Periodicity of Elements

Why?

Within musical scales the notes form a series that repeats every eighth note. Eight notes up from a C note is another C note. Each interval or series is referred to as an octave since it contains eight notes. Elements also form an eight step series. The purpose of this activity is to explore how valence electrons generate an eight step series that repeats itself within the Periodic Table.

Learning Objectives

- Associate groups on the periodic table with a number of valence electrons in an electron configuration.
- Associate periods on the periodic table with a number of principal energy levels (shells) in an electron configuration.

Success Criteria

- Assign a group number for the elements in groups 1, 2 and 13-18 based upon the number of ground-state valence electrons in their atoms.
- Assign a period number for the elements in groups 1, 2 and 13-18 based upon the number of occupied shells in a ground-state electron configuration for the element.

Prerequisites

- Electron Configuration
- Nuclear Charge

Information

Periodic Table is grid made up of:

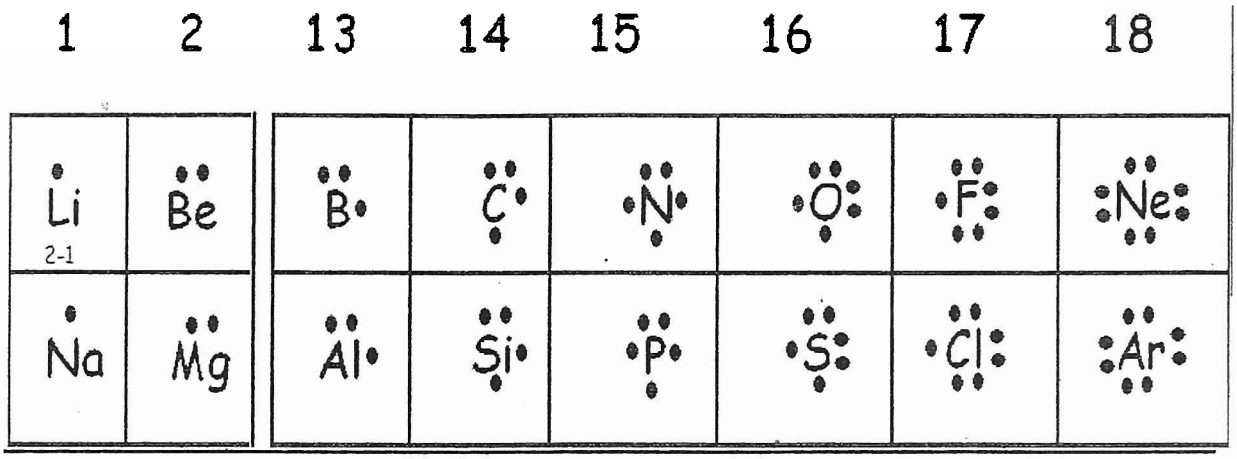
- Rows (or periods) that proceed horizontally (from side to side) across the table
- Columns (or groups) that proceed vertically (up and down) on the table

Resources

Periodic Table

Authored by Cornelius Brosnan; Revised by Lizabeth M. Tumminello, Josephine Parlagreco & Cynthia Gorman
Edited by Linda Padwa and David Hanson, Stony Brook University

Model: An Electron Dot Diagram of the Elements



Task

Below the symbol for each element, write an electron configuration for the elements in the model. Lithium has been done for you.

Key Questions

1. How are members of the same column (group) similar in terms of the number of valence electrons?

2. Which group contains the least number of valence electrons?

3. Which group contains the largest number of valence electrons?

4. Which period (row) contains three occupied shells?

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5. Within a group, which period, top or bottom is likely to contain atoms with the larger radius? Explain your answer.

6. In terms of the number of valence electrons, describe one cyclic property that can be observed in the model.

7. Refer to a Periodic Table and write the number of protons in the nucleus for the period 2 elements listed:

Li ___ Be ___ B ___ C ___ N ___ O ___ F ___ Ne ___

8. Which element within period 2 contains the greatest nuclear charge?

9. Which element within period 2 generates the greatest force of attraction between its nucleus and its valence electrons? Explain your answer.

