sustainability) as a possible model, and evaluate its relevance to modern (and future) society. The students are then given a short list of issues that the Polynesians and the modern Mars explorers may have to deal with (e.g., transportation, energy use, food production, housing, etc.) In small groups the students use poster boards to draw their ideas of how the Polynesians dealt with one of the issues and on the reverse side how modern explorers may deal with the same issue.

4. **Volcanoes vs. Impact Craters**

The students begin by looking at one of Hawai’i’s volcanoes in a satellite image and briefly learn about the Hawaiian mythology that the volcanoes embody. Students revisit the NASA images of Earth and Mars that they previously examined in Lesson 2. The class then hypothesizes about the processes for the features that they do not believe were formed by water in the Mars images. In particular, students hypothesize possible origins of circular features (e.g., volcanic or impact craters). Then, the students conduct hands-on experiments intended to simulate the impact process. By comparing their resulting craters to those in the images, they can test their hypothesis the same way that NASA scientist use models when investigating features seen in satellite images.

5. **How do we get there?**

The class begins with an overview of how Polynesians might have gotten to Hawai’i. The students learn that Polynesians used their knowledge of astronomy, climatology, ethology and other sciences to successfully explore the Pacific Ocean. Next the students learn how modern day explorers might navigate to another planet using some of the knowledge that the Polynesians employed as well as contemporary knowledge of energy transfer, rocket technology, and computers. Students learn basic (Newtonian) physics through hands-on activities and demonstrations using Cat-A-Pult rocket launchers. Students also learn that landing on Mars requires hitting a moving target (since Mars is in motion around the Sun) and conduct a hands-on activity to simulate this.

6. **Introduction to Biospheres**

and

7. **Making an in-class Biosphere**

These two lessons focus on Biospheres. In Lesson 6, students tackle the issue of surviving in the Martian thin, oxygen-poor atmosphere. The class revisits the Hawaiian land management idea of the Ahupua’a and discusses the hydrologic cycle, nitrogen cycle, and nutrient use of the land for sustainable living. Next, the students learn the how’s and why’s of building a biosphere to support human life on Mars. Lesson 7 involves creating a biosphere using basic materials (e.g., glass jar soil, native plants).
Once created students seal the biospheres and predict how long each organism will survive (it is common for plants to live for years).

8. **Hawai’i to Mars: A Voyage of Discovery (Board game)**

The final lesson and culminating activity of this unit is a board game entitled “Hawai’i to Mars: A Voyage of Discovery” (Appendix 1). This activity is designed as a fun, engaging way of assessing student’s knowledge of Hawaiian culture and Mars science.

![Appendix 1: “Hawai’i to Mars: A Voyage of Discovery” board game](image)

**DISCUSSION**

Linking cultural values and science is a way for students to feel a connection with a seemingly abstract subject. Creating hands-on curriculum that brings together a culture and science makes the subject matter relevant and important to the students. When I was teaching the lessons, I found that the students who normally do not raise their hand and participate (according to their regular teacher) were enthusiastically interacting with my lecture. Linking the science of today and the science of the past was an important step in getting the students to identify with the idea that science matters. Polynesian voyagers and Hawaiian culture used science everyday to be successful civilizations. Astronomy, climatology, oceanography, ethology, and hydrology were just a few of the sciences that were employed by the ancient Pacific Islanders. Making the link between modern day exploration (Mars) and ancient Polynesian exploration is an easy way to make the sciences relevant and important to Hawai’i’s students.
CONCLUSION

The use of NASA data and existing high quality curriculum was an important factor with regards to the success of the unit. Developing culturally relevant lessons and making the entire unit available online as a resource for educators was another goal of my fellowship that was obtained. Inspiring Hawaiian and Pacific Islander students to study science was a key goal in my Space Grant fellowship and I believe that the goals were accomplished in this 8-lesson unit.

FUTURE WORK

Since I have been a Space Grant fellow I have enjoyed working with many talented scientists and educators. In the future I plan to continue to present my 8-lesson unit at teacher’s workshops and educational conferences. I will be presenting the 8-lesson unit at a teacher’s workshop at Windward Community College on June 12th 2007. I am also organizing a teacher’s workshop (to be held in October 2007) to continue to disseminate the curriculum that I have developed during my fellowship.

