Matter & Energy Series

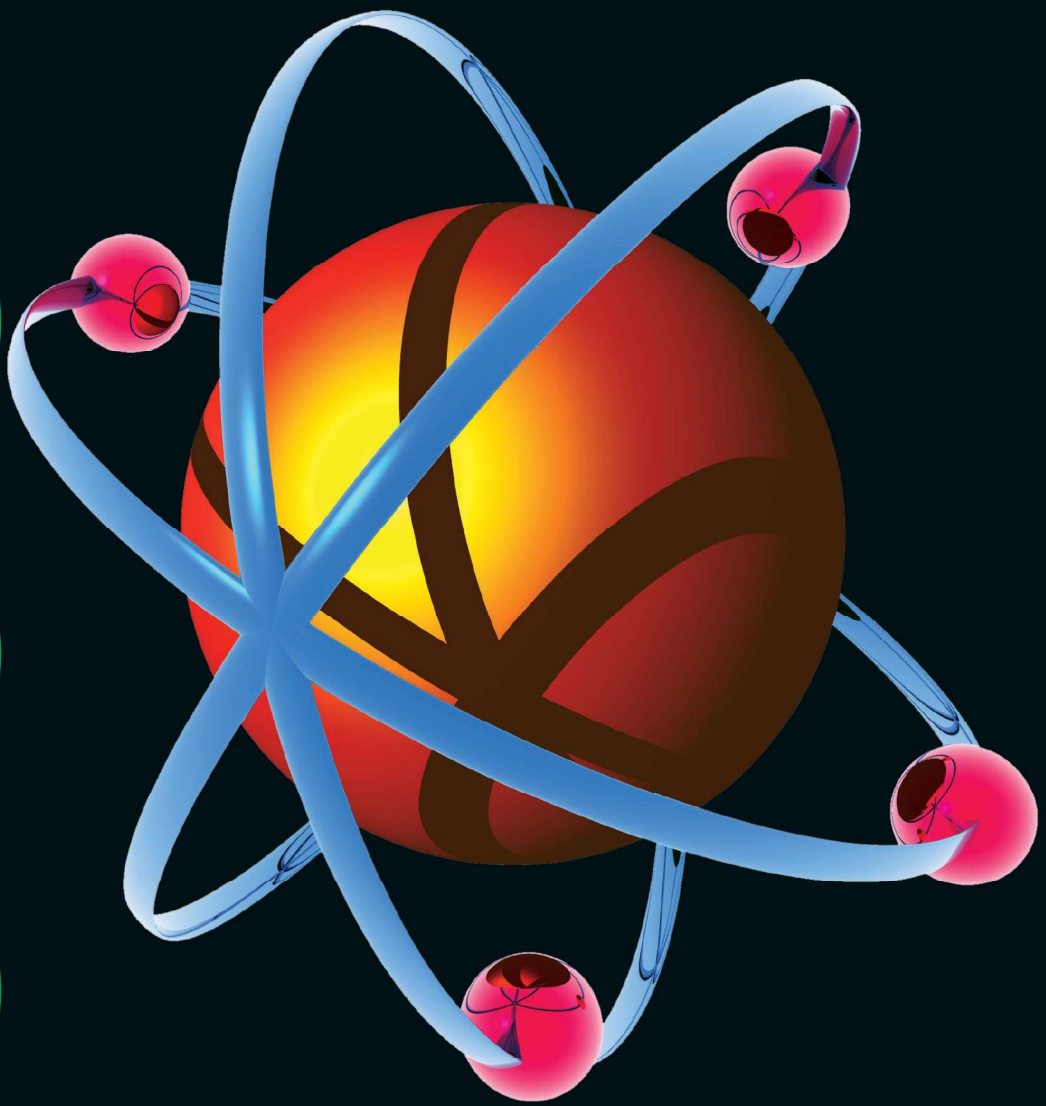
Atoms, Molecules & ELEMENTS

High-Interest • Low-Vocabulary

CC4505

GRADES 5-8

READING LEVELS 3-4



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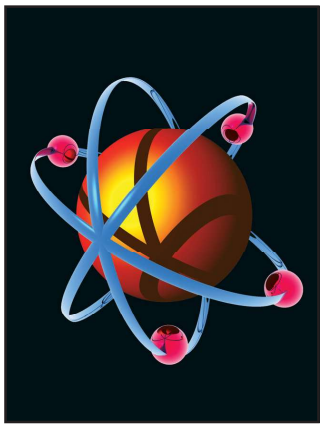

ATOMS, MOLECULES & ELEMENTS

Matter & Energy Series

Written by George Graybill, Ph. D.

GRADES 5 - 8

Reading Levels 3 - 4

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P.O. Box 19729
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Tel: 1-800-663-3609 / Fax: 1-800-663-3608
Email: service@classroomcompletepress.com

www.classroomcompletepress.com

ISBN-13: 978-1-55319-371-5
ISBN-10: 1-55319-371-7

Critical Thinking Skills

Atoms, Molecules & Elements

Skills For Critical Thinking		Reading Comprehension							Hands-on Activities
		Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	
LEVEL 1 Knowledge	• List Details/Facts	✓	✓					✓	
	• Recall Information	✓	✓	✓		✓	✓	✓	
	• Match Vocab. to Definitions	✓	✓			✓			
	• Define Vocabulary			✓	✓	✓	✓		
	• Label Diagrams							✓	✓
	• Recognize Validity (T/F)	✓	✓	✓	✓	✓	✓	✓	
LEVEL 2 Comprehension	• Demonstrate Understanding	✓	✓	✓	✓	✓	✓	✓	✓
	• Explain Scientific Causation		✓	✓		✓	✓		
	• Rephrasing Vocab. Meaning		✓	✓					
	• Describe			✓	✓	✓		✓	
	• Classify into Scientific Groups	✓		✓	✓			✓	
LEVEL 3 Application	• Application to Own Life		✓	✓		✓			
	• Model Scientific Process	✓				✓	✓		✓
	• Organize and Classify Facts	✓		✓		✓	✓	✓	✓
	• Utilize Alternative Research Tools								✓
LEVEL 4 Analysis	• Distinguish Roles/Meanings								
	• Make Inferences	✓				✓	✓	✓	✓
	• Draw Conclusions Based on Facts Provided	✓			✓		✓	✓	✓
	• Classify Based on Facts Researched		✓		✓		✓		
LEVEL 5 Synthesis	• Compile Research Information		✓		✓	✓			✓
	• Design and Application			✓					✓
	• Create and Construct			✓		✓	✓		✓
	• Imagine Self in Scientific role								✓
LEVEL 6 Evaluation	• State and Defend an Opinion				✓	✓	✓		✓
	• Justify Choices for Research Topics								
	• Defend Selections and Reasoning					✓			✓

Based on Bloom's Taxonomy

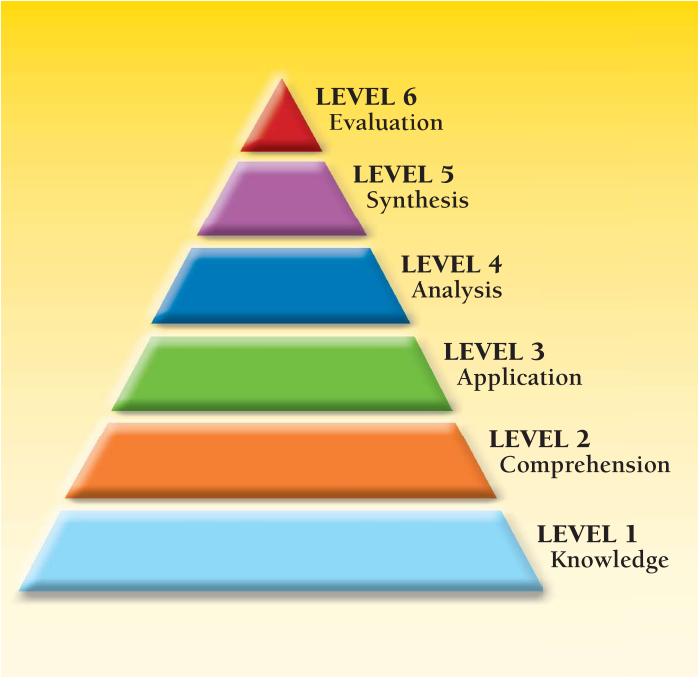
Bloom's Taxonomy

Our resource is an effecctive tool for any ***SCIENCE PROGRAM.***

Bloom's Taxonomy* for Reading Comprehension

The activities in our resource engage and build the full range of thinking skills that are essential for students' reading comprehension and understanding of important science concepts. Based on the six levels of thinking in Bloom's Taxonomy, and using language at a remedial level, information and questions are given that challenge students to not only recall what they have read, but move beyond this to understand the text and concepts through higher-order thinking. By using higher-order skills of application, analysis, synthesis and evaluation, students become active readers, drawing more meaning from the text, attaining a greater understanding of concepts, and applying and extending their learning in more sophisticated ways.