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Exercises

1. Identify the element, group number, period number, and nuclear charge for atoms with the following ground state electron configurations:

Electron Configuration	2-8-4	2-8-8-1	2-8-1	2-8-18-7	2-8-18-32-18-8
Element Symbol					
Group Number					
Period or Row Number					
Nuclear Charge					

2. Would any of these elements likely have similar chemical properties? Which ones and why?

3. Pick two elements from the chart that have very different chemical properties and explain why they are different.

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Periodic Trends

STUDENT SHEET

Description

For the following data, plot the atomic number on the x-axis and the property on the y-axis. Each property should be graphed on a separate sheet of graph paper.

Element	Atomic Number	Atomic Radius (pm)	1st Ionization Energy (kJ/mol)	Electron Affinity (kJ/mol)	Electro negativity (Pauling Units)
H	1	53	1312	-73	2.1
He	2	31	2372	0	NA
Li	3	167	520	-60	1.0
Be	4	112	899	240	1.5
B	5	87	801	-27	2.0
C	6	67	1086	-122	2.5
N	7	56	1402	0	3.0
O	8	48	1314	-141	3.5
F	9	42	1681	-328	4.0
Ne	10	38	2081	0	NA
Na	11	190	496	-53	0.9
Mg	12	145	738	230	1.2
Al	13	118	578	-44	1.5
Si	14	111	787	-134	1.8
P	15	98	1012	-72	2.1
S	16	88	1000	-200	2.5
Cl	17	79	1251	-349	3.0
Ar	18	71	1521	0	NA

Analysis

1. Based on your graphs, what is the trend in atomic radius across a period? down a family?
2. Based on your graphs, what is the trend in ionization energy across a period? down a family?
3. Based on your graphs, what is the trend in electron affinity across a period? down a family?
4. Based on your graphs, what is the trend in electro negativity across a period? down a family?
5. Using an activity series, what can you deduce about the relationship between ionization energy and reactivity of metals?

Using an activity series, what can you deduce about the relationship between electron affinity and reactivity of nonmetals? Explain in 3-4 paragraphs the organization and usefulness of the modern periodic table based on what you have learned in class and what you have learned from this activity.

Exercises

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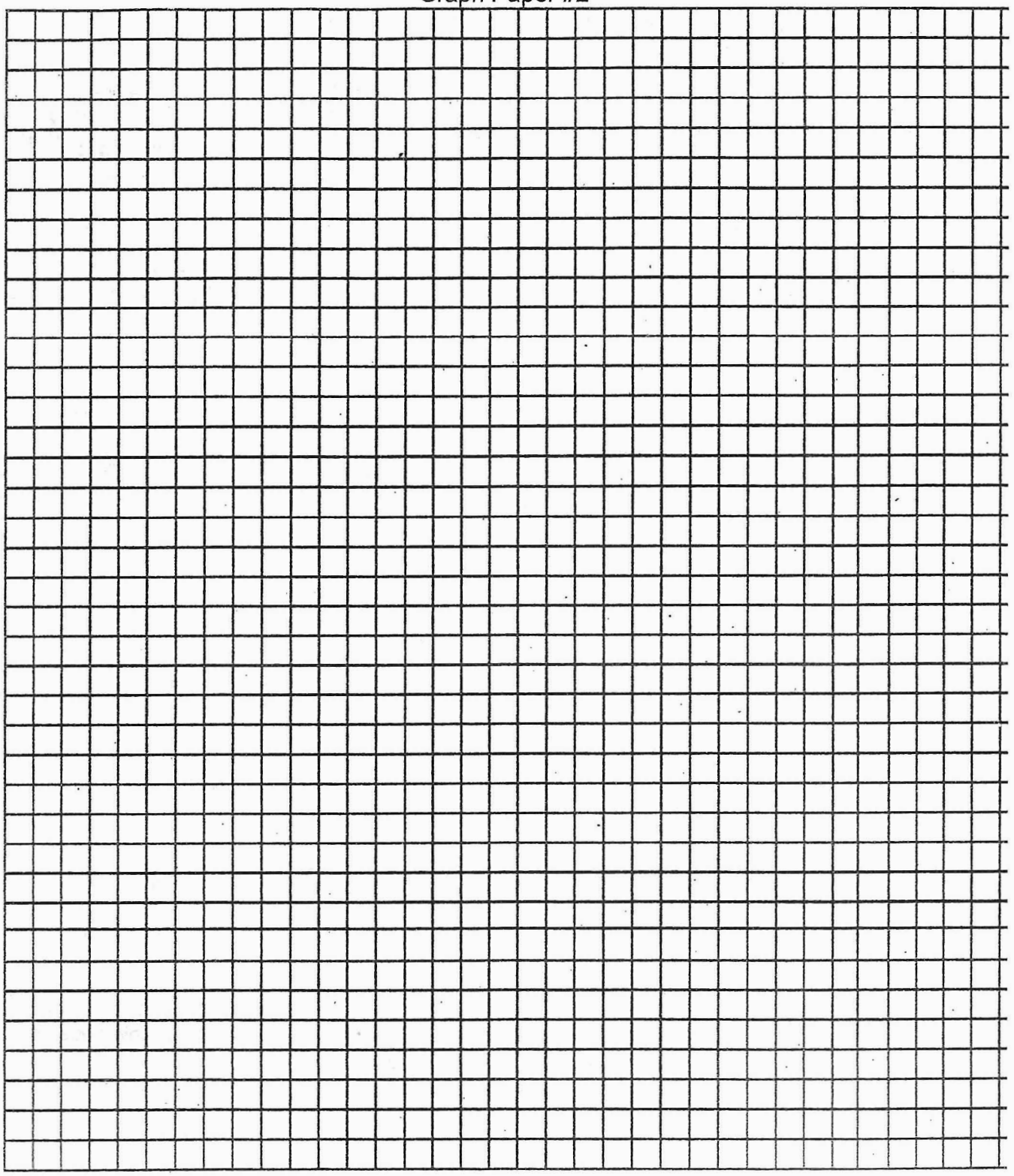
Rick's Math Web
www.ricksmath.com

