Class: Science 6

Lesson Title: Electric Circuits

Class Size:**24**
Time: **60 mins**

Curriculum Outcomes:
303-24 describe the role of switches in electrical circuits
303-25 compare characteristics of series and parallel circuits

Learning Objectives:
1. Students will demonstrate an understanding of series and parallel circuits (differences, similarities and uses).
2. Students will show understanding of parts of a circuit (switches, resistors, batteries).

Materials:
- Pinnies of various colours (or in lieu of pinnies, nametags: Battery, Light, Switch, Motor, other mechanical device)
- Flashlight(s)
- Hand-held fan(s)
- Any other mechanical object of your choosing
- 4-7 Volleyballs and sticky notes
- *Optional*: Class set of plastic cups and15-20 small balls (plastic, bouncy, or other material)

Note: There are three possible variations for this activity. The choice described in this lesson plan will be using students as electrons. To see details on two other possible choices see the bottom of this document. If you decide to use one of the other choices of electron mediums, you will require the "optional" materials above.

Preparation beforehand:
- You will need a large enough area that students can form a circle in (maybe by clearing desks, or using the gym or outside space)
- Create the nametags as described above, or obtain pinnies

Introduction:
1. Discuss features of electric circuits that students can recall from memory (possibilities):
    - Metal wires form circles (closed); types of metals: aluminum, copper, iron, steel, etc.
    - Electricity is made up of electrons that move in the wire from atom to atom
    - Used to power things (motors, lights, etc.)
    - Switches used to stop and start electron flow
2. Explain what a kinulation is (broken up into kinesthetic and simulation). Tell them that these are used to help students learn difficult concepts that are otherwise difficult to picture. It allows students to become part of the demonstration, and therefore easier to remember and learn. Ask students if they would like to try one.

Electric Circuits:
Variation #1:
1. Have students form a circle (the circuit). Ask them what kind of circuit this would be (closed, simple, series).
2. Ask them what they might represent in this circuit (either atoms of the circuit, or electrons of the imaginary circuit). If they aren't going to be moving, what would they represent in the circuit (do the atoms of the circuit actually move, or is it just the electrons)?
3. Today we will be using volleyballs to represent electrons, i.e. students will represent stationary metal atoms. You can never have more than one electron per atom, meaning never more than one ball per person. Sticky notes will be used to represent energy provided by the battery.
4. Ask the students where the electrons might come from and what they need in order to motivate their electrons to move (battery to push the electrons: positive force to attract, or negative force to repel, or combination of both). Designate students as positive, negative, and inner/neutral parts of the battery. These students will stand together. The inner/neutral role will be in charge of adding sticky notes (energy from the battery) to the volleyball (electron) as it is circulated around the circuit.
5. Have electron(s) passed around the circuit in the correct direction (toward +, away from -).
6. You can ask students what would happen if a circuit was setup like this, simply wire and a battery (is it

doing anything? Is there any point in having a battery just attached to a wire?). What they would need to fix the problem. This will bring up the idea that there is potential for doing something with the electricity (energy from the battery – sticky notes), like powering something; in order to not have a short circuit, we need resistors.

7. Add a resistor (light) to the circuit, and as the electrons pass the light, the student can remove a sticky note (to represent the transfer of energy) and turn on their light.
8. As students are circulating the electron(s) with their new light in the circuit, ask them: how they would stop or start the electrons flowing? What do you need in a circuit to "tell" the electrons to go or stop (we can't just tell them verbally). This will bring up the role of a switch, which you can now add to the circuit.
9. Discuss what other things that can be run by electricity that you might want to add into the circuit (fans, motors, music players, etc.). These can be added in as well to the circuit.
10. Ask students what would happen if say the light stopped working (so the student holding the light, could not take a sticky note nor receive the volleyball). In this setup could electrons keep going? (NO).
    a. What could we do to overcome the burnt out light without physically taking it out of the circuit or replacing it? (Have a detour or second path around the light that electrons could flow – becomes a parallel circuit!)
11. Students should be able to setup pathways so that a few different resistors are on their own paths (in case something breaks down). You can then proceed to have the circuit back on and call out for a resistor to fail (like the light, fan, etc.) and students must react to the break (passing the volleyball – electron – around the functional circuit).
12. This activity can be tailored to include as much or as little about electric circuits as necessary. Students can be asked to give further explanation or model different scenarios as electrons within a circuit.

Variation #2: Instead of using volleyballs to represent electrons, students themselves will represent the moving electrons. In this scenario, the atoms (or circuit) will simply be the imaginary path the students follow. You do not need a inner/neutral role for this variation, simply the positive and negative roles of the battery to attract and repel students (negatively charged electrons). Instead of having sticky notes for the resistors to grab, resistors will simply turn on when students pass them by (representing electrons flowing by/through the resistors).

Variation #3: Instead of students representing the electrons and circulating, students can represent the atoms (stationary) and circulate small balls (representing electrons). Each student would be given a plastic cup to represent their capacity for electrons (1 electron) as metal atoms. The rest of the activity is exactly the same except small balls are circulated instead of students. You may wish to add the neutral/inner battery role to be in charge of adding small balls to the circuit, but it is not necessary.

Conclusion – Possible wrap-up questions:

1. What benefits do you see in becoming part of the demonstration of the concept?
2. Is anything clearer to you because of being involved?
3. What type of system (parallel or series) would seem most beneficial for power grids? Can you see any downfalls (costs associated with parallel are greater, but if everyone was on series, one house blowing a fuse could knock out an entire neighborhood)?