Exploring the Solar System: Student-Designed Planetary Missions

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Course Web Site: http://www.scidiv.bcc.ctc.edu/rv/solarsystem/

The Premise of the Project

"Historically, the exploration of the solar system has been undertaken by large government agencies, with the financial support of the taxpayers. For years, spacecraft were only launched by the United States and Russia, the only countries that could really "afford" a space program. In the past decade, however, the European and Japanese space agencies have been playing a larger role in planetary exploration. Up until now, no space mission has been privately funded. That is about to change... Whenever a wealthy benefactor from Western Washington (named Paul Smallen) decided to finance his own planetary mission. In our case we usually purchase a prize for those team members who made the most convincing proposal."

Benefits of the Project

Integrates many concepts from geology and astronomy
Understand how science is done (where do data come from?)
Rewards both scientific and artistic creativity
Enhances teamwork skills
Creates life-long learners

Comments:

1. Proposals and Research Teams

Students write a proposal describing the target they would like to explore and why. Based on these proposals, they form research teams and name their project, team, and spacecraft mission. Some teams also design a mission logo. Students then work in these teams for the entire quarter.

2. Reference Web Page

One of the first tasks assigned to each team is to research online reference sites for their target. They are expected to evaluate these sites for quality and to post them to a shared class web site. This reference site is available to the whole class.

3. Background Research Assignments & Progress Reports

Throughout the quarter, students complete several assignments. One assignment, called "Seeing Through Robotic Eyes" requires that they research instruments on other spacecraft and how they collect different types of data. In addition, they research the naming convention for their target and summarize previous missions. Each project team submits regular progress reports to ensure that they stay on task.

4. Mission Design

The core of the project involves designing a robotic scientific mission to another object in the solar system. As a part of this project, students are expected to design the science of the mission as well as plan the design of the spacecraft itself and the mission logistics.

4A. Mission Science

The science of the research project focuses on understanding what is known about the target object, what questions still remain to be answered, and how to go about answering those questions. To do this the students must understand the scientific method, the basic principles of geology and astronomy, and the methods that astrogologists employ, to study places where no human observer has ever been.

Once the students have decided on questions they would like to address, they must then figure out what instruments they require to collect their data and how to get those instruments to the target object.

4B. Spacecraft Design and Logistics

A. Mission type: Orbiter, flyby, lander, etc.
B. Propulsion system & energy supply
C. Onboard instruments
D. Launch and arrival dates
E. Trajectory & necessary slingshot calculations
F. Launch vehicle

Cost analysis
Team must include the weight of their spacecraft and then use existing NASA web sites to determine the cost of spacecraft development and construction. In addition they include the cost of the launch vehicle and "Mission Operations and Data Analysis" cost.

Written Grant Proposal & Oral Presentation

The Final Project Consists of the following "deliverables":

Oral Presentations - "The Pitch"
Each team makes a 15-20 minute PowerPoint presentation to the class on their target object. This presentation includes a history of the target object, as well as the team’s proposal for exploring the object (science and spacecraft design/logistics). Everyone on the team is required to participate in the presentation.

Written Grant Proposal
The grant proposal includes the following sections:

Introduction
Exploration History
What We Know about the Target Object
Mission Goals (What We Don’t Know)
Spacecraft Design/Logistics
Mission Cost
Significance of the Mission
References

Highlights/Press Release
This one-page summary includes the highlights of the mission statement and a pitch for why it should be funded. This is generally written as a press release that addresses the question, "What would make the general public excited about your mission?"

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7. Evaluation

Each team’s presentation and written grant proposal is evaluated by the instructors and other teams (peer review). In addition, the contributions of each team member are evaluated by the rest of the team via an anonymous online evaluation form. Students’ grades are based on a combination of all of these evaluations. In addition, the team that made the strongest proposal, based on the feedback of the instructors and the feedback from the class, is “awarded the grant”. (In our case we usually purchase a prize for those team members. This year the top team members each received a copy of “A Traveler’s Guide to Mars” and the top three teams all received small meteorite samples.)