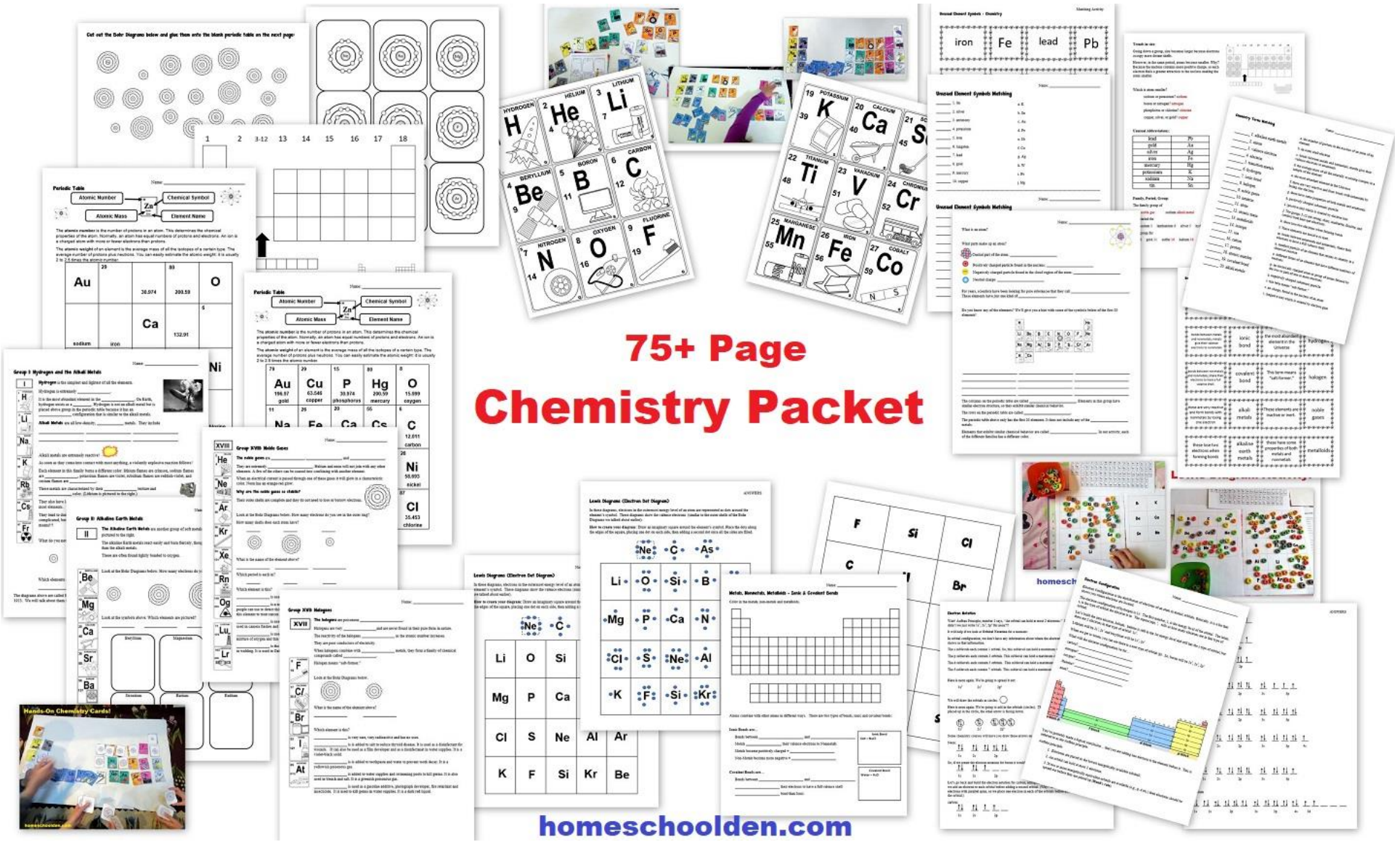
Chemistry Packet

Periodic Table, Valence Electrons, Periods, Groups, Lewis Diagrams and More!



As you know, we love hands-on activities and I want to show you some of the fun ways we explored the periodic table and touched on topics like valence electrons, Bohr Diagrams, Lewis Diagrams (electron dot diagrams), ions, isotopes, and more!

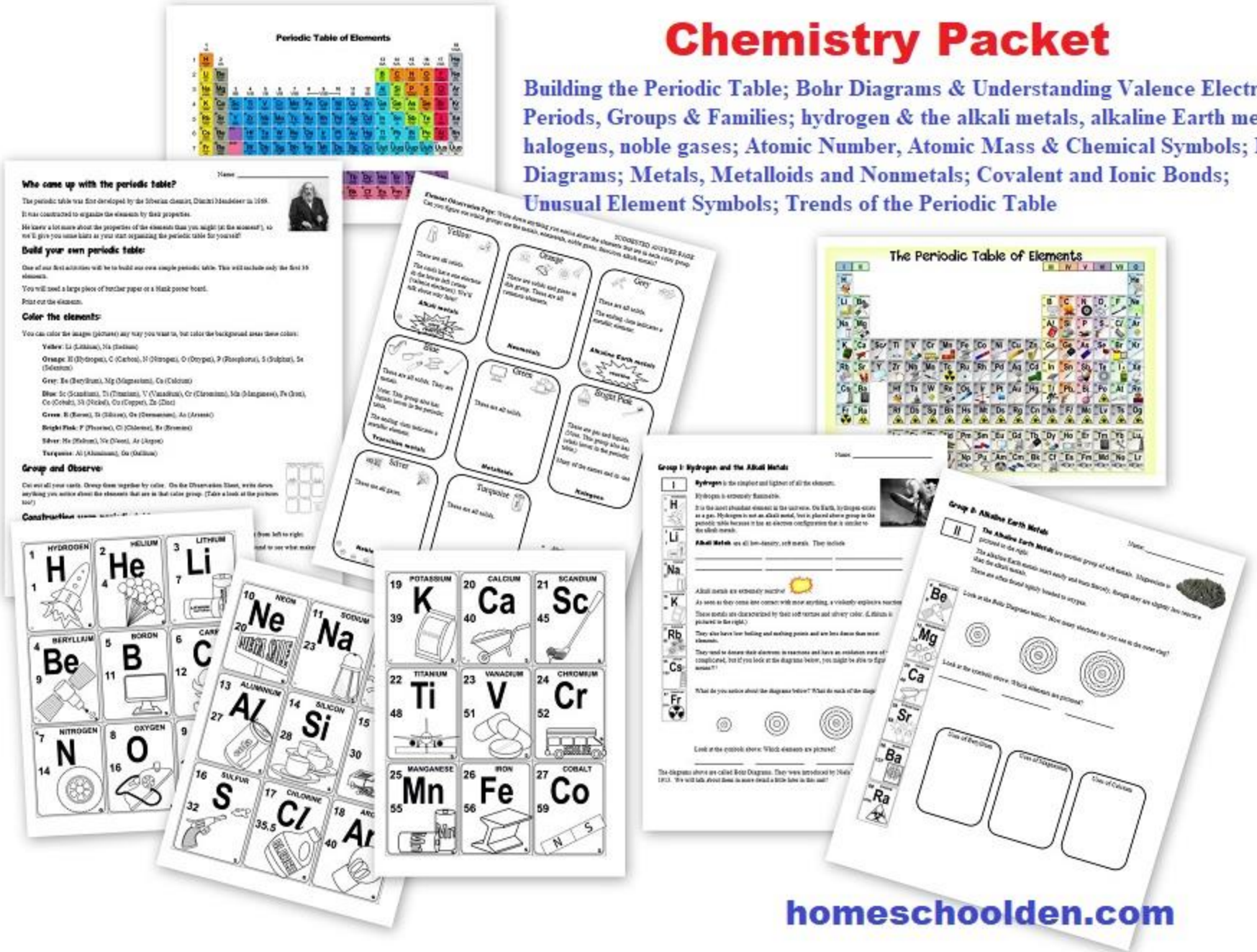
Some of the topics we explored included:

- **Building the Periodic Table**
- **Bohr Diagrams & Understanding Valence Electrons**
- **Periods, Groups & Families**
- **hydrogen & the alkali metals, alkaline Earth metals, halogens, noble gases**
- **Atomic Number, Atomic Mass & Chemical Symbols**
- **Lewis Diagrams**
- **Metals, Metalloids and Nonmetals**
- **Unusual Element Symbols**
- **Trends of the Periodic Table**
- **Electron Configuration**

We did this unit together when the kids were 10, 12 and 14. I think this unit is best for middle school and up (perhaps as a supplement to for high schoolers being introduced to chemistry for the first time).

