# Unit 4: Periodic Table

## Lesson Plan Day 1

**1. Student Activities:** Students will immediately be assigned a project in which they will have to solve a "mysterious" puzzle in which there is a cryptic card missing out of a group. They need to find out what is on the missing card. They will then find out how what the project relates to the periodic table constructed by Dimitri Mendeleev.

**2. Goals and Objectives:** Students will begin to recognize patterns that occur in nature and the periodic table. They will mimic what Dimitri Mendeleev did and realize that his greatest contribution was to leave spaces for elements yet to be discovered.

**3. Materials:** Class Notes 1- Periodic Table and 4:13-Periodic Table Puzzle Lab.

**4. Description and Procedures:**
*Suggested Teaching Strategy:* Do not give students much direction on the "Periodic Table Puzzle Lab". Initially they will complain about it and then eventually organize the cards in patterns and trends to solve for the "properties" on the missing card. This is exactly what Mendeleev did. Stress to students that there are certainly more than one way to organize the cards to find the answer. Start on Periodic Table notes and draw similarity to lab.

**5. Teacher Content Information:**
***Content Background.*** Below is a great portion of the information concerning the periodic table. It would be wise NOT to go over all of this in one day.

- Periodic Table Groups and Families: These are the vertical columns of the periodic table. Elements in the same family are different but have similar properties. Ex. All the noble gases ( Group 8) are all inert gases.
- Periods - Horizontal rows going across the periodic table. Usually labeled 1,2,3….
- Atomic Mass - The amount of matter in an atom.
- Atomic Density - Mass per volume.
- First ionization energy - Energy needed to expel the outer most electron in an atom and thus leaving an ion (charged atom).
- Electron Affinity - How much a neutral atom wants to accept an extra electron.
- Electronegativity - A scale that indicates how much an atom wants to pull on other electrons in bonds with other atoms.
- Atomic Volume - The amount of space taken up by an atom.
- Atomic Radius - The distance from the nucleus to the outer most electron.

*The Importance of the Periodic Table*

What it exhibits:

- Types of elements

- Number of elements
- If elements are natural or synthetic
- Atomic number and weights of each elements
- Electron energy levels
- Electron configuration

Properties that can be predicted with use of the Periodic Table

- Physical properties
- Chemical properties
- Relative ionization energies
- Affinity for electrons

*A Brief History of the Periodic Table*.

Scientists have always been trying to find patterns in nature.

1800s - Scientist found chemicals and elements that could not be broken down any more. They tried to place these in groups and arrange them in some fashion that made sense.

1860s - Scientists discovered that each element had an atomic weight.

1865 - John Newland arranged elements in order of atomic weights. Elements of similar properties were multiples of 7 apart. They repeated every multiple of 8. He called this the law of octaves and suggested it was related to music. His idea was not well accepted.

Dimitri Mendeleev - Russian scientist who rarely shaved (once a year) and taught science classes to students who could not afford education or who were not allowed an education.

He studied properties of known elements and reasoned that not all of them had been discovered. He arranged elements in such a way that "gaps" were left. He predicted the properties of the undiscovered elements and was soon found to be correct (especially for Ge). He realized that the atomic weight and properties followed a pattern. Properties reoccurred at periodic intervals - thus the periodic law and periodic table was born.

New discoveries that helped transform Mendeleev's table:

Ramsay began discovering noble gases. This added a new r Group to Mendeleev's table.

Mosley - Used x-rays to find protons. Called the number of protons for each element the atomic number. Arranging the periodic table by atomic mass worked well with a few exceptions (K and Ar, Co and Ni). Arranging by atomic number worked perfectly.

Glen Seaborg - Discovered the transuranium elements and completed the modern version of the periodic table. The transuranium elements actually have the exception of having similar properties going across the period, not down the rows. He pulled these out (starting with La and Ac). A controversial move at the time but now accepted.

*Arrangement of the Periodic Table:*

Horizontal Rows: Periods or series.
Vertical Columns: Groups or families

*The Families*

Group 1 - Alkali - Very reactive metals
Group 2 - Alkaline Earth - Reactive metals
Group 5 - Metals and metalloids with nitrogen
Group 7 - Halogen Family - Reactive nonmetals
Group 8 - Noble Gases - Very unreactive gases.
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**6. Performance Assessment:** See lab.

**7. Rubric:** See lab.

## Lesson Plan Day 2, 3, 4, 5

**1. Student Activities:** Students take some brief notes about atomic properties. They will be broken up into groups. Each group will be assigned a property, given an edited periodic table, periodic table elemental data, a well plate, scissors and a ruler. Given their assigned property they first must devise a scale and cut a straw based on that scale the appropriate length. As an example, suppose they are assigned electronegativity. Element X has and electronegativity of 1 and element Y has an electronegativity of 2. The Y straw will be twice as long as the X straw. They will do this for all of the elements on the periodic table and create a three-dimensional model of their trend.

**2. Goals and Objectives:** Students will create models of periodic trends so they will be able to predict the trends.

**3. Materials:** See 4:14 Periodic Trends Lab. Class Notes 2 - Trends

**4. Description and Procedures:** See lab.

**5. Teacher Content Information:**
***Content Background.***
General trends. There may be some exceptions and the transition metals are excluded.

- Atomic Radius and Volume: Gets bigger going down a family and smaller across a period (left to right).
- $1^{st}$ ionization Energy, Electronegativity, Electron Affinity - Gets smaller going down a family and bigger going across a period (left to right).

**6. Performance Assessment:** See lab. Quiz over lab and notes.