Science Unit: ***Electricity with Applications***

Lesson 1: ***Elements***

School Year:	2010/2011
Developed for:	Pierre Eliot Trudeau Elementary School, Vancouver School District
Developed by:	Scott Morgan (scientist), Alison Diesvelt and Paula Jeram (teachers)
Grade level:	Presented to grades 5 and 6; appropriate for grades 5 - 7 with age appropriate modifications
Duration of lesson:	1 hour and 30 minutes (revise as needed)
Notes:	

Objectives

1. To learn about the periodic table, electrons, protons, and their relation with conduction and insulation.
2. To learn which elements make good conductors and which do not.
3. To learn about the structure of an atom.

Background Information

This lab introduces the periodic table, the structure of the atom, and how the positions of the elements in the periodic table relate to conduction and insulation.
An element is a piece of matter in its simplest form. All matter (solid, liquid, gas) is made of atoms. Atoms join together to make *molecules.* For example, two hydrogen atoms combine with one oxygen atom to make a molecule of water (H_20). The nucleus of an atom cannot be broken down into smaller pieces, except through nuclear decay (fission, fusion, etc.)

Atoms consist of a nucleus containing a number of protons, which have a positive charge and neutrons, which have no charge, and surrounded by a cloud of electrons, which have a negative charge equal in magnitude to the proton charge. There is usually one electron per proton. Elements are defined by the number of protons in the nucleus, regardless of the number of neutrons. For example, Carbon has six protons, but occurs sometimes with six neutrons and sometimes with eight. Typically there are approximately the same number of neutrons as protons.

The periodic table lists all of the known elements in a table according to the number of protons. The number of protons in an element is known as the atomic number. Carbon has six protons, so its atomic number is 6. The periodic table is arranged so that the atomic number increases as you read from left to right in a row. The columns are arranged according to common properties the elements exhibit. This is why the table is called periodic: there is a periodicity in the properties of the elements as the atomic number increases. Column 18, for example, is called the noble gases. These elements almost never combine with other atoms.

Vocabulary

atom	A basic unit of matter made of a nucleus composed of protons and neutrons surrounded by a cloud of electrons.
proton	The positively charged parts of an atom.
neutron	The particles of an atom that have no charge.
electron	The negatively-charged parts of an atom.
element	It is a type of atom defined by its number of protons. Hydrogen has one proton, helium has two protons, and so on.
molecule	Two or more atoms held together by strong bonds.
periodic table	A table of all elements arranged according to their chemical properties.
conductor	A material that conducts electricity well.
insulator	A material that does not conduct electricity well.
metal	Elements that are usually shiny solids that conduct heat or electricity

Materials

- Yellow, red and green plasticine.
- 10-cm cardboard disks
- Examples of elements for showing to students. (Eg. Helium balloon, aluminum foil, copper wire, gold ring. Table salt (NaCl), nail, tin can, lead fishing weight, lithium battery, plant food, water, titanium in sun cream).

In the Classroom

Introductory Discussion

What is all matter made of (atoms!)? Discussion of atoms. How many atoms can you fit on the head of a pin? How many different atoms are there? How are they different from one another? What's bigger, an atom or a cell? Can you see atoms? Can you see atoms with a powerful microscope (yes! See http://www.physicscentral.com/explore/action/atom-research.cfm)

- Review solids, liquids and gases.
- Show examples of elemental substances and ask what they are (tin foil, iron nail, etc.).
- Introduce element and atomic number.
- Using plasticine, introduce the concept of the proton, neutron, nucleus, electron and atom.
- Introduce the periodic table. Discuss the periodicity of the properties. Show how it is arranged by atomic number and according to shared properties. This organization shows us which elements are called metals, and are good conductors and other elements which are good insulators.
- Ask the students to identify the position on the periodic table of each of the examples brought into class.
- Which of these items are metals?
- Can you give an example of an element which is a solid (aluminum, tin, copper), liquid (mercury) and gas (oxygen, nitrogen)?

Science Activity/Experiment

1. In this activity students will construct simple atomic models of different elements, and identify whether the element is a good conductor or insulator. Cardboard discs will be used to represent 1 2-dimensional atomic structure, and coloured plasticine will be used to represent the protons, neutrons and electrons: protons are green balls (grape size), neutrons are yellow balls (grape size) and electrons are red balls (pea size).

2. The teacher will model the building of the first atom as an example. In table groups students will practice building two more atoms together.

