

HOW DOES A ROBOT WORK ?

50 minutes



Image 1, Ref - see slide 18

1

PRE ASSESSMENT QUESTIONS

1. What is electricity?
2. Name two electric devices we use daily and how they work.
3. Mention two devices that do not use electricity.
4. Name one common form of storing electrical energy.

ELECTRICITY

Have you ever wondered what makes a cell phone, refrigerator or a light bulb work?

One thing that all these devices have in common is ‘they are all electronic devices’ which means they work when charged with electricity.

So what is ‘Electricity’?

The words ‘electron’, ‘electric’, ‘electricity’ originate from the Greek word ‘elektor’, meaning ‘beaming sun’.

Electricity is flow of electrical charge. Everything in the universe is made of atoms and atoms are made of even smaller particles called ‘electrons’, ‘protons’ and ‘neutrons’, some of which are charged. Electricity is due to the flow of electrons that have gotten loose from atoms.

ELECTRIC CURRENT

- **Electricity is the flow of electrical charges through conductors.**

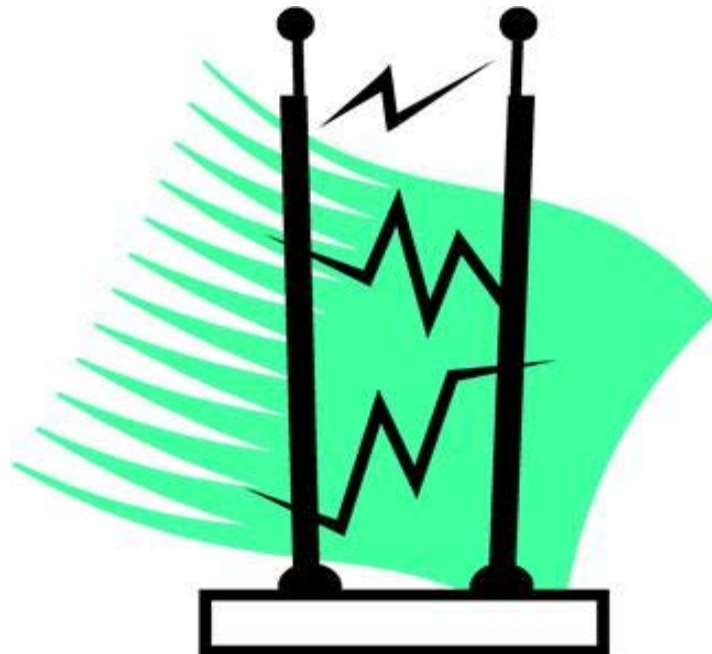


Image 2, Ref - see slide 18

ELECTRIC CURRENT

- **Example for direct current:** electricity created by batteries.
- Electricity comes from outlets at home too – but don't use them!
- Electric current passes through metals.

Example: Copper wire is a very good conductor of electricity, wood is a poor conductor of electricity.



Batteries



Electrical outlet



Copper Wire



Wood

WHAT IS A BATTERY?

- A battery is a source of electrical current. It is a device that stores chemical energy which is converted to electrical energy when connected in a circuit. That is, it caused electrons (charged particles) to flow through conductors.
- Batteries are of two types:
 - Primary: these cannot be recharged.
 - Secondary: these batteries can be recharged.
- When a metal wire is connected across the two terminals of a battery (one positive and one negative), an electric current passes through the conductor (metal wire).

ELECTRICAL CIRCUIT

- What is an electric circuit?

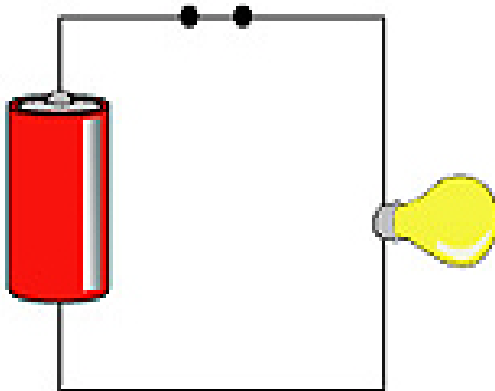
A source of electricity (battery) connected to one terminal of any electrical device (e.g., motor) using a wire, with the other terminal of the device connected back to the source through another wire is a simple ‘electric circuit’.

