

Name: \_\_\_\_\_

#: \_\_\_\_\_

### Unit 5 Vocabulary: Atomic Structure

1. **Atom:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. **Proton:** \_\_\_\_\_  
\_\_\_\_\_

3. **Neutron:** \_\_\_\_\_

4. **Electron:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

5. **Nucleus:** \_\_\_\_\_  
\_\_\_\_\_

6. **Electron Cloud:** \_\_\_\_\_  
\_\_\_\_\_


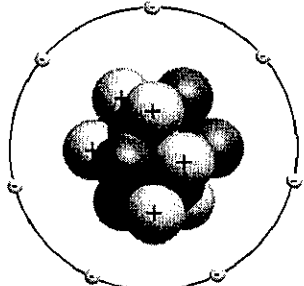
7. **Atomic Mass Unit(AMU):** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. **Atomic Number:** \_\_\_\_\_

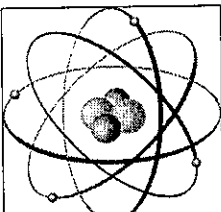
9. **Isotope:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10. **Mass Number:** \_\_\_\_\_  
\_\_\_\_\_


11. **Atomic Mass:** \_\_\_\_\_  
\_\_\_\_\_

**ATOMS!**  
Mr. Coffey



		Group	
		1	2
2	6.941 Li 2-1	+1	9.01218 Be 2-2
3	22.98977 Na 2-8-1	+1	24.305 Mg 2-8-2



## MODELS!

- A MODEL: is representation that shows the \_\_\_\_\_ or \_\_\_\_\_ of something.
- As our technology has evolved our theories and models have also evolved.
- Models of the \_\_\_\_\_ have changed through the years as we have discovered new things.

## Some History

- Meet DEMOCRITUS (about 2400 years ago)

Remember how questions are important?

- Well Democritus asked:

“Can I cut something in half  
FOREVER?”



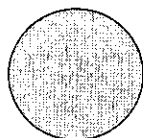
- He decided NO; with the help of his students they were the \_\_\_\_\_ to name the smallest piece: \_\_\_\_\_, which means, can't divide.

## How does an atom behave?

- Democritus and his students didn't know what atoms looked like so long ago.
- They thought atoms were \_\_\_\_\_, \_\_\_\_\_ and were made out of the \_\_\_\_\_ but had different shapes and sizes.
- They also thought atoms were infinite in number and that they were \_\_\_\_\_ and could be joined together.

## Then there was DALTON

- 1800's
- He said the atom was a CANNONBALL - \_\_\_\_\_  
\_\_\_\_\_.
- Some of his theories have been proven wrong, or evolved into our current theories.



*His model is called  
the Cannonball  
Model.*



## DALTON'S ATOMIC THEORY OF MATTER

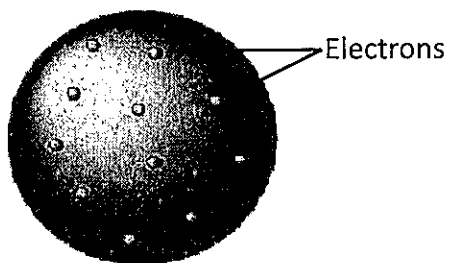
- All elements are composed of atoms. \_\_\_\_\_  
\_\_\_\_\_.
- Atoms of the same element are \_\_\_\_\_ alike.
- Atoms of different elements are \_\_\_\_\_  
from each other.
- The atoms of 2 or more elements can join  
together to form types of matter called  
\_\_\_\_\_.

## J.J. Thomson's Model

- The \_\_\_\_\_ scientist to suggest that an atom contains \_\_\_\_\_ was J.J. Thomson of England in 1897.
- \_\_\_\_\_ using a cathode ray tube while studying atoms.
- Because \_\_\_\_\_, Thomson reasoned that there must also be positively charged particles inside the atom.

## J.J. Thomson's Model

- Thomson hypothesized that an atom was made up of \_\_\_\_\_ charged material with \_\_\_\_\_ charged particles scattered evenly throughout the atom.
- His model was called the "Plum Pudding Model".



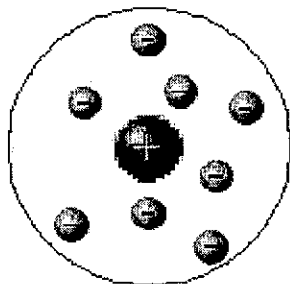
*Plum Pudding –  
electrons are scattered  
like raisins in pudding.*

## Rutherford's Model

- In 1911 a British scientist named Ernest Rutherford performed an experiment to test Thomson's atomic model.
- He discovered that an atom is mostly \_\_\_\_\_.
- He said that the center of the atom is a small, dense nucleus that is \_\_\_\_\_.

## Rutherford's Model

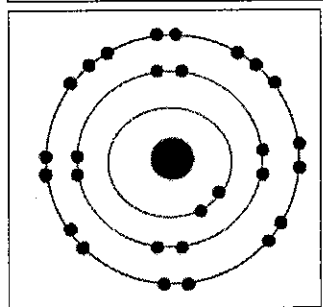
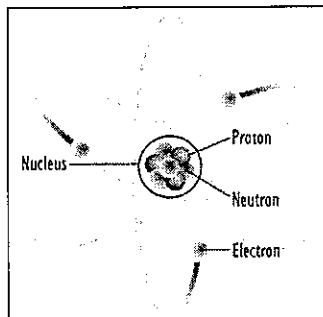
- Rutherford said the negatively charged particles were \_\_\_\_\_ to the positively charged particles found in the \_\_\_\_\_.



- He said this attraction \_\_\_\_\_ the negatively charged particles in the atom.
- He didn't really address electrons.

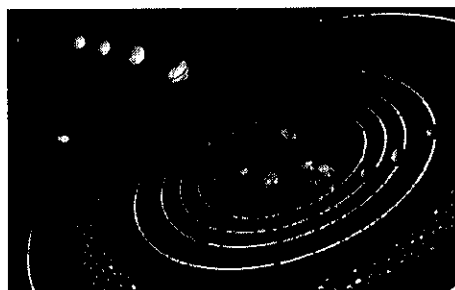
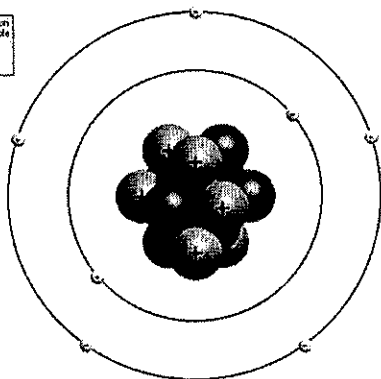
## Bohr's Model

- This is what is on Jimmy's shirt!
- 2 main pieces of an atom:
  1. a \_\_\_\_\_ containing positively charged protons and
  2. The \_\_\_\_\_ that orbit around the nucleus much like planets orbiting around the sun.
- He called these orbits \_\_\_\_\_  
\_\_\_\_\_.



## The Bohr Model

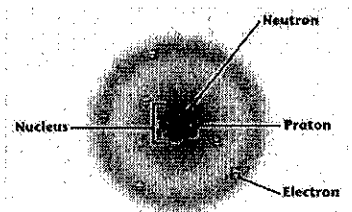
Milner's Electron Configuration Table  
 $1s^2$   
 $2s^2 2p^3$



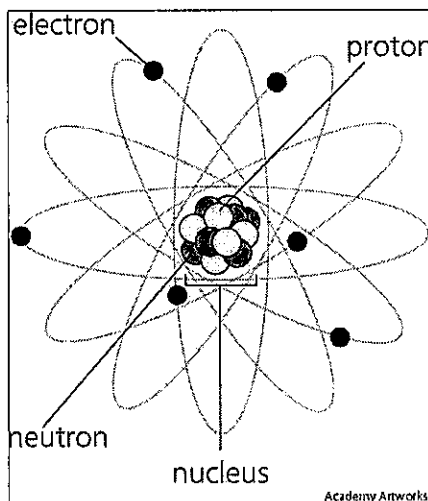
## What is true today:

- The nucleus ( the center of the atom) is composed of 2 things:
  - \_\_\_\_\_
  - \_\_\_\_\_
- The electrons do not move in orbits like Bohr said.
- Electrons are in a \_\_\_\_\_ - they are in orbital or regions of probable electron location.
- They \_\_\_\_ move around the nucleus in different patterns.

