

ALT 1: Patterns in the Periodic Table

SUBTARGETS:

I can communicate about the value of the concept "element" in terms of something that remains unchanged in both chemical and physical changes (Copper Cycle Lab)

I can use the periodic table as a model to predict the relative properties of groups/families of elements.

I can identify trends in the periodic table, use them to predict the relative properties of elements and explain the organization of the periodic table.

1. **Define** the following words and **give an example** of each one. Be able to choose examples from a list.
 - a. Element: **A pure substance that cannot be broken down into simpler substances by physical or chemical processes. Elements are the building blocks of matter. Silver (Ag) and copper (Cu) are examples of elements on the Periodic Table. P. 24**
 - b. Compound: **A pure substance that is a chemical combination of two or more elements in a specific ratio. NaCl is a compound made up of one atom of sodium to one atom of chlorine. P. 24**
 - c. Mixture: **a blend of two or more substances that are not chemically combined. P. 25**
 - d. Chemical formula: **A combination of element symbols and numbers that show the composition of a chemical compound. NaCl is an example. Page 24**
2. How do you measure the mass of an object? What are the units of mass?
Mass of a substance is measured on an electronic balance or scale. The SI units are grams(g).
3. Explain how you use a graduated cylinder to measure the volume of an irregular solid?
 - 1) **Fill the graduate about half-full of water and read the volume at the meniscus.**
 - 2) **Record this as Initial volume in mL.**
 - 3) **Carefully slide the object into the graduate being careful not to splash water on the sides.**
 - 4) **Read the volume at the meniscus and record this as Final volume in mL.**
 - 5) **To calculate the VOLUME in mL of the object subtract the Initial Volume from Final Volume.**

How can density be used to identify a substance? [Lesson 5 and Density Lab]

4. Write the formula for density: $\text{Density} = \frac{\text{mass}}{\text{volume}}$

Know how to solve problems!

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- a. A piece of metal has a volume of 30.0 cm^3 and a mass of 252 g . What is the density of the metal [Show your calculation & include the correct units!]:

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{252 \text{ g}}{30.0 \text{ cm}^3} = 8.4 \frac{\text{g}}{\text{cm}^3}$$

- b. A gold ring weighs 7.50 g and has a volume of 0.388 mL . What is the density of the gold ring? [Show your calculation & include the correct units!]:

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{7.50 \text{ g}}{0.388 \text{ mL}} = 19.3 \frac{\text{g}}{\text{mL}}$$

- c. Is the gold ring in #5.b. made of real gold? How do you know this? Refer to the data in Table 1 to answer this question.

Yes, the ring is made of pure gold because the calculated density equals the actual density, which is 19.3 g/mL according to Table 1.

Table 1: Densities of Select Metals

Metal	Copper	Zinc	Gold	Lead
Density (g/mL)	9.0	7.1	19.3	11.4

What happens to elements and compounds in a chemical reaction? [Lessons 7 and 8]

5. Explain in your own words what the Law of Conservation of Mass means (think about the Copper Cycle Lab, and what happened to the copper at the beginning, and end) P. 29

This law says that mass cannot be gained or lost (it is conserved/saved) in a chemical reaction. Matter cannot be created or destroyed. In the copper cycle lab the video showed a mass of copper metal combined with aqueous nitric acid produced a new blue liquid and brown gas. In a series of five steps of the copper cycle lab, a substance was changed into a different substance by mixing it with a liquid or heating it. In the last step, elemental copper metal was isolated and the cycle was completed since we ended up with a mass of copper metal.

6. Name 3 signs that indicate a chemical change has occurred (Copper Cycle Lab!) p.29:

A color change

Formation of a new solid when two solutions are combined.

Formation of a gas seen as bubbles or fizzing.

7. In a chemical reaction, the mass of the products _____ the mass of the reactants because of the Law of Conservation of Mass.

A. Differs B. **Equals**

8. Complete the following chemical reactions. (Hint: Apply the Law of Conservation of Mass to figure out the missing chemical formulas.)

Since mass is conserved in a chemical reaction and matter is not created or destroyed all of the elements making up the products must be in the reactants.

$\text{NaOH (aq)} + \text{Cu(NO}_3)_2 \text{ (aq)} \rightarrow \underline{\text{Cu(OH)}_2} \text{ (s)} + \text{NaNO}_3 \text{ (aq)}$ Mark out Na and NO_3 and what is left formed the new solid.