- Electric circuits are of two types:
 - Open – the wire not connected back to the source.
 - Closed – the wire connected back to the source.
- For electricity to flow, an electric circuit should be closed.
- Watch this video:

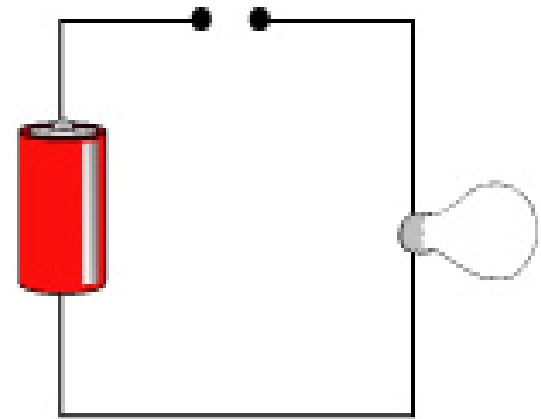
<http://www.youtube.com/watch?v=AY9qcDCFfeVI>

CLOSED AND OPEN CIRCUITS

CLOSED CIRCUIT

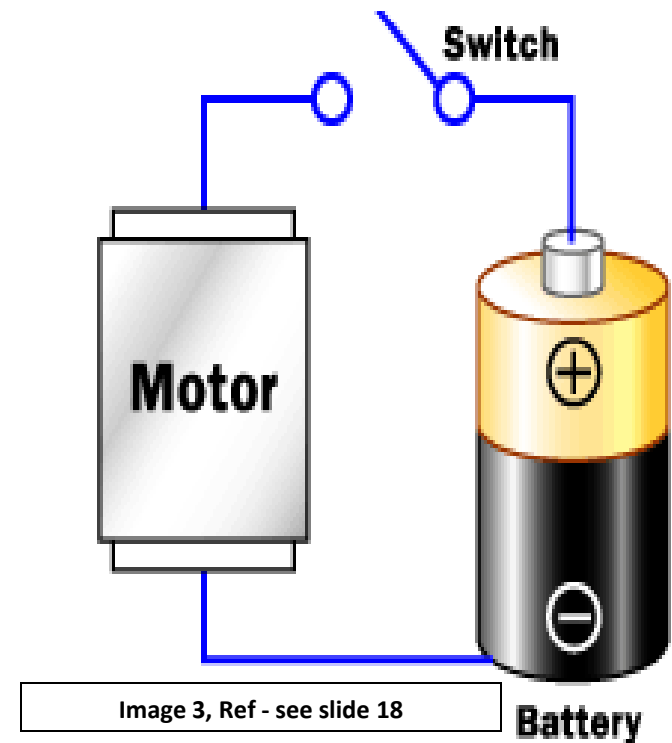


OPEN CIRCUIT



HOW DOES A BATTERY PRODUCE ELECTRICITY?

- In the figure, you see a circuit:
 - Battery's (source) positive terminal connected to switch and negative terminal connected to motor (electrical device).
- When the switch is pressed, the circuit is closed and electricity flows to power the motor.
- Motor: Converts the electrical energy to useful mechanical energy (movement of motor)

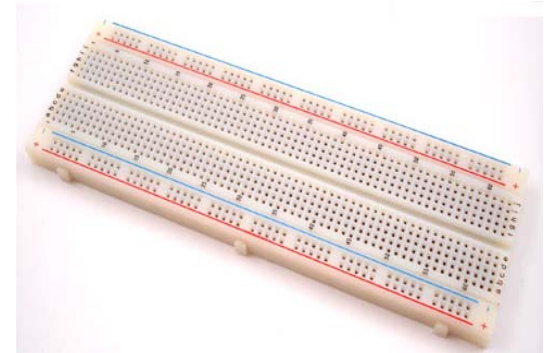


DEMONSTRATION OF AN ELECTRIC CIRCUIT

- This demonstration takes 10 minutes assuming the electric circuit is already assembled.
- Components needed:
 - Bread board
 - DC motor
 - Battery
 - LED
 - Buzzer



