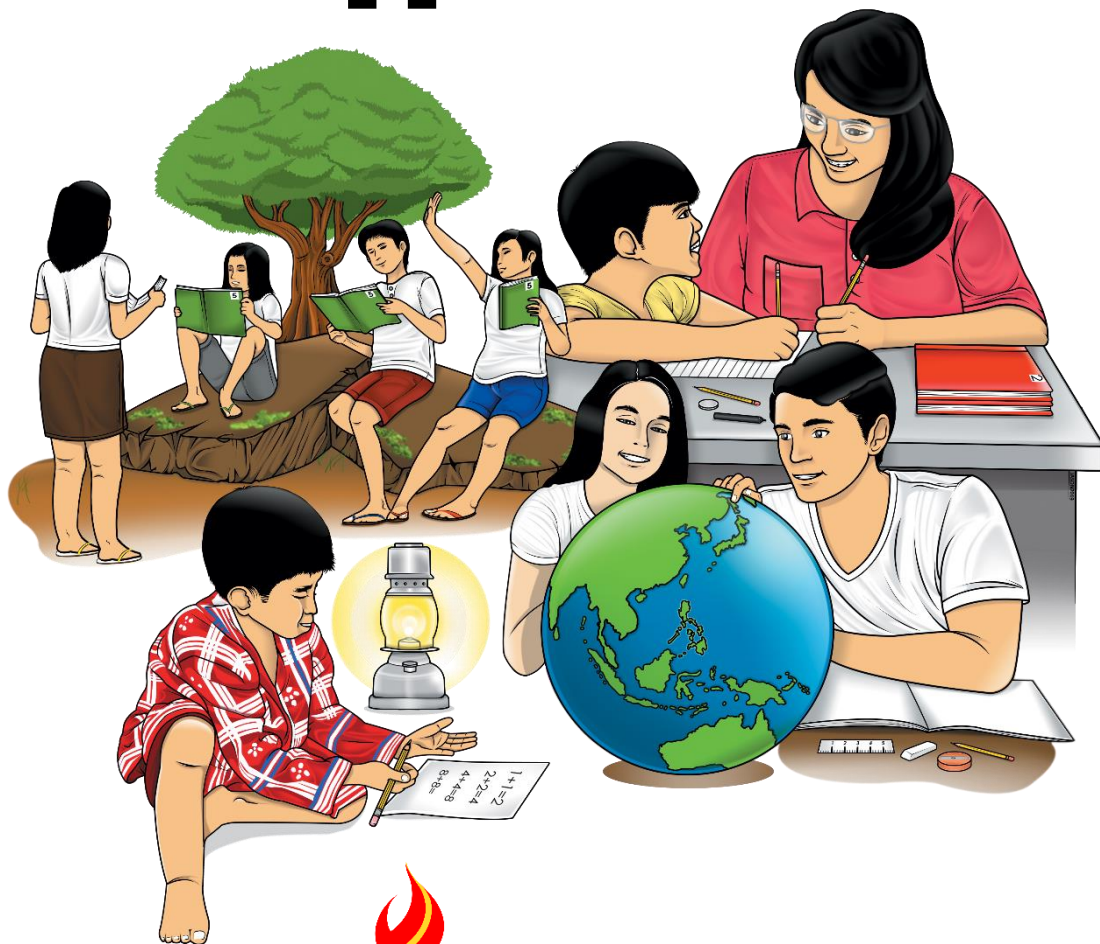


Science

Quarter 1 - Module 9:

Safe Electricity Application



Science – Grade 8
Alternative Delivery Mode
Quarter 1- Module 9: Safe Electricity Application
First Edition, 2019

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Science
Quarter 1 - Module 9:
Safe Electricity
Application

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using them.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Need to Know

This module was designed and written with you in mind. It is here to help you understand and apply electrical safety measures and devices at home. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

After going through this module, you are expected to:

1. Explain the functions of circuit breakers, fuses, earthing, double insulation, and other safety devices in the home. (*MELC Week 7 S8F*)



What I Know

Directions: Choose the letter of the correct answer. Write your answers on a separate sheet of paper.