Name_____
Date_____

Graph Paper #2



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Name_____
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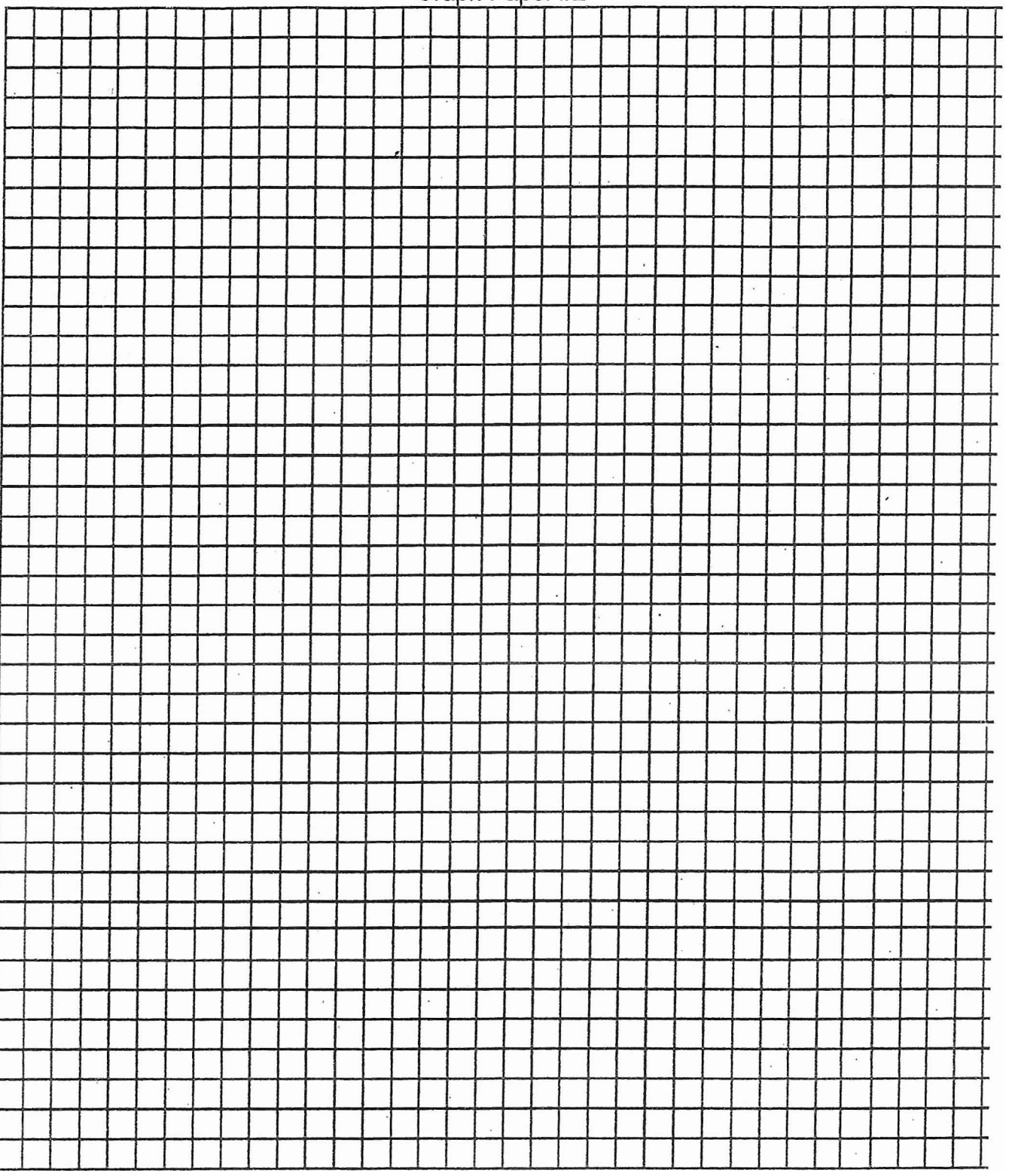
Graph Paper #2