Buzzer



Bread Board



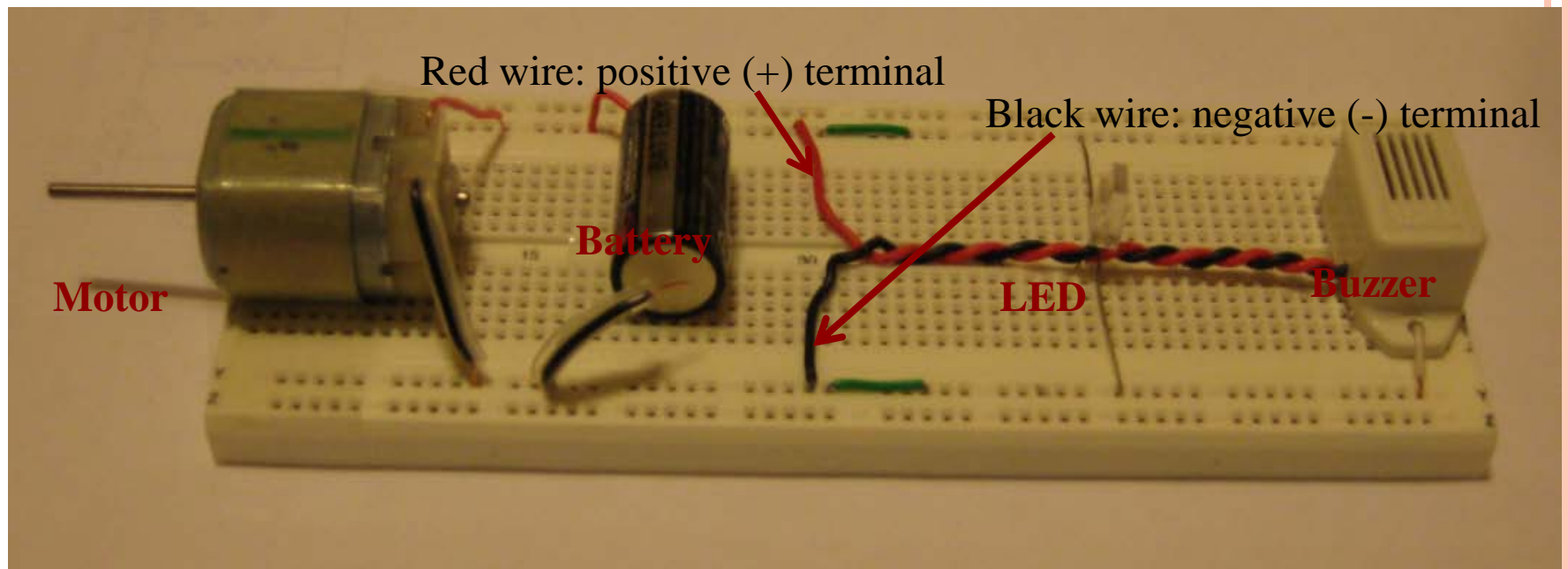
LED



DC motor

SIMPLE ELECTRIC CIRCUIT

Connect the black wire of the battery to the rails. What happens?



Slide provided by Dr. Jae Kwon,
Univ of Missouri

BATTERY IN THE LEGO ROBOT

- In the figure, you see the battery used in LEGO NXT robot.
- This is a ‘secondary’ type battery as it can be recharged.
- When this battery is inserted into the battery case of NXT, it powers the NXT robot and when you press the orange button on the brick it is similar to pressing the switch to ‘close’ the circuit.



LEGO NXT battery

LED, BUZZER AND MOTOR NEED ELECTRICITY TO WORK

Electricity comes from energy stored in the battery.