1. It is a device that maintains steady supply of voltage to your appliances at home.
 - A. Fuse
 - B. Resistor
 - C. Circuit breaker
 - D. Voltage regulator

2. Which of the following statements is NOT true about safety devices used at home?
 1. Safety devices are used to prevent electric shock.
 2. Safety devices cut the flow of current in case of overloading.
 3. Safety devices supply unsteady amount of voltage to protect appliances against overloading.
 4. Safety devices are used to provide alternative route for current in the case of a grounded circuit.

3. The fuse at home has “blown” up many times. Which of the following must NOT be done to solve the problem and prevent it from happening again?
 - A. Buy fuse with standard amperage rating.
 - B. Do not use all appliances simultaneously.
 - C. Call your barangay electrician to fix your electrical problem.
 - D. Use jumper wire or cover the blown fuse with available silver paper.

4. Which electrical device shuts down when there is overloading in the circuit?
 - A. Fuse
 - B. Voltage source
 - C. Circuit breaker
 - D. Electrical switch

5. Which electrical device blows up when there is overloading in the circuit?
 - A. Fuse
 - B. Switch
 - C. Resistor
 - D. Circuit breaker

6. Why is earthing used at home?
- A. To prevent short circuit
 - B. To cut the circuit in case of overloading
 - C. To reduce the resistance of the appliance
 - D. To provide alternative route of upsurge current in case of grounded circuit.
7. At home, you noticed that a portion of an electrical wire is worn out, exposing its metallic part. What do you think might happen if you will just ignore this problem?
- A. short circuit may happen
 - B. circuit is of better condition
 - C. overloading may not happen
 - D. nothing happens when someone touches the wire
8. What electrical circuit condition in which current returns and takes the path of metal casing of an appliance?
- A. short circuit
 - B. series circuit
 - C. parallel circuit
 - D. grounded circuit
9. Which of the following directs any excess current in the metal casing of appliances to the ground?
- A. Fuse
 - B. Earthing
 - C. Circuit breaker
 - D. Electric sockets
10. Which electrical connection involves plugging of several devices to an outlet or to an extension wire with multiple outlets?
- A. Earthing
 - B. Single insulation
 - C. Double insulation
 - D. Octopus connection
11. Which situation shows that current could go through the body?
- A. Direct contact with a grounded surface
 - B. Direct contact with live parts of the installation
 - C. Accidental contact with damaged wires that are seemingly not live
 - D. All of the above

12. What safety measure has been done by appliance manufacturers to prevent electric shock and grounded external casing of appliances?
- A. Grounding
 - B. Using AVR
 - C. Double Insulation
 - D. Using circuit breaker
13. The following are effects of alternating current in the body EXCEPT:
- A. It can lead to stronger muscles in the body.
 - B. It can cause improper function of the brain and heart.
 - C. Muscles will involuntarily contract which will be hard to control.
 - D. The body will experience intense heat that can cause skin burning.
14. How do you prevent from experiencing electric shock at home?
- A. Recycle blown up fuse
 - B. Regularly check household wirings
 - C. Plug electrical appliances with wet hand
 - D. Continue using worn-out extension wire
15. When do you consider repairing electrical wirings at home?
- A. when a newly bought extension cord is used
 - B. when electrical appliances are in good condition
 - C. when fuses blows out or circuit breakers trip off frequently
 - D. when lights do not flicker even if other appliances are turned on

Lesson 1

Electrical Safety Measures and Devices at Home

Electricity, if not properly installed and not properly used could mean injury, harm, or even death. So, what safety measures should we follow to prevent injury or an untimely death? What are the electrical devices that can protect us from a sudden surge of electrical energy?



What's In

Activity 1. Calculating Current with Varying Resistance

Directions: Calculate the current, complete the table and answer the questions below. Write your answers on a separate sheet of paper.