Our resource, therefore, is an effective tool for any Science program. Whether it is used in whole or in part, or adapted to meet individual student needs, our resource provides teachers with essential information and questions to ask, inspiring students' interest, creativity, and promoting meaningful learning.



BLOOM'S TAXONOMY:
6 LEVELS OF THINKING

**Bloom's Taxonomy is a widely used tool by educators for classifying learning objectives, and is based on the work of Benjamin Bloom.*

Vocabulary

atom	group	nonmetals
atomic model	inert	organic
atomic number	inert gas	outer electron
bond	metals	particle
chemical symbols	material	periodic table
compound	metal oxide	proton
electron	molecule	pure material
element	neutron	reactive

NAME: _____

What Are Atoms?

1. Circle T if the statement is TRUE or F if it is FALSE.

T F **a)** People have always agreed that matter is made of atoms.

T F **b)** Some atoms are large enough to see with our eyes.

T F **c)** All molecules contain more than one atom.

T F **d)** Atoms and molecules are two kinds of particles.

T F **e)** Atoms are made of even smaller parts.

2. Complete each sentence with a word from the list. Use a dictionary to help you.

atom	chemical change	physical change	molecule	particle

a) Melting is a _____.

b) Molecules can break apart into _____s during a chemical change.

c) _____s can form new molecules.

d) All atoms are _____s.

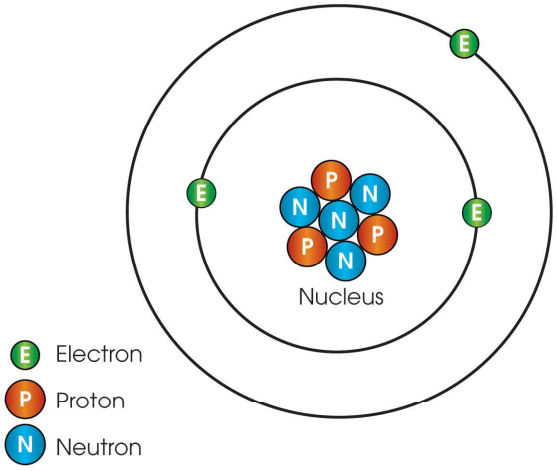
e) Chemical properties tell how and when atoms form _____s.

NAME: _____

What Are Atoms?

Matter is made of **atoms.** Atoms are sort of like building blocks or bricks in a building. Like blocks and bricks, some atoms fit together well to make something larger and some don't.

To understand chemical changes, we need to understand what atoms are. Atoms are the smallest bits of matter that get changed around during a chemical change. But, like building blocks, atoms don't change so they will fit better. Think of a child playing with building blocks. She wouldn't saw a block in half to make it fit better.



Atomic Model

About 200 years ago, scientists agreed that matter is made of atoms. It took another 100 years to learn what the main parts of atoms are and how they are arranged. This picture shows the three main parts of an atom. They are electrons, protons, and neutrons.

This is called an **atomic model**. A model is not a true picture of a thing. Scientists use models like this to help explain things that are hard to picture exactly. These are some ideas that the atomic model helps us understand:

1. Atoms are mostly empty space.

2. The three main parts of an atom are **electrons**, **protons**, and **neutrons**.

3. Most of the mass of an atom is in the small center area called the **nucleus**. The nucleus is where all the neutrons and protons are found.

4. Electrons circle the nucleus at different distances.

5. Neutrons and protons have about the same mass. Electrons have much less mass than neutrons or protons.

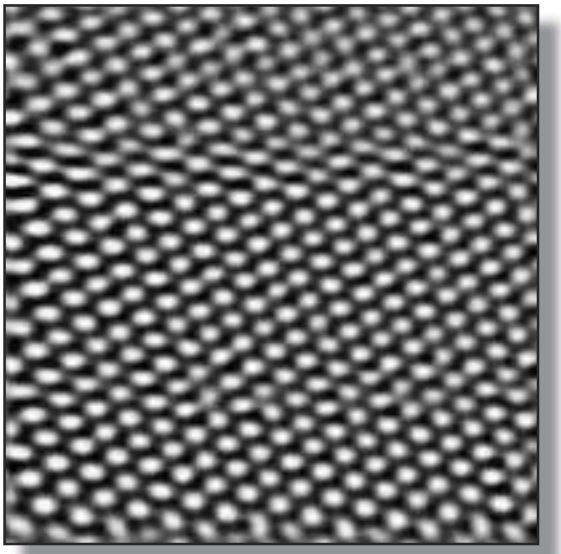
6. The number of electrons in an atom equals the number of protons. The number of neutrons is about the same but can be a little different.

7. Electrons have a minus (or **negative**) electrical charge. Protons have a plus (or **positive**) electrical charge. Neutrons have no charge.

NAME: _____

What Are Atoms?

Now let's put all these ideas together: In an atom, small, negative electrons circle the nucleus. The nucleus is made of larger, positive protons and uncharged neutrons. Atoms are mostly empty space. Most of an atom's mass is in the middle. The number of electrons equals number of protons.



Actual atoms

Scientists have learned a lot more than this, but these are the most important things to remember about atoms.

The model on page 8 shows one kind of atom, called a lithium atom. There are about 100 other kinds of atoms, each with its own numbers of electrons, protons, and neutrons.

Suppose the atomic model shown did not have the electrons, protons, and neutrons named. How could you tell which were the PROTONS?

_____

_____

_____

All of these things about atoms were figured out before anyone ever saw an atom. People just thought hard about how matter behaved in experiments. They got ideas, which led to more experiments. After many years, they came up with this model of the atom.

NAME: _____

What Are Atoms?

1. Put a check mark (✓) next to the answer that is most correct.

a) Which is true about an atom?

- ○ **A** Atoms have no mass.
- ○ **B** Atoms are mostly empty space.
- ○ **C** Most of the space in an atom is taken up by the nucleus.
- ○ **D** Electrons have much more mass than protons or neutrons.

b) Which two things have about the same mass?

- ○ **A** protons and atoms
- ○ **B** atoms and electrons
- ○ **C** neutrons and protons
- ○ **D** electrons and protons

c) Which did scientists understand first?

- ○ **A** Matter is made of atoms.
- ○ **B** Electrons circle the nucleus.
- ○ **C** Atoms are mostly empty space.
- ○ **D** Atoms are made of electrons, protons, and neutrons.

2. Fill in each blank with a word from the list. Some words will be used more than once.

electron nucleus neutron proton

a) _____s circle the nucleus.

b) The _____ is made up of neutrons and protons.

c) _____s have a plus charge.

d) Most of the mass of an atom is in the _____.

e) Atoms have the same number of _____s and _____s.

f) _____s have no charge.

NAME: _____

After You Read

What Are Atoms?

3. Tell what kind of **electrical charge** electrons, protons, and neutrons have.

_____

_____

4. Where are electrons, protons, and neutrons found in an atom?

_____

_____

Extensions & Applications

5. On the next page are a table and a diagram about atoms for you to complete.

a) Show what you have learned about electrons, protons, and neutrons by filling in the table on the next page.

- **A.** In each box under Mass, write **a lot** or **a little.**
- **B.** In each box under Charge, write **plus, minus** or **zero.**
- **C.** In each box under Position, write **inside** or **outside.**
- **D.** In the last boxes on the right, put a **check mark** in the two boxes for the parts of an atom that have equal mass.

b) Show what you have learned about electrons, protons, and neutrons by labeling the diagram of the atom on the next page.

6. a) After scientists decided matter is made of atoms, it took about 100 years to figure out the parts of an atom. Why do you think it took so long?

