

# **BACK TO THE ELEMENTS**

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**PRESENTED BY  
THE CENTER FOR TEACHING AND LEARNING  
AND  
DANIEL FOX, SCIENCE TEACHING ASSISTANT**

# Today we will discuss:

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- Matter
- Atomic structure
- Elements
- The Periodic Table of Elements
- Applications

# Matter

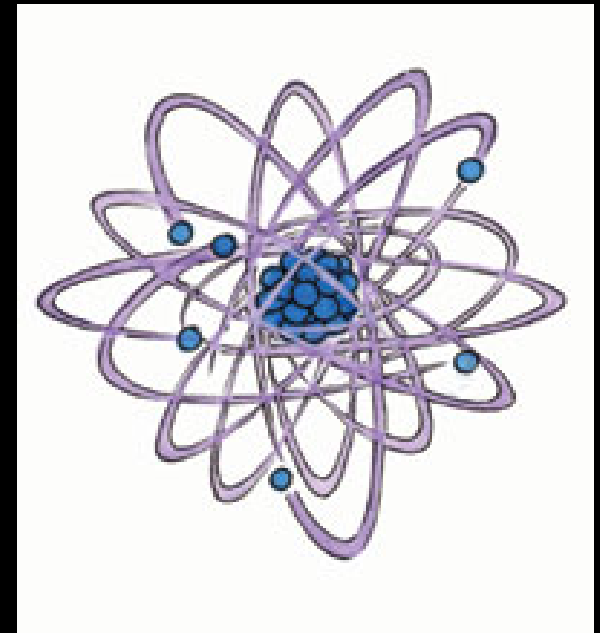
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- Three different states
  - Solid
    - Definite shape and volume
  - Liquid
    - Definite volume, but no specific shape
  - Gas
    - No fixed volume or shape

# The Atom

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- Three subatomic particles:
  - Protons
  - Neutrons
  - Electrons



# Protons

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- Mass
  - 1.0073 amu
- Charge
  - 1+
- Location in atom
  - In nucleus at center of the atom

# Neutrons

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- Mass
  - 1.0087 amu
- Charge
  - Neutral (no charge)
- Location in atom
  - In nucleus at center of atom

