Expectations for Electricity

1. Students should understand the structure and **implications** of Coulomb's Law. *Equation, Relation to Gravity, Implications for distance and force:*

2. Students should be able to describe the behavior of point charges near each other and in a constant E-field. Students should be able to draw electric field lines representing the E-field around a point charge and between two parallel metal plates covered with charge. *Pictures:*

3. Students should understand charging by friction, electron affinity, and how to determine the charge on an object by comparing it to something with a known charge. *Examples:*

4. Students should understand the concept and units of the electric field and its relation to the force on charged particles. *Equation, Units:*

5. Students should understand that it takes work to move a charge in an electric field, and that the work is stored as potential energy. *Picture, Equation, Example:*

6. Students should understand and be able to interpret and work with Ohm's Law. *Equation:*

7. Students should understand the distinctions between series and parallel circuits. *Picture, list characteristics*:

8. Students should be able to calculate equivalent resistance of a circuit and rank the brightness of each bulb in the circuit. *Equation, examples*:

9. Students should understand that the power dissipated in a lightbulb (or any resistor) is proportional to both the current through the resistor and the voltage across it. Students should be able to calculate the power dissipated in a resistor. *Equation*:

10. Honors: Students should be able to solve problems involving arrangements more than 2 point charges. Students should also be able to analyze and solve for voltage, current, and resistance values in circuits with a complex arrangement of multiple resistors.

Electricity Review problems:

1. Charge A = +2 mC, Charge B = -5 mC. If the two charges are 10cm apart, what force do they exert on eachother? How would that force change if they were moved to 20cm apart? What is the ratio of the force at 10cm to the force at 30cm?
2. A particle with a charge of +1mC is placed between two parallel plates which are 1m apart. The left plate is negatively charged, the right plate is positively charged. The E-field has a CONSTANT strength of 2 N/C.
    a. draw a picture showing the E-field.
    b. describe the motion of the particle if you let it go (direction, rate).
    c. Determine the magnitude and direction of the force on the particle and draw it on your picture above.
    d. Determine the amount of work it would take to move it 30cm to the right (hint: what is the definition of work?).
    e. Determine the amount of potential energy stored in the E-field if you move the particle 10cm to the right. Explain where that energy comes from.
3. How much power is dissipated by a 100 ohm resistor attached to a 9V battery?
4. A pickle is hooked up to a 110V power source and 5 amps of current flow. What is the resistance of the pickle? How much power is dissipated by the pickle? If you put a second pickle in series, what would happen to the current? The voltage across each pickle? The voltage from the power source? The resistance?
5. There are three 6-ohm resistors in a circuit. Resistors A and B are in parallel, and Resistor C is in series with those first two. Draw a circuit diagram. Rank the brightness of each bulb. Determine the equivalent resistance. Determine the current flowing through each resistor and the current produced by the battery.
6. Honors: An electron is placed at one corner of a square with side length 1micrometer. The corner directly opposite the electron holds a hydrogen nucleus, the other two corners also hold electrons. What is the net force on the first electron mentioned?
7. Honors: in the following circuit, find the current through each resistor, the voltage across each resistor, and the equivalent resistance of the circuit. Each battery has a voltage of 9V, R1 = 2Ω, R2 = 6Ω, R3 = 20Ω.