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# An Electrical Consumer's Survival Plan

Curriculum Unit 81.05.01
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This unit is designed for use with a sixth grade Science class over a period of three to four weeks. The primary objectives will be (1) understanding of a kilowatt-hour (2) learning how electric consumption is measured (electric meter) (3) learning how to read and record meter readings (4) to monitor daily electric consumption in the home (5) identify electric energy users and (6) understanding and calculating an electric bill.

It is suggested that this unit be part of a sequential development of Science concepts beginning with the theory of the atom in relation to the three states of matter. If we follow the basic curriculum for the city, we find that by beginning with the "basic building blocks" of nature, the atom, we can develop a curriculum which allows us to build and expand in many directions. The atomic theory is an excellent reference point, since everything around you is made up of extremely tiny atoms—the chair on which you sit, the pages of a book, etc. An atom is the smallest particle of matter that has distinct chemical and electrical characteristics. The atom is basically composed of three parts, the proton, neutron and electron. Electricity is a *form* of energy. We know what it is by what it does. It is important that the student understand that the atom is composed of electrically charged parts. The separation, frictional or chemical, of these parts creates an attraction or flow as a result of the particles re-uniting. This electron-proton flow thus creates a flow. Electrons are the smallest particles of electricity.

Electricity is not as awesome and difficult as we are led to believe. The atom is made up of a positive(proton) negative(electron) charge and a neutral neutron. Think word charge. What general impression does it bring to mind? The charge of an army? Moving with a force towards some goal. What makes electrons flow? How is this force created? This leads us to the two types of electricity: static and current. Static electricity to the sixth grader is a tangible, realistic concept that they can relate to with their experiences. For instance, lightning, shocks from wool carpets, balloons that stick to walls and static cling.

Everything is basically electrical and all matter consists of atoms which are composed of an electron, proton and neutron. It is important that the student realize that these particles are always equal, opposite and neutral. (The Law of Charges comes into effect.) This can be demonstrated by the fact that we don't receive a shock from your desk, because the atoms are electrically neutral. Therefore the atomic structure is without charge or movement. They should be familiar with conductive materials which lose electrons easily. For instance, wool, silk, carbon, zinc and copper—materials which are used to make an electric cell. The problem now for the student is to understand how electrons and protons separate creating an electromotive force. Students should be familiar with current electricity, batteries, motors, generators, electromagnets, turbines etc. By this point, the student should have established the fact that electricity is the movement of electrons, resulting from either frictional or chemical imbalances.

Now we need a path for a charge (electron flow). An army wouldn't just run all over the place. Their energies need direction, a path, so does the electron flow which we will call the current. Since current, in general terms, means a flow whether we are talking about wind, water or electricity, the path is called a circuit. With electricity, the end result may be music, pictures or some kind of work being done for us.

Current electricity works for people. In order to conduct electricity, atoms must have electrons that are free to move from atom to atom. Metals make good conductors because only the electrons move in metal conductors.

Now we have established that the charge is the moving factor in electricity. The path wire (circuit) is needed for direction. As something is needed to force these parts to move, we will call this the electromotive force. We are reminded that a force is a push or pull. The children know this fact if nothing else. Ask them, how many have been forced to do something that needed a little push or pull from someone? Now I have my force, my path (wire) and my destination—maybe a light, or TV.

Electric current in a circuit works much like a long hose with water. By connecting the hose to a faucet, spurts of water come out the far end almost immediately. You will have sent a signal from one end to the other. Now the flow (current) depends on three factors:

1. The pressure that causes the current flow or which we can measure in *volts* .
2. The rate or amount of flow which we can measure in *amperes* .
3. The resistance of the conductor (wire) measured in *ohms* .

The flow produces a power measured in *watts* . That is, they can do work.

In general, electrons travel through any conductor from a negative source to a positive source.

To summarize for the student in recognizable terms, we might say to the students: Listen. When your parents ask you to do some work it's going to take some amount of energy. The energy you put into your work depends on how much *pressure* (electromotive force, or volt) is placed on you by your parents. The more force (volts) you use the more power you can exert. A powerful army is judged by the number of soldiers or volts that are in one place. If I direct this mighty force along a definite path (conductor) that has a beginning and end (circuit), the more powerful my power will be, What does it mean to be powerful? Everyone wants power. Obviously, the energy (volts) I put into a task, the more powerful I feel, the more work I do. If my charges or forces are scattered the less effective my output will be.

By no means has this been a complete background of electrical theory. This is not the intention of this unit. But I feel there must be a basic understanding of electrical concepts and theory to fully understand the intent of the major objectives of my unit.

At this point, we are primarily interested with measuring the input of electricity into our homes, which is recorded by the electric meter. In order to understand how this apparatus works, it is necessary to review the following units used to measure electricity. Each unit has a specific significance and the first three bear a relationship to each other:

*Volt* is the unit that measures the potential difference in electrical force or “pressure” between two points on a circuit. The current, at most receptacles and lights, is at a moves from the hot supply wire through the load presented by an appliance or light, it loses voltage in doing work. When the current leaves the load and enters the return circuit provided by and is pressure, the dame as the earth.