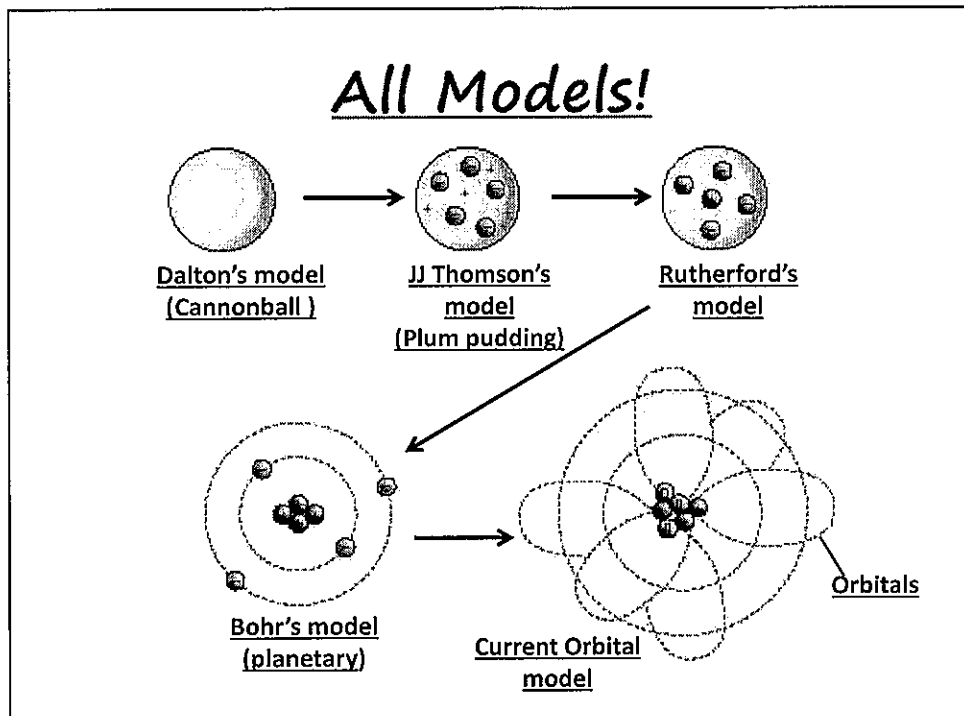
## Wave-Mechanical Model



Electrons are moving so fast that they look like a cloud. **Orbitals** are regions of most likely electron location.

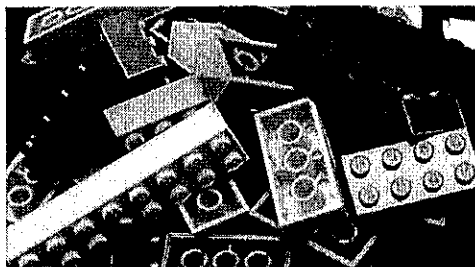






## *Some things to remember:*

- Atoms are the building blocks of \_\_\_\_\_!



- Atoms are made up protons, electrons, and neutrons.

## Components of an Atom

- a. Atoms are the building blocks of EVERYTHING!
- b. Atoms are made up of subatomic particles
  - Sub means **smaller** or less than.
  - Atomic means **atom**.
- c. So subatomic particles are the smaller particles (parts) that make up an **atom**.
- d. The 3 subatomic particles are:
  - protons
  - electrons
  - neutrons

## Meet the ATOM!

Subatomic Particle	Location in the Atom	Charge	Weight
Protons	Center (in the nucleus)	+ (Positive)	1 amu*
Neutrons	Center (in the nucleus)	Neutral (no charge)	1 amu
Electrons	Around the nucleus in a cloud or orbitals	- (Negative)	Almost none! It rounds to 0 amu

\*Amu means Atomic Mass Unit

## AMU

- AMU= **Atomic Mass Unit**
- This is the unit of measure scientists use to measure the **mass of an** \_\_\_\_\_.
- 1 amu = mass of 1 proton or 1 neutron
- The mass of an electron = 1/1836 amu

### PROTONS

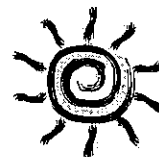
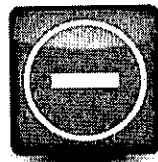
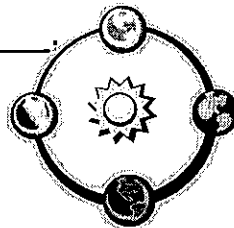
- **POSITIVE** charges
- Found in the **CENTER** of the atom - aka **nucleus**
- **"HEAVY!"** (1amu)

### ELECTRONS

- **NEGATIVE** charges
- **FLY** around the nucleus in "**orbitals**" or **energy levels!**
- **LIGHT!** So light in fact, that they don't factor in to the mass of an atom!

## Back to the atom...why it works

- Forces hold the \_\_\_\_\_.
- Remember that opposite charges \_\_\_\_\_ and like \_\_\_\_\_!
- The electrons are moving so fast that they stay in orbit around the positive nucleus, the same way we stay in orbit around the sun.



## Remember elements?

- An element, remember, is a substance that \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_!
- Elements are made up of \_\_\_\_\_!
- There are many different elements
- There are about 118 known today.
- They're organized and arranged on the Periodic Table!

## # of Protons in an Atom

- Every element on the periodic table has a different number of protons, neutrons and electrons.
- **Atomic Number =** \_\_\_\_\_
- **Number of Protons =** \_\_\_\_\_

KEY		
Atomic Mass →	12.011	-4
Symbol →	<b>C</b>	+2 +4
Atomic Number →	<b>6</b>	
Electron Configuration →	2-4	

## Mass of an Atom

- The **Mass** is \_\_\_\_\_.
- Round to the nearest whole number.
- In this example, the mass of carbon is \_\_\_\_\_.

KEY		
Atomic Mass →	12.011	-4
Symbol →	<b>C</b>	+2 +4
Atomic Number →	<b>6</b>	
Electron Configuration →	2-4	

## # of Neutrons in an Atom

- The number of neutrons is equal to the mass minus the number of protons.

KEY	
Atomic Mass →	12.011      -4
Symbol →	<b>C</b> +2
Atomic Number →	<b>6</b> +4
Electron Configuration →	2-4

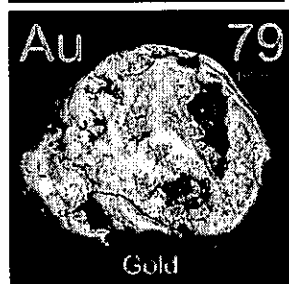
## Some examples!

10.81 <b>B</b> 5 2-3	+3	12.011 <b>C</b> 6 2-4	-4 +2 +4	14.0067 <b>N</b> 7 2-5	-3 -2 -1 +1 +2 +3 +4 +5	15.9994 <b>O</b> 8 2-6	-2	18.998403 <b>F</b> 9 2-7	-1
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Mass	Mass	Mass	Mass	Mass
# of protons	# of protons	# of protons	# of protons	# of protons
# of neutrons	# of neutrons	# of neutrons	# of neutrons	# of neutrons

## A harder example...

196.967	+1
<b>Au</b>	+3
79	
-18-32-18-1	



Mass: \_\_\_\_\_

# Protons: \_\_\_\_\_

# Neutrons: \_\_\_\_\_

(# Protons = # electrons!)

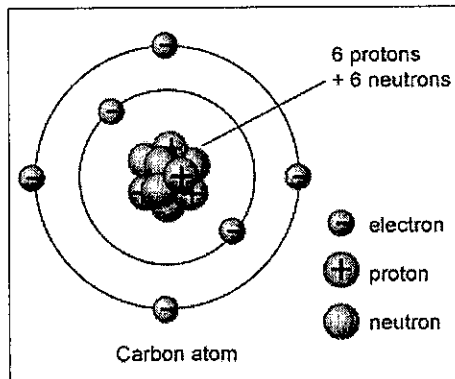
# \_\_\_ Protons = # \_\_\_ Electrons

## Models of Elements

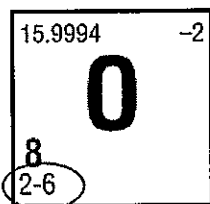
12.0111	-4
<b>C</b>	+2
6	+4
2-4	

According to the Periodic Table, Carbon has a mass of 12 and has 6 protons.  $12 - 6 = 6$  neutrons.

This tells you where the electrons go in shells. Here, there are 2 shells. 2 electrons go in the first shell and 4 go in the second shell.

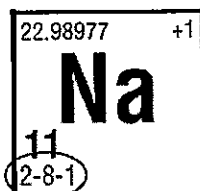


## An atom of oxygen



This tells you 2 shells:  
1<sup>st</sup> shell has 2 electrons  
2<sup>nd</sup> shell has 6 electrons

## One more!



This tells you 3 shells:  
1<sup>st</sup> shell has 2 electrons  
2<sup>nd</sup> shell has 8 electrons  
3<sup>rd</sup> shell has 1 electron



## Ions

a. If an atom gains or loses electrons it has a **charge**.

- The charge could be positive (if the atom \_\_\_\_\_ electrons)
- The charge could be negative (if it \_\_\_\_\_ electrons).

b. An atom is still the same element if it gains or loses electrons, it just now has a **charge**.

c. We call an atom with a charge an **ion**.

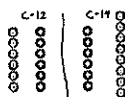
## Isotopes

a. **Isotopes**-atoms of the same element that have the same number of **protons** as the other atoms of the element but a different number of **neutrons**.

b. Just like an ion, an isotope is still the same element. It is just a little different from every other atom of the same element.

c. For example-A carbon atom can have 12 neutrons or 14 neutrons. It is still carbon. It just has a slightly different mass.

i. Think of a pillow- some have more stuffing than others so their mass may be different but they are still all pillows.



