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NADA SCIENTIFIC
1-800-799-NADA

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2. Electricity and Heat

3. Generator or Motor?

Junior GENECON Kit

8

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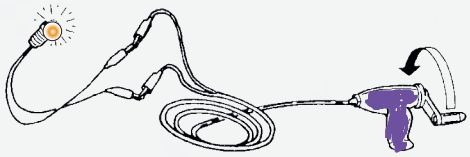
Version2.0.JL032114

GETTING TO KNOW YOUR GENECON

PROCEDURE:
1. The output cord should be plugged into the back of the Genecon.
2. Connect the leads of the Genecon to one of the miniature bulb sockets with leads
3. Slowly turn the rotary handle of the Genecon with increasing vigor until the bulb lights.
4. Notice that the bulb becomes brighter as the handle is turned more rapidly. In general, the brighter the bulb, the more voltage the Genecon is producing.
5. Try to turn the handle of the Genecon in the opposite direction. Once again, the bulb will dlight as before.

KEY CONCEPTS:
1. A generator converts mechanical energy (the energy of moving parts) into electrical energy (the flow of electrons through a conductor).
2. The brightness of the bulb is directly related to the voltage of the current passing through it.



USING
* 1 GENECON 12
* 1 Bulb in socket

TEACHING TIPS:
1. Discuss proper operation of the Genecon with the students.
2. Discuss how lighting the bulb demonstrates a whole series of energy conversions: Chemical energy in the cells of your body was converted into the mechanical energy of your muscles, which the Genecon changed into electrical energy. The electricity passing through the filament of the bulb got it so hot (thermal energy) that it radiated energy.
3. Discuss how much effort it takes to light just one bulb. How much do they think it would take to power the whole classroom or lab?

ELECTRICITY AND HEAT

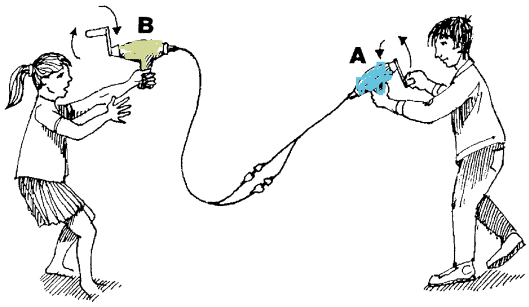
USING
*1 GENECON 12
* 1 Bulb in socket
* 1 Nichrome wire

PROCEDURE:
1. Have a student wrap the wire loosely around their index finger.
2. Attach it to the Genecon using the alligator clips.
3. Have a second student turn the crank.
4. Does the first student feel heat?
5. Connect the Genecon to the bulb in socket.
6. Have the students hold a finger over the light bulb when it is lit. (Do not directly touch the bulb).
7. Can they feel the temperature? Is it warmer or cooler than the wire?

KEY CONCEPTS:
1. Electricity generates heat. Energy is converted from mechanical energy to thermal energy.
2. There are different ways to measure electricity – by the amount of heat or amount of light.

TEACHING TIPS:
1. Discuss how the energy is converted, building on the discussion from the previous activity.
2. Discuss temperature and how it relates to light.

GENERATOR OR MOTOR?



PROCEDURE:
1. Label one Genecon A and the other B.
2. Attach leads A directly to leads B.
3. Have one student turn the handle of the Genecon A while another student holds B by the grip only.
4. The handle of B will begin to rotate.
5. Note the direction in which the handle of B is turning: Is it clockwise or counterclockwise?
6. What happens to B when the student operating Genecon A reverses its direction of rotation?
7. What happens when Genecon B is operated while A is held passively by the grip? Which one is the "motor" Genecon now?

USING
* 2 GENECON 12

KEY CONCEPTS:
1. A generator changes mechanical energy into electrical energy; a motor changes electrical energy in to mechanical energy.
2. The Genecon can function as either a generator or a motor depending upon the form of energy supplied.
3. The polarity of the electricity supplied determines the direction of rotation of the "motor" Genecon

TEACHING TIPS:
1. Observation the interior mechanisms of a Genecon to see a small DC motor!
2. Review the discussion of polarity in Activity 8. Note that when the color-coded leads of the two Genecon's are connected, both handles will rotate in the same direction. Why do the students think this occurs?

