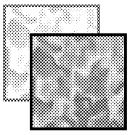
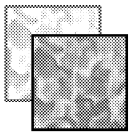
Mastering the Periodic Table: *50 Activities on the Elements*

Linda Trombley
Revised by Faye Williams



Contents



To the Teacher

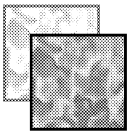
This set of activities has been created and assembled to provide a variety of materials for both students and teacher. The activities are designed to cover every aspect of the periodic table and are divided into categories (listed in the Table of Contents). The types of activities range from worksheets to demonstrations and from group projects to games and puzzles. Some activities are cross-curricular and incorporate history (Activity 9 or 48), music (Activity 1), art (Activity 2 or 18), writing (Activity 1 or 31b), and math (Activity 13). You can select an activity to introduce an idea or to reinforce prior knowledge. The activities can be used singly or as a complete unit. Depending on the class, one activity can be assigned as remediation to clarify a concept (Activity 19, 29, or 30) and another activity can be given as an enrichment assignment (Activity 11, 28b, or 31b). With Activities 12–14, students make up their own stories or problems using the elements.

The reproducible readings are designed to provide the teacher with enough information to explain the design, uses, and complexities of the periodic table. They are also intended for students to read for background information prior to completing the selected activity. In fact, a simple recall activity, such as Activity 21a or 32a, can be done after reading and before an assignment. This same recall activity format can be used for element properties, electron configuration, or specific series or families of elements.

Depending on the ability level of the students, the activities can be used for middle school, junior high, or high school students. Some of the puzzles can be done by fourth or fifth graders using the reproducible readings as guides. Younger students can complete some of the quizzes as worksheets when used in conjunction with the reproducible readings.

For biology classes, Activities 3–8, 12–17, 32–34 and Bonus Activities 1 and 2 could be useful. For general science classes, Activities 1–9, 12–22, 32–34 and Bonus Activities 1 and 2 are suggested. Physical science teachers may want to use the same activities as suggested for general science, plus Activities 37–42. The majority of the activities are designed for chemistry classes. However, as indicated above, you should select the activities that are best suited to your classroom situation and students. Some of the activities can even be used as handouts for a substitute, especially Activities 12–14. All the substitute needs is a periodic table and the worksheet. The appendices also contain a short list of web sites that have links to other sources. Classrooms with Internet capability can open an even wider vista for students to explore.

As the introductory reading states: The periodic table of elements is the most important tool of a chemist. These activities are designed to help students discover the myriad of information available from this simple chart of elements and understand how this information affects their lives.



About the Periodic Table

The **periodic table of elements** is the most important tool of a chemist. The table provides a myriad of information about all the elements, both natural and synthetic.

By the year 2000, there were **115 elements** — 92 occurring naturally and 23 synthetic. Technetium and all the transuranium elements are synthetic. Plutonium is found in very minute quantities in uranium ores, so it is counted as part of the 92 naturally occurring elements; however, the majority of plutonium is synthetic.

The elements have been placed in **periods** (the horizontal rows). These indicate electron energy levels. They are also placed in **groups** or **families** (the vertical columns); these reflect similar chemical properties. There are 7 periods and 18 groups, numbered from left to right. All elements from bismuth (atomic number 83) to the latest synthetic element are radioactive.

The types of information available from the periodic table vary depending on the version, but each table has the element symbol and the atomic number. Other types of information that can be found on the periodic table are:

- element name
- mass number
- atomic mass
- electron configuration
- oxidation states
- phase at room temperature
- melting point
- boiling point
- density
- atomic radius
- electronegativity

Chemists are able to use the periodic table to determine which elements can combine and in what proportions and which elements have similar properties. Using this information they can help manufacturers determine how to improve products and processes. For example, the substitution of potassium for sodium strengthens glass, and the use of helium instead of hydrogen in dirigibles provides safety.