Voltage (V)	Current (A)	Resistance (Ω)
12.0		1.0
12.0		0.5
12.0		0.25
12.0		0.125
12.0		0.062
12.0		0.031
12.0		0.016
12.0		0.008
12.0		0.004
12.0		0.002

1. What happens to current as resistance decreases?

2. Predict what will happen to current as resistance approaches zero?

Activity 2. Advantages and Disadvantages of Series and Parallel Circuits

Directions: Write AS if the statement tells about an advantage of a series circuit, DS if it tells about a disadvantage of a series circuit, AP if it is an advantage of a parallel circuit, and DP if it is a disadvantage of a parallel circuit. Write your answers on a separate sheet of paper.

1. If one of the light bulbs is damaged or removed, all other light bulbs in the circuit will not light too.
2. Even if one of the light bulbs is damaged in this circuit, all other light bulbs will still function since the flow of current is not entirely interrupted.
3. It is difficult to install, maintain, and repair since large volume of conducting wires is needed.
4. It does not overheat easily.
5. Overloading may happen if appliances are simultaneously used at home.



What's New

Activity 3: It is Reading Time!

Directions: Read the news article carefully. List all the mentioned electrical hazards that may lead to fire. Write your answers on a separate sheet of paper.

Electrical Misuse is No. 1 Cause of Fires in Cebu City

BEWARE of “octopus” connections, substandard Christmas lights and cooking fires that go untended.

These are some of the reminders of the Bureau of Fire Protection (BFP) in Cebu City in its daily visits to barangays.

In mid-October, Cebu City Fire Marshall Aderson Comar and the Visayan Electric Co. (Veco) launched the fire safety inspectors’ barangay visitation program. Handouts remind residents about common causes of fire—throwing lighted cigarette butts, unattended cooking, children playing with matches or lighters, electrical misuse, gas leaks, bonfires and arson.

Comar said electrical misuse tops the list (103 cases) followed by unattended cooking (26) in Cebu City cases from Jan. 1 to Nov. 30.

Two deaths were recorded and property damage reached P15.4 million. “This is mostly because of illegal connections and the use of octopus wires,” Comar told Cebu Daily News.

An octopus electrical connection involves plugging several devices to a wall socket. This also refers to an extension cord with multiple outlets.

This poses overheating or an electrical overload. Fire incidents increased during the last quarter of the year because of the use of Christmas lights, said Comar.

“Christmas lights especially substandard products are dangerous because these can cause fire,” said Ethel Natera, Veco corporate communications manager.

Each of the city’s nine fire substations has one fire safety inspection team composed of a firefighter and Veco personnel.

Escorted by barangay officials, the inspection team visits barangays and devotes at least an hour each day to encourage residents to adopt fire safety measures.

They remind residents to prevent their children from playing with matches and candles as well as do away with the use of octopus wiring.

Veco staff also extend free service to residents who want their electrical connections checked.

“Our barangay campaigns are proven effective because it increased people’s awareness especially on the causes of fire,” said Comar.

He said residents have also learned not to panic and to immediately call the nearest fire substation for assistance in case of fire.

With the Cebuanos’ increased awareness, Comar said firefighters are also able to respond to fire alarms in less than seven minutes, which is the standard emergency response time in the country.

Illegal Connections

According to Veco, illegal connections are the most common causes of fire especially in thickly populated areas.

Unauthorized connections are normally done using “bare wires” and without any protective devices.

Illegal connections tend to overload the supply line thereby causing power tripping and interruption.

Overloading also causes power voltage to drop. Overvoltage or undervoltage is one cause of damaging appliances like refrigerators, air conditioners and television sets.

Illegal connection is punishable under Republic Act No. 7832 or the Rules and Regulations of the Anti- Pilferage of Electricity and Theft of Electric Transmission Lines/Materials Act of 1994.

Unauthorized electric tapping is tantamount to theft. The penalty is imprisonment of six to 12 years or a fine ranging from P10, 000 to P20, 000 or both upon the discretion of the court.

Violators will pay the estimated amount of stolen electricity plus a surcharge of up to 100 percent.

Natera said Veco created a revenue protection department in mid-2010 to go after electricity thieves.

Personnel conduct random check on residences especially after they noticed a sudden drop in the occupant's electric consumption.

