The Lemon Battery

Background
Remember that a battery uses stored chemical energy and turns it into electrical energy through a chemical reaction. The primary parts of a battery include the cathode, anode, and electrolyte solution.

Prelab Questions
1. What is a cathode?
2. What is an anode?
3. What is an electrolytic solution?

Problem
What materials can be used to generate electricity from a lemon?

Materials
- Lemon
- Multimeter
- Various objects – coins (penny, nickel, dime, quarter), metal wire, crayons, toothpicks, straws, plastic fork, metal fork etc.

Safety
- Always wear safety goggles and aprons when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- The lemon battery that you will make will generate a low amount of electricity, so we can experiment with it in the lab. It is important to remember that you should not experiment with car or other batteries or electric outlets because they produce a strong current that can be fatal.

Procedure
1. Obtain a lemon from the supply table.
2. Roll the lemon on the table, but do not break the skin.
3. Examine the items on the supply table.
4. Which item would you like to use as an anode? Why?
5. Which item would you like to use as a cathode? Why?
6. Select one item to use as an anode and push it through the skin of the lemon. Record your choice in the table below. Leave enough of the item sticking out to attach the multimeter to.
7. Select one item to use as the cathode and push it through the skin of the lemon,
without having it touch the anode. Record your choice in the table below. Leave enough of the item sticking out to attach the multimeter to.

8. Attach the multimeter to the cathode and the anode. Record the registering voltage in the table below.

9. Select a different anode and cathode and repeat steps 6-8 two more times, or until you are able to generate voltage on the multimeter. Record your results.

<table>
<thead>
<tr>
<th>Results</th>
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<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Anode</td>
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<tr>
<td>Test #1</td>
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<td>Test #2</td>
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<tr>
<td>Test #3</td>
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**Analysis**

1. How many attempts did it take for you to generate voltage?

2. Which anode and cathode combination produced the highest voltage?

3. Were there any available materials that you decided to not select to use as an anode or a cathode? Why/why not?

4. In this activity, what was the electrolytic solution?
Conclusion
  1. Why does the lemon battery work? In your answer, explain what is happening to electrons?

  2. Do we need the lemon? Why or why not?

  3. Based on your experiment, would lemons be a good source of chemical energy for electronic devices? Why or why not?