Project Number: JMW – Mars – 46

DoSPACE OUTREACH CAMPAIGN

An Interactive Qualifying Project Report

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

____

James Curry

Date: May 18, 2006

____

William Benedict

Date: May 18, 2006

____

Keithe Baggett

Date: May 18, 2006

Approved:

____

Professor John M. Wilkes, Major Advisor

WORCESTER POLYTECHNIC INSTITUTE

ABSTRACT

DoSPACE OUTREACH CAMPAIGN

By: William Benedict, James Curry and Keithe Baggett

Interactive Qualifying Project Advisor: Professor John M. Wilkes
Department of Social Sciences

This project spread education about space back into the public school system. The objective was accomplished via two main avenues. The first avenue provided after-school space education enrichment programs, including live activities and interactive demonstrations. The second avenue shared presentations with students about the possible future of space, via raising awareness about current news in the industry. DoSPACE acknowledged the level of public opinion and understanding about space and initiated a movement that increases student curiosity and awareness of space.

TABLE OF CONTENTS

Acknowledgements

The authors would like to thank the advisor of this project, Professor John M. Wilkes, for the leadership, expertise and enthusiasm he provided, as well as his limitless patience and understanding. We would also like to thank all of the teachers who acted as points of contact in the local high schools, as well as Charles Aleksweickz from Bancroft School. Thank you also the teachers of the Rocketeers after school program at Goddard Elementary School. And last but not least we are grateful to the students who allowed us to come into their classroom.

Introduction

"To confine our attention to terrestrial matters would be to limit the human spirit." - Stephen Hawking

Humans are inherently curious creatures and delve into opportunities that enhance their experiences on Earth. We wonder about the pyramids, so we pursue the path that will lead to their unveiling. We look into the ocean and marvel at the unknown, so we find ways that lead down to things waiting to be discovered. How is the sky at night different? People have the inspiration and drive to stalk their curiosities until they are satisfied with the answer. We now also have technology in its infancy that allows us to reach beyond the stars. Do we now stop the cycle of learning and limit ourselves because it is outside our safety zone?

As the saying goes: knowledge is power, and knowledge about space is what the general American public is lacking. This lack of knowledge leads to a lack of enthusiasm. How can you be enthusiastic about something you know nothing about? Without the enthusiasm there is no support for the space program. Without the support there is no motivation to provide funding, and thus we can not progress into space. But we see here that a public that is well informed about space is more inclined to want to provide it with more funding so that our progression into space can advance. The question now is this: what will it take to advance the public knowledge about space enough to rekindle our enthusiasm to progress further into space?

Space Generation Congress

In October of 2005, Keithe was selected to attend the Space Generation Congress (SGC)[1] in Fukuoka, Japan. This is an international conference of space enthusiasts and is structured in conjunction with the International Astronautics Congress (IAC) and the United Nations Office on Outer Space Affairs (UNOOSA). The Space Generation was a two and a half day meeting of approximately 200 international young delegates for the purpose of refining and articulating the vision of young people on the future utilization and exploration of space by humanity. This student oriented conference offered multiple workshops. These included but were not limited to teams such as the Moon Mars Working Group (MMW) that looked at the human and psychological factors needed by the explorers who must endure a three-year round trip to Mars or the UN COPUOS group where a youth delegation would participate in a "mirror" session of the annual Legal Subcommittee meeting of the United Nations Committee On the Peaceful Uses of Outer Space.

Keithe participated in a workshop called InspireSpace[2] that employs space enthusiasts to further the space-related interest of the public. InspireSpace is a novel, grassroots space education program, where participants commit to give at least one presentation on a space topic to the general public, particularly children. Keithe's group members assembled in Fukuoka from all around the U.S. including California, Kansas, Washington D.C., Massachusetts, and Florida. Though all under the umbrella of InspireSpace, these contacts around the country are all devoted to the same cause, and as the seeds are planted locally, the movement will grow. This international outreach campaign will ideally extend to the outer reaches of the globe, but must begin at the local level. DoSPACE exists in states around the nation and is the local version of this international effort.

The NASA Institute for Advanced Concepts (NIAC) attended a Space Policy conference that was hosted at WPI in 2004. Simulating a UN debate at the conference, participants at the mock trial familiarized themselves with international space policies. NIAC and other present organizations, such as the Mars Homestead Project from MIT[3], encouraged the WPI team to send delegates to conferences such as the SGC to foster interest in international space news and current events.

This year there were about fifteen teams working on Space Policy as IQPs. By sending ambassadors of WPI to get involved in the next big policy debate of the space industry, the campus gained visibility in the professional realm and was able to project a solid image of a long-standing commitment to astronomical and aerospace studies. This is especially pertinent as the school has recently turned the Aerospace concentration of Mechanical Engineering into its own major. With an article in Tech News, and presentations at area high schools, WPI is rightly seen as an

[1] Space Generation: http://explorerswanted.com/
[2] InspireSpace: http://fukuoka.spacegeneration.org/delegates/project_inspirespace.php
[3] Mars Homestead Project: www.marshome.org

institute whose students are well traveled and knowledgeable about the implications of the up and coming space industry.

Originally, this IQP was entitled Moon or Mars? Intended to analyze and take a skeptical view at the colonization of both the Moon and Mars, this earlier project would have made a case for one or the other. This case would have required detailed analyses of both the benefits and shortcomings of colonization on the surface of the Moon and/or Mars. The DoSPACE team met with Joe Palaia, the co-founder of the Mars Homestead Project during the WPI hosted Space Policy conference in 2004. He assured his audience that there exists a "unified plan for building the first habitat on Mars by exploiting local materials". [3] The Mars Homestead Project is the main endeavor of the Mars Foundation and provides a solid case for building an ever-growing, permanent settlement beyond Earth. Palaia is a nationally recognized figure in the space industry and Keithe met with him again upon her arrival in Japan. As part of Moon or Mars? the IQP team would have investigated into the validity and technical as well as sociological feasibility of this enormous undertaking. Palaia and colleagues eased the harshness of such an ambitious venture with lectures about their technology focus, including locally produced fiberglass, plant products as a byproduct of food growth, and many disciplines like materials, structural and mechanical engineering. Fostering the growth of a new planet is by no means a simple task. William Bainbridge believes that human colonies on other planets would impart a wide girth of opportunity upon human society. However in his Sociological Study, the *Spaceflight Revolution*[4] his confidence in current technology dwindles as does his conviction that it would appreciate enough over the next few decades to get us to a new planet. Bainbridge quotes the cultural historian William Irwin Thompson, illustrating the future that would dishearten even the technological enthusiast:

> "The technology of our industrial civilization has reached a peak in putting a man on the moon, but, as the ancients knew, the peak is also the moment of descent. Before we ascend the next peak to Mars, there is a very dark valley waiting beneath us, and, poetically enough, its darkness is made up of just those things our civilization did in order to succeed. In straining our industrial technology to the limit, we have, in fact, reached the limit of that very technology."[5]

Though pessimistic, Thompson clearly indicates how he feels about the "second wave of intense and dynamic progress", a second stage to the Spaceflight Revolution, that Bainbridge questions. Though technology is more present in the 21st century than in was in the early 1980's, skeptics will argue we are still just not ready to peruse the universe. However the dichotomy of wanting to put humans on Mars and being able to put humans on Mars is lessening. Bainbridge offers more insight into the reasoning behind colonization. "Colonies would have to be more than mere places to put people; they would have to provide an economic boost for industrial society before investing in them would be reasonable".[4]

Identifying this economic boost would identify the case for why colonization on Mars is realistic. The Mars Homestead Project is currently pursuing that very issue. The next question was the case for the Moon. Some individuals believe that colonizing the Moon is a better goal than trying to tame the red beast. Sam Dinkin of NASA, justifies this in an article[6], by discussing the proximity to Earth and thereby the fuel efficiency, rescue missions and a potential practice mission to Mars before actually going there. The intent of the original IQP project would pit WPI as a Moon supporter, while MIT maintained their Mars Homestead stance. Taking an active look into both sides, the IQP would reflect our findings.

It was the belief of the team that we would be researching concepts that have already been researched and writing about findings that have already been proven. We wanted to diverge from this and InspireSpace offered an avenue to lead us into a new IQP topic.

---

4 Bainbridge: *The Spaceflight Revolution,* pg 235 - 245
5 Thompson: *At the Edge of History*, p.ix.

6 http://www.thespacereview.com/article/221/1

Education about space in the Worcester area private and public school system is lacking. Our project is designed to motivate young students to consider the possibilities for themselves and humankind in space. We do not intend to instigate a movement that modifies current school curricula. However, raising awareness about space news and current events as they directly pertain to students is important; not only in the pursuit of knowledge about space, but the bettering of humankind. Nothing great has ever been accomplished without passion.

Sharing this passion and vigor with the next space generation is the goal of DoSPACE. Since there is little opportunity to integrate the intricacies of space into a classroom curriculum, extra-curricular activities were the focus of our initiative, conveyed via lesson plans, hands-on activities and enthusiasm for our cause.

Proposal and Timelines

Objective

The objective of this project is to establish and maintain an outreach campaign that will motivate and inspire middle and high school students to become actively involved in the space industry. Often, the first astronomy, aerospace or astronautics class one encounters is in college, and by that time students have decided upon their studies. This project will focus on enhancing the knowledge of the younger generation to include goals, dreams, and current space news and provoke awareness, if not interest, in an industry that will emerge during their lifetimes.

Deliverables

In order to attain these goals, there are standards that need to be established as a fundamental basis. The project is a grassroots space education program, mimicking its international counterpart, InspireSpace. The program's intent will be bidirectional: (1) to motivate members of the global space community to more actively engage the general public, (2) to inspire the general public, especially children, through presentation of space topics, to more strongly support space exploration. Team members of the space community *begin* their involvement by pledging to give at least one civic presentation on a space topic of their choice to an audience of their choice.

It also incorporates a simple yet novel idea, where team members are not only required to commit to giving a space presentation, but also to find two peers who are willing to make the same commitment. In this way, the program will spread in a grassroots manner, and may in fact be passed along annually to new IQP groups so the effort continues. This project would bring visibility to the WPI community, as members would be acting as ambassadors of the campus and their individual majors.

Group members will either independently or together create a presentation to give to students that can include anything from their specific interests in space to a general discussion about why space exploration is important. As part of this campaign, material goods may be designed with a creative logo, to give away at the presentations in order to engage the audience, as well as acting as walking advertisements for the space industry. This is not essential for the project, but may provoke interest; the point is to make space fun and appealing.

Vehicles by which these goals will be accomplished will include exhibition fairs at the high schools and WPI (during registration week), as well as after school programs at local schools that engage children in space exploration differently depending on the age group. For elementary school kids, LEGO-robotics may be used to design space shuttles and the International Space Station, at least familiarizing them with the terminology. For middle and high school aged students, a timeslot may be procured after school for a club that meets regularly to discuss applications of their intended major in college to space or how to integrate space science into their curriculum. Another potential idea for students includes networking opportunities with representatives from various space organizations.

Social Implications and Benefits

Developing an inspired public with a goal is a challenging, yet rewarding, feat. If the global public is inspired, then the possibilities in space are endless. By beginning at a local level, and hopefully working to the global level eventually, not only will the public benefit from such presentations and discussions but the presenters themselves will inevitably be learning from the process. Frequently the only space reports and information presented to society are the tragedies and devastations, impending disaster, unsuccessful launches, and missions that claim lives. It will be the belief of this project that it is this unawareness of dreams and successes that leads to lack of support and enthusiasm for space exploration and the space industry itself. To verify this information, the team will create and distribute surveys to the students and audiences. This project offers a breadth of knowledge to the community by sharing the good news and the progress of the industry, instilling in youth the desire to know more and investigate further.

Initial Timeline

A tentative timeline is listed below, depicting realistic targets for this project.

Start of B-term (November 10 - Thanksgiving Break):

- Proposal approval
- Create presentations
- Meet with Bancroft School. Establish space program for Saturday mornings
- Meet with Rocketeers at the Goddard School. Gather input and schedule time slots to involve interactive space topics, including, but not limited to, LEGO-robotics
- Talk to local schools and ask to present at general assemblies and in Physics classes
- Create survey

End of B-term (Thanksgiving Break - December 15):

- Establish repertoire of various presentations applicable to different audiences
- Present to one audience as an IQP team effort
- Establish test group to present to and give surveys

C-term (January12 – March 2):

- Begin analysis of feedback (via surveys) that will provide data for the paper
- Begin presenting to various audiences as individuals – at least 3 presentations each
- Begin Saturday morning teaching curriculum at Bancroft School (grades 1-5)
- Contact representatives of NASA/ESA/JAXA and ask them to speak in reference to current space issues

D-term (March 14 – May 2):

- Finalize paper
- Establish lasting ties with involved schools to continue project next year
- Set up Space Exhibition Fair on campus during next recruitment event
- Compile collection of teaching materials, resources and curriculums for future school programs

Actual Timeline

The timeline we actually followed is listed below.

B-Term

- Proposal approval
- Began inquiries into creating programs to spread awareness about space
- Met with Bancroft School. Established space program for Saturday mornings
- Began planning curriculum for weekend program at Bancroft
- Acquired materials that aided in planning curriculum

C-Term

- Created curriculum for K-6th grades
- Implemented curriculum at Bancroft for a five week/once a week program
- Began inquires to make one shot presentations possible in local high schools
- Contacted Goddard Elementary School about after school program
- Created PowerPoint presentation

- Destination Imagination presentation
- International Association for Science, Technology & Society (IASTS) conference, Baltimore, MD

D-Term

- Hosted Yuri's Night at WPI
- Developed Goddard after school program with the Rocketeers.
- Shared our PowerPoint presentation at North High School
- Shared our PowerPoint presentation at Holy Name High School
- Shared our PowerPoint presentation at Doherty High School
- Report written
- Compile collection of teaching materials, resources and curriculums for future school programs
- Establish lasting ties with involved schools to continue project next year
- International Space Development Conference (ISDC), Los Angeles, CA

Lesson Plan Correlation with State Standards

The Massachusetts Department of Education begins the Science and Technology/Engineering curriculum at a very young age. The framework embodies several strands such as Earth and Space Science, Life Science (Biology), Physical Sciences (Chemistry and Physics), and Technology/Engineering. DoSPACE attempted to consume the Earth and Space Science strand in its entirety, to then parallel the state teachings with our own lesson plans. This is not to say that the latter strands are of less importance, but rather chemistry, physics and biology should be targeted only when the students realize the direct application to their daily lives. This is accomplished by recognizing current space events and news that hold immediate relevance to the students.

DoSPACE considered four options when deciding how to proceed with the project, to attain our desired result. The decision not to follow the lead of prior IQP teams that worked in the schools and developed a curriculum unit for teachers is addressed as our third option.

Firstly, we thought to change the Massachusetts state curriculum in order to give students (grades 4-12) exposure to what an expansion of society's space science knowledge could mean for the future. Reviewing the current breakdown of Massachusetts' grade 3-5 and 6-8 curricula, we discovered that subject matter regarding space was only covered briefly and with little emphasis in the 6-8 grade curriculum. The learning standards that apply under the Earth and Space Science category include: Mapping the Earth, Earth's Structure, Heat Transfer in the Earth's System, Earth's History and lastly, the Earth in the Solar System. This framework has existed in its current state since January of 1996. The large emphasis on Earth within this strand has ensconced itself within the skeleton of the state standards and has not been questioned. There is, undoubtedly, a small section devoted to our planet within the Solar System. This fragment instructs teachers to

> "Recognize that gravity is a force that pulls all things on and near the earth toward the center of the earth. Gravity plays a major role in the formation of the planets, stars and solar system and in determining their motions. Describe lunar and solar eclipses, the observed moon phases, and tides. Relate them to the relative positions of the earth, moon, and sun. Compare and contrast properties and conditions of objects in the solar system (i.e. sun, planets, and moons) to those on Earth (i.e. gravitational force, distance from the sun, speed, movement, temperature and atmospheric conditions). Explain how the tilt of the earth and its revolution around the sun result in an uneven heating of the earth, which in turn causes the seasons. Recognize that the universe contains many billions of galaxies and that each galaxy contains many billions of stars."[7]

This touches upon what we wish to convey in our presentations however only minimally. Ideally, current events about space would perhaps be more helpful in the development of students' space interest. Knowing how space

[7] http://www.doe.mass.edu/frameworks/scitech/2001/standards/es6_8.html

technology directly affects their lives and that these teachings about new techniques are no longer science fiction, may spark the interest in the next space generation. Therein, the Massachusetts History and Social Science Curriculum would be applicable for our purposes and perhaps subject to change, more so than the Science and Technology/Engineering curriculum. Not to our surprise, the History and Social Science[8] framework makes no mention to space in the least. Teachers are instructed to educate grades 6 and 7 about the following:

> "Sixth graders systematically study the world outside of the United States and North America by addressing standards that emphasize political and physical geography and embed five major concepts: location, place, human interaction with the environment, movement, and regions. Students systematically learn geography around the world continent by continent, similar to the way in which atlases are organized. They also learn about each continent in an order that reflects, first, the early development of the river valley civilizations and then the later development of maritime civilizations in the Mediterranean area and in Northern and Western Europe. In so doing, students are better prepared for the study of early civilizations around the Mediterranean area in grade 7.
>
> Seventh graders study the origins of human beings in Africa and the ancient and classical civilizations that flourished in the Mediterranean area. They study the religions, governments, trade, philosophies, and art of these civilizations, as well as the powerful ideas that arose in the ancient world and profoundly shaped the course of world history."

The sheer breadth of the material covered is impressive, even in these two grades alone. However, there is little mention of *any* reference to current events, never mind space related current events. If DoSPACE undertook this task, we would be starting at square one and prompting a movement which would eschew traditional format and encourage an entirely new approach to motivate students about space. We came to the conclusion that a curriculum change would involve cutting through various layers of red tape in order to effectively distribute our ideas to even the local school system. Many schools may be unwilling to divert from the state's curriculum, due to standardized tests like the MCAS, the Massachusetts Comprehensive Assessment System. Enlisting the aid of the creators of the MCAS would prove extremely difficult, if not impossible, and this was the only way to ensure that our curriculum changes would be used on a broad scale. Additionally if our attempts to change a school curriculum failed then our project would essentially achieve nothing and perhaps make it more difficult, if not outright prevent future inquires along these lines. While a success would mean that material and ideas would reach a broad base of students, these students may not become interested as it is being forced upon them during a school lecture. This means we may inadvertently dissuade those who could have been interested, had they sought out the information themselves as opposed to an obligatory curriculum.

Secondly, we briefly considered flooding the media and schools with information similar to an advertising campaign undertaken by large companies upon the launch of a major product With commercials, short television spots on the local news, shirts with the DoSPACE logo for high school presentations, handouts to potentially pass out at tollbooths and access to a billboard on a major highway, this local campaign would have matured into a blossoming movement very quickly. However, a publicity campaign was too ambitious, as we realized we did not posses the revenue as a new group to pool resources together for advertising and material and thus removed this option from consideration.

Thirdly, previous IQP teams had delved into the high schools and developed a curriculum unit for teachers to use year after year. However, the IQPs that DoSPACE came across would not have been relevant for our purposes, nor were they up to date with current space technology or news of the industry. The only IQP that we referenced and adapted to accommodate the Goddard School program was Robin Castle's *Competition in Space LRPG* (Live action Role Playing Game). IQP teams of this year included groups that attended Doherty and implemented an after school program that helped the students become more familiar with engineering and technology, but did not pertain to

---

[8] http://www.doe.mass.edu/frameworks/current.html

space. However, these teams have established strong contacts at area high schools and will serve as excellent resources next year with the subsequent generation of DoSPACE.