# Electrons

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- Mass

- $5.46 \times 10^{-4}$  AMU

- Charge

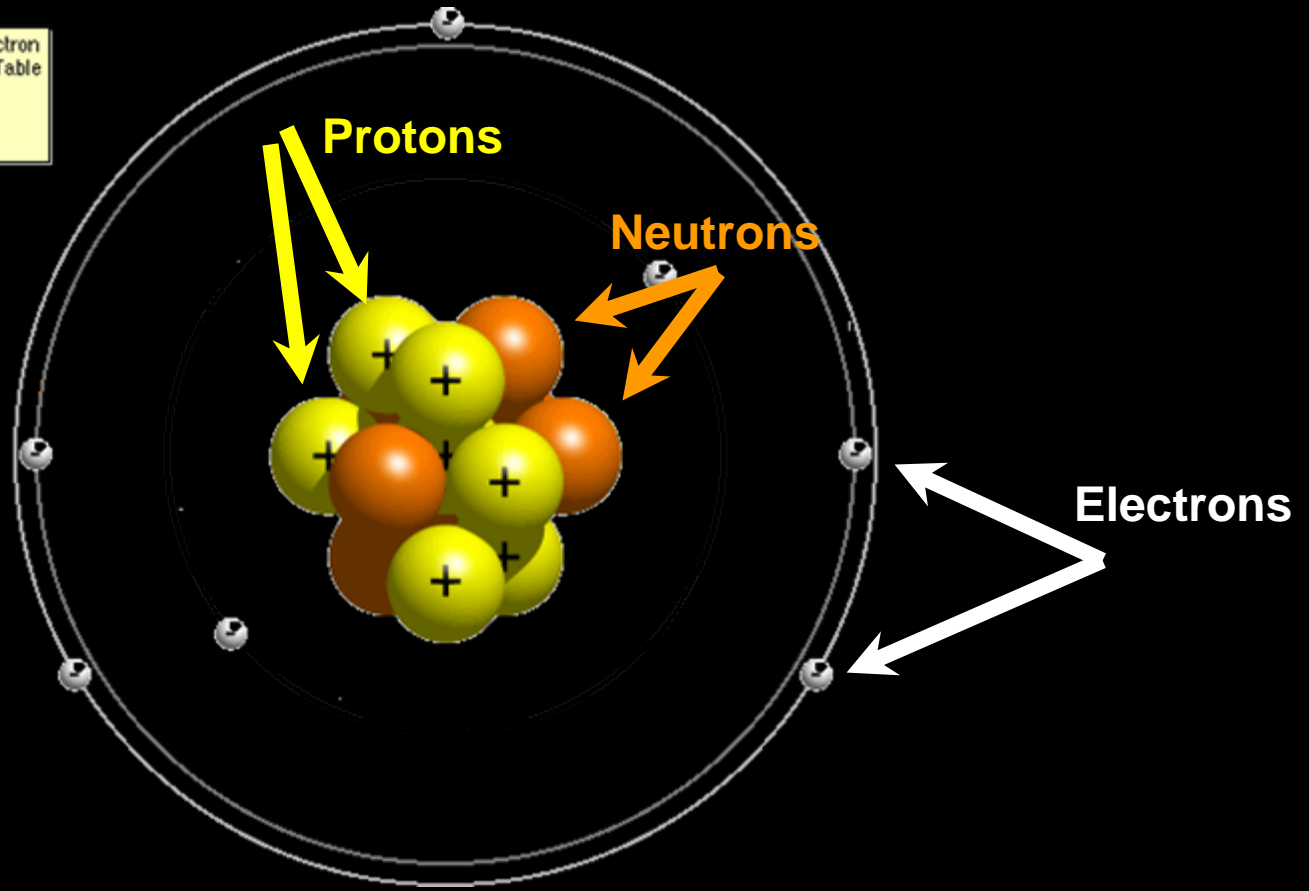
- 1-

- Location in atom

- Orbital found outside of the nucleus

# Atomic structure

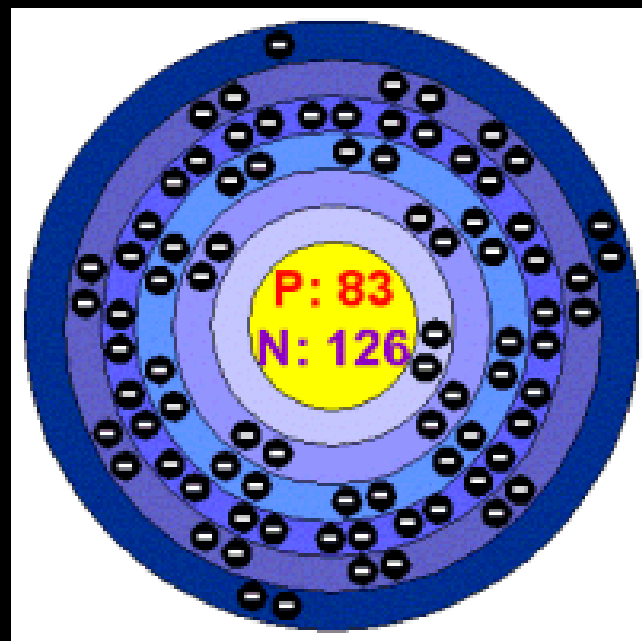
Nitrogen's Electron  
Configuration Table  
 $1s^2$   
 $2s^2 2p^3$



# Electron Configuration

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- Follows the Octet Rule
  - Outermost 'shell' is valence shell of electrons
  - 'Octet' refers to 8 electrons that fill valence shell



# Elements

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- What defines an element?
  - Elements are defined by the # of protons located inside the atom
    - Ex:
      - All Carbon (C) atoms have 6 protons
      - All Oxygen (O) atoms have 8 protons
      - All Gold (Au) atoms have 79 protons