# The Periodic Table of Elements

1 G1 H HYDROGEN 1	2 G18 He HELIUM 4	NON-METALS																																																																																																		
3 G2 Li LITHIUM 7	4 G2 Be BERYLLIUM 9	5 G13 B BORON 11	6 G14 C CARBON 12	7 G14 N NITROGEN 14	8 G14 O OXYGEN 16	9 G16 F FLUORINE 19	10 G17 Ne NEON 20	11 G13 Na SODIUM 23	12 G13 Mg MAGNESIUM 24	13 G13 Al ALUMINUM 27	14 G14 Si SILICON 28	15 G14 P PHOSPHORUS 31	16 G16 S SULFUR 32	17 G17 Cl CHLORINE 35	18 G17 Ar ARGON 40	19 G13 K POTASSIUM 39	20 G13 Ca CALCIUM 40	21 G13 Sc SCANDIUM 45	22 G14 Ti TITANIUM 48	23 G14 V VANADIUM 51	24 G14 Cr CHROMIUM 52	25 G14 Mn MANGANESE 55	26 G14 Fe IRON 56	27 G14 Co COBALT 59	28 G14 Ni NICKEL 59	29 G14 Cu COPPER 64	30 G14 Zn ZINC 65	31 G14 Ga GALLIUM 70	32 G14 Ge GERMANIUM 73	33 G14 As ARSENIC 75	34 G16 Se SELENIUM 79	35 G17 Br BROMINE 80	36 G17 Kr KRYPTON 84	37 G13 Rb RUBIDIUM 85	38 G13 Sr STRONTIUM 88	39 G13 Y YTRIUM 89	40 G14 Zr ZIRCONIUM 91	41 G14 Nb NIOBIUM 93	42 G14 Mo MOLYBDENUM 96	43 G14 Tc TECHNETIUM 98	44 G14 Ru RUTHENIUM 101	45 G14 Rh RHODIUM 103	46 G14 Pd PALLADIUM 106	47 G14 Ag SILVER 108	48 G14 Cd CADMIUM 112	49 G14 In INDIUM 115	50 G14 Sn TIN 119	51 G14 Sb ANTIMONY 122	52 G16 Te TELLURIUM 128	53 G17 I IODINE 127	54 G17 Xe XENON 131	55 G13 Cs CESIUM 133	56 G13 Ba BARIUM 137	57 G13 La LANTHANUM 139	58 G13 Ce CERIUM 140	59 G13 Pr PRASEODYMIUM 141	60 G13 Nd NEODYMIUM 144	61 G13 Pm PROMETHIUM 145	62 G13 Sm SAMARIUM 150	63 G13 Eu EUROPIUM 152	64 G13 Gd GADOLINIUM 157	65 G13 Tb TERBIUM 159	66 G13 Dy DYSPROSIUM 163	67 G13 Ho HOLMIUM 165	68 G13 Er ERBIUM 167	69 G13 Tm THULIUM 169	70 G13 Yb YTTERIUM 173	71 G13 Lu LUTETIUM 175	72 G13 Hf HAFNIUM 178	73 G13 Ta TANTALUM 181	74 G13 W TUNGSTEN 184	75 G13 Re RHENIUM 186	76 G13 Os OSMIUM 190	77 G13 Ir IRIDIUM 192	78 G13 Pt PLATINUM 195	79 G13 Au GOLD 197	80 G13 Hg MERCURY 201	81 G13 Tl THALLIUM 204	82 G13 Pb LEAD 207	83 G13 Bi BISMUTH 209	84 G13 Po POLONIUM 209	85 G13 At ASTATINE 210	86 G13 Rn RADON 222	87 G13 Fr FRANCIUM 223	88 G13 Ra RADIUM 226	89 G13 Ac ACTINIUM 227	90 G13 Th THORIUM 232	91 G13 Pa PROTACTINIUM 231	92 G13 U URANIUM 238	93 G13 Np NEPTUNIUM 237	94 G13 Pu PLUTONIUM 244	95 G13 Am AMERICIUM 243	96 G13 Cm CURIUM 247	97 G13 Bk BERKELEIUM 247	98 G13 Cf CALIFORNIUM 251	99 G13 Es EINSTEINIUM 252	100 G13 Fm FERMIUM 257	101 G13 Md Mendelevium 258	102 G13 No Nobelium 259	103 G13 Lr Lawrencium 262

Atomic Number = Number of Protons = Number of Electrons

Chemical Symbol

Chemical Name

Atomic Weight = Number of Protons + Number of Neutrons\*

6 ← C → 12

**KEY**

☐ = Solid at room temperature

☉ = Liquid at room temperature

☁ = Gas at room temperature

☄ = Radioactive


⚡ = Artificially Made

\* The atomic weights listed on this Table of Elements have been rounded to the nearest whole number. As a result, this chart actually displays the mass number of a specific isotope for each element. An element's complete, unrounded atomic weight can be found on the IUPAC Elemental web site: <http://education.jlab.org/elemental/index.html>

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Class: \_\_\_\_\_

**1**  **What is the significance of the periodic table of elements? Choose the best answer.**

- A** It lists all the different metals known to humans
- B** It predicts and lists all the chemical elements in the universe
- C** It explains where different atoms can be found
- D** It proves that atoms are the building blocks of matter

**2** **What do electrons in the same shell have in common?**

- A** They have the same amount of energy
- B** They are all positively charged
- C** They are all made up of atoms
- D** They all have neutral charges

**3** **Which of the following is an example of a subatomic particle?**

- A** Carbon
- B** Oxygen
- C** Electron
- D** Hydrogen

**4** **What might happen if the strong force didn't exist?**

- A** Electrons would have positive charges
- B** Atomic nuclei would fly apart
- C** It would be more difficult to split atoms
- D** Neutrons would not exist

**5**  **What two types of particles exist within an atomic nucleus?**

- A** Protons and neutrons
- B** Neutrons and electrons
- C** Protons and neutrinos
- D** Positrons and neutrons

**6** **Oxygen has an atomic number of 8. What can you conclude from this fact?**

- A** An atom of oxygen weighs 8 grams
- B** An atom of oxygen has 4 protons and 4 electrons
- C** An atom of oxygen has 8 positrons
- D** An atom of oxygen has 8 protons

**7** **The word "atom" comes from a Greek word for "indivisible." In what way are atoms indivisible?**

- A** They cannot be separated once they've bonded with other atoms
- B** They cannot be broken apart without losing their chemical properties
- C** They cannot form bonds with other atoms
- D** They cannot gain or lose electrons

**8** **How are molecules different from atoms?**

- A** They consist of several atoms bonded together
- B** They do not contain neutrons
- C** They do not have nuclei
- D** Their particles do not have electrical charges

**9** **What can you conclude from the fact that electrons orbit far away from atomic nuclei?**

- A** Electrons are extremely small
- B** Atoms are comprised mostly of empty space
- C** Protons have a positive charge
- D** Atoms consist of subatomic particles

**10**  **In the following diagram, what does the number 12 represent?**

- A** An atomic number
- B** A number of electrons
- C** An atomic mass
- D** A chemical symbol

## 3-2 What are atoms?

### Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.

- \_\_\_\_\_ 1. A piece of copper cannot be broken down into some simpler type of matter.
- \_\_\_\_\_ 2. The atomic theory states that atoms of two or more elements can join together to form other elements.
- \_\_\_\_\_ 3. The first person to suggest the idea of atoms was Dalton.
- \_\_\_\_\_ 4. All elements are composed of atoms.
- \_\_\_\_\_ 5. The word element comes from a Greek word that means "cannot be divided."
- \_\_\_\_\_ 6. The smallest part of an element that can be identified as that element is an atom.
- \_\_\_\_\_ 7. Atoms of different elements are the same.
- \_\_\_\_\_ 8. The atomic theory states that atoms can be destroyed.
- \_\_\_\_\_ 9. Democritus and his students thought that atoms were always moving.
- \_\_\_\_\_ 10. A modern atomic theory was stated by Democritus.

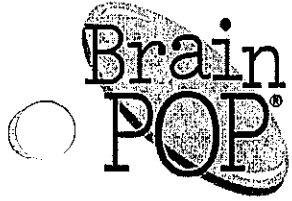
### Skill Challenge

*Skills: interpreting, analyzing*

The table below lists the four main parts of Dalton's atomic theory. In the spaces provided, write which part of the atomic theory supports the given statement.

DALTON'S ATOMIC THEORY
1. All elements are composed of atoms. Atoms cannot be divided or destroyed.
2. Atoms of the same element are exactly alike.
3. Atoms of different elements are different from each other.
4. The atoms of two or more elements can join together to form types of matter called compounds.

- \_\_\_\_\_ 1. Atoms of sodium can combine with atoms of chlorine to form table salt.
- \_\_\_\_\_ 2. Every calcium atom has the same number of protons.
- \_\_\_\_\_ 3. All neon atoms have the same number of electrons.
- \_\_\_\_\_ 4. Hydrogen atoms can combine with oxygen atoms to form water.
- \_\_\_\_\_ 5. An atom of hydrogen weighs much less than an atom of silver.