Finally, we deemed building a more specific approach to reach out to individual students a worthy endeavor. By delivering our own after school and one shot presentations, DoSPACE independently attempted to manufacture a method to raise awareness about space. Students who were predisposed to space, in any of its myriad forms, gradually became our target audience. IQP teams that worked simultaneously with us offered their services in the form of presentations that we attempted to utilize at the North High after school program. DoSPACE did not purposely work in isolation but rather found it beneficial to the students to design our own lesson plans and implement them as a group whose principle focus was general space knowledge. This extremely broad horizon included briefings about various space happenings but conveyed an overall fascination to the kids. Other IQP teams worked in very specific areas, making cases for space, such as mining Helium 3 from the moon, or the Space Elevator. DoSPACE makes the case that without instilling in younger generations the passion that is required to get us to the Moon or Mars, we will continue to postpone launches and shove space exploration back onto the top shelf. The average age at NASA is 54 years old[9]. If students do not take the initiative to plunge forward with this industry, whether government or private, there will be a vacuum when these officials retire. Unless we can make Helium 3 or the Space Elevator exciting for students, this void will not be filled.

Social Applications – After School Clubs

The material developed for the after school programs at both Bancroft and Goddard were designed as a model that we used for both programs but was fundamentally designed for future IQP groups as well as teachers who enjoyed the material.

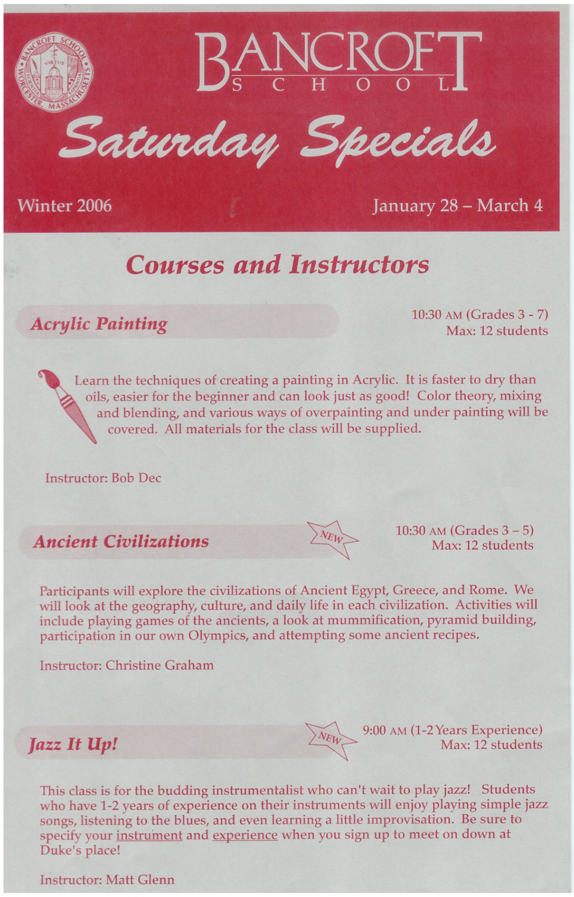
The program at Bancroft was initiated and carried out entirely by the DoSPACE team. The Goddard after school program was conceived in a grant contributed by NASA and was running before we were in contact with the advisors of the program. Students being taught by students are important for our cause, because it brings a real world perspective to the classroom. This program essentially will continue running regardless of our involvement with it and can actually become another source of new material, as well as being another forum for evaluating our material in which we develop. The make up of the Goddard after school program was composed of advanced students already with an initial interest in space. Next years team DoSPACE may want to come up with new lesson plans to be taught at Goddard as some of the students will be the same. However we created the lesson plans of this year assuming they would be recycled.

Bancroft School Program

The first program we established was at the Bancroft School in Worcester, Massachusetts. During this 5 week program we developed a list of activities and drew up a course syllabus to execute. Two classes were taught at Bancroft each Saturday for two different age groups. The first age group ranged from kindergarten through third grade. The lesson plans for this group were developed with the understanding that this group had a shorter attention span, and minimal knowledge about space. The second age group was students in grade 4-6. This older group had their lesson plans focused more on discussion and group exercises, with an emphasis on team dynamics. It was also expected that they would have a stronger space foundation.

[9] http://nasapeople.nasa.gov/workforce/age/present.htm

The following is a copy of the brochure that depicted the type of class we taught:



BANCROFT SCHOOL

Saturday Specials

Winter 2006 January 28 – March 4

Courses and Instructors

Acrylic Painting — 10:30 AM (Grades 3 - 7) Max: 12 students

Learn the techniques of creating a painting in Acrylic. It is faster to dry than oils, easier for the beginner and can look just as good! Color theory, mixing and blending, and various ways of overpainting and under painting will be covered. All materials for the class will be supplied.

Instructor: Bob Dec

Ancient Civilizations — NEW — 10:30 AM (Grades 3 – 5) Max: 12 students

Participants will explore the civilizations of Ancient Egypt, Greece, and Rome. We will look at the geography, culture, and daily life in each civilization. Activities will include playing games of the ancients, a look at mummification, pyramid building, participation in our own Olympics, and attempting some ancient recipes.

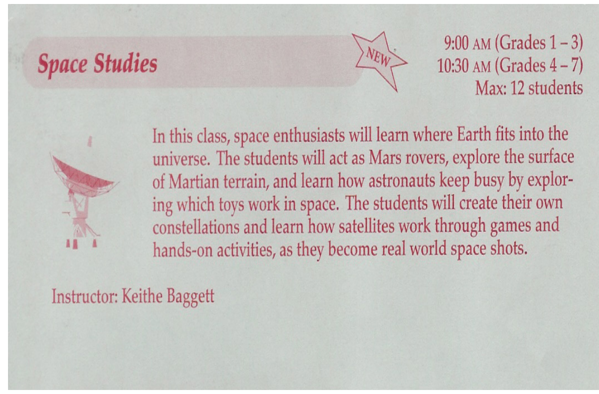
Instructor: Christine Graham

Jazz It Up! — NEW — 9:00 AM (1-2 Years Experience) Max: 12 students

This class is for the budding instrumentalist who can't wait to play jazz! Students who have 1-2 years of experience on their instruments will enjoy playing simple jazz songs, listening to the blues, and even learning a little improvisation. Be sure to specify your instrument and experience when you sign up to meet on down at Duke's place!

Instructor: Matt Glenn

Figure 1



Space Studies — NEW — 9:00 AM (Grades 1 – 3) 10:30 AM (Grades 4 – 7) Max: 12 students

In this class, space enthusiasts will learn where Earth fits into the universe. The students will act as Mars rovers, explore the surface of Martian terrain, and learn how astronauts keep busy by exploring which toys work in space. The students will create their own constellations and learn how satellites work through games and hands-on activities, as they become real world space shots.

Instructor: Keithe Baggett

Figure 2

Included within this report are the lesson plans that DoSPACE created and exercised at Bancroft and Goddard. While some are similar, they are adapted for both schools, individually. The lesson plans immediately following include feedback that the team believes is important for the future development of the campaign. The actual lesson plans are located at the end of the report, as well as necessary hand outs, contact information and posters that are available for publicity purposes, advertising and the furthering of the DoSPACE effort

LESSON PLAN I & Feedback - Mars Rover

Target Audience: Grade Level 4-5
Approximate Time: One hour

Objective: The first activity uses the format of the relay race to illustrate the delay between sending and receiving a message in outer space. Students will learn the difficulties of communicating to and from outer space by acting as probes and communication systems while building a sense of teamwork in the second activity.

Objective Feedback: It is important to simplify this activity with younger students. Our experience was that the students were easily confused by the multiple communication systems. As long as their tasks and titles are clearly identified, the activity should flow smoothly. Relay racing was the form of competition that we employed to get the students motivated and interested in the activity.

Materials: Large gloves, nut and bolt, 20 paper cups, blindfold

Materials Feedback: To enhance the second activity, bulky gloves are ideal to make the activity more challenging and similar to what the astronauts wear. Our team made the mistake of purchasing small gloves the first time we ran the activity. If a large, bulky jacket is available, this would make the students feel even more like the astronauts, whose suits can weigh up to 400lbs.

Discussion: Introduction:

Why do you like space? What do you know about space?
What do you know about robots? Why are they important? Why do we need them on Earth?
Are there/Have there ever been robots in space? (i.e. Rovers, *Spirit* & *Opportunity*)
How long were they designed to operate on Mars? (3 months – but after 2 years, they still are working! http://marsrovers.jpl.nasa.gov/overview/)
Are they different from robots on Earth? Can robots do things that humans can't? (i.e. Easily go on outside of spaceship to fix problems)

Activity I: Nut-Bolt Relay

This is a timed activity. All students act as robots, and stand in a line next to each other. The first student picks up a nut and bolt from the floor and secures them together, then places the two pieces back on the floor separately after taking them apart. The students continue this down the line until they are finished. Read off the finished time.

All students will now act as astronauts, and stand in a line next to each other, as before. Before assembling the nut and bolt, they must put on (preferably large and cumbersome) gloves and then attempt to do the same task. Read off the finished time.

Activity I Feedback: For this activity, the nut and bolt were just tools used to exemplify the activity. It is definitely appropriate to use other tools for this activity, such as putting puzzle pieces together. This will be difficult with the gloves. Any task that includes small objects that are difficult to maneuver will be effective. Because the gloves we obtained for this activity were too small for the students to use, we were forced to use dishtowels that the students had to work through and could not touch the nut ant bolt directly.

Discussion: Which team was faster? Robots or astronauts? Why? (Robots don't need to dress. They can be programmed)
Does that mean that robots are (always) better?
What can astronauts do that robots can't? (Talk, communicate if there is a problem)

Activity II: Mars Rover on Rough Terrain

This activity will demonstrate why robots/rovers are not always good. Obstacles – chairs, tables etc – should be positioned in classroom so students cannot easily maneuver around them.

Rover: 1 student to act as Mars Rover. Blindfold student.
Central Command ("Houston"): 3-5 students unable to see obstacle course
Messenger A is Signal from Rover to "Houston": 3-5 students
Messenger B is Signal from "Houston" to Rover: 3-5 students

The mission is to reach the target on the opposite side of the room from where the Rover starts. The target is a stack of paper cups on a desk.

Since the Rover cannot see, it must be told what to do and where to go.
1. Messenger A will decide how many steps and in which direction the Rover should go. He/she will go and tell "Houston" then return to the Rover's side, without speaking to Messenger B.
(ie "Take 4 steps left then 6 steps right")
2. "Houston" will then tell Messenger B the directions.
3. Messenger B will then actually move the rover into position, without speaking to Messenger A.

4. Once the target is reached, the rover must build a pyramid of paper cups while blindfolded, following the same procedure as before. This time, Messenger A will not give directions in paces or steps, but rather explicit commands (ie "Pick up the cup with your right hand and place it next to the other cup")
(This building of the paper cups will represent the rover collecting data or gathering information.)

Activity II Feedback: This activity may become confusing because of the many steps of communication. However, this is a realistic scenario, because often times, signals are relayed from one command center to another and the wrong directions are given. To make the activity more challenging simply increase the difficulty of the obstacle course. Take time before you implement this activity because it can be confusing, so it is best to familiarize yourself with the material.

Discussion: Is there a problem with the robot? (They need constant instruction, someone to tell them what to do; Humans/Astronauts do not need to wait for instructions.)
Which do we need more? Robots/Rovers or Astronauts? (Both!)

Important Concepts:

In this activity, a message is carried only several feet. Actual satellites are useful because they can relay information over several thousand miles. Delays occur because it takes time for the radio signals to travel to their destination via satellite.

We can obviously see the Messengers, or signals, in the relay, but actual radio signals are not visible to the human eye.

(http://www.physics.rutgers.edu/hex/visit/lesson/lesson_links1.html)

Extended Exercises:

In addition to the cup pyramid, another task/target could be to build a Mars Rover out of puzzle pieces that the students have made themselves. (Have them draw their own interpretations of the rovers, then show a picture of the real rovers and vote on which is closest to the real thing. After the students pick the picture most resembling, they cut it into pieces and try to have the Rovers put it back together with commands from the Messengers)

With more time, there could be more than one team. Activity II could be a relay as well, seeing which team could successfully reach the target and "collect Mars samples" first. Or repeat with one team, and have different rovers, each time. To increase difficulty and make the obstacle course harder, extra students may act as meteors that fall right in the path of the rover, or an unexpected crater that forces the rover to take another route.

Extended Exercise Feedback: If the activity is finished and there is still time, have the students run through the Mars Rovers activity again, with different roles, so that more than one child can act as the rover. As an introduction activity if there is time, have the students draw their interpretations of Mars Rovers. The following are some samples:

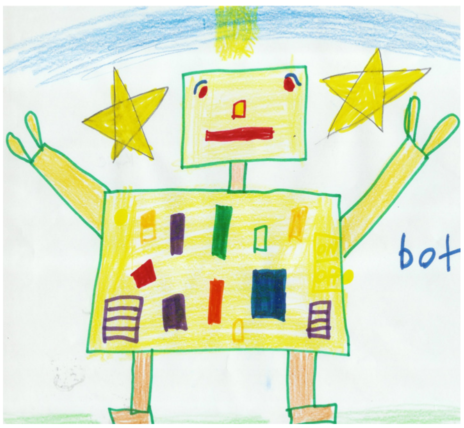


Figure 3

Figure 4

Suggestions

We have found that younger children react to this activity differently than older children, so the level of difficulty relates directly to the age group to make the activity more engaging. The younger students found obstacles themselves that would act as interfering objects, such as "craters on the surface of Martian terrain" (a hoola-hoop) or "meteorites" that impacted the rovers during their mission (Styrofoam balls). We recommend a competitive edge for the older groups to make the task more stimulating. With two rovers, led by two teams of communications systems, the game becomes twice as challenging and twice as exciting.

LESSON PLAN II & Feedback - Constellations Mythology

Target Audience: Grade Level K-8
Approximate Time: One hour

Objective: To inform and educate the students on constellations their stories and locations and where they come from in order to increase their general space awareness and interest in space. This is achieved by telling several interesting stories which will hopefully inspire the students to investigate further.

Objective Feedback: Simplification of the subject matter may be necessary for younger groups but in general the stories should be able to be understood by young students.

Materials: The information on the constellations and the constellation finder printout.

Materials Feedback: There are many variations for constellation stories so different stories may be obtained.

Discussion: Introduction:

What do you know about the stars at night?
Do any of you know what a constellation is?
Have any of you heard of Ursa Minor or Major?
Perseus is a significant mythological character, have any of you heard of him?

Activity I: Constellation Finder Construction

The students are instructed on how to cut out the constellation finder's separate pieces. The students are then shown how to put together those pieces. Next they were instructed in its use and a description of the exterior markings.

Activity I Feedback: The constellation finder is for the northern hemisphere and covers all months of the year. We found that the younger students had little patience for waiting for other students to finish when they had finished, so keeping order was difficult even with a group of just ten students. The older students we instructed were much better behaved.

Discussion: Students may have a little difficulty with the operation of the constellation finder so a more advanced explanation may be required as follow up.

Activity II: Constellation story telling, identification, and location finding

The constellation discussion began with locating a constellation and identifying the shape so that the students can recognize it. The discussion was continued by relaying the story filling in any relevant details from Greek or Roman mythology. We started with locating the North Star and the fact that it is part of Ursa Major. Next, we moved on to locate Ursa Minor and identify it. We then continued on to locate a relatively simple constellation to locate and identify which is Cassiopeia. Continuing on we moved on to her husband King Cepheus which is very close by and can have the story tied into Cassiopeia. After telling a shortened version of Cepheus's story the discussion moved to his daughter Andromeda, his future son in-law Perseus and Perseus's steed and mythical mount Pegasus which are all located very close together and have a very interesting and good sized story involving all of them. If that did not take up all the time then the discussion moved onto constellations such as Orion the Hunter, Hercules, the twins Castor and Pollocks, Cetus the Whale, and Draco the Dragon.

Activity II Feedback: The younger students were much more distracted and we were not able to get any farther than the Perseus and Andromeda story. The older students were much better and the discussion moved on to Orion, Hercules, and the Twins.

Discussion: While there is general consent on the names of the constellations there is some dispute on the accompanying story and it is therefore possible to find multiple stories about the same constellation. The stories supplied about the constellations here are the ones that we were most familiar or the most interesting stories we could find.

Important Concepts:

While this exercise does not directly relate to the exploration of or expansion of space awareness however it is a significant point in history, constellations and stars were used by sailors for hundreds of years to navigate at night it was also used as a form of oral history.

Suggestions:

As mentioned earlier there are multiple stories for most of the constellations and several can be found. The best should be chosen and repeated for the students.

LESSON PLAN III & Feedback - Solar System

Target Audience: Grade Level 4-6
Approximate Time: One hour

Objective: To give students a sense of perspective about the Solar System and the size of the planets.

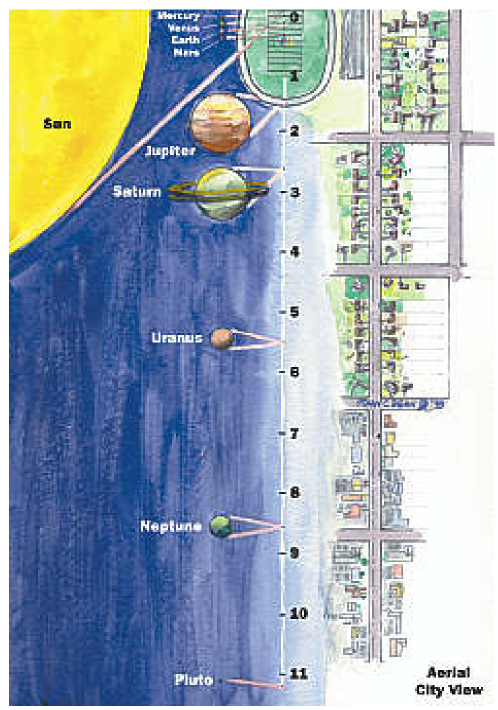
Objective Feedback: This lesson may not have been as successful with the younger student because of their lack of ability to comprehend the sheer magnitude of the distances in space. We may have given them the impression of the vastness of space, but comprehension of such huge distances is difficult even for adults so we tried our best to give them the correct impression of the vastness of space..

Materials: Styrofoam balls of various sizes representing planets, access to a large room or playground, chalk

Discussion: Introduction:

Name all the planets in the Solar System (Have students make up new acronyms to help them remember)
How many Earths could fit inside Jupiter?
How many football fields would it take to demonstrate correctly the size of the Solar System, if the Earth was only a basketball?
Is the Sun the biggest star in the galaxy?

Activity I: Orbit Game



Every student will be designated an entity in the Solar System:

- Sun
- Mercury
- Venus
- Earth
- Mars
- Asteroid Belt
- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
- Comets
- Moons around various Planets
- Rings around various Planets

The Sun will begin and stand in the middle of the room. Each planet will then slowly begin their rotation, one at a time around the Sun, until all of the entities are (rotating) in orbit. Students may observe others in their orbits until it is their turn.
http://www.solarspace.co.uk/

If the students are very hyper, they can pick up the pace a bit until they are going pretty fast. Yell "Freeze!" and see where the planets are in their rotating orbits.

If students are on a playground, use different colored chalk for each planet to have them draw their orbits as they rotate around the Sun. Then discuss afterwards if any of the lines crossed each other.

Activity I Feedback: The students got very riled up and started to run, so make sure that they only walk in an orbit. Also an interesting thing to do if you have too many students is to have some of them act as moons to some of the planets and have the students note the paths that the moons take.

Discussion: After "freezing", if Pluto is next to the Sun, or other planets are in disarray, discuss the consequences of this and why we must maintain our orbit as Earth to continue living here. If we were as close to the sun as Mercury or as far away as Pluto, we would receive too much, or not enough sunlight, respectively, to nourish life.