# Isotopes

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- Elements with differing neutrons are called isotopes
  - Example:
    - C has Isotopes of 12, 13, and 14
    - All Carbons have 6 atoms, but number of isotopes vary

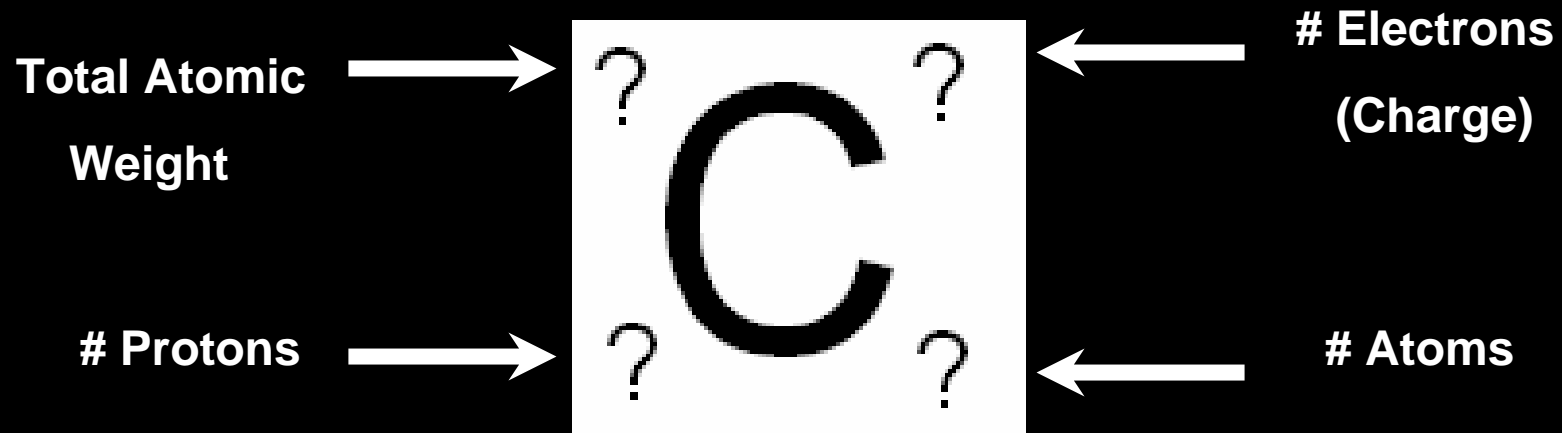
# Ions

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- Elements with differing electrons are called ions
  - Ex.
    - $H^+$
    - $Cl^-$
    - $Ca^{2+}$

# How to read an element

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# The Periodic Table of Elements

## Periodic Table of the Elements

**Rows** →

Legend:

- Alkali Metals (Red)
- Alkaline Earth Metals (Light Green)
- Transition Metals (Yellow)
- Other Metals (Orange)
- Nonmetals (Light Blue)
- Noble Gases (Dark Blue)
- Inner Transition Metals (Light Orange)

States:

- GI Gaseous State
- LI Liquid State
- SI Solid State
- SP Synthetically Prepared