# ATOMIC MODEL

Date: \_\_\_\_\_

Name: \_\_\_\_\_

Class: \_\_\_\_\_

**1 How do scientists know how atoms are structured?**

- A** By looking at them under a microscope
- B** By running experiments that expose their properties
- C** By examining only the largest atoms
- D** By splitting them apart

**2 What can you conclude from the fact that scientists continue to update the atomic model?**

- A** New information about atoms continues to be discovered
- B** Old information about atoms is completely useless
- C** Scientists did not have any information about atoms until a few years ago
- D** Scientists still have no idea what atoms look like

**3**  **What contribution did John Dalton make to atomic theory?**

- A** He discovered that every atom was positively charged
- B** He discovered that every element consisted of one type of atom
- C** He discovered that atoms had nuclei
- D** He discovered that atoms could be divided into smaller parts

**4 Place the following scientists in order, from earliest to latest: A) Ernest Rutherford; B) J.J. Thomson; C) John Dalton**

- A** B, C, A
- B** C, A, B
- C** A, C, B
- D** C, B, A

**5 The majority of an atom's mass exists where?**

- A** In the nucleus
- B** In the electron cloud
- C** In the space between the nucleus and the electrons
- D** In the neutrons

**6 What are electrons?**

- A** Positively charged particles
- B** Neutrally charged particles
- C** Negatively charged particles
- D** Uncharged particles

**7 Ernest Rutherford discovered that atoms were mostly:**

- A** Negatively charged
- B** Positively charged
- C** Electrons
- D** Empty space

**8**  **What does the nucleus of an atom contain?**

- A** Electrons and neutrons
- B** Protons and neutrons
- C** Neutrinos and positrons
- D** DNA and RNA

**9 How are neutrons different from protons and electrons?**

- A** They are more massive than protons and electrons
- B** They have no electrical charge
- C** They are less massive than protons and electrons
- D** Protons and electrons exist in atomic nuclei; neutrons orbit the nucleus in a "cloud"

**10 How are electrons arranged in an atom?**

- A** In groups of five
- B** In energy levels
- C** By color
- D** By shape

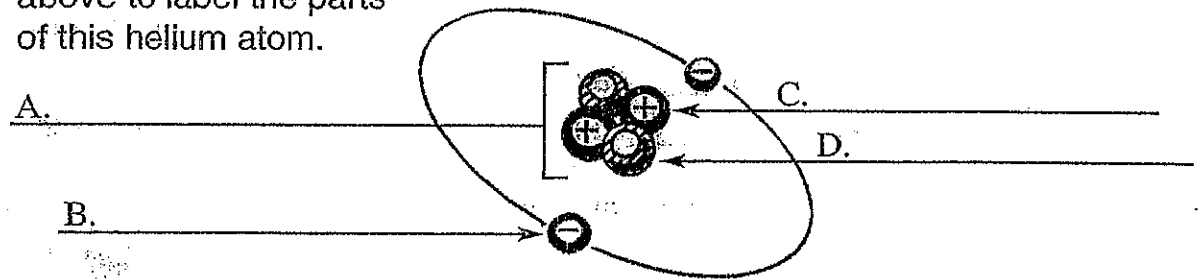
## Atoms

Everything around you is made up of matter. All matter is made of tiny particles called **atoms**. Atoms are so small you cannot see them with your eyes or even with a powerful microscope.

An atom has many parts. The center of an atom is called its **nucleus**. The nucleus is made up of protons and neutrons. **Protons** have a positive charge. **Neutrons** have no charge. Outside of an atom's nucleus are negatively charged particles called **electrons**. Electrons move around the atom's nucleus.

An **element** is one of over one hundred basic substances scientists have discovered or created. All atoms of an element are exactly the same. The element iron, for example, is made up of only iron atoms. The element carbon is made up of only carbon atoms. The number of protons, neutrons, and electrons within an atom is what makes elements different from one another.

1. Use the information above to label the parts of this helium atom.



2. Whether a substance is a solid, liquid, or gas is determined by how close together its atoms are. Think about water, iron, and oxygen.

A. Which substance has the most tightly packed atoms? \_\_\_\_\_

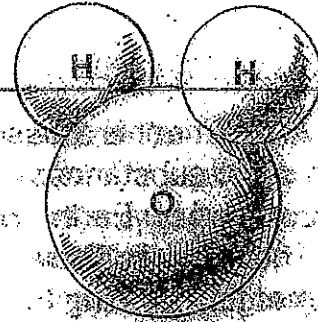
B. Which substance has the most loosely packed atoms? \_\_\_\_\_

3. Write letters in the blanks to match each word with its definition.

_____ a negatively charged particle	A. proton
_____ the center of an atom	B. atoms
_____ anything that has weight and takes up space	C. nucleus
_____ a particle with no charge	D. electron
_____ a basic substance	E. matter
_____ a positively charged particle	F. neutron
_____ the "building blocks" of matter	G. element

# Molecules

Atoms are very tiny particles of matter. Atoms can combine with other atoms to form a molecule. Some molecules are made up of only two atoms. Others are made up of many atoms. Some molecules contain atoms of only one type of element. Others are a combination of different elements.



water molecule

Water is a combination of two elements: hydrogen and oxygen. Imagine a drop of water on the head of a pin. Now imagine dividing that drop of water again and again until it cannot be divided anymore without separating the water into hydrogen and oxygen atoms. That tiny amount of water is a molecule. A **molecule** is the smallest possible amount of any substance that is still that substance.

1. Salt is made up of two elements: sodium and chlorine. Imagine you could divide a crystal of salt over and over again. What will happen when you finally divide a single molecule of salt?

\_\_\_\_\_

\_\_\_\_\_

2. Define the following terms.

atom \_\_\_\_\_

\_\_\_\_\_

molecule \_\_\_\_\_

\_\_\_\_\_

3. Number the following items to put them in order from smallest to largest:

\_\_\_\_\_ an atom's nucleus

\_\_\_\_\_ an atom

\_\_\_\_\_ an atom's neutron

\_\_\_\_\_ the head of a pin

\_\_\_\_\_ a molecule

Write T for true or F for false before each statement below.

4. \_\_\_\_\_ Atoms are a combination of molecules.

5. \_\_\_\_\_ Some molecules are made up of only one element.

6. \_\_\_\_\_ A water molecule is made up of helium and oxygen.

7. \_\_\_\_\_ If a molecule is divided, it will separate into atoms.

### 3-3 What are the parts of an atom?

#### Lesson Review

Complete the following.

1. The first scientist to suggest that atoms contain smaller particles was \_\_\_\_\_ of England.
2. Positively charged particles in an atom are called \_\_\_\_\_.
3. Bohr proposed that electrons in an atom are found in specific \_\_\_\_\_.
4. Negatively charged particles in an atom are called \_\_\_\_\_.
5. Rutherford found that an atom is made up mostly of \_\_\_\_\_.
6. The center, or core, of an atom is called the \_\_\_\_\_.
7. Surrounding the core of an atom is a cloud of very small particles called \_\_\_\_\_.
8. According to Bohr's model, electrons move around the center of an atom in separate \_\_\_\_\_, much as the planets move around the Sun.
9. Neutral particles in an atom are called \_\_\_\_\_.
10. Rutherford found that \_\_\_\_\_ are located in the core of an atom.

#### Skill Challenge

**Skills:** *comparing, classifying*

Write *yes* or *no* in the correct columns to identify whether each statement is true for protons, neutrons, and electrons.

	Proton	Neutron	Electron
1. Has an electric charge			
2. Found in the nucleus			
3. Positively charged			
4. Moves in energy levels			
5. Negatively charged			

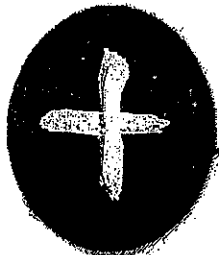
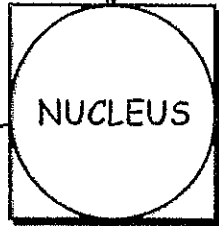


Name: \_\_\_\_\_

# \_\_\_\_\_



ATOMS -  
the smallest  
part of an  
element



PROTONS

Charge?  
.....

Location?  
.....  
NUCLEUS

# PROTONS =  
# ELECTRONS



Charge?  
.....

Location?  
.....

mass = TO  
PROTON  
MASS



ELECTRONS

Charge?  
.....

SMALL MASS

Location?  
.....

# electrons =  
.....

Name: \_\_\_\_\_

# \_\_\_\_\_

### FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some answers may be used more than once.

outside  
protons  
nucleus

neutrons  
atoms  
smaller

same  
negative  
no

cancel out  
electrons  
positive

1. All matter is made of tiny parts called \_\_\_\_\_.
2. The center part of an atom is called the \_\_\_\_\_.
3. A nucleus is made up of \_\_\_\_\_ and \_\_\_\_\_.
4. Electrons are found \_\_\_\_\_ the nucleus.
5. Electrons are \_\_\_\_\_ than protons or neutrons.
6. The main parts of an atom are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
7. Since protons have a \_\_\_\_\_ charge, and neutrons have \_\_\_\_\_ charge, the nucleus will have a \_\_\_\_\_ charge.
8. Electrons have a \_\_\_\_\_ charge.
9. An atom has the \_\_\_\_\_ number of protons and electrons.
10. The plus and minus charges of an atom \_\_\_\_\_ each other.