Activity II: Walk the Planets

With enough adults present, this can be done on a long, private street. Keeping the students in their roles as planets and Solar System entities, have them hold their Styrofoam Planet as everyone walks a scaled distance of the Solar System. As a scale, one may use a square of toilet paper, or a pace as 100 million miles.

Assign a "Pacer" who will lead the rest, and count loudly.

Starting at the Sun, take:	3.5 paces to Mercury
From Mercury, take:	3 paces to Venus
From Venus, take:	6 paces to Earth
From Earth, take:	5 paces to Mars
From Mars, take:	34 paces to Jupiter
From Jupiter, take:	40 paces to Saturn
From Saturn, take:	65 paces to Uranus
From Uranus, take:	150 paces to Neptune
From Neptune, take:	50 paces to Pluto

Activity II Feedback: This is where we try to impress upon the students the magnitude of space. This may have been more impressive if we were not confined to a single hallway and were required to double and triple back down the hallway. This would have been much more impressive if we could have walked straight down a long stretch of sidewalk perhaps.

Important Concepts:

What would happen if the planets were to freeze or stop in place like the students demonstrate? Explain how the Earth's gravitational pull keeps the Moon in its orbit and why we only see one side of the Moon. This is the case for every planet with moons, even planets that have 63 moons! (Jupiter; most are asteroids that were caught in Jupiter's gravitational pull)

Extended Exercises:

Additional students that have not been assigned a planet for each exercise can be assigned positions such as the "moon" of other planets, or as the asteroid belt. With string during the Orbits game, moons could literally attach themselves to their orbiting planets

Suggestions

It is recommended that the students not try to spin in their orbits for extended periods of time as it will cause them to become very dizzy and possibly a safety hazard if the exercise is being performed on a hard surface.

LESSON PLAN IV & Feedback - LEGO Robotics Space Elevator

Target Audience: Grade Level K-6
Approximate Time: One hour (at least)

Objective: To familiarize the students with the terminology and basic construction of a newly proposed space technology: the Space Elevator.

Objective Feedback: The goal of this lesson is not to discuss the detailed assembly of the Space Elevator nor its material composition. We want to provide the students with an understanding that this structure is a future concept that is being developed, and is no longer only a science fiction brainchild, but rather an idea that is coming to fruition with the maturity of developing space technologies.

Materials: MINDSTORMS LEGO Robotics Kit, LEGO Elevator instructions, images of space elevator

Materials Feedback: MINDSTORMS LEGO Robotics Kit may be purchased at Toys 'R' Us, or any similar store. However, it is an expensive kit so depending on the size of the class, one will usually suffice. The Space Elevator images are not critical to the activity, but simply aid in the visualization of construction.

Activity: Building a LEGO Robotics Space Elevator

This activity helps students stimulate an interest in engineering as a possible avenue to space. We introduce a team dynamic by having only one MINDSTORMS kit. The children may either follow the elevator directions, or improvise to create their own rendition of what they believe the space elevator looks like.

Activity Feedback: The elevator instructions are not specific to a space elevator. However, because we are not focusing on the technological aspect of this concept, it is reasonable to have the children follow these directions and talk to them about how it differs from a model of a real space elevator. We had the students divided into four group - each group having a full set to make their own elevator and directions to do so however most of the groups decided to band their resources together and attempt to build one extremely large elevator. While they were not actually successful in creating a working elevator they did begin to understand problems with creating one, as well as coming very close to finishing one.

Discussion: Discuss how long the elevator will be (22,000 miles)

There are some very hard, durable materials used on Earth to make elevators. Can anyone name some? (Diamond, Steel) Would we be able to use the same materials to build a space elevator? (No – diamond is brittle and rare. Subjected to varying weather and temperature conditions, steel is susceptible to material changes.)

Are they any kinds of natural material that is just as strong? (Spider Silk) Why can't we use this as the cable for the space elevator? (We don't have a big enough spider to produce the silk, and not enough spiders to collect 22,000 miles worth of silk)
Introduce new material called carbon nanotubes that scientists are using to make the ribbon. Discuss the timeline for the construction of this elevator, and if the students think it is a feasible idea.

Talk about where the space elevator would lay its foundation, taking into consideration the varying environments and atmospheres around the globe. (Right now, Ecuador is the prime spot for its foundation because of its mild environment and its proximity to the Equator.)

Mentioning the purpose of the space elevator is a good discussion piece. Ask why we may need an elevator to help us in the future. (Loading dock for future missions to Mars, more fuel efficient, will enhance the space tourism industry) http://en.wikipedia.org/wiki/Carbon_nanotube

Suggestions

One hour was not quite enough time for the students to finish construction in our class. This was because not everyone arrived on time, and we began with an introduction activity. This lesson plan is relatively flexible in its time restrictions, as students enjoy LEGOS and would have continued playing with them after class ended.

LESSON PLAN V & Feedback - Jeopardy

Target Audience: Grade Level 3-6
Approximate Time: One hour

Objective: To test student's current knowledge and expand their knowledge with the tougher questions.

Objective Feedback: Simplification of the subject matter may be necessary for younger groups. Using simpler questions may be chosen to make the Jeopardy suitable for younger students.

Materials: The information questions for the Jeopardy game as well as numbers for points and category names.

Materials Feedback: More jeopardy questions can be made or found in various resources such as the internet or in a teaching resource books.

Activity: Jeopardy

Before the game initiates the questioner should set up the board so it should not impede upon the game time. After the game board is set up the questioner should divide the students into groups so that anywhere from 3-6 students are in a group we recommend groups of 4 or 5. The questioner then chooses questions such that the difficulty is on level with the question asked for. One option for identifying which group is ready to answer first is for a designated student from each group to simultaneously raise their and slap their hand on the table when they know the correct answer. As in normal Jeopardy correct answers are awarded points and incorrect answers take away points.

Activity Feedback: The students were separated into two groups of their own choosing, unfortunately the groups they choose were along grade lines and the older group had a clear advantage. The younger students quickly fell behind and lost interest excepting one or two who were extremely interested, this lead to the younger students wandering and becoming extremely distracted.

Discussion: Additional questions can be added to the question list. The questions are currently not in order and such should be chosen by difficulty according to the audience.

Important Concepts:

While this exercise does not directly relate to the exploration of or expansion of space awareness however it is a significant point in history, constellations and stars were used by sailors for hundreds of years to navigate at night it was also used as a form of oral history.

Extended Exercises:

One way to extend Jeopardy is with double Jeopardy with harder and more questions as well as Daily Doubles. Additionally you can always have a Final Question as done in Jeopardy in which the question is asked then bid on by each group and then answered in written form.

Extended Exercise Feedback: Double and Final Jeopardy are options for extending the exercise however in our experience we have yet to finish a single session in single Jeopardy and so the Double and Final Jeopardy may not be necessary.

Suggestions

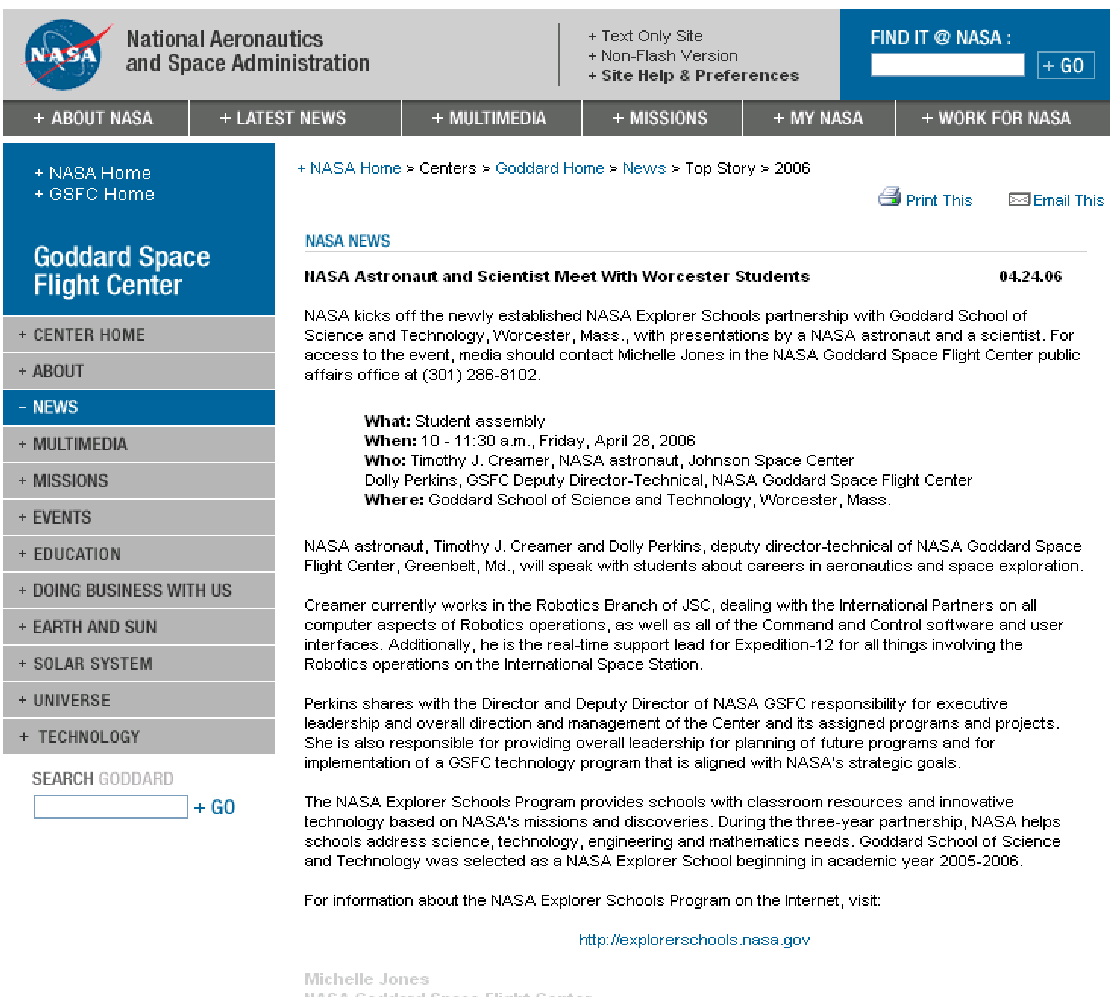
The teacher may choose to include more questions in this lesson plan. We also suggest possibly organizing the questions in order of difficulty. The problem with ranking the questions ahead of time is that some teachers may have covered certain material and not other subject matter, changing the difficulty of some questions significantly, and thus we left the questions unordered in order to give the questioner more control, as they will know the appropriate level of difficulty.

Goddard School of Technology and Science Program

With the success of the Bancroft program, a very similar program was implemented at Goddard Elementary School in Worcester, Massachusetts. Many of the lesson plans are very similar, with the changes being made to correct for the flaws which were discovered during the Bancroft program. This program ran after school on Tuesdays for four weeks. The students ranged from grades 5-6, and the activities chosen were focused on this age group. Four days of activities were run, with one all new activity to accommodate the higher audience age, as well as the increased audience size.

The Goddard school is markedly different from Bancroft. The facilities are deteriorating, and it is located in an area of the city where signs read “A concerned and caring neighborhood”. This inner-city school provides a stark contrast to that of Bancroft, where the hallways are carpeted and a broken bulb is seemingly the cause of the most serious financial concern. However, both schools are equally blessed in very different ways.

The Goddard School of Technology and Science affords its students a strong basis in fundamental math and science. As engineering is encouraged, students’ interest in technology is heightened. Goddard is one of the NASA Explorer Schools (NES) that partners with the space industry to endorse public support of space exploration. The following is an article that demonstrates the capacity that this program has to affect young students.



National Aeronautics and Space Administration

+ Text Only Site
+ Non-Flash Version
+ Site Help & Preferences

FIND IT @ NASA : + GO

+ ABOUT NASA | + LATEST NEWS | + MULTIMEDIA | + MISSIONS | + MY NASA | + WORK FOR NASA

+ NASA Home
+ GSFC Home

Goddard Space Flight Center

+ CENTER HOME
+ ABOUT
– NEWS
+ MULTIMEDIA
+ MISSIONS
+ EVENTS
+ EDUCATION
+ DOING BUSINESS WITH US
+ EARTH AND SUN
+ SOLAR SYSTEM
+ UNIVERSE
+ TECHNOLOGY

SEARCH GODDARD + GO

+ NASA Home > Centers > Goddard Home > News > Top Story > 2006

Print This Email This

NASA NEWS

NASA Astronaut and Scientist Meet With Worcester Students **04.24.06**

NASA kicks off the newly established NASA Explorer Schools partnership with Goddard School of Science and Technology, Worcester, Mass., with presentations by a NASA astronaut and a scientist. For access to the event, media should contact Michelle Jones in the NASA Goddard Space Flight Center public affairs office at (301) 286-8102.

What: Student assembly
When: 10 - 11:30 a.m., Friday, April 28, 2006
Who: Timothy J. Creamer, NASA astronaut, Johnson Space Center
Dolly Perkins, GSFC Deputy Director-Technical, NASA Goddard Space Flight Center
Where: Goddard School of Science and Technology, Worcester, Mass.

NASA astronaut, Timothy J. Creamer and Dolly Perkins, deputy director-technical of NASA Goddard Space Flight Center, Greenbelt, Md., will speak with students about careers in aeronautics and space exploration.

Creamer currently works in the Robotics Branch of JSC, dealing with the International Partners on all computer aspects of Robotics operations, as well as all of the Command and Control software and user interfaces. Additionally, he is the real-time support lead for Expedition-12 for all things involving the Robotics operations on the International Space Station.

Perkins shares with the Director and Deputy Director of NASA GSFC responsibility for executive leadership and overall direction and management of the Center and its assigned programs and projects. She is also responsible for providing overall leadership for planning of future programs and for implementation of a GSFC technology program that is aligned with NASA's strategic goals.

The NASA Explorer Schools Program provides schools with classroom resources and innovative technology based on NASA's missions and discoveries. During the three-year partnership, NASA helps schools address science, technology, engineering and mathematics needs. Goddard School of Science and Technology was selected as a NASA Explorer School beginning in academic year 2005-2006.

For information about the NASA Explorer Schools Program on the Internet, visit:

http://explorerschools.nasa.gov

Michelle Jones
NASA Goddard Space Flight Center

[10]

DoSPACE adapted some of the lesson plans from Bancroft to accommodate those students at Goddard. The ages varied from school to school so the curriculum was adjusted accordingly. Some feedback is given within the lesson plans while a total review follows, given by Mrs. Debrales Seles who advises the after school Goddard Rocketeers.

LESSON PLAN I - Mars Rover

Target Audience: Grade Level 5-6
Approximate Time: One hour

Objective: The first activity uses the format of the relay race to illustrate the delay between sending and receiving a message in outer space. Students will learn the difficulties of communicating to and from outer space by acting as probes and communication systems while building a sense of teamwork in the second activity.

Objective Feedback: Though this group was only slighter older, compared to Bancroft, the students communicated much better as teams, and worked together to achieve the goal. At Bancroft we assigned the students to one team and modified it to two teams at Goddard. With a sense of competition in the air, the students worked hard to help their team.

Materials: Large gloves, nut and bolt, 20 paper cups, blindfold

Materials Feedback: This time, we arrived with gloves that were definitely too large for the students, learning from the Bancroft experience. Also, we brought a very large down overcoat that is bulky even for us, to make the students feel that they were getting in and out of a space suit.

Discussion: Introduction:
Why do you like space? What do you know about space?
What do you know about robots? Why are they important? Why do we need them on Earth? Are there/Have there ever been robots in space? (i.e. Rovers, *Spirit* & *Opportunity*) How long were they designed to operate on Mars? (3 months – but after 2 years, they still are working! http://marsrovers.jpl.nasa.gov/overview/)
Are they different from robots on Earth? Can robots do things that humans can't? (i.e. Easily go on outside of spaceship to fix problems)

Discussion Feedback: Allow the students to lead the discussion if possible. Asking generic questions about robots in space immediately led into Spirit *and* Opportunity *at Goddard.*

Activity I: Nut-Bolt Relay

This is a timed activity. All students act as robots, and stand in a line next to each other. The first student picks up a nut and bolt from the floor and secures them together, then places the two pieces back on the floor separately after taking them apart. The students continue this down the line until they are finished. Read off the finished time.

All students will now act as astronauts, and stand in a line next to each other, as before. Before assembling the nut and bolt, they must put on (preferably large and cumbersome) gloves and then attempt to do the same task. Read off the finished time.

Activity I Feedback: Considering the edge of competition that children enjoy so much, this activity may be split up into two teams, assuming there are enough students to do so.

Discussion: Which team was faster? Robots or astronauts? Why? (Robots don't need to dress. They can be programmed)

---

[10] http://www.nasa.gov/centers/goddard/news/topstory/2006/nes_visit_1.html

Does that mean that robots are (always) better?
What can astronauts do that robots can't? (Talk, communicate if there is a problem)

Activity II: Mars Rover on Rough Terrain

This activity will demonstrate why robots/rovers are not always good. Obstacles – chairs, tables etc – should be positioned in classroom so students cannot easily maneuver around them.

Rover: 1 student to act as Mars Rover. Blindfold student.
Central Command ("Houston"): 3-5 students unable to see obstacle course
Messenger A is Signal from Rover to "Houston": 3-5 students
Messenger B is Signal from "Houston" to Rover: 3-5 students

The mission is to reach the target on the opposite side of the room from where the Rover starts. The target is a stack of paper cups on a desk.

Since the Rover cannot see, it must be told what to do and where to go.
1. Messenger A will decide how many steps and in which direction the Rover should go. He/she will go and tell "Houston" then return to the Rover's side, without speaking to Messenger B. (ie "Take 4 steps left then 6 steps right")
2. "Houston" will then tell Messenger B the directions.
3. Messenger B will then actually move the rover into position, without speaking to Messenger A.

4. Once the target is reached, the rover must build a pyramid of paper cups while blindfolded, following the same procedure as before. This time, Messenger A will not give directions in paces or steps, but rather explicit commands (ie "Pick up the cup with your right hand and place it next to the other cup") This building of the paper cups will represent the rover collecting data or gathering information.

Activity II Feedback: It may help to have images of the rovers for this activity. The students often asked what the rovers look like and we explained it to the best of our knowledge, however since rovers may look like anything, photos or pictures may help.

Discussion: Is there a problem with the robot? They need constant instruction, someone to tell them what to do; Humans/Astronauts do not need to wait for instructions.
Which do we need more? Robots/Rovers or Astronauts? (Both!)

Important Concepts:

In this activity, a message is carried only several feet. Actual satellites are useful because they can relay information over several thousand miles. Delays occur because it takes time for the radio signals to travel to their destination via satellite.

We can obviously see the Messengers, or signals, in the relay, but actual radio signals are not visible to the human eye.

(http://www.physics.rutgers.edu/hex/visit/lesson/lesson_links1.html)

Extended Exercises:

In addition to the cup pyramid, another task/target could be to build a Mars Rover out of puzzle pieces that the students have made themselves. (Have them draw their own interpretations of the rovers, then show a picture of the real rovers and vote on which is closest to the real thing. After the students pick the picture most resembling, they cut it into pieces and try to have the Rovers put it back together with commands from the Messengers)

With more time, there could be more than one team. Activity II could be a relay as well, seeing which team could successfully reach the target and “collect Mars samples” first. Or repeat with one team, and have different rovers, each time. To increase difficulty and make the obstacle course harder, extra students may act as meteors that fall right in the path of the rover, or an unexpected crater that forces the rover to take another route.

Figure 5

Figure 6

These pictures reveal some students from Goddard acting as astronauts and rovers. The rover could quickly maneuver the nut and bolt without bulky gloves while the astronaut took longer to complete the exercise because of the cumbersome gloves. Figure 3 shows how astronauts may have difficulties with other small scaled tasks. These are comparable to how they fix problems on the outside of the space shuttle. These would all be made harder if there was no gravity as well.

