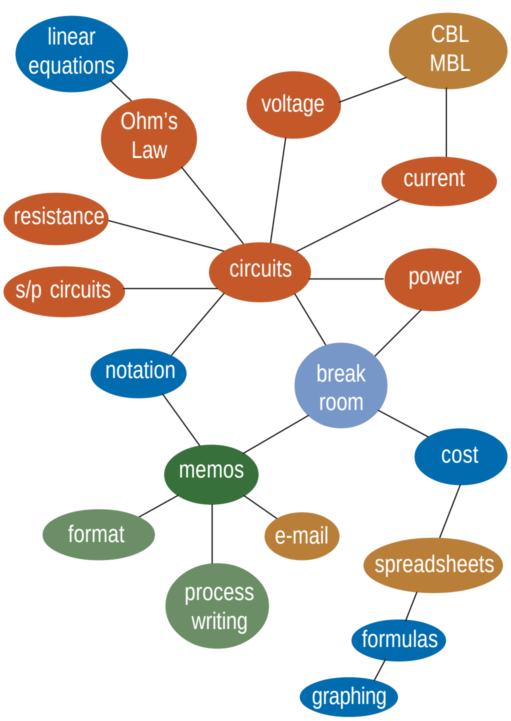
Student Handout: Technology Gateway Project #3

Basic Electricity

Objectives

- ❑ Investigate the power needed to support a number of electrical appliances, and determine a plan to equip an employee break room using available electrical power and budget.
- ❑ Measure voltage and current in an electrical circuit, and determine power in an electrical circuit.
- ❑ Investigate Ohm's Law series and parallel circuits.
- ❑ Write an interoffice memorandum.
- ❑ Write a process-based report.

Concept Map



Problem Scenario for the Student

You are a physical plant employee in a small manufacturing plant. A group of employees has requested a break room. In the plant is a storage room that can be converted to a break room. Your supervisor has asked your team to develop a plan for the room and has supplied a list of the appliances requested by the employees for the room.

The power for the storage room is a single 120-volt line from a 20-amp circuit breaker on the main plant floor. Eight fluorescent lights (60 watts each) are in the room. Employees requested the following appliances (in priority order):

- ◆ Coffee maker
- ◆ Microwave oven
- ◆ Toaster
- ◆ Television/VCR
- ◆ Refrigerator
- ◆ Stereo

Your team will investigate the power requirements of these appliances and develop a plan that will make the most effective use of the room's electrical circuit yet still meet local electrical codes. The plan will indicate capital expenditures not to exceed $1,000 and will predict monthly operational costs. You will submit to your supervisor a comprehensive report describing the process necessary to complete the renovation, including time and cost projections as well as any foreseeable problems.

Performance Expectations

- ❑ Instructors will evaluate student teams and individual students on the project; the evaluation will include problem-solving and teaming skills used by students and student teams.
- ❑ Students will have opportunities for self-evaluation, peer evaluation, and team evaluation.
- ❑ Individual instructors will test and grade students individually on content workshops and activities.
- ❑ The team presentation will be evaluated and graded by the faculty team.

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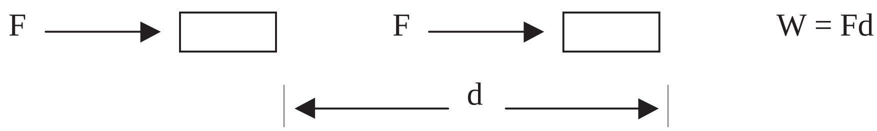
Background Information

In a mechanical system, you have seen that the work done is the product of the force (F) applied in the direction of the motion and the distance (d) moved. Therefore, work (W) can be thought of as the product of a quantity that causes motion and the measure of the resulting motion.



This concept can be applied in an electrical system as well. The quantity that causes motion is the voltage difference and the measure of the motion is the charge. Therefore, work in an electrical system can be calculated by:

Work = (voltage difference) x charge

W = Vq, where V = voltage difference and
q = charge

Electric motors transform electrical energy into mechanical energy to perform tasks. Motors may turn fans to move air, operate pumps to move fluids, and turn metalworking machines such as lathes, mills, and drills. Therefore, the purpose of most electrical devices is to convert electrical work into other forms of work or energy, such as energy of motion, heat, light, or sound.

The motion of charge through conductors will transform some of the electrical energy into heat. In devices such as toasters, ovens, and hair dryers, the heat is wanted and is useful. In other devices such as an incandescent light bulb, computers, and televisions, the heat is an unwanted byproduct caused by the operation of the device.

In electrical systems, the amount of electrical energy used is important. In fact, the bills that we receive from the electric company are based on the energy that we use. In many electrical systems, however, not only is the energy used important, but so is the rate at which the energy is delivered. All electrical devices are rated on the rate of use of electrical energy. This rate is called power (P) and is measured in watts.

Power = work/time

Power = (voltage x charge)/time

Power = voltage x charge/time

Power = voltage x current