# Unit 2 Study Guide
# Atomic Structure & the Periodic Table

**E1.** *Trace the development of models of the atom to the present and describe how each model reflects the scientific understanding of their time.*

**E6.** *Compare the physical and chemical characteristics of elements.*

**E7.** *Describe nuclear reactions, including fusion, fission, and decay, their occurrences in nature, and how they can be used by humans.*

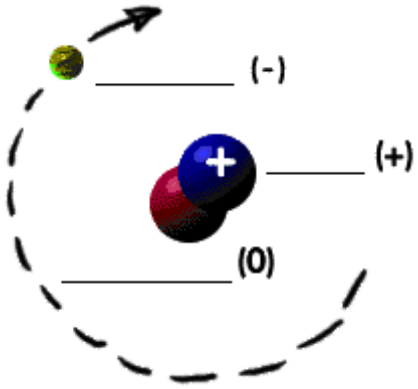
## Activity #1 – Atomic Structure

*Read ATOMS AROUND US.*

1. Fill in the blank: All elements are made of _____.

*Read ATOMS = BUILDING BLOCKS.*

2. Label the major subatomic particles in the atom on the diagram below.




3. Fill in the blanks: The _____ and _____are always in the center of the atom. Scientists call the center of the atom the _____. The _____ are always found whizzing around the center in areas called _____.

4. What do the "0", "-", and "+" refer to on the diagram above?

**Activity #2 – Atomic Builder**

The stuff you scrape off burnt toast is made primarily of atoms of carbon. But what makes up a carbon atom -- or any other atom?

Here's a chance for you to construct a carbon atom. You'll start with a hydrogen atom, which contains one proton and one electron. Just add protons, neutrons, and electrons. By the way, you must also build each proton and neutron from two types of quarks -- up quarks and down quarks. Finally, some advice: try to keep the particles' charges balanced. You'll have a difficult time if you don't. Before you start, answer the questions below.

*Read The Atom Builder Guide to Elementary Particles.*

1. In activity #1, you learned about the three major subatomic particles. It turns out that protons and neutrons are made of even smaller particles. What are these particles called?

2. Record the color code in the picture of an atom on this page (you will need it later). What color represents the
   a. protons? _____
   b. neutrons? _____
   c. electrons? _____

3. Fill in the "recipes" for the nucleons (particles found in the nucleus) below:

   1 proton = ____ up quark(s) + ____ down quark(s)

   1 neutron = ____ up quark(s) + ____ down quark(s)

*Read The Atom Builder Guide to Building a Stable Atom.*

4. Fill in the blanks: A stable atom has a net charge of _____. In other words, it has an equal number of _____ and _____.

5. When is an atom **ionized**? Why don't you want this to happen in this activity?

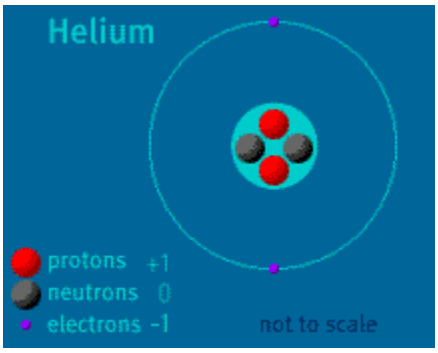
6. When does an atom become **radioactive**? Why don't you want this to happen in this activity?

7. Up to how many electrons can occupy
   a. the 1st shell _____?
   b. the 2nd shell _____?

*Now you are ready to build a carbon atom! Open the Atom Builder.*

8. Construct a **neutron** from the up and down quarks in the "Nucleon Assembly" area. Move this to the hydrogen nucleus on the right. Did adding a **neutron** change hydrogen into helium?

9. Construct another **neutron** from the up and down quarks in the "Nucleon Assembly" area. Move this to the nucleus on the right. What happened to the atom?




10. Construct a **proton** from the up and down quarks in the "Nucleon Assembly" area. Move this to the hydrogen nucleus on the right. Did adding a **proton** change hydrogen into helium? What else happened?

11. Add an electron to the atom. Try putting it in the 2nd energy level (the outer circle). What happens? Where does the electron end up?

12. At this point you should have a stable **helium** atom. How many electrons _____? Protons _____? Neutrons _____?

13. Add another electron to the atom. Try putting it in the 1st energy level (the inner circle). Are you allowed to do this? Why or why not?

14. Continue building your atom in this manner until you have constructed a stable **carbon** atom. Show your carbon atom to your teacher and have her initial below.

    Teacher's initials _____

    How many electrons _____? Protons _____? Neutrons _____?

