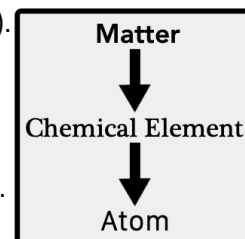
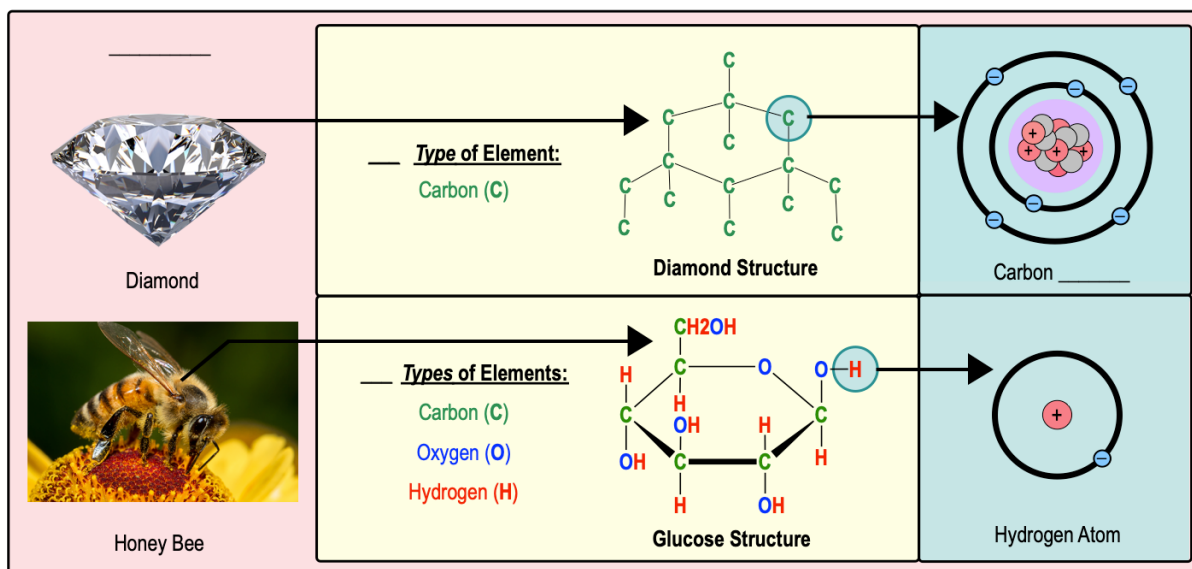


CONCEPT: ATOMS - SMALLEST UNIT OF MATTER

- _____: anything that takes up *space* & has *mass* (ex. organisms, rocks, oceans, etc.).
 - All *matter* consists of at least 1 *chemical* _____.
- *Chemical Elements*: pure substances made of only *one* type of _____.
 - *Atom*: the _____ unit of an *element* (& therefore, the smallest unit of *matter*).
 - Atoms makes up both _____ & _____ matter.



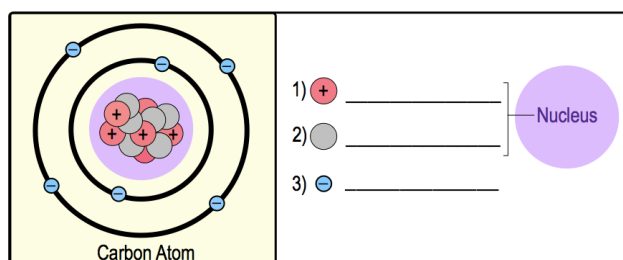
EXAMPLE: Atoms are the Smallest Units of Matter.



Atomic Structure

- *Atoms* are made of _____ *subatomic particles*, each with a characteristic *charge*, *mass* & *location* in the atom.

| Subatomic Particle | Electric Charge | Atomic Mass Unit (AMU) | Location |
|--------------------|-----------------|------------------------|------------------|
| 1 Proton | — | — | Nucleus |
| 2 Neutron | — | — | — |
| 3 Electron | — | — | Orbiting Nucleus |



EXAMPLE: Negatively charged particles of atoms with almost no mass are called:

- a) Electrons. b) Protons. c) Neutrons. d) Ions. e) Polymers.

PRACTICE: A proton _____:

- a) Has one positive charge. b) Has one AMU. c) Is found in the nucleus of the atom.
 d) Only a and b are true. e) a, b, and c are true.