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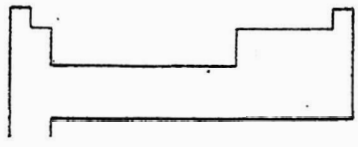
Periodic Properties I: Overview

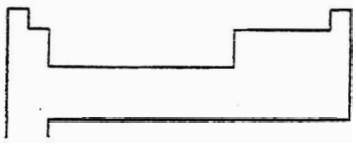
1. Indicate "high" and "low" areas for each property on the mini periodic tables below. Explain each trend briefly.

a) Ionization Energy

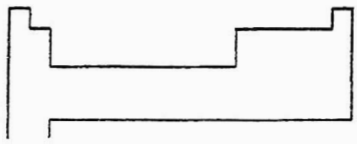
b) Atomic Mass



c) Atomic Radius

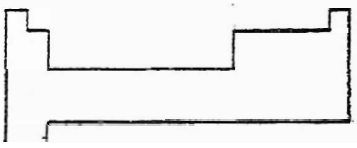


d) Metallic Character



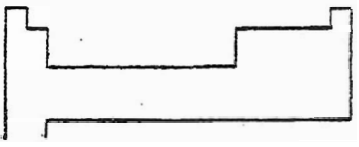
2. Find the following on the periodic tables below, and indicate their identity:

a) Most reactive metal



Identity: _____

b) Most reactive nonmetal



Identity: _____

NAME _____ DATE _____ 1

ATOMIC NUMBERS

The atomic number tells how many protons the atom of that element contains in the nucleus. Use the periodic table in your textbook, or another periodic table, to look up the atomic numbers. It will be the whole number just above the element symbol. To find the answer to the question, use only the first letter of the element corresponding to that atomic number. Put the first letter of the element in the space above the number.

A Child's Definition of the Term Gas Might Be:

34	8	25	99	52	2	77	41	31	81	1	13	43

31	76	99	14	92	15	5	92	22

66	76	63	21	28	22	W	33	7	22	90	8

32	76	4	18	6	36	66	8	W	10

EXAMPLE:

G	A	S
31	18	21

31 is the atomic number of the element gallium, and it starts with the letter G. The letter G goes above the number 31. The other two letters are found in the same way.

