Technological and Education Satellite

Ricardo Wells[1], Ali Guarneros Luna[2], Marcus Murbach[3]
Southern Illinois University Edwardsville[1], San Jose State University[2], San Jose State University[3] NASA

Introduction

Magnetorquer wrapping is an important part of satellite systems and how efficient they are when placed into orbit to record and transmit various types of information such as weather, life, dangers, and data for space missions. It is important to teach the public and school children about magnetorquers and other satellites as most do not know how they receive most of their information. This project aimed to develop a lesson plan with in-class activities to teach 4th graders about magnetorquers and satellites that are launched into space.

Topics included in the lesson plan address science/engineering practices, disciplinary core ideas, and crosscutting concepts

NGSS

- Asking questions and defining problems
- Defining and delimiting engineering problems
- Influence of science, engineering, and technology on society and the natural world

Methods

This project had three phases:

1. Researching Magnetorquers and Satellites

Background research on the topic of developing effective satellites, procedures, and lesson plans included reading various articles, manuals, and books by engineers at the NASA Ames Research Center, as well as attending public lectures by leading NASA engineers and scientists. In addition, weeks of training was also needed before stepping into the lab, then observations were required for more in depth learning where notes were recorded in detail.

2. Lab work for the magnetorquer wrapping

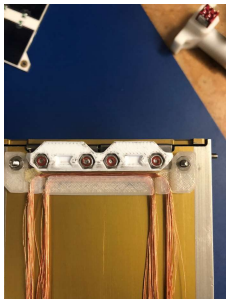
The field work was conducted with full-time and collegiate level engineers at NASA's Jet Propulsion Lab in the Electrostatic Discharge room. Where NASA engineers try to better understand how to make satellites more effective and efficient than their last models, and why their previous models were not as successful as they wanted them to be, as well as improving their designs for future models. Our field work focused on designing and building a CubeSat Satellite that would be ready to launch by a set date. Once the lab work was completed a written procedure was needed to inform future engineers who may encounter the project on how, what, when, and why to perform the magnetorquer wrapping for a CubeSat Satellite.

3. Development of lesson plan and classroom activity

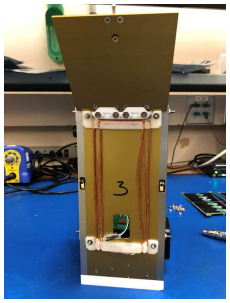
The research conducted included extensive note taking and during field work was used to develop a lesson plan about satellites and magnetorquer wrapping with a connection to human lifestyle. The lesson plan includes a short article, worksheet, and a hands-on project for students, that engages them in a simulation where they design and create their own satellite.

Results of the Magnetorquer Wrapping

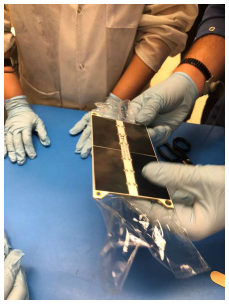
TES 7 Extrusion



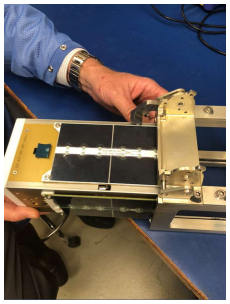
Brackets on TES 7 for Magnetorquer Wrapping



Completed Magnetorquer Wrapping



Solar panels used to power TES 7



Solar panels on top of Magnetorquer Wrapping

TES 7 doing the vibration test

Results - Lesson Plan

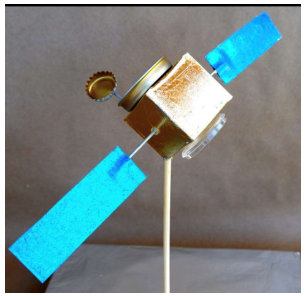
The lesson plan that was created during this internship is based on field work conducted through reading various books, articles, and engaging in various training workshops. Through the activities outlined in this lesson plan students and teachers gain an insight about the satellites and magnetorquer wrapping and the impact they have on everyday human living. The lesson plan includes a short article, worksheet, and hands-on project that students complete to help them better understand satellites and magnetorquer wrapping and their relationship to each other and to human lifestyle.

Included in the lesson plan:

- Lesson Description
- Performance Expectations
- Phenomena
- Essential/Driving Question
- Specific Learning Outcomes
- How they will be assessed
- Science & Engineering Practices
- Disciplinary Core Ideas
- Crosscutting Concepts
- Lesson Integration
- Lesson Relevance
- Lesson Opportunities
- Build Knowledge

Activity included in the lesson plan:

- Short Article
- Discussion
- Worksheet
- Design their satellite
- Create their satellite



NATIONAL MARINE SANCTUARY FOUNDATION

Conclusions

As a teacher- in- training it has been invaluable to engage in scientific research. In-class observations has significantly influenced my understanding of how people learn and my capacity to communicate effectively. When shadowing a veteran teacher, I noticed children were highly interested and more engaged when they were able to touch relevant objects. In addition, I noticed the importance of color and purposeful lessons that make things interesting. It was clear that 4th grade students love to be actively engaged, which in turn motivated me to develop a hands-on activity. The goal of this project was to teach 4th grade students about the power of satellites and their importance in our lives . The hands-on activities combined with the illustrated booklet will help teachers to do so effectively.

References

Begum, Jessica. "How to Make a Model Satellite." EHow, Leaf Group, 9 July 2013, www.ehow.com/how_5006567_make-model-satellite.html.

Benn, Chris, and Ralph Martin. "Some Background about Satellites." Planetary Satellites, 25 June 2006, pp. 1–38., doi:10.1107/s0108768106025249/bs5030sup1.cif.

Murbach, Marcus. "The Development of On-Demand Sample Return Capability (SPQR) (TechEdSat-4)." NASA, NASA, 7 Dec. 2017, www.nasa.gov/mission_pages/station/research/experiments/1815.html.

Puig-Suari, Jordi, et al. "Satellite Launch Vehicles." AccessScience, 29 Aug. 2000, doi:10.1036/1097-8542.yb040600.

Acknowledgements

I would like to thank the STAR program and NASA Ames Research Center for hosting me this summer, and SIUE for introducing me to this opportunity. In addition, I would like to thank Karen C. Roark, Ali Guarneros Luna, Marcus Marbach, Greg Stoehr, Kaylene Wakeman, Elias T. Reyes, Sanny Omar, and Forest A. Tanner for mentoring me on this project.
This material is based upon work supported by the National Science Foundation through the Robert Noyce Teacher Scholarship Program under Grant #1340110. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. The research was also made possible by the California State University STEM Teacher and Researcher Program, in partnership with Chevron www.chevron.com), the National Marine Sanctuary Foundation www.marinesanctuary.org, NASA Ames Research Center.