Voyages to the Terrestrial Planets Lab: *Rocketry*

Overview: OK, so this is the part of the course I have been really looking forward to all term and I hope you're excited as well. What we doing in this lab is a) building a rocket, b) learning how a rocket flies and operates, c) launching a rocket, and d) collecting data about the launch to reinforce our knowledge of how rockets work. You will synthesize all of the above into a report that you and your group will turn in at the end of the term.

Rocketry has been a hobby that has interested people for the past 50+ years and has been largely inspired by the space race that developed in the 1950's. It is amazing to think that although technology has advanced greatly over the past 50 years, our ability to get into space still fundamentally relies on rockets. It was rockets that first took us into space that sent us to the Moon, that sent objects to Mars, and that keep sending the space shuttle into orbit and going to the international space station. Subsequently, in order to do and understand any sort of planetary exploration that occurs, it is critical to have some basic knowledge of how a rocket operates and there is no better way to begin gaining that knowledge than building your own rocket and launching it.

To begin gaining that basic knowledge, this lab is broken into three different parts: 1) You will build your rocket in your groups and begin doing background research into how rockets operate; 2) You will launch your rocket and collect data as to how high it went and how fast it flew; and 3) Synthesizing the information collected from parts one and two into a coherent lab report that will be turned in at finals.

To do: For this part of the lab I want you to just focus on building your rocket and launch pad and doing some background research on rockets. So, we can break today's part of the project into two parts:

1) Building your rocket – open your rocket bags and follow the instructions detailing how to build your rocket. You will need minimal amounts of glue, which I have at the front of the room – you will need to share between groups as I only have a few tubes; you will also need to share other supplies as well such as knives and rulers.

2) Decide what payload you would like to launch as part of your rocket. You have a choice between a 'human-based' mission and a robotic mission. The human aspect of the mission would involve sending a plastic figurine into 'space' and the robotic mission would involve launching a clothes pin. You will need to find a way to attach your item to or inside the rocket – meaning that you will need to play the part of engineers for part of this. Before you decide what you want to launch, you need to decide where you want your mission to go – do you want it to go to the Moon, Mars, Venus, somewhere else? This means you will need to play the part of mission designers for this mission as well. You will have a set budget you need to stick to while designing and launching your mission. I will hand out a detailed description of your budget.

3) Begin doing background research online about how rockets work. Really what you will be doing is making a comparison to how close to reality your model rocket is to the real thing. Specifically, you should be answering the following questions:
a) What are the different types of rockets that have been in use by the United States since the 1960s?
b) What is the difference between reusable launch vehicles and one time launch vehicles?

c) What are the different parts of a rocket?
d) What stabilizes a rocket during flight?
e) How fast do rockets fly when leaving our atmosphere?
f) Are different amounts of thrust required for various orbits to be achieved?

Remember that this is a group project and you will be turning in one final item per group at the end of all of this, which includes both a lab report and class presentation. Subsequently, the grade that one person gets, is the grade that the whole group gets. So, make sure that everyone pulls their own weight within the group. If one of your team members is not doing their job fully and it is bringing you and the rest of your group down, please feel free to come to me to express your concerns – our conversation will be strictly confidential.

Budget overview:
You have a budget of $5,000,000 for your launch. This is a much smaller budget than what typical missions have, but it will do here as I still think of 5 million dollars as a lot of money. The following is a breakdown in terms of costs:

Launch:

Unmanned mission:
Moon – $1.5 million
Mars – $2 million
Venus – $2 million
Mercury – $2.5 million
Asteroid – $2.5 million
Beyond asteroid belt – $3 million

Manned mission are a half million dollars more than unmanned missions

Parts:

Parts you need to attach your astronaut or satellite will be bundled into one price. For unmanned missions, your parts will cost $1 million. For manned missions, parts will cost you $500,000. In order to entice more risky missions, the government has decided to subsidize the parts needed to send someone into space. Going beyond asteroid belt, parts are reduced to $250,000.

Mission actions:

Orbiting satellite: $500,000
Lander (unmanned): $750,000 (no sample return)/sample return = $1 million
Lander (manned): $1.5 million
Building a base: $2 million

You must plan a mission that will address a scientific question. You will be scored based on the realistic scientific nature of your mission and its creativity and risk. The more realistic risk you take with your mission, the higher you will score on this part of the project. If you need more money than what you have been assigned, you can write a proposal to me requesting more money.