3. Students will then play a game, to see how well each table group can identify the name of different atoms, by the number of atoms it has, and say whether it is an insulator or conductor. The teacher will need the following: a periodic table chart for display that the atomic number, abbreviations, and name of each element, a copy of the activity sheet (see the end of the lesson plan), one set of "game cards" per group and one set of "game score sheets" per group (see the end of the lesson plan).

4. Put periodic table chart on the board and hand out activity sheets.

5. Review vocabulary and key ideas.

6. Explain how the periodic table chart works. Point out the arrangement of conductors and insulators on the table and get students to help identify some of the elements using their names and their atomic numbers.

7. Allow students to try the questions on the activity sheets and model and practice the building of the atomic models.

8. Play the game.

Note: After student groups have finished their atomic models for the game, do a few practice runs with atomic numbers in the higher ranges, before actually playing the game. *Eg. I have ___ protons. I am an insulator/conductor. Who am I? Then explain how the game score sheet works – 2 marks for correctly recording the number of protons and correctly circling conductor or insulator. 3 marks for correctly naming and spelling the element. Total possible score 7 x 5 = 35. The secret goal of the teacher is to have as many winners as possible!*

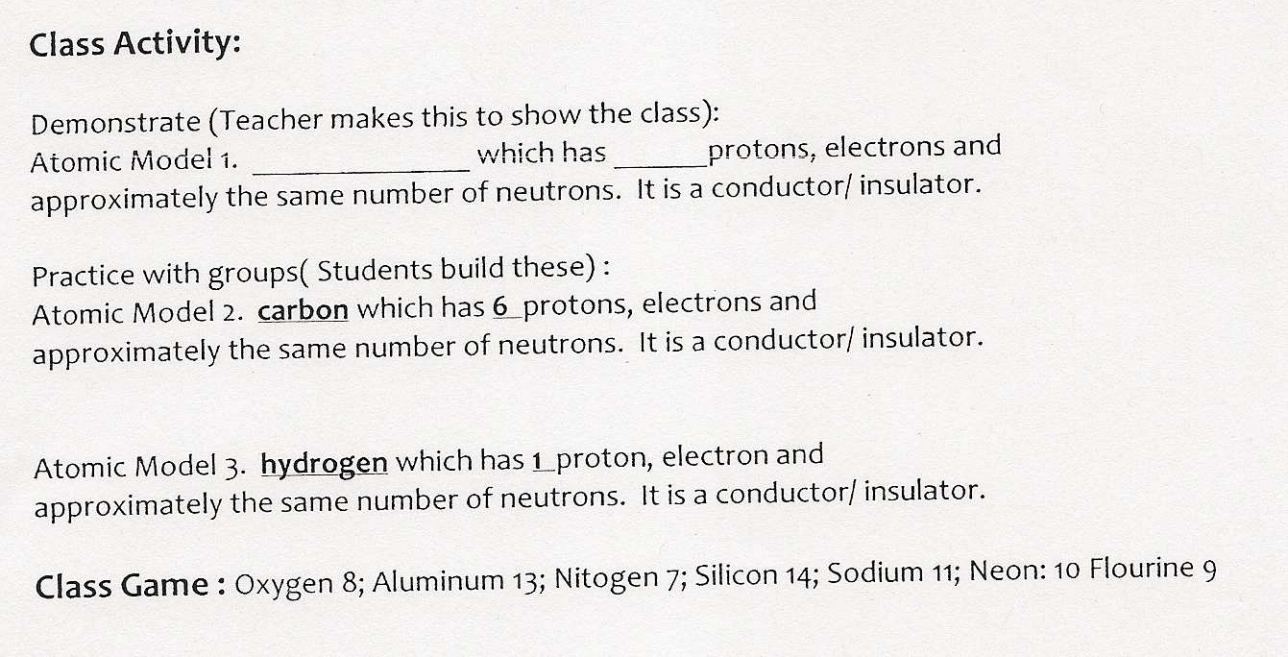
Closure Discussion

1. What is matter made of? (Atoms)
2. How is an atom structured? (protons and neutrons in the nucleus, electrons around the outside)
3. What is the difference between an atom and a molecule?
4. How is the periodic table arranged (by the chemical properties of the elements)? (a molecule is a collection of atoms joined by chemical bonds)
5. What elements are really good conductors? (see attached period table).
6. Where do elements come from? (helium comes from oil deposits)
7. Discuss shortness of supply for important applications. (tantalum, etc. in cell phones, helium)