### TRUE OR FALSE

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

- \_\_\_\_\_ 1. A proton is found outside the nucleus.
- \_\_\_\_\_ 2. A proton has a negative charge.
- \_\_\_\_\_ 3. A neutron has a positive charge.
- \_\_\_\_\_ 4. An electron has a negative charge.
- \_\_\_\_\_ 5. An electron is found inside the nucleus.

### 3-4 What is an atomic number?

#### Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.

- \_\_\_\_\_ 1. Each element has a different atomic number.
- \_\_\_\_\_ 2. An atom of gold is made up of fewer protons than an atom of oxygen.
- \_\_\_\_\_ 3. In an atom, the number of protons is greater than the number of electrons.
- \_\_\_\_\_ 4. Hydrogen has an atomic number of 79.
- \_\_\_\_\_ 5. The number of electrons found in the nucleus of an atom is that element's atomic number.
- \_\_\_\_\_ 6. An atom has no overall electric charge.
- \_\_\_\_\_ 7. In an atom, the charges of the electrons are cancelled by the charges of the protons.
- \_\_\_\_\_ 8. The atomic number of oxygen is 8.
- \_\_\_\_\_ 9. The element with the smallest atomic number is helium.
- \_\_\_\_\_ 10. No two elements have the same atomic number.

#### Skill Challenge

**Skills:** *interpreting a table, analyzing*

Use the table on page 58 of your text to complete the following table.

Element	Atomic Number	Number of Electrons
1.	2.	82
3.	11	4.
5.	6.	29
Gold	7.	8.
9.	16	10.

### 3-5 What is an atomic mass?

#### Lesson Review

Complete the following.

1. The total mass of the protons and neutrons in an atom is called the \_\_\_\_\_.
2. One amu is equal to the mass of one \_\_\_\_\_.
3. The element \_\_\_\_\_ has a mass number and an atomic number of 1.
4. The total number of \_\_\_\_\_ in an atom is determined by subtracting the atomic number from its mass number.
5. Neutrons and \_\_\_\_\_ have the same mass.
6. The total number of protons and neutrons in the nucleus of an atom is called the \_\_\_\_\_.
7. The mass of an atom is measured in \_\_\_\_\_.
8. Each \_\_\_\_\_ has its own mass number.
9. The element \_\_\_\_\_ has an atomic number of 8 and a mass number of 16.

#### Skill Challenge

*Skills: synthesizing, comparing*

Use the table below to answer the following questions.

Element	Atomic Number	Mass Number
Helium	2	4
Sodium	11	23
Iron	26	56
Gold	79	197
Lead	82	207

1. How many neutrons are in an atom of helium? \_\_\_\_\_
2. How many protons are in an atom of iron? \_\_\_\_\_
3. How many neutrons are in an atom of lead? \_\_\_\_\_
4. How many electrons are in an atom of sodium? \_\_\_\_\_

## 3-6 How are electrons arranged in an atom?

### Lesson Review

Write *true* if the statement is true. If the statement is false, change the underlined term to make the statement true. Write your answers in the spaces provided.

- \_\_\_\_\_ 1. The lowest energy level of an atom is the one farthest from the nucleus.
- \_\_\_\_\_ 2. If an electron gains energy, it may jump to a higher energy level.
- \_\_\_\_\_ 3. The area in an atom where an electron is likely to be found is called the electron cloud.
- \_\_\_\_\_ 4. The first energy level of an atom can hold two electrons.
- \_\_\_\_\_ 5. If an atom contains three electrons, then its second energy level would hold three electrons.
- \_\_\_\_\_ 6. Electrons cannot move from one energy level to another.
- \_\_\_\_\_ 7. A maximum of eight electrons can be held in the fourth energy level of an atom.
- \_\_\_\_\_ 8. Electrons are arranged in energy levels.
- \_\_\_\_\_ 9. The third energy level can hold up to 16 electrons.
- \_\_\_\_\_ 10. Electrons with higher energy are in the energy levels closest to the nucleus.

### Skill Challenge

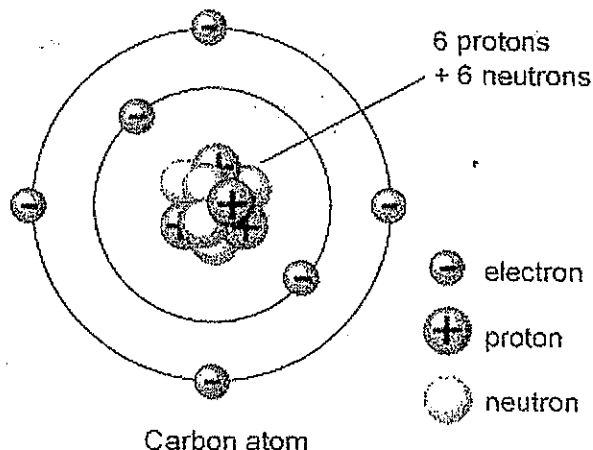
**Skills:** comparing, applying concepts

Complete the following table.

Element	Atomic Number	Number of Electrons in First Energy Level	Number of Electrons in Second Energy Level	Number of Electrons in Third Energy Level
Helium	2	1.	2.	3.
Nitrogen	7	4.	5.	6.
Sulfur	16	7.	8.	9.
Sodium	11	10.	11.	12.
Chlorine	17	13.	14.	15.

# The Atomic Number and Atomic Mass

6	Atomic Number Number of electrons & protons	
C		Symbol/Name CARBON
12		



The \_\_\_\_\_ found in the nucleus is the **atomic number**

Each element has a \_\_\_\_\_ atomic number

An atom is neutral. It has neither a positive nor a negative charge, so.....

The number of protons \_\_\_\_\_ the number of electrons

**Protons = Electrons = Atomic number (PEA)**

**Atomic Mass** - The total mass of the \_\_\_\_\_ and the \_\_\_\_\_ in an atom.

Mass number is the total amount of protons and neutrons in an atom. It is the \_\_\_\_\_ rounded to the nearest whole number.

$$\text{Mass number} - \text{atomic number} = \text{number of neutrons}$$

$$12 - 6 = 6 \quad \text{Carbon}$$

## Atomic Mass Unit

Mass of 1 AMU = 1 proton

Mass of 1 AMU = 1 neutron

1/1,836 AMU = electron, this is so small that it is not used in calculating the mass of the atom

Name \_\_\_\_\_  
Period \_\_\_\_\_


Date \_\_\_\_\_  
Number \_\_\_\_\_

**Bill Nye the Science Guy-Atoms**  
**Unit 4**

1. What are the three parts of an atom?
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
2. What is the heaviest part of an atom? \_\_\_\_\_
3. Atoms are mostly \_\_\_\_\_.
4. When electrons flow from one atom to another it is called \_\_\_\_\_.
5. When atoms combine together they form \_\_\_\_\_.
6. Water's CHEMICAL FORMULA is \_\_\_\_\_
7. What are the 2 elements (type of atoms) in water?
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
8. When two or more DIFFERENT elements bond (join) together they make a \_\_\_\_\_.
9. To separate the atoms in water you need to \_\_\_\_\_.

Part II

10. All elements are arranged in a table called the \_\_\_\_\_.
11. All elements are written using 1 or 2 \_\_\_\_\_ and a \_\_\_\_\_ which represents the amount of \_\_\_\_\_ in the atom.
12. \_\_\_\_\_ elements occur naturally.



13. NaCl is a \_\_\_\_\_ because 2 different elements bonded together and formed \_\_\_\_\_.

14. Nitro Glycerin ( $C_3H_5N_3O_9$ ) is used for making \_\_\_\_\_.

15. \_\_\_\_\_ is the element that is everywhere. It makes chemicals of living things.



Name: \_\_\_\_\_  
Periodic Table: Finding Protons, Electrons, Neutrons

Date \_\_\_\_\_  
Science

Directions: Use the chart to find the number of protons, electrons and neutrons.

**Remember: Atomic Number = # of protons in nucleus**  
**# of protons = # of electrons**  
**Atomic mass = # of protons + # of neutrons**  
**# of Neutrons = Atomic mass - Atomic number**

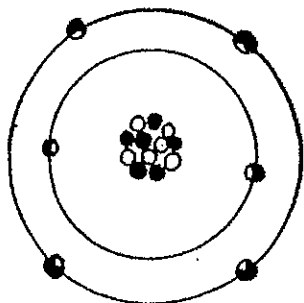
*\* Same #*

Element	Atomic #	# of Protons	Atomic Mass #	# of Neutrons	# of Electrons
Hydrogen		1	1		
Lithium		3	7		
Beryllium		4	9		
Boron		5	11		
Carbon		6	12		
Nitrogen		7	14		
Oxygen		8	16		
Fluorine		9	19		
Neon		10	20		
Sodium		11	23		

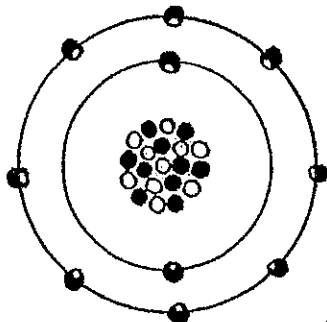
# WHICH ATOM IS WHICH?