**Activity #3 – Dream Journey into the Atom (The Particle Picture)**

*You will need to use the poster here. (You may get a print-out of this poster from your teacher if you wish.) Matter is made of tiny particles. And those particles are made of even tinier particles ... Name the particles described in the clues. You will find all of the answers in the poster.*

**1** Brownian motion: You see these microscopic specks of dust or smoke moving around ...

**2** ... because we believe they are pushed about by these particles of the air ...

**3** ... which are made up of these particles of oxygen and nitrogen.

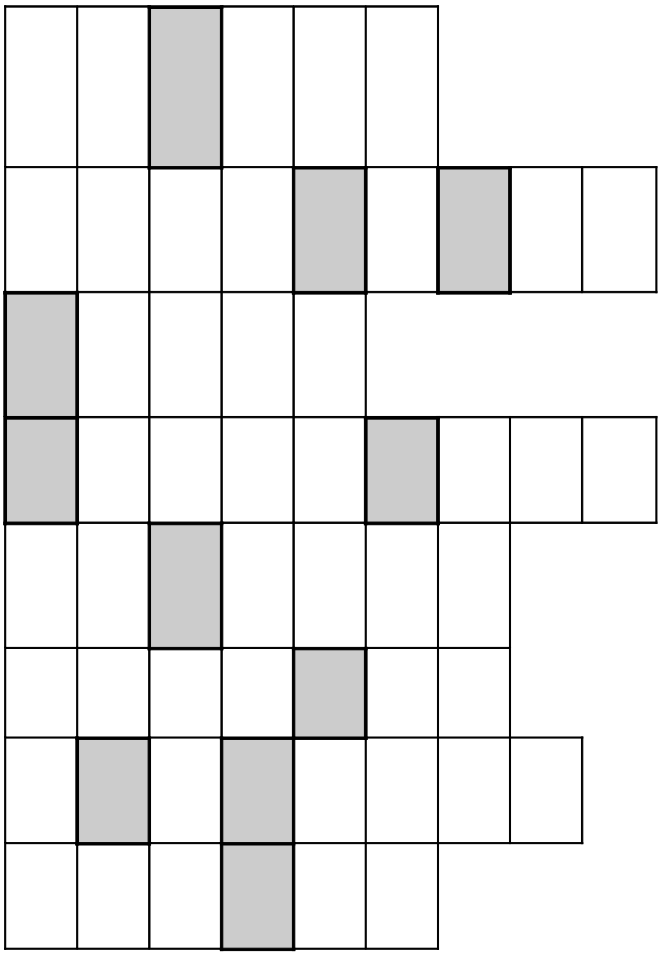
**4** JJ Thomson discovered these particles ...

**5** ... which orbit around this particle at the center of every atom ...

**6** ... which is made up of these positively-charged particles ...

**7** ... and these uncharged ones ...

**8** ... which are made up of these even tinier particles.



Now, use the 11 letters in the highlighted boxes to make a word which is the name of a machine used for making sub-atomic particles move faster.

*At the start of the twentieth century, there was no way that scientists could hope to see individual atoms. Indeed, many scientists still did not accept that matter was made of atoms.*

## Activity #4 – Dream Journey into the Atom (Changing Pictures)

*At the start of the twentieth century, there was no way that scientists could hope to see individual atoms. Indeed, many scientists still did not accept that matter was made of atoms. Since then, some very clever experiments have allowed us to find out a lot more about the structure of atoms. Our picture of the atom has changed a lot.*

*(You will find the answers to these questions in the poster.)*

1) **Model 1: The 'pudding' model**
   In the pudding model:

   a) What is the dough? What charge does it have?

   b) What are the currants? What charge do they have?

   c) Why must there be equal amounts of positive and negative charge?

2) **Model 2: The 'nuclear' model**
   In the nuclear model:

   a) What is at the center of the atom? What charge does it have?

   b) What particles orbit around the outside? What charge do they have?

3) **Changing models**
   Ernest Rutherford suggested an experiment to test the pudding model.

   a) What metal did he use as his target?

   b) Which particles did he fire at the target?

   c) What was the source of the particles?

   d) If the pudding model was correct, what would happen to the particles?

   e) What was the surprising result of the experiment?

   f) How did Rutherford account for this result?

4) **Changing ideas**
   The word **atom** means **indivisible**.

   a) Is an atom indivisible?

   b) Why do you think we stick with the word **atom**?