Figure 7

Figure 7 depicts a team during the Nut-Bolt Relay, though they were using small blocks to get the same idea across. Their team of about 10 students worked on this while another team of 10 students worked to screw the nut and bolt together. At Goddard, both relays were run simultaneously.

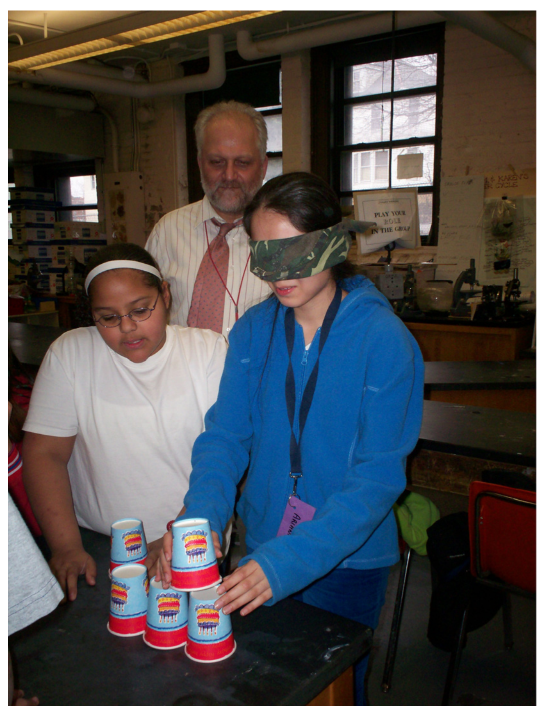


Figure 8

The volunteer in Figure 8 acts as the Mars Rover and blindly follows the instructions of her teammates. They coach her about how to "gather data" from the Martian terrain (simplified to stacking paper cups into a pyramid)

Suggestions

These two activities were both run in one hour, however separating them is more than appropriate. One hour could easily be designated to the Mars Rover activity alone. Also, with more students, the Nut Bolt Relay has the potential to last much longer.

LESSON PLAN II - Solar System

Target Audience: Grade Level 4-6
Approximate Time: One hour

Objective: To give students a sense of perspective about the Solar System and the size of the planets.

Materials: Styrofoam balls of various sizes representing planets, access to a large room or playground, chalk

Discussion: Introduction:

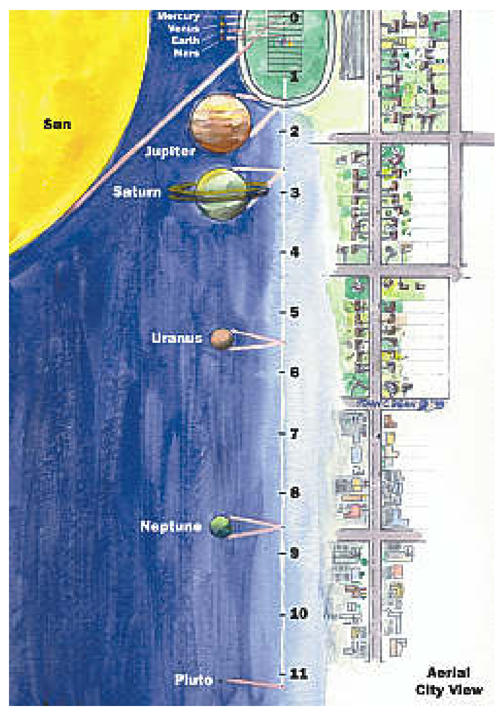
- Name all the planets in the Solar System (Have students make up new acronyms to help them remember)
- How many Earths could fit inside Jupiter?
- How many football fields would it take to demonstrate correctly the size of the Solar System, if the Earth was only a basketball?
- Is the Sun the biggest star in the galaxy?

Activity I: Orbit Game

Every student will be designated an entity in the Solar System:

- Sun
- Mercury
- Venus
- Earth
- Mars
- Asteroid Belt
- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
- Comets
- Moons around various Planets
- Rings around various Planets

The Sun will begin and stand in the middle of the room. Each planet will then slowly begin their rotation, one at a time around the Sun, until all of the entities are (rotating) in orbit. Students may observe others in their orbits until it is their turn.



http://www.solarspace.co.uk/

If the students are very hyper, they can pick up the pace a bit until they are going pretty fast. Yell "Freeze!" and see where the planets are in their rotating orbits.

If students are on a playground, use different colored chalk for each planet to have them draw their orbits as they rotate around the Sun. Then discuss afterwards if any of the lines crossed each other.

Activity I Feedback: The students at Goddard were very excited to pursue this activity outside. After designating students as various entities in the solar system (i.e. planets, asteroid belt, and comets) they lined up in planetary order. We began the activity after the students lined up. Shouting "Orbit!" the students started their revolutions around the Sun. As explained in the game, when the students froze, it was clear which planets were out of synch with the rest of the planetary bodies. We discovered that a more effective way of teaching the students would be to start with the Sun and distribute the children into their orbits individually. This process allows for other students to see what happens as they await their turn to orbit.

Discussion: After "freezing", if Pluto is next to the Sun, or other planets are in disarray, discuss the consequences of this and why we must maintain out orbit as Earth to continue living here. If we were as close to the sun as Mercury or as far away as Pluto, we would receive too much, or not enough sunlight respectively to nourish life.

Activity II: Walk the Planets

With enough adults present, this can be done on a long, private street. Keeping the students in their roles as planets and Solar System entities, have them hold their Styrofoam Planet as everyone walks a scaled distance of the Solar System. As a scale, one may use a square of toilet paper, or a pace as 100 million miles.

Assign a "Pacer" who will lead the rest, and count loudly.

Starting at the Sun, take:	3.5 paces to Mercury
From Mercury, take:	3 paces to Venus
From Venus, take:	6 paces to Earth
From Earth, take:	5 paces to Mars
From Mars, take:	34 paces to Jupiter
From Jupiter, take:	40 paces to Saturn
From Saturn, take:	65 paces to Uranus
From Uranus, take:	150 paces to Neptune
From Neptune, take:	50 paces to Pluto

Important Concepts:

What would happen if the planets were to freeze or stop in place like the students demonstrate? Explain how the Earth's gravitational pull keeps the Moon in its orbit and why we only see one side of the Moon. This is the case for every planet with moons, even planets that have 63 moons! (Jupiter; most are asteroids that were caught in Jupiter's gravitational pull)

Extended Exercises:

Additional students that have not been assigned a planet for each exercise can be assigned positions such as the "moon" of other planets, or as the asteroid belt. With string during the Orbits game, moons could literally attach themselves to their orbiting planets

Suggestions

It is recommended that the students not try to spin in their orbits for extended periods of time as it will cause them to become very dizzy and possibly a safety hazard if the exercise is being performed on a hard surface.

This picture shows how the students lined up in order to begin the orbits game, with the "Sun" on the far left.

LESSON PLAN III - Careers in Space

Target Audience: Grade Level 4-6
Approximate Time: One hour

Objective: To expose students to different careers in the space industry, that may seem inapplicable

Materials: Reference sheets for each career type with examples and explanations of potential reasons for wanting to represent their field of study in space, paper, pen

Discussion: Introduction:
What kinds of careers do you think of when you think of space? (Astronauts, Pilots, Engineers)
Can you think of a need for Doctors, Entertainers, Teachers, Lawyers in space?

Activity: Debate

The year is 2060 and the colonization of Mars is well underway. A blossoming community has been developing with luscious trees still growing, accessible hospitals and a government system underway. There will be another payload mission en route within the next year with critical supplies and more people. There is one seat remaining and NASA must fill it with someone they deem worthy of the trip.

The students are broken into four teams: Doctors, Lawyers/Politicians, Scientists/Engineers and Business Entrepreneurs. Before the game begins, distribute the details of the professions to the appropriate teams and allot 10-15 minutes for the students to write down their reasonings as to why they should be the representative of their discipline to be sent to space. When all teams have enough justifications to support their career, the debate will ensue. Each team will take turns speaking in the front of the class. While they try to persuade the class to believe that they are the most significant out of all the groups to go to Mars, the other career teams are writing down their questions. These questions are asked at the conclusion of each specific topic.

Activity Feedback: This activity was one of the most successful at Goddard. The students came away from the game with a newfound appreciation for why a colony in space would need these previously seemingly unnecessary jobs. An obvious debate reigned between the students from the Doctor and Lawyer/Politician teams. With strong, valid arguments, both rationalized their cases extremely well. Teachers may be needed to keep the groups focused.

Discussion: Was there a clear winner? What would have happened on Earth if we only had Doctors or Lawyers running the place?

Important Concepts:
While this activity will help the students to understand that there are roles for many different types of careers in space, there really will be no clear winner. For a colony to be successful, if not merely survive, all mentioned professions are important.

Extended Exercises:
Teachers may include any professions they like. Educators and Entertainers were popular at Goddard, though did not offer much in the way of justifying their cause.

Suggestions

Make it known that while each team is speaking in front of the classroom, they are the only ones speaking. Often, the term “debate” implies a heated argument. The students at Goddard were very civil and polite as long as they knew the rules of the game. At the beginning of the game, we did not include Politicians in our career choices. We thought having Lawyers would suffice. However, the students argued that political recognition was essential for the beginning of a new colony, and so the Lawyers became a joint group that encompassed an aspect of government as well.

LESSON PLAN IV - Jeopardy

Target Audience: Grade Level 3-6
Approximate Time: One hour

Objective: To test student's current knowledge and expand their knowledge with the tougher questions.

Materials: The information questions for the Jeopardy game as well as numbers for points and category names.

Activity: Jeopardy

Before the game initiates the questioner should set up the board so it should not impede upon the game time. After the game board is set up the questioner should divide the students into groups so that anywhere from 3-6 students are in a group we recommend groups of 4 or 5. The questioner then chooses questions such that the difficulty is on level with the question asked for. One option for identifying which group is ready to answer first is for a designated student from each group to simultaneously raise their and slap their hand on the table when they know the correct answer. As in normal Jeopardy correct answers are awarded points and incorrect answers take away points.

Discussion: Additional questions can be added to the question list. The questions are currently not in order and such should be chosen by difficulty according to the audience.

Important Concepts:

While this exercise does not directly relate to the exploration of or expansion of space awareness however it is a significant point in history, constellations and stars were used by sailors for hundreds of years to navigate at night it was also used as a form of oral history.

Extended Exercises:

One way to extend Jeopardy, is with double Jeopardy, with harder questions and more questions as well as Daily Doubles. Additionally you can always have a Final Question as done in Jeopardy in which the question is asked, then bid on by each group, and then answered in written form.

Suggestions

This lesson plan was successful because Jeopardy is a popular, fun game. However we found that the questions could have been more difficult. The student knew many of the questions we asked, however when asked what entity is at the center of our solar system, three students answered incorrectly before the class yelled "The Sun!" Organizing the questions in order of difficulty beforehand would be helpful, though not imperative.

Goddard Feedback

A survey was created to seek feedback from the attending teachers at Goddard school so that they could input their opinions about the applied lesson plan. The following is the survey response from Mrs. Debralee E. Seles who is a fifth grade teacher, and also a NASA Explorer School (NES) Team Member at Goddard Elementary. The questions are followed by her responses and are specific to Goddard.

1. What would you change about the lesson plans?

Mars Rover: I would make direction cards for each group, i.e. the robot, the communicators, the map makers, etc. and make sure that each group clearly understood their task before allowing them to move to their respective positions. I would also split the class into smaller groups and provide perhaps 4 sets of gloves instead of two to minimize wait time for the kids.

Solar System: This was an excellent activity. The students enjoyed being outside seeing the solar system from the perspective of a different scale. In a confined space, I might reduce the planets to include only the first Five planets. Otherwise, I might move the activity to Crystal Park where the kids would have more room to spread out.

Career Debate: The Career Debate was a highly engaging activity for all of the students. I would make sure that there is a monitor to keep order and make sure that all children get a chance to participate. I would also give each team a description of what each professional does, and give some examples.

2. What have you found in teaching this age group that would help to inspire them further about space? Could we combine their favorite subjects with an interest in space?

This age group likes movement, hands-on activities, and an opportunity to share their findings. They are delighted with authentic engineering activities for example egg drop, and making things move as in a Mars Rover model they built that was balloon powered, and a Puff Mobile that was balloon powered. Any subject can be combined with space studies and space exploration. For example, they love extremes. How about studying space extremes such as speed, high and low temperatures, incredible distances, extreme density and black holes, etc? Weather concepts such as convection, could be studied from the perspective of weather on a planet, etc.

3. What kinds of vehicles would be best to do this? Would a brief PowerPoint presentation be feasible? More competitive, hands-on activities?

Brief, zippy power points with some "bells and whistles" make great attention getters, give necessary background information and provide motivation for a follow-up activity. The keys are to keep them brief and zippy. As you probably observed, the kids love competitive, hands-on activities. What is important is that all kids participate, and that all kids come away from the experience feeling like they accomplished something. Competition should be according to rules that keep the competition friendly and fun. hands-on activities should allow all students opportunities to participate in the activity. This is aided by designating specific jobs.

4. Would you suggest approaching this age group with more scientific, technical background? i.e. doing an activity about toys in space and then discussing the physics of why toys behave differently on Earth than in space, or keeping to the larger picture without addressing fundamental questions?

Discussing the physics in this example would be highly relevant and exciting to the kids if it was posed in "kid talk" with fun questions that get them wondering and asking further questions. Keep in mind Bill Nye the Science Guy and Ms. Frizzle of The Magic School Bus. They bring in all kinds of great science background using kid speak and a sense of humor that engages kids and teaches them at the same time.

5. Would you be interested in having WPI students return to help teach about space.?

We would like to maintain a partnership with WPI students and the Goddard School of Science and Technology to continue to visit our students and teach them about space.

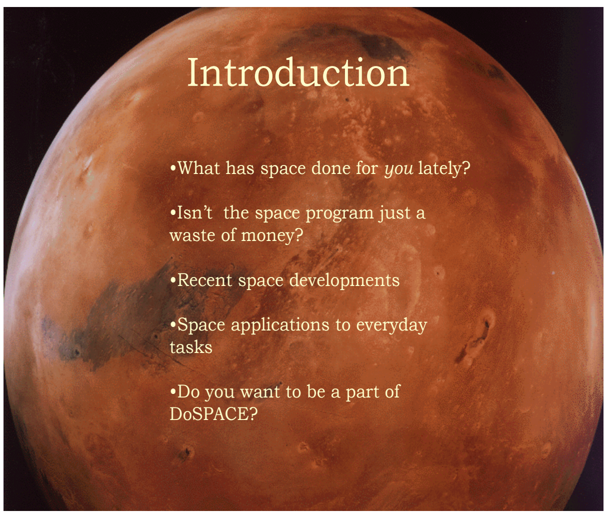
6. Do you believe that there should be more time designated to space studies in the classroom or do you believe the time is sufficient?

If we as humankind are to continue to reach beyond our planet so that we can better understand our universe and ourselves, then we need to devote more classroom time to science in general so that our students get the foundational knowledge necessary to know what to ask, know what to look for and know what to do with the information gained from future space studies. We need to spend more time relating earth science to space science.

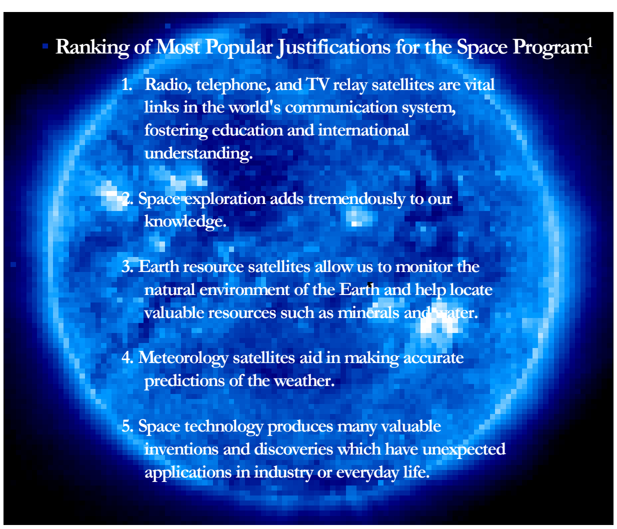
Social Applications – Presentations

PowerPoint Slide Show and Commentary

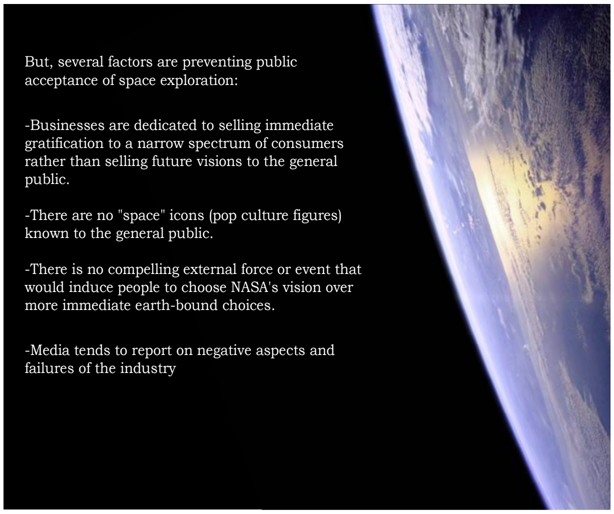
This outreach campaign began as an international effort in Japan, during the Space Generation Congress workshop called InspireSpace. DoSPACE is a local chapter of this grassroots movement. The goal is to raise awareness about space news and current events in the space industry by going to different schools and bringing attention to the positive aspects of the industry and the benefits it brings to our everyday lives.



In this presentation, we'll be discussing new space technologies and how they affect us. In addition we will explore future avenues for exploring space and the benefits exploring space will bring to humanity. Also information will be provided on future job and business opportunities in the space industry.

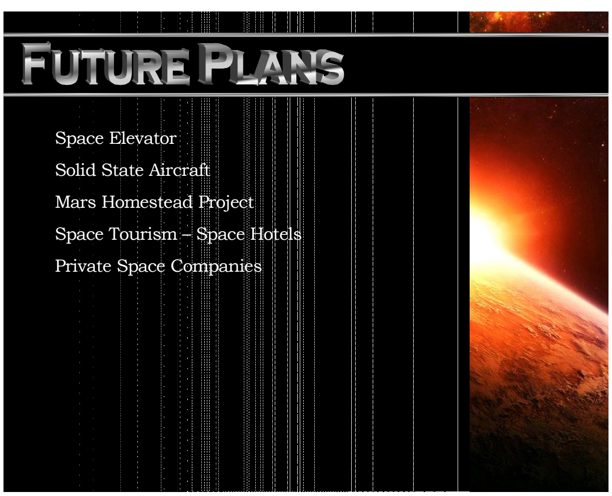


Space allows for communication via radio, telephone, TV, and internet. Satellites monitor our climate and weather, warning of inclement patterns. Some technological breakthroughs developed by NASA include our modern day sneakers, of which Nike borrowed the rubber from NASA astronaut boots. Sunglasses evolved from the visors of the astronauts to protect their eyes from the sun's vicious rays.

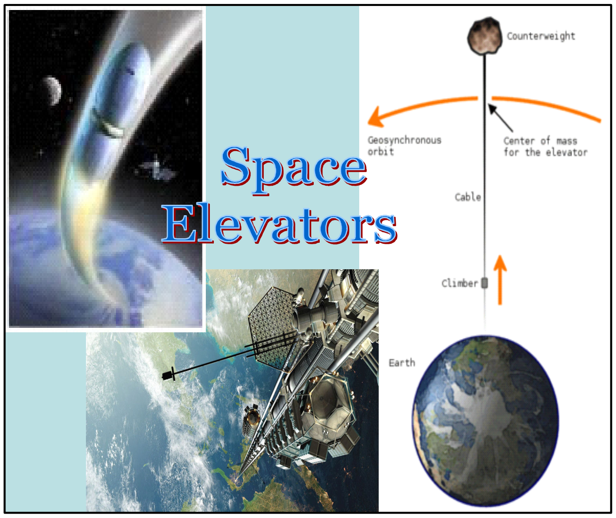


Due to the lack of short term returns in space, businesses are reluctant to start venturing into totally new territory. Additionally with only negative media attention the space programs are suffering from a lack of public support especially when the public feels that the money allocated to NASA and other space programs could be better spent on more terrestrial programs.