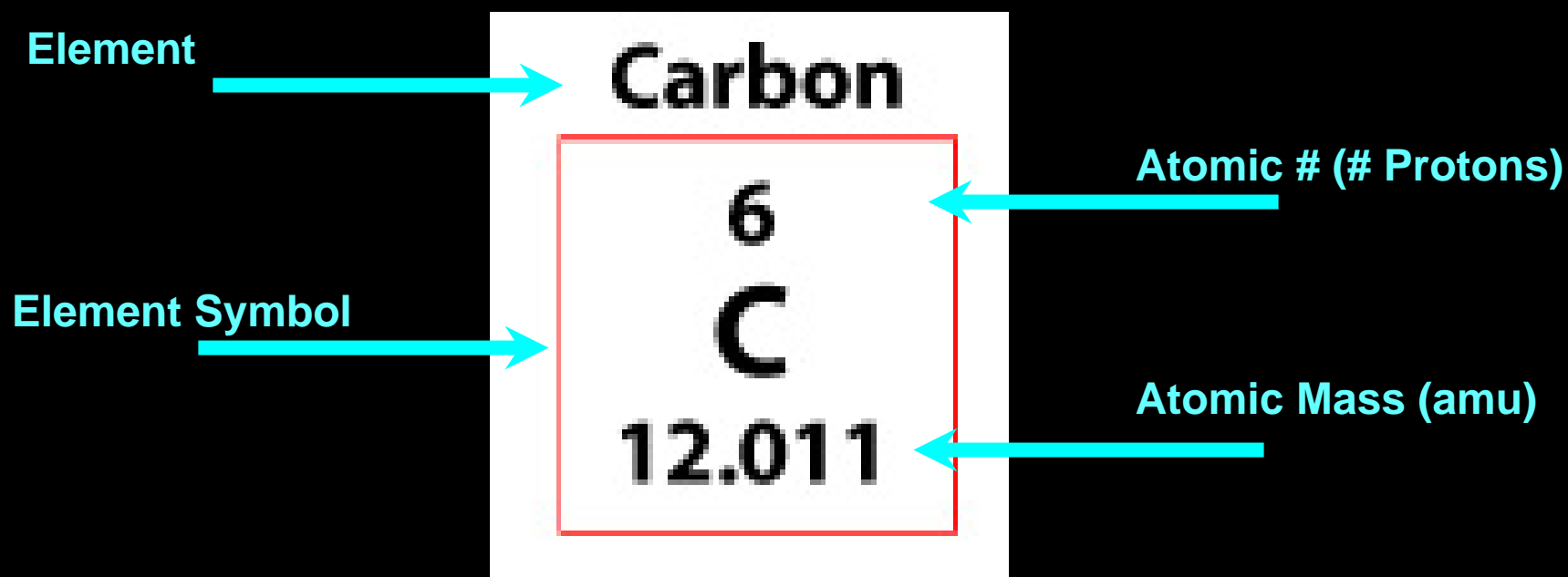
IA 1 <b>H</b> 1.0079																	VIIIA 2 <b>He</b> 4.0026		
3 <b>Li</b> 6.941	IIA 4 <b>Be</b> 9.0122											IIIA 5 <b>B</b> 10.81	IVA 6 <b>C</b> 12.011	V 7 <b>N</b> 14.007	VIA 8 <b>O</b> 15.999	VIIA 9 <b>F</b> 18.998	10 <b>Ne</b> 20.179		
11 <b>Na</b> 22.990	12 <b>Mg</b> 24.305	IIIIB 21 <b>Sc</b> 44.956	IVB 22 <b>Ti</b> 47.90	VB 23 <b>V</b> 50.941	VIB 24 <b>Cr</b> 51.996	VIIIB 25 <b>Mn</b> 54.938	26 <b>Fe</b> 55.847	27 <b>Co</b> 58.933	28 <b>Ni</b> 58.71	29 <b>Cu</b> 63.546	IIB 30 <b>Zn</b> 65.38	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.59	33 <b>As</b> 74.922	34 <b>Se</b> 78.96	35 <b>Br</b> 79.904	36 <b>Kr</b> 83.80		
19 <b>K</b> 39.098	20 <b>Ca</b> 40.08	37 <b>Rb</b> 85.468	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.906	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.906	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.4	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.69	51 <b>Sb</b> 121.75	52 <b>Te</b> 127.60	53 <b>I</b> 126.90	54 <b>Xe</b> 131.30
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.33	71 <b>Lu</b> 174.97	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.95	74 <b>W</b> 183.85	75 <b>Re</b> 186.21	76 <b>Os</b> 190.2	77 <b>Ir</b> 192.22	78 <b>Pt</b> 195.09	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.37	82 <b>Pb</b> 207.2	83 <b>Bi</b> 208.98	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)		
87 <b>Fr</b> (223)	88 <b>Ra</b> 226.03	103 <b>Lr</b> (260)	104* (261)	105* (262)	106* (263)	*Name Not Officially Assigned													