**Activity #5 – Dream Journey into the Atom (Particles & People Puzzle)**

Use the poster to solve these clues:

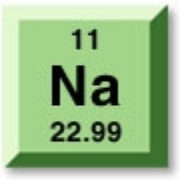
| | |
|---|---|
| 1. In 1897, I made a beam of electrons in a vacuum tube. Who am I? | |
| 2. You'll find me in an atom and in a lightning flash. I sometimes travel along wires. I'm naturally negative! What am I? | |
| 3. It was a surprise to me when an alpha particle bounced back! My prediction was completely wrong! Who am I? | |
| 4. I may be small, but I'm a lot heavier than those electrons. Maybe that's why they orbit around me! What am I? | |
| 5. I'm using electrons to study what is inside protons. Who am I and where do I work? | |
| 6. I am one of these: a molecule, a proton, an electron, an atom or a nucleus. I'm the only one of these who isn't made up of other particles. What am I? | |
| 7. Jude uses me in a beam with loads of others just like me so that she can look into new materials. What am I? | |
| 8. I work on the world's biggest particle accelerator looking for answers to big questions. Who am I and where is the accelerator? | |
| 9. Gavin is working on me. I am going to be the new version of the World Wide Web! What am I? | |
| 10. I use work done in particle physics experiments to make better X-ray detectors which should help us to treat cancer. Who am I? | |

The next two of these have answers but not clues! Can you think of good clues for them?

| | |
|---|---|
| 11. | Quark |
| 12. | Molecule |

## Activity #6 – Ions, Atomic Number, Atomic Mass and Isotopes

1. On this page:




Element: **Sodium**
Symbol: **Na**
Atomic Number (Z): **11**
Number of Protons: **11**
Number of Electrons: **11**

**11 protons – 11 electrons = 0**
**(overall charge is neutral)**

   a. Define **atomic number**.

   b. Click "extra". What defines the identity of an element?

   c. If you add a proton to sodium, what element do you have? What is its atomic number?

   d. If you subtract a proton from sodium, what element do you have? What is its atomic number?

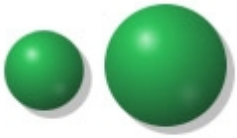
2. On this page:

   a. define **ion**:

   b. define **cation**:

   c. define **anion**:

**$Na - e^- = Na^+$**
*(sodium atom – electron = sodium cation)*

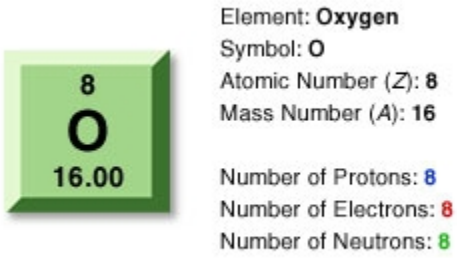


**$Cl + e^- = Cl^-$**
*(chlorine atom + electron = chloride anion)*

   d. If you remove an electron from a neutral atom, does it become positive or negative?

   e. If you add an electron to a neutral atom, does it become positive or negative?

3. On this page:

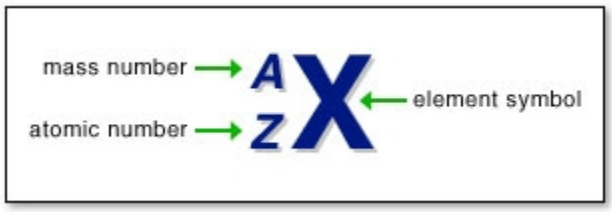



   a. Define **mass number.**

   b. You can figure out the number of neutrons in an atom of oxygen by subtracting its _____ (the number of protons) from its _____.
   c. How many neutrons are there in an oxygen atom with an atomic mass of 16? _____
   d. How many neutrons are there in a sodium atom with an atomic mass of 23? _____

4. On this page:

   a. Define **isotope**.




   b. The standard format for writing an isotope is shown above, where A is the _____ number ( _____ + _____ ) and Z is the _____ number (number of _____ )


   c. For a neutral atom of boron-10, what is the
      1. mass number _____
      2. atomic number _____
      3. number of protons _____
      4. number of neutrons _____

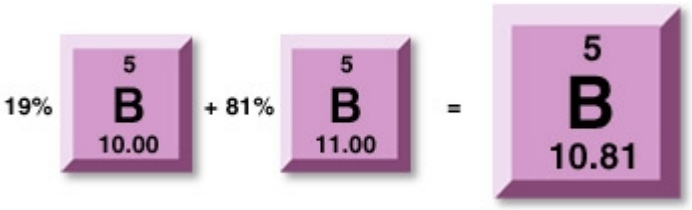
d. For boron-11, what is the
    1. mass number _____
    2. atomic number _____
    3. number of protons _____
    4. number of neutrons _____

5. On this page:

    a. Define **atomic mass**.

    b. The units for atomic mass are _____, or _____.

    c. One amu is defined as _____ the mass of a _____ atom (specifically the carbon-12 isotope). Therefore, the mass of one atom of carbon-12 is exactly _____ _____.