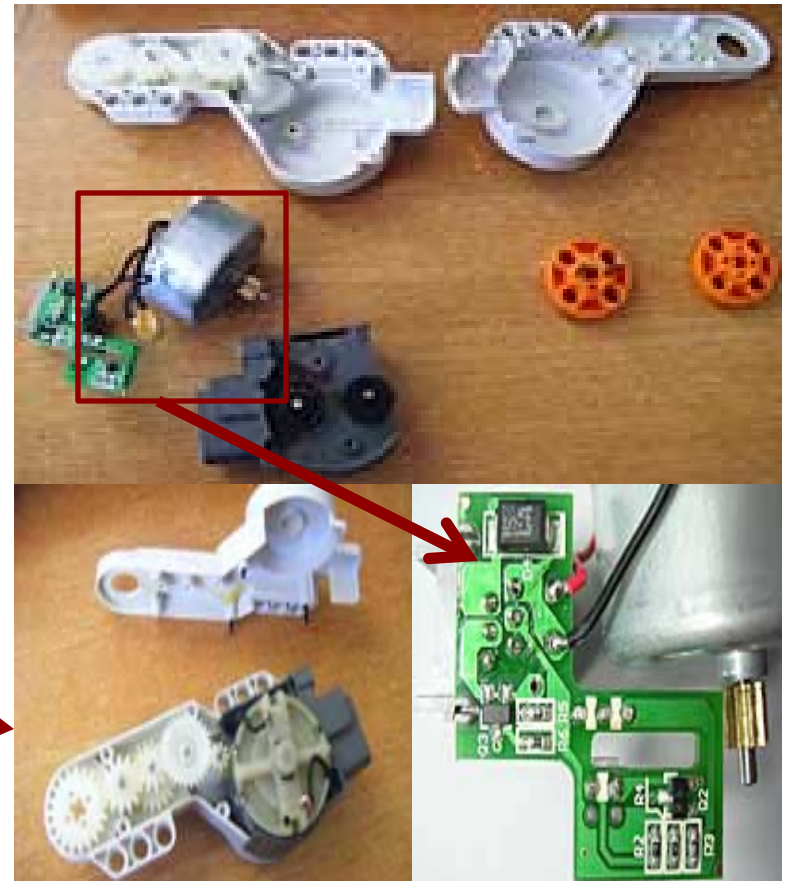
The electrical circuit enables the LED to convert electrical energy to light energy.

Similarly, the circuit enables the buzzer convert electrical energy to sound energy.

Finally, the motor converts electrical energy into mechanical energy, similar to what is done in your NXT taskbot.

THE LEGO NXT MOTOR OPENED UP

- When the circuit is closed, the battery powers the motor and drives the **gear train** inside the motor which in turn drive the wheels of the robot.



Can you see that the NXT motor inside is similar to the demo motor!

Image 4, Ref - see slide 18

ACTIVITY: BALL SHOOTER - USING LEGO NXT

- Switch to the Activity PowerPoint



Image 5, Ref - see slide 18

POST-ASSESSMENT QUESTIONS

1. Draw a simple electric circuit to show how a bulb can be lighted using a switch.
2. How does an NXT motor move?
3. Electrical energy can be converted to other forms of energies. Name two forms and electrical devices that use them.
4. Mention any human activity analogous to NXT motor shooting balls.

POST-ASSESSMENT QUESTIONS

1. Draw a simple electric circuit to show how a bulb can be lighted using a switch.

See picture on slide 8

2. How does an NXT motor move?

The NXT battery supplies electrical energy to the motor and makes it move

3. Electrical energy can be converted to other forms of energies. Name two forms and electrical devices that use them.

Buzzer – converts electrical energy to sound energy.

LED – converts electrical energy to light energy.

4. Mention any human activity analogous to NXT motor shooting balls.

Using of your arm to throw a ball.

IMAGE SOURCE/RIGHTS

Image 1:ADA Description: Robot

Image file name: robot.jpg

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Image 2:ADA Description: Electricity

Image file name: electricity flow

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Image 3:ADA Description: Simple Electric Circuit

Image file name: battery.jif

Source/Rights: static.howstuffworks.com/gif/battery.gif

Image 4:ADA Description: NXT Motor internal parts

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Image 5:ADA Description: NXT Ball shooter

Image file name: ball_shooter.htm

Source/Rights:http://www.nxtprograms.com/NXT2/ball_shooter/index.html

END OF LESSON