$\text{NaCl (aq)} + \text{AgNO}_3 \text{ (aq)} \rightarrow \underline{\text{AgCl}} \text{ (s)} + \text{NaNO}_3 \text{ (aq)}$

Explain why you placed the compounds that you placed on the blank. The law of conservation of mass says mass is conserved in a chemical reaction therefore all of the elements on the reactant side (left of arrow) must appear in the products on the right side.

9. Use a periodic table to answer the question, what is the correct ordering of the groups from left to right in the periodic table?

The correct ordering of groups from left to right is 1A Alkali Metals, 2A Alkaline Earth Metals, ten groups of transition metals with B in the group name, 3A, 4A, 5A, 6A, 7A the halogens, and 8A the Noble gases.

10. Use a periodic table to answer the question, which pairs of elements would you expect to have the most similar properties, and why?

a. germanium, Ge, and silicon, Si These are in the same group and will have similar properties because they share the same valence electron structure.

b. copper, Cu, and gallium, Ga

c. nitrogen, N, and oxygen, O

d. hydrogen, H, and helium He

11. Use the periodic table to answer the question, which metal and which non metal have the greatest reactivity of all elements, and why?

Francium at the bottom of group 1A Alkali metals is the most reactive metal.

Fluorine at the top of Group 7A Halogens is the most reactive nonmetal.

WHY is not tested in chemistry 1. But for those interested:

Metal reactivity is related to how readily a metal gives up its valence electron when it forms an ion. A measure of this is called ionization energy. The lower the ionization energy the easier it is for an atom to donate its valence electrons. Ionization energy decreases across a period from RIGHT to LEFT and it decreases down a group from TOP to BOTTOM therefore Francium is MOST reactive metal.

Nonmetal reactivity is related to how strongly a nonmetal atom attracts electrons in a chemical bond. A measure of this is electronegativity. The higher the electronegativity the more strongly that atom attracts the electrons in a chemical bond. Fluorine has the biggest value of electronegativity and it is the most reactive nonmetal.

Vocabulary: Know these key terms for the Periodic table.

- Group (p.46)
- Period (p. 46)
- Alkali Metals (p. 46)
- Alkaline Earth Metals (p. 46)
- Halogens (p. 46)
- Noble gases (p. 46)
- Transition elements (p. 46)

12. Label the periodic table using the vocabulary words above.

What ~~does~~ info. does the P.T. reveal
 Lesson 10 Notes: About the elements?

Periodic Table of the Elements
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 About Chemistry
 http://www.ck12.org/

13. Which of the following are nonmetals? Circle all that apply.

- Boron (B) Cobalt (Co) Selenium (Se)
- Carbon (C) Copper (Cu) Thallium (Tl)
- Calcium (Ca) Radon (Rn)

14. What is the pattern in valence electrons across the 2nd period of the periodic table?

Across the 2nd period for the main group elements, the valence electrons increase by 1.

15. What is the pattern of valence electrons down one of the main groups (ie. Group 1A, 2A, 3A, 4A, 5A, 6A, 7A, and 8A)?

Down a main group, the valence electrons remain the same.

16. Applying your new knowledge of valence electrons and Noble Gas envy explain why the Group 1A Alkali Metals and Group 7A Halogens are the most reactive elements on the periodic table. You might consider drawing a few diagrams to enhance your explanation.

See Diagram at top of page 96 in the textbook.
 The Group 1A alkali metals are just one electron away from having a Noble gas electron configuration.
 The Group 7A Halogens are also just one electron away from having a Noble gas electron configuration.
 For this reason, these two groups are the most reactive elements in the Periodic Table since the elements form ions to obtain a Noble Gas configuration

ALT 2: Atomic Structure

SUBTARGETS:

I can read and analyze information texts about the small scale structure of matter to answer relevant questions.

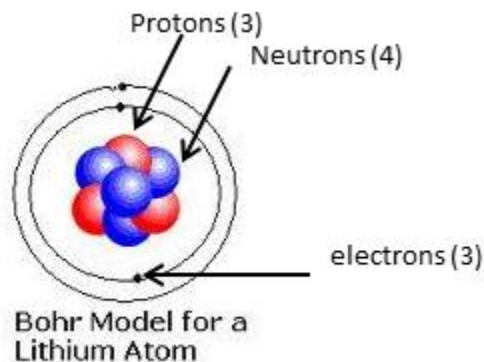
I can use models and words to compare and contrast different atomic arrangements in terms of elements, isotopes, and ions.