Veco is closely coordinating with the local government and the police in the program.

Natera said some consumers resort to illegal tapping to avoid the application cost without realizing the risk they are taking. ***/Doris C. Bongcac, Chief of Reporters***

Source: <https://newsinfo.inquirer.net/118483/electrical-misuse-is-no-1-cause-of-fires-in-cebu-city#ixzz6QT5NFtJI>



What is It

What is Electrical Hazard?

Electrical hazard or electric shock is a condition due to direct or indirect electrical contact with energized conductor or equipment, and from which a person may sustain electrical injury from shock or damage to property or both.

When working with or nearby electrical installations, an electrical shock, arc flash or arc blast can occur and current can go through the body due to the following situations:

- ✓ Direct contact with live parts of the installation.
- ✓ Accidental contact with damaged wires that are seemingly not live.
- ✓ Direct contact with a grounded surface

The Fatal Current

Electric current damages the body in three ways:

1. It can cause improper function of the brain and heart.
May lead to cardiac arrest or death.
2. The body will experience intense heat that can cause skin burning.
3. Muscles will involuntarily contract which will be hard to control.

Dry skin has a resistance against current over 500,000 Ω , while wet skin has only 1000 Ω . However, once the skin breaks through, for example by burning or wire piercing the skin, the body will have 500 Ω resistance.

A current traveling from finger to elbow through the arm may produce only a painful shock, but that same current traveling from hand to foot or through the chest from hand to hand may well be dangerous. So, the practice of using only one hand (keeping one hand behind your back) while working on high-voltage circuits is a good safety habit. Even better would be to disconnect all sources of power from the equipment you are about to repair. Do not rely on insulated tool handles, rubber-soled shoes, etc., to protect you. But it is better to shut down the main switch of voltage source before doing any electrical repairs. Relying on insulated handles, rubber-soled shoes are not completely safe.

A.C. is More Dangerous than D.C.

Direct Current (D.C.) – is a current that travels from negative to the positive terminal. It does not change its direction. It is the current we can get from a battery. D.C. passing your body can not cause electric shock but can cause burning if the positive and negative wire can come into contact.

Alternating Current (A. C.) – is a current that travels from negative to positive; and, from positive to negative terminals. In our country, it keeps on changing direction 60 times every second. It is the current that does the damage, not the voltage.

The changing direction of A.C. has a lot to do with the effect of the human body. The frequency of 60 Hz or 60 cycles/second as little as 25 volts can kill. It stimulates sweating, which lowers the skin resistance. That is why it is very important to free the victim from current contact as quickly as possible, without endangering the rescuer, before cardiac arrest to happen.

Faulty Electrical Wiring

One leading cause of the fire is faulty electrical wiring. How do you know that you should have your house electrical wiring be repaired? Check on for the following warning signs:

1. Lights dim or flicker when another appliance is turned on.
2. Appliances do not have permanent outlet.

3. Many extension cords are utilized.
4. Fuses blow or circuit breakers trip frequently

To prevent fire from happening, contact your barangay electrician to fix your faulty electrical wiring. Here are the following circuit conditions with faulty electrical wiring:

1. Short Circuit refers to a circuit condition in which a current takes the path of less resistance or zero resistance as shown in Figure 2. A short circuit happens when there is overloading of current making the conducting wire extremely hot that can cause the melting of insulators until two live wires come into contact. Why does short circuit happen when electrical connection has worn out wires? Since metallic part of conducting wires is exposed, current could possibly flow through another path.

Using Ohm's Law: $V = I R$

$$I = \frac{V}{R} \text{ when } R = 0$$

$I =$ approaches infinity. Meaning the amount of current is extremely high. It is the huge amount of current that sparks violently if the main switch does not shut down through its safety devices, and fire will surely happen.

