Name: _____ Date: _____

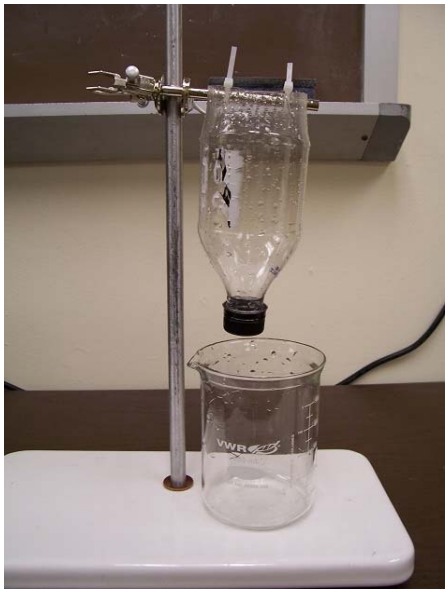
Simple Coulter Counter Lab Handout

Introduction
The first Coulter counter was patented in 1953 to count blood cells in blood samples. Today, the Coulter "electric sensing zone method" is used in many different fields whenever the number or size of small particles must be known. In this lab, you will build a simple Coulter counter and use it to test a sample of "paint" from Riverside Paint & Supply to see if the concentration of dye particles per ml meets the expected standard.

Part 1: Construct Coulter Counter

Materials:

- plastic beverage bottle with hole drilled in cap
- hole punch
- 2 plastic cable ties
- ring stand with clamp holder and rod
- scissors



Procedure:

1. **Cut** the bottom 5 cm from the bottom of the bottle.
2. **Punch** two holes 4-5 cm away from each other near the cut end of the bottle.
3. **Attach** the metal rod to the ring stand using the clamp holder.
4. **Hang** the bottle on the metal rod using the cable ties through the punched holes. Not too tight.

Part 2: Assemble Circuit

Materials:

- 1 kΩ resistor
- 9V battery
- electrical tape
- insulated wire
- snap connector
- wire strippers

Procedure:

1. **Attach** the snap connector to the 9V battery.
2. **Cut** two lengths of 30 cm insulated wire.
3. **Strip** the ends of the wire.
4. **Attach** the battery, 1 kΩ resistor, and wires, as shown to the right. ➔
5. **Secure** connections with electrical tape.

Part 3: Set Up Data-Taking Equipment

Materials:

- computer
- data-taking equipment
- voltage probes

Procedure:

1. **Connect** the measurement device to the computer.
2. **Open** the data-taking software application.
3. **Attach** the voltage probe leads to the circuit (as shown above).
4. **Change** the data-taking settings:
    - Sampling rate: (number provided by teacher)
    - Record length: 30s
5. **Record** a trial run.
6. **Adjust** the horizontal scale to show only data from 10s to 11s.
7. **Adjust** the vertical scale so that your data takes up at least one-third of the screen.
8. **Ask** the teacher to check your work. **Teacher's initials:**_____

Part 4: Make Salt Solution

Materials:

- 600-ml beaker
- liquid soap
- NaCl salt
- stirrer
- water

Procedure:

1. **Fill** a beaker with 500-ml of water.
2. **Add** 0.3 g NaCl.
3. **Add** 2-3 drops of liquid soap.
4. **Stir.**

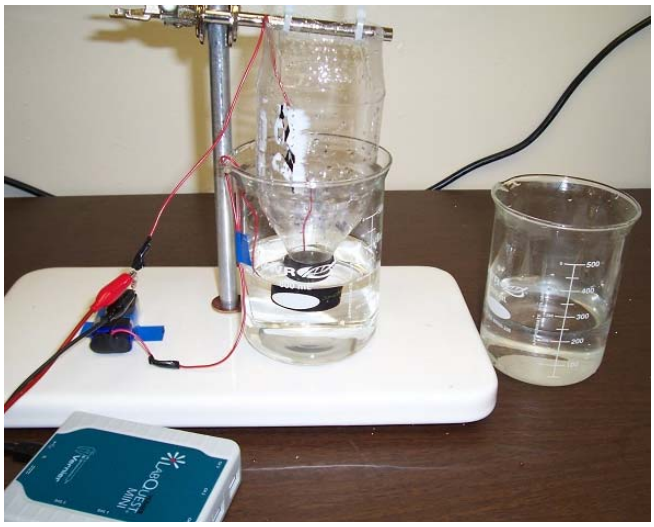
Part 5: Run Coulter Counter without Particles

Materials:

- Coulter counter set-up
- salt solution
- additional 600-ml beaker
- printer

Procedure:

1. **Place** a second beaker beneath the bottle.
2. **Lower** the bottle until its cap is a few cm above the bottom of the beaker, as shown to the right. ➔
3. **Fill** the beaker with the salt solution, until its cap is covered.
4. **Place** one wire from the circuit in the beaker so that its end is below the water level and **secure** with tape. **Place** the second wire in the open end of the bottle so that its end is covered in water.
5. **Pour** 100 ml of the remaining salt solution into the end of the bottle. The water will slowly flow through the aperture in the bottle cap.
6. **Record** the voltage over the resistor for 30s.
7. **Save** the file as "flowing_no_particles."
8. **Print** and label the graph.



Part 6: Test Paint Sample

Materials:

- vial with "paint sample"

Procedure:

1. **Repeat** steps 1-6 above.
2. *Immediately* after beginning the 30s recording, **pour** the vial of "paint" solution into the end of the plastic bottle. As each particle passes through the aperture, the current through the circuit will drop and a "dip" will appear in the voltage measurement.
3. **Watch** to make sure all particles pass through the aperture before the 30s is finished. If they do not, estimate how many particles were left in the bottle at the end of 30s.
   _____ particles left over
4. **Save** the file as "flowing_with_particles" or "paint_sample."
5. **Print** and label the graph.

Part 7: Count Particles

(No additional materials required)

Procedure:

1. **Look** at your graph. At what time do the first "dips" indicating particles moving through the aperture appear? _____ s
2. **Count** the number of particles that passed through the aperture. Tips:
   - If the dips are too clustered to count, change your graph to look at smaller time intervals.
   - If the dips are too small, adjust your vertical axis so your data takes up more of the screen.

   # of particles counted _____

3. Add the above number to your estimate of the number of particles left over in bottle (Part 6, step 3).

   Total # of particles in 5 ml sample _____

Analysis

1. What was the concentration per ml of dye particles in the 5 ml vial of paint?

2. To meet product standards, the paint must have at least 100 dye particles per ml. Does this sample of paint meet product standards?

3. How well did your Coulter counter work? Provide support from your data or observations.

4. How could your device be improved?

5. Attach to this report the graphs you printed during the experiment.