    d. How do you get the mass of boron (10.81 amu) that is found on the periodic table? Do the calculation below:
        1. boron-10 is found in nature 19% of the time so
           0.19 X 10.00 amu = _____
        2. boron-11 is found in nature 81% of the time so
        3. 0.81 X 11.00 amu = _____
        4. to get the average atomic mass of all the isotopes of boron found in nature, add #1 and #2 above = _____

6. Quiz yourself: What element in the periodic table
    a. has 23 protons? _____
    b. has an atomic mass of 14? _____
    c. has 12 electrons in a neutral atom? _____
    d. has 16 electrons in its -1 anion? _____
    e. has two isotopes, one with a mass of 35 amu (77.5% abundance) and one with a mass of 37 amu (22.5% of the time) _____

7. Quiz yourself:

**Question:**

1. Silicon-28 and silicon-29 are examples of

A atomic numbers.

B elements.

C protons.

D isotopes.

**Question:**

2. Which of the following is NOT true?

A Electrons have a charge of -1.

B Phosphorus has 15 protons

C Neutrons have a mass which is less than half that of an electron.

D In comparison to a neutral atom, a cation has lost an electron.

**Question:**

3. Most of the volume of an atom is

A occupied by neutrons.

B occupied by protons.

C comprised of empty space.

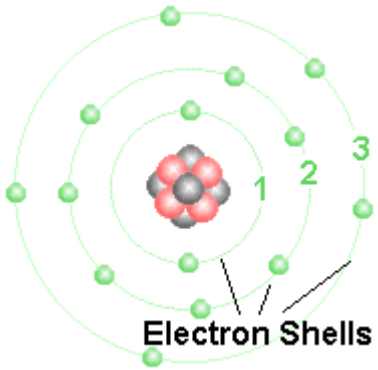
D more dense than the Sun.

| Question: | | |
|---|---|---|
| 4. Phosphorus-31 has | A | 15 protons. |
| | B | 31 neutrons. |
| | C | 16 electrons. |
| | D | a charge of -2. |

**Activity #7 – Electron Shells**

*Fill in the blanks using this website.*

Electrons are arranged around the _____ in _____. For simplicity they can be thought of like mini-planets orbiting a central sun, but it is closer to the truth to think of them as "clouds" of electric charge around the Nucleus.



The shells are numbered _____ from the Nucleus. Fill in the maximum number of electrons found in each shell in the table below.

| **Shell Number** | **Maximum Number of Electrons in the Shell** |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

**The Octet Rule:**

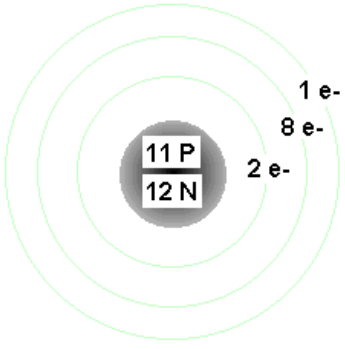
In general, atoms are most stable when they have_____ electrons in their outer-most shell. ( _____ means 8.) The exception is the _____ shell which is most stable with _____ electrons.

If you know the _____ _____ and _____ _____ of an element and the maximum number of electrons in each electron shell you can draw a diagram of the element.

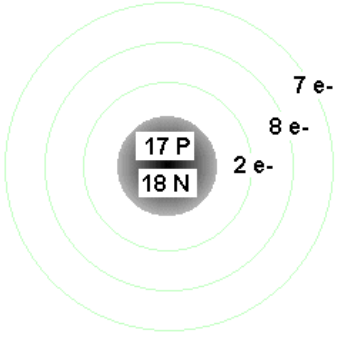
**For example:** Sodium has an Atomic Number of 11 and an Mass Number of 23. This means an atom of Sodium has _____ Protons and therefore _____ electrons.

Since the number of Protons + Neutrons is _____ and there are _____ Protons there must be _____ Neutrons.

From the table above the electrons are arranged as: First Shell = _____, Second Shell = _____, Third Shell = _____ (Giving a total of _____.)



An atom of Sodium



An atom of Chlorine

**Example 2:** Chlorine has a Mass Number of 35 and an Atomic Number of 17.

This means an atom of Chlorine has _____ Protons and therefore _____ electrons.