The periodic table on page 3 is based on the existing published periodic tables and information gathered from various web sites. The published periodic tables are from the American Chemical Society (ACS). Most periodic table sources do not identify the latest elements. Gesellschaft für Schwerionenforschung (GSI), currently one of the leading researchers in developing new elements, provides the latest information on their web site. GSI follows International Union of Pure and applied Chemistry (IUPAC) guidelines. The periodic table found in the Webelements web site does list elements 113, 115, and 117 although these have not, as of 2000, been identified.

Periodic Table of Elements

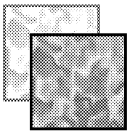
Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1																	0
1	1 H																	2 He
	IA	IIA											IIIA	IVA	VA	VIA	VIIA	
			IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB						
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub		114 Uuq		116 Uuh		118 Uuo

6 - Lanthanides	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
7 - Actinides	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Represents period numbers

Represents new group numbers

Represents old group numbers



Activity 1: **Element Song**

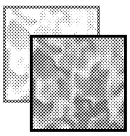
Objective: Students creatively present information about an element.

Materials:
- Recording of "The Element Song" by Tom Lehrer
- Copy of the periodic table of elements for each student (can be reproduced on page 3)
- Resources for information on elements (for example, *CRC Handbook of Chemistry and Physics*)

Procedure: If possible, play "The Element Song" by Lehrer. Discuss with the class. Have students select an element and write a song or poem about it. They should be sure to include the element name, symbol, atomic number, group number or family name, major characteristics, and uses.

Results: Students will present their songs or poems to the class. This is an opportunity for students to be creative and have some fun with a potentially dry subject.

Variation:
1. Students can update Lehrer's song to include the latest elements.
2. Students can work in groups, with each group writing a song about the elements in an assigned period from the periodic table (horizontal row).



Activity 2: **Element Boxes**

Objective: Students create their own periodic table.

Materials:
- 15-cm x 15-cm squares of white paper
- Resources for information on elements (for example, *The Elements* by John Emsley)

Procedure: Have students each select an element and design an "element box" for it. The box (white paper square) should include element name, symbol, atomic number, and a picture representative of either the element's characteristics or uses.

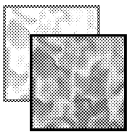
Results: Students will place their element boxes in the correct periodic table location on a large bulletin board or piece of poster board.

Extension: As they continue to learn about the periodic table, students can add more information to their element boxes. For example, atomic mass or mass number, electronegativity, phase at room temperature, date of discovery, mineral source, oxidation states, etc., can be included as time goes on.

Halogens

Preliminary Handout:
- Halogens (reproducible reading)

Activities:
39. Halogen Color Codes (reproducible)
40. Halogens Quiz (reproducible)



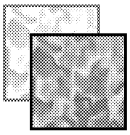
Halogens

The halogens are fluorine, chlorine, bromine, iodine, and astatine. The name halogen comes from the Greek words meaning "salt former." The name is aptly given because halogens readily form salts with alkali metals. The halogens have seven valence electrons and tend to take electrons. Thus, they form negative ions or anions with a 1- charge.

Characteristics of the halogens include:

- Fluorine, chlorine, bromine, and iodine are the most reactive nonmetals, and are not found free in nature. In fact, in their elemental form, when not combined with other elements, they form diatomic molecules.
- The gaseous phase of the four nonmetallic halogens have distinct colors. Fluorine is a pale yellow gas, chlorine is a yellow green gas, bromine forms a red gas, and iodine sublimes into a purple gas. All the gases are toxic and corrosive.
- Astatine is one of the semimetals, and is radioactive. Astatine is rarely found in nature; it is usually made in research laboratories by combining bismuth and an alpha particle.

Name _____ Date _____



Activity 39: **Halogen Color Codes**

Directions: The nonmetallic halogens form distinctly colored gases. Write the names of these elements, their symbols, and their atomic numbers in the color of their gases in the table below. For the semimetal member, use black. Then, using the color clues in parentheses, answer the questions.

