Lesson 4:

SNC1P

4.4 How can people control and use the movement of charges?

1. A constant source of electrical energy can drive a steady current (flow of charges).

- The device that supplies electrical energy to operate any electrical equipment is called the **s**_____. A source may be an electrical **o**_____ or a **b**_____. You would describe your sources by a quantity called its **p**_____. The symbol for potential difference is **V** (in italics). Charges **g**_____ energy when they pass through a source. Potential difference describes how much their energy changes as they pass through a source. The potential difference across a source is the difference in the energy of a unit of charge **e**_____ one end of the source and the energy of a unit of charge **l**_____ the other end of the source. Some people also use the word "**v**_____" to mean potential difference. The SI unit of potential difference is the **v**_____, and the symbol for the volt is **V** (not in italics). A normal electrical outlet in your home or classroom has a potential difference of **120** V. A typical battery such as an AA battery or AAA battery provides a potential difference of **1.5** V.

2. An electric current carries energy from the source to an electrical device (a load) that converts it to a useful form.

- Whenever you want to use the energy from a source to make a device work, you must connect the source to the device. The connection is usually made with metal wire conductors that are covered by an **i**_____.

- Current: The Flow of Charges. The energy from the source causes charges to move through the wires, carrying energy to the device. The moving charges are called an **e**_____. The symbol for current is ___. Charges cannot build up in a conductor. The amount of current flowing into one end of the wire is the **s**_____ as the amount of current flowing out the other end. In fact, the amount of current flowing past every point in the wire is the same. The unit to describe the amount of current flowing through the wire is called **a**_____. The symbol for amperes is ___.

- The Load: An Energy Converter. Any device that converts electrical energy into a different form of energy is called a **l**_____. A light bulb is a load. It converts electrical energy into **l**_____ energy. A radio is a load. A radio converts electrical energy into **s**_____ energy. A printer is a load. A printer converts electrical energy into **m**_____ energy (mechanical energy). A load always converts electrical energy into another useful form of energy.

- The Load and Resistance. A **l**_____ resists the flow of current. This means that a load hinders the flow of the charges passing through it. A filament in a light bulb is a very thin wire. Many charges are trying to move from a much larger wire into it. As the charges move into the small wire, they collide with each other so hard that the filament gets very hot. This heat makes the filament glow.

- The quantity that describes this hindering is called **r**_____. The symbol for resistance is ___. The unit used to measure resistance is the **o**___. The symbol for ohm is the Greek letter omega, Ω.

- As charges pass through a load, they **l**_____ energy. This happens because the electrical energy has been converted into another form of energy such as heat or light.

3. A source, load, and connecting wires form a simple circuit.

- When a current, load, and conductor are connected in a way that can allow current to flow, it is called an **e**_____. Charges cannot build up in a conductor. All charges that leave the source must return to the source. Therefore, a circuit must form a closed **l**_____.

Source: Science Links 9. McGraw-Hill Ryerson. 2009

How charges move from a source and through a load in a working circuit.

- The wires that are attracted to the ends of the battery (source) already have charges in them that can move. The negatively charged end of the battery **r**_____ the negative charges in the wires. The positively charged end of the battery attracts the negative charges in the wire. As a result, the negative charges move along the conducting wires. Some negative charges that were inside the battery also start to move into the wire.

- As the negative charges pass through the load, they **t**_____ some of their energy to the load. They then leave the load and return to the battery.

- When negative charges enter the battery, they combine with positive charges and make them neutral (no charge). The process results in a smaller number of negative charges at the negative end and a smaller number of positive charges at the positive end of the battery.

How a switch controls current in a circuit

- In a typical flashlight, there is a switch to turn the light on and off. With the switch open, the circuit is not a closed loop. Because negative charges cannot build up at any point in a circuit, the current cannot flow while the switch is open.
- When you close the switch, you **c**_____ the circuit. Current can flow, and the light bulb goes on.

Symbols for Circuit Diagrams.