The Mars rovers Spirit and Opportunity have become unmitigated success lasting 8 times their expected lifespan and still going. We are currently working on a mission to send a satellite to survey Pluto which will be the first mission to reconnoiter the farthest planet from the sun. Missions are also being organized to survey several of the moons of Jupiter, which have water, for signs of life. Research done by NASA, for the astronauts in space, on bone and muscle loss could benefit those still on Earth with similar ailments. Storm tracking has also saved lives from large weather systems such as hurricanes. Additionally international cooperation is achieved in the ISS or International Space Station. And from space telescopes we can get amazing imagery not possible on Earth due to distortions by the Earth's atmosphere.

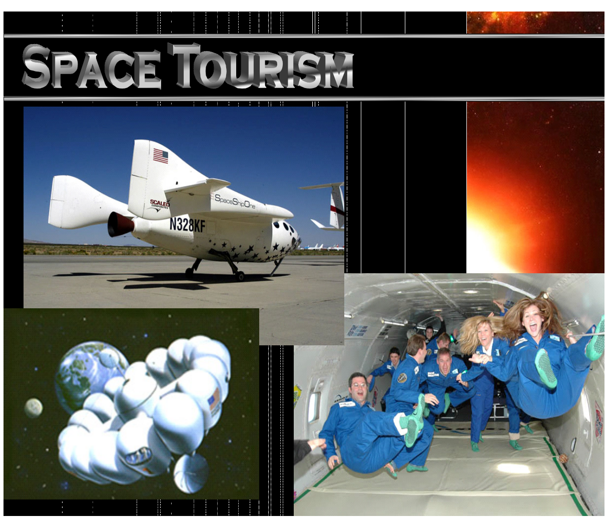


Here are some possible future endeavors that will hopefully be implemented within the next 20 years.

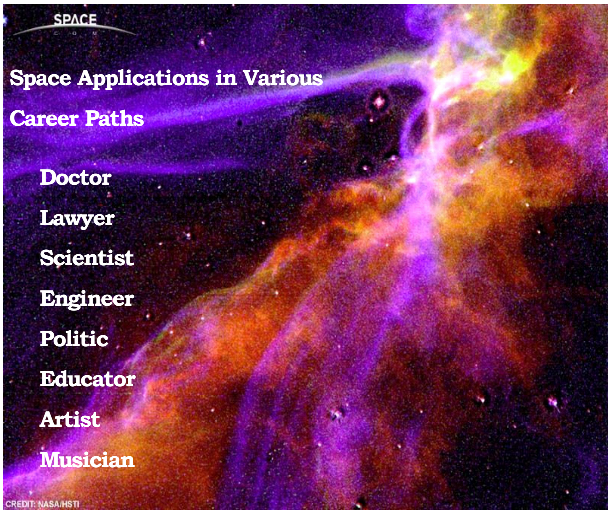


The space elevator is an interesting idea that would utterly change Earth's interactions with space. The idea is to form a ribbon based in Ecuador (due to meteorological reasons) that reaches up 22,000 miles to finally be anchored in place by a captured asteroid. Once constructed gondola like climbers will ascend the ribbon to the desired elevation and simple depart from the climber to achieve launch. This would decrease the costs of launching objects into space from several thousand dollars per pound to several hundred dollars or even less. Unfortunately one major problem with the design is that the ribbon is composed almost entirely of a super strong new material called carbon-nanotubes. The problem is not that it does not meet the requirements for the project but that we at this point in time have only manufactured approximately 3 inches of nanotubes which falls far short of the necessary 22,000 miles needed.

The Mars Foundation is an independent group whose goal is to design and implement a mission to set up a permanent colony on Mars. To do this they are doing research into core technologies as well as establish commercial and financial interests which will be necessary to permanently creating a colony on Mars. They are currently doing the programming, networking and research funding necessary in order to bring their goals to fruition.



Space Tourism will give a large boost to the public interest in space. For example when Dennis Tito paid the Russian space program $20 million dollars for a ride into space and it received lots of media attention. Future tourist opportunities such as a space hotel will generate significant amounts of revenue and media attention. But before we get to space hotels we need to concentrate on how to get there for which there are several companies popping up for such as Virgin Galactic and Scaled Composites, which created the Space Ship One which won the X-Prize after successfully flying 2 missions to 100 Kilometers within 2 weeks of each other as well as being capable of carrying 3 people.



There will be many opportunities for all types of people when we finally get to space. Doctors will have several new avenues of research opportunities as well as having to possible fight bacteria and viruses never before encountered on Earth. Lawyers and Politicians will have to set up the rules and regulations for mining valuable minerals and resources such as Helium-3 which is almost impossible to obtain on Earth but extractable on the Moon. These lawyers and politicians will also have to set up land and mining rights as well as the possible creation of an independent moon or mars nation which operates independently of Earth based governments. Scientists and Engineers will have numerous new research opportunities including research in zero gravity environments and access to entirely new or previously unobtainable materials. Educators will be responsible for the education of children on new colonies on Mars and the Moon. Artists will have some new opportunities in creating 3 dimensional water sculptures as well as new materials for both artists and musicians.

The next step is you. The future of space is on the rocks with a public interest in space failing. You have the ability to revive that space interest just by gaining knowledge yourself in this area. This brings us to the Space Generation Advisory Council. This is a program dedicated to bringing information about apace to the youth of today. SGAC provides up to date bulletins about political actions, scientific discoveries, social implications, upcoming conferences, available resources, and much more about what is affecting the progression of the space programs of the world.

These organizations and events are available to fuel your appetite for knowledge about space, and interacting with the space community.

These are some resources that were used for our information and pictures and are excellent sources if you are interested in knowing more about space.

This gives you a little perspective as we fly out from our home planet of earth, and eventually we seen an artists rendition of the universe.

Holy Name

The presentation at Holy Name Senior High School in Worcester was the first of our many visits to local schools. Technical difficulties proved that bringing our own projector and laptop are relatively essential for a smooth presentation. Since not all high schools are equipped with up to date technology, we learned quickly to provide our own gear. Presenting to eighth graders allowed DoSPACE the opportunity to harness their feedback and change the presentation accordingly. The students asked questions about Black Holes and the feasibility of space elevators. Not one student in the class had heard of any of the new concepts presented, not to mention the International Space Station, which gave the campaign more incentive to continue to preach space to younger generations.

Yuri's Night

Yuri's Night is a world space party that celebrates the passion and vigor that people all over the globe share for space. Yuri's Night is a world space party that celebrates the passion and vigor that people all over the globe share for space. It is on April 12th and this year marked the 45th anniversary of the first human in space Yuri Gagarin and the 25th anniversary of the first US space shuttle launch.

We hosted Yuri's Night in WPI's bowling alley. We procured snacks such as chips and salsa as well as drinks. We got there early and began to set up decorations and food. However when the celebration was scheduled to begin the bowling alley technician had yet to arrive and did not do so until a half hour after the celebration began. However up till then we had a DJ playing and food and drink to occupy our guests' time until the technician showed up. Once the technician showed up everything went smoothly, hosting about thirty guests in total. They enjoyed free bowling and a gathering of like minded individuals who were free to discuss space and similar subjects.

Destination Imagination

On April 1st, we presented our presentation to MADI, the Massachusetts chapter of Destination Imagination. This was a fantastic opportunity to publicize Yuri's Night as well as pilot our PowerPoint. We presented two times for anyone to show up once in the morning at 11 and once in the afternoon at 2. Unfortunately for us the DI teams were still competing at 11 and thus no one showed up. This wasn't all bad however because this gave us a chance to rehearse how we would present later that day. The 2 o'clock showing was much more successful for which we in fact filled the room beyond seating capacity. As we gave our presentation we received a few scattered inquiries but at the end they really start firing off the questions. The make up of this group was about half 6th-8th graders who were competing in the Destination Imagination program and half were their parents. Both the students and the parents responded well and about one quarter stayed longer after we were done presenting and answering questions to further discuss our presentation and future space opportunities.

Doherty High School

Next, we presented to the Engineering and Technology Academy at the 1,500-student Doherty Memorial High School. 'The engineering focus blends math and science in creative projects. Math, science, and engineering teachers meet twice a week to coordinate their lessons across the disciplines. For more real-world experience, every senior completes a practicum at a local engineering business. Many have gone on to take internships and, later, salaried positions at their practicum sites. But, as teacher John Staley says, "The Academy is not designed to crank out engineers. It's designed to prepare students to do whatever it is that they want to do."'[11] We presented to high school students who were not there of their own volition, as we presented during class time and thus were generally not too excited about our presentation. They were somewhat rambunctious and essentially cared little for who we were and what we were doing. We did reach a few students with our presentation, but overall, we answered more questions about WPI and its curriculum than we did about our project. This was our least successful venture of our project.

North High School

Contrary to Doherty, North High was extremely interested in our project. This presentation was also given during school, however more specifically to a Physics class of juniors and seniors, studying the relevant topics of centripetal motion and gravitational forces. Many knew the direction they intended to pursue after high school and space intrigued a great majority of the class. Detailed questions about the space elevator and the carbon nanotubes therein were constant and a productive discussion ensued about the likelihood of such concepts. The skeptics in the crowd were doubtful about projects like the Mars Homestead but eventually grew more comfortable as we legitimized these ideas with engineering techniques and current technologies that would indeed allow us to colonize another celestial body. The experience as North was rewarding and exciting. We entered a classroom that was intrigued but ignorant about space news and left a classroom as they were still debating about these breakthroughs.

North High School Program

DoSPACE presented at North High School twice. The first was explained previously as we presented to a single classroom. The second time we visited the school was an effort to instigate an after school club. Initially intending to piggyback with another IQP group, this Science and Technology Club had several difficulties getting started, including funding. These complexities led us to inherit this club. We had our contact teacher at North invite around thirty students to our presentation after school. Unfortunately not enough notice was given and combined with conflict of other after school programs only eight people showed up. On the upside however all those that did show up were extremely interested in what we had to say. So while the number of people we presented to was small those we did present to were extremely interested. And so the questions asked and the discussion afterwards was very refined.

[11] http://www.mos.org/doc/1961

Discussion of Results and Conclusion

Exposure and Public Relations

An outreach campaign has as much to do with publicity and social awareness as the activists' enthusiasm and motivation. In order to captivate society's interest and imagination, bright colors, big posters and entertaining events are necessary. DoSPACE as a grassroots endeavor employs people at a local level, rather than at the center of a major political activity. In order for this to be successful, DoSPACE needs to reach beyond the space enthusiasts and make space applicable for potential doctors, lawyers, educators and entrepreneurs. This is easily accomplished, but only once the audience is in attendance.

Space conferences also allowed an increased awareness for the presenters to share with their audiences. The International Association for Science, Technology and Society conference in Baltimore made space technology pertinent to everyday life as well as allowed for a networking opportunity with students from other universities who were establishing a science outreach program. Trading ideas, DoSPACE grew from this conference and shared our ideas via PowerPoint with professionals from the industry.

Though Yuri's Night was publicized around campus via posters and emails, DoSPACE attempted to bring the local newspapers onboard, without success. The Telegram and Gazette and Worcester Magazine would have been great promoting avenues for this event, however time constraints and communication difficulties within these organizations resulted in no articles pertaining to Yuri's Night.

The following is an article that we submitted to WPI's Tech News that recognizes the event and its success.

Tech News

Yuri's Night 2006 – World Space Party!
By Keithe Baggett
Class of 2007

Have you ever heard of a space elevator? Or the space hotel that would provide your orbital accommodations once you're beyond the Earth's atmosphere? Or how about the Mars Homestead Project whose "ultimate goal is to build a growing, permanent settlement beyond the Earth, allowing civilization to spread beyond the limits of our small planet"[12] - basically set up shop and not come home These are concepts and projects being developed to cater to the blossoming world of space tourism.

It is reasonable to say that a good percentage of Aerospace Engineering students here are space enthusiasts. With groups on campus like the WPI chapter of the American Institute of Aeronautics and Astronautics (AIAA), and the Astronomical Society (WAS), it is easy to become more aware of current events in the space community, but only if you're looking.

The media tends to report on the negative aspects of the industry – the launch failures, the seemingly endless amounts of tax dollars going nowhere, and the devastating tragedies like Challenger and Columbia. We rarely hear about the first spacecraft to visit Pluto and its moon Charon called New Horizons, launched just in January. We hear even less about the experiments being done on the International Space Station by astronauts and cosmonauts living above us for months at a time.

Technologies developed for space exploration include sunglasses, and allow for our cell phones and Internet via satellites. The knowledge we obtain from space exploration has direct implications to our lives. On Wednesday, April 12th, 33 countries over 7 continents had 91 amazing parties. It's called Yuri's Night and every year celebrates the anniversary of the first human space flight by Yuri Gagarin and the first US Space Shuttle Flight. Everyone like a good party. So this year, as part of local outreach campaign called DoSPACE, WPI hosted our first annual Yuri's Night, celebrating the 45th anniversary of human spaceflight and the 25th anniversary of the first shuttle launch.

[12] www.marshome.org

With a DJ and the black light ambience of Gompei's Gutters, the party was a success and will only be better next April 12th. Hope to see you there!

Telegram and Gazette Article

The following is an example of a positive press release about the successes of the space industry, and one of its forefathers, Robert Goddard, who led the way. This article was featured on the front page of the Worcester Telegram and Gazette and proves that locals are interested in learning about Worcester's contributions to the space scene. With this in mind, perhaps next year it will be easier to publicize Yuri's Night because it will be the second annual world space party at WPI - Goddard's alma mater!

Saturday, May 13th

Worcester dedicates monument honoring Robert Goddard

By Richard Nangle TELEGRAM & GAZETTE STAFF
rnangle@telegram.com

WORCESTER— In 1920 The New York Times mocked him as a dreamer doomed to fail. But Robert H. Goddard persevered and six years later his pioneering experiments led to the launch of the world's first liquid-fueled rocket from his Auburn farm.

Under a driving rain yesterday, state and local officials and presidents of Worcester Polytechnic Institute and Clark University honored Mr. Goddard in a dedication ceremony for a monument at Goddard Memorial Drive and Apricot Street. They used the occasion to dub the city "The Birthplace of the Space Age."

Mr. Goddard grew up on nearby Tallawanda Drive and, according to City Manager Michael V. O'Brien, was known to walk by the monument site.

"As a child, he dreamed of space flight. As a student and then as a physicist, he turned his dream into reality," Mr. O'Brien said.

Mr. Goddard was a graduate of South High School, WPI and Clark, and later taught physics at Clark. But he earned little recognition for his work in his lifetime. Only after World War II, when captured German-made V-2 rockets were found to have been based upon his oft-ignored designs, did his work begin to receive attention from American scientists.

“Goddard’s perseverance in the face of disbelief and ridicule provides a lesson for all of us,” Mr. O’Brien said. “He believed in his work and kept at it, ultimately attracting the attention of scientists the world over. His story instructs us to dream, think big and work hard.”

The monument features an artist’s rendition of a rocket and tower, and is surrounded by eight panels of detailed drawings, photos and text that document the highlights of the life and accomplishments of the man known as the Father of Modern Rocketry. The photos and diagrams came from Clark, WPI and NASA. Barbara Berka, president of the Goddard Memorial Association, calls the monument an outdoor educational exhibit.

Mr. Goddard was born in 1882 in Worcester. He held 214 patents, many of which were incorporated into the modern rockets that carried man to the moon by 1969. Mr. Goddard died in 1945 and is buried at Hope Cemetery.

U.S. Rep. James P. McGovern, D-Worcester, said the monument will be a constant reminder that “a lot of good things that have happened in this world have happened because of people in this community.

“I think we all need a better sense of history in this country,” he said.

State Rep. John J. Binienda Sr., D-Worcester, recalled having to hide the $15,000 state grant he secured for the project in the education budget because naysayers, including the Boston Herald, were criticizing the project.

But the city and the Goddard committee persevered with the sense that “we’re going to do it and we don’t care what people think,” said City Councilor-at-Large Kathleen M. Toomey.

As for The New York Times, in 1969, after the first man had walked on the moon, it did the honorable thing and issued a long-overdue correction. Mr. Goddard had not been nearly as pessimistic.

In a 1930 article he wrote for Modern Mechanics magazine, he predicted that a rocket would propel a man to the moon. [13]

IASTS Conference

In February of 2006, Keithe and a few students from various IQPs attended The International Association for Science, Technology and Society (IASTS) in Baltimore, Maryland. This conference directly correlates to the outreach effort because their partial mission is to create a technologically literate population. Even more relevant is their intent to provide a radically new approach to education concerned with science and technology at all levels.

DoSPACE presented a PowerPoint to professionals that addressed the next generation of space policy in a forum entitled *The Space Generation Conference-2005: A Moon-Mars Movement in the Making*. Discussing SGC and the proposed efforts of DoSPACE, Keithe felt it was a report about something new and different – bringing kids to space. A couple questions were asked about the campaign, but it has become more obvious that the project is not breakthrough research but rather an attempt that will hopefully have a societal impact, which was the goal.

There was a session that discussed STS Education. Science, Technology and Society encompasses a web of interwoven ideas that are only recently being relayed in the school systems. Keithe spoke with Pamela Mack, from Clemson Univeristy who spoke to the *General Education and STS at Clemson* and questioned why this was not an inherent part of the curriculum – how can there be science courses without discussing the implications it has on society? Students would not be interested or motivated if there are no real world applications. It seems that the current Space Generation was brought up in an STS environment because the speaker was never taught that way. Pure science and pure engineering were the leaders and because they were so precise in their own rights, society was a “mess” in comparison, and lacked organization, never mind a connection to the more esteemed science and engineering. STS is seemingly a triangle that balances science, technology and society in the three corners, though

[13] http://telegram.com/apps/pbcs.dll/article?AID=/20060513/NEWS/605130415/0/FRONTPAGE

often there is more emphasis on one over the others. DoSPACE is trying to bringing these social aspects of science and the vigor of technology back into the classroom to make the learning exciting and applicable.

ISDC Conference

In May of 2006, Keithe attended a conference in Los Angles on behalf of DoSPACE. The 25th International Space Development Conference included featured speakers such as Buzz Aldrin, Burt Rutan, founder of Scaled Composites, Elon Musk, CEO of SpaceX, Peter Diamandis of the X-Prize competition, Robert Zubrin from the Mars Society and Dennis Tito, the first space tourist. Though DoSPACE did not share a presentation at the conference, Keithe approached Buzz Aldrin with the idea of speaking at WPI and/or local high schools to aid the campaign. After mentioning that Guy Bluford, the first African American in space, spoke at our college, Aldrin seemed interested in the offer and encouraged further discussion at a later date. Held for the first time in conjuction with the Planetary Society, ISDC 2006 featured dozens of presentations, panel discussions, interactive exhibits and activities spanning the entire spectrum of space-related issues: exploration, tourism, science, technology, policy and commerce.

The emphasis and agenda of the international conference directly relates to this IQP. The opening day of ISDC was Space Day, a national space education day, which speaks to how important relaying this information to students really is. At the conference, this day was celebrated by the National Space Society announcing a new global space education initiative. This initiative was the implementation of NASA grants in all fifty states. The purpose of the grants is to inspire students to pursue careers in science, technology, engineering and mathematics (STEM). One such grant was awarded to the Goddard School of Science and Technology.

