



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY**

Name(s) Maxwell Chen	Project Number J0609
Project Title How Can We Efficiently Generate Hydrogen from Water?	
<p style="text-align: center;">Abstract</p> <p>Objectives Hydrogen is a clean energy source. It can be generated from water by using electricity. In this project, I compare the rate of hydrogen production from water using solutions of different pH and find that the lower the pH the faster the production rate. I also compare the rate of hydrogen production by using different electrode materials, and find that copper wire works much better than pencil lead as the electrode.</p> <p>Methods Materials: pencil, solid copper wire, plastic centrifuge tube, power supply, connection cable, autopipette, timer (iPhone)</p> <p>Method: 1. I prepared four solutions: 0.05 M H₂SO₄ (pH = 1), 0.005 M H₂SO₄ (pH = 2), 0.1 M KH₂PO₄ (pH = 6.8), and 0.1 M KOH (pH = 13) 2. I sharpened both ends of two pencils 3. I cut off the tip of the plastic centrifuge tube, inserted a pencil into the tube, and used waterproof tape to seal the gap. I calibrated the volume using an autopipette to transfer a known amount of water into the tube, and marked the volume with a permanent marker. 4. I used a beaker and put 100 mL of one of the solutions into it. 5. Then I took an autopipette and filled up the plastic tubes until it was almost overfilled. 6. I then took wax paper and carefully covered the opening with it, making sure not to let any bubbles inside. 7. Then I flipped the tubes over and submerged them into the beaker and removed the paper once they were in. 8. I then connected cables from the power supply to the electrodes and timed the amount of hydrogen and oxygen produced. 9. I repeated the study by replacing the pencil with a solid copper wire.</p> <p>Results I did two sets of experiments. In the first experiment, I used the most acidic solution, 0.5 M H₂SO₄. I observed that once the power supply (6 V) was connected to the outside pencil tips, bubbles started to form on the other pencil tips, and the amount of gas collected in the negative tube was almost twice as much that in the positive tube, because the amount of hydrogen in water is two times that of oxygen.</p>	
Summary Statement Acidic solution and metal electrodes are preferred in efficient hydrogen production from water.	
Help Received Dr. Yi Peng, University of California Santa Cruz	