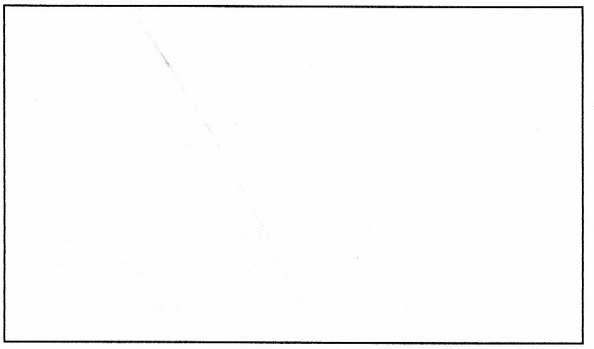
Component of circuit	Component symbol	Quantity	Unit of measurement
S_____ (battery)		Potential difference (V)	Volt (V)
C_____		Current (I)	Ampere (A)
L_____ (resistance)			Ohm (Ω)
S_____ - open - closed			

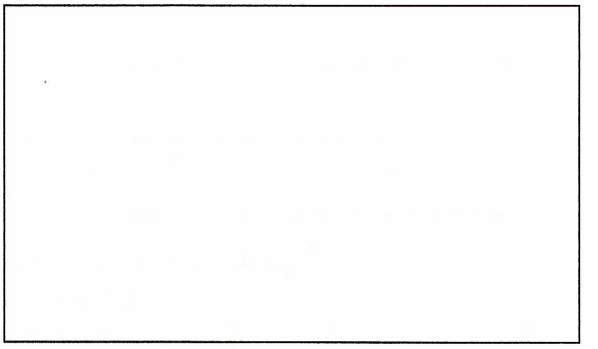
4. Meters can measure potential difference and current.

- The instrument you use to measure the potential difference across a battery or across a load is called a **v**_____. Because you always measure the difference in energy between two points in the circuit, the voltmeter must be connected to these two points.

- The instrument that you use to measure the current passing through a circuit is called an **a**_____. Current flows through every point in a circuit, so you must connect the ammeter into the circuit so the current flows through it.

Source: Science Links 9. McGraw-Hill Ryerson. 2009





5. Potential difference and resistance affect current.

- If you increase the potential difference of the source in a circuit but keep the resistance the same, the current will **i**_____.
- If you increase the resistance in a circuit and keep the potential difference the same, the current will **d**_____.

Homework: *p.***142 and 143**

Source: Science Links 9. McGraw-Hill Ryerson. 2009

Name _____ Date _____

Topic 4.4 Summary

Electrical Circuits

Textbook pages 274–291

Before You Read

How can people control and use the movement of charges? Write your ideas on the lines below.

_____

_____

Mark the Text

Check for Understanding

As you read this section, stop and read again any parts you do not understand. Highlight all the sentences that help you get a better understanding.

Reading Check

1. What is potential difference?

_____

_____

What is current?

_____

_____

2. Which meter is used to measure potential difference?

_____

Which meter is used to measure current?

_____

What is an electrical circuit?

An **electrical circuit** is a closed path made of connecting wires, a source, and load(s).

The **source** provides the energy needed to operate any electrical device. This energy causes charges to move through the circuit. Examples of sources are a battery or electrical outlet.

A **load** is any device that converts electrical energy (carried by the charges) into another form of energy, such as heat or light. Examples of loads are a light bulb or a radio.

What are potential difference, current, and resistance?

Potential difference (*V*), or voltage, describes how the energy of each unit of charge changes as it passes through the source or a load. This change, or difference, in energy can be an increase or a decrease. As charges pass through a source, entering one end and exiting the other, they gain energy.

As charges pass through a load, they lose energy. Potential difference is measured in **volts (V),** using an instrument called a **voltmeter**.

