Electric Power and Energy

Materials
- Kill-a-Watt device, light socket with standard and CFL bulbs
- Student Groups: Kill-a-Watt device, stopwatches, styrofoam cups, appliances
- possible appliances include (microwave, heaters, hair dryer, Electric kettles - prefer 8 - 12 total)

Part Definitions
1. Voltage is like ________________ unit _____
2. There are 2 types of power supply AC or DC
   DC is ________________ which means it is ________________
   AC is ________________ which means
   USA this happens ________________ / sec - frequency = ________________ (Europe is 50 Hz 240V)
   Batteries (AA) ________________, wall power ________________ (Big square plugs change 120V AC to DC 6V, 9V)
3. Current measures the number of electrons flowing per second. Symbol is ________________
   The standard units are ________________, or millamps ** ________________ mA = 1 A
4. Electrical power is the product of ________________ x ________________ UNIT ________________ same as ________________ / sec
   Because this is a very small unit we usually use kilowatts 1 kilowatt = ________________
5. Power = ________________ therefore Energy = ________________
6. We actually pay for Energy. The unit could be Joules but kilowatt hours is much bigger and more practical
   To find kilowatt hours (kWhr) = Power in watts x time in hours
   ____________________________

Electric Power Problems

1. a) What power is produced when 120 V causes a 2 A current in a piece of equipment?
   b) What is the power if the voltage is 350 V and the current is 0.2 A?

Equation (2) Use Power equation to solve for Current
   I = ________________
2. How much Current do lamps connected to 120 V draw?
   a) 60 W
   b) 100 W
   c) 15 W

Equation (3) Use Power equation to solve for Voltage
   V = ________________
3. Find the voltages for these circuits
   a) 360 W, 3 A
   b) 2400 W, 20 A
   c) 120 W, 10 A

Part 2. Kill a Watt Unit - gives all details related to power usage of any electric device plugged into standard domestic power

Each group will do 3 different appliances - see teacher chart - then write your groups appliances in the data table - page 2.
The light bulbs will be run as demos by the teacher
1. For the microwave put two cups of water in a LARGE styrofoam cup before starting it - set it for exactly two minutes
2. Toaster Oven - Dial to position 2 marks from darkest - let run - time and watch the AMPs!
3. For the floor heater or the hair dryer - use the highest setting. - RUN FOR 3 MINS
4. For the electric kettle put in at least 4 cups of water - RUN FOR 3 MINS
5. BE CAREFUL - Expect previously used equipment to be HOT - add fresh COLD water each time.
6. Computer - get up and running with a phet simulation - record Watts when running!
7. Hot plate + pot of water. Put on setting 6 time for 3 mins - watch AMPs

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Name ____________________________
Date ______ per ______ Grp ______

6/2/16
- NOTE there are 2 different versions of the Killawatt unit - identify yours and find the correct instructions.

Group ______ type of Killawatt (circle) Killawatt P3 or Killawatt EZ P3

**Killawatt P3**

1. Plug Killawatt into the socket, and appliance into the killawatt and START stopwatch.
   At first it will show Voltage - record, then push the buttons in turn to get the Amps, Watts. Return to Amps and observe
2. When the time is finished unplug JUST the appliance and push buttons to find kWhr. Then unplug Killawatt

**EZ Killawatt P3**

This unit can hold the information after it is unplugged but we don't really need that feature.

1. Plug in Killawatt EZ and press RESET button - hold until rSET appears, then release Push MENU button until kWhr appears. It should be zero. If not repeat RESET.
2. Plug in appliance and start stopwatch. Push the MENU button to read Volts - record. Push DOWN for Amps, DOWN again for Watts. Return to Amps and observe

3. When the time is complete unplug appliance and push MENU button to get kWhr and time

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Rating watts</th>
<th>Time On (mins)</th>
<th>Kill a Watt readings</th>
<th>Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>V</td>
<td>Amps</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
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<tr>
<td>3.</td>
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<tr>
<td>Std bulb</td>
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<td>10</td>
<td></td>
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<tr>
<td>CFL bulb</td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Questions**

1. Which of your appliances used the most current? the most power?
2. Calculate the kWhr for each using Watts and time kWhr = Watts * time in hours/1000
   Put answers in last column - SHOW WORK for in the space below

3. Compare your Calculated kWhr reading on the Kill a Watt. Why might they sometimes be different?

4. How much energy would a 1500 W floor heater use in a 30 day month if used 8 hours a day?

5. Calculate the monthly (30 day) energy for 24 hours a day in kWhr
   a) new 50 watt fridge
   b) old 700 watt fridge (before 1993)
   c) the difference between a) b)
   d) new fridge savings/year at $0.2 per kWhr
   e) is the cost of a new fridge justified?

**Bonus Q1** Calculate how long the CFL would need to be on in order to reach .01 kWhr

**Bonus Q2** - explain about the fridge to your parents and get their signature and a brief comment!

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