ELEMENT	SYMBOL	ATOMIC NUMBER

1. This element is the liquid member of the family. (red) _____
2. This element is used in photography and as an antiseptic. (violet)

   _____
3. All of the elements are nonmetals except this member. (black)

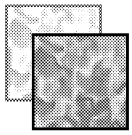
   _____
4. This element is the most reactive nonmetal. (yellow) _____
5. This element is extracted from sea water. (red) _____
6. This element forms a poisonous gas and is used in pools. (green)

   _____
7. This element is the radioactive member of the family. (black)

   _____
8. This element combines with sodium to form common table salt. (green)

   _____
9. This element is a solid nonmetal. (violet) _____
10. This is the lightest member of the group. (yellow) _____

Name _____ Date _____



Activity 40: **Halogens Quiz**

Part A. Directions: Circle the correct response from the choices given in parentheses.

1. The halogens are found in Group (**17** or **18**).
2. The halogens form (**anions** or **cations**) with a (**1+** or **1-**) charge.
3. The first four halogens are diatomic (**metals**, **semimetals**, or **nonmetals**).
4. The element with the highest electronegativity is (**fluorine**, **chlorine**, **bromine**, **iodine**, or **astatine**).
5. These elements form strong (**acids** or **bases**) when mixed with water.

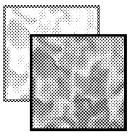
Part B. Directions: Indicate if the statement is true or false. If false, change the underlined word(s) to make the statement true.

6. Astatine is a radioactive product of uranium decay. _____
7. All of the nonmetallic halogens form non-corrosive gases. _____
8. Although the elemental forms are toxic, the ions of fluorine, chlorine, and iodine are essential for humans. _____

Noble Gases

Preliminary Handout:
- Noble Gases (reproducible reading)

Activities:
41. Noble Gases Puzzle (reproducible)
42. Noble Gases Pictionary® (reproducible)



Noble Gases

The noble gases are helium, neon, argon, krypton, xenon, and radon. They are the least reactive of the elements because of their electron configuration. All of these elements, except helium, have eight electrons in their outermost energy level and are, therefore, complete. Although helium only has two electrons in its outermost energy level, it is complete since the 1*s* sublevel can only hold two electrons. Since the valence shells of the noble gases are complete, they do not react readily with any other elements. Only the heavier noble gases (krypton, xenon, and radon) have reacted with fluorine under controlled laboratory conditions.

Characteristics of the noble gases include:

- All of the noble gases are colorless, odorless gases.
- All except radon are nontoxic.
- Radon is radioactive and emits alpha particles. It is formed when uranium and thorium disintegrate, and also collects over radium samples. This noble gas phosphoresces when cooled below its freezing point.
- Xenon is the proverbial "lead balloon." When a balloon is filled with xenon, it falls with a thud.
- Krypton also is heavier than air and a balloon filled with krypton will fall toward the ground. The red-orange line in krypton's spectrum is used as the fundamental standard for the meter. Krypton is also used in light bulbs and welding.
- Argon is probably best known as a welding gas. It is also used in light bulbs, including mercury vapor lamps for street lights.
- Neon is probably best known as the gas in neon signs. It is also used in welding and is mixed with oxygen for deep sea divers.
- Helium is the lightest of the noble gases and is best known as the gas used for party balloons or dirigibles. It is also used in mercury vapor lamps and mixed with oxygen for deep sea divers.

All of the noble gases except radon have names derived from Greek.