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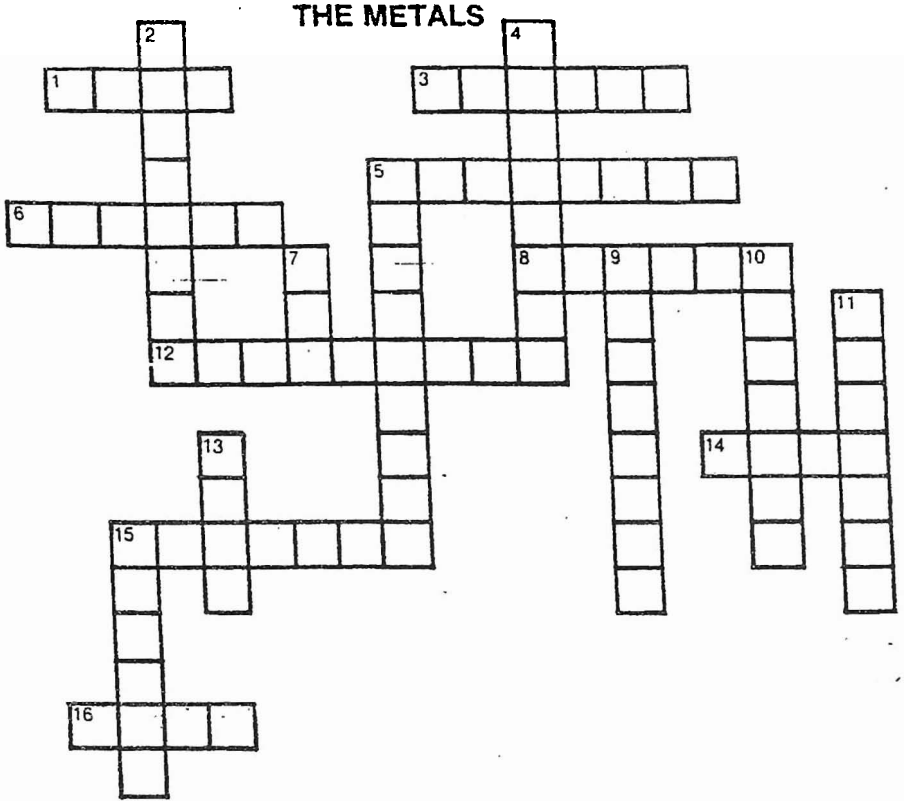
THE METALS



This puzzle uses the chemical symbols and their corresponding names. Only those elements which are metals are included. Since this is a rich puzzle indeed, two very valuable metals are used in each column. Fill in the proper word on the puzzle and on the lines provided by the chemical symbol.

ACROSS

1. _____ (Au)
3. _____ (Ag)
5. _____ (Pt)
6. _____ (Na)
8. _____ (Ni)
12. _____ (Mg)
14. _____ (Zn)
15. _____ (Ca)
16. _____ (Pb)

DOWN

2. _____ (Al)
4. _____ (Pt)
5. _____ (K)
7. _____ (Sn)
9. _____ (Cr)
10. _____ (Li)
11. _____ (Hg)
13. _____ (Au)
15. _____ (Cu)

(3)

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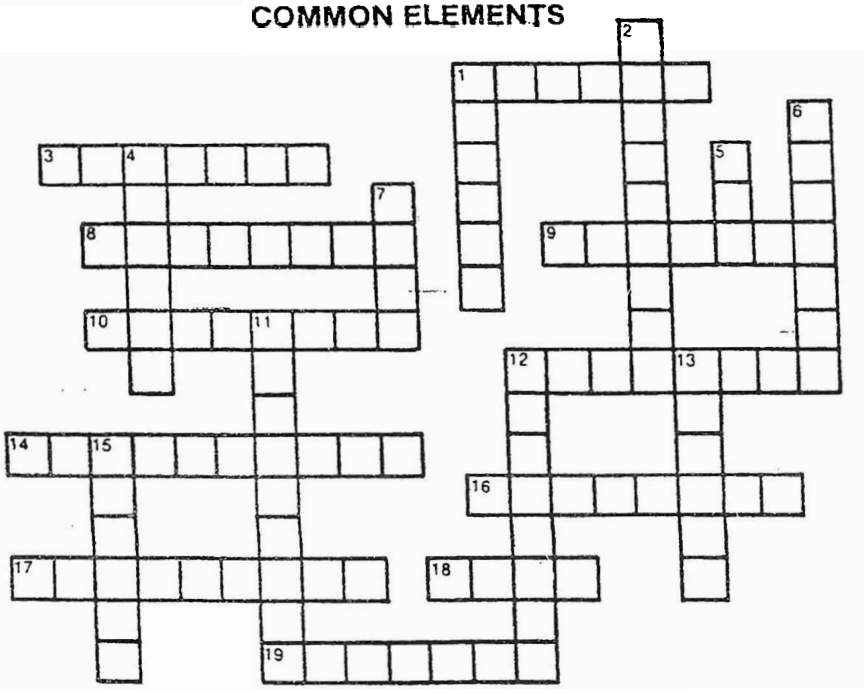
COMMON ELEMENTS



This puzzle uses the chemical symbols and their corresponding names. Fill in the proper word in the puzzle and on the lines provided in front of the chemical symbol. These are some common symbols used in chemistry, so learn them!

