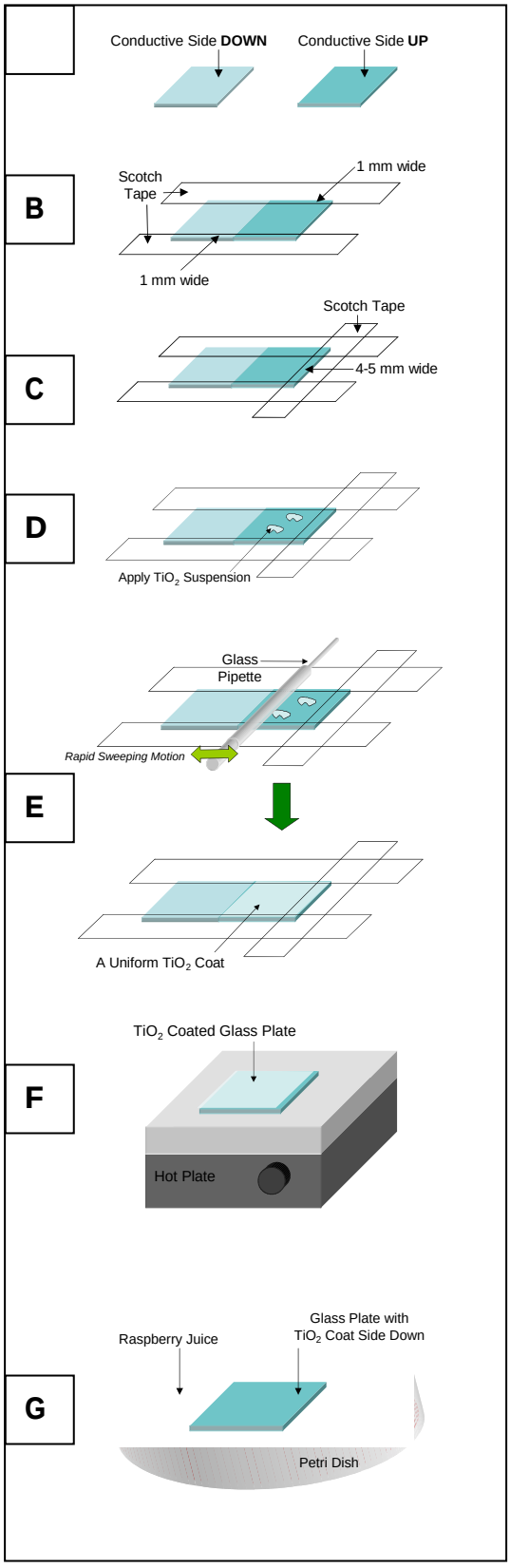
How to Make a Solar Cell



Day One – Preparation of TiO_2-Coated Glass

1. Obtain 2 glass plates and clean with ethanol. Do not touch the faces of the plates once they are cleaned!

2. Determine which side of each glass plate is conducting with a multimeter.

3. Put the glass plates side by side with one conducting side up and one conducting side down (**A**).

4. Cover **1mm** of each long edge of the plates with Scotch tape (**B**).

5. Cover **4-5 mm** of the short edge of the conductive side up with Scotch tape (**C**).

6. Add 2 drops of the white TiO_2 solution on the conductive side up glass (**D**).

7. Quickly spread the white TiO_2 solution evenly with a glass pipette, sweeping first away from the second slide, then sweeping the extra TiO_2 onto the second glass slide (**E**).

8. Remove the tape and place the TiO_2-coated glass on the hot plate, keeping track of where your plate is – you will need it again tomorrow (**F**).

9. Clean the TiO_2 from the other glass plate with ethanol and save it for the next lab period. Clean the pipette and return it to your teacher.

Day Two - Staining of the TiO_2-Coated Glass with Raspberry Juice and Preparing the Carbon-Coated Glass Plate