_____

_____

b) Is an atomic model the same as a real atom?

_____

_____

c) How is an atomic model useful?

_____

_____

NAME: _____

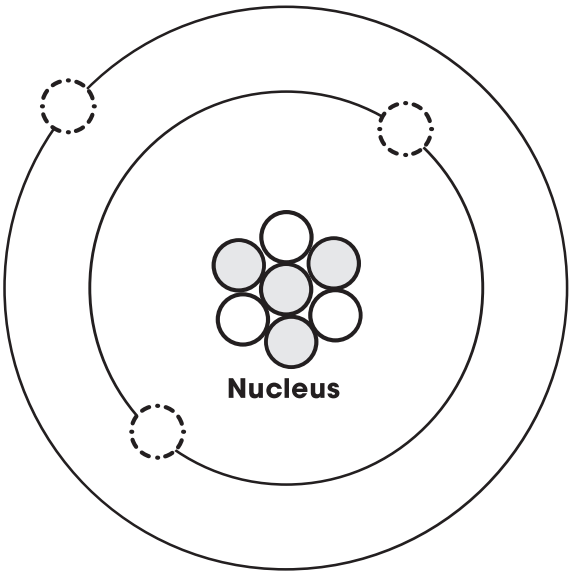
What Are Atoms?

5. a) Complete the table with information from the reading passage.

Atom Part	A. How much mass? A lot or a little?	B. Electrical Charge plus, minus, or zero?	C. Position inside or outside the nucleus?	D. Which two have about equal mass?
Electron				
Proton				
Neutron				

b) Label the parts of the atom in the diagram below. Write **E** in the circle if it is an ELECTRON. Write **P** in the circle if it is a PROTON. Write **N** in the circle if it is a NEUTRON.

Atomic Model



NAME: _____

What Are Molecules?

1. Circle T if the statement is TRUE or F if it is FALSE.

T	F	a)	Connecting links between atoms are called **bonds.**
T	F	b)	Atoms contain more than one molecule.
T	F	c)	All particles in a pure material are the same.
T	F	d)	Outer electrons form links that hold atoms together.
T	F	e)	New molecules are formed during physical changes.

2. Put a check mark (✓) next to the answer that is most correct.

a) All organic molecules contain the element

- ○ **A** calcium
- ○ **B** carbon
- ○ **C** iron
- ○ **D** nitrogen

b) Which is true of all polymer molecules?

- ○ **A** They are all gases.
- ○ **B** They are all very long.
- ○ **C** They can all be used as fuel.
- ○ **D** They are all made in factories.

c) Which of these contains one or more bond?

- ○ **A** all atoms
- ○ **B** all materials
- ○ **C** all molecules
- ○ **D** all particles

NAME: _____

What Are Molecules?

Silver

Sulfur

Some atoms are separate from each other and other atoms are fastened together. Groups of atoms fastened together are called **molecules**. When atoms fasten together to form molecules it is called a chemical change. When molecules break up into separate atoms, that is a chemical change too.

Silver atoms bond to sulfur atoms to form silver sulfide

In molecules, atoms are held together by connecting links. These links are called **bonds**. Atoms become connected when some of the electrons from each atom act together to form a bond. Not all electrons can help form bonds. Only the electrons farthest from the nucleus form bonds. Also, not all atoms can bond together. The atoms must have the right number of electrons with the right energy to form a bond. The pictures show what happens when silver atoms bond to sulfur atoms to form silver sulfide.

Atoms and molecules are two kinds of **particles**. When all the particles in something are the same, it is called a **pure material**. All the particles in pure gold are gold atoms. All the particles in pure water are water molecules.

Complete these sentences by filling the blanks with the words below. Use each word once.

chemical **molecules** **atoms**

Bonds connect _____ to form _____. A _____ change happens whenever bonds are formed or broken.

Scientists often use **chemical symbols** instead of names to talk about atoms. For an atom of oxygen they write "O". For an atom of sulfur they write "S". For some atoms the symbol is a big letter and a little letter. Aluminum is "Al". The symbol can mean just one atom or it can mean a material made of those atoms.

NAME: _____

What Are Molecules?

Molecules are made of two or more atoms bonded together. The atoms in a molecule can be different or they can be the same. Oxygen in the air is made of oxygen molecules. An oxygen molecule is two oxygen atoms bonded together. Molecules of water are made of two kinds of atoms. Every water molecule has two hydrogen atoms and one oxygen atom.

Oxygen and water are small molecules. Many of the molecules that make up living things are much larger. Some molecules are made of hundreds or even thousands of atoms! Even these large molecules are much too small to see.

Most molecules in living things are called **organic** molecules. One thing is the same for all organic molecules. They all contain atoms of carbon. Another kind of molecules are called **polymers**. These are very long molecules. Polymer molecules become long by repeating the same small group of atoms over and over. Our clothes are made mostly of polymers. Some of these come from nature, like cotton and wool. Others are made in factories, like nylon and rayon. All these kinds of cloth are made of very long polymer molecules.

NAME: _____

What Are Molecules?

1. Circle T if the statement is TRUE or F if it is FALSE.

T	F	**a)**	Water molecules are polymers.
T	F	**b)**	Sodium chloride is an organic molecule.
T	F	**c)**	The letter "O" can mean "one oxygen atom."
T	F	**d)**	A "pure material" can contain many kinds of molecules as long as they are pure.
T	F	**e)**	Chemical bonds between atoms are formed by outer protons.
T	F	**F)**	Any atom can form a molecule with any other atom.

2. Write each word beside its meaning. Some words will not be used.

bond	material	molecule
organic	polymer	symbol

_____ **a)** a short way to write the name of an atom

_____ **b)** the connecting link between atoms on a molecule

_____ **c)** a molecule that contains carbon

_____ **d)** a long molecule with repeating groups of atoms

3. When two atoms bond together to form a molecule, which parts of the atoms become part of the bond?

_____

_____

NAME: _____

What are Molecules?

4. What is part of every *organic* molecule?

_____

_____

5. What kind of molecule is a *polymer*?

_____

_____

Extensions & Applications

6. Learn more about atoms and molecules by studying the materials around you. Some things you often see around you are made of separate atoms. Others are made of molecules. All of the materials listed below are **pure materials**. Some are made of **atoms**, and some are made of **molecules**.

iron	**water**	**oxygen**	**helium**	**neon**	**aluminum**
baking soda	**silver**	**rust**	**charcoal**	**sugar**	

For this activity make a chart like the one below:

A. MADE OF SEPARATE ATOMS		B. MADE OF MOLECULES	
Common Name	Scientific Name	Common Name	Scientific Name

Put each material above in the correct list.
Some of these materials have scientific names. For those that do, write the **scientific name** next to its common name. Looking the names up in a large dictionary will help with some of the materials. Your teacher may also be able to tell you books or websites that will help.
See if you can find any other pure materials to **add** to the list. Try looking in the bathroom, kitchen, classroom, supermarket, and outdoors.

NAME: _____

What Are Elements?

1. Circle T if the statement is TRUE or F if it is FALSE.

T F **a)** There are about 100 different kinds of atoms.

T F **b)** Molecules contain two or more atoms.

T F **c)** Fire, air, earth, and water are all elements.

T F **d)** Forming rust is a chemical property of iron.

T F **e)** All atoms have the same number of electrons.

T F **f)** All atoms are the same size.

2. Draw one line from each word on the left to its meaning.

bonds	**a**	the parts of an atom equal in number to the atom's electrons
chemical	**b**	the properties that tell how and when an atom forms molecules
electrons	**c**	the connections that hold atoms together
elements	**d**	materials made of one kind of atom
protons	**e**	the parts of an atom that circle the nucleus

NAME: _____

Reading Passage

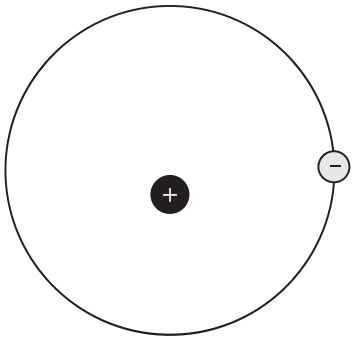
What Are Elements?

You learned earlier that there are about 100 kinds of atoms. A material made of only one kind of atom is called an **element**. Some elements you may know about are iron in nails, helium in balloons, and iodine in medicines.