At the *NASA Outreach* session of the conference, Chief Education Officer, Angela Diaz spoke about these grants. Keithe had the opportunity to speak with her afterwards about DoSPACE and ask her what she intended for these NASA grants. Offering one shot presentations and after school clubs, Diaz agreed that these were quite appropriate, as well as hands-on activities. It had been her experience that students learn in quite a variety of ways, and because of this possibilities are endless for teachers.

Conferences are a fantastic way to network with people from the industry and get the inside scoop about how realistic the space elevator is, or when Spaceship Two is due onto the runway. International conferences, in particular allow a means to compare public space knowledge on a much larger scale. As DoSPACE is a local campaign, we have immediate access to local public space knowledge; however that is only a small piece in a much larger scope.

Current Public Space Knowledge and Opinion

It became abundantly clear as we progressed, that a movement cannot be fashioned with a few glitzy PowerPoint presentations and some enthusiasm. The real question comes down to Why? Why should we go to space? At the conclusion of this project, it isn't awareness that the public needs, it is persuasion and convincing that space is a worthwhile investment of time, money and effort. This requires making a case for space and conveying this compelling reason, this economic epiphany or this opening of possibilities to the public. At the ISDC Keithe heard Robert Zubrin make a compelling case of his own that is entirely in line with the thinking of DoSPACE. Zubrin, chairman of the executive committee of the National Space Society, turned the heads of many at the conference with a tight rope analogy. He asks how much rope it takes to get from one point to another. He answers that it takes as much rope as one wants.

To reach Mars within the decade, the rope needs to be pulled tight, thereby finding the direct path. In 1961, the reason Apollo mission succeeded was because President John F. Kennedy pulled the rope tight, and the way he did that was with the schedule. Instead of chewing on ideas and recycling them through the industry for decades, JFK set a date and claimed responsibility for that date. NASA then had an imperative to design an efficient plan to get to the moon by generating hardware items and then applying them. We have a different reason to explore the stars now. NASA's budget since 1990 has been at Apollo levels, yet the level of accomplishment has not been remotely the same because they have not been driven. NASA unveiled the unthinkable in 1961 when we beat the Russians to the moon. NASA is no longer mission oriented, and the rope is slack.

"Spending 16 years to reach the moon when it took 8 years the last time is inappropriate and unworthy of our pioneer heritage".[14] Public support is seemingly waning because we are not in the midst of another space race. It is incumbent upon the next generation of space explorers to find a reason why space is still exciting and refreshing. Perhaps we need a leader that commits to doing something because it has never been done before and because it's hard. The Aerospace Industry is seemingly organizationally and technologically stagnant at present. Future explorers need motivation to change this.

Bainbridge says that many liken the Apollo Missions to that of Egypt's Great Pyramids. Skeptics saw the pyramids as symbols for "useless expenditure on superfluous projects,"[15] while NASA skeptics viewed the Apollo Missions as the same. While proponents of NASA likened Apollo to that of the pyramids, they did so in a different fashion, they saw the Apollo Missions as monuments to human ingenuity and engineering prowess that man could walk on the moon and that as Americans all could be proud. This view is very similar to those held by Americans today. Accordingly to a poll done by an independent polling company in 2004, surprisingly public support for NASA has changed little since before the Apollo missions. One year after the Challenger disaster found that public support remained high at around 48% both for and against which is almost the same as before the fateful Apollo missions so many years before.[16] However the poll also states the majority of support comes from highly educated white males which gives NASA only the support of the elite, as it's termed, of America. As Leonard David wrote for an article on Space.com "'NASA has lost its broad popular charm with others,' the Ipsos-Reid survey states".[17] What this all means is that while public support is high it is more centered on those of higher education with the general public disapproving to rising space agency costs. Our experience with the knowledge of our subjects was that in general they were very uninformed about what we presented. Even though some of those who we presented to were too young to have a chance to be exposed to the space material yet, students who we thought would have at least some knowledge were not very well-informed. For example, the International Space Station was unfamiliar to even engineering students at Doherty. There were several important lessons learned throughout this project. In order to appreciate these lessons learned, we need to look at how well our objective was completed.

During the programs at Bancroft and Goddard we encountered the broad spectrum of knowledge that the students had. We decided that the students could be broken down into 3 tiers of knowledge levels. The lowest tier might be able to name the 9 planets in order, but would probably not know too much about each planet. They might ask for clarification about certain concepts such as how the moon does not actually give off light, but instead reflects light from the sun back to earth. They were familiar with satellites, and how they function to enhance our everyday lives, but did not know much about our space program other than we have a shuttle system that sometimes blows up. This group was the hardest to keep on track, as their attention span seemed to be shorter than others, but they were often the most eager to learn more, thus they were the ones always running off to the sides of the room to look at the models of planets during activities.

The middle tier could easily name the nine planets in order, and might know some specific details about more notable planets, such as Jupiter having the red eye, Saturn having rings, and Mars as the red planet. They were also familiar with other celestial bodies such as the asteroid belt, comets, and expressed great interest in meteors, satellites and space missions. They were familiar with satellites, and how they function to enhance our everyday lives, and are also familiar with how America's space program has had a long history of technological advancements to get satellites into space. These students were often the hardest to motivate as they already knew some, and what we introduced to them they might have find trivial or repetitive. The real trick to keeping them interested, we found was to point out some detail, and teach about how it applies to a bigger picture.

There was definitely one group of students who knew what they were doing, and were certainly at the top of their class. These students were still confused about how gravity works, and why things stay in orbit and don't crash into what they are orbiting, or go spinning off into space. This group loved to get up and help others understand various concepts, they were often the outspoken ones of the class and very eager to share their space stories. Because there were only 1-2 of them in each class it was easy to allot time for them to share with the class, and then get back on

[14] Zubrin, *The Case for Mars*
[15] Bainbridge: *The Spaceflight Revolution*, pg. 245
[16] Orlando Sentinel: Poll, Public Opinion of NASA,
[17] Leonard David: http://www.space.com/news/nasa_poll_020510.html

schedule. This group is always eager to broaden their knowledge of space, we found it was important to discuss with the class how much they already knew before continuing with an exercise so that information would not be to repetitive for this group. We also discovered that if this group knew a lot about the lesson already, then it was a great time to allow this group to stand up and teach what they knew to bring the class up to date.

There is the concept of the space elevator that needs to be considered when looking at public opinion. Professor Aravind produced a paper on the progress of the space elevator where he compares it to the ancient Tower of Babel which was the last time mankind tried to build into space. He points out that the tower of Babel failed due to a lack of cooperation. This is the same situation we have to compare to today. The future of space is very dependant upon cooperation with other nations. This cooperation will depend on public opinion. During the Cold War there was little effort to cooperate with the Russian space program. Now is the opportunity to do so, as well as every other space program out there. However an uneducated public may see this as losing a nonexistent space race. The public may fear another country being allowed to surpass America in one area, and thus do not support cooperation. But at the same time they may see the space program as a waste of money. Thus the position of: if we can't do it, no one else will either. The space elevator would be a grand embodiment of cooperation from many countries around the world. It would have to be placed in Ecuador for the location, involve American ingenuity to learn how to mass produce the carbon nanotubes, and it will take the trade and skill of many nations to produce it. By increasing public awareness about the space elevator we are helping to rekindle the enthusiasm for space, and emphasizing the right way to do it.

Future Predictions for DoSPACE

The future of Team DoSPACE is very reliant on personnel. We need an IQP team to take over our work if DoSPACE is to continue as efficiently as this team did. The groundwork as been made and the standards have been set within this last year for future generations as IQP DoSPACE members to follow along and turn this organization into a successful nation wide unit.

However if a team can not be acquired due to lack of interest, then there are alternatives so that the groundwork that has been laid does not get thrown away with the conclusion of this IQP. One option available is to pull a team member from each of the existing space IQP teams and designate them a liaison to the community. These members will form a separate group which will take the ongoing results of their individual teams, and present it to the community. The community in question should be the schools which we have established connections with already this year and give presentations, orientations, or activities, amended for the target audience, whether it is a local high school, elementary school or public assembly. Another option is to utilize the oversight committee as the official team DoSPACE. This team would solicit information from the other IQP teams and present to the community based on the advancements of the other teams.

Possibly the best solution for the future of team DoSPACE is to form a combination of the two above solutions. Each team could appoint a member to act as liaison to the oversight committee, as well as have the oversight committee in charge. The oversight committee can employ the liaisons to send in their information from their individual teams, compile it all into presentable information, and then redistribute it to the liaisons with a scheduled plan to work in teams of 2-3 and present all of it to the community.

Making an effort to send team DoSPACE global needs to be a main objective of the future DoSPACE team. Getting this program published so that others across the country can take up the call and continue the education about space utilizes the pay it forward philosophy.

It is also important to keep in mind that there are several IQP groups who are doing their projects on forming after school groups. These could be a great potential resources if used correctly. They could be given the information needed, and sent to go start any after school clubs desired. With the new team DoSPACE providing the resources for the club, they will most likely be very enthusiastic to go and start a club and assist with the management of it. These teams may also be looking for presenters for existing clubs. This means that it could easily be organized by the new team DoSPACE to organize each group to go and present their findings at these clubs.
When it comes down to getting team DoSPACE to become successful, it is important to think outside the box, and look for other sources of information, and new ways to spread awareness of space. This has only been some suggestions and minimal goals to achieve, and should not be thought of as constricting limitations to what can be done. The future of team DoSPACE is yours.

The material developed for the after school programs at both Bancroft and Goddard were designed as more of a model that we used for both programs but was fundamentally designed for future IQP groups as well as teachers who enjoyed the material.
The program at Bancroft was initiated and carried out entirely by the DoSpace team with the Bancroft school only providing a forum for our team to expand awareness and interest in space of the students participating and thus a continuation of this program is dependent on another group from WPI contacting Bancroft and continuing this program. The Goddard after school program was conceived in a grant contributed by NASA and was running before we were in contact with the teachers running the program. Our involvement in this program enriched the experience of the students and relieved the teachers involved for several days of observation of the students reaction to our material. This program essentially will continue running regardless of our involvement with it and can actually become another source of new material, as well as being another forum for evaluating our material in which we develop. The make up of the of the Goddard after school program was composed of advanced students already with an initial interest in space. Next years team DoSPACE should come up with a new lesson plan to be taught at Goddard as some of the students will be the same.

The following is a recommended timeline for the next generation of DoSPACE.

A-Term

- Meet with advisor and get proposal approved.
- Began inquiries into creating weekend, and after school programs to spread awareness about space.
- Began inquires and networking contacts to make 1 shot presentations possible in local high schools.
- Contact club IQP teams to piggyback on their after schools clubs.

B-Term

- Contact with Bancroft School Representative.

C-Term

- Implement Bancroft after school presentation.
- Begin advertisement for Yuri's Night 2007.

D-Term

- Host Yuri's Night at WPI.
- Type up end report.

Every term

- Continue presentations at local high schools.
- Ensure that the presentation is being continued on for the next term.
- Continue to come up with ever more creative ideas to expand the guidelines for the DoSPACE project.
- Distribute the updated curriculum to the general public.
- Update power point presentation based upon the advanced knowledge of the current IQP teams research.
- Attempt to reach beyond the local level and communicate with contacts around the US, such as peers who share the enthusiasm about space, including but not limited to NASA representatives
- Implement after school programs at elementary schools.

Final Thoughts

This project could be thought of as a pilot for a television series. An underlying goal of our project was to establish what did and did not work and trim and refine what did work into a solid base that future DoSPACE teams could expand on. We feel we have done this and even gone ahead and created guidelines for future teams to continue and expand where our project has left off. The efforts of this team throughout the last three semesters have been no small feat. We have presented at three different high schools on four different occasions, made presentations in Baltimore, and to creative students who claim membership to the Destination Imagination program, along with their parents. We have created a curriculum for an after school program to educate and interest students in the possibilities of space. This curriculum was generally very successful and most of the students who participated in our program enjoyed themselves and learned something in the process.

In planning for the future continuation of this project we have established contacts at five different schools, prepared presentations to be given, provided the lessons plans needed to return to the schools and continue our project with little preparation work. We have provided the administrative organizational plan required to effectively continue the project.

This continuity which we are leaving will endow the next generation of Team DoSPACE in whatever form they continue in, with little excuse for not advancing far past what we have been able to do. They will not in any way have to “reinvent the wheel” for so much of our progression. This will free up their time to progress past what we have done, and into ideas of their own.

Reporting back to the Space Generation groups will be the task at the next ISDC in Valencia, Spain in 2006. The original InspireSpace team members will regroup and trade ideas and presentations about the individual localized campaigns. Through the many chapters of DoSPACE around the nation, we, the current space generation, will be able to drive our goals into younger students, and thus, future generations.

Contacts

Bancroft School

- Mr. Charlie Aleksiewicz
  Director of Special Programs
  508.853.2640 ext. 209
  Special Programs: http://www.bancroftschool.org/page.cfm?p=59

Holy Name

- Mr. Edward Reynolds
  Principal
  508.753.6371
  - Meaghan McKenney
    Eighth Grade Science Teacher

North High School

- Mr. David Elworthy
  Principal
  508.799.3370
- Mr. Joseph Marzilli
  Physics Teacher
- Mr. Greg Morse
  Chemistry Teacher, Potential advisor for after school Science Club (2006-2007)

Doherty Memorial High School

- Ms. Sally Maloney
  Principal
  508-799-3270
- Kathy Kambosos
  Engineering and Technology Academy:
  http://www.wpsweb.com/doherty/2003_2004/Engineering/engin.htm

The Goddard School of Science and Technology

- Marion Guerra, Principal
  508 .799.3594
- Mrs. Debralee Seles
  Fifth Grade Teacher, Advisor to after school Rocketeers Program, NES Team member

Bibliography

Abell, George. Exploration of the Universe. University of California. Holt, Rinehart and Winston. 1964.

Bainbridge, William Sims. Public Support for the Space Program. http://mysite.verizon.net/wsbainbridge/dl/public.htm

Bainbridge, William Sims. The Spaceflight Revolution. Malabar, Florida. Robert E. Krieger Publishing Company. 1983.

Bauchspies, Wenda. Science, Technology and Society – a Sociological Approach. New York. 2005

Bell, Cathy. The Mythology of the Constellations. http://www.comfychair.org/~cmbell/myth/myth.html

Curtis, Judith G. Space Almanac. Woodsboro, Maryland. Arcsoft Publishers. 1990

Gibson Roy, Space. Oxford. Clarendon Press. 1992

Lesikar, Arnold V. Constellation list. http://domeofthesky.com/clicks/constlist.html

Maffei, Paolo. Beyond the Moon. Cambridge, Massachusetts, London, England. The MIT Press. 1977.

N.A. Elementary School lesson plans. http://www.physics.rutgers.edu/hex/visit/lesson/lesson_links1.html

N.A. Learn More at Space.com. www.space.com

N.A. Space Generation Advisory Council. http://www.spacegeneration.org/

N.A. Sherwood Engineering Design Services. www.seds.com

N.A. Yuri's Night. www.yurisnight.net

N.A. Space: America's New Competitive Frontier. Washington, D.C. Business Higher Education Forum. 1986

N.A. Practical Approach to Using Learning Styles in Higher Education. Greenwood Publishing Group. 2000.

N.A. Digital Library. http://mysite.verizon.net/wsbainbridge/dl/digit.htm#Part36

N.A. Constellation Mythology. http://www.coldwater.k12.mi.us/lms/planetarium/myth/index.html

Nicogossian, Arnauld E. Space Biology and Medicine Volume I. Washington D.D. American Institute of Aeronautics and Astronautics, Inc. 1993.

Nicogossian, Arnauld E. Space Biology and Medicine Volume II. Washington D.D. American Institute of Aeronautics and Astronautics, Inc. 1993.

Shipman, Harry L. Space 2000 meeting the Challenge of a New Era. New York and London. Plenum Press 1987.

Struve, Otto. Elementary Astronomy. New York, Oxford University Press. 1959.

Thomas, Christopher. The Solar Space Station. http://www.solarspace.co.uk/

Thompson, William Irwin. At the Edge of History. New York. Harper. 1971

Tyler, Edward A. The Space Around Us. New York, Evanston and London, Harper & Row Publishers. 1964.

Zubrin, Robert. The Case for Mars. New York, Touchstone. 1996.

LESSON PLAN-Mars Rover

Target Audience: Grade Level 5-6
Approximate Time: One hour

Objective: The first activity uses the format of the relay race to illustrate the delay between sending and receiving a message in outer space. Students will learn the difficulties of communicating to and from outer space by acting as probes and communication systems while building a sense of teamwork in the second activity.

Materials: Large gloves, nut and bolt, 20 paper cups, blindfold

Discussion: Introduction:
Why do you like space? What do you know about space?
What do you know about robots? Why are they important? Why do we need them on Earth? Are there/Have there ever been robots in space? (i.e. Rovers, *Spirit* & *Opportunity*) How long were they designed to operate on Mars? (3 months – but after 2 years, they still are working! http://marsrovers.jpl.nasa.gov/overview/)
Are they different from robots on Earth? Can robots do things that humans can't? (i.e. Easily go on outside of spaceship to fix problems)

Activity I: Nut-Bolt Relay

This is a timed activity. All students act as robots, and stand in a line next to each other. The first student picks up a nut and bolt from the floor and secures them together, then places the two pieces back on the floor separately after taking them apart. The students continue this down the line until they are finished. Read off the finished time.

All students will now act as astronauts, and stand in a line next to each other, as before. Before assembling the nut and bolt, they must put on (preferably large and cumbersome) gloves and then attempt to do the same task. Read off the finished time.

Discussion: Which team was faster? Robots or astronauts? Why? (Robots don't need to dress. They can be programmed)
Does that mean that robots are (always) better?
What can astronauts do that robots can't? (Talk, communicate if there is a problem)

Activity II: Mars Rover on Rough Terrain

This activity will demonstrate why robots/rovers are not always good. Obstacles – chairs, tables etc – should be positioned in classroom so students cannot easily maneuver around them.

Rover: 1 student to act as Mars Rover. Blindfold student.
Central Command ("Houston"): 3-5 students unable to see obstacle course
Messenger A is Signal from Rover to "Houston": 3-5 students
Messenger B is Signal from "Houston" to Rover: 3-5 students

The mission is to reach the target on the opposite side of the room from where the Rover starts. The target is a stack of paper cups on a desk.

Since the Rover cannot see, it must be told what to do and where to go.

1. Messenger A will decide how many steps and in which direction the Rover should go. He/she will go and tell "Houston" then return to the Rover's side, without speaking to Messenger B.
(ie "Take 4 steps left then 6 steps right")
2. "Houston" will then tell Messenger B the directions.
3. Messenger B will then actually move the rover into position, without speaking to Messenger A.

4. Once the target is reached, the rover must build a pyramid of paper cups while blindfolded, following the same procedure as before. This time, Messenger A will not give directions in paces or steps, but rather explicit commands (ie "Pick up the cup with your right hand and place it next to the other cup") This building of the paper cups will represent the rover collecting data or gathering information.

<u>Discussion</u>: Is there a problem with the robot? They need constant instruction, someone to tell them what to do; Humans/Astronauts do not need to wait for instructions. Which do we need more? Robots/Rovers or Astronauts? (Both!)

<u>Important Concepts:</u>

In this activity, a message is carried only several feet. Actual satellites are useful because they can relay information over several thousand miles. Delays occur because it takes time for the radio signals to travel to their destination via satellite.

We can obviously see the Messengers, or signals, in the relay, but actual radio signals are not visible to the human eye.