Every kind of atom has its own unique look. All the atoms of an element have this same look. Here's a chance for you to look at some atoms and tell what elements they are. Write the name of the element next to each atom. You may need to use the Periodic Table to help you out.

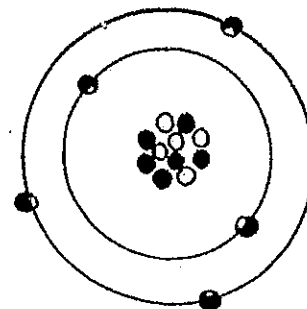
A.



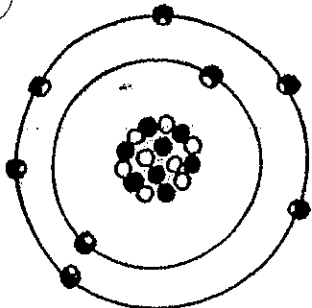
B.



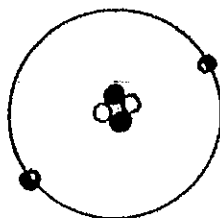
C.



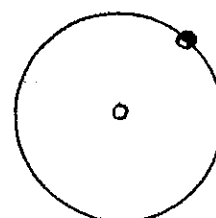
D.



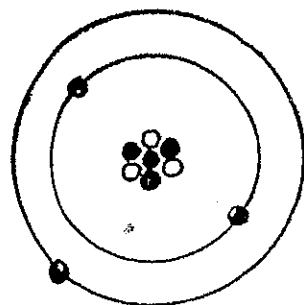
E.



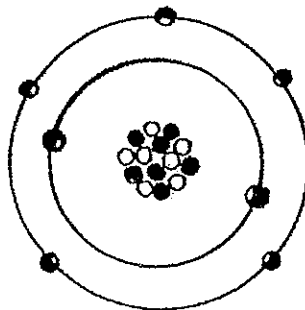
F.



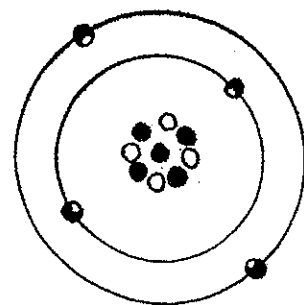
G.



H.



I.



Name \_\_\_\_\_

# A WORLD-FAMOUS TABLE

There is a table (not one for dinner) that's probably the most famous table of science. (You can find it in your physical science book or on page 52 of this book.) If you learn how to read it, you'll have quick access to important stuff about elements. It's called the Periodic Table (because it's written in rows, called periods). Build your skill at reading the Periodic Table by finding the missing information in the samples below.

*# neutrons = Atomic mass - Atomic #*

**REMEMBER:**  
 atomic mass = protons + neutrons  
 atomic number = # protons or # electrons  
 # protons = # electrons

1. a. atomic number \_\_\_\_\_  
 b. atomic mass \_\_\_\_\_

5. a. # electrons \_\_\_\_\_  
 b. # protons \_\_\_\_\_  
 c. atomic number \_\_\_\_\_  
 d. name of element \_\_\_\_\_

9. a. element name \_\_\_\_\_  
 b. # protons \_\_\_\_\_

2. a. # electrons \_\_\_\_\_  
 b. # protons \_\_\_\_\_  
 c. atomic number \_\_\_\_\_  
 d. name of element \_\_\_\_\_

6. a. atomic mass \_\_\_\_\_  
 b. element symbol \_\_\_\_\_

10. a. # electrons \_\_\_\_\_  
 b. atomic mass \_\_\_\_\_

3. a. # protons \_\_\_\_\_  
 b. element symbol \_\_\_\_\_

7. a. element symbol \_\_\_\_\_  
 b. # neutrons \_\_\_\_\_  
 c. element name \_\_\_\_\_

11. a. atomic number \_\_\_\_\_  
 b. # neutrons \_\_\_\_\_

4. a. atomic number \_\_\_\_\_  
 b. # neutrons \_\_\_\_\_

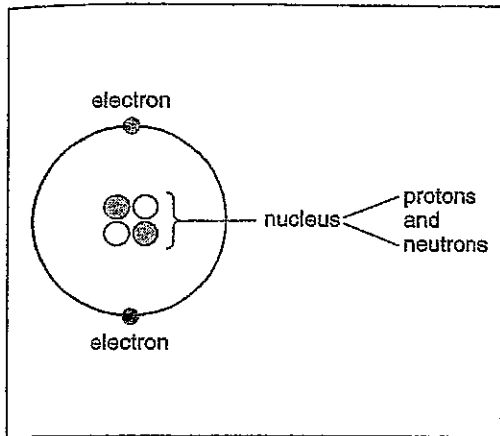
8. a. atomic number \_\_\_\_\_  
 b. # neutrons \_\_\_\_\_

12. a. element symbol \_\_\_\_\_  
 b. # neutrons \_\_\_\_\_  
 c. element name \_\_\_\_\_

Name \_\_\_\_\_

Name: \_\_\_\_\_

# \_\_\_\_\_



**NUCLEUS**  
PROTONS + NEUTRONS = ATOMIC MASS

Each proton has a value of one.

Each neutron has a value of one.

Figure A

**ATOMIC MASS**

The diagrams below show six different atoms. Look at each one closely. Find the atomic mass of each atom. Write your answer in the space below the diagram.

**Remember: atomic mass = protons + neutrons**

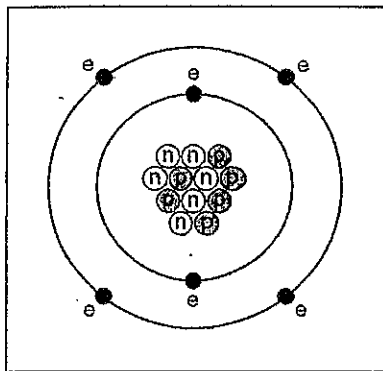


Figure B

Atomic Mass \_\_\_\_\_

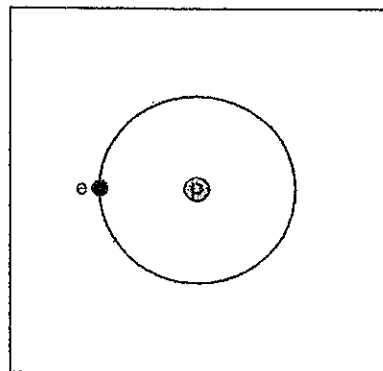


Figure C

Atomic Mass \_\_\_\_\_

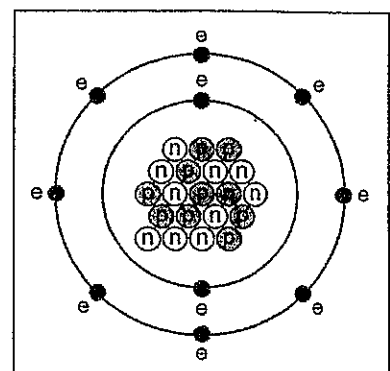


Figure D

Atomic Mass \_\_\_\_\_

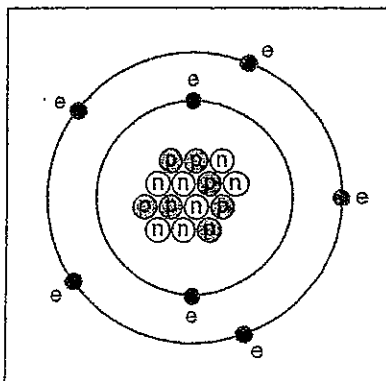


Figure E

Atomic Mass \_\_\_\_\_

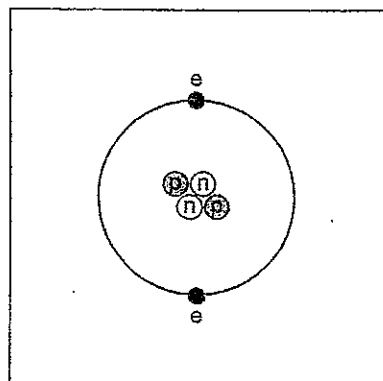


Figure F

Atomic Mass \_\_\_\_\_

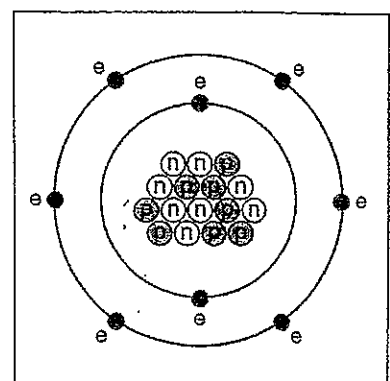


Figure G

Atomic Mass \_\_\_\_\_

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Per: \_\_\_\_\_

### Atomic Structure

Directions: You can become more familiar with the atomic structure of some common substances by completing the chart below. For each substance, you have been given enough information to fill in all the blanks.