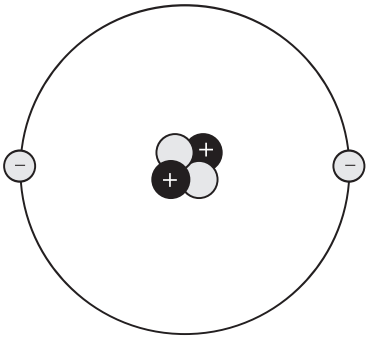
The atoms of each element have different chemical and physical properties. But why are the atoms different? Atoms of each element have a different number of protons in their nucleus. Hydrogen is the simplest element. Its atoms have only one proton. Uranium has much larger atoms with 92 protons.

Remember that the number of protons in an atom equals the number of electrons. Hydrogen atoms have one electron and uranium atoms have 92 electrons. The number of electrons in the atoms of an element give the element its chemical properties. This is because different numbers of electrons cause atoms to form bonds in different ways.

Atoms of the Two Simplest Elements



A Hydrogen Atom



A Helium Atom

Name TWO things that are different about atoms of different elements.

_____

_____

Elements can be made of single atoms, or they can be made of molecules. The helium in helium balloons is made of separate atoms. You may remember that oxygen we breathe is made of molecules that have two oxygen atoms bonded together.

Long ago people thought there were only four elements: fire, air, earth, and water. Now we know that none of these are elements. Water molecules are made of hydrogen and oxygen atoms. The other three are mixtures of different molecules.

NAME: _____

What Are Elements?

1. Put a check mark (✓) next to the answer that is most correct.

a) How many elements are there?

- ○ **A** three
- ○ **B** four
- ○ **C** about 100
- ○ **D** many millions

b) Why do all atoms of an element have the same chemical properties?

- ○ **A** They all have the same size electrons.
- ○ **B** Their electrons all have the same charge.
- ○ **C** They all have the same number of neutrons.
- ○ **D** They all have the same number of electrons.

c) Long ago, people believed there were four elements: fire, air, earth, and water. How many of these are called elements today?

- ○ **A** none
- ○ **B** one
- ○ **C** two
- ○ **D** three

2. a) Circle the words that are the names of elements.

air helium hydrogen iron sunlight water

b) Underline the words that are made of elements but are not elements.

air helium hydrogen iron sunlight water

NAME: _____

What Are Elements?

3. Tell what an *element* is. Use the word "atoms" in your answer.

_____

_____

4. What is the *simplest* element?

_____

_____

5. Name *two* other elements.

_____

_____

Extensions & Applications

6. Look back at the pictures of the atoms of hydrogen and helium. Hydrogen has one proton in its nucleus circled by one electron. Helium has two protons and two neutrons in its nucleus circled by two electrons.

Make drawings of atoms of the elements **carbon** and **lithium**. For both atoms, put the first two electrons in an inner circle and the other electrons in an outer circle.

Carbon has six protons and six neutrons in its nucleus, circled by six electrons.

Lithium has three protons and four neutrons in its nucleus. You will have to figure out how many electrons circle the nucleus of a lithium atom.

NAME: _____

What Are Compounds?

1. Circle T if the statement is TRUE or F if it is FALSE.

T	F	**a)**	Atoms are made of molecules.
T	F	**b)**	Molecules and atoms are particles.
T	F	**c)**	Pure materials are made of one kind of particle.
T	F	**d)**	Atoms can be thought of as the building blocks of matter.
T	F	**e)**	Water is an element.
T	F	**f)**	Electrons are one kind of atom.

2. Put a check mark (✓) next to the answer that is most correct.

a) Which of these is an element?

- ○ **A** air
- ○ **B** gold
- ○ **C** sugar
- ○ **D** water

b) Which of these is made of more than one atom?

- ○ **A** a bond
- ○ **B** a nucleus
- ○ **C** a molecule
- ○ **D** an electron

c) There are about 100 different

- ○ **A** electrons.
- ○ **B** elements.
- ○ **C** molecules.
- ○ **D** particles.

NAME: _____

Reading Passage

What Are Compounds?

You have learned that molecules are particles made of more than one atom. If the atoms in the molecules of a material are the same, the material is an element. If the atoms in the molecules of a material are different, the material is a **compound**.

Oxygen


Salt


Sugar

Remember that atoms and molecules are very small particles. Elements and compounds are materials made of many particles. The particles in a compound are always molecules, not atoms. Because the particles of a molecule have more than one kind of atom, they must have more than one atom. Particles with more than one atom are molecules.

Explain why water is a COMPOUND and not an element.

_____

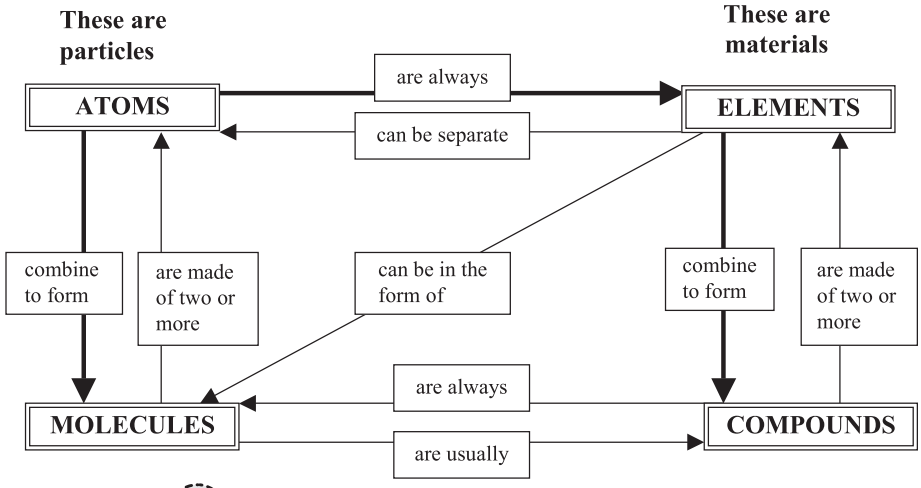
_____

Remember we learned that all pure materials are made of just one kind of atom or just one kind of molecule. Also pure materials are made of only one element or only one compound.

These are some common elements you may have heard of: hydrogen, helium, carbon, nitrogen, oxygen, neon, aluminum, chlorine, calcium, nickel, copper, silver, iodine, gold, tin, mercury, and lead.

These are some common compounds you may have heard of: salt, sugar, water, rust, and carbon dioxide.

We have been studying four words that are easy to confuse: atoms, molecules, elements, and compounds. This diagram may help you keep them straight. Follow the direction that the arrows point to make sentences. For example, at the top: "**ATOMS** are always **ELEMENTS**." The most important sentences have thick arrows.



NAME: _____

What Are Compounds?

1. Use the words in the list to answer each question.

atoms	molecules	elements
compounds	particles	pure materials

_____ **a)** Which particles make up all elements?

_____ **b)** Which particles are always made of more than one atom?

_____ **c)** What is made of one kind of atom or one kind of molecule?

_____ **d)** Which materials are made of one kind of atom?

_____ **e)** What are single atoms or single molecules called?

_____ **f)** Which materials are made of more than one element?

2. a) Circle the words that are elements.

aluminum	salt	sugar	oxygen
rust	copper	gold	water

b) Underline the words that are compounds.

aluminum	salt	sugar	oxygen
rust	copper	gold	water

NAME: _____

What are Compounds?

3. Tell what elements are using the word "atom."

_____

_____

4. Tell what molecules are using the word "atom."

_____

_____

5. Tell what compounds are using the word "element."

_____

_____

Extensions & Applications

6. Find out what **elements** have combined to form some of the **common compounds** you see around you. You may have to look them up in the dictionary, a science book, or on the Internet. Ask your teacher for the best place to look.

Find the elements that make up these compounds:

a) water

_____

b) glass (It is the same compound as sand.)

_____

c) sugar

_____

d) Try to find **two** more materials you think are compounds. Read about them to see if they really are compounds. If they are compounds, find which elements are in them. See if they have scientific names.

_____

_____

Before You Read

NAME: _____

The Periodic Table

1. Put a check mark (✓) next to the answer that is most correct.

a) What gives the atoms of an element their chemical properties?

