IMHOTEP'S LEGACY ACADEMY

6.1 - CIRCUIT PATHWAYS

Grade 6 Activity Plan

Reviews and Updates

6.1 Circuit Pathways

Objectives:

1. To compare a variety of electrical pathways by constructing simple circuits, and illustrate the electrical circuits with drawings and appropriate symbols.
2. To test the conductivity of different solids and liquids, and draw conclusions as to which materials tested were insulators or conductors.
3. To describe the role of switches in electrical circuits, and identify materials that can be used to make a switch.

Keywords/concepts: switch, circuit, conductor, insulator, current, battery, conductance

Curriculum outcomes: 106-3, 106-4, 107-9, 108-2, 205-3, 205-9, 206-5, 207-2, 300-20, 303-22, 303-23, 303-24.

Take-home product: Electric car

Segment	Details
African Proverb (10 min.)	"If you think you are too small to make a difference, you haven't spent the night with a mosquito." African Proverb
Pre-test (5 min.)	Ask students to give examples of everyday uses for electricity and circuits and how they help us. What would we do without electricity?
Activity 1 (20 min.)	Test the conductivity of various objects with a simple circuit.
Activity 2 (20 min.)	Students create circuits based on diagrams and then draw circuit diagrams based on pictures of circuits.
Activity 3 (35 min.)	Make an electric toy car out of cardboard, rubber bands and a motor.
Post-test (5 min.)	Circuit sentences

Suggested Interpretation of the proverb

The mosquito is a tiny insect but it is able to prevent us from sleeping well at night if it is in the same room with us. This goes on to say that size is not an important factor in making a difference in someone's life or in any situation. In today's activity, you will discover the different important items responsible for the creating electricity.

Background Information

Electricity

Electricity is a type of energy that can build up in one place or flow from one place to another. When electricity gathers in one place it is known as static electricity (the word static means something that does not move); electricity that moves from one place to another is called current electricity.

Electricity is the most versatile energy source that we have; it is also one of the newest: homes and businesses have been using it for not much more than a hundred years. Electricity has played a vital part of our past. But it could play a different role in our future, with many more buildings generating their own renewable electric power using solar cells and wind turbines.

Circuits

For an electric current to happen, there must be a circuit. A circuit is a closed path or loop around which an electric current flows. A circuit is usually made by linking electrical components together with pieces of wire cable. Thus, in a flashlight, there is a simple circuit with a switch, a lamp, and a battery linked together by a few short pieces of copper wire. When the switch is turned on, electricity flows around the circuit. If there is a break anywhere in the circuit, electricity cannot flow. If one of the wires is broken, for example, the lamp will not light. Similarly, if the switch is turned off, no electricity can flow. This is why a switch is sometimes called a circuit breaker.

Switch

A switch is a small device that starts or stops the flow of electricity to something (such as a lamp or a machine) when it is pressed or moved up and down

Insulators and conductors

Materials such as copper metal that conduct electricity (allow it to flow freely) are called conductors. Materials that don't allow electricity to pass through them so readily, such as rubber and plastic, are called insulators. What makes copper a conductor and rubber an insulator?

A current of electricity is a steady flow of electrons. When electrons move from one place to another, round a circuit, they carry electrical energy from place to place like marching ants carrying leaves. Instead of carrying leaves, electrons carry a tiny amount of electric charge.

Electricity can travel through something when its structure allows electrons to move through it easily. Metals like copper have "free" electrons that are not bound tightly to their parent atoms. These electrons flow freely throughout the structure of copper and this is what enables an electric current to flow. In rubber, the electrons are more tightly bound. There are no "free" electrons and, as a result, electricity does not really flow through rubber at all. Conductors that let

electricity flow freely are said to have a high conductance and a low resistance; insulators that do not allow electricity to flow are the opposite: they have a low conductance and a high resistance.

Batteries

Electricity is pushed around a circuit by a source of power. This source can be a battery. A battery is a small store of electricity. A battery has chemicals inside it. The battery is linked to a circuit. Then the chemicals inside the battery react together. This pushes a flow of electrons around the circuit.