(http://www.physics.rutgers.edu/hex/visit/lesson/lesson_links1.html)

<u>Extended Exercises:</u>

In addition to the cup pyramid, another task/target could be to build a Mars Rover out of puzzle pieces that the students have made themselves. (Have them draw their own interpretations of the rovers, then show a picture of the real rovers and vote on which is closest to the real thing. After the students pick the picture most resembling, they cut it into pieces and try to have the Rovers put it back together with commands from the Messengers)

With more time, there could be more than one team. Activity II could be a relay as well, seeing which team could successfully reach the target and "collect Mars samples" first. Or repeat with one team, and have different rovers, each time. To increase difficulty and make the obstacle course harder, extra students may act as meteors that fall right in the path of the rover, or an unexpected crater that forces the rover to take another route.

LESSON PLAN-Constellations Mythology

Target Audience: Grade Level K-8
Approximate Time: One hour

Objective: To inform and educate the students on constellations their stories and locations and where they come from in order to increase their general space awareness and interest in space. This is achieved by telling several interesting stories which will hopefully inspire the students to investigate further..

Materials: The information on the constellations and the constellation finder printout.

Discussion: Introduction:

What do you know about the stars at night?
Do any of you know what a constellation is?
Have any of you heard of Ursa Minor or Major?
Perseus is a significant mythological character, have any of you heard of him?

Activity I: Constellation Finder Construction

The students are instructed on how to cut out the constellation finder's separate pieces. The students are then shown how to put together those pieces. Next they were instructed in its use and a description of the exterior markings.

Discussion: Students may have a little difficulty with the operation of the constellation finder so a more advanced explanation may be required as follow up.

Activity II: Constellation story telling, identification, and location finding

The constellation discussion began with locating a constellation and identifying the shape so that the students can recognize it. The discussion was continued by relaying the story filling in any relevant details from Greek or Roman mythology. We started with locating the North Star and the fact that it is part of Ursa Major. Next, we moved on to locate Ursa Minor and identify it. We then continued on to locate a relatively simple constellation to locate and identify which is Cassiopeia. Continuing on we moved on to her husband King Cepheus which is very close by and can have the story tied into Cassiopeia. After telling a shortened version of Cepheus's story the discussion moved to his daughter Andromeda, his future son in-law Perseus and Perseus's steed and mythical mount Pegasus which are all located very close together and have a very interesting and good sized story involving all of them. If that did not take up all the time then the discussion moved onto constellations such as Orion the Hunter, Hercules, the twins Castor and Pollocks, Cetus the Whale, and Draco the Dragon.

Discussion: While there is general consent on the names of the constellations there is some dispute on the accompanying story and it is therefore possible to find multiple stories about the same constellation. The stories supplied about the constellations here are the ones that we were most familiar or the most interesting stories we could find.

Important Concepts:

While this exercise does not directly relate to the exploration of or expansion of space awareness however it is a significant point in history, constellations and stars were used by sailors for hundreds of years to navigate at night it was also used as a form of oral history.

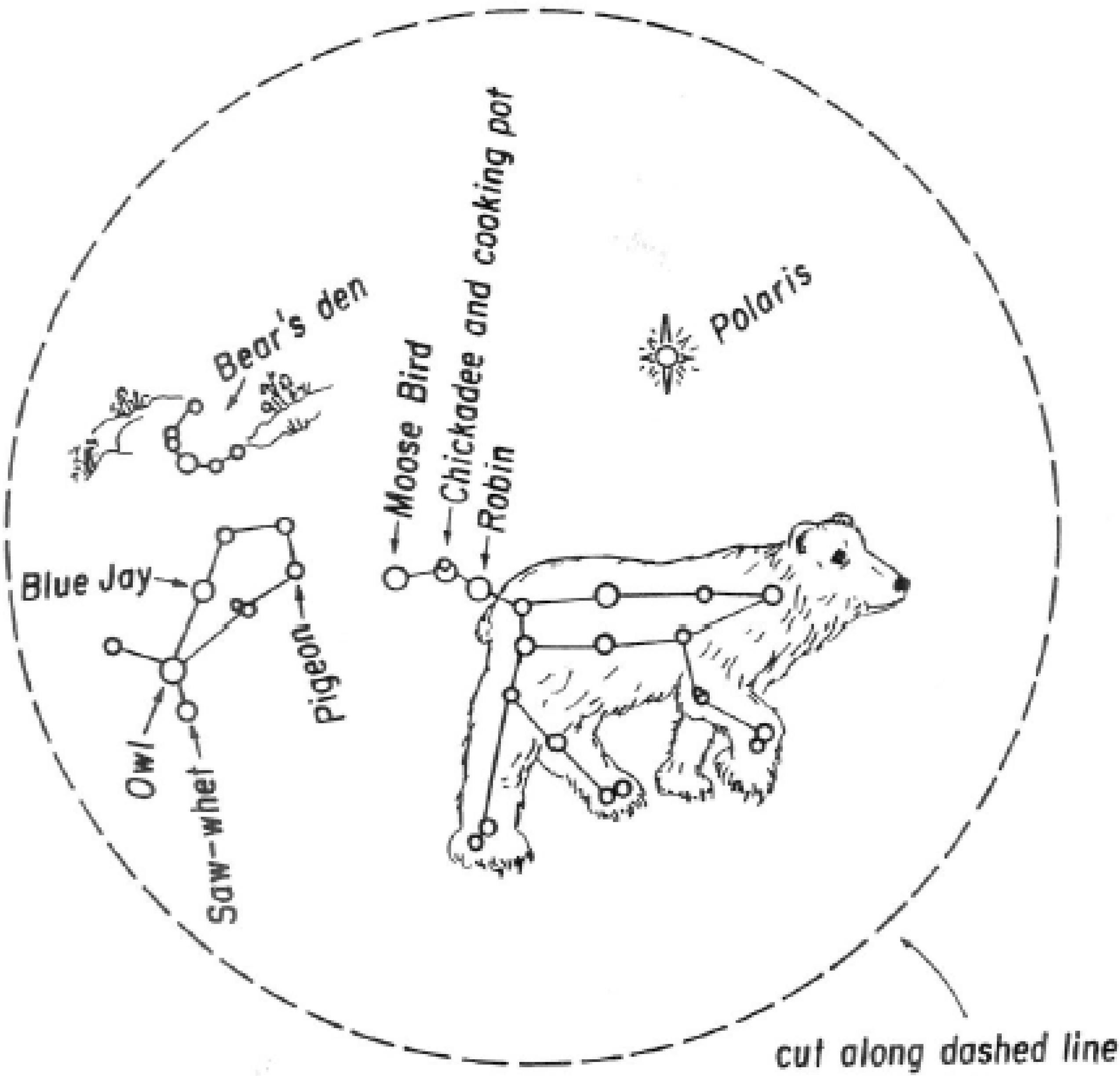
Suggestions:

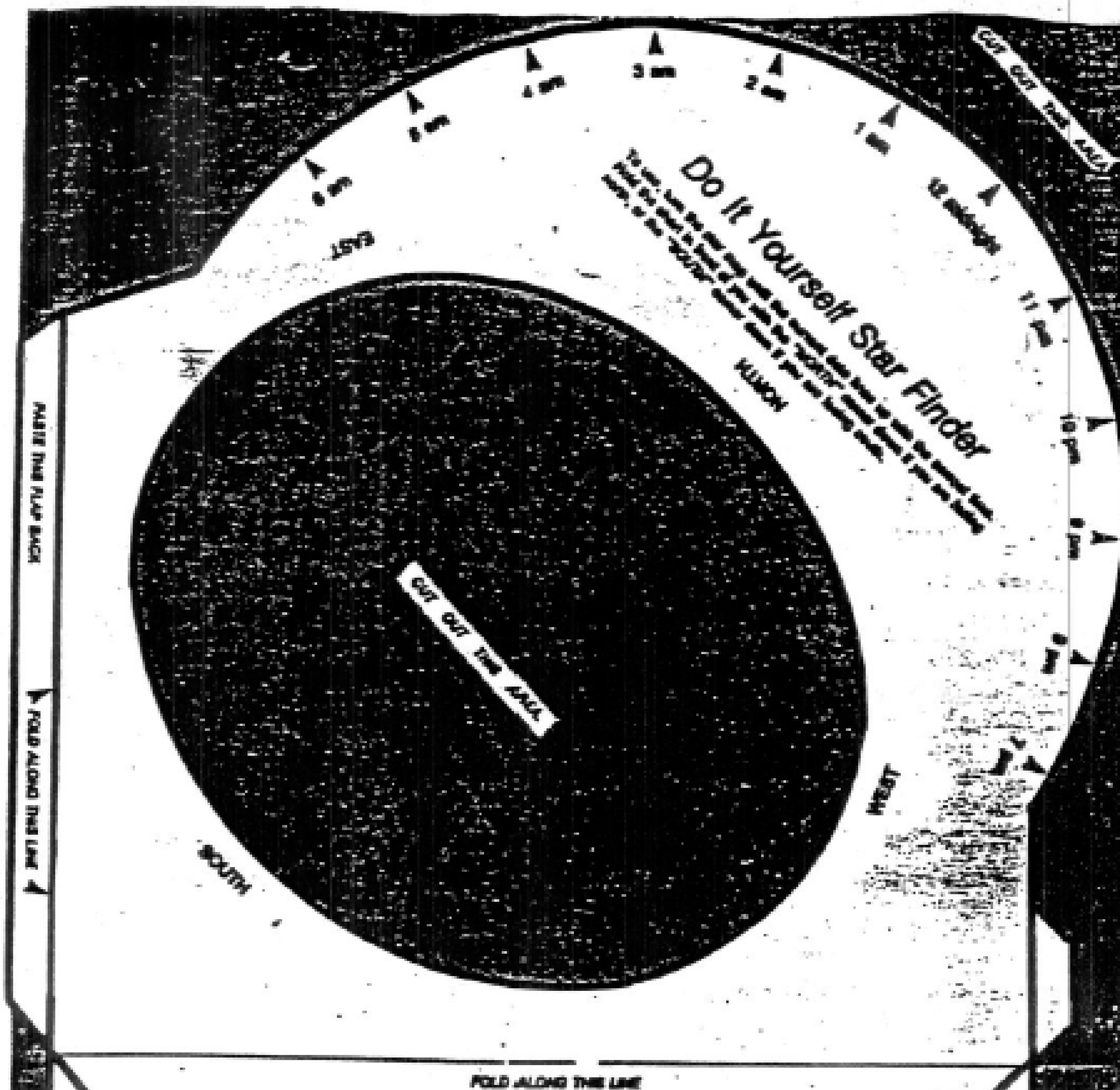
As mentioned earlier there are multiple stories for most of the constellations and several can be found. The best should be chosen and repeated for the students.

The following are Printable Sheets as stated above in the materials.

Diagram of the constellations

The Bear Hunt story follows the yearly apparent motion of three circumpolar constellations: Ursa Major (the Great Bear), Boötes (the Herdsman, Plowman, Ox Driver, or Bear Driver), and Corona Borealis (the Northern Crown) and surrounding stars. Most of Ursa Major represents the bear. The seven brightest stars in Ursa Major form the asterism of the Big Dipper. The three stars that are usually seen as the handle of the Big Dipper represent three of the hunters: Moose-bird, Chickadee, and Robin. Even the faint star Alcor, which appears near the middle star of the Big Dipper's handle, plays a part in the story—Chickadee's cooking pot! Four of the stars in Bootes represent the remaining hunters: Saw-whet, Owl, Blue Jay, and Pigeon; Corona Borealis is the bear's den.





FOLD ALONG THIS LINE

The *'Do it Yourself Star Finder'* was designed by Edna De Vore as an adaptation of the *'Sky Challenger'* by Budd Wentz of Lawrence Hall of Science. For information contact:

Edna De Vore
Independence Planetarium
1776 Educational Park Drive
San Jose, CA 95133

Lawrence Hall of Science
Astronomy Education Department
U.C. Berkeley
Berkeley, CA 94720

CUT OUT THIS AREA.

Name ______________________________ Date __________

CONSTELLATION DISC

Perseus the Hero

Constellation Mythology Stories

Perseus the Hero

Perseus is said to be the son of Zeus and Danae. His grandfather King Acrisius was told by a cleric that his daughter's son would kill him. Acrisius decided to take no chances and set Danae and Perseus adrift in a wooden chest, hoping the sea would carry them away and they would perish. Fate was kind to the two however, and only the next day they were blown ashore on an island where they befriended the fisherman and soon had a happy home. Then the King Polydectes fell in love with Danae, but did not want Perseus in the picture. And so Polydectes let it be known that, above all else, he wished for the head of Medusa as a wedding present. Eager to please, Perseus set off to win the prize. With some magical items given him by some of the other gods, Perseus was able to slay Medusa. Flying home aboard Pegasus, the winged horse, Perseus made a detour to accomodate the rescue of Andromeda.

Pegasus

Pegasus is the famous winged horse connected with the legends of Perseus and Andromeda. It is said that the animal was created from the blood of the monster Medusa which Perseus killed. Pegasus lived on Mt. Helicon and was said to have struck his hoof upon the ground and caused a fountain of water to gush forth. He was tamed by Neptune or Minerva and sometimes used by Jupiter to carry thunder and lightning. The symbol of the winged horse is found as far back as 430 BC on coins.

Andromeda

The most commonly known story relating o this group of stars comes from the Greeks. Andromeda was the daughter of the King and Queen of Ethiopia. They are represented by the nearby constellations Cassiopeia and Cepheus. As the story goes, Cassiopeia, who was a very vain woman, bragged that she was the most beautiful living thing. This enraged the sea nymphs who sent a sea monster to punish the town. The only thing that would save them was for Cassiopeia to sacrifice her daughter Andromeda to the sea monster.

In the end, Cassiopeia relents and chains her daughter to a rock by the sea and leavers her to her fate. This time, though, fate was kind and before the sea monster could devour the girl, Perseus happened along on Pegasus returning from slaying Medusa. Perseus saw Andromeda and instantly fell in love with her. He slew the sea monster and carried Andromeda away to be his wife.

The Arabs saw this group of stars as a seal. But it is known most commonly as the maiden in chains.

Cetus

Cetus is the legendary whale, or sea monster. Often it is the sea monster that was sent to devour Andromeda in the Cassiopeia ordeal. The Babylonians referred to this area of the sky as the chaos of the deep and Aratus called this group of stars the dusky monster

Cassiopeia

Cassiopeia is the legendary queen of Ethiopia and wife of the king, Cepheus. The royal couple had a daughter Andromeda who Cassiopeia was forced to offer up to a sea monster because she had offended the sea nymphs boasting about her beauty. Cassiopeia was later transported to the sky, where she sits on her throne and circles the pole. This group of stars was also seen by the Arabs as a hand or a kneeling camel. The Eskimos called it the stone lamp.

Cepheus the King

This constellation is believed to date as far back as 23 centuries and that is was recognized by the Chaldeans. Cepheus, King of Ethiopia, and husband of the vain Caaaiopeia sits on his throne as he circles the pole. It has also been said that Cepheus was one of the Argonauts and that he accompanied Jason on the quest for the golden fleece. For his honor and bravery, he was placed in the sky. The Chinese regarded these stars highly and associated them with royalty by calling them the Inner Throne of the Five Emperors. The Arabs saw in these stars a shepherd, his dog and a flock of sheep.

Orion the Hunter

Orion is one of the oldest and best known constellations. It is also one of the easiest to pick out. Orion is the legendary great hunter of the Greek mythology. It was said he was the most beautiful of men and the most skillfull of hunters. Unfortunately Orion accepted this praise with utter confidence it was true, and then some. He began boasting of his skills, claiming to have total superiouity over all creatures. Quite naturally, this annoyed the gods that be and they decided to punish him for his greatly inflated ego. Firmly believing in capitol punishment, the gods sent Scorpius, the scorpion was to earth to sting Orion's foot, and kill him. Diana, an admirer of Orion (and his ego) implored the gods to place the great hunter in the sky to remember him by. This they agreed to, so long as they also placed the scorpion there to warn against such nasty crimes as ego. In Orion's last dying breatls he begged not to be placed near the scorpion. And so, Orion dominates the winter skies while Scorpius' domain is the summer skies.

Ursa Major

One Greek myth tells that the nymph Callisto, a servant of the hunter Artemis was made to bear a child by Zeus. Artemis banished Callisto for impurity. Artemis gave birth to the child named Arcas. This made Zeus' wife Hera very jealous and in revenge, Hera turned Callisto into a bear which ran awy into the forest. Arcas grew up to become a hunter. One day while he was hunting, the bear Callisto heard Arcas' voice and rushed to greet her son. Arcas, not knowing the bear was his mother was about to kill her when Zeus intervened and sent both mother and son into the sky as the Greater and Lesser Bears. The way Zeus got the bears into the sky explains why their tails are so long, apparently Zeus grabbed them by their tails and swung them around over his head and finally flung them into the sky, and that is why these two bears have long tails!

Draco the Dragon

During the time that Draco's star Thuban was the pole star, it would have appeared to ancient sky watchers that the Earth revolved around Draco. Dragons and other similar creatures often played a role in creation myths. In these stories the gods would often battle such creatures for control of the Earth. When defeated, the dragons were flung up into the skies.

Roman myth calls this dragon Ladon and he guarded the golden apples on a tree in a garden tended by the Hesperides, the daughters of Atlas. Hercules was sent to obtain the apples while under pledge to Eurystheus. He learned from Nereus that he could not pluck the apples himself, but must get help from Atlas. Hercules shot and killed Ladon with an arrow, making way for Atlas to enter and pluck the golden apples. The goddess Hera was greatly distressed by the death of Ladon and placed the dragon in the heavens.

A Greek legend tells the story of Draco as a horrible dragon that guarded a sacred spring and slew the soldiers of Cadmus (first king of Thebes) who had been sent to gather water. Cadmus then fought the dragon and won,. After the dragon died, Athena appeared and told Cadmus to sow the ground with the creature's teeth. The teeth immediately sprang up as a group of armed soldiers who helped Cadmus found Thebes.

A Babylonian creation story tells of Tiamat, who turned herself into a dragon but was later defeated and split into two parts. One part became the heavens and the other, the Earth.

A Chinese tale sees the stars as the dragon who eats the Sun or Moon (possible represented by the north star Polaris) in an eclipse. During a real eclipse, ancient Chinese would make as much noise as possible, banging on pots and pans to try and scare away the dragon which was eating the Sun or Moon.

A Norse creation myth tells of a dragon who gnaws at the roots of Ygdrasil, the tree that covers the world.

Because Thuban was the pole star 5000 years ago the ancient Egyptians keenly observed it. Some of Draco's stars were part of their constellation of Hippopotamus and some were of the Crocodile. They appear on the planisphere of Denderah and the walls of the Ramesseum at Thebes. The hieroglyph for the Hippopotamus was used for the heavens in general while the constellation is supposed to have been a symbol of Isis Rathor, Athor, or Athyr, the Egyptian Venus. Draco's stars were also said to represent the falcon headed god Horus.

Around 800 BC, the prehistoric Adena people who lived in the Ohio area of the United States created Serpent Mound which is believed to mirror the constellation Draco. This huge mound is nearly a quarter mile long.

The Persians have regarded Draco as a man-eating serpent called Azhdeha.

In early Hindu worship, Draco is given the form of an alligator known as Shi-shu-mara.