I can develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay

1. Fill in the following chart with the three main particles that are found in atoms:

Subatomic Particle	Charge	Mass
Electron	-1	About 0
Proton	+1	1 amu
Neutron	0	1 amu

2. Label all the subatomic particles in the model of the atom below:



3. What is the mass of the atom in the diagram to the right? 7 amu (count the protons and neutrons to get the mass!)

4. An atom of Carbon has the atomic number 6. Fill in the following chart for Carbon:

Name	Protons	Neutrons	Electrons	Mass
Carbon	6	6	6	12

5. **Isotopes** of an element differ only in the number of what subatomic particles? **electrons**

6. The average atomic mass of lithium is 6.941 amu. Why isn't it just 7 amu? How is average atomic mass calculated? **Atoms have isotopes which have different numbers of neutrons and therefore different isotope masses. Average atomic mass is weighted average that reflects the percent abundance of each isotope in nature. Therefore the average is usually a decimal number and not a whole number.**

7. Complete the table below. Assume they are neutral unless you are given evidence that they have a charge.

Completely correct table = Highly Proficient

Mostly Filled in = Proficient

Element	Symbol	Atomic Number	Mass Number	Protons	Neutrons	Electrons
aluminum	Al	13	28	13	15	13
Nitrogen	N	7	13	7	6	7
potassium	K	19	42	19	23	19
oxygen	$^{16}\text{O}^{2-}$	8	16	8	8	10
Magnesium	Mg	12	24	12	12	12

LT2c Radioactivity

Vocabulary: Define the following terms using your Living By Chemistry textbook.

Alpha decay (p. 74)

An unstable nucleus emits a helium nucleus and it loses two protons and its mass decreases by 4 amu.

Alpha particle (p. 74)

The particle emitted in alpha decay is a helium nucleus made up of 2 protons and 2 neutrons

Beta decay (p. 75)

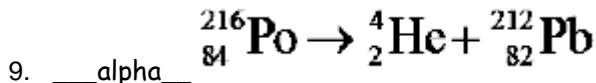
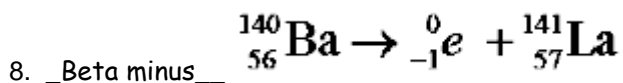
When an unstable nucleus emits an electron adding a proton to the nucleus but not mass since the electron has 0 mass

Beta particle (p. 75)

The particle emitted in beta decay. It is an electron with a charge of -1 and zero mass

Questions 8-9: Identify the following reactions using the letter of the type of nuclear reaction listed below:

a) alpha decay b) beta decay



10. How are radioactive elements different from stable elements?

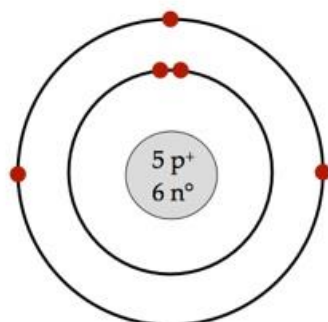
Radioactive elements have unstable nuclei

11. Fill in the blanks for the following nuclear equations. Use your periodic table.

Type of decay	Reaction
Alpha decay	$^{192}\text{Ir} \rightarrow ^4_2\text{He} + ^{189}_{75}\text{Re}$
Beta decay	$^{102}\text{Ru} \rightarrow ^0_{-1}e + ^{102}_{45}\text{Rh}$

ALT 3: Chemical Bonding

1. Draw a shell model for boron, B. Identify the difference between the core and valence electrons.



Boron

Two core electrons in the first shell
Three valence electrons in the outermost shell