Activity 1: Testing Conductivity

Purpose: To test the conductivity of different solids and liquids and draw collusions as to which materials were insulator or conductors.

Item	**Quantity (10 students)**
6V Battery	10
3 wire leads with alligator clips at both ends (red, black and another colour)	30 (10X3)
6V Light bulb	10
Light bulb holder	10
Various small pieces of material to test (foil, paper clips, wood, plastic, rubber bands, string, etc…)	

Procedure:

1) Attach one clip of the black wire to the negative (−) battery terminal by clipping the alligator clip securely to the terminal.
2) Attach one clip of the red wire to the positive (+) battery terminal by clipping the alligator clip securely to the terminal.
3) Attach the other end of the black wire to one of the metal components of the light bulb holder with an alligator clip
4) Attach another red (positive wire) to the other metal component on the battery holder with an alligator clip
5) You will connect different materials between the free ends of the red wire and the black wire. to do this simply attach both wire at different ends of the various materials using alligator clips
6) Fill out the data table with your results
7) Next, place the first material into the circuit by clipping one end to the free black wire to the material and the other end to the red wire.
8) Does the light bulb light up? How bright is it? Write down the results in the data table.
9) Repeat steps 7 and 8 for each different material you want to test. Remember to write down, in your data table, how bright the light bulb appears for *each* material you test.
10) How do the different materials compare? Do some materials make the light bulb glow brightly while others only make it glow dimly? Do some materials not make the light bulb light up at all?
11) Categorize the materials according to your results. Put materials with high brightness readings (high brightness = high conductivity = low resistance) into the conductor category. Put materials with 'dim' brightness readings into the 'poor conductor' category. Put materials with 'off' brightness readings (no brightness = high resistance = low conductivity) into the insulator category.

Testing Conductivity of Materials

Type of Material	Brightness of Bulb (e.g., off, dim, bright)
Paper Clip	
Rubber Gloves	
Pencil Lead	
Metal Fork or Spoon	
Water	
Water Bottle	
Student's Choice:	

Categorizing Materials by Conductivity

Materials	Insulators	Poor Conductors	Conductors
Paper clip			
Rubber Gloves			
Pencil Lead			
Metal Fork or Spoon			
Water			
Water Bottle			
Student's Choice:			

Activity 2: Drawing and testing a Circuit

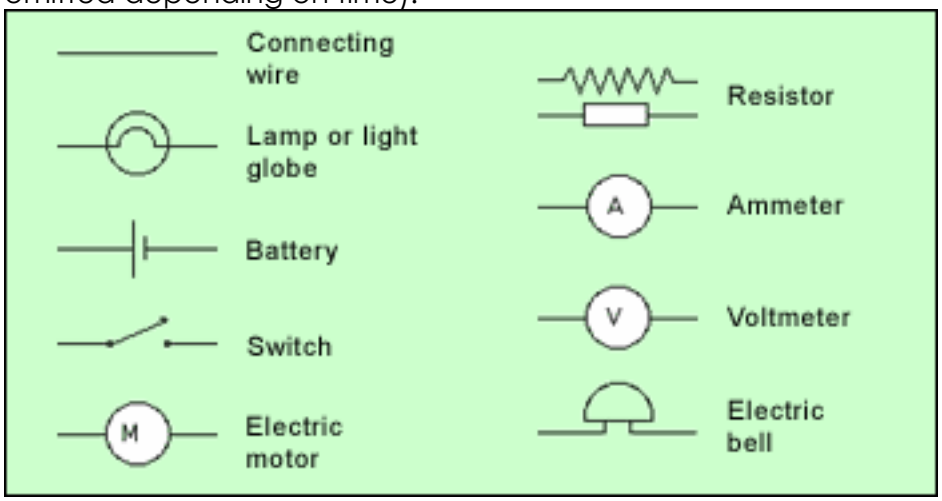
Purpose: To illustrate electrical circuits with drawings and appropriate symbols.