LESSON PLAN-Solar System

Target Audience: Grade Level 4-6
Approximate Time: One hour

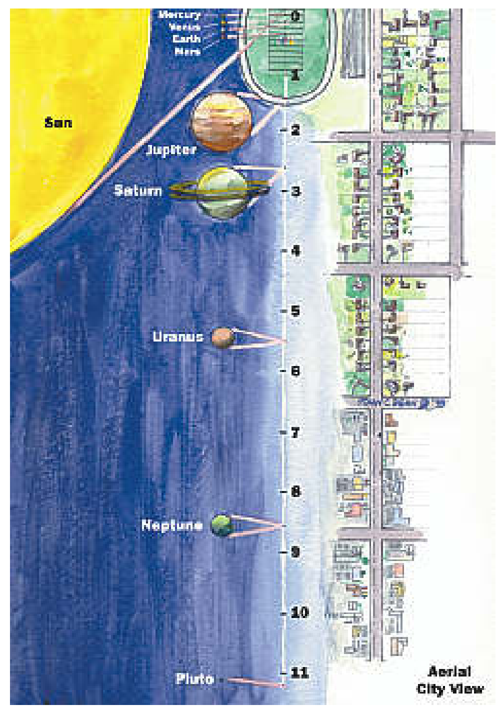
Objective: To give students a sense of perspective about the Solar System and the size of the planets.

Materials: Styrofoam balls of various sizes representing planets, access to a large room or playground, chalk

Discussion: Introduction:

Name all the planets in the Solar System (Have students make up new acronyms to help them remember)
How many Earths could fit inside Jupiter?
How many football fields would it take to demonstrate correctly the size of the Solar System, if the Earth was only a basketball?
Is the Sun the biggest star in the galaxy?

Activity I: Orbit Game



Every student will be designated an entity in the Solar System:

- Sun
- Mercury
- Venus
- Earth
- Mars
- Asteroid Belt
- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
- Comets
- Moons around various Planets
- Rings around various Planets

The Sun will begin and stand in the middle of the room. Each planet will then slowly begin their rotation, one at a time around the Sun, until all of the entities are (rotating) in orbit. Students may observe others in their orbits until it is their turn.
http://www.solarspace.co.uk/

If the students are very hyper, they can pick up the pace a bit until they are going pretty fast. Yell “Freeze!” and see where the planets are in their rotating orbits.

If students are on a playground, use different colored chalk for each planet to have them draw their orbits as they rotate around the Sun. Then discuss afterwards if any of the lines crossed each other.

Discussion: After “freezing”, if Pluto is next to the Sun, or other planets are in disarray, discuss the consequences of this and why we must maintain out orbit as Earth to continue living here. If we were as close to the sun as Mercury or as far away as

Pluto, we would receive too much, or not enough sunlight respectively to nourish life.

Activity II: Walk the Planets

With enough adults present, this can be done on a long, private street. Keeping the students in their roles as planets and Solar System entities, have them hold their Styrofoam Planet as everyone walks a scaled distance of the Solar System. As a scale, one may use a square of toilet paper, or a pace as 100 million miles.

Assign a "Pacer" who will lead the rest, and count loudly.

Starting at the Sun, take:	3.5 paces to Mercury
From Mercury, take:	3 paces to Venus
From Venus, take:	6 paces to Earth
From Earth, take:	5 paces to Mars
From Mars, take:	34 paces to Jupiter
From Jupiter, take:	40 paces to Saturn
From Saturn, take:	65 paces to Uranus
From Uranus, take:	150 paces to Neptune
From Neptune, take:	50 paces to Pluto

Important Concepts:

What would happen if the planets were to freeze or stop in place like the students demonstrate? Explain how the Earth's gravitational pull keeps the Moon in its orbit and why we only see one side of the Moon. This is the case for every planet with moons, even planets that have 63 moons! (Jupiter; most are asteroids that were caught in Jupiter's gravitational pull)

Extended Exercises:

Additional students that have not been assigned a planet for each exercise can be assigned positions such as the "moon" of other planets, or as the asteroid belt. With string during the Orbits game, moons could literally attach themselves to their orbiting planets

Suggestions

It is recommended that the students not try and spin in their orbits for extended periods of time as it will cause them to become very dizzy and possibly a safety hazard if the exercise is being performed on a hard surface.

The following is a printable sheet that can accompany this exercise.

Find the Hidden Words

C	V	O	Y	A	G	E	R	G	P
O	U	R	S	P	A	C	E	A	L
M	O	B	U	M	O	O	N	L	A
E	R	I	N	G	A	X	J	A	N
T	O	T	O	P	X	P	Z	X	E
U	M	I	L	K	Y	W	A	Y	T
M	A	S	T	E	R	O	I	D	S
A	S	T	R	O	N	A	U	T	Z

___asteroid	___galaxy	___orbit	___space
___astronaut	___Milky Way	___planets	___sun
___comet	___moon	___ring	___Voyager

LESSON PLAN-LEGO Robotics Space Elevator

Target Audience: Grade Level K-6
Approximate Time: One hour (at least)

Objective: To familiarize the students with the terminology and basic construction of a newly proposed space technology: the Space Elevator.

Materials: MINDSTORMS LEGO Robotics Kit, LEGO Elevator instructions, images of space elevator

Activity: Building a LEGO Robotics Space Elevator

This activity helps students stimulate an interest in engineering as a possible avenue to space. We introduce a team dynamic by having only one MINDSTORMS kit. The children may either follow the elevator directions, or improvise to create their own rendition of what they believe the space elevator looks like.

Discussion: Discuss how long the elevator will be (22,000 miles)

There are some very hard, durable materials used on Earth to make elevators. Can anyone name some? (Diamond, Steel) Would we be able to use the same materials to build a space elevator? (No – diamond is brittle and rare. Subjected to varying weather and temperature conditions, steel is susceptible to material changes.)

Are they any kinds of natural material that is just as strong? (Spider Silk) Why can't we use this as the cable for the space elevator? (We don't have a big enough spider to produce the silk, and not enough spiders to collect 22,000 miles worth of silk)
Introduce new material called carbon nanotubes that scientists are using to make the ribbon. Discuss the timeline for the construction of this elevator, and if the students think it is a feasible idea.

Talk about where the space elevator would lay its foundation, taking into consideration the varying environments and atmospheres around the globe. (Right now, Ecuador is the prime spot for its foundation because of its mild environment and its proximity to the Equator.)

Mentioning the purpose of the space elevator is a good discussion piece. Ask why we may need an elevator to help us in the future. (Loading dock for future missions to Mars, more fuel efficient, will enhance the space tourism industry)
http://en.wikipedia.org/wiki/Carbon_nanotube

Suggestions

One hour was not quite enough time for the students to finish construction in our class. This was because not everyone arrived on time, and we began with an introduction activity. This lesson plan is relatively flexible in its time restrictions, as students enjoy LEGOS and would have continued playing with them after class ended.

LESSON PLAN-Careers in Space

Target Audience: Grade Level 4-6
Approximate Time: One hour

Objective: To expose students to different careers in the space industry, that may seem inapplicable

Materials: Reference sheets for each career type with examples and explanations of potential reasons for wanting to represent their field of study in space, paper, and pen.

Discussion: Introduction:
What kinds of careers do you think of when you think of space? (Astronauts, Pilots, Engineers)
Can you think of a need for Doctors, Entertainers, Teachers, Lawyers in space?

Activity: Debate

The year is 2060 and the colonization of Mars is well underway. A blossoming community has been developing with luscious trees still growing, accessible hospitals and a government system underway. There will be another payload mission en route within the next year with critical supplies and more people. There is one seat remaining and NASA must fill it with someone they deem worthy of the trip.

The students are broken into four teams: Doctors, Lawyers/Politicians, Scientists/Engineers and Business Entrepreneurs. Before the game begins, distribute the details of the professions to the appropriate teams and allot 10-15 minutes for the students to write down their reasoning's as to why they should be the representative of their discipline to be sent to space. When all teams have enough justifications to support their career, the debate will ensue. Each team will take turns speaking in the front of the class. While they try to persuade the class to believe that they are the most significant out of all the groups to go to Mars, the other career teams are writing down their questions. These questions are asked at the conclusion of each specific topic.

Discussion: Was there a clear winner? What would have happened on Earth if we only had Doctors or Lawyers running the place?

Important Concepts:
While this activity will help the students to understand that there are roles for many different types of careers in space, there really will be no clear winner. For a colony to be successful, if not merely survive, all mentioned professions are important.

Extended Exercises:
Teachers may include any professions they like. Educators and Entertainers were popular at Goddard, though did not offer much in the way of justifying their cause.

Suggestions

Make it known that while each team is speaking in front of the classroom, they are the only ones speaking. Often, the term "debate" implies a heated argument. The students at Goddard were very civil and polite as long as they knew the rules of the game. At the beginning of the game, we did not include Politicians in our career choices. We thought having Lawyers would suffice. However, the students argued that political recognition was essential for the beginning of a new colony, and so the Lawyers became a joint group that encompassed an aspect of government as well.

Synopsis of professions in space

Doctors – With widespread space travel being common there are many things for a doctor to do. With the to contact new life forms, even non-intelligent ones, the likelihood of coming in contact with lethal bacteria and viruses that we can not defend against. Additionally developing new medicines in zero gravity is also very likely.

Lawyers/Politicians – As we extend humanity's reach to the stars new potential land will become available. This new land will have to have regulations to set up ownership as well as rights to new minerals not available on Earth. Another consideration that both lawyers and politicians will have to deal with is whether or not those brave souls who venture into this new frontier will still be governed by the governments they belonged to on Earth or entirely new governments on their new world.

Scientists/Engineers – While inhabiting new worlds we will gain access to a variety of new materials. With these new materials both scientists and engineers will be able to make improvements to computers and electronics as well as normal things in which your everyday life is affected.

Entrepreneurs (Business People) – With humanity now spread out on more that one world trading will become profitable between worlds. Additionally with the new research being done by the scientists and engineers they will have new products to sell and produce. They will even be able to take advantage of the new ability to visit another world and expand the tourist trade to interplanetary levels.

LESSON PLAN-Jeopardy

Target Audience: Grade Level 3-6
Approximate Time: One hour

Objective: To test student's current knowledge and expand their knowledge with the tougher questions.

Materials: The information questions for the Jeopardy game as well as numbers for points and category names.

Activity: Jeopardy

Before the game initiates the questioner should set up the board so it should not impede upon the game time. After the game board is set up the questioner should divide the students into groups so that anywhere from 3-6 students are in a group we recommend groups of 4 or 5. The questioner then chooses questions such that the difficulty is on level with the question asked for. One option for identifying which group is ready to answer first is for a designated student from each group to simultaneously raise their and slap their hand on the table when they know the correct answer. As in normal Jeopardy correct answers are awarded points and incorrect answers take away points.

Discussion: Additional questions can be added to the question list. The questions are currently not in order and such should be chosen by difficulty according to the audience.

Important Concepts:

While this exercise does not directly relate to the exploration of or expansion of space awareness however it is a significant point in history, constellations and stars were used by sailors for hundreds of years to navigate at night it was also used as a form of oral history.

Extended Exercises:

One way to extend Jeopardy is with double Jeopardy with harder and more questions as well as Daily Doubles. Additionally you can always have a Final Question as done in Jeopardy in which the question is asked then bid on by each group and then answered in written form.

Suggestions

More questions is really all this lesson plan could use except for possibly organizing the questions in order of difficulty. The problem with ranking the questions ahead of time is that some teachers may have covered certain material and not other subject matter, changing the difficulty of some questions significantly, and thus we left the questions unordered in order to give the questioner more control, as they will know the appropriate level of difficulty.

The following are Printable Sheets as stated above in the materials.

Jeopardy Questions

The Universe

Questions	Answers
True or false? The universe is made up of all the galaxies and the space around them.	True.
Some scientists think that the universe began with a giant explosion. What do they call that explosion?(hint-don't bang your head against the wall if you don't know the answer)	The Big Bang
The universe is enormous-it's infinite, but what does that mean?	The universe is so big that it has no boundaries- it never ends.
Are galaxies and stars the same thing?	No galaxies are clusters of stars, planets, gas, and dust.
Choose one. How many galaxies are in the universe- hundreds, thousands, billions?	Billions(one billion is 1000 millions)
Name the galaxy that our solar system is part of.(hint-there's a famous candy bar with the same name)	The Milky Way
True or false? Galileo was the first astronomer to look at space through a telescope.	True- in the early 1600s he built his own telescope ands saw craters on the moon, spots on the sun, and the four largest moons of Jupiter.
These collapsed stars are mysterious, cant be seen, and seem to swallow up everything around them-including light.	Black holes
What is a "dirty snowball" that develops a long, shining tail when it comes close to the sun? (hint-Halley's is one of the most famous in the universe)	A comet- Comets are called "dirty snowball" because they're made of frozen gas and dust
True or false? Distances in space are so great they're measured in light-years no miles.	True-a light-year is the distance a beam of light travels in a year.
If Fred weighs 70 pounds on earth, and Frieda weighs 60 pounds who weighs more in space?	Weight a minute, that's a trick question! Neither would weigh more because they are both weightless.

The Solar System

What is at the center off the solar system?	The sun
How many planets are in the solar system?	Nine (that we know of)
Choose one. Is the sun an asteroid, a planet, or a star?	A star- think of this "star" as "taking center stage" in our solar system.
True or false? Without the sun we'd be alive, but very cold.	False- without the sun there wouldn't be any life on Earth.
True or false? The sun is hottest at its center.	True- that's where the sun makes its heat and light energy.
What are the dark spots on the sun's surface called?	Sunspots- theses "freckles" on the sun look darker because they are cooler than the rest of the sun's surface.
True or false? Staring directly at the sun can damage your eyes and can even blind you.	True (just ask the famous astronomer Galileo. He damaged his eyes by looking at the sun through his telescope.
What is the five-letter word that names the path each planet follows around the sun?	ORBIT
What is the invisible force that holds the planets in their paths around the sun?	Gravity (the same force that keeps you glued to your seat)
This happens when the moon passes directly between earth and the sun and blocks the sun's light.	A solar eclipse
Is the moon a planet?	No – the moon is a satellite that orbits the planet earth.
Choose one. Which of these is not a phase of the moon – a new moon, a blue moon, or a full moon?	A blue moon (although there is a saying, once in a blue moon, which means "hardly ever")
True or false? Like the sun, the moon gives off its own light.	False- the moon steals light form the sun and reflects it back to us on earth.

The Planets

Name the planets, in order, starting with the planet that is closes to the sun.	Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto
True or false? All of the planets travel around the sun in the same direction.	True
Can you name the biggest and the smallest planets?	Jupiter is the biggest, Pluto is the smallest (also the coldest)
Which planet is the hottest?	Venus-the clouds that cover Venus hold in the heat, making it hotter than an oven.
Name at least two of the four planets that do not have solid surfaces. (they are all outer planets)	Jupiter, Saturn, Uranus, Neptune
This planet looks like it is tipped sideways.	Uranus-this tipped position cause Uranus to have 42 years of sunlight followed by 42 years of darkness.
The Great Red Spot is found on which planet?	Jupiter
This planet is often called the "red planet"	Mars-the rust in its soil makes it look red.
True or false? All of the planets have moons.	False- Mercury and Venus are moonless.
Which planets have plants and animals?	Trick question! Only one –Earth (as far as we know)
Name the blue Planets.	Uranus and Neptune-they look blue because of the methane gas in their atmosphere.
Which planet has the most moons? (hint-it's also known for its beautiful rings)	Saturn- it has more than 20 moons.

The Inner Planets

Name the inner planets.	Mercury, Venus, Earth, Mars.
Why are they called the "inner planets"?	They're the ones closest to the sun, as well as inside the asteroid belt.
Are the surfaces of the inner planets made up of rocks or gasses?	Rocks – these planets are also known as the "terrestrial planets".
True or false? Since Mercury is closes to the sun, it is the hottest planet.	Sounds true, but it's false – Venus is the hottest planet.
This planet is the only one with liquid water on its surface.	Earth – we need that water to stay alive.
At one time, people thought there might be life on this planet. (hint-they thought little green men lived there)	Mars-those little green men were known as Martians.
True or false? The largest volcano in the system is on Earth.	False – the largest volcano is Olympus Mons, a huge volcano on Mars. It's 16 miles or almost 26 kilometers, high.
Which two inner planets are called the "sisters planets" because they're almost the same size?	Venus and Earth-these two planets are neighbors, too, which is another reason they're called the "sister planets".
This is the only planet which rotates from east to west- all other planets rotate from west to east.	Venus-that means the sun rises in the west and sets in the east on Venus.
This planet has the largest canyon in the solar system.	Mars-the canyon is 13 times longer and 4 times deeper than the Grand Canyon.
Which is the smallest inner planet? (hint-it's also the speediest planet in its orbit around the sun.)	Quick, did you answer Mercury? (Mercury was named after the speediest messenger of the Roman gods.)

The Outer Planets

How many outer planets are there? Can you name them?	Five-Jupiter, Saturn, Uranus, Neptune, Pluto.
Name the only outer planet that is not made up of gasses. (hint this one's way out there)	Pluto-its made up of rock and ice.
How many of the outer planets have moons?	All of them-they range in number from 1(Pluto) to more than 20(Saturn).
True or false? All of the outer planets have rings?	False – all of the outer planets except Pluto have rings.
Only this planet's rings can be seen through a telescope from Earth.	Saturn's – we didn't know about the other planet's rings until space vehicles called probes discovered them.
Choose one. Is the great Red Spot on Jupiter a storm, a volcano, or a crater?	A huge storm- its actually the largest hurricane in the solar system, measuring almost three times the size of Earth.
True or false? Neptune has a Great Dark Spot, which is like Jupiter's Great Red Spot.	True.
Choose one, are the rings around Saturn made mostly of beautiful rays of light, chunks of ice and rock, or poofs of sparkles and smoke?	Chunks of Ice and rock-Some pieces are as tiny as grains of sand, while other pieces are as big as houses!
True or false? Some astronomers think that Uranus is tipped sideways because a huge object smashed into it after it was formed.	True (this poor planet doesn't know which end is up)
Which planet was hit by a comet in 1994	Jumpin' Jupiter!-A string of 21 fragments from the comet Shoemaker-Levy 9 struck Jupiter during the week of July 16, 1994.
Do astronomers believe that there's a planet beyond Pluto in our solar system?	Yes and no – some astronomers think that there's a "Planet X" beyond Pluto. Others think its unlikely.

SPACE GENERATION

the biggest global space youth network

representing youth to the United Nations

JOIN US !

And become active in:
space policy, space education, capacity building and more

Enjoy the benefits of belonging to our global network:
be informed, make friends, enhance your skills, find a job,
share your passion, meet VIPs, travel the world, have fun, etc.

www.spacegeneration.org

info@spacegeneration.org

DO SPACE

- What has the space industry done for you lately?
- Is there really a space elevator in the making?
- How do your career aspirations fit into the space industry?
- Privatize the space program?

Space Info Session
Morgan Room, Campus Center
April 1st - 11am & 3pm

www.spacegeneration.org


YURI'S NIGHT 06
WORLD SPACE PARTY APRIL 12


WORLD SPACE PARTY
APRIL 12
YURI'S NIGHT
People everywhere love to party. Most parties don't require a special reason or significant event. But when the celebration in question marks something as extraordinary as the dawn of human spaceflight, expect a HUGE party.
That party is Yuri's Night, celebrated in 73 cities around the world, on ALL seven continents. Yes, even Antarctica occasionally throws a Yuri's Night party, and residents of the International Space Station have even been known to join in on the fun.
Yuri's Night is the global celebration of human space travel, held annually on April 12. Yuri's Night commemorates both the historic first flight of Cosmonaut Yuri Gagarin on April 12, 1961, as well as the launch of the first Space Shuttle (STS-1) exactly 20 years later. This year we're celebrating the 45th anniversary of Yuri's flight and the 25th anniversary of STS-1, so join events around the world to celebrate your passion for space!
HERE'S WHAT'S GOING ON IN WORCESTER:
Wednesday, April 12th, 2006; 7:30 – 9:30
(what else do you have to do on a Wednesday night?)
Blacklight Bowling @ Gompei's Gutters
DJ
Food
FREE!
For more info, contact:
Keithe Baggett
508.308.2518
Kbaggett@wpi.edu
www.yurisnight.net
www.spacegen.org
DO SPACE