2. Find Carbon, C, on your periodic table and identify the following:
- How many core electrons in a neutral atom 2
 - How many valence electrons in a neutral atom 4
3. For elements in Group 6A, answer the following questions:
- Number of valence electrons 6
 - Number of electron shells it depends on the Period. Oxygen has 2, Sulfur has 3 etc.
 - Which Group will atoms in Group 6A bond to in a 1:1 ratio? Group 2A ions with 2+ charge
4. What is the symbol of an ion with 22 protons, 24 neutrons, and 18 electrons? Titanium ion (Ti^{4+})
5. Lithium oxide has the formula Li_2O .
- What is the charge on the lithium ion? Li^+
 - What is the charge on the oxygen ion? O^{2-}
 - Is Lithium a cation or an anion? cation
 - What is the total number of valence electrons in all the atoms in Li_2O ? $1+1+6 = 8$ valence electrons
 - Show that the charges on the ions add up to zero. $2(1+) + (-2) = 0$
6. Write ionic formulas for each pair of ions given.
- | | | |
|---------------------|-----------------|---|
| a. Ni^{2+} | I^- | <u>NiI_2</u> |
| b. In^{3+} | S^{2-} | <u>In_2S_3</u> |
| c. Fe^{2+} | Cl^- | <u>FeCl_2</u> |
7. Write formulas for the following ionic compounds.
- | | | |
|------------------------|--|--|
| d. Gallium bromide | <u>Ga^{3+} and Br^-</u> | <u>GaBr_3</u> |
| e. lithium nitrate | <u>Li^+ and NO_3^-</u> | <u>LiNO_3</u> |
| f. iron (II) phosphate | <u>Fe^{2+} and PO_4^{3-}</u> | <u>$\text{Fe}_3(\text{PO}_4)_2$</u> |
| g. iron (III) sulfide | <u>Fe^{3+} and S^{2-}</u> | <u>Fe_2S_3</u> |
8. Name the following ionic compounds.
- | | |
|----------------------------|--------------------------|
| h. SnCl_2 | <u>Tin chloride</u> |
| i. H_2Se | <u>hydrogen selenide</u> |
| j. SrSO_4 | <u>strontium sulfate</u> |
| k. K_2SO_3 | <u>potassium sulfate</u> |

9.

Characteristics	Ionic	Covalent	metallic
What types of elements is it made of?	Metal and nonmetal	Nonmetals and metalloids	Metals only
Does it dissolve in water?	Yes	No	No
Does it conduct electricity?	When dissolved in water	No	Yes
What happens to the valence electrons?	Transferred from metal to nonmetal	Shared between atoms	Move freely as a sea of electrons

10. Which of the following ions have the correct charge? Choose all that apply. **FIX the ones that are wrong.**

f. Na^{2+} b. Li^+ c. Al^{4+} d. Ca^{2+} e. Ga^{3+}

— Na^+ — — Al^{3+} — — —

11. Explain why the following compound does not form, CaCl .

Ca^{2+} and Cl^- in the compound shown violate the rule of zero charge because it would have an overall charge of +1. They combine in the ratio CaCl_2

12. Predict the formulas for ionic compounds between the following metal and nonmetal elements. Name each compound.

a. Al and Br AlBr_3 b. Al and S Al_2S_3 c. Al and As AlAs

aluminum bromide aluminum sulfide aluminum arsenide

d. Na and S Na_2S e. Ca and S CaS f. Ga and S Ga_2S_3

sodium sulfide calcium sulfide gallium sulfide

13. For each compound, write the cation and anion with the appropriate charge. Then write the chemical formula for each compound.

The first row is completed as an example: sodium fluoride.

Name	Cation	Anion	Formula
<i>Sodium fluoride</i>	Na^+	F^-	NaF
14. Magnesium oxide	Mg^{2+}	O^{2-}	MgO
15. Aluminum chloride	Al^{3+}	Cl^-	AlCl_3
16. Strontium iodide	Sr^{2+}	I^-	SrI_2

17. Predict whether or not Magnesium chloride will conduct electricity. It is made up of a metal ion and a nonmetal ion and is an ionic compound therefore it conducts when dissolved in water.

Will it melt quickly or slowly? **Won't melt because Ionic compounds have high melting points.**

18. Predict whether or not Ammonium chloride will conduct electricity. It is an ionic compound therefore it conducts when dissolved in water Will it melt quickly or slowly? **Won't melt. Ionic compounds have high melting points.**

19. Use your periodic table and the table of polyatomic ions to fill in the missing parts of the following table.

Name	Cation	Anion	Formula
<i>Sodium hydroxide</i>	Na^+	OH^-	$NaOH$
20. Magnesium sulfate	Mg^{2+}	SO_4^{2-}	$MgSO_4$
21. Ammonium oxide	NH_4^+	O^{2-}	$(NH_4)_2O$
22. Strontium phosphate	Sr^{2+}	PO_4^{3-}	$Sr_3(PO_4)_2$
23. lithium carbonate	Li^+	CO_3^{2-}	Li_2CO_3