- ○ **A** the inner protons
- ○ **B** the outer protons
- ○ **C** the inner electrons
- ○ **D** the outer electrons

b) What is different for atoms of every element?

- ○ **A** the number of electrons
- ○ **B** the size of the electrons
- ○ **C** the mass of the electrons
- ○ **D** the number of outer electrons

c) What is a chemical symbol?

- ○ **A** the matter at the center of an atom
- ○ **B** a model showing the parts of an atom
- ○ **C** the most important property of an element
- ○ **D** a short way to write the name of an element

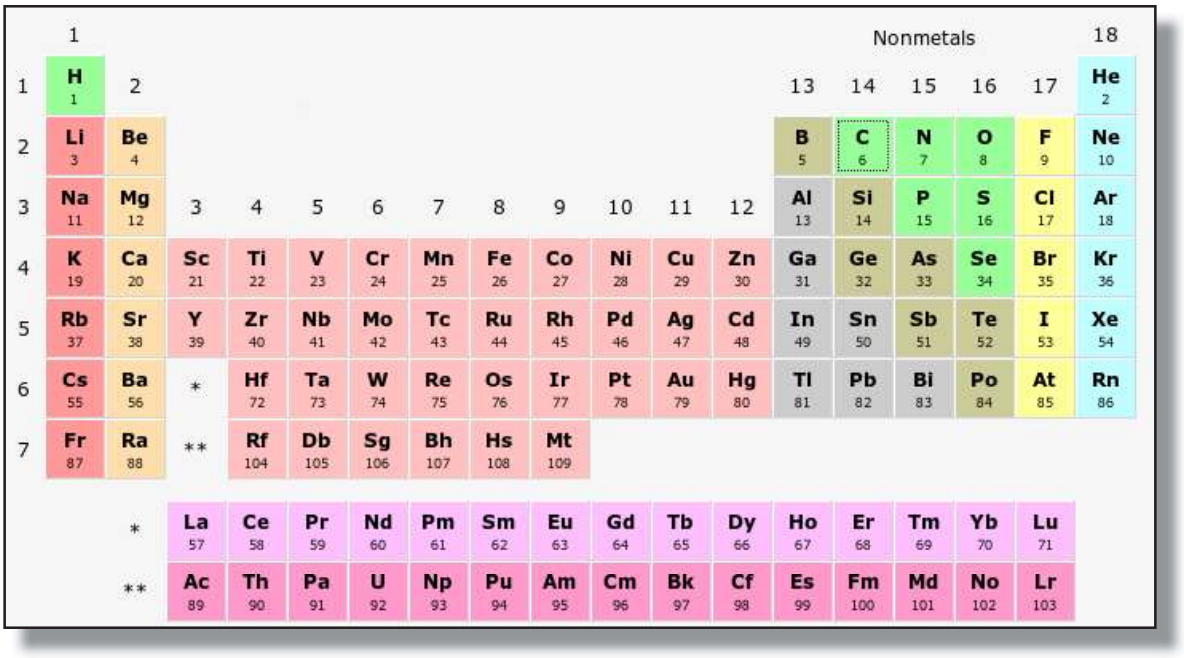
2. Circle T if the statement is TRUE or F if it is FALSE.

T	F	**a)**	Some elements have the same chemical and physical properties.
T	F	**b)**	Scientists discovered most of the elements thousands of years ago.
T	F	**c)**	Atoms of every element have a different number of protons.
T	F	**d)**	All atoms of an element have the same chemical properties.
T	F	**e)**	Molecules can be divided into smaller parts called compounds.

NAME: _____

Reading Passage

The Periodic Table



Each element has its own chemical and physical properties. For hundreds of years, Scientists have tried to learn more about the elements by studying their properties.

Early scientists didn't know much about atoms. They didn't have the atomic model you studied earlier. They did know a little about the mass of atoms. They were able to arrange the elements in order from the atom with least mass to the atom with the most mass.

When they looked at this list, they saw something interesting. The properties of the elements repeated every so often. For example, the 4th, 12th, and 20th elements showed the same properties.

They arranged the elements in a table that showed how properties repeated. Each time the properties started to repeat, they started a new row of the table. This table is called the **periodic table of the elements.** The periodic table shown here is the one scientists use today.

The periodic table told scientists a lot about how each element would behave. It told them when to expect elements to form compounds. But they still didn't understand why elements behaved the way they did. They also did not understand or why properties repeated.

NAME: _____

The Periodic Table

It all became clear when they learned about electrons and protons. Remember that it is the outer electrons that form bonds. Also remember that the way atoms form bonds is what gives an element its chemical properties. So the reason properties repeat is because the number of outer electrons repeats. If atoms of two elements have the same number of outer electrons, they form bonds in the same way.

Where are the ELECTRONS found in an atom? Where are the PROTONS found in an atom? Use the word "nucleus" in your answers.

_____

_____

Look at the periodic table. Each square has the symbol of a different element. Some of the symbols do not look like the names of the elements. For example, the symbol for gold is "Au". The numbers in the squares are called **atomic numbers**. Notice that the numbers get bigger from left to right in each row. The atomic number is equal to the number of protons in the nucleus of each atom of that element. The atomic number is also equal to the number of electrons. So each element has one more proton and one more electron than the element just before it.

Each up-and-down row is called a **group**. The groups are numbered from 1 to 18 across the top of the table. Next we will learn what the periodic table shows about properties of the elements.

Sometimes we will put the symbol of an element after its name, so you can find it in the periodic table. For example: hydrogen (H) or helium (He).

NAME: _____

The Periodic Table

1. Fill in each blank with a word or group of words from the list.

atomic number | element | symbol | group | atom

a) The periodic table lists all the _____s in order of increasing _____s.

b) The letter "C" is the _____ for the element carbon.

c) In the periodic table, elements in the same _____ have many of the same properties.

d) Elements with the smallest _____s are near the top of the periodic table.

2. Put a check mark (✓) next to the answer that is most correct.

a) What repeats when elements are arranged in order of increasing atomic mass?

- ◯ **A** size of atoms
- ◯ **B** atomic numbers
- ◯ **C** chemical properties
- ◯ **D** number of electrons

b) What did scientists study to make the first periodic table?

- ◯ **A** atomic models
- ◯ **B** outer electrons
- ◯ **C** each atom's nucleus
- ◯ **D** properties of elements

NAME: _____

The Periodic Table

3. Tell *three* things you can learn about an element by looking at one square in the periodic table.

_____

_____

4. Explain why the scientists who made the first periodic tables didn't understand why properties of elements repeated.

_____

_____

Extensions & Applications

5. A scientist from Russia, named **Dmitri Mendeleev,** made the **first** really good periodic table. Even though he drew up his table about 150 years ago, it is a lot like the one used today. Look for things to read about Mendeleev and his periodic table. Searching for his last name on the Internet will be some help. Your teacher may also have some books to help you.

a) When did he formally present his periodic table?

_____

b) Try to find out what other scientists thought of his periodic table.

_____

_____

_____

_____

c) He left some squares in his table **blank.** Why did he do this? How did this show later that his periodic table was correct?

_____

_____

d) One story says that the periodic table came to Mendeleev in a dream. Try to find out if this story is true.

_____

_____

NAME: _____

Before You Read

Patterns In the Periodic Table

1. Circle T if the statement is TRUE or F if it is FALSE.

T F **a)** The periodic table came before the atomic model.

T F **b)** Each element in the periodic table has one more proton than the element to its left.

T F **c)** Only the most important elements are included in the periodic table.

T F **d)** The symbol "W" in the periodic table stands for water.

T F **e)** "Inert" means the same as "reactive."

2. Draw a line from each word or words on the left to its meaning on the right.

inert	**a**	an up-and-down row in the periodic table
bonds	**b**	a material made of one kind of atom
group	**c**	connections between atoms in a molecule
atomic number	**d**	almost never forms compounds with other elements
element	**e**	equal to the number of protons in each atom of an element

Reading Passage

NAME: _____

Patterns In the Periodic Table

You learned that the number of electrons increases from left to right in a row of the periodic table. The elements in group 18, at the far right, have a full set of outer electrons. These elements almost never form compounds with anything. We say these elements are **inert**. Since they are all gases, they are called the **inert gases**.