Chemistry Packet

Building the Periodic Table; Bohr Diagrams & Understanding Valence Electrons; Periods, Groups & Families; hydrogen & the alkali metals, alkaline Earth metals, halogens, noble gases; Atomic Number, Atomic Mass & Chemical Symbols; Lewis Diagrams; Metals, Metalloids and Nonmetals; Covalent and Ionic Bonds; Unusual Element Symbols; Trends of the Periodic Table



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Chemistry Unit, Activity 1:
Building the Periodic Table


Name: _____

Who came up with the periodic table?

The periodic table was first developed by the Siberian chemist, Dmitri Mendeleev in 1869.

It was constructed to organize the elements by their properties.

He knew a lot more about the properties of the elements than you might (at the moment!), so we'll give you some hints as your start organizing the periodic table for yourself!

Build your own periodic table:

One of our first activities will be to build our own simple periodic table. This will include only the first 36 elements.

You will need a large piece of butcher paper or a blank poster board.

Take the print out of the elements and color them as instructed below:

Color the elements:

You can color the images (pictures) any way you want to, but color the background areas these colors:

Yellow: Li (Lithium), Na (Sodium), K (Potassium)

Orange: H (Hydrogen), C (Carbon), N (Nitrogen), O (Oxygen), P (Phosphorus), S (Sulphur), Se (Selenium)

Grey: Be (Beryllium), Mg (Magnesium), Ca (Calcium)

Blue: Sc (Scandium), Ti (Titanium), V (Vanadium), Cr (Chromium), Mn (Manganese), Fe (Iron), Co (Cobalt), Ni (Nickel), Cu (Copper), Zn (Zinc)

Green: Br (Boron), Si (Silicon), Ge (Germanium), As (Arsenic)

Bright Pink: F (Fluorine), Cl (Chlorine), Br (Bromine)

Silver: He (Helium), Ne (Neon), Ar (Argon), Kr (Krypton)

Turquoise or Light Blue: Al (Aluminum), Os (Osilium)

Group and Observe:

Cut out all your cards. Group them together by color. On the Observation Sheet, write down anything you notice about the elements that are in that color group. (Take a look at the pictures too!)


Name: _____

Element Observation Page: Write down anything you notice about the elements that are in each color group. Can you figure out which groups are the metals, nonmetals, noble gases, transition, alkali metals?

Yellow | Orange | Grey

Blue | Green | Bright Pink

Silver | Turquoise


Chemistry Packet

Notes to Teacher:

Do the "Build the Periodic Table" activity before bringing out the actual Periodic Table! We did not spend time looking at the Periodic Table before doing this activity (though they knew what it was because we have talked about chemistry before). I wanted the kids to understand how complicated it was to devise a system that was logical and made sense!

General Teaching Plan for this Unit:

Day 1: Materials for the Student: Print out pages 4, 7, 9, 10, 11, 12

Have the students color and cut out the elements. (Perhaps do this beforehand.)

Build the Periodic Table & the Observation Sheet

Day 2: Materials for the Student: Print out page 13

Go over the parts of the atom, try to identify some of the elements. Have the students re-build the periodic table faster than the previous day.

Day 3: Have the students construct their periodic table again & glue the elements onto a large piece of butcher paper or poster board. Have the students bring out their Element Observation Page (page 6) and explain that the groups have different names. Have the students write the names of the groups on their page (i.e. the yellow group is the Alkali Metals). Each group has different properties. The Alkali Metals, for example are very reactive.

Day 4: Materials for the Student: Print out pages 17, 18, 19 on cardstock and cut out.

Bohr Diagrams – Mix the cards up, have them lay the cards on top of the elements on their Periodic Table Project.

What do they notice about the diagrams? (Each Bohr diagram adds one electron. The columns each have the same number of electrons in the outer shell.)

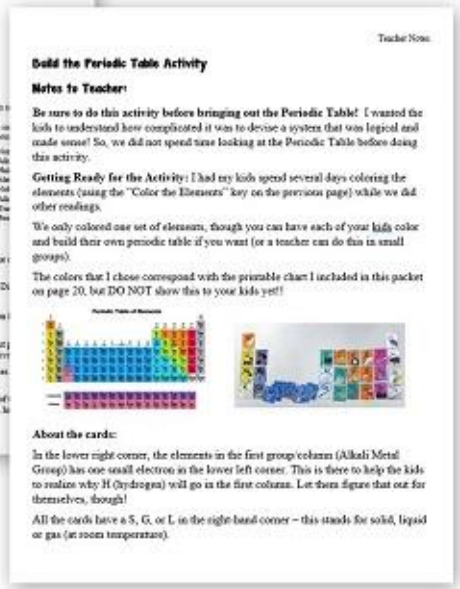
Day 5: Materials for the Student: Print out pages 20-22 Have the students cut out the Bohr Diagrams and glue them on the sheet provided.

Print out student worksheet, **Examine the Bohr Diagrams**, (page 24) and have them work on the answers together.

Day 6: Information on the Periodic Table – Atomic Number, Atomic mass, symbol. Print out page 28 and print out the periodic table on page 28 for the students to use as a reference page for this activity.

Day 7-8: You can have the students complete the quick quiz on page 26. There are two copies of the quiz since it is quite short. The answers are provided on page 30.

Groups of the Periodic Table. (student pages are on: 31, 32, 33, 37, 38, 40) Go over some of the groups of the periodic table in more detail: alkali metals, alkaline Earth metals, halogens, noble gases, transition metals, lanthanoids, actinoids, metalloids, nonmetals, and poor metals.


Teacher Notes

Build the Periodic Table Activity

Notes to Teacher:

Be sure to do this activity before bringing out the Periodic Table! I wanted the kids to understand how complicated it was to devise a system that was logical and made sense! So, we did not spend time looking at the Periodic Table before doing this activity.

Getting Ready for the Activity: I had my kids spend several days coloring the elements (using the "Color the Elements" key on the previous page) while we did other readings.

We only colored one set of elements, though you can have each of your kids color and build their own periodic table if you want (or a teacher can do this in small groups).

The colors that I chose correspond with the printable chart I included in this packet on page 20, but DO NOT show this to your kids yet!!

About the cards:

In the lower right corner, the elements in the first group/column (Alkali Metal Group) has one small electron in the lower left corner. This is there to help the kids to realize why H (hydrogen) will go in the first column. Let them figure that out for themselves, though!

All the cards have a S, G, or L in the right-hand corner – this stands for solid, liquid or gas (at room temperature).

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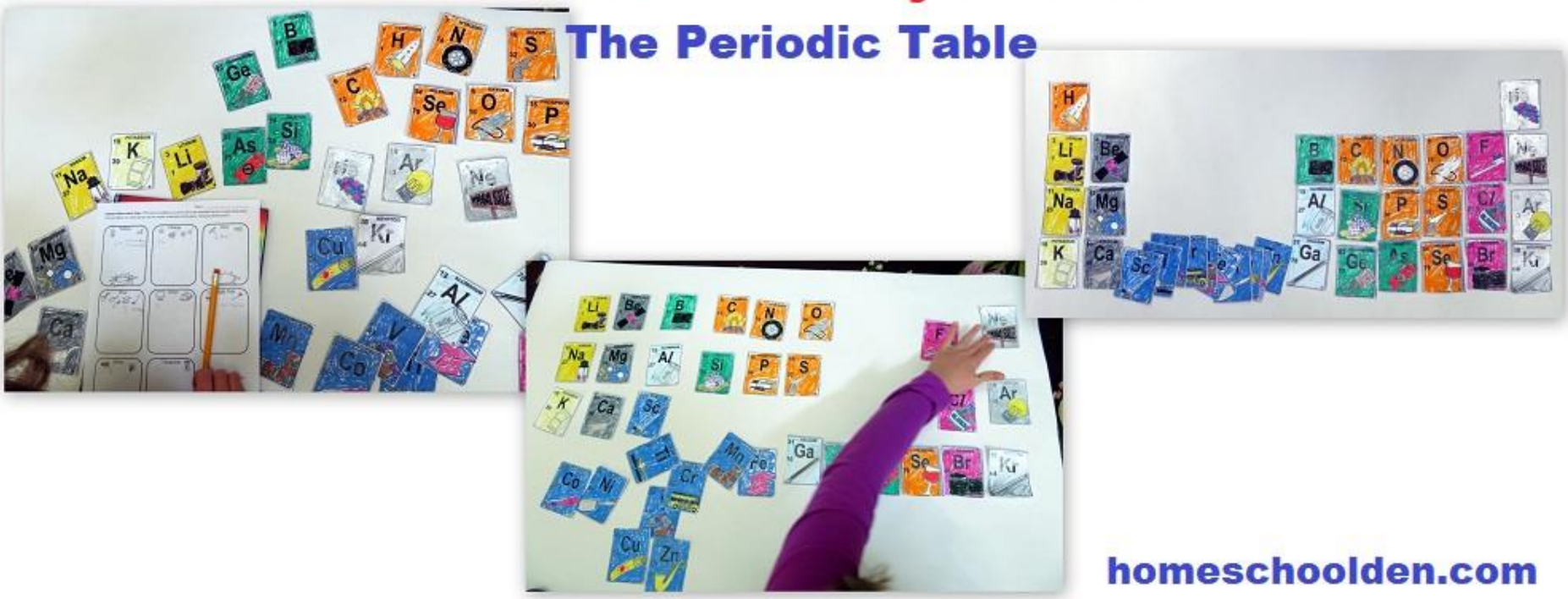
Hands-On Chemistry Activities