*Ampere* is the unit used to measure the amount of current, that is, the number of electrically charged particles, called electrons, that flows past a given point on a circuit each second. If you could see the particles moving along a wire and could count to 6.28 billion in one second, then you would have counted enough particles to make 1 ampere. has an it completes the circuit and returns to the power plant.

*Watt* is the unit of power. It indicates the rate at which a device converts electric current to another form of energy, either heat or motion, or to put it another way, the rate at which the device consumes energy.

*Kilowatt-Hour* is the unit of energy, measuring the total amount of electricity that is consumed. The relationship of volts, amperes and watts to one another is expressed in a simple equation that enables you to make any calculations you may need: Volts x amperes = watts. If the current is at 120V and a device requires 4 amps of current the equation will read: 120V x 4 amps = 480 watts.

To figure the current needed for a device rated in watts, turn the equation around: Watts x volts = amps. For example, if you have an appliance such as a toaster that uses 1200 watts: 1200 watts Ö 120 = 10 amps.

In order to help the students understand how the electricity reaches their homes, a diagram will be included demonstrating the path from the power plant to the home. (See diagram #1) At the service head, house wires connect to the utility wires and lead down the side of the house to a meter and then into the house to a service panel, from which power is distributed through the house by wiring systems called branch circuits. See diagram #2 for basic reference to demonstrate how the wiring is distributed throughout the home. Now the student has a basic conception of where the electricity comes from and how it is channeled around the house. At this point, I will begin discussion of the six major objectives of unit.

## I. UNDERSTANDING A KILOWATT-HOUR.

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The kilowatt-hour previously mentioned is the unit of energy measuring the total amount of electricity that is consumed by a household. Discuss with the students that when we go shopping most items are purchased by the amount we plan on consuming. We wouldn’t buy 100 lbs. of meat for one week. We buy according to what we use. We estimate what we will need and buy accordingly. The problem with electricity is that we consume without considering the cost. Since we cannot see how much we use, we aren’t too concerned about waste. One of the secondary goals of this unit is to create an awareness among our children. The unit will be a cooperative adventure between the students and parents that will help families, especially children, become more responsible for their use or abuse of electrical energy. Hopefully by actually monitoring how much (kilowatts) are being used, a conservative attitude will follow.

As a warm up exercise, have student brainstorm the various units of measurement we use everyday—pounds, inches, ounces, quarts, gallons etc. Have them bring in these items and fill, measure, pile and weigh different substances. Ask them to bring a kilowatt hour in. Is it possible? (Discuss) Then how do we measure how much electricity we use at home?

Have available a number of light bulbs with different wattage. Maybe a toaster, iron, radio also. Ask: How can I calculate how much it cost to run this appliance ? Start with the light bulb. Depending on the level of the group you may use the other appliances or just the light bulb will be sufficient. Distribute “What is a kilowatt-hour?” worksheet.

This exercise can be extended to a variety of other exercises. List the amount of wattage that appliance will use if operated one hour. Check wattage. This lesson could be correlated with your math lessons.

Again the watt is a unit used to measure (rate of producing or using energy). An electric device uses 1 watt when 1 volt of electric potential drives 1 amp of electric current through it. A light bulb operating at 100 volts and using 2 amps consumes 200 watts (100 x 2 amps).

## II. LEARNING HOW ELECTRIC CONSUMPTION IS MEASURED LEARNING HOW TO READ A METER.

At this point in the unit, there exists many possibilities for pupil-parent participation. With the permission of their parents, the students are instructed to call the U.I. for the I.D. number of their electric account. At this time children are encouraged to get into the habit of reading their electric meters and checking utility bills for accuracy. As a writing exercise the children will compose a letter to their parents informing them of what they are doing and are to be used as verification that parents approve and are willing to offer assistance. Also children will write for information specifically for pamphlets “You and Your Electric Company”, “How to Understand Your Electric Bill”. (See Bibliography)

Using “How to Read Your Meter” as a guide, show students how to read a meter and how to determine daily, weekly or monthly consumption. Distribute meter reading exercises.

## III, IV, V. MONITORING ELECTRIC CONSUMPTION IN THE HOME. IDENTIFYING ELECTRIC ENERGY USERS.

For this section, distribute kwhr questionnaire to the students. Students will be asked to draw their own electric meters. At this point, they should have called U.I. to find out what their account numbers and meter numbers are. They will take and record daily meter readings at home. If this is not possible, a simulated meter will be provided in class with readings or if possible I will attempt to secure an actual meter from the U.I. with a representative to actually demonstrate and answer any questions. From this point, the students should calculate daily and monthly consumption. Have students go through their homes, room by room, and list all electrical devices to be used with the last objective, identifying electric energy users. List and categorize into high-medium-low energy consumers.