Elements in group 17 are one electron short of a full outer set. They form compounds very easily. This means that they are very **reactive**. The elements in group 1 have just one outer electron, and they are also very reactive.

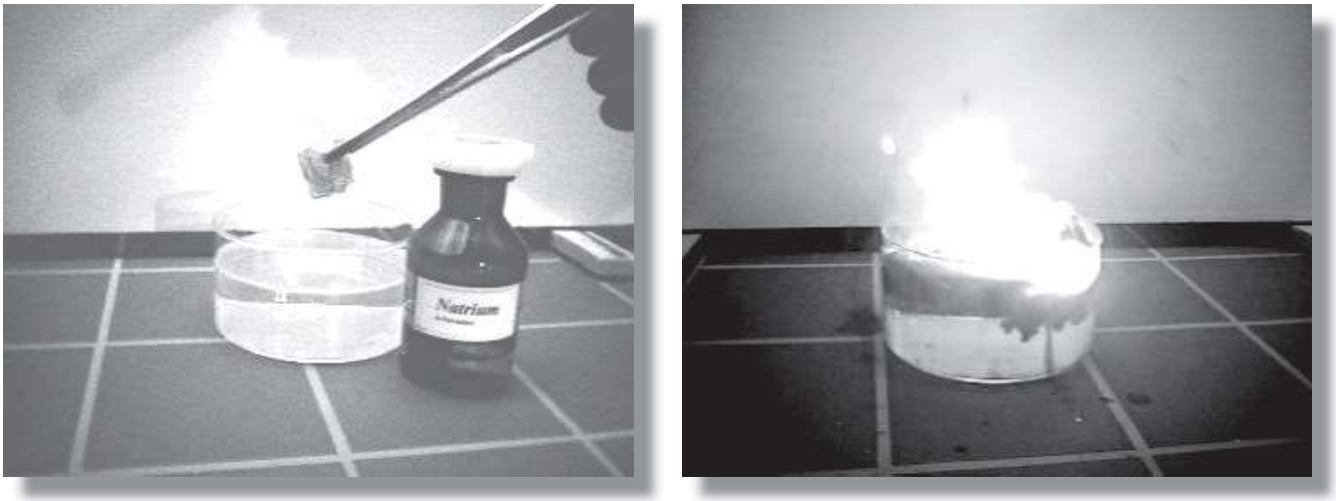
You wouldn't think that a metal would react with water. But sodium metal (Na) from group 1 reacts with water very quickly. In fact, flames appear when the two materials are put together! Elements in group 1 are most reactive with elements in group 17. Sodium reacts with the element chlorine (Cl) in group 17 to form sodium chloride. Sodium chloride is the scientific name for table salt.

STOP

Name an element with ONE outer electron. Name an element with TWO outer electrons. Use the periodic table to help you choose your answers.

_____

_____



Pictures of sodium reacting with water

NAME: _____

Reading Passage

Patterns In the Periodic Table

Except for group 18, the most reactive elements are in the groups to the far left and far right. Elements in the top rows are also more reactive than elements in lower rows. So what does it mean when we put these two rules together? We see that the most reactive elements are in the top left and top right parts of the periodic table. When elements from these two parts of the periodic table react with each other, they react very easily and give off a lot of energy.

The periodic table shows other patterns of properties, too. Here is one of the most important things it shows: Elements in each group have very similar properties. For example, as we said, group 18 elements are all gases; these gases are all inert.

The numbers of electrons, protons, and neutrons in atoms all get larger from left to right and from top to bottom. This means the mass of atoms also gets greater in the same directions. So the atoms with the least mass are in the top left of the periodic table. Those atoms with the most mass are in the bottom right.

The size of atoms also gets larger from top to bottom. This is because there are more electrons and they are farther and farther from the nucleus. Changes in size from left to right do not follow a simple rule.

NAME: _____

Patterns In the Periodic Table

Look at the periodic table to help you answer these questions.

1. Number the elements from 1 to 5 in the order of **most** reactive (1) to **least** reactive (5).

☐	**a)** silver (Ag)
☐	**b)** arsenic (As)
☐	**c)** fluorine (F)
☐	**d)** krypton (Kr)
☐	**e)** nitrogen (N)

2. Put a check mark (✓) next to the answer that is most correct.

a) Lithium (Li) forms a compound most easily with

- ○ **A** beryllium (Be)
- ○ **B** fluorine (F)
- ○ **C** neon (Ne)
- ○ **D** sodium (Na)

b) Where are the *most* reactive elements in the periodic table?

- ○ **A** far right row
- ○ **B** top and bottom rows
- ○ **C** lower left and lower right
- ○ **D** upper left and upper right

c) Which of these elements has properties *most* like those of sodium (Na)?

- ○ **A** argon (Ar)
- ○ **B** chlorine (Cl)
- ○ **C** magnesium (Mg)
- ○ **D** potassium (K)

NAME: _____

Patterns In the Periodic Table

3. Explain why elements in the same group have many of the same chemical properties.

_____

_____

4. Explain why atoms of elements in the bottom rows of the periodic table are larger than those in the top rows.

_____

_____

Extensions & Applications

Find calcium (Ca), chlorine (Cl), and helium (He) in the periodic table. For each of these elements answer the questions below.

5. Calcium (Ca):

a) Name the two elements with properties most like calcium.

_____

b) How many electrons and protons does an atom of calcium have?

_____

c) Is calcium more reactive than potassium (K)? _____

d) Is a calcium atom larger than a magnesium (Mg) atom? _____

6. Chlorine (Cl):

a) Name the two elements with properties most like chlorine.

_____

b) How many electrons and protons does an atom of chlorine have?

_____

c) Is chlorine more reactive than sulfur (S)? _____

d) Is a chlorine atom larger than a bromine (Br) atom? _____

7. Helium (He):

a) Name the two elements with properties most like helium.

_____

b) How many electrons and protons does an atom of helium have?

_____

c) Is helium more reactive than hydrogen (H)? _____

d) Is a helium atom larger than a neon (Ne) atom? _____

Before You Read

NAME: _____

Properties of Important Elements

1. Put a check mark (✓) next to the answer that is most correct.

a) How many protons are in an atom of boron (B)?

- ○ **A** 2
- ○ **B** 4
- ○ **C** 5
- ○ **D** 13

b) Which word describes both lithium (Li) and fluorine (F)?

- ○ **A** inert
- ○ **B** large
- ○ **C** metallic
- ○ **D** reactive

c) Which element is in all organic compounds?

- ○ **A** calcium (Ca)
- ○ **B** carbon (C)
- ○ **C** iron (Fe)
- ○ **D** sodium (Na)

2. Circle T if the statement is TRUE or F if it is FALSE.

T F **a)** Group 18 elements are inert.

T F **b)** Group 17 elements are very reactive.

T F **c)** Elements in the bottom rows of the periodic table have very small atoms.

T F **d)** Hydrogen (H) has the simplest atoms of any element.

T F **e)** Most metals react with oxygen.

NAME: _____

Reading Passage

Properties of Important Elements

Look at the periodic table again. Notice the two black lines. One line zigzags, like steps, and the other is a straight line. These lines separate three important kinds of elements.

The elements to the left of the zigzag line are called **metals**. The elements between the zigzag line and the straight line are called **nonmetals**. You already learned that the elements to the right of the straight line are called inert gases.

We said that inert gases almost never react. Metals usually react with nonmetals. This means many compounds are part metal atoms and part nonmetal atoms.

Copper

Silver

Gold

Three Group 11 Metals

Bromine

Three Group 17 Nonmetals

Which TWO groups of elements in the periodic table are MOST reactive? Answer by giving the group numbers.

_____

Which group of elements is LEAST reactive?

_____

Many metals react with oxygen (O) to form **metal oxides**. You have probably seen the oxide of iron (Fe). Its common name is rust. Most metals have other properties in common. Many metals are hard and shiny and melt at high temperatures. Some, like gold (Au), silver (Ag), and platinum (Pt), are used to make jewelry. Mercury (Hg) is the only common metal that is a liquid at room temperature.

Many metals can be bent into different shapes without breaking. Heat and electricity pass through most metals easily. Most metals sink in water.