Item	Quantity (10 students)
6V Batteries	10
Wires	20
6V Light bulbs	10
Light bulb holders	10

Procedure:

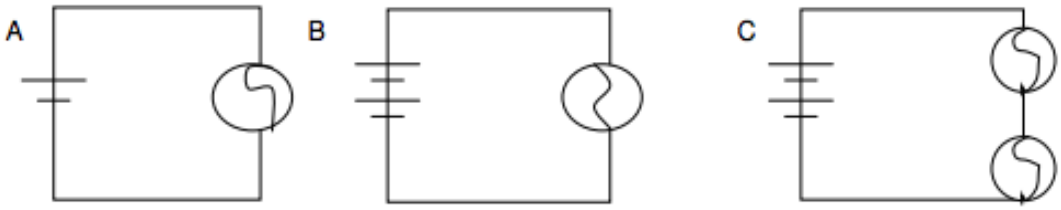
Part 1:

1) **TO BE DONE BY MENTOR (prior to activity):** Print off "Drawing a Circuit" worksheet.
2) **TO BE DONE BY MENTOR:** Draw each circuit component on the board and explain (resistor, ammeter, voltmeter and electric bell can be omitted depending on time).



Part 2:

1) **TO BE DONE BY MENTOR:** Draw the following circuits on the board.



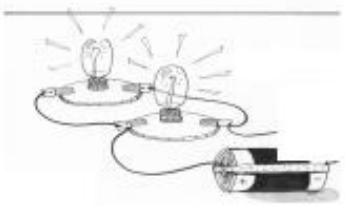
2) Pair up the students.
3) Have the pairs create each circuit with the provided materials.

Drawing a Circuit Diagram

Pictured below are six complete electrical circuits. On another sheet of paper illustrate each circuit with the appropriate symbols.

1.

2.



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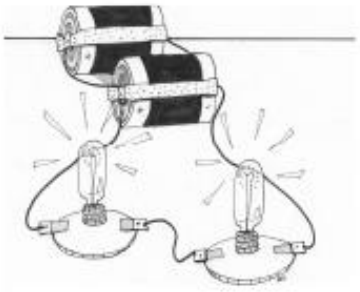

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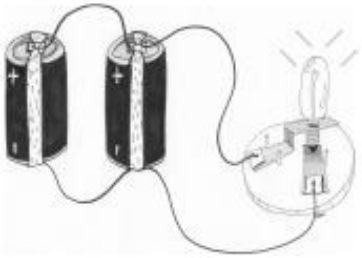

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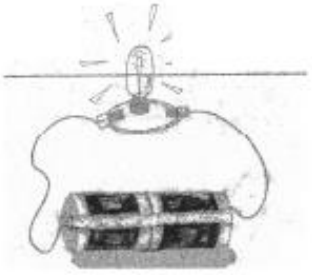

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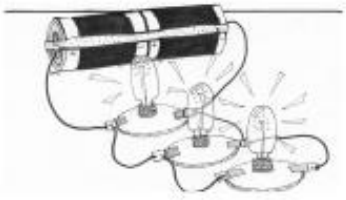


Activity 3: Making an Electric Car

Purpose: To compare a variety of electrical pathways by constructing simple circuits and to describe the role of switches in electrical circuits

Suggested format: Before going to the school, prepare a model for the students to look at or make a model with the students at the front of the class,(have cardboard cut?)

Item	**Quantity (10 students)**
Strong piece of cardboard 13 X 18 cm	10
Straws 13cm	20
Skewers (16cm and 20cm)	10
Empty bobbin	40
Wheel made out of cardboard (5cm diameter, if cardboard is too thin glue two together)	10
9V Battery and Battery holder(optional)	10
Motor	10
Thick rubber bands	50
Electrical tape	2 rolls
Brass fasteners	20
Paperclip	1
Wire cutter	1
Coated wires (red and black)	30
Rulers	10
Scissors	10
Glue gun	2

Procedure:

1) **TO BE DONE BY MENTOR (prior to activity):** Measure and cut out the 13X18cm chassis and the four 5cm wheels out of the piece of cardboard.

2) Draw the circuit for the car on the board and have the students make their own by changing the location of the switch. Explain what everything in the circuit means. Explain the switch and why it works.

3) Cut pieces of rubber band to fit the perimeter of the wheels and attach them using the glue gun (this adds traction).

4) Cut and measure the two different sized skewers and cut the straws these will act as the axles.