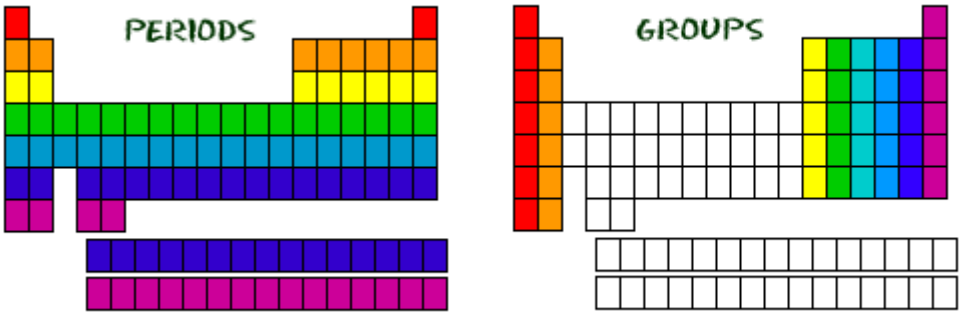
Since the number of Protons + Neutrons is _____ and there are _____ Protons there must be _____ Neutrons.

From the table above the electrons are arranged as: First Shell = _____, Second Shell =_____, Third Shell = _____ (Giving a total of _____.)

## Activity #8 – A Periodic Table of Colors

1. Open this article. Fill in the blanks

   The **periodic table** is organized like a big _____. The elements are placed in specific places because of the way they _____ and _____. If you have ever looked at a grid, you know that there are _____ (left to right) and _____ (up and down). The periodic table has rows and columns, too, and they each mean something different.




2. Open The Periodic Table of Colors. Make a periodic table of colors by arranging them into **groups** and **periods** that have similar properties. **(Requires Word)**

   Note in the pictures above, that **periods** are horizontal rows and **groups** are vertical columns. In a periodic table, elements that are in the same periods and groups have similar properties. A periodic table is also arranged in a way that shows periodic or recurring trends in the properties of elements.

   Your periodic tables of colors should be arranged in a way that clusters colors and intensities with similar properties into rows and columns and also shows trends as you go from left to right across groups and from top to bottom down periods.

After you have finished your periodic table, have your teacher initial here _____.

a. How did you decide which colors to put in the same group?

b. How did you decide which colors to put in the same period?

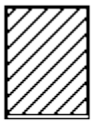
c. What trend(s) do you have as you go down groups?

d. What trend(s) do you have as you go across periods?

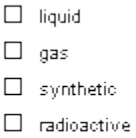
## Activity #9 – Color Coding the Periodic Table

Color code the attached **periodic table** according to the instructions below:

1. Make the dividing line (the zig-zag looking staircase) between the metals and nonmetal more visible by using a highlighter or colored pencil.
2. Label each side with arrows. **"Metals"** on the left and **"Nonmetals"** on the right.
3. **"Metalloids"** are the elements that touch the staircase line on one side. Draw diagonal lines in the metalloids boxes as shown below and label **"Metalloids".**

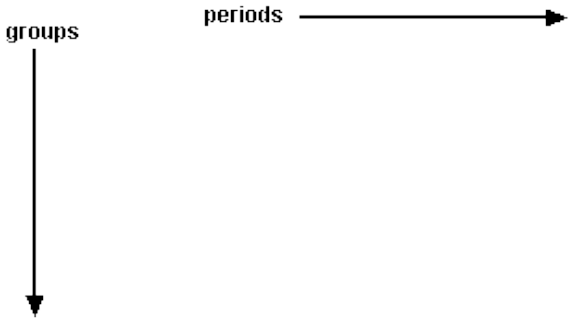


*Metalloids*




*Color Key*

4. Make a **key** at the bottom of the periodic table using four different colors (see above).
5. Color the boxes of the two **liquid** elements according to your key. Their atomic numbers are 35 and 80.
6. Color the eleven **gas** elements – atomic numbers 1, 2, 7, 8, 9, 10, 17, 18, 36, 54 and 86.
7. Color the twenty **synthetic** or **manmade** elements – atomic numbers 43, 61, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109 and 110.
8. Use the fourth color to OUTLINE ONLY the boxes containing the twenty-nine **radioactive** elements. – atomic numbers 43, 61, 84, 85, 86, 86, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109 and 110.
9. Near the top of the page, label the groups and periods with arrows as shown below.




10. Above group 1A, in the box, write the **number of electrons in the outer shell** which is 1. Continue across the top with the remaining numbers of electrons as shown in the table below.

| **column number** | 1A | 2A | 3A | 4A | 5A | 6A | 7A | 8A |
|---|---|---|---|---|---|---|---|---|
| **# of electrons in the outer shell** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

11. Write the **number of energy shells** in the boxes in the period column. Hint: the top row is 1 and the bottom is 7.

**Activity #10 – Metals, Nonmetals, & Metalloids**

*Read this website and then write "metal", "nonmetal", or "metalloid" on the blanks next to the properties.*