CONCEPT: ATOMS - SMALLEST UNIT OF MATTER

Elements of Life

- Of all the known elements, only a _____ subset is found in living organisms.
 - *Periodic Table of _____*: arranges all of the known elements based on their *chemical* properties.
- ~97% of the mass of most life is composed of Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorus & Sulfur (**CHNOPS**).
 - _____ *Elements*: required for life in _____ amounts.

EXAMPLE: Periodic Table of Elements.

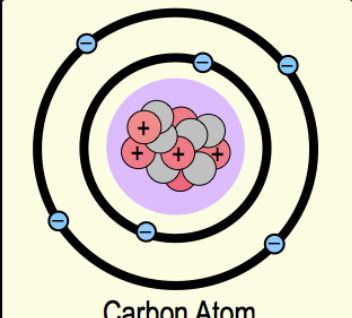
| | | | | | | | | | | | | | | | | | |
|------------------|----------|---------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 1.008 Li | 2 He | <div>_____ Elements</div> | | | | | | | | | | | | | | | |
| 3 Li | 4 Be | <div>_____ Trace Elements</div> | | | | | | | | | | | | | | | |
| 11 Na | 12 Mg | | | | | | | | | | | | | | | | |
| 19 K | 20 Ca | 21 Sc | 22 Ti | 23 V | 24 Cr | 25 Mn | 26 Fe | 27 Co | 28 Ni | 29 Cu | 30 Zn | 31 Ga | 32 Ge | 33 As | 34 Se | 35 Br | 36 Kr |
| 37 Rb | 38 Sr | 39 Y | 40 Zr | 41 Nb | 42 Mo | 43 Tc | 44 Ru | 45 Rh | 46 Pd | 47 Ag | 48 Cd | 49 In | 50 Sn | 51 Sb | 52 Te | 53 I | 54 Xe |
| 55 Cs | 56 Ba | 57 La | 72 Hf | 73 Ta | 74 W | 75 Re | 76 Os | 77 Ir | 78 Pt | 79 Au | 80 Hg | 81 Tl | 82 Pb | 83 Bi | 84 Po | 85 At | 86 Rn |
| 87 Fr | 88 Ra | 89 Ac | 104 Rf | 105 Db | 106 Sg | 107 Bh | 108 Hs | 109 Mt | 110 Ds | 111 Rg | 112 Cn | 113 Nh | 114 Fl | 115 Mc | 116 Lv | 117 Ts | 118 Og |

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

Atomic Properties

- Each atom of an element has *unique* properties:
 - _____ *Number*: # of _____ in the *nucleus* (*atomic number* _____ each element).
 - _____ *Number*: mass of the *nucleus* (# of _____ & _____).
 - *Atomic mass* (or *atomic* _____) = _____ total mass of *all* atoms of an element.

EXAMPLE: Atomic Properties of a Carbon Atom.



Carbon Atom

⊕ Protons = _____ = Atomic Number

● Neutrons = _____

_____ + _____ = Mass Number = _____

12.011

6

C

Carbon

Periodic Table View

Atomic _____

Atomic _____

Chemical Symbol

Element Name

CONCEPT: ATOMS - SMALLEST UNIT OF MATTER

EXAMPLE: The atomic number of an element is equal to the number of:

- a) Neutrons only.
- b) Protons plus electrons.
- c) Protons plus neutrons.
- d) Neutrons plus electrons.
- e) Protons only.

PRACTICE: The average oxygen atom has a mass number of 16 and an atomic number of 8. This means that the number of neutrons in this oxygen atom is:

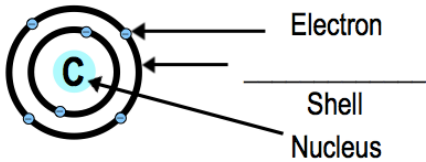

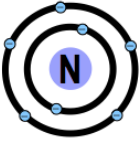
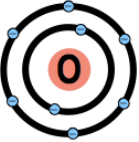
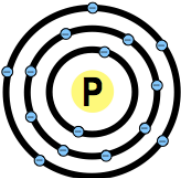

- a) 24.
- b) 8.
- c) 16.
- d) 4.
- e) 2.

Electron Orbitals & Energy Shells

● **Electron** _____: 3D-regions around a nucleus where electrons are found (envisioned in 2D as *energy shells*).