ACROSS

1. _____ (C)
3. _____ (Bi)
8. _____ (F)
9. _____ (As)
10. _____ (W)
12. _____ (Al)
14. _____ (P)
16. _____ (Ti)
17. _____ (Mg)
18. _____ (Fe)
19. _____ (Hg)

DOWN

1. _____ (Cu)
2. _____ (K)
4. _____ (S)
5. _____ (Sn)
6. _____ (Ca)
7. _____ (Ne)
11. _____ (Sr)
12. _____ (Sb)
13. _____ (I)
15. _____ (O)

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UNUSUAL ELEMENT SYMBOLS

O is the symbol for oxygen, and Ne is the symbol for neon. Why, then, isn't I or Ir the symbol for iron? Because scientists already had a name for iron—it was *ferrum*. They decided to use the already well-known Latin term for iron (and ten other elements). The exercises below will help you find and learn the universal names of the elements. Write the universal term for the element that corresponds with its symbol.

SYMBOL	UNIVERSAL TERM
1. Ag	1 18 7 5 14 20 21 13
2. Au	1 21 18 21 13
3. Cu	3 21 16 18 21 13
4. Hg	8 25 4 18 1 18 7 25 18 21 13
5. K	11 1 12 9 21 13
6. Na	14 1 20 18 9 21 13
7. Pb	16 12 21 13 2 21 13
8. Sn	19 20 1 14 14 21 13
9. Sb	19 20 9 2 9 21 13
10. W	23 15 12 6 18 1 13

On a separate sheet of paper, write the alphabet, one letter at a time. Put a number under each letter:

A ... Z
1 ... 26

Use these numbers as clues to help you find the terms.

Ex: Fe F e r r u m
6 5 18 18 21 13

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FIND THE TWO GROUPS

	SYMBOL	ELEMENT
1.	At	1 _ _ 11 _ _ _ _
2.	Br	_ _ 3 _ _ 6 _
3.	Cl	9 10 _ _ _ _ 15 _
4.	F	_ 2 _ 13 _ _ _ _
5.	I	_ _ 8 _ _ 14
6.	O	17 _ _ 4 _ _
7.	Po	19 _ _ _ 7 _ _ _
8.	Se	_ _ _ 5 _ _ _ _
9.	S	_ _ 12 _ 18 _
10.	Te	_ _ _ _ _ 16 _ _ _

Write the name of each element on the spaces after the corresponding symbol of that element. Put only one letter on each line.

EXAMPLE: At A S T A T I N E

1 11

When a number lands on a blank that is numbered, write that letter on the line below that has the same number. Ex: A _____ A _____

1 11

H _ _ _ _ _ _ A _ _ _

1 2 3 4 5 6 7 8

_ _ _ _ C _ G _ _ G _ _ _ _ S

9 10 11 12 13 14 15 16 27 18 19

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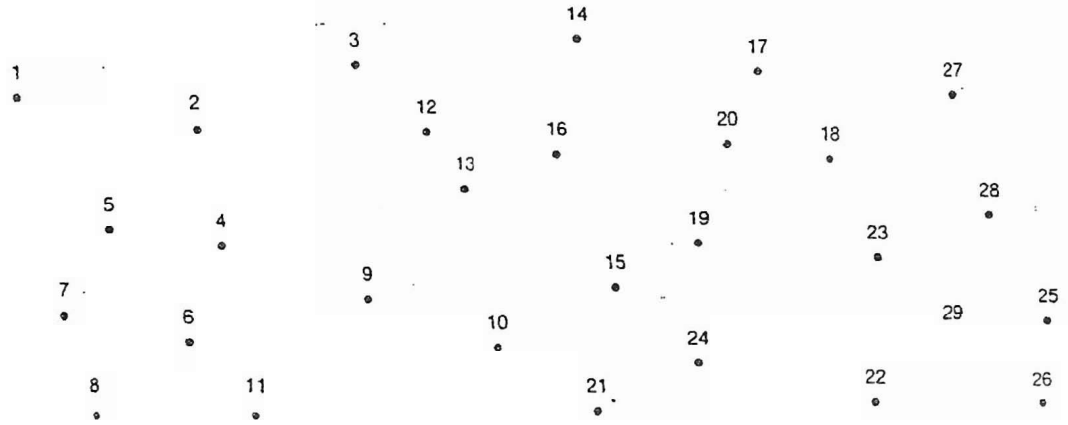
ELEMENTS ABUNDANT IN THE EARTH'S CRUST