1. _____ semiconductors (are not the best or worst conductors)
2. _____ on the right side of the periodic table
3. _____ typically shiny
4. _____ good conductors of heat and electricity
5. _____ low density
6. _____ can be shiny or dull
7. _____ malleable (bendable, can be pounded into sheets
8. _____ will corrode
9. _____ dull surface
10. _____ high density
11. _____ poor conductor of heat and electricity
12. _____ are along the staircase dividing line on the periodic table
13. _____ most elements on the periodic table are this
14. _____ will melt at low temperatures
15. _____brittle
16. _____ have properties of both metals and nonmetals
17. _____ only melt at high temperatures
18. _____ ductile (can be drawn into wires)

**Activity #11 – Chemical Families**

Do the following crossword puzzles. You will find the links to them on this page. After you are done, answer/do the following:

1) In what group number, would you find the:
   a) alkali metals _____
   b) alkaline earth metals _____
   c) chalcogens _____
   d) halogens _____
   e) noble gases _____

2) Label the above groups on your colored periodic table.

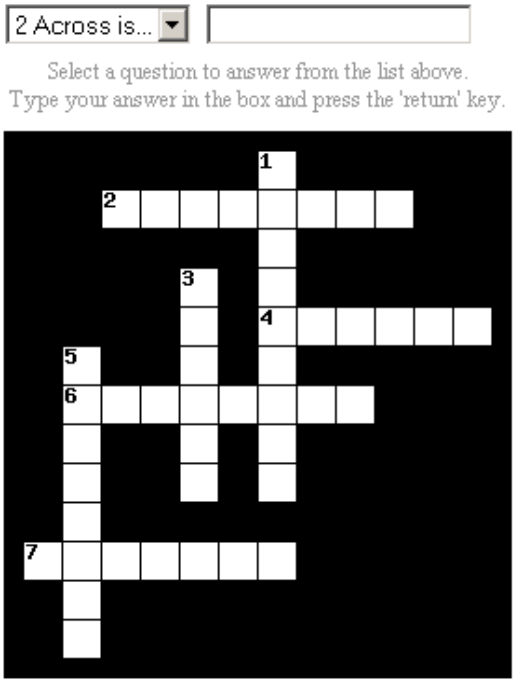
## The Alkali Metals

**Across**

2. While normally shown at the top of this group, this element is **not** an alkali metal.
4. This alkali metal joins with a member of the halogen group to form table salt.
6. This element's chemical symbol is Rb.
7. The first member of the alkali metals.

**Down**

1. This element's chemical symbol comes from the Latin word for alkali, kalium.
3. This element, which is used in atomic clocks and photocells, melts at temperatures slightly above room temperature.
5. The last member of this group, all isotopes of this element are radioactive.



# The Alkaline Earth Metals

### Across

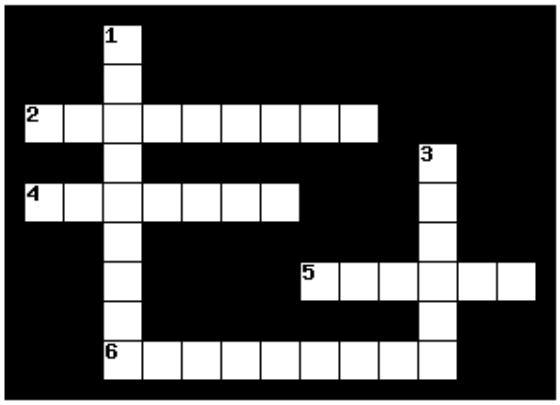
2. Two of this element's compounds burn with a red flame and are used in fireworks and signal flares.
4. A fair amount of this element can be found in your bones.
5. One of this element's compounds is used to produce X-ray images of the intestinal tract.
6. This element burns with a brilliant white light.

### Down

1. The first member of this group, this element can be used as a neutron source.
3. All isotopes of this element are radioactive.

2 Across is...

Select a question to answer from the list above.
Type your answer in the box and press the 'return' key.




# The Chalcogen Group

### Across

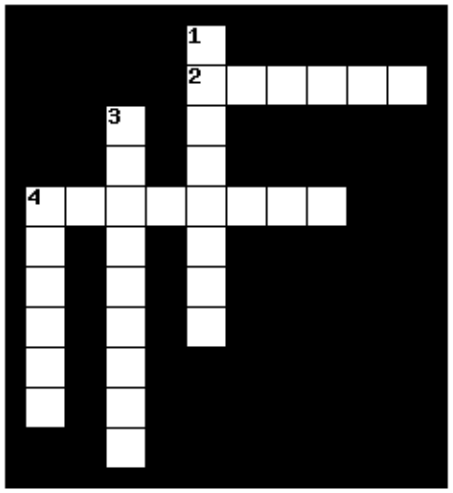
2. The gas that you need to live.
4. This element's resistance to the flow of electricity is greatly affected by the amount of light shining on it.