1. Get your TiO_2-coated glass plate from the hot plate where you left it last period.

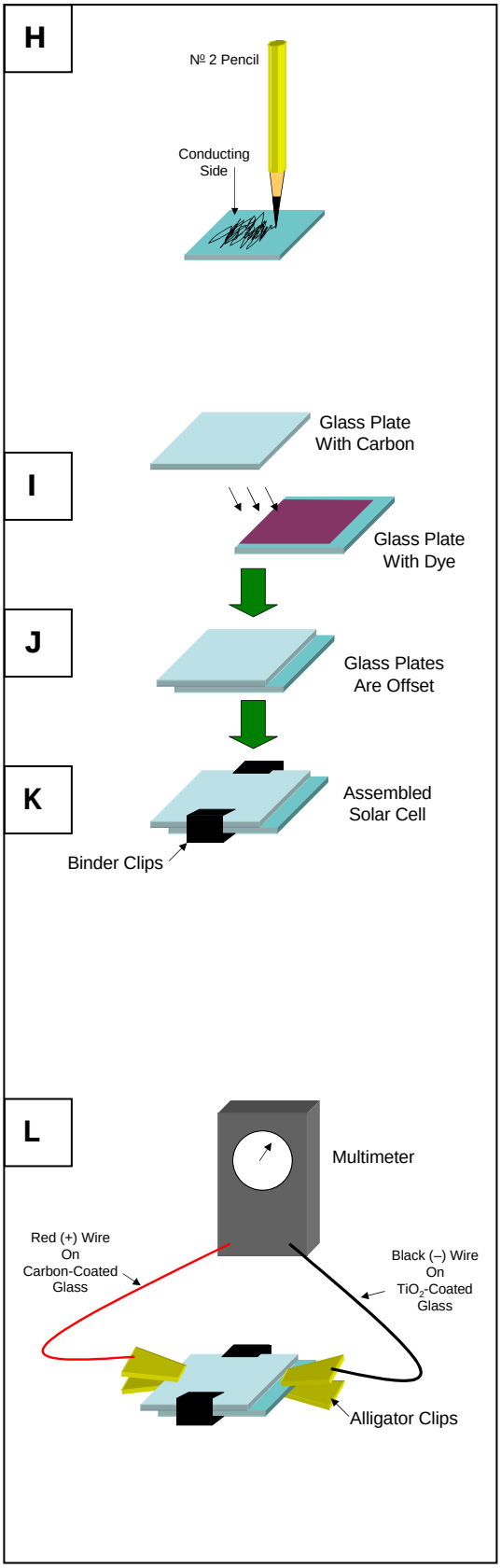
2. Place the TiO_2-coated glass face down in a Petri dish containing raspberry juice. Soak for about 10 minutes (**G**).

3. While it is soaking, wash the other glass plate with ethanol.

4. Use the multimeter to figure out which side is conducting.

5. Use a Nº 2 pencil to apply a thin carbon coating on the conductive side of the glass plate (**H, page 2**).

6. Don't miss any spots.



Assembly of the Solar Cell

1. Complete steps 2-5 in less than 2 minutes.
2. Remove the first glass plate from the raspberry juice (after the 10 minutes) and rinse it with deionized water, then with ethanol.
3. Gently blot dry with a tissue.
4. Place the carbon-coated glass plate face down on the TiO_2-coated glass plate (**I**).
5. The two glass plates must be slightly offset (5 mm) (**J**).
6. Hold the plates together with binder clips on each side of the longer edges (**K**).
7. Add 2 drops of the iodide solution on an offset side and allow it to soak through.
8. Alternately open and close each side of the solar cell by releasing and returning the binder clips.
9. Make sure that all of the stained area is contacted by the iodide solution.
10. Wipe off excess iodide solution on the exposed area (important) with tissue paper.

Measuring the Electrical Output

1. Fasten alligator clips to the two exposed sides of the solar cell to make an electrical contact (**L**).
2. Attach the black (–) wire of the multimeter to the TiO_2-coated glass plate (negative electrode) (**L**).
3. Attach the red (+) wire of the multimeter to the carbon-coated glass plate (positive electrode) (**L**).
4. Place the solar cell on top of an overhead projector.
5. Measure the current (set to mA) before and after the overhead projector has been turned on.
6. Measure the voltage (set to volts) before and after the overhead projector has been turned on.

Did you make a successful solar cell?

Experimental Data Sheet

My Name: _____ My Partner's Name(s): _____

My Data:

Overhead Projector Off:

My Solar Cell's Voltage: _____V My Solar Cell's Current: _____mA

Overhead Projector On:

My Solar Cell's Voltage: _____V My Solar Cell's Current: _____mA

Class Data:

Who Made the Solar Cell?	Overhead Projector Off		Overhead Projector On	
	Voltage (V)	Current (mA)	Voltage (V)	Current (mA)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
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26.				
27.				
28.				
29.				
30.				
Class Averages:				

Discussion Questions

1. Did your solar cell work? How can you tell? If it didn't work, why do you think this might have happened? If it did work, how might you be able to improve it?

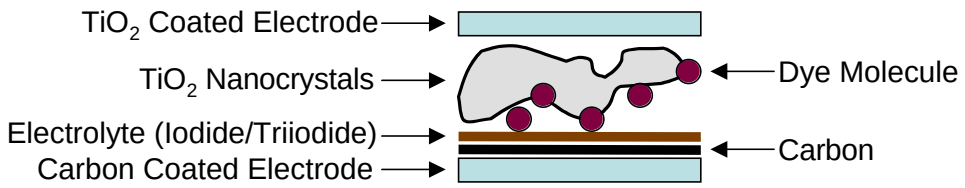
2. How did your solar cell compare to the class average solar cell in each of the four categories tested?

3. Looking at the data from the entire class, which solar cells didn't work? Eliminate these solar cells and recalculate the class averages in all four categories tested. How does your solar cell compare to the class average solar cell now?

4. Scientists make predictions, design experiments, and then collect and analyze data. As such, they may have to decide which data they choose to analyze and which data they choose to ignore. When is it ethical to ignore scientifically collected data as you may have done in question three?

5. Photosynthesis is a process in which plants generate chemical energy from light energy. How is this similar to what happens with your solar cell? How is it different?

6. What is the function of each part of the solar cell that you built?



7. What are other sources of energy? How do these sources of energy compare to solar energy?

8. ADVANCED: Write balanced chemical equations for each of the chemical processes that happen in the solar cell.