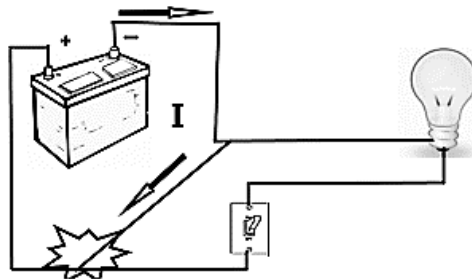


Fig. 2 Schematic Diagram of Short Circuit

Illustrated by: Rosa Mia L. Pontillo

2. Grounded circuit refers to circuit condition where current traveling from the positive conducting wire, bypass the negative conducting wire and flows through by through the metal casing of an appliance instead, as shown in Figure 3. Remember that A.C. changes direction 60 times/second so touching the grounded metal can cause electric shock.

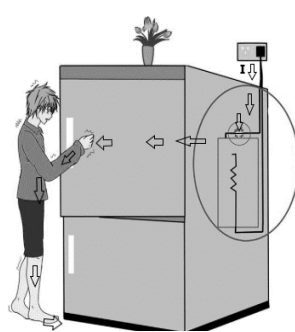


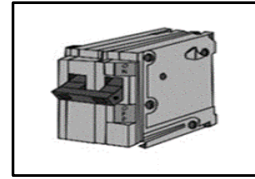
Fig. 3 Grounded refrigerator

Illustrated by: Rosa Mia L. Pontillo

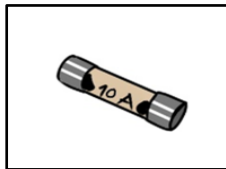
In order to prevent accidents and injuries brought about short and grounded circuits, safety devices must be installed in all electrical lines and safety measures must be observed at home.

Electrical Safety Devices

Circuit breaker uses electromagnets and bimetallic strips to open a switch in cases of overloading. It automatically shuts down if there is overloading due to short circuit. It cannot be turned on unless the short circuit is fixed.



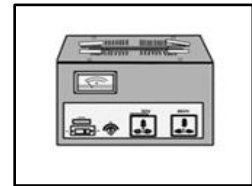
Illustrated by Rosa Mia L. Pontillo



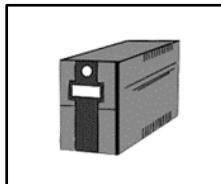
Fuse is made up of metal ribbon that will heat up and melt if the current exceeds its current rating. Once the fuse is blown out, it must be replaced with a new one after the source of overloading is determined and repaired. It is unsafe to use jumper wire since it may not melt when there is current overloading.

Illustrated by Rosa Mia L. Pontillo

Automatic Voltage Regulator (AVR) is a device designed to protect our home appliances by regulating voltage automatically. It takes a fluctuating voltage level return into a constant voltage level.



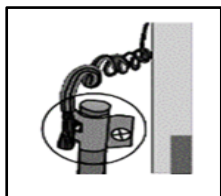
Illustrated by Rosa Mia L. Pontillo



Uninterruptible Power Supply (UPS) an electrical safety device which provides emergency power to the load when there is unexpected power disruption. It also functions like an AVR.

Illustrated by Rosa Mia L. Pontillo

Electrical Safety Measures



Earthing or Grounding is a system of connecting the metal casing of the appliance to earth. Earthing protects the user from a grounded circuit. Earth is the best path for any excess current. Grounding prevents damage to appliances, injury, and death of an electrical user.

Illustrated by Rosa Mia L. Pontillo

Double Insulation is a safety measure done by appliance manufacturers to prevent electric shock and grounded external casing of appliances. With double insulation, live wires within the appliances cannot touch the casing even if wires become loose, thus eliminating the need for earthing.



Illustrated by Rosa Mia L. Pontillo



What's More

Activity 4: Safety at Home

Directions: Complete the table below. Write your answers on a separate sheet of paper.

Electrical Devices and Safety Measures	Check if found at home, otherwise mark X if not found at home.	Explain in your own simple words the function.
1. Circuit breaker		
2. Fuse		
3. Automatic Voltage Regulator		
4. Uninterruptible Power Supply		
5. Earthing		
6. Double insulation		

Rubric for Scoring	
2 points	Explanations are conceptually complete.
1 point	Explanations are conceptually incomplete.
0	No explanations



What I Have Learned

Directions: Fill in the blanks. Write your answers on a separate sheet of paper.