### Down

1. Named for the country of Poland, all isotopes of this element are radioactive.
3. This element's chemical symbol is Te.
4. In its solid form, this element is pale yellow, brittle and odorless.

2 Across is...

Select a question to answer from the list above.
Type your answer in the box and press the 'return' key.



# The Halogen Group

### Across

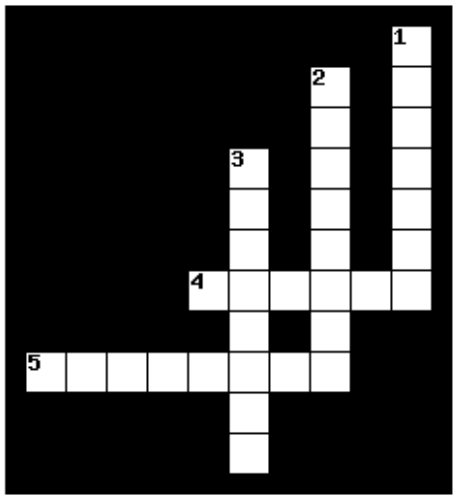
4. Discovered when too much sulfuric acid was accidentally added to seaweed ash.
5. It is estimated that there is no more than 30 grams of this element in the earth's crust at any one time.

### Down

1. This element is a liquid at room temperature.
2. This element combines with an alkali metal to form table salt.
3. This is the most reactive of all elements.

4 Across is...

Select a question to answer from the list above.
Type your answer in the box and press the 'return' key.




# The Noble Gases

### Across

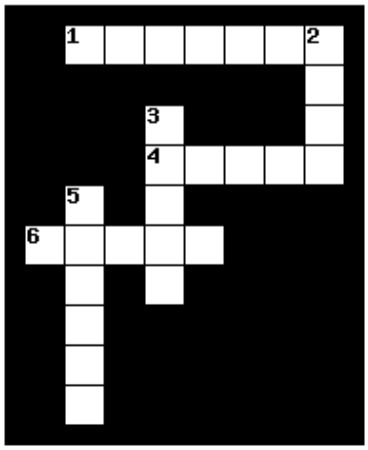
1. This element's name comes for the Greek word for hidden.
4. This element makes up nearly 1% of the earth's atmosphere.
6. Ions of this element were used as a propellant aboard the space probe Deep Space 1.

### Down

2. This element is the fourth most abundant element in the universe.
3. This radioactive gas sometimes seeps into and accumulates in houses.
5. The first member of the Noble Gases, this element is the second most abundant element in the universe.

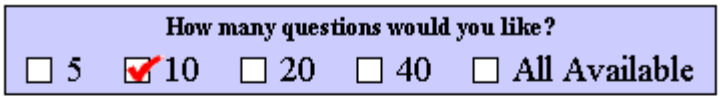
1 Across is...

Select a question to answer from the list above.
Type your answer in the box and press the 'return' key.

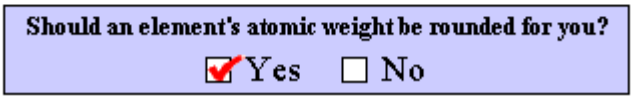


**Activity #12 – Review Games and Worksheets**

1. Element Math Game - Choose the following options and then click "I'm ready! Let's start!:








When you finish, click "All Done" to get your results. Show your results to your teacher and have her initial here _____.

2. Element Word Scramble - Play the fifteen question version with clues. After you finish, show your teacher the "Results" screen and have her initial here: _____

3. Periodic Table Jeopardy - After you finish, show your teacher your score and have her initial here: _____
4. Atomic Structure, Isotopes, and Electron Structure - Enter your answers in the form online as well as below so that you can check your answers.

15 2 2 2.7 2.8.5 21 21 22 26 26 2nd 3 30 4th
5 5th 7 8 8 9 atomic atomic electrons electrons
electrons group iron isotopes mass mass neutrons neutrons
nucleus number period shell shells three

Q1(a) Atoms are made of fundamental particles called protons (+), (0) and (-). (b) The centre of the atom is called the . (c) It consists of protons and and contains most of the mass of the atom.

Q2(a) The number of protons in the atom is called the number. It also equals the number of in a neutral atom. (b) The is the sum of the protons and neutrons in the nucleus.

Q3 An atom of mass number 43, and atomic number 21, consists of protons, neutrons and electrons.

iron_56.gifQ4 (a) In the symbol for an atom of shown on the left, the atom

$^{56}_{26}Fe$

consists of protons, neutrons and electrons. (b) Atoms of the same element with a different number due to different numbers of neutrons are called .