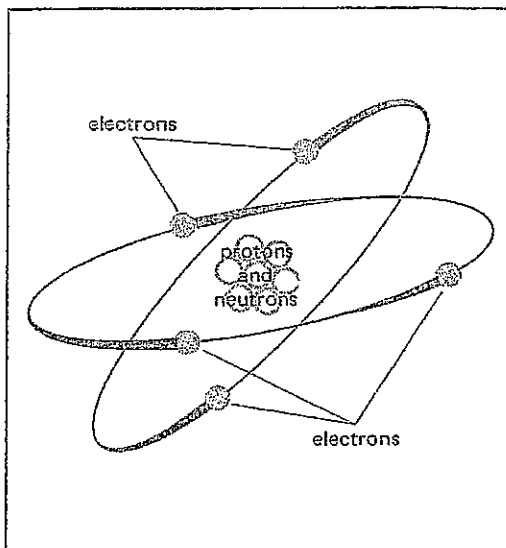
Substance	Symbol	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
Helium	He	2	4			
Magnesium	Mg	12			12	
Zinc	Zn	30	65			
Bromine	Br		80			35
Aluminum	Al			13	14	
Uranium	U				146	92
Sodium	Na	11			12	
Krypton	Kr				48	36
Calcium	Ca		40	20		
Silver	Ag			47	61	

$A\# = \#p = \#e$       $m = p + n$  or  $E + N$       $A\# = \#p$       $m - p$       $\#p = \#e$

**CORRECT  
THE CHART**

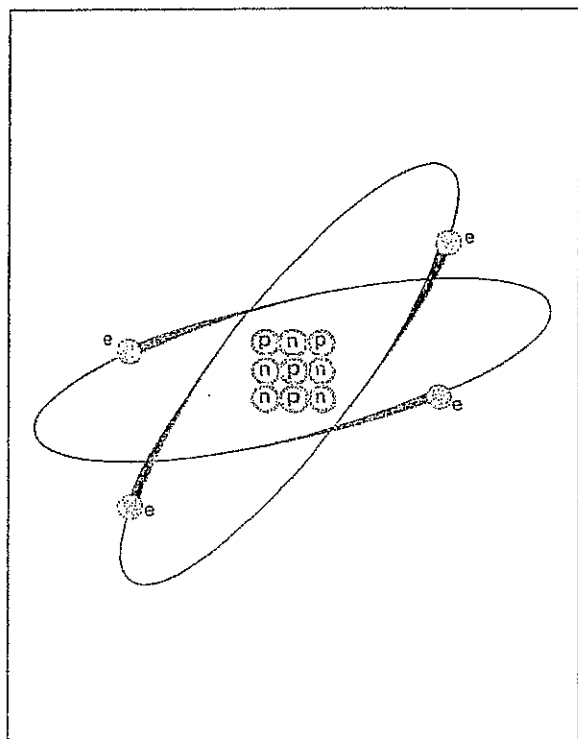
Make this chart correct by circling the right answers in columns B and C.

A	B	C
Part of the atom	Where it is found	Electrical charge
proton	inside the nucleus outside the nucleus	plus minus none
neutron	inside the nucleus outside the nucleus	plus minus none
electron	inside the nucleus outside the nucleus	plus minus none



A.

B.



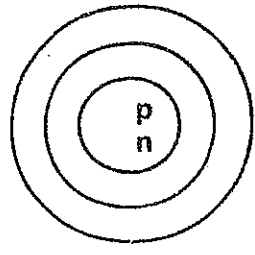
I. Look at this diagram carefully. Then answer the questions next to the diagram.

1. a) How many protons does this atom have? \_\_\_\_\_  
 b) How many electrons does this atom have? \_\_\_\_\_
2. a) How many plus charges does this have? \_\_\_\_\_  
 b) How many minus charges does this atom have? \_\_\_\_\_
3. The plus and minus charges \_\_\_\_\_  
do, do not  
 balance each other.

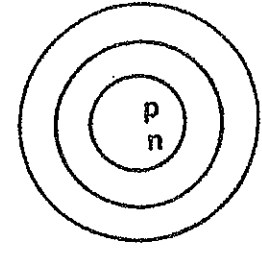
## Atomic Structure

Use the information provided for each element to complete the diagrams. Draw the electrons in their proper shells, and place the correct numbers in the nucleus to indicate the number of protons and the number of neutrons.

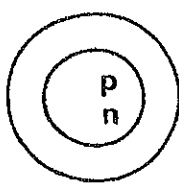
1. Sulfur: atomic number 16  
atomic mass 32



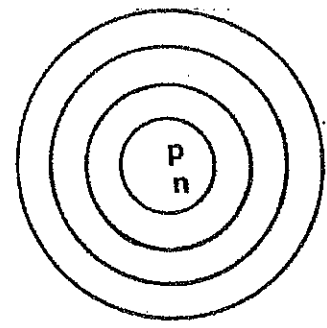
4. Sodium: atomic number 11  
atomic mass 23



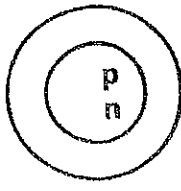
2. Beryllium: atomic number 4  
atomic mass 9



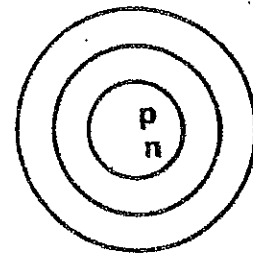
5. Potassium: atomic number 19  
atomic mass 39



3. Nitrogen: atomic number 7  
atomic mass 14



6. Argon: atomic number 18  
atomic mass 40



# LESSON 2

## What parts make up an atom?

It is hard to believe how tiny an atom is. Yet, the tiny atom is made up of even smaller parts. Can you imagine how small these parts are?

An atom has three main parts: **protons, neutrons, and electrons.**

Protons and neutrons make up the center of an atom. The center of an atom is called the **nucleus.**

The electrons are outside the nucleus. They spin around the nucleus at very great speeds. Electrons have much less mass than protons or neutrons.

Protons and electrons have electrical charges.

- Each proton has a **positive (+)** charge.
- Each electron has a **negative (-)** charge.
- A neutron is neutral. It has no charge.

An atom has the same number of protons as electrons.

### NUMBER OF PROTONS = NUMBER OF ELECTRONS

This means that the number of plus charges equals the number of minus charges. They balance each other. Because of this, the entire atom has no charge.

The **atomic number** is also the same as the number of protons.

### NUMBER OF PROTONS = ATOMIC NUMBER

Three things, then, are equal: the number of protons, the number of electrons, and the atomic number.

P	rotons =
E	lectrons =
N	umber (atomic)

Remember this. If you know any one of these numbers, you know the number of the other two. They are the same!

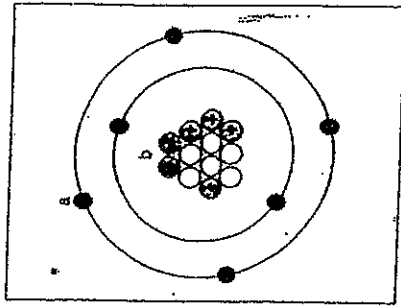


Figure A

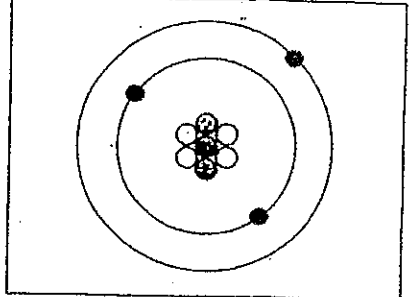


Figure B A lithium atom

Look at Figure A. Answer the questions.

1. The nucleus is labeled \_\_\_\_\_.
2. The electrons are labeled \_\_\_\_\_.
3. Name the parts that make up a nucleus.
4. A proton is \_\_\_\_\_ than an electron.
5. An electron is \_\_\_\_\_ than a neutron.
6. A proton has \_\_\_\_\_ charge.
7. An electron has \_\_\_\_\_ charge.
8. A neutron has \_\_\_\_\_ charge.

## UNDERSTANDING ATOMIC MASS

Every kind of atom has an atomic mass. The atomic mass is not a reading from a laboratory balance. It is a way to compare the mass of one atom to that of another atom.

The atomic mass of an atom is the number of parts in its nucleus. The nucleus contains protons and neutrons. Therefore the number of protons plus the number of neutrons is the atomic mass. Electrons are so light that they do not count in atomic mass.

- Each proton is given a mass of one.
  - Each neutron is given a mass of one.
- For example, a lithium atom has 3 protons and 4 neutrons. The atomic mass of a lithium atom is 7 (3 + 4 = 7).
- Each different kind of atom has its own number of protons.
  - Each different kind of atom has its own atomic mass.



COMPLETE THE CHART

Complete the chart by filling in the missing information.

Name of Element	Number of Protons	Number of Neutrons	Atomic Mass
Neon		10	20
Cobalt	27	32	
Gold	79		197
Chlorine	17		35
Thorium	90	142	
Lead	82		207
Nickel		31	59
Chromium		28	52
Silicon	14		28
Tungsten	74		184

WHAT DO THE PICTURES SHOW?

Figures C and D show atoms. Study each figure and answer the questions about each.