1. _____ is a condition due to direct or indirect electrical contact with energized conductor or equipment.
2. Circuit breaker is a device that automatically trips off or shuts down when _____ exists in the circuit.
3. _____ is a device that blows up when there is overloading in the current.
4. Earthing is a safety measure that connects the metal parts of an appliance to the _____.
5. Double insulation prevents live wires or exposed wires from _____ the metal part of an appliance.
6. Short circuit condition occurs when current takes the path of _____ resistance that would result to infinite amount of current, causing sudden explosion in the circuit.
7. _____ is a condition when conducting wire touches the metallic part of the appliances, potentially causing electric shock to anyone who is able to touch the appliances.



What I Can Do

Activity 5. Electrical Hazard at Home

Directions: Study the picture and answer the questions that follow. Write your answers on a separate sheet of paper.

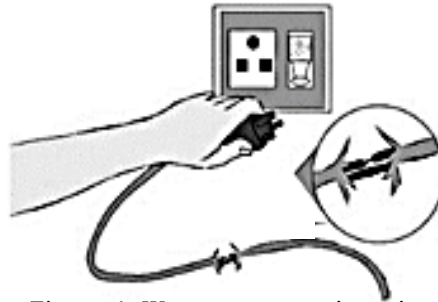


Figure 4. Worn out extension wire
Illustrated by Rosa Mia L. Pontillo

1. Is it safe to use a worn-out extension wire at home? Why?

2. Suggest 2 to 3 ways on how to keep your family members safe from the electrical hazard.

Rubric for Scoring	
2 points	Discussions are conceptually complete.
1 point	Discussions are conceptually incomplete.
0	No discussion



Assessment

Directions: Write True if the statement is correct and change the underlined word if the statement is false. Write your answers on a separate sheet of paper.

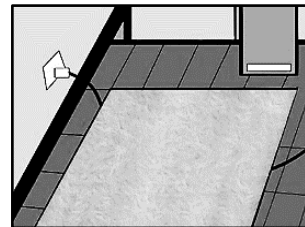
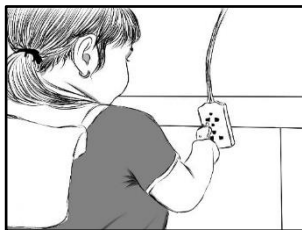
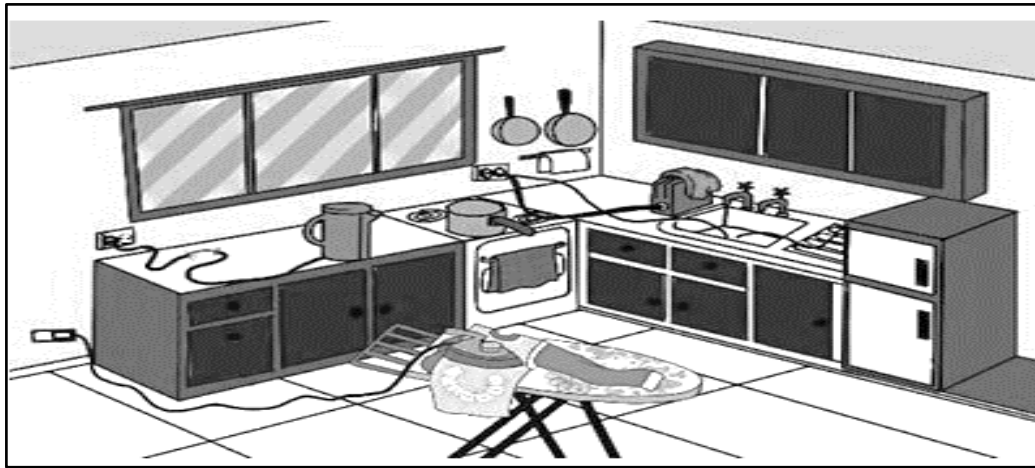
1. Operating any appliances with a wet hand is unsafe.
2. If you happen to touch with your bare hands an uninsulated wire, it is safe if it has low current.
3. Blown out fuse can be replaced with a jumper wire.
4. A circuit breaker automatically shuts down if there is overloading in the circuit.
5. When the circuit breaker automatically shuts down, it is proper to reset it even without inspecting the conducting wire for any short circuit.
6. Your washing machine and refrigerator should have proper earthing for safe operation.
7. The refrigerator has double insulation that functions as a second layer to protect the user from electric shock.
8. It is a good practice to connect the computer set to a voltage regulator to protect it from overloading.
9. It is safe if a household line consumed 30 A of current even if its circuit breaker has only 20 A capacity.
10. It is unsafe to consume 35 A of current if the fuse has only 30 A capacity.
11. Grounded circuit happens when current takes a short cut to a zero-resistance conducting wire instead of passing through the load.
12. Short circuit happens when a live wire is in direct contact with the metal casing of the appliances.
13. Earthing protects the appliance user from the grounded appliances.
14. Fuse and circuit breaker are safety devices that open the circuit when there is overloading.
15. A fuse should be replaced immediately once it has blown up.