NAME: _____

Properties of Important Elements

You already know about a few other metals. Chromium (Cr) is usually called "chrome" and is used on cars. Pennies are made of copper (Cu), and nickels are made of (you guessed it...) nickel (Ni). Lead (Pb) is a heavy, gray metal used to make weights for fishing lines. Tin (Sn) is used to make tin cans, but it is not the whole can. The tin is only a very thin layer on the inside of the can, which is mostly iron.

Most nonmetals have properties opposite those of metals. Most nonmetals aren't shiny, don't bend, and melt at low temperatures. Heat and electricity do not move easily through most nonmetals.

Bromine (Br) is the only nonmetal that is a liquid. Nitrogen (N), oxygen (O), fluorine (F), and chlorine (Cl) are gases, and the others are all solids. Carbon (C) is in almost all of the important compounds that make up plants and animals. Compounds containing carbon are called **organic** compounds. The other elements in organic compounds are mostly nonmetals. Many organic compounds contain hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), and sulfur (S). Although hydrogen is in group 1, it behaves like a nonmetal in organic compounds.

Carbon takes three interesting forms when it is just an element and not part of a compound. Carbon can be a black lump, as in coal or charcoal. The lead in a lead pencil is not the element lead (Pb); it is a form of carbon, called graphite. Finally, diamonds are a form of the element carbon.

NAME: _____

Properties of Important Elements

1. What kind of properties do these elements have? Write a word from the list beside each name. Each word will be used twice.

metal nonmetal inert gas

_____ **a)** oxygen (O)

_____ **b)** helium (He)

_____ **c)** carbon (C)

_____ **d)** potassium (K)

_____ **e)** tin (Sn)

_____ **f)** xenon (Xe)

2. Circle T if the statement is TRUE or F if it is FALSE.

T F **a)** Most elements are solids at room temperature.

T F **b)** Heat moves easily through metals.

T F **c)** Most nonmetals are shiny and bend easily.

T F **d)** Most metals melt at low temperatures.

T F **e)** Hydrogen (H), oxygen (O), and carbon (C) are in many organic compounds.

NAME: _____

Properties of Important Elements

3. In which parts of the periodic table are *metals*, *nonmetals*, and *inert gases* found?

_____

_____

4. Tell *two* ways that metals and nonmetals are different.

_____

_____

Extensions & Applications

5. Look at the periodic table on the next page. You will see that it has some blank squares. Some of the answers to the questions below you will write in these squares.

a) What is the **atomic number** of the missing element between silicon (Si) and sulfur (S)? Write the number in the square.

b) Calcium (Ca) has an atomic number of 20. Write the **symbol** and **atomic number** of calcium in the correct square.

c) Lead (Pb) is a metal in the sixth row. Write the **symbol** for lead in the correct square.

d) Radon (Rn) is an inert gas. Write the **symbol** for radon in the correct square.

e) Carbon is a nonmetal in group 14. Write the **symbol** for carbon in the correct square.

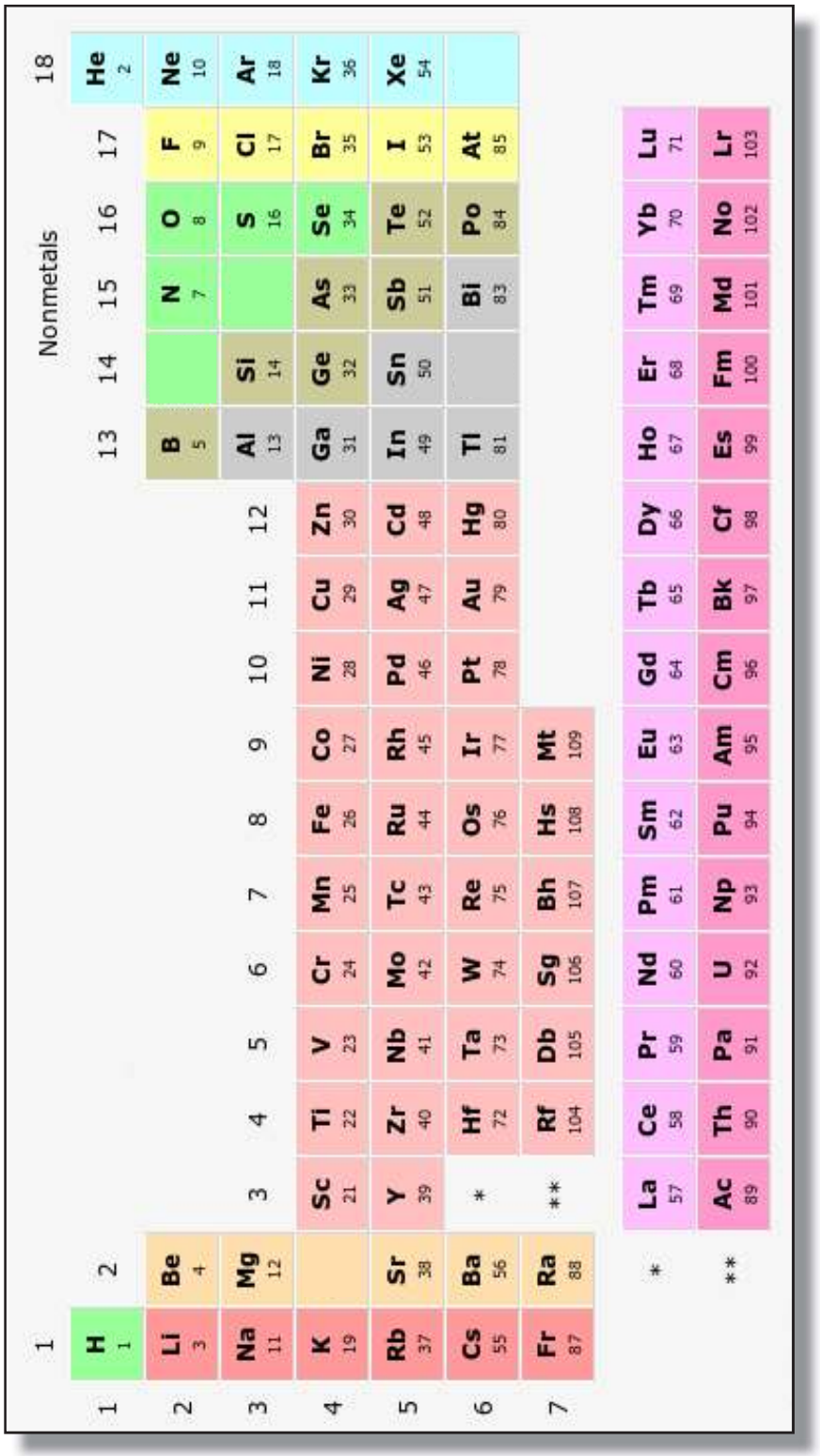
f) Which element has atoms with **13 protons**? _____

g) How many **electrons** are in an atom of radium (Ra)? _____

NAME: _____

After You Read

Properties of Important Elements



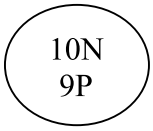
Atomic Models

For this activity you will DRAW atomic models of these three atoms:

- fluorine (F)
- neon (Ne)
- sodium (Na)

Make them look like the model on page 8. Put two electrons in the first ring and no more than eight in the second. Make a third ring if you need it.

You do not have to draw each neutron in the nucleus. Just use numbers, and write **N** for neutrons and **P** for protons. For example, the nucleus of FLUORINE would look like this:



NEON has 10 neutrons, and SODIUM has 11 neutrons. Use the periodic table to find the number of protons and electrons. Remember to label each atomic model with the correct name.

Compounds and Molecules

On page 14, you saw pictures of the elements silver and sulfur and of the compound silver sulfide.

Try to find more pictures of elements and the compounds they form.

You can usually find a picture of a material on the Internet by searching for its name. Some websites have pictures of all the elements and some have pictures of many compounds. You may be able to find a periodic table that shows a picture of each element in its square.

If you cannot copy and print the pictures, try to **draw** or **describe** the materials. It is interesting when the compound looks very different from the elements they are made of.

Here are some elements and compounds you can look for. You can ask your teacher for other ones.