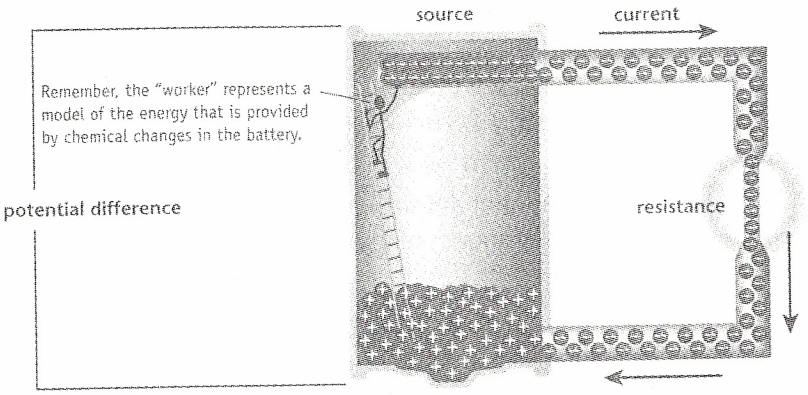
Current (*I*) is the moving charges in an electric circuit. Since charges cannot build up in a conductor, the amount of current flowing past every point in the wire is the same. The amount of current flowing through a wire is measured in **amperes (A),** using an instrument called an **ammeter**. A **switch** in the circuit helps control the flow of current. When it is closed, it allows charges to flow through. When it is open, it prevents charges from passing through.

A load resists the flow of current. This hindering of the movement of charges is called **resistance (*R*)**. Resistance is measured in **ohms (Ω)**.

Name _____ Date _____

Topic 4.4 Summary

The diagram below shows how the negative charges move through a circuit that consists of a battery, light bulb, and connecting wires.



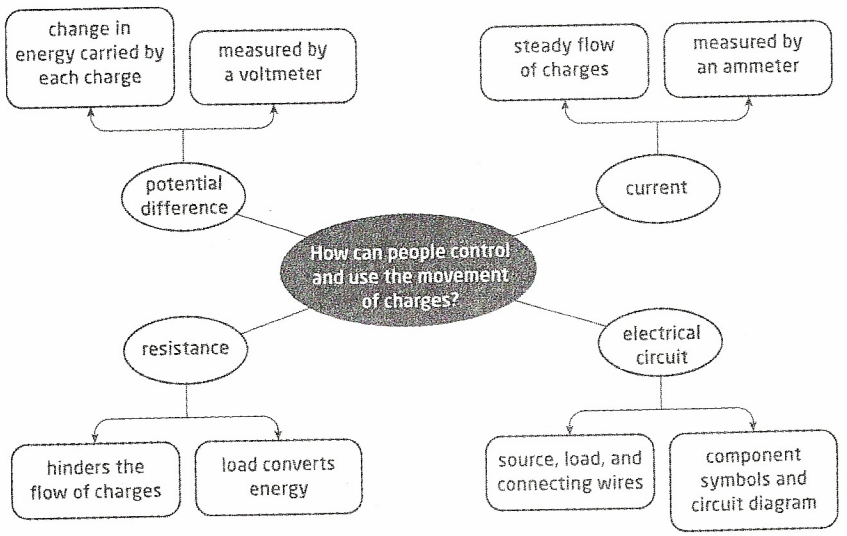
What is a circuit diagram?

Symbols are used to represent different components in a circuit. A picture drawn using these symbols to represent an actual circuit is called a **circuit diagram**.

Component of Circuit	Component Symbol
Source (battery)	
Conducting wire	
Load (resistance)	
Switch: open / closed	
voltmeter	V
ammeter	A

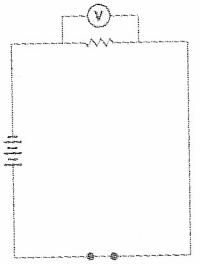
What are the effects of potential difference and resistance on current?

If the potential difference across the source increases, while the resistance of the load remains the same, then each charge carries more energy and flows more easily, and the current becomes higher. If the potential difference across the source stays the same, while the resistance in the circuit increases, the current passing through a particular point in the wire becomes smaller.



Reading Check

3. Name all of the components in the circuit diagram below.



Name _____ Date _____

Cloze Activity
Topic 4.4

Use with textbook pages 276–283.