ENERGY LOSS

USING
* 2 GENECON 12

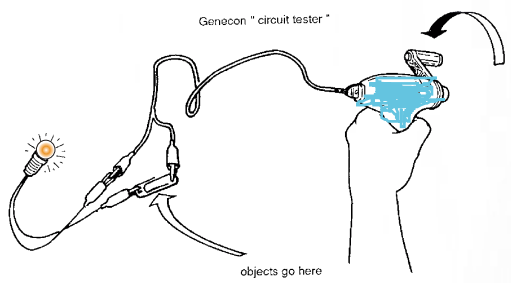
PROCEDURE:
1. Connect the leads of the two Genecons together as shown in Activity 3.
2. Have one student turn the handle of one Genecon exactly 10 times, while the class counts the number of rotations of the "motor" Genecon.
3. Repeat, using a different number of rotations. Why does the "output" Genecon always rotate less that the "input" one? Where does the energy go?

KEY CONCEPTS:
1. According to the Second Law of Thermodynamics, in all energy conversions some energy is "lost" (not recoverable) into the environment.
2. The ratio of input energy to output energy is a measure of the efficiency of the energy conversion system.
3. In mechanical systems (like the Genecon) much of the "lost" energy is in the form of heat due to friction.

TEACHING TIPS:
1. Have the students calculate the apparent efficiency of the "motor" Genecon using data they collected. Express the result as a percentage.
2. Call attention to the fact that both generators and motors produce a lot of noise (a form of sound energy)
3. Make sure students realize that "lost" energy refers to energy which dissipates uselessly into our surroundings, not that we don't know what happened to it or that it "disappeared"

CONDUCTOR OR INSULATOR ?

PROCEDURE:
1. Prepare a "circuit tester" by connecting one lead of a bulb to one lead of the Genecon.
2. With one student operating the Genecon, have another touch the two loose leads together closing the circuit and lighting the bulb.
3. Separate the leads, thereby breaking the circuit. Place an object in between the leads as shon below. If a conductive material is placed between these leads, the bulb will light.
4. Have the students test the conductivity of a variety of objects with the Genecon circuit tester.



KEY CONCEPTS:
1. Materials that allow an electric current to pass through them easily are called conductors.
2. Metals typically are excellent conductors.
3. Materials that do not conduct electricity very well are called insulators.

TEACHING TIPS:
1. Compare the results of this activity to materials that are purposely used as conductors and insulators in our environment.
2. Include among the items to be tested some "tricky" materials, like pipe cleaners and metal coated wrapping paper.
3. What are some of the uses of conductors and insulators? What is the difference between the two?

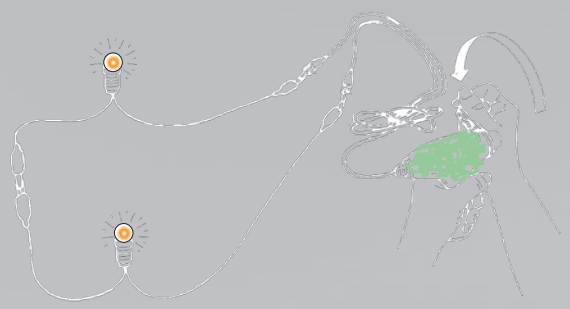
USING
* 1 GENECON 12
* 1 Bulb in socket
* Variety of objects

BULBS IN SERIES

USING
* 1 GENECON 12
* 4 Bulbs in socket

PROCEDURE:
1. Connect one of the bulbs to the Genecon and light it up.
2. Add another bulb to the circuit by inserting it between the first bulb and the Genecon.
3. Light up both bulbs by rotating the handle at the same rate as before. Note any change in brightness.
4. Add a third and then a fourth bulb in a similar manner, noting any changes in brightness.
5. A student should unscrew any bulb in the circuit. What happens to the other bulbs?

KEY CONCEPTS:
1. The bulbs in this circuit are wired in series, providing only one path for the current.
2. When a bulb burns out or is removed from the circuit, the flow of electricity stops.
3. As bulbs are added to a series circuit, there is an increase in resistance and a corresponding decrease in current.
4. Bulbs and other electrical devices are considered as loads on the circuit in that they convert electricity into some other form of energy while altering the characteristics of the circuit itself.



TEACHING TIPS:
1. The observable result of adding bulbs in a series circuit is a decrease in the brightness of the bulbs. Discuss what would happen if there were 100 bulbs in the circuit.
2. Reference to Ohm's Law (I= V/R) is appropriate here.