5) Prepare the chassis by carefully hot gluing the straws to the bottom.

6) Carefully punch holes in the centre of all wheels using a sharp pencil or a pair of scissors.

7) Assemble the back wheels by sticking the 20cm skewer through one of the wheels and secure it with hot glue. Next slide the bobbin onto the skewer and attach it to the wheel with hot glue. Slide the skewer through one of the straws and glue the second wheel to the free end of the skewer. Make sure the wheels are spaced equally.

8) Assemble the front wheels by attaching a wheel and securing it with hot glue. Slide the skewer through the remaining straw then attach the last wheel to the end of the free skewer with hot glue.

9) Place a large drop of hot glue at the end of the rotating part of the motor so that the rubber band doesn't slip off when it is rotating.

10) Map out the circuit:

    a. Place the motor on the side facing the bobbin; attach the motor to the bobbin using a rubber band making sure that the rubber band is tight enough to rotate the bobbin. Make sure the motor rotates the wheel in the desired direction.

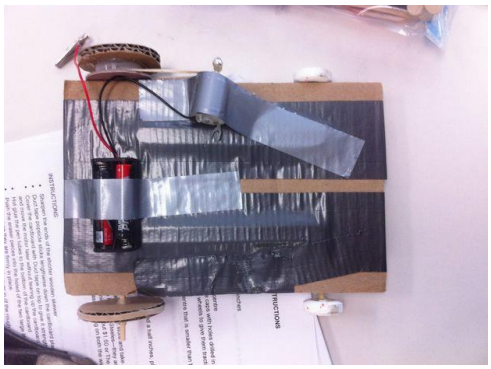
    b. The switch is made by connecting the paperclip to a brass fasteners and sticking it into the chassis the second tack is placed the distance of the paperclip away so that the paperclip can rotate to touch it which closes the circuit. Wires are connected to each tack.

    c. The battery should be placed at the front of the car to balance out the motor.

    d. Once everything is mapped out cut the wires to fit the circuit.

11) Glue the battery and the motor onto the chassis.

12) Attach all of the wires and secure them with electrical tape when needed.



(Similar electric car)

REFERENCES

Background:
http://www.explainthatstuff.com/electricity.html
http://science.jrank.org/kids/pages/232/All-in-Circuit.html

Activity 1: Testing Conductivity
http://www.sciencebuddies.org/science-fair-projects/project_ideas/Elec_p018.shtml#procedure

Activity 2: Drawing and testing a Circuit
http://www.caboces.org/sites/default/files/mst/electrical_circuits_-__student_activity_book_0.pdf

Activity 3: Making an electric car
http://www.instructables.com/id/Motorized-Toy-Car/?ALLSTEPS

https://www.youtube.com/watch?v=_3l2kHxaUB8

Post Test

Print off the "Circuit Sentences" worksheet on the following page.

Answers:

1) Materials such as copper that allow electricity to flow freely are called conductors.
2) Materials that don't allow electricity to pass through them so readily, such as rubber and plastic, are called insulators.
3) A current of electricity is a steady flow of electrons.
4) A switch is a small device that starts or stops the flow of electricity to something (such as a lamp or a machine) when it is pressed or moved up and down.
5) A circuit is a closed path or loop around which an electric current flows.
6) Conductors that let electricity flow freely have a high conductance and a low resistance.
7) Insulators that do not allow electricity to flow have a low conductance and a high resistance.

Circuit Sentences

Use the words in the list below to complete the sentences; each word can be used once.

1) Materials such as copper that allow electricity to flow freely are called _____.
2) Materials that don't allow electricity to pass through them so readily, such as rubber and plastic, are called_____.
3) A _____ of electricity is a steady flow of electrons.
4) A _____ is a small device that starts or stops the flow of electricity to something (such as a lamp or a machine) when it is pressed or moved up and down.
5) A _____ is a closed path or loop around which an electric current flows.
6) _____ that let electricity flow freely have a _____conductance and a _____ resistance.
7) _____ that do not allow electricity to flow have a _____ conductance and a _____ resistance.

Insulators
circuit
high
Conductors
switch
conductors
current
low
high
insulators
low