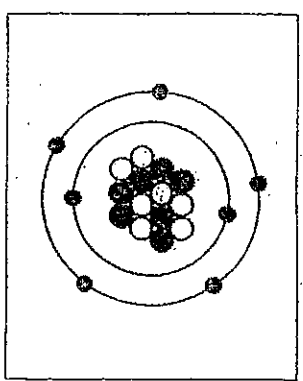


Figure C

1. How many protons does the atom in Figure C have? \_\_\_\_\_
2. How many neutrons? \_\_\_\_\_
3. How many electrons? \_\_\_\_\_
4. What is the atomic mass of this atom? \_\_\_\_\_

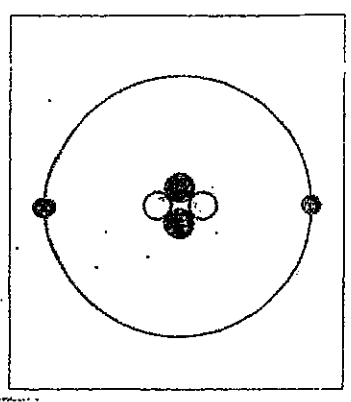


Figure D

5. How many protons does the atom in Figure D have? \_\_\_\_\_
6. How many neutrons? \_\_\_\_\_
7. How many electrons? \_\_\_\_\_
8. What is the atomic mass of this atom? \_\_\_\_\_

FILL IN THE BLANK

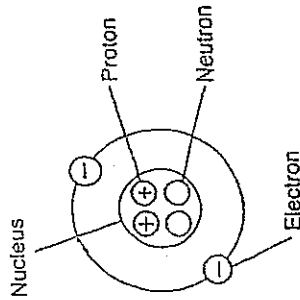
Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some words may be used more than once.

- |          |         |          |               |
|----------|---------|----------|---------------|
| positive | no      | neutrons | atomic number |
| atoms    | one     | circle   | electrons     |
| negative | protons |          |               |

1. All matter is made up of tiny \_\_\_\_\_.
2. The three main parts of an atom are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
3. A nucleus is made up of \_\_\_\_\_ and \_\_\_\_\_.
4. Electrons \_\_\_\_\_ the nucleus.
5. A proton has a \_\_\_\_\_ charge; an electron has a \_\_\_\_\_ charge; a neutron has \_\_\_\_\_ charge.
6. Protons = electrons = \_\_\_\_\_.
7. The atomic mass of an atom is the number of its \_\_\_\_\_ and \_\_\_\_\_.
8. Each proton or neutron is given a mass of \_\_\_\_\_.
9. In figuring atomic mass, we do not count the mass of an atom's \_\_\_\_\_.

Chapter 4 Structure of Atoms

Atoms



Mass number = number of protons + number of neutrons

Chemical symbol for carbon

Atomic number = number of protons

12

6

C

Element	Symbol	Atomic Number	Atomic Mass	Number of Electrons	Number of Protons	Number of Neutrons
Hydrogen	H	1	1			
Helium	He	2	4			
Lithium	Li	3	7			
Beryllium	Be	4	9			
Boron	B	5	11			
Carbon	C	6	12			
Nitrogen	N	7	14			
Oxygen	O	8	16			
Fluorine	F	9	19			
Neon	Ne	10	20			
Sodium	Na	11	23			
Chlorine	Cl	17	35			
Lead	Pb	82	207			
Uranium	U	92	238			

COMPLETE THE CHART

Complete the chart by filling in the missing information.

	Kind of Matter	Protons	Neutrons	Atomic Mass	Electrons	Atomic Number
1.	Oxygen	8		16	8	8
2.	Sodium			23	11	
3.	Carbon		6	12		
4.	Phosphorus		16			15
5.	Potassium	19	20			
6.	Iron	26		56		
7.	Copper	29	35	64		
8.	Chlorine			35		17
9.	Boron	5	6			
10.	Aluminum		14	27		

TRUE OR FALSE

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

1. An atom has no mass. \_\_\_\_\_
2. An electron is the largest part of an atom. \_\_\_\_\_
3. All atoms have the same mass. \_\_\_\_\_
4. All protons have the same mass. \_\_\_\_\_
5. All oxygen atoms have the same mass. \_\_\_\_\_
6. An oxygen atom has the same atomic number as a hydrogen atom. \_\_\_\_\_
7. To find the atomic mass of an atom, we add the protons and electrons. \_\_\_\_\_
8. The atomic number of an atom is the number of neutrons it has. \_\_\_\_\_
9. Atoms of the same kind that have different numbers of neutrons are called isotopes. \_\_\_\_\_
10. Atomic number = atomic mass. \_\_\_\_\_

Name: \_\_\_\_\_

Period: \_\_\_\_\_

### Unit 5 Review Sheet

Complete the answers on a separate piece of paper by restating the question.

1. What does the atomic number tell you?
2. When are ions formed?
3. What is found inside the nucleus of an atom?
4. What 3 subatomic particles make up an atom?
5. Which of the 3 subatomic particles has the least mass?
6. If an atom has 5 protons how many electrons are orbiting the nucleus of this neutral atom?
7. What do you get when you change the number of protons of an atom?
8. How many electrons are found in an atom of Calcium (Ca)?
9. How many electrons are found in an atom of Copper (Cu)?
10. How many protons are found in an atom of Neon (Ne)?
11. How many protons are found in an atom of Silver (Ag)?
12. How many neutrons are found in an atom of Sodium (Na)?
13. How many neutrons are found in an atom of Iron (Fe)?
14. What subatomic particles make up the mass of an atom?
15. What is the smallest particle of an element that still has all of its properties?
16. What did Ernest Rutherford call the center of an atom?
17. Compare the mass of an electron to a proton and neutron.
18. What is the definition of an isotope?
19. How are electrons arranged within an atom?



20. Describe the nucleus of an atom.

21. Where is a neutron found in an atom?

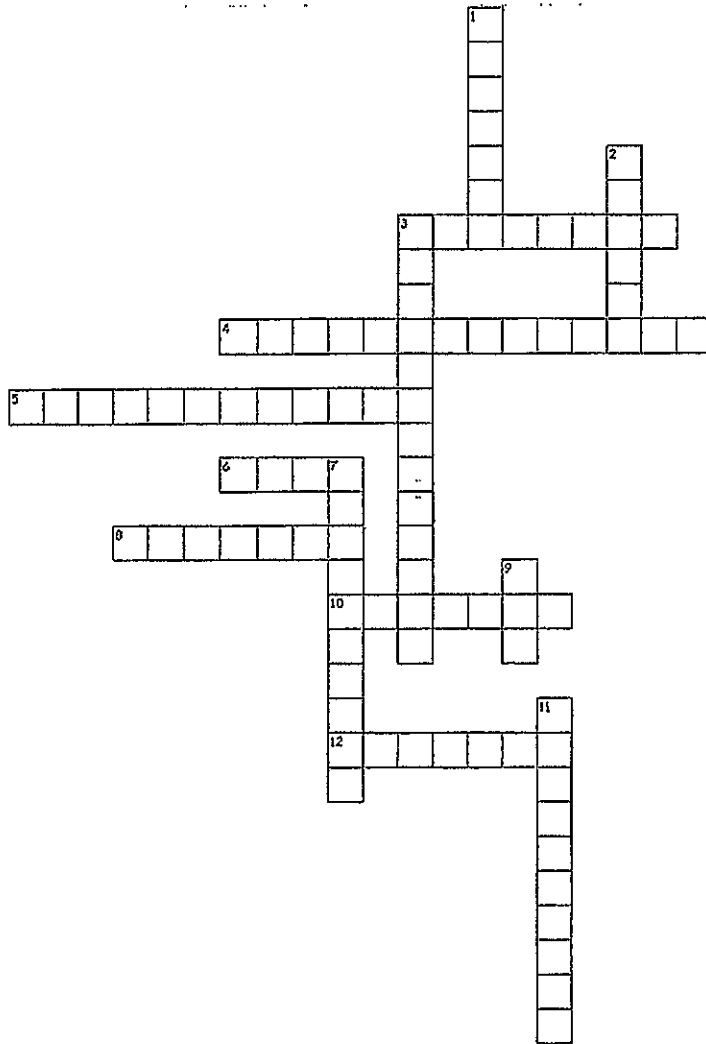
22. Where is an electron found in an atom?

23. How many electrons would an atom of Aluminum (Al) with 13 protons and 14 neutrons have?

24. How is the atomic mass of an element found?

25. What would the atomic mass of Boron be if it has 5 protons, 5 electrons and 6 neutrons be?

### Unit 5-Atomic Structure



**Across**

- 3. A negatively charged particle that flies around the nucleus in a cloud of orbitals or energy levels. They are so light that the
- 4. This is the unit of measure scientist use to measure the mass of an atom.
- 5. This is the number of protons in an atom.
- 6. The smallest part of an element that can be identified as that element. (Can't be cut into a smaller piece.)
- 8. It is the center of an atom and contains the protons and neutrons
- 10. A particle in the nucleus that has no charge.
- 12. A substance that cannot be chemically broken down into simpler things.

**Down**

- 1. Atoms of the same element that have the same number of protons as the other atoms of the element but a different number of neutrons
- 2. A positively charged particle found in the nucleus of an atom. It is very heavy.
- 3. This is where the electrons move around in energy levels around the nucleus.
- 7. The number of protons and neutrons in the nucleus of an atom.
- 9. An atom with a positive or negative charge.
- 11. The total mass of the protons and neutrons in an atom and is measured in atomic mass units.

13 of 13 words were placed into the puzzle

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