Q5(a) Electrons are arranged around the nucleus in energy levels or . (b) The 1st shell can have a maximum of electrons, the shell a maximum of electrons and the 3rd shell a maximum of electrons. (c) The 19th and 20th electrons go in the shell. (d) The electron arrangement, showing the number of electrons in each can be written out in shorthand eg 2.8.6 for the 1st, 2nd and 3rd shells respectively.

Q6(a) Apart from hydrogen and helium in period 1 of the Periodic Table the last number in the arrangement is equal to the number in the Periodic Table. (b) The number of shells used containing electrons is equal to the number. (c) The number of electrons in an atom is equal to the or proton number.

Q7(a) Phosphorus has an atomic number of 15 so the atoms have protons or 15 . (b) The electron arrangement will be . (c) In the Periodic Table it will be a member of Group and it will be the element along Period .

Q8(a) Fluorine has an atomic number of so the atoms have 9 protons or electrons. (b) Its electron arrangement is and it belongs to Group on Period .

5. **The Periodic Table** - Enter your answers in the form online as well as below so that you can check your answers.

+1 -1 0 1 1 1 2 2 7 alkali atomic balloons before boiling brittle catalysts coloured coloured covalent densities diatomic down dull electronic electrons floats gases gases gases greater groups halide halogens heat heat heat high higher hydrogen hydrogen hydroxide inert ionic left less less less level liquid liquid low low lower mass mercury metals metals metals more more noble non-metals non-metals number period periods poor properties right same shiny similar similarities single solids transition unreactive

**Q1(a) The chemical elements in the Periodic Table were originally arranged in order of the atomic .**
**(b) This list can then be arranged in rows so that elements with properties are in the same columns, known as .**
**(c) The complete horizontal rows of disimilar elements are called .**

**Q2(a) Although most elements are in appropriate Groups, a few are not.**
**(b) Argon atoms, for example, have a relative atomic mass than potassium atoms but argon is better placed potassium in the periodic table so that it is in Group and potassium is in Group .**
**(c) In the modern periodic table elements are arranged in order of their or proton number.**

**Q3(a) The periodic table can be seen as an arrangement of the elements in terms of their electronic structure.**
**(b) From left to right, across each of the periodic table, a particular energy is gradually filled up with and in each successive period, the next energy level is filled with electrons.**
**(c) The and differences between the of elements in the same group of the periodic table can be explained by the structure of their atoms.**
**(d) Elements in the same group have the of outer electrons.**

**Q4(a) The elements in Group of the periodic table are known as because they form hydroxides which dissolve in water to give alkaline solutions.**
**(b) They react with to form ionic compounds in which the metal ion carries a charge of .**
**(c) In Group 1, the further down the group an element is - the reactive the element; the its melting point and boiling point.**
**(d) When a piece of lithium, sodium or potassium is placed in cold water the metal , and may melt and move around the surface of the water with fast fizzing!**
**(e) The metal reacts with the water to form a metal solution and gas.**

**Q5(a) Fewer than one quarter of the elements are .**
**(b) Non-metal elements are found in the Groups at the hand side of the periodic table.**
**(c) The elements in Group 7 and Group 0 have the typical properties of non-metals - they have melting points and boiling points (at room temperature all the Group 0 elements are ).**

**Q6(a) The Group elements are called the The first two are and the third, bromine, is a ).**
**(b) They are and crumbly when solid and are conductors of and electricity even when solid or liquid.**
**(c) These elements have vapours and consist of molecules which are made up of atoms.**
**(d) They form salts with metals in which the chloride, bromide or iodine ion ( ions) carries a charge of .**
**(e) They form molecular compounds with other non-metallic elements.**
**(f) In Group 7, the further the group the element is - the reactive the element; the its melting point and boiling point.**

**(g) A reactive halogen can displace a reactive halogen from an aqueous solution of its salt.**

**Q7(a) The elements in Group 0 are called the .**
**(b) They are all chemically very gases and exist as atoms rather than as gases like other gaseous elements such as oxygen or .**
**(c) They are used as gases in filament lamps and in electrical discharge tubes.**
**(d) The first element in the Group, helium, is much dense than air and is used in .**

**Q8(a) More than three-quarters of the elements of the periodic table are .**
**(b) They are mainly found in the hand columns (Group and Group ) and in the central blocks.**

**Q9(a) In the middle of the Periodic Table are horizontal blocks called the which are typically strong, , and have melting and points and .**
**(b) The metals or their compounds can act as and many of their compounds are highly .**
**(c) All are solid at room temperature and pressure except which is a .**
**(d) They are good conductors of and electricity.**

**Q10(a) About one quarter of the elements are non-metals and these can be gases, liquids or .**
**(b) The solids tend to be in appearance and are poor conductors of and electricity.**
**(c) The boiling points and melting points and densities tend to be relatively .**