The Periodic Table



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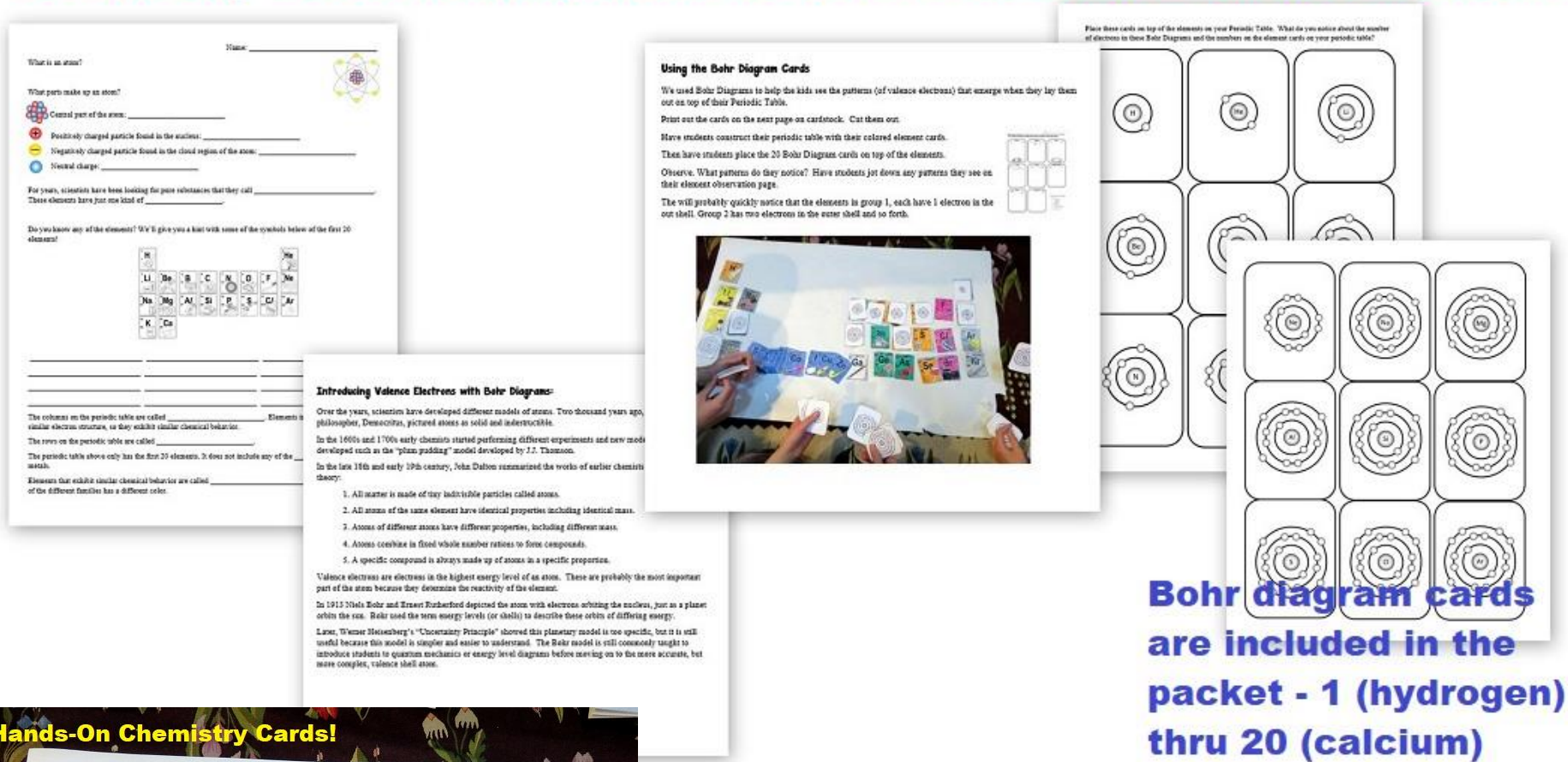
Chemstry Unit: Learning about the parts of the atom & valence electrons



Name: _____

What is an atom?

What parts make up an atom?

Central part of the atom: _____

Positively charged particle found in the nucleus: _____

Negatively charged particle found in the cloud region of the atom: _____

Neutral charge: _____

For years, scientists have been looking for pure substances that they call _____. These elements have just one kind of _____.

Do you know any of the elements? We'll give you a hint with some of the symbols below of the first 20 elements!

The columns on the periodic table are called _____. Elements in similar electron structure, so they exhibit similar chemical behavior.

The rows on the periodic table are called _____.

The periodic table above only has the first 20 elements. It does not include any of the _____ metals.

Elements that exhibit similar chemical behavior are called _____ of the different families has a different color.

Introducing Valence Electrons with Bohr Diagrams:

Over the years, scientists have developed different models of atoms. Two thousand years ago, philosopher, Democritus, pictured atoms as solid and indestructible.

In the 1600s and 1700s early chemists started performing different experiments and new models developed such as the "plum pudding" model developed by J.J. Thomson.

In the late 18th and early 19th century, John Dalton summarized the works of earlier chemists theory:

1. All matter is made of tiny indivisible particles called atoms.
2. All atoms of the same element have identical properties including identical mass.
3. Atoms of different atoms have different properties, including different mass.
4. Atoms combine in fixed whole number ratios to form compounds.
5. A specific compound is always made up of atoms in a specific proportion.

Valence electrons are electrons in the highest energy level of an atom. These are probably the most important part of the atom because they determine the reactivity of the element.

In 1913 Niels Bohr and Ernest Rutherford depicted the atom with electrons orbiting the nucleus, just as a planet orbits the sun. Bohr used the term energy levels (or shells) to describe these orbits of differing energy.

Later, Werner Heisenberg's "Uncertainty Principle" showed this planetary model is too specific, but it is still useful because this model is simpler and easier to understand. The Bohr model is still commonly taught to introduce students to quantum mechanics or energy level diagrams before moving on to the more accurate, but more complex, valence shell atom.

Using the Bohr Diagram Cards

We used Bohr Diagrams to help the kids see the patterns (of valence electrons) that emerge when they lay them out on top of their Periodic Table.

Print out the cards on the next page on cardstock. Cut them out.

Have students construct their periodic table with their colored element cards.

Then have students place the 20 Bohr Diagram cards on top of the elements.

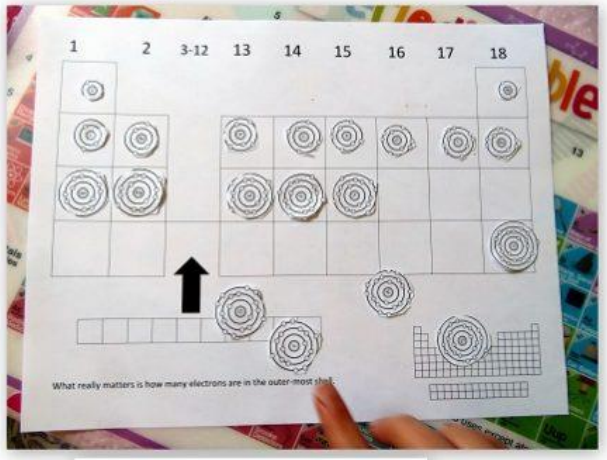
Observe. What patterns do they notice? Have students jot down any patterns they see on their element observation page.