- ☐ Shells *closer* to the nucleus are _____ in energy than distant shells, which are *higher* in energy.
- ☐ **Valence Electrons**: electrons found in the _____ energy shell (*valence shell*).
- ☐ *1st shell* holds up to _____ electrons; *2nd shell* holds up to _____ electrons; each shell holds varying #'s.

EXAMPLE: Energy Shells for C, H, N, O, P, S.

| Carbon | Hydrogen | Nitrogen | Oxygen | Phosphorus | Sulfur |
|---|---|---|--|---|---|
|  |  |  |  |  |  |
| <div>_____ Number → 12</div> <div>_____ Number → 6</div> <div>C ← Chemical Symbol</div> | <div>1 H</div> <div>1</div> | <div>14 N</div> <div>_____</div> | <div>16 O</div> <div>_____</div> | <div>31 P</div> <div>15</div> | <div>32 S</div> <div>_____</div> |

PRACTICE: How many valence electrons does an atom with five total electrons have?

- a) 5.
- b) 7.
- c) 3.
- d) 2.
- e) 1.

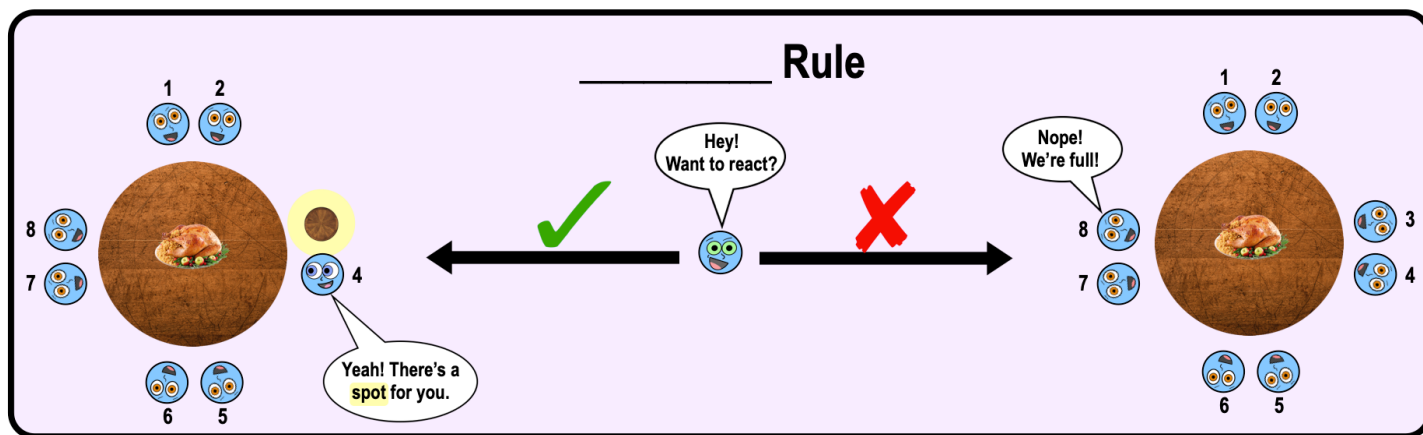
PRACTICE: Which of the following is true about electron energy shells?

- a) They represent regions around the nucleus in which the electrons orbit.
- b) The shells closest to the nucleus contain electrons with higher energy.
- c) They contain electrons of the same energy.
- d) a and b only.
- e) a and c only.

CONCEPT: ATOMS- SMALLEST UNIT OF MATTER

Octet Rule

- _____ Rule: atoms are more stable (less reactive) when their valence shells are *fully occupied*.
 - Recall: 1st energy shell holds up to _____ electrons; 2nd energy shell holds up to _____ electrons.
 - Atoms are _____ reactive when their outer valence shells are _____.



EXAMPLE: According to the octet rule, electron distribution in each shell of a neutral nitrogen atom (atomic number 7) is:

- a) 1,5. b) 2,4. c) 2,5. d) 1,4.

PRACTICE: An average neon atom (Ne) is unreactive for which of the following reasons?

- a) It has 7 valence electrons. b) It has 8 valence electrons.
c) Its valence shell is full of electrons. d) It has 20 valence electrons.
e) b and c only.

| | |
|--------|----|
| 20.180 | 10 |
| Ne | |
| Neon | |

PRACTICE: How many electrons does an Oxygen atom need to fulfill the octet rule by filling its valence shell?

- a) 8.
b) 4.
c) 1.
d) 2.
e) 6.

| | |
|--------|---|
| 15.999 | 8 |
| O | |
| Oxygen | |