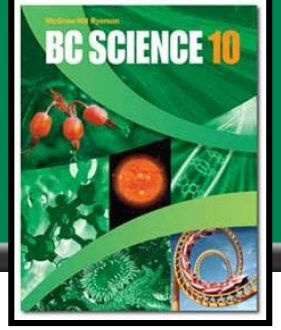
4.3 Balancing Chemical Equations



- **Chemical reactions result in chemical changes.**
  - **Chemical changes occur when new substances are created by change in the arrangements and connections between ions and atoms.**
  - **The original substance(s), called reactants, change into new substance(s) called products.**
  - **https://www.youtube.com/watch?v=2S6e11NBwiw**

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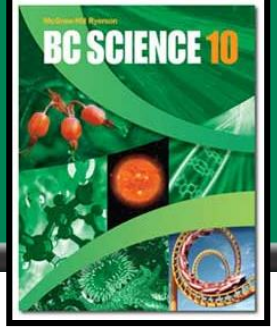
See pages 202 - 203

Chemical Equations



- **Chemical reactions can be written in different ways.**
  - **A word equation:**
    - **Nitrogen monoxide + oxygen → nitrogen dioxide**
  - **A symbolic equation:**
    - **$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$**

Coefficients

- Indicate the ratio of compounds in the reaction.

- Here, there is twice as much NO and NO_2 than as is O_2.

-2 molecules of NO react with one molecule of O_2 to produce two molecules of NO_2

State of matter

- Letters indicate the state of each compound.

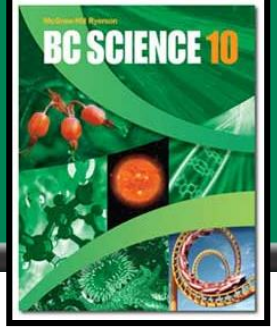
(aq) = aqueous/dissolved in water

(s) = solid

(l) = liquid

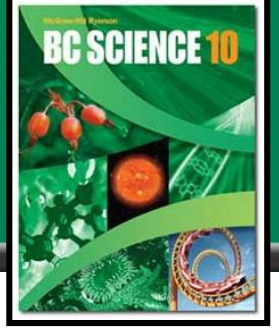
(g) = gas

So Why do we have to balance the equation?



- Conservation of Mass in Chemical Change
- Chemical change means new compounds are created.
  - No new matter is created or destroyed; atoms are just rearranged.
  - All of the matter in the reactants = all of the matter in the products.
  - John Dalton, 200 years ago, realized that atoms simply rearrange themselves during chemical reactions.
  - Number of each atom in reactants = number of each atom in products.
- The law of conservation of mass:
  - In chemical reactions, atoms are neither created nor destroyed.
  - This law