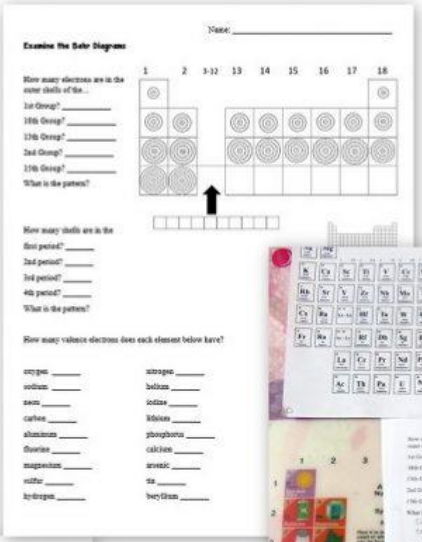
The will probably quickly notice that the elements in group 1, each have 1 electron in the out shell. Group 2 has two electrons in the outer shell and so forth.

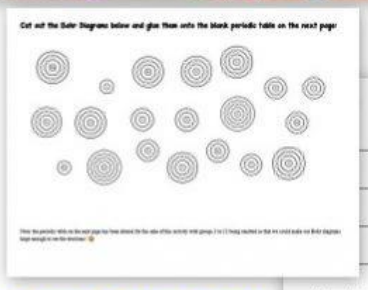
Place these cards on top of the elements on your Periodic Table. What do you notice about the number of electrons in these Bohr Diagrams and the numbers on the element cards on your periodic table?

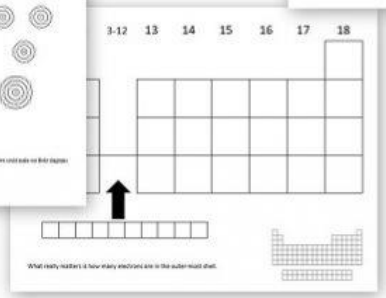
Bohr diagram cards are included in the packet - 1 (hydrogen) thru 20 (calcium)

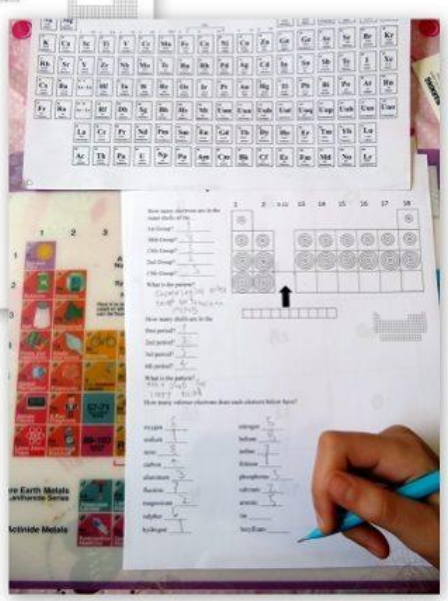
Bohr Diagrams & Valence Electrons - Cut & Paste Activity; Worksheet











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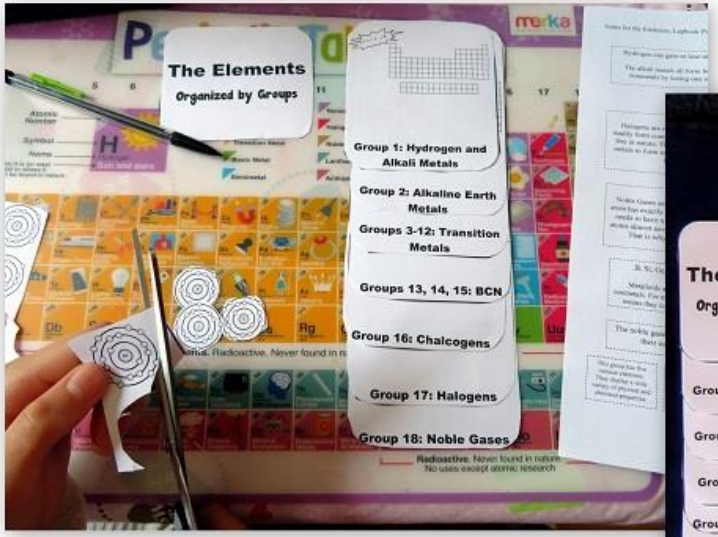
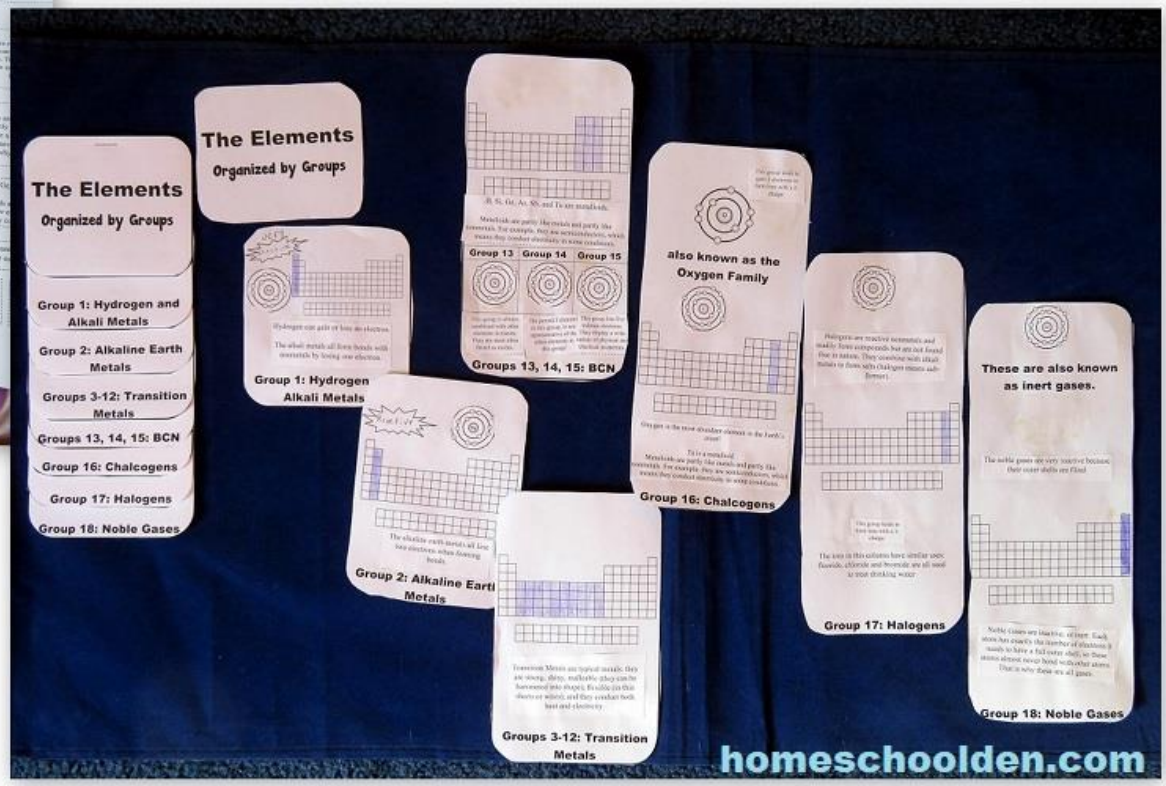
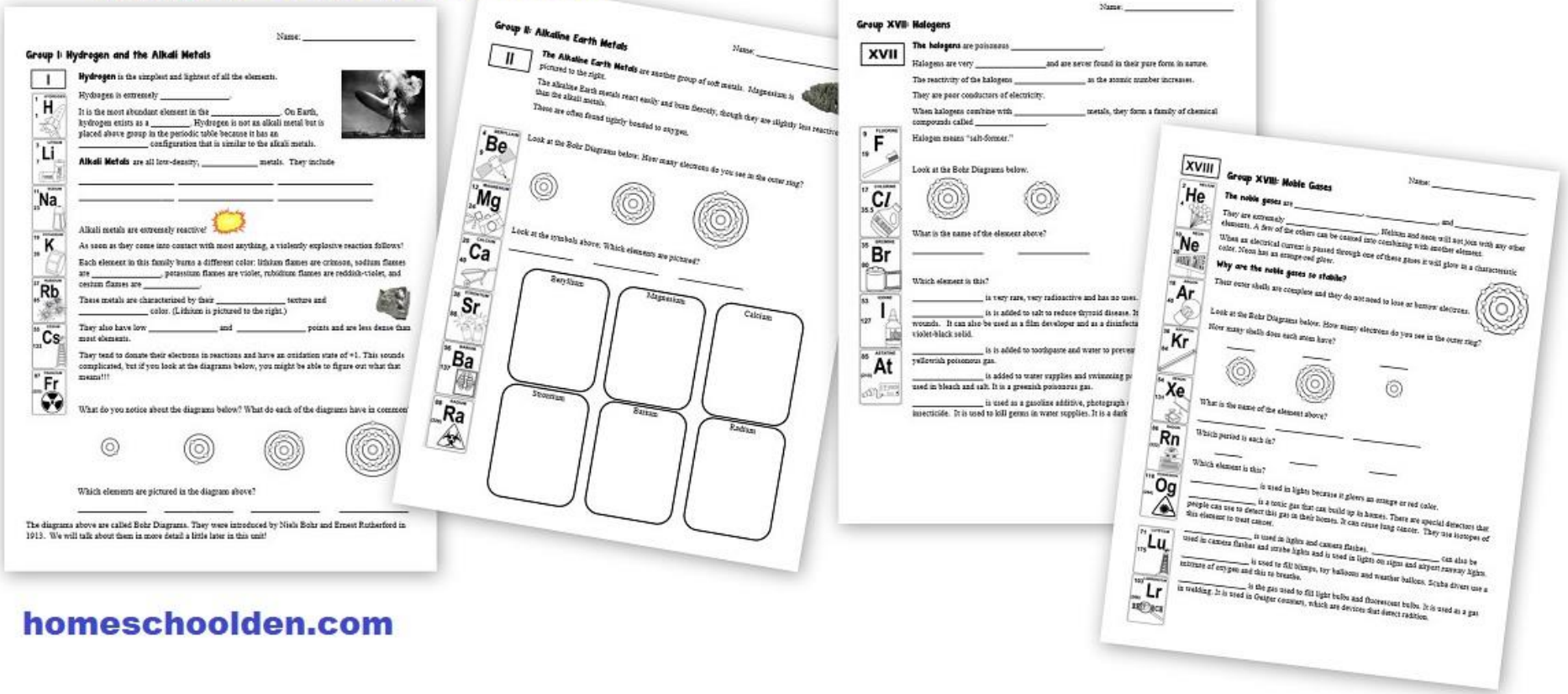
Chemistry - Interactive Notebook Piece