JUNIOR GENECON KIT
8 Hands-on Experiments

NADA SCIENTIFIC
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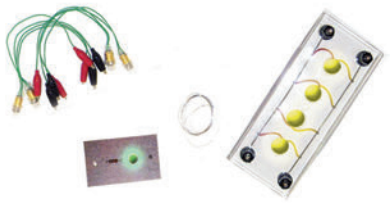
CONTENTS:
* 2 GENECONS with output cords
* 4 Bulbs in Sockets
* 1 Parallel Bulb Base
* 1 Polarity Tester
* 1 Nichrome Wire 18 " long
* 1 Experiment Manual

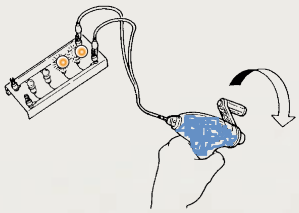


Please Route to Science Teachers

BULBS IN PARALLEL

USING
* 1 GENECON 12
* 4 Bulbs in a parallel

PROCEDURE:
1. Connect the clips of the lead cord of the Genecon to either pair of terminals on the Parallel Bulb Base.
2. Put a bulb in the socket nearest the terminals being used.
3. Light the bulb by rotating the handle of the Genecon.
4. Place bulbs loosely in each of the three remaining sockets.
5. As one student continues to rotate the Genecon handle at constant speed, another student should screw in these bulbs one at a time.
6. What changes or effects does the person operating the Genecon feel?
7. Take each of the bulbs out of the circuit one-by-one in reverse order. What does the operator feel then?



KEY CONCEPTS:
1. The bulbs in the base are wired in parallel, providing more than one path for the electricity
2. When one of the bulbs in parallel circuit burns out or is removed from the circuit, the other bulbs remain lit. The current does not have to pass through one bulb to get to the next one.
3.As bulbs (or other loads) are added to a parallel circuit, there is a decrease in resistance and a corresponding increase in current.
4. As the load (more bulbs) increases, the mechanical energy to operate the Genecon must also be increased.

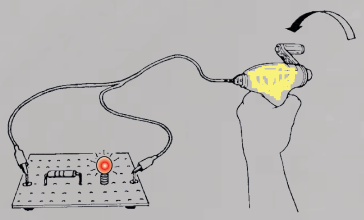
TEACHING TIPS:
1. Additional bulbs, and even another Genecon, can be added as loads in parallel using the terminals at the opposite end of the Bulb base. However, the circuit can become overloaded, causing a slippage in the handle of the Genecon. That means the demands of the circuit exceeded the capacities of the Genecon power supply. If this happens, stop turning the handle and remove some of the load until the Genecon functions normally.
2. Relate the results of this activity and the preceding one to Ohm's Law (I = V/R).
3. Compare the results of these two activities to familiar experiences. How does this effect strings of light, such as holiday lights and decorations? How is the number of household appliances related to increases in fossil fuel consumption and utility bills?

TESTING FOR POLARITY

PROCEDURE:
1. Connect the leads of the Genecon to the two terminals of the Polarity Tester.
2. Turn the handle of the Genecon in a clockwise direction.
3. The diode will glow either red or green. If it emits a red llight, the lead closest to the diode is of positive polarity. If the light is green, that same lead is negatively charged.
4. Reconnect the leads of the Genecon (if necessary) so that the red lead is at the terminal closest to the diode. Turn the handle of the Genecon (again, clockwise).
5. The diode should glow red. If it does not, the output cord from the Genecon has been plugged in upside down. The red lead should be on top.
6. This standard arrangement for using the Genecon (clockwise rotation, with red lead on top) will ensure that the red lead always has the positive polarity. Some of the activities in this manual will not work if the prescribed polarity is reversed.
7. With the Genecon connected to the Polarity Tester, turn the handle clockwise then counterclockwise. The alternating colors of the diode clearly show that by reversing the direction of the Genecon's handle, you are reversing the direction of the current.

USING
* 1 GENECON 12
* 1 Polarity tester

KEY CONCEPTS:
1. Electricity is the flow of negatively charged particles, called electrons, through a conductor.
2. Electricity flows from the negative electrode (where there is a surplus of electrons) to the positive electrode (where there is a shortage of electrons).
3. The polarity of an electrical source refers to the location of the positive and negative electrodes.
4. The direction of rotation of the Genecon's handle determines the polarity of its leads (connectors).
5. Whichever color (red or green) the diode glows, the positive lead is at the terminal of the same color as the diode.
6. Incorrect polarity may cause certain appliance to work improperly or become damaged.



TEACHING TIPS:
1. Ask students to consider what happens when batteries are not installed properly in flashlights or radios. What does "properly" really mean?
2. Discuss the wider blade on one side of the plugs of typical electrical appliances. Such plugs will go into electrical outlets in only one direction. Why is this?