ACKNOWLEDGEMENTS

I would like to say Mahalo Nui Loa to all of the teachers that have been an important part of this Mars science-Hawaiian culture unit. They are: BarbaraJean Kahawai‘i from Laie Elementary, Scott Oberg from Makaha Elementary, Mahina hou Gandharva from Moloka‘i Middle and High, and Kristen Phillips from Highlands Middle. Without these educators allowing me to pilot my lessons to their students and giving their time to guide me in writing the lessons I would not have been nearly as successful. I would like to thank Tracy Tayama for sharing her great knowledge of Adobe Photoshop which was integral in creating the “Hawai‘i to Mars: A Voyage a Discovery” board game. I would like to thank the University of Hawai‘i at Manoa Space Grant office, in particular Marcia Rei Sistoso and Edward Scott, for all of their organization, hard work and dedication to the trainees and fellows. I would also like to thank my mentor, Dr. Barbara Bruno. Dr. Bruno has the amazing ability to challenge and encourage people to work together and strive for the highest goals. And last I would like to thank NASA for knowing the importance of education to our national scientific community and giving people like me the opportunity to make a difference to our young future scientists.

REFERENCES

Lesson 1
- Ancient Times in the Islands
  http://www.hawaiiischoolreports.com/history/ancient.htm
- Hawaiians as Navigators and Seamen by Samuel Wilder King
  http://pvs.kcc.hawaii.edu/hawaiians.html
- Greenpeace: Climate
- Greenpeace: Pollution
  http://www.greenpeace.org/international/campaigns/toxics
- Greenpeace: War and Weapons
http://www.greenpeace.org/international/campaigns/peace

- U.S. Census: Population
  http://www.census.gov/popest/archives/1990s/popclockest.txt
- ONE: Poverty
  http://www.one.org/
- ONE: Disease
  http://www.one.org/gvideo/view/34
- Map of the Solar System
  http://www.gcse.com

Lesson 2

- NASA Educators Resource Guide: Mars and Earth Science Learning Activities for Afterschool Participants ages 5-12/ Activity #5
  http://mars.jpl.nasa.gov/classroom/resources.html
- Hawaiian Ahupua’a
  http://www.pixi.com/~isd/ahupuaa.html
  http://www.k12.hi.us/~ahupuaa/
- Ancient times in Hawai’i
  http://hawaiischoolreports.com/history/ancient.htm
- Artistic rendering of a Hawaiian ahupua’a
  http://www.asahi-net.or.jp
- The Hawaiian Canoe by Tommy Holmes, Polynesian Voyaging Society website
  http://pvs.kcc.hawaii.edu/holmesprovisions.html
- Island Wake
  http://cat.inist.fr/?aModele=afficheN&cpsidt=15362804
- Images of sandy beach, Ka’a’awa Beach Park, O’ahu, by Dr. Barbara Bruno 2006

Lesson 3

- Greenpeace: Climate

- Greenpeace: Pollution
  http://www.greenpeace.org/international/campaigns/toxics
- Greenpeace: War and Weapons
  http://www.greenpeace.org/international/campaigns/peace
- U.S. Census: Population
  http://www.census.gov/popest/archives/1990s/popclockest.txt
- ONE: Poverty
  http://www.one.org/
- ONE: Disease
  http://www.one.org/gvideo/view/34
- The Ahupua’a Land divisions of O’ahu
  http://www.pixi.com/~isd/map.html
- Hawaiian Ahupua’a
  http://www.pixi.com/~isd/ahupuaa.html
  http://www.k12.hi.us/~ahupuaa/
• The Hawaiian Ahupua’a system and population
  http://hawaiischoolreports.com/history/ancient.htm
• Nitrogen Cycle
  http://www.physicalgeography.net/fundamentals/9s.html
• Hawaiian vocabulary

Lesson 4
• NASA Educators Resource Guide: Mars and Earth Science Learning Activities for Afterschool Participants ages 5-12/ Images
  http://mars.jpl.nasa.gov/classroom/resources.html
• Compact Reconnaissance Imaging Spectrometer for Mars Curriculum Guide
  http://crism.jhuapl.edu/

Lesson 6 and 7

Websites
• Building Terrarium
  http://edis.ifas.ufl.edu/BODY_MG356
• Arizona Living Biosphere
  http://www.biospheres.com/experimentchrono1.html
• Nitrogen Cycle in Terrariums
  http://www.boomspeed.com/shadowedfate/imgs/biology.htm
• Biosphere 2 Center website:
  http://www.desertusa.com/mag99/apr/stories/bios2.html
• Living in the Biosphere: Production, Pattern, Population, and Diversity By Dwight Brown
  http://www.colorado.edu/geography/virtdept/module/biosphere/toc.html

Books