Potential difference, current, and resistance

Vocabulary	
ammeter	ohms
amperes	potential difference
circuit diagram	resistance
current	source
electrical circuit	switch
energy	voltmeter
load	volts

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

1. A constant source of electrical energy causes charges to move through a circuit. This flow of charges is called a _____.
2. When the electrical energy in a circuit reaches the _____, it is converted into a useful form.
3. The change in energy of an electric charge as it passes through the source or a load is called _____.
4. A(n) _____ is used to measure potential difference and a(n) _____ is used to measure current.
5. As charges move through a load, there is a hindering or _____ to the flow of current.
6. The units used for potential difference are _____, for current are _____, and for resistance are _____.
7. The _____ in a circuit is used to allow or prevent the flow of current.
8. In a _____, symbols are used to represent components in the actual circuit.

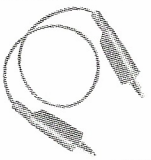
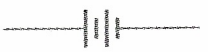
Name _____ Date _____

Applying Knowledge
Topic 4.4

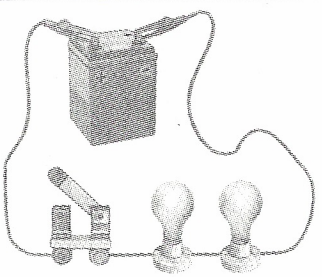
Use with textbook pages 280–281.

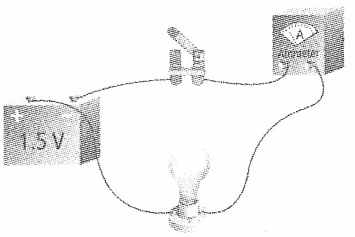
Circuit symbols and circuit diagrams

Match the Term in the first column with the correct Illustration and Circuit Symbol in the other two columns. Place the corresponding letter and Roman numeral in the blank spaces provided.

Term	Illustration	Circuit Symbol
1. bulb _____ _____	A. 	I. 
2. battery _____ _____	B. 	II. _____
3. open switch _____ _____	C. 	III. 
4. conducting wire _____ _____	D. 	IV. 

Use circuit symbols to draw circuit diagrams for each of the following.

5. 

6. 

Name _____ Date _____

Comprehension
Topic 4.4

Use with textbook pages 276–283.

True or false?

Read the statements given below. If the statement is true, write "T" on the line in front of the statement. If it is false, write "F" and rewrite the statement to make it true.

1. ___A load in a circuit transforms light energy into electrical energy.

_____

2. ___The wire through which electric current flows is a conductor.

_____

3. ___A switch supplies the energy in a circuit.

_____

4. ___Potential difference describes how the energy of each unit of charge changes as it passes through the source or a load.

_____

5. ___Current is measured in volts.

_____

6. ___An ammeter is used to measure the resistance in a circuit.

_____

7. ___Circuit diagrams use circuit symbols to illustrate actual electrical circuits.

_____

8. ___Resistance is the flow of charges in a circuit.

_____

9. ___With the potential difference across the source remaining unchanged, the current will decrease if the resistance increases.

_____

10. ___With the resistance in the circuit remaining the same, the current will decrease if the potential difference increases.

_____

Name _____ Date _____

Assessment
Topic 4.4

Electrical circuits

Use with textbook pages 274–291.

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
1. _____ ammeter	A. the change in energy of a unit of charge
2. _____ current	B. the flow of charges in a conductor
3. _____ electrical circuit	C. a quantity that describes the hindering of the flow of charges
4. _____ load	D. formed by connecting a source, load, and wires into a closed loop
5. _____ potential difference	E. a device that supplies electrical energy to operate any electrical equipment
6. _____ resistance	F. a device that converts electrical energy into another form of energy
7. _____ source	G. a device that allows or prevents the flow of current in a circuit
8. _____ switch	H. a device used to measure the potential difference across a battery or load

9. Complete the chart below to compare potential difference, current, and resistance.

Quantity	Symbol	Unit
potential difference		volts (V)
current		
resistance	*R*	

10. Describe what happens to the negative charges in a simple circuit when

a) the switch is closed

_____

b) they travel through a load

_____

c) they travel through the source

_____

11. Draw a circuit diagram of a circuit that consists of a source, a resistor, connecting wires, and a voltmeter connected to measure the potential difference across the source.

12. Describe two ways in which potential difference and resistance affect current.

_____

_____