The Elements Organized by Groups

Chemistry Worksheets on Hydrogen & the Alkali Metals, the Alkaline Earth Metals, Halogens & the Noble Gases



Name: _____

Group I: Hydrogen and the Alkali Metals

I

Hydrogen is the simplest and lightest of all the elements.

Hydrogen is extremely _____.

It is the most abundant element in the _____. On Earth, hydrogen exists as a _____. Hydrogen is not an alkali metal but is placed above group in the periodic table because it has an _____ configuration that is similar to the alkali metals.

Alkali Metals are all low-density, _____ metals. They include

_____ _____ _____

_____ _____ _____

Alkali metals are extremely reactive!

As soon as they come into contact with most anything, a violently explosive reaction follows!

Each element in this family burns a different color: lithium flames are crimson, sodium flames are _____, potassium flames are violet, rubidium flames are reddish-violet, and cesium flames are _____.

These metals are characterized by their _____ texture and _____ color. (Lithium is pictured to the right.)

They also have low _____ and _____ points and are less dense than most elements.

They tend to donate their electrons in reactions and have an oxidation state of +1. This sounds complicated, but if you look at the diagrams below, you might be able to figure out what that means!!!

What do you notice about the diagrams below? What do each of the diagrams have in common?

Which elements are pictured in the diagram above?

_____ _____ _____ _____

The diagrams above are called Bohr Diagrams. They were introduced by Niels Bohr and Ernest Rutherford in 1913. We will talk about them in more detail a little later in this unit!

Group II: Alkaline Earth Metals

Name: _____

II

The Alkaline Earth Metals are another group of soft metals. Magnesium is pictured to the right.

The alkaline Earth metals react easily and burn fiercely, though they are slightly less reactive than the alkali metals.

These are often found tightly bonded to oxygen.

Look at the Bohr Diagrams below. How many electrons do you see in the outer ring?

Look at the symbols above. Which elements are pictured?

_____ _____ _____

Beryllium | Magnesium | Calcium

Strontium | Barium | Radium

Name: _____

Group XVII: Halogens

XVII

The halogens are poisonous _____.

Halogens are very _____ and are never found in their pure form in nature.

The reactivity of the halogens _____ as the atomic number increases.

They are poor conductors of electricity.

When halogens combine with _____ metals, they form a family of chemical compounds called _____.

Halogen means "salt-former."

Look at the Bohr Diagrams below.

What is the name of the element above?

_____ _____

Which element is this?

_____ is very rare, very radioactive and has no uses.

_____ is is added to salt to reduce thyroid disease. It

wounds. It can also be used as a film developer and as a disinfecta

violet-black solid.

_____ is is added to toothpaste and water to preven

yellowish poisonous gas.

_____ is added to water supplies and swimming p

used in bleach and salt. It is a greenish poisonous gas.

_____ is used as a gasoline additive, photograph

insecticide. It is used to kill germs in water supplies. It is a dark

XVIII

Group XVIII: Noble Gases

Name: _____

The noble gases are _____, _____, _____ and _____.

They are extremely _____. Helium and neon will not join with any other elements. A few of the others can be coaxed into combining with another element.

When an electrical current is passed through one of these gases it will glow in a characteristic color. Neon has an orange-red glow.

Why are the noble gases so stable?

Their outer shells are complete and they do not need to lose or borrow electrons.

Look at the Bohr Diagrams below. How many electrons do you see in the outer ring?

How many shells does each atom have?

_____ _____ _____

What is the name of the element above?

_____ _____ _____

Which period is each in?

_____ _____ _____

Which element is this?

_____ is used in lights because it glows an orange or red color.

_____ is a toxic gas that can build up in homes. There are special detectors that people can use to detect this gas in their homes. It can cause lung cancer. They use isotopes of this element to treat cancer.

_____ is used in lights and camera flashes. _____ can also be used in camera flashes and strobe lights and is used in lights on signs and airport runway lights.

_____ is used to fill blimps, toy balloons and weather balloons. Scuba divers use a mixture of oxygen and this to breathe.

_____ is the gas used to fill light bulbs and fluorescent bulbs. It is used as a gas in welding. It is used in Geiger counters, which are devices that detect radiation.

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Unusual Chemical Symbols

Unusual Element Symbols - Chemistry

Matching Activity

iron	Fe	lead	Pb
mercury	Hg	copper	Cu
silver	Ag		
gold	Au	an	
potassium	K	tu	

Name: _____

Unusual Element Symbols Matching

_____ 1. tin	a. K
_____ 2. silver	b. Sn
_____ 3. antimony	c. Au
_____ 4. potassium	d. Fe
_____ 5. iron	e. Sb
_____ 6. tungsten	f. Cu
_____ 7. lead	g. Ag
_____ 8. gold	h. W
_____ 9. mercury	i. Pb
_____ 10. copper	j. Hg

Name: _____

Unusual Element Symbols Matching

_____ 1. Fe	a. gold
_____ 2. Au	b. tungsten
_____ 3. Cu	c. potassium
_____ 4. Hg	d. silver
_____ 5. Ag	e. copper
_____ 6. K	f. antimony
_____ 7. W	g. tin
_____ 8. Pb	h. mercury
_____ 9. Sb	i. lead
_____ 10. Sn	j. iron

Trends in the Periodic Table

ANSWER PAGES

Trends in the Periodic Table

Trends in chemical activity:

Metals tend to become more chemically active to the left and as you go down. As you go to the left, elements don't have to lose as many electrons in order to fill their outer shells.

Nonmetals tend to be more chemically active as you go to the right and up the periodic table.

PERIODIC TABLE OF THE ELEMENTS

Which is more active?

carbon or oxygen? oxygen

beryllium or lithium? lithium

nitrogen or [illegible]? [illegible]

rubidium or [illegible]? [illegible]

copper or iron? iron

chlorine or iodine? chlorine

calcium or aluminum? calcium

rubidium or strontium? rubidium

Trends in mass:

Molar mass increases as you go right and down the periodic table?

which has more mass?

lithium or fluorine? fluorine

iron or gold? gold

calcium or barium? barium

oxygen or krypton? krypton

PERIODIC TABLE OF THE ELEMENTS

Trends in size:

Going down a group, size becomes larger because electrons occupy more distinct shells.

