TEACHER'S GUIDE

SCIENCE KEY CONCEPTS SERIES:

PERIODIC TABLE: PROPERTIES OF ELEMENT GROUPS

17 minutes, Video

Chapters: 1. Mendeleev's Periodic Table 5 min.
2. Noble Gases: Properties and Uses 5 min.
3. Transitional Metals: Properties and Uses 7min.

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FOR USE IN: Chemistry, Physics

LEVEL: Grades 9-12

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EDUCATIONAL OBJECTIVES:
To help the student understand these key concepts:

- **Dmitri Mendeleev's discovered that a certain arrangement of elements in a table (a periodic table) according to their atomic mass, correlated with their chemical properties, and empty spaces in the pattern of this table would predict the atomic mass and properties of as yet unknown elements.**
- **the location of an element in the modern periodic table is determined by the number of protons in its nucleus and the configuration of the electrons in its shell(s).**
- **the location of an element in the modern periodic table describes the chemical properties of that element**
- **that groups and blocks of elements share similar chemical properties.**

BACKGROUND:

The main value of the periodic table is the ability to predict the chemical properties of an element based on its location on the table. It should be noted that the chemical properties of the elements are similar when moving vertically down a

column in the table, but differ when moving horizontally along the rows from one column to another. The periodic table is now ubiquitous within the academic discipline of chemistry providing an extremely useful framework to classify, systematize and compare all the many different forms of chemistry behavior. The table has also found wide application in physics, biology, engineering, and industry. The current standard table contains 117 confirmed elements as of October 16, 2006.

CONTENT

Chapter 1. Mendeleev's Periodic Table 5 min

In 1869, Dmitri Mendeleev, a brilliant Russian chemist, was searching for a possible relationship between an element's atomic mass and its chemical properties. With the symbol for each then known element (60) and its mass represented on a card, he arranged the cards in order of increasing atomic mass in a series of vertical columns. He then adjusted elements within the vertical columns so that those with similar chemical properties were next to each other in the same horizontal rows. His genius was that where ever an empty space appeared, he predicted an element would be discovered with a given atomic mass and its expected chemical properties. And so they were with approximately the same atomic mass.

Since Mendeleev, new discoveries of an atom's nucleus, which contains protons and neutrons, while electrons orbit the nucleus, has led to a different arrangement of elements in the modern periodic table.

Now each element, reading from left to right along a row, called a period, and from top row to bottom, has exactly one more proton in its nucleus. An element's atomic number equals the number of protons in its nucleus. One proton more or less creates a different element. An element's atomic mass equals the number of protons plus neutrons it its nucleus. For every positively charged proton in the nucleus of an atom, there is one negatively charged electron circling that nucleus.

In the modern periodic table, it is now elements in the same column, called a group, which share the same chemical properties

Chapter 2. Noble Gases: Properties and Uses 5 min.

The six elements, all gases, in the far right column (or group) of the periodic table, group 18, like all groups, share a common structure in their outermost electron shell. That outermost shell, whatever its electron capacity, is always full. That

makes these elements extremely non-reactive, and that's why they are called the Noble Gases. Being non-reactive chemically is a very useful property.

Luminescent lights, known as neon lights, are a familiar use of the noble gases neon, helium, or argon or a mixture of them within a clear glass tube. Pass an electric current through the gas, and the color we see is electrical energy absorbed by the gas, then emitted as light energy in a visible color – different gases, different colors. Because there is no chemical reaction, their chemical properties remain unchanged, and these lights can last for up to 30 years.

Fluorescent lights have a fluorescent coating on the inside of a glass tube, and are filled with a noble gas. Electrical energy passed through the gas is absorbed and emitted as light energy, which in turn can be absorbed by a variety of fluorescent coatings and then radiated as visible light energy in any one of a spectrum of colors.

A welding torch releases a flow of the noble gas argon, so unreactive, it shields the hot metal from oxygen in the air to prevent oxidation or an explosion.

Deep divers replace a nitrogen-oxygen mixture with a helium-oxygen mixture because helium being a smaller, lighter molecule than nitrogen, allows for faster passage through body cell membranes during a rapid ascent.

The physical property of density in which helium is lighter than air, makes it both useful and safe in airships. An experiment shows that as one goes down the group of noble gases, each is more dense than the preceding one.

<u>Chapter 3. Transitional Metals: Properties and Uses 7 min.</u>

A large block of elements in the middle of the periodic table, are the transitional metals with common properties that are very useful. They are not as reactive as elements in groups 1 & 2 on the far left of the periodic table.

All have the following common, useful properties with examples given for each. They are hard for tools; shiny for decorative purposes, malleable, ductile, good tensile strength for construction, conduct heat and electricity well, sonorous for musical instruments, high melting points for safe use as a tungsten light filament, combine in alloys which are stronger & harder than pure metal, as catalysts in automobile catalytic converters to change noxious gases into safe ones.

Solutions of transitional metal compounds are colorful, and how they are used artistically as glazes for kiln fired pottery is illustrated.

AFTER VIEWING

The following are a few questions to help stimulate student discussion:

1. **Why are the noble gases relatively non-reactive?**
2. **If you wanted a material with the properties needed to make automobile bodies, where in the periodic table would you look? To make airplane frames?**
3. **If the properties you needed were not those of any element, what would you do?**
4. **What is the relationship between an element's electron configuration, and its properties, both chemical and physical?**

LINKS:

http://www.brainpop.com/science/matter/atoms/index.weml This site contains an animation showing the structure of atoms.

http://www.ewart.org.uk/ This site is called the Interactive Learning Pages and contains a number of interactive pages for students on atoms and atomic structure.

http://www.watertown.k12.wi.us/HS/Staff/Buescher/atomtime.asp This is a timeline covering important dates in the history of atomic structure.

http://www.schoolscience.co.uk/content/4/physics/atoms/partch1pg3.html This is an excellent KS4 site on atoms and their structure. It is designed for self-study by students and contains quizzes and short animation.

http://scienceworld.wolfram.com/biography/ This site is called the Eric Weisstein's World of Scientific Biography and contains useful information about all the key players in the story of atomic theory from Democritus to Rutherford.

http://www.touchspin.com/chem/DisplayTable.html
To view an interactive periodic table, and select any element to view all of its important properties.

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