## Periods

Lanthanide Series	57 <b>La</b> 138.91	58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.91	60 <b>Nd</b> 144.24	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.4	63 <b>Eu</b> 151.96	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.93	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.93	70 <b>Yb</b> 173.04
Actinide Series	89 <b>Ac</b> (227)	90 <b>Th</b> 232.04	91 <b>Pa</b> 231.04	92 <b>U</b> 238.03	93 <b>Np</b> 237.05	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (254)	100 <b>Fm</b> (257)	101 <b>Md</b> (258)	102 <b>No</b> (259)

# How to Read the Element Boxes

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# Element classifications

- Metals
- Non-Metals
- Metalloids
- Transition Metals

**Periodic Table of the Elements**

Legend:

- Alkali Metals
- Alkaline Earth Metals
- Transition Metals
- Other Metals
- Nonmetals
- Noble Gases
- Inner Transition Metals
- EI Gaseous State
- EI Liquid State
- EI Solid State
- EI Synthetically Prepared

1 H 1.007																	2 He 4.0026	
3 Li 6.941	4 Be 9.0122											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179	
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948	
19 K 39.098	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.941	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.71	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.80	
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30	
55 Cs 132.91	56 Ba 137.33	57 La 138.91	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	*Name Not Officially Assigned																

Lanthanide Series:	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
Actinide Series:	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)

# Element Classifications contd.

- Alkali Metals
- Alkali Earth Metals
- Chalcogens
- Halogen
- Noble Gas

**Periodic Table of the Elements**

**Legend:**

- Alkali Metals
- Alkaline Earth Metals
- Transition Metals
- Other Metals
- Nonmetals
- Noble Gases
- Inner Transition Metals
- Gaseous State
- Liquid State
- Solid State
- Synthetically Prepared

IA 1 H 1.0079	IIA 2 He 4.0026																	IIIA 5 B 10.81	IVA 6 C 12.011	VA 7 N 14.007	VIA 8 O 15.999	VIIA 9 F 18.998	VIIIA 10 Ne 20.179							
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19 K 39.098	20 Ca 40.08	39 Y 88.906	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30													
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55 Cs 132.91	56 Ba 137.33	103 Lr 260.10	104*	105*	106*	*Name Not Officially Assigned												118 Og (284)	119 Uu (285)	120 Uu (286)										
87 Fr (223)	88 Ra (226)																	115 Nh (284)	116 Fl (284)	117 Ts (284)	118 Og (284)									
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# Electron Configurations

## ■ Sublevels

- S level
- P level
- D level
- F level

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- E Gaseous State
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87 Fr [?]	88 Ra [?]	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)		

\*Name Not Officially Assigned

# Applications

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- The Periodic Table can be used to:
  - Identify elemental characteristics
  - Classify all matter
  - Predict reactions between elements

# Elemental Characteristics

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- The Periodic Table will show:
  - Protons, neutrons, and electrons
  - Class order and valence shell electrons
  - Average mass of elements (mass number)

# Classifying Matter

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- All matter, regardless of physical status, is represented on The Periodic Table in one form or another

# Predicting Reactions

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- The number of valence electrons will predict the how many bonds an element will form
    - Elements will follow the octet rule
    - Example:
      - Cl has 7 electrons and will therefore form 1 bond
      - H has 1 valence electron and therefore forms 1 bond
- \*Why do both elements form the same number of bonds, but appear to be so different?

# Predicting Reactions contd.

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- It is easier for Cl to accept an electron, where it is easier for H to donate an electron
- Often, Rows 4A and up will accept electrons, where 1A through 3A will donate electrons

# Next Time.....

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- Balancing and using chemical equations