However, in the same period, atoms become smaller. Why? Because the nucleus contains more positive charge, so each electron feels a greater attraction to the nucleus making atoms smaller.

sodium or potassium? sodium

boron or nitrogen? nitrogen

phosphorus or chlorine? chlorine

copper, silver, or gold? copper

Unusual Abbreviations:

lead	Pb
gold	Au
silver	Ag
iron	Fe
mercury	Hg
potassium	K
sodium	Na
tin	Sn

Family, Period, Group:

The family group of

neon noble gas

sodium alkali metal

chlorine halogen

The period for

magnesium 3 lanthanum 6 silver 5 hydrogen 1 iodine 5

The group for

iron 8 gold 11 sulfur 16 helium 18 potassium 1 titanium 4

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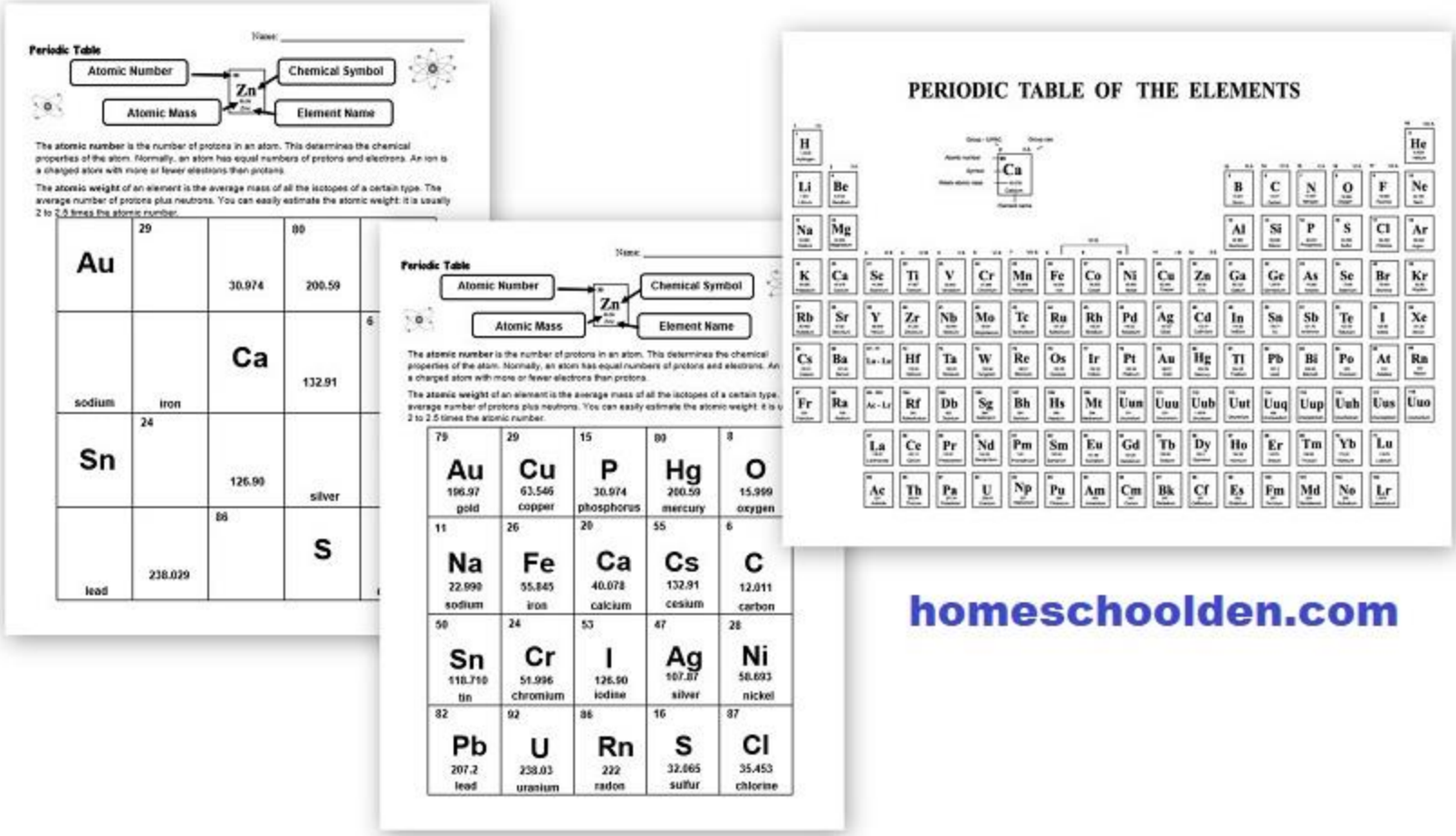
Periodic Table -- atomic number, atomic weight, chemical symbols & the element names



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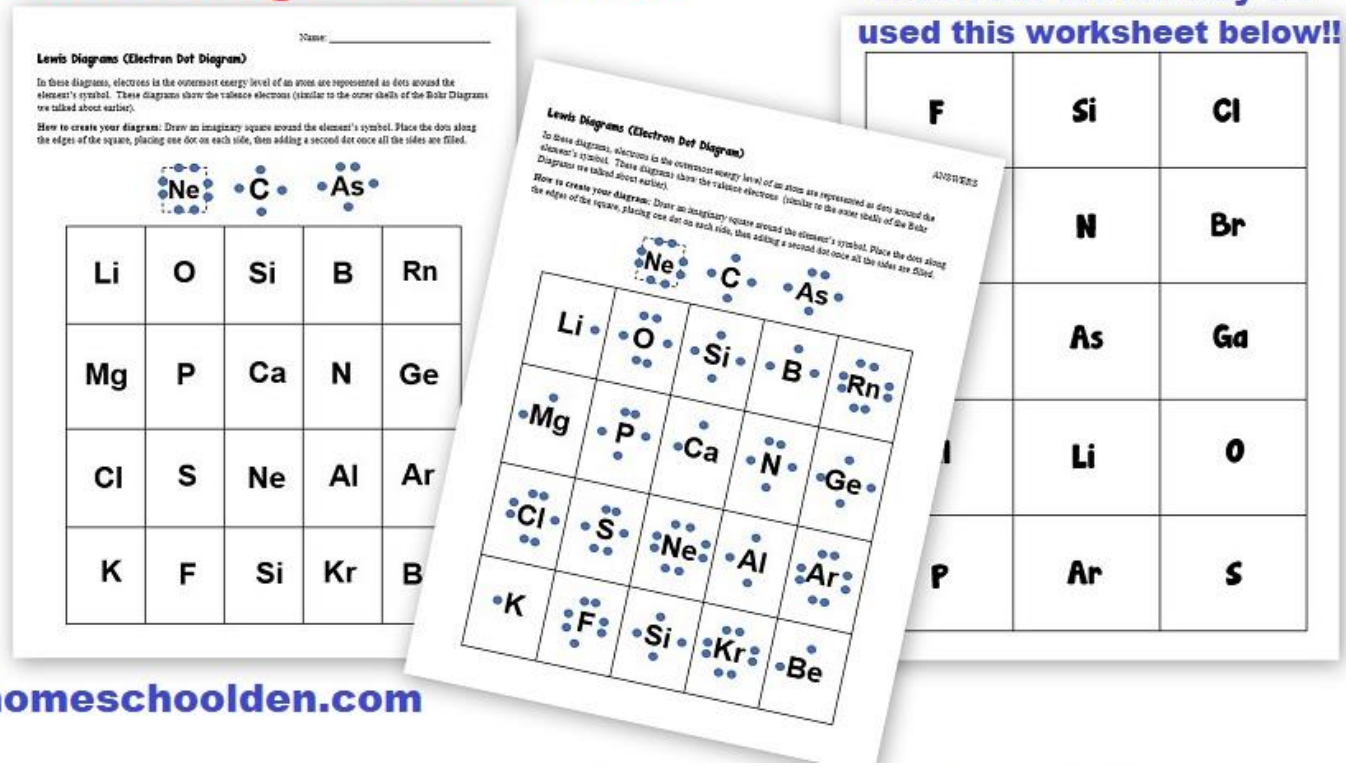
Lewis Diagram Worksheet



Check out the fun way we used this worksheet below!!

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Lewis Diagram Activity!