Additional Activities

Activity 6: House of Hazards

Directions: List down at least 8 electrical hazards in the pictures below. Write your answers on a separate sheet of paper.



Illustrated by Rosa Mia L. Pontillo

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____



Answer Key

- What I Know**
1. D
 2. C
 3. D
 4. C
 5. A
 6. D
 7. A
 8. D
 9. B
 10. D
 11. D
 12. C
 13. A
 14. B
 15. C

What's In

Activity 1

Voltage (V)	Current (A)	Resistance (Ω)
12.0	12.0	1.0
12.0	24.0	0.5
12.0	48.0	0.25
12.0	56.0	0.125
12.0	112	0.062
12.0	224	0.031
12.0	448	0.016
12.0	896	0.008
12.0	1792	0.004
12.0	3584	0.002

1. As resistance decreases, current increases.

2. When resistance approaches zero, the amount of current becomes very large.

- What's New**
- Activity 2**
1. DS
 2. AP
 3. DP
 4. AS
 5. DP

What's New

Activity 3

1. octopus connections
2. substandard Christmas lights
3. electrical misuse
4. illegal connections/unauthorized connections

<p>What's More</p> <p>Activity 4</p> <p>Keywords</p> <p>1. Circuit</p>	<p>Electrical Devices and Safety Measures</p> <p>Check if found at home, otherwise mark X if not found at home.</p>	<p>a. when there is circuit overloading</p> <p>b. Shuts down automatically</p>	<p>a. when there is circuit overloading</p> <p>b. automatically blows up</p>	<p>3. Automatic Voltage Regulator</p> <p>supply constant amount of voltage</p>	<p>4. Uninterruptible Power Supply</p> <p>provides emergency power in case of power interruption.</p>	<p>5. Earthing</p> <p>a. grounded appliances.</p> <p>b. alternative route for excess amount current</p>	<p>6. Double insulation</p> <p>a. when there is exposed wire within the circuit</p> <p>b. second layer protection is provided.</p>
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What I Have Learned

1. Electric hazard/electric shock
2. overloading
3. fuse
4. earth/ground
5. touching/connecting/contacting
6. zero
7. grounded circuit

What I Can Do

Activity 5

1. No. Worn out wire has an electrical hazard and can short circuit.
2. Possible answers:
 - a. use new extension cord
 - b. avoid octopus connection
 - c. directly replace worn out conducting wire
 - d. regularly check electrical connections at home

- Additional Activities**
 (answers can be in any order)
1. electrical wires pass through the water in the sink
 2. overuse of electrical appliances
 3. unused appliances plugged in the conventional outlet
 4. electrical outlet placed within the reach of the child
 5. child playing an electrical outlet
 6. multiple appliances plugged in a single outlet
 7. electrical wires improperly placed
 8. electrical wire passes under the rug or carpet

- Assessment**
1. True
 2. unsafe
 3. cannot
 4. True
 5. improper
 6. True
 7. True
 8. True
 9. unsafe
 10. True
 11. Short circuit
 12. Ground circuit
 13. True
 14. True
 15. True

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