8. Why are thieves stealing copper pipes? (high cost of copper due to supply shortage)
9. What should we do with electronic devices when we are finished with them? (recycle them)
10. Why are rare earth metals rare? (not commonly found)

References

1. Theodore Gray. 2009. The Elements: A Visual Exploration of Every known Atom in the Universe. Black Dog and Leventhal Publishers, ISBN-13-978-1-57912-814-2.
2. <http://periodictable.com/> A web site to accompany the book *The Elements* (see Reference 1.)
3. <http://http://www.webelements.com/> Everything you might want to know about the elements. Accessed May 29, 2011.
4. <http://www.youtube.com/watch?v=7FesjAdIWBk> YouTube video about the book *The Elements* (see Reference 1.), including a humourous song about the elements by Tom Lehrer.



Class Activity:

Demonstrate (Teacher makes this to show the class):
Atomic Model 1. _____ which has _____protons, electrons and approximately the same number of neutrons. It is a conductor/ insulator.

Practice with groups(Students build these) :
Atomic Model 2. **carbon** which has **6** protons, electrons and approximately the same number of neutrons. It is a conductor/ insulator.

Atomic Model 3. **hydrogen** which has **1** proton, electron and approximately the same number of neutrons. It is a conductor/ insulator.

Class Game : Oxygen 8; Aluminum 13; Nitogen 7; Silicon 14; Sodium 11; Neon: 10 Flourine 9

Activity Sheet:

Questions: Use the Periodic Chart to find these answers.

1. a.) How many *protons* does iron have? _____
   b.) How many *electrons* does iron have? _____
   c.) About how many *neutrons* does iron have? Approximately _____
   d.) Is this element an *insulator* or a *conductor*? _____

2. a.) How many *protons* does nickle have? _____
   b.) How many *electrons* does nickle have? _____
   c.) About how many *neutrons* does nickle have? Approximately _____
   d.) Is this element an *insulator* or a *conductor*? _____

3. a.) How many *protons* does argon have? _____
   b.) How many *electrons* does argon have? _____
   c.) About how many *neutrons* does argon have? Approximately _____
   d.) Is this element an *insulator* or a *conductor*? _____

4. a.) How many *protons* does arsenic have? _____
   b.) How many *electrons* does arsenic have? _____
   c.) About how many *neutrons* does arsenic have? Approximately _____
   d.) Is this element an *insulator* or a *conductor*? _____

5. a.) How many *protons* does copper have? _____
   b.) How many *electrons* does copper have? _____
   c.) About how many *neutrons* does copper have? Approximately _____
   d.) Is this element an *insulator* or a *conductor*? _____

Class Activity:

In this activity we will construct simple atomic models of different elements and identify which whether the element is a good conductor or insulator.

We will use cardboard discs as to represent a 2-dimensional atomic structure, and coloured plastercine to represent the protons, neutron and electrons.

Protons: green (grape size) balls
Neutrons: yellow (grape size) balls
Electrons: red (pea size) balls

The teacher will model the building of the first atom so everyone can see how it is done.
In table groups we will practice the building of two more atoms.
Then we will play a game to see how well each table group can identify the name of different atoms by the number of atoms it has and say whether it is an insulator or conductor.

Oxygen

1. You must build me **secretly**, so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Aluminum

1. You must build me **secretly**, so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Nitrogen

1. You must build me **secretly,** so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Silicon

1. You must build me **secretly**, so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Sodium

1. You must build me **secretly,** so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Neon

1. You must build me **secretly**, so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Flourine

1. You must build me **secretly**, so no one can see me, and figure out if I am an insulator or conductor.

2. When every one is ready you will as your opponents to guess who I am **without telling them my name.**

3. **You will say:**
I have _____protons. I am an insulator/conductor (say which).
Who am I?

Game Score Sheets

Team Name/Table Number: _____

Element Number 1. Protons_____, Insulator/ Condutor (2) My name is: _____(3)
Element Number 2. Protons_____, Insulator/ Condutor (2) My name is: _____(3)
Element Number 3. Protons_____, Insulator/ Condutor (2) My name is: _____(3)
Element Number 4. Protons_____, Insulator/ Condutor (2) My name is: _____(3)
Element Number 5. Protons_____, Insulator/ Condutor (2) My name is: _____(3)
Element Number 6. Protons_____, Insulator/ Condutor (2) My name is: _____(3)
Element Number 7. Protons_____, Insulator/ Condutor (2) My name is: _____(3)

Total game score for team: _____/35