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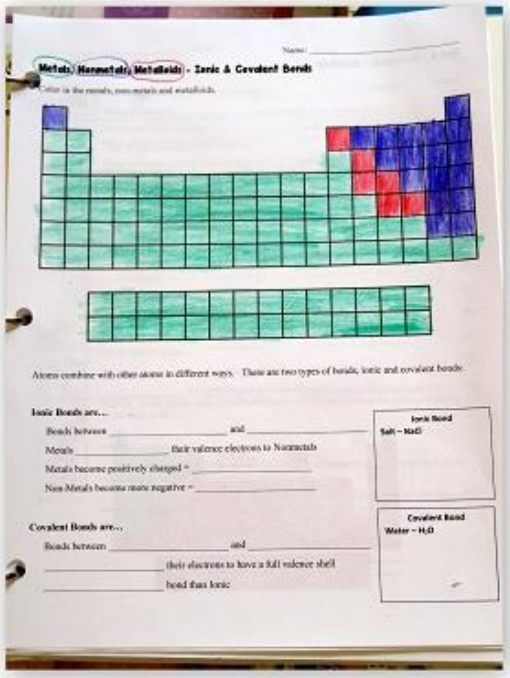
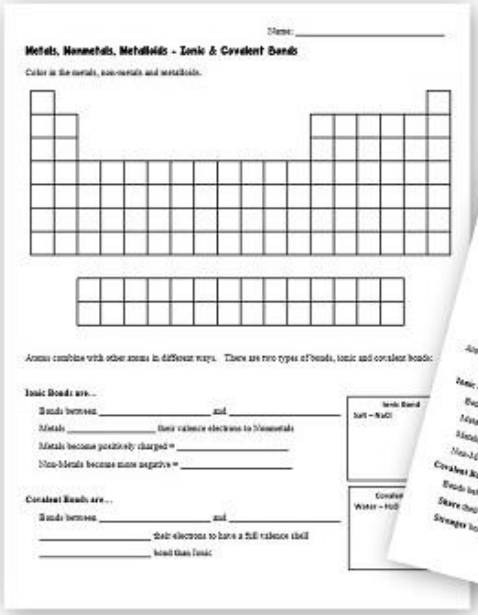
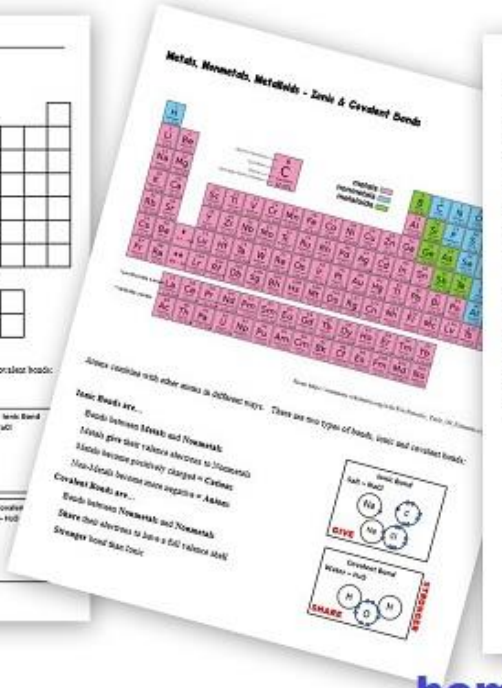
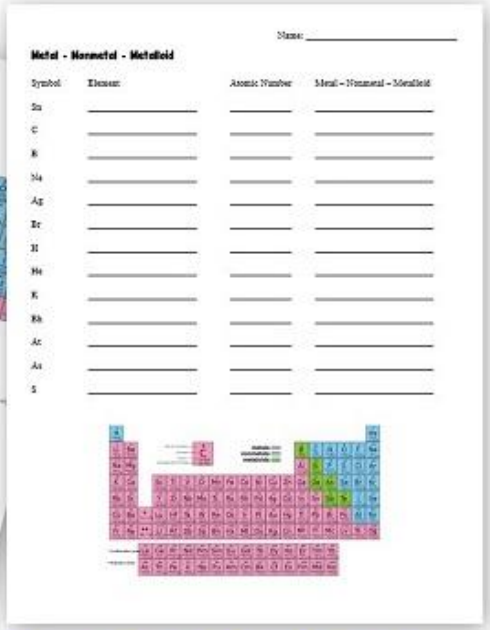
Periodic Table - Metals - Nonmetals - Metalloids









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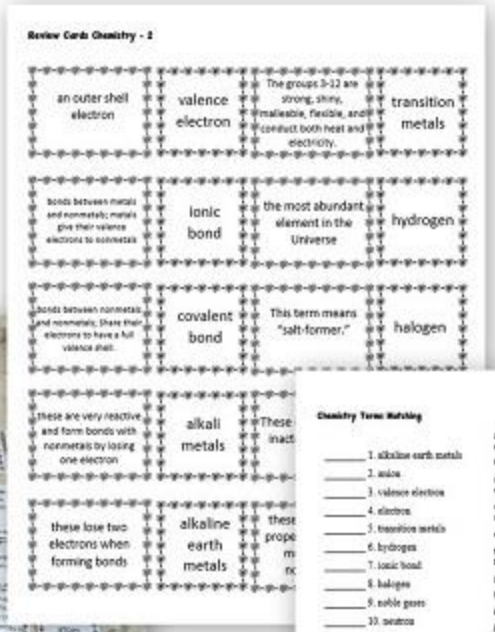
Chemistry Unit Review!



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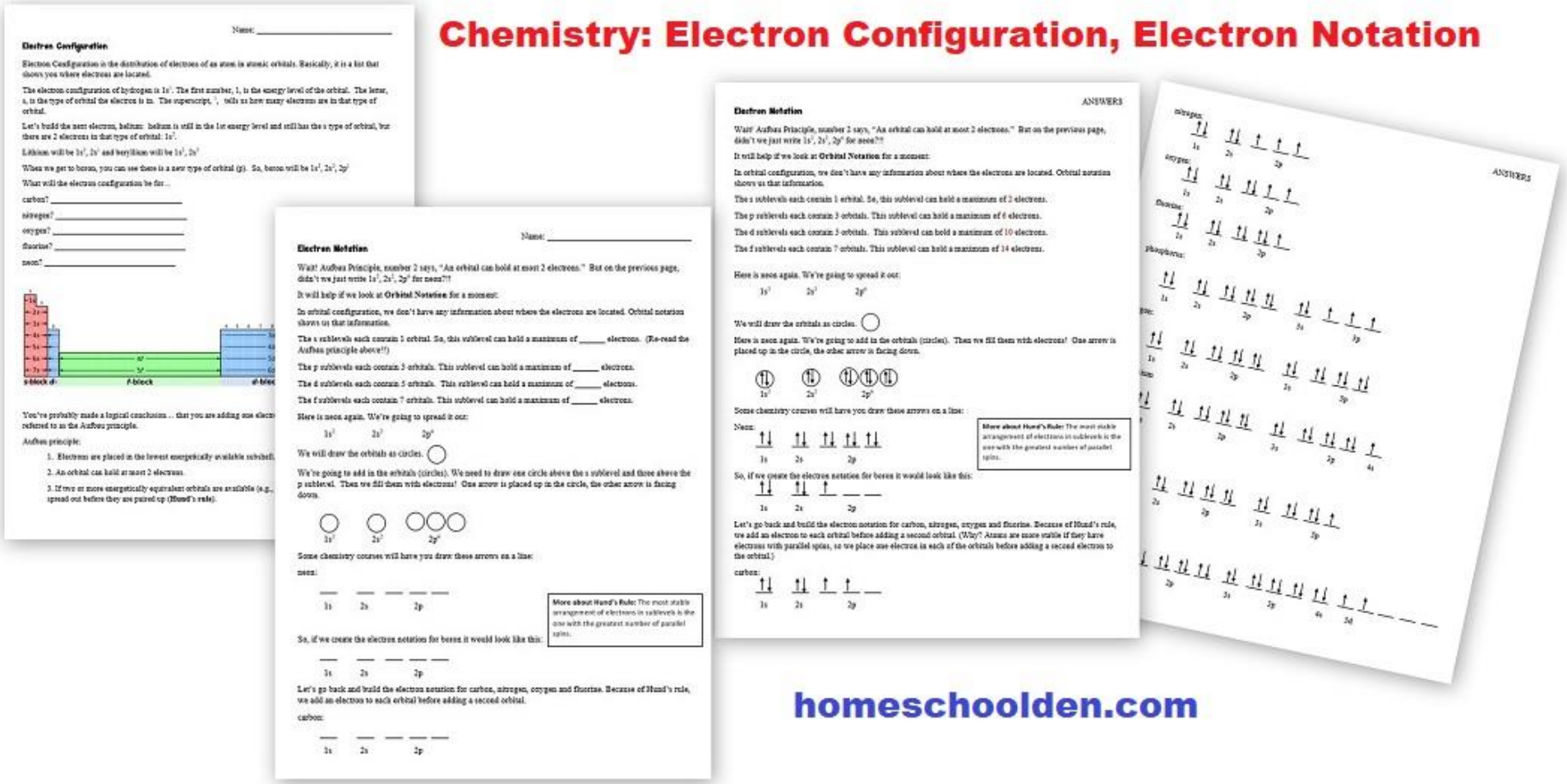
Chemistry: Electron Configuration, Electron Notation



Name: _____

Electron Configuration

Electron Configuration is the distribution of electrons of an atom in atomic orbitals. Basically, it is a list that shows you where electrons are located.

