



**CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY**

Name(s) Caroline E. Vance	Project Number J0227
Project Title Machines in Your Motions	
Abstract Objectives/Goals The objective of my project was to determine a possible explanation of why people lean forward to stand up from a sitting position. My hypothesis was that if a person leans forward, moving their center of mass closer to their knees, then it requires less force to rise. Methods/Materials Through research, I was able to find that the knee joints and legs, parts of the body heavily involved in standing up, act as a lever. With this knowledge, I built a third class lever to simulate the body standing up. The fulcrum was the knees, the lever was the body above the knees, and the effort was a person pulling up with their leg muscles. The center of mass was simulated by a container of weights, moved to a different place on the lever for each measurement. The lever was lifted to a given distance with the cup of weights at a point on the lever. The amount of force needed to lift the lever a given distance was then recorded from the spring scale. Results I found that the farther away the weights were from the fulcrum, the greater the force needed to lift the lever a given distance. This was consistent through every trial including those that lifted the lever to greater heights. Conclusions/Discussion Using the data achieved during testing, I derived a conclusion relevant to the human body. By moving the center of mass closer to the knees, the fulcrum, it took less force to raise the lever, the body above the knees. I proved my hypothesis correct because moving the weights closer to the knees required less force to raise the lever.	
Summary Statement My project was about finding a reason why people lean forward when standing up from a sitting position.	
Help Received Neighbor was interviewed for background research.	