

Electrons & the Synchrotron

Created by: Tanya Spelay, College of Education, University of Saskatchewan A lesson plan for Grade 11 Chemistry

Pan-Canadian Objectives

| Science Grade | Knowledge | Science, technology, society and the environment | Skills | ATTITUDES |
|----------------------|----------------------------------------|---------------------------------------------------------|-----------------------------------|------------------|
| 10-12 | 321-9, 321-10 | 114-8, 114-9, 116-3, 116-4, 117-10 | 214-1, 214-5, 215-1, 215-2, 215-6 | 436 |
| 7-9 | 307-12, 307-14, 307-15, 307-16, 308-12 | 111-1, 111-3 | 211-2 | 425, 429 |

Factors of Scientific Literacy

- ✿ B15 – Model
- ✿ C13 - Formulating Models
- ✿ C15 - Analyzing
- ✿ D1 – Science and Technology
- ✿ D5 – Public Understanding Gap
- ✿ E5 - Computer Interaction

Common Essential Learnings

- ✿ TL – To develop an understanding as to what technology does for our society
- ✿ PSVS – To enable students to work together to accomplish a common goal
- ✿ COMM – To enable students to express their knowledge and understanding of chemistry terms and ideas
- ✿ NUM – To allow students examine the different numbers associated with electrons

Materials

| | |
|--------------------------------------------------------------|--------------------------------------------|
| Pipe cleaners | Glue |
| Styrofoam balls | Tape |
| Fishing line | Chemistry Textbook |
| Markers | Periodic Table with Electron Configuration |
| Computers | Internet |
| Worksheets (Patterns in Electron Configuration, Synchrotron) | |
| Synchrotron Science classroom resources | |

Time

This lesson is estimated at approximately 2-3 hrs long, depending on how long you allow for discussion and building of the atom.

Establishing Students' Prior Knowledge

The following concepts should have already been taught in order to complete this lesson:

- ✿ Properties of Electrons
- ✿ Properties of Atoms
- ✿ Valance Electrons
- ✿ Electron Configuration
- ✿ Electron orbitals (s,p,d,f)

Motivational Set

Teacher Will (if available):

- ✿ Using a Crook's tube, demonstrate to the students that the path of the stream of electrons is made visible on a fluorescent screen. As well, show the student that the path can be deflected by a magnet
- ✿ Explain to the students that in the lesson, we will be examining different aspects of the electron and how it can be used in technology very similar to the Crook's tube.

Body of the Lesson

Teacher Will:

- ✿ Refresh the students on how you can get the electron configuration of an element
- ✿ Go through some sample elements on the periodic table to ensure the students are able to determine the correct electron configurations
 - Example: Na – $1s^2 2s^2 2p^6 3s^1$

Activity One

Teacher Will:

1. Ask the students to take out their periodic tables and textbooks
2. Hand out the patterns in electron configuration worksheet.
3. Explain to the students that there are patterns in the periodic table dealing with electron configuration
4. Have the students examine the periodic table and find the patterns between period number and group number

Students Will:

1. Examine the periodic table to determine the different types of groups that are in the different orbitals
2. Answer the questions on the worksheet

Activity Two

Teacher Will:

1. Divide students into partners

2. Give each group two different elements (any element 1 – 18)
3. Hand out the supplies needed: Styrofoam balls, pipe cleaners, fishing line, glue and markers
4. Ask the students to make a model of the elements using the materials provided, see if they can figure out how they can do it
5. Have them place the electrons in the appropriate orbitals for their element

Students Will:

1. Get all of the supplies needed
2. Propose a strategy to represent the element using the supplies provided
3. Make the atom ensuring that the electrons are in the appropriate orbitals
4. Once done, hang the elements in the classroom

Activity Three

Teacher Will:

1. Discuss with the students why some elements will give off their electrons more easily than others.
2. Have the students compare different elements in the periodic table and determine which element will lose their electrons more easily
 - ✿ Compare carbon and oxygen, which element would lose their electrons more easily?
 - ✿ Compare sodium and cesium, which element would lose their electrons more easily?
3. Have the students draw on their periodic table the pattern that is being established (ionization energy)
4. Explain to the students that using this idea of electron configuration and how electron are placed into different energy levels (orbitals) was the foundations for many technological advances. *Editor's note: A connection can be made here to X-Ray Absorption Spectroscopy. Refer to Synchrotron Science classroom resources for more information.

Students Will:

1. Discuss their ideas as to why some elements will give off their electrons
2. Compare different elements to see which one will lose their electrons more easily
3. Draw on their periodic table the pattern established

Activity Four

Teacher Will:

1. Take the class to the computer room
2. Ask the students to go to www.lightsource.ca (Canadian Light Source Website)
3. Explain to the students that electrons are used in different areas in technology
4. Hand out the Synchrotron worksheets
5. Have the students examine the Canadian Light Source website and answer the questions on the worksheet.
6. Explain to the students that they may have to research other websites to finish the worksheet

Students Will:

1. Go to the computer room and go to the CLS website
2. Answer the questions on the worksheet

Debrief

- ✿ Go through the main points of the lesson: electron orbitals, electron configuration, ionization energy
- ✿ Go through information that the students found on the internet about the synchrotron
- ✿ If possible, have the students go on a tour of the Canadian Light Source Synchrotron

Evaluation

Formal – Marking of worksheets and completion of atom mobile

Informal – Observations of the students working in the computer lab

This information should further be evaluated on the unit exam.

Resources

Canadian Light Source Website - www.lightsource.ca

Periodic Table of Elements - <http://periodictable.tsx.org>

Crook's Tube -

http://genchem.chem.wisc.edu/demonstrations/Gen_Chem_Pages/02_atomsmolpage/atoms%26molecules.htm

The High School Laboratory -

http://www.jozie.net/JF/HS_Chem/Laboratory/labs.htm

Name _____

Date _____

Patterns in Electron Configuration

One of the many patterns contained in the periodic table is that of electron configuration. In this activity, you will identify these patterns. Later, you will use these patterns to determine the order in which electrons fill the orbitals of an atom. As you complete the activity, keep the following in mind:

- ✿ Period = row, Group = column
- ✿ Use the table on your textbook cover, or periodic table handed out which shows the electron configurations and valence electrons.
- ✿ There are two number systems for the Groups. We will focus on the A/B system.

1. Which Groups have an s-orbital as the *last* orbital? _____
2. Which Groups have a p-orbital as the *last* orbital? _____
3. Which Groups have a d-orbital as the *last* orbital? _____
4. Which section of the table is left? This section corresponds to the f-orbitals.
5. Look at Group 1A. What is the relationship between the Period number and the energy level of the valence electrons?
6. Look at Group 3A. What is the relationship between the Period number and the energy level of the valence electrons?
7. Look at Group 3B. What is the relationship between the Period number and the energy level of the d-orbitals?
8. Look at the Inner Transition Metals (bottom section). The Lanthanide series (58-71) is part of Period 6. The Actinide series (90-103) is part of Period 7. What is the relationship between the Period number and the energy level of the f-orbitals?
9. Look at all of the A Groups. What is the relationship between the Group number (1A, 2A, etc.) and the total number of valence electrons for each element? (Add up the exponents to find the total number of valence electrons.)