	ELEMENT	ATOMIC NUMBER
1.	Aluminum	_____
2.	Calcium	_____
3.	Iron	_____
4.	Magnesium	_____
5.	Oxygen	_____
6.	Potassium	_____
7.	Silicon	_____
8.	Sodium	_____
9.	Titanium	_____

WHERE ARE THESE ELEMENTS FOUND?



DIRECTIONS:

Look up the atomic number of each element and write the number down on the line. Find the number among the group of numbers above, and fill in the circle by that number. Connect the dots you have formed, being careful to keep the numbers in order from the smallest number to the next highest number according to your list of atomic numbers.

EXAMPLE: Oxygen has an atomic number of 8 and sodium's is 11. Connect these, then go on to the next highest number from your list. Stop with the atomic number of iron.

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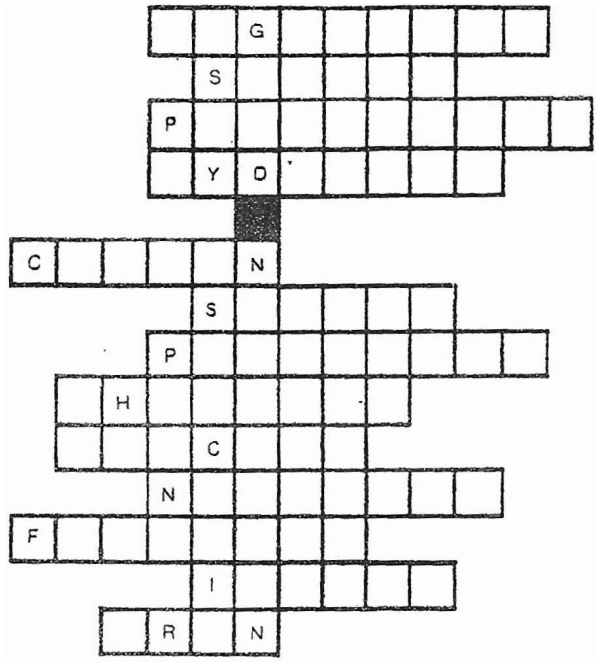
ELEMENTS IN THE HUMAN BODY



The word puzzle above contains several elements that are all found in the human body. Find the names of the elements using the list of symbols as clues. Refer to the periodic table to find the element names. Some letter clues are included to aid you. *Example*: The symbol for oxygen is O, so write O X Y G E N in the space provided.

ELEMENT SYMBOLS

C	H	O
Ca	K	P
Cl	Mg	S
F	N	I
Fe	Na	

PUZZLE QUESTION:

What does the human body need in order to be healthy?

_____ _____

(See if you can answer the puzzle question after completing the puzzle.)

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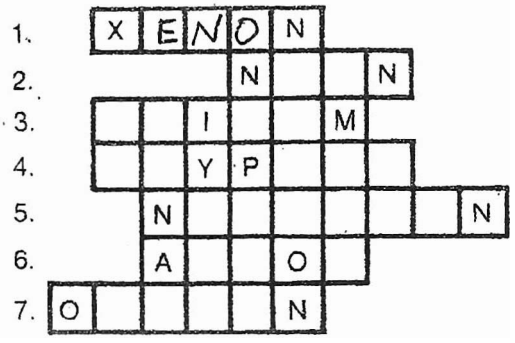
8

ELEMENTS FOUND IN THE AIR

What is the part of the nucleus of the atom which contains uncharged, or *neutral*, particles? _____



Above is a puzzle containing seven elements that can be found in the air. Fill in the name of each element, and you will have the answer to the puzzle question. Some of the letters have been filled in for you. After completing the puzzle, write down each element, its atomic number, and its symbol below on the lines.

ELEMENT	SYMBOL	ATOMIC NUMBER
1. XEON	Xe	-FROM P. TABLE
2.		
3.		
4.		
5.		
6.		
7.		