The majority of American homes now have at least 16 different electrical appliances. To find out how much it costs to operate an appliance, multiply the cost for a kilowatt-hour by the number of kwhr the appliance uses.

An additional exercise may involve the student recording (estimate if necessary) the actual time that a particular appliance is used in a day, week or month. For instance, an electric stove—how many hours a week is it used? While your usage of any appliance may not be the same

as the average consumption listed, this calculation will Provide approximate operating costs. Using the pamphlet “You and Your Electric Company” follow the chart on Annual Energy Requirement. Kilowatt-hour rates vary widely. Utilities list the rate for a kilowatt-hour on statements to customers.

## VI . UNDERSTANDING AN ELECTRIC BILL AND CALCULATING AN ELECTRIC BILL.

The pamphlet “How to Understand Your Utility Bill” is an excellent reading guide which should be assigned as homework for parents and students. Each student should have received a copy by now. Basically the pamphlet explains such terms as the btu, cubic feet, watt, kilowatt, fuel adjustment cost, PGA, and rate schedule. Topics include: How to Read Your Electric and Gas Meters; How to Apply Your Meter-Reading Skills; How to Understand Your Electric and Gas Bills; Energy Costs of Major Home Appliances. The pamphlet is self-explanatory and vital, therefore I will not elaborate on its content except to mention some possible adaptations. For instance, the sample bill can be dittoed, and used as a study guide which will aid the explanation of the “Calculating” section.

As part of the total energy curriculum, in relationship to this entire Science curriculum and in coordination with other programs such as the “Captain Power and Power Quiz” program, we can develop programs that can be useful and relevant.

This unit can and should be correlated with previous mentioned programs designed for the U.I. to introduce upper elementary pupils to basic concepts and understandings related to the current energy situation and to help them develop energy conservational skills to use and apply on a daily basis.

Hopefully, one of the underlining outcomes of this unit will provoke people through their children into realizing that a little awareness goes a long way. Dr. Glenn Seaborg, Nobel Prize winner and former Chairman of the now disbanded Atomic Energy Commission, has this vision of the future: “The wise use of energy can restore nature and rejuvenate man. It can help us to turn green again much of the desert wasteland that was once natural gardens. It can help us clean up our man—made environment and rebuild the lives of men and the lands and cities they inhabit. It can help us build the foundation for lasting peace on this planet—to open new frontiers to man, physical frontiers of the mind and spirit. In short, the future of energy is the future of man. Without it we become nothing. With it, we wish to be.”

## WHAT IS A KILOWATT-HOUR?

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Take a look at an ordinary light bulb and you will notice that its wattage is indicated. For example, the bulb might read 100 watts, 60 watts, 40 watts, and so on. The wattage marked on a bulb *indicates the amount of electricity that bulb will use in one hour* .

For example, a 100-watt bulb will use 100 watt-hours of electricity in 1 hour. Similarly, a 60-watt bulb will use 60 watt-hours of electricity in 1 hour. How many watt-hours of electricity will a 40-watt bulb use in one hour? _________ watt-hours

Will a 15-watt bulb use 30 watt-hours of electricity in 1 hour?__________

Since a 40-watt bulb will use ___ watt-hours of electricity in 1 hour, then the same bulb will use ___ watt-hours of electricity in 2 hours. How many watt-hours of electricity will a 40-watt bulb use in four hours? ___ To answer this question you must multiply the number ___by the number ___. You find that a 40-watt bulb will use 16 0 watt-hours of electricity in four hours.

Answer the following:

1. A 100-watt bulb will use 100 ______ of electricity in one hour.
2. Two 100-watt bulbs will use ________ of electricity in one hour.
3. How many watt-hours of electricity will three 60-watt bulbs use in 1 hour? In 3 hours?

1 hour_________ 3 hours________

The average family will use many 100-watt bulbs, many other bulbs of varying wattages, and a number of electrical appliances as well. It is for this reason that the typical home will probably use during one month several thousand watt-hours of electricity.

Because the average home will use several thousand watt-hours of electricity in one month, it is more convenient to measure the amount of electricity in a unit larger than the watt-hour. One kilowatt-hour is equal to 1000 watt-hours.

1 kwhr = 1000 watt-hours

REMEMBER that the kilowatt-hour is larger than the watt-hour.

Two kilowatt-hours equal ___ watt-hours.

500 watt-hours equal ___ of a kilowatt-hour.

How many watt-hours equal 5 kilowatt-hours? ___

*If five 200-watt bulbs were used for one hour, they would use a total of 5 times 200 watt-hours or 1000 watt-*

*hours or 1 kilowatt-hour* .

Answer the following:

1. If each fluorescent tube in the lighting fixtures in your classroom is labeled 40 watts, how many watt-hours of electricity is being used in 1 hour? How many kilowatt hours in 1 hour?
2. How many kilowatt-hours are lights in this classroom are turned on for 8 hours?
3. In what other ways besides the overhead lighting is electricity used in the classroom?

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