



**CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY**

Name(s) Mark A. Chodas	Project Number J0104
Project Title Landing Humans on Mars	
Abstract Objectives/Goals The objective of my project was to find out if humans can land on Mars and return to Earth using existing rocket technology. I hypothesize that this can be accomplished although it will take many launches. Methods/Materials First, I designed a theoretical Mars mission and calculated its mass. Then, I figured out how much propellant it would take to get it to Mars and back. Next, I added the propellant mass to the mass of the vehicle and found the total launch mass of the spacecraft. Finally, I divided this number by the amount of mass an existing heavy-lift rocket can carry to Low Earth Orbit to find the number of launches necessary. Results I concluded that the mission would have a total mass of about 1,218,000 kg. It would take 49 launches of a Delta IV Heavy rocket to get this mass to Low Earth Orbit. This proves my hypothesis correct. Conclusions/Discussion My hypothesis was correct: humans can get to Mars but it is not feasible with current technology. Forty-nine launches would require too much in-orbit assembly. The mass can be reduced, however, by employing mass saving techniques such as aerobraking into Mars orbit and in-situ resource utilization on Mars. For comparison, if the old Saturn V rocket were used, it would only take 10 launches to carry the spacecraft into Low Earth Orbit because the Saturn V was a more powerful rocket.	
Summary Statement My project is about finding the launch mass of a manned spacecraft to Mars and calculating the required number of launches using an existing rocket.	
Help Received My dad, Dr. Paul Chodas, helped me understand some of the math required for this project.	