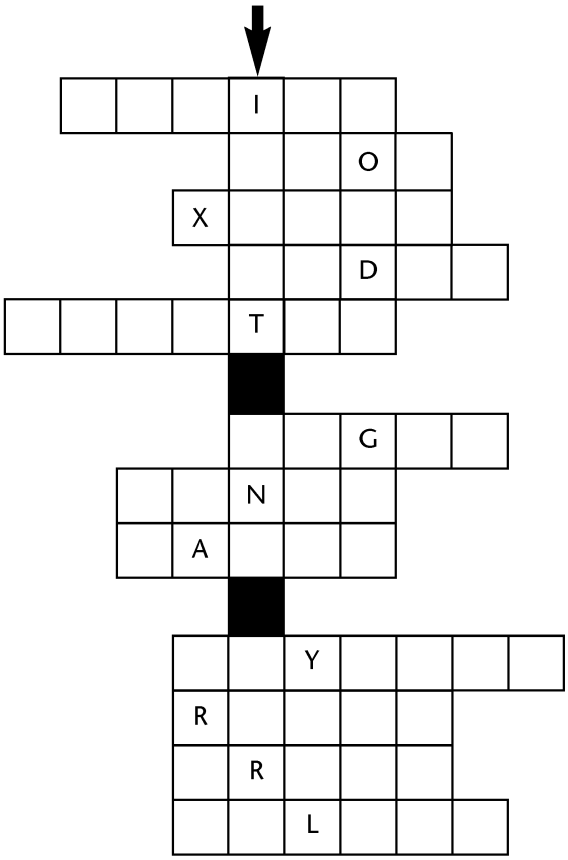
- Helium comes from *helos* meaning "sun" since helium was first observed in the sun's spectrum.
- *Neon* is the Greek word meaning "new."
- Argon is derived from *argos* meaning "inactive" since it does not react with any other element.
- Krypton comes from *kryptos* meaning hidden.
- The name xenon is derived from the Greek word *xenos* meaning "stranger."

Name _____ Date _____

Activity 41: **Noble Gases Puzzle**

Directions: Two words once used by scientists to describe the noble gases no longer apply. What are they? Use the names of the six noble gases to find those words.

First, use the letter clues in each horizontal row to complete the name of the correct noble gas. You will use most names more than once—in fact, you may use one noble gas name three times! When you have completed the puzzle, read down vertically starting at the black arrow. Now you know the answer to the question asked above!



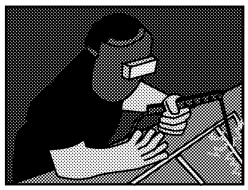
Name _____ Date _____

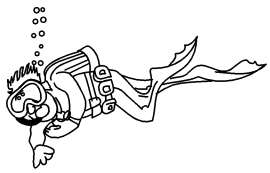
Activity 42: **Noble Gases Pictionary®**

Directions: List the noble gases, their symbols, and their atomic numbers in the chart below. Then use the picture clues to identify each noble gas.

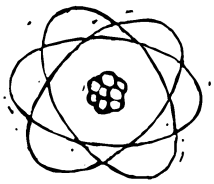
ELEMENT	SYMBOL	ATOMIC NUMBER

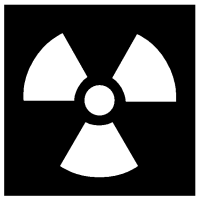
1



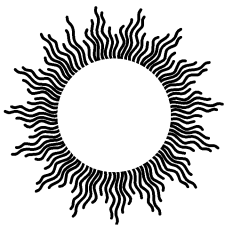


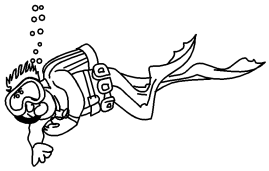
2

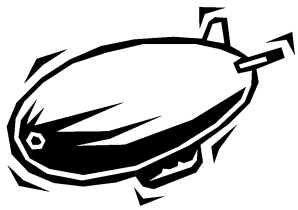




3







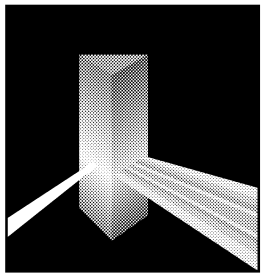
(continued)

Name _____ Date _____

Activity 42: **Noble Gases Pictionary®** *(continued)*

4

5



6