The electron configuration of hydrogen is $1s^1$. The first number, 1, is the energy level of the orbital. The letter, s, is the type of orbital the electron is in. The superscript, ^{1}, tells us how many electrons are in that type of orbital.

Let's build the next electron, helium: helium is still in the 1st energy level and still has the s type of orbital, but there are 2 electrons in that type of orbital: $1s^2$.

Lithium will be $1s^2$, $2s^1$ and beryllium will be $1s^2$, $2s^2$

When we get to boron, you can see there is a new type of orbital (p). So, boron will be $1s^2$, $2s^2$, $2p^1$

What will the electron configuration be for...

carbon? _____

nitrogen? _____

oxygen? _____

fluorine? _____

neon? _____

You've probably made a logical conclusion... that you are adding one electr
referred to as the Aufbau principle.

Aufbau principle:

1. Electrons are placed in the lowest energetically available sublevel.
2. An orbital can hold at most 2 electrons.
3. If two or more energetically equivalent orbitals are available (e.g., spread out before they are paired up (**Hund's rule**).

Name: _____

Electron Notation

Wait! Aufbau Principle, number 2 says, "An orbital can hold at most 2 electrons." But on the previous page, didn't we just write $1s^2$, $2s^2$, $2p^2$ for neon?!?

It will help if we look at **Orbital Notation** for a moment:

In orbital configuration, we don't have any information about where the electrons are located. Orbital notation shows us that information.

The s sublevels each contain 1 orbital. So, this sublevel can hold a maximum of _____ electrons. (Re-read the Aufbau principle above!!)

The p sublevels each contain 3 orbitals. This sublevel can hold a maximum of _____ electrons.

The d sublevels each contain 5 orbitals. This sublevel can hold a maximum of _____ electrons.

The f sublevels each contain 7 orbitals. This sublevel can hold a maximum of _____ electrons.

Here is neon again. We're going to spread it out:

$1s^2$ $2s^2$ $2p^6$

We will draw the orbitals as circles.

We're going to add in the orbitals (circles). We need to draw one circle above the s sublevel and three above the p sublevel. Then we fill them with electrons! One arrow is placed up in the circle, the other arrow is facing down.

Some chemistry courses will have you draw these arrows on a line:

neon:

More about Hund's Rule: The most stable arrangement of electrons in sublevels is the one with the greatest number of parallel spins.

So, if we create the electron notation for boron it would look like this:

Let's go back and build the electron notation for carbon, nitrogen, oxygen and fluorine. Because of Hund's rule, we add an electron to each orbital before adding a second orbital.

carbon:

ANSWERS

Electron Notation

Wait! Aufbau Principle, number 2 says, "An orbital can hold at most 2 electrons." But on the previous page, didn't we just write $1s^2$, $2s^2$, $2p^6$ for neon?!?

It will help if we look at **Orbital Notation** for a moment:

In orbital configuration, we don't have any information about where the electrons are located. Orbital notation shows us that information.

The s sublevels each contain 1 orbital. So, this sublevel can hold a maximum of 2 electrons.

The p sublevels each contain 3 orbitals. This sublevel can hold a maximum of 6 electrons.

The d sublevels each contain 5 orbitals. This sublevel can hold a maximum of 10 electrons.

The f sublevels each contain 7 orbitals. This sublevel can hold a maximum of 14 electrons.

Here is neon again. We're going to spread it out:

$1s^2$ $2s^2$ $2p^6$

We will draw the orbitals as circles.

Here is neon again. We're going to add in the orbitals (circles). Then we fill them with electrons! One arrow is placed up in the circle, the other arrow is facing down.

Some chemistry courses will have you draw these arrows on a line:

Neon:

More about Hund's Rule: The most stable arrangement of electrons in sublevels is the one with the greatest number of parallel spins.

So, if we create the electron notation for boron it would look like this:

Let's go back and build the electron notation for carbon, nitrogen, oxygen and fluorine. Because of Hund's rule, we add an electron to each orbital before adding a second orbital. (Why? Atoms are more stable if they have electrons with parallel spins, so we place one electron in each of the orbitals before adding a second electron to the orbital.)

carbon:

ANSWERS

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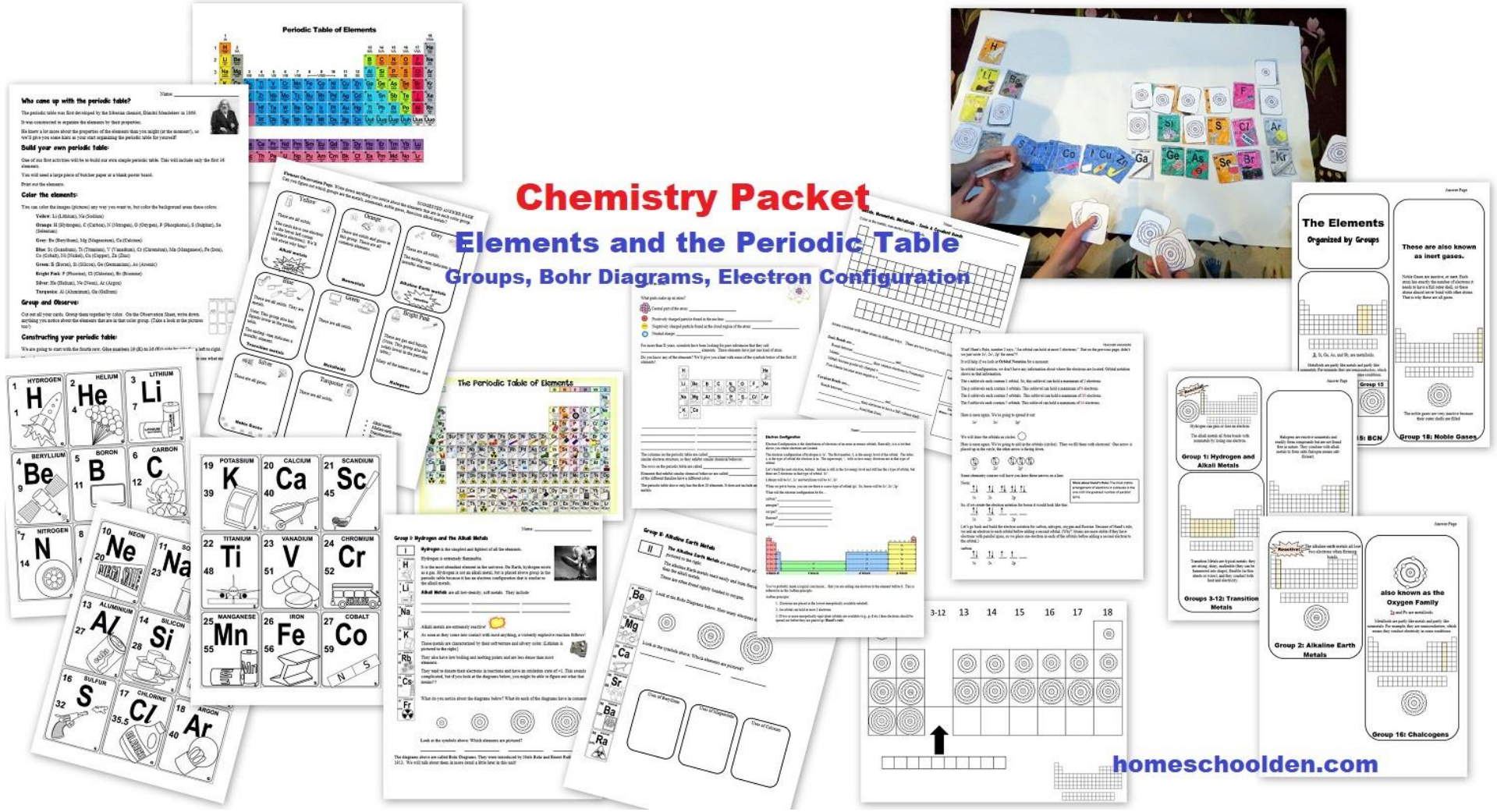
Periodic Table of Elements
Who came up with the periodic table?
Build your own periodic table:
Color the elements:
Group and Observe:
Constructing your periodic table:
Chemistry Packet
Elements and the Periodic Table
Groups, Bohr Diagrams, Electron Configuration
The Periodic Table of Elements
The Elements
Organized by Groups
These are also known as inert gases.
Group 1: Hydrogen and Alkali Metals
Group 2: Alkaline Earth Metals
Group 3-12: Transition Metals
Group 16: Chalcogens
Group 18: Noble Gases
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