

## Common Misconceptions About Electric Circuits Lesson Notes

### Learning Outcomes

- What are common preconceived ideas that cause difficulty understanding circuits?
- What is the essential problem with those ideas?

### What Do You Believe?

Often times in Physics it is the ideas we do know that creates a greater barrier to learning than the ideas that we don't know. What pre-conceptions do you have regarding circuits? Identify the following statements as being True (T) or False (F).

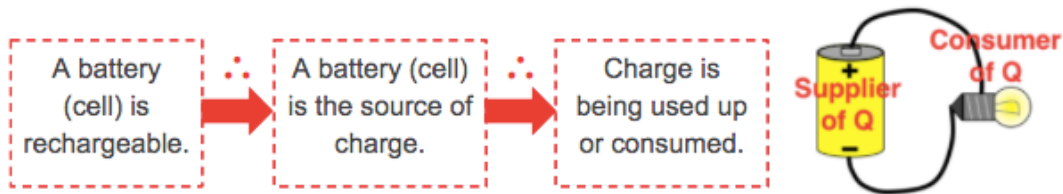
#### Statement

- |   |               |
|---|---------------|
|   | <b>T or F</b> |
| a. When an electrochemical cell no longer works, it is out of charge and must be recharged before it can be used again.                                   | T or F        |
| b. An electrochemical cell can be a source of charge in a circuit. The charge that flows through the circuit originates in the cell.                      | T or F        |
| c. Charge becomes used up as it flows through a circuit. The amount of charge that exits a light bulb is less than the amount that enters the light bulb. | T or F        |
| d. Charge flows through circuits at very high speeds. This explains why the light bulb turns on immediately after the wall switch is flipped.             | T or F        |
| e. The local electrical utility company supplies millions and millions of electrons to our homes everyday.  | T or F        |

### A Bad Starting Point

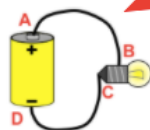
Let's suppose:

- An electrochemical cell is re-chargeable.
- Recharging: restoring/replenishing lost or used up charge.

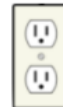


The above thought pattern is a perfectly logical extension of these two suppositions yet ... all three claims all contrary to the model of electric circuits presented in our Tutorial Series.

### More Wrong Turns



Charge moves very fast from A to B.  
 Charge gets used up between B and C.  
 Less charge enters at D than exits at A.



A public utility company delivers millions or billions (or a countless #) of electrons to customers every day.

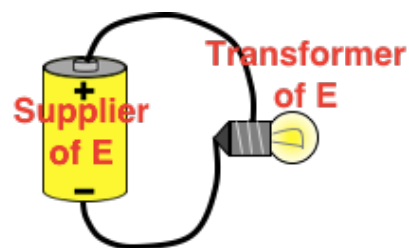
## Batteries are NOT Rechargeable

- Rechargeable batteries can be bought in stores, used, placed in devices known as re-chargers, and have their lifespan increased. What's so bad about that?
- If "rechargeable" means having the lost and expended charge replenished/restored, then it's a real rip-off ... at least to the Physics student trying to learn Physics.
- Circuits don't consume or destroy or diminish charge!
- If the amount of charge in a circuit is never changing, then why would one ever need to replenish it
- If re-chargers don't re-charge, let's not call them re-chargers!



## It's All About Energy

- The cell supplies the energy to pump the charge from low potential to high potential. This motion is against the E field and requires work.
- The electrical energy of moving charge is transformed by the load (bulb, motor, heater, etc.) into non-electrical forms. The charge leaves the load less energized than it entered. It needs an energy boost.
- As reactants in the electrochemical cell become depleted, the cell no longer has energy-producing ability.



## Some Batteries (Cells) Are Reversible

The cells we call re-chargeable would best be called **reversible**. They have the ability to be reversed.

### When Using the Device/Cell

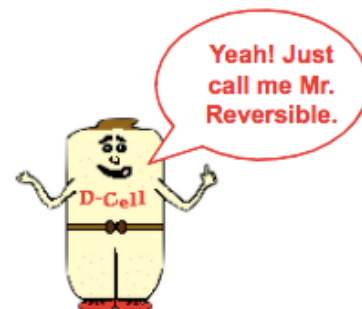
Reactant Chemicals  $\Rightarrow$  Product Chemicals + Energy

Energy makes the device work.

### During "Re-charging"

Product Chemicals + Energy  $\Rightarrow$  Reactant Chemicals

Energy is supplied by the *outlet*.



**Reversing** or **re-energizing** would be a much better name for the process that we call re-charging.

## Two Models of Chare Flow

	<b>Preconceived Ideas</b>	<b>Your Physics Teacher's Model</b>
1.	A cell that no longer works is out of charge.	A cell that no longer works is out of energy-producing reactants.
2.	A cell is a source of charge. The charge that flows originates in the cell.	A cell is a source of energy. It pumps the charge that is already present in wires.
3.	Charge becomes used up as it passes through circuit elements.	Electrical energy is transformed to other forms by circuit elements.
4.	Charge moves at high speeds, lighting bulbs instantaneously.	Charge moves slowly; its motion begins instantly ... leading to instant lighting.
5.	The utility company supplies millions of e <sup>s</sup> to our homes each day.	Utility companies don't supply e <sup>s</sup> ; they supply millions of Joules of energy.