- **Elements sodium (Na) and chlorine (Cl) form the compound sodium chloride.**
- **Elements silver (Ag) and chlorine (Cl) form the compound silver chloride.**
- **Elements calcium (Ca) and carbon (C) form the compound calcium carbide.**
- **Elements lead (Pb) and sulfur (S) form the compound lead sulfide.**
- **Elements magnesium (Mg) and iodine (I) form the compound magnesium iodide.**

If you can find how the compound is used, tell about it below the pictures. You may find other interesting compounds to look for in books or by asking your teacher.

The Lives of Elements

Choose several elements and see how many interesting FACTS you can find out about them.

Some things you might look for are:

- **When the element was discovered**
- **Why its symbol doesn't sound like its name**
- **What its name means—was it named after a person?**
- **Where on Earth it can be found**
- **What it is used for**
- **What unusual properties it has**

For example, the metal element tungsten has the symbol W because "wolfram" is the German word for tungsten. Tungsten was discovered by Carl Scheele in 1783. Tungsten has the highest melting point of any metal. The glowing wire in the middle of a light bulb is made of tungsten.

You will find interesting facts about most of the elements. You might try **one** element each from groups 1, 17, and 18, and **one or two** of the metals in the middle of the periodic table.

Alchemists

Today, scientists that study elements and compounds are called CHEMISTS. Hundreds of years ago they were called ALCHEMISTS. They used science, but they were also something like magicians or wizards. They did discover many of the elements and laws of science, but they had some ideas that seem strange today. What they studied was called "alchemy."

Write a short report about the **history of the alchemists**. Find out which elements they discovered. Did they know what elements were? Is the story true that alchemists thought they could change lead into gold?

Use the space below to write notes as you conduct your research.

NAME: _____

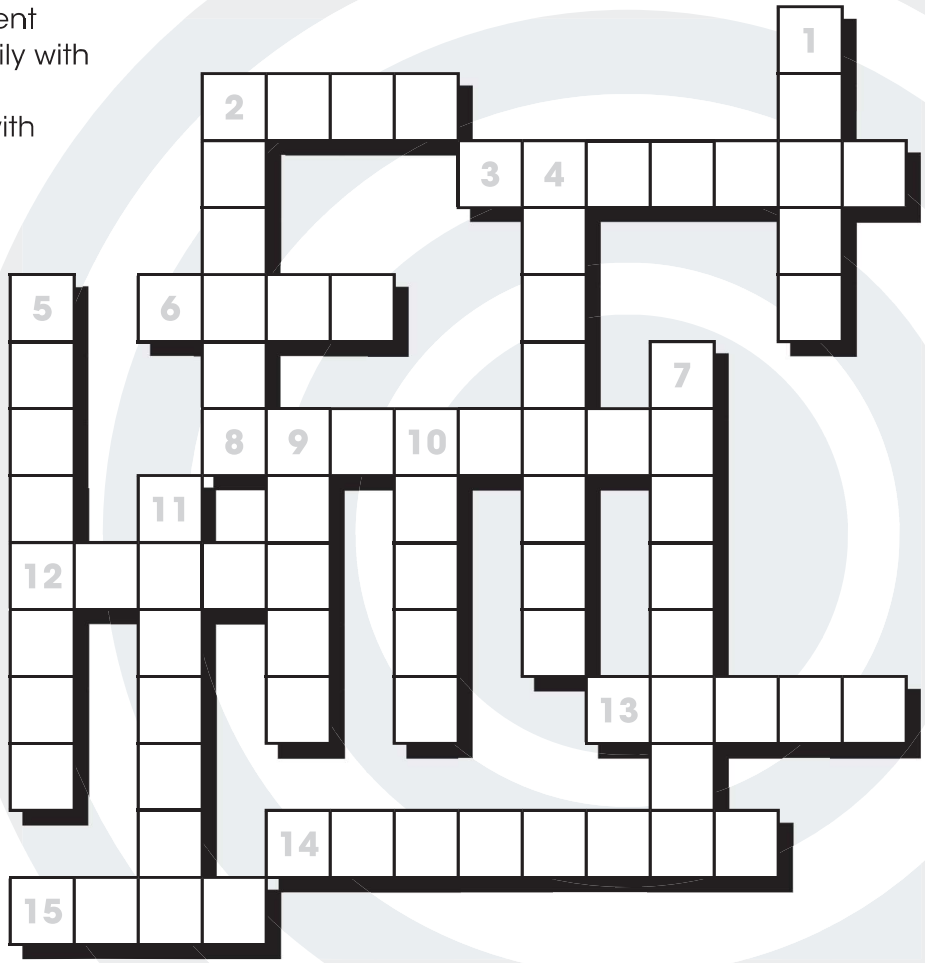
Crossword Puzzle!

Across

2. All particles are the same in a ____ material
3. The kind of molecules that contain carbon
6. The smallest bit of an element
8. An element that reacts easily with metals
12. Elements that don't react with anything are _____
13. An up-and-down row in the periodic table
14. A pure material made of more than one element
15. It connects atoms in a molecule

Down

1. A metal and oxygen form a metal _____
2. Found inside the nucleus of an atom
4. Groups 1 and 17 are very _____
5. What you call an atom or a molecule
7. It circles the nucleus
9. Bonds are formed by the _____ electrons
10. An atomic _____ shows how the parts of an atom are arranged
11. It is in the nucleus and has no charge



Word List

Bond	Reactive	Inert
Outer	Oxide	Atom
Pure	Proton	Neutron
Organic	Compound	Model
Particle	Group	Electron
Nonmetal		

NAME: _____

Word Search

Find all of the words in the Word Search. Words are written horizontally, vertically, diagonally, and some are even written backwards.

B	O	C	P	E	R	I	O	D	I	C
D	X	F	G	H	P	J	N	K	L	W
R	I	T	Y	U	R	U	P	S	D	L
E	D	K	R	J	O	H	O	G	F	A
L	E	E	L	P	T	E	Z	R	X	I
C	S	Y	M	B	O	L	S	A	G	R
I	N	O	O	O	N	E	B	V	C	E
T	C	M	T	N	L	M	R	W	L	T
R	L	P	A	D	Y	E	T	E	R	A
A	E	K	J	H	B	N	C	G	F	M
P	V	T	C	M	X	T	Z	U	S	D
B	N	M	U	T	R	E	N	I	L	Q
Y	T	N	M	O	D	E	L	R	W	E
P	S	D	N	E	U	T	R	O	N	F

ATOM
BOND
COMPOUND
ELECTRON
ELEMENT
GAS
GROUP
INERT
MATERIAL
MOLECULE
NUMBER
OUTER
OXIDE
PARTICLE
PERIODIC
PROTON
SYMBOLS
NEUTRON
MODEL

NAME: _____

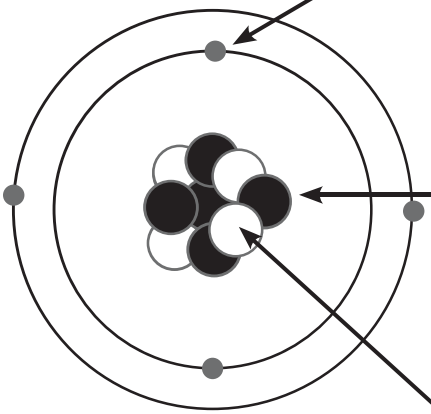
Comprehension Quiz

25

Part A

This is a model of a beryllium atom.

Label each part of the atom. Tell the name, charge, and mass of the part. For charge, write **minus**, **plus**, or **zero**. For mass, write **not much** or **a lot**.



1. Name _____
2. Charge _____
3. Mass _____

3

1. Name _____
2. Charge _____
3. Mass _____

3

1. Name _____
2. Charge _____
3. Mass _____

3

SUBTOTAL: /9

NAME: _____

Comprehension Quiz

Part B

Answer each question in complete sentences.

1. Use the word "particle" to explain what a **pure material** is. Name the **two** kinds of particles. (3)

_____

_____

_____

2. Use the words "atom" and "material" to explain what an **element** is. (3)

_____

_____

_____

3. Use the words "element" and "material" to explain what a **compound** is. (3)

_____

_____

_____

4. Tell how the elements in a "group" in the periodic table are arranged. Use the word "electrons" to explain why elements in a group have the same kind of properties. Where are the elements with the smallest atoms found in a group? (4)

_____

_____

_____

5. Where are the **metals**, **nonmetals**, and **inert gases** found in the periodic table? (3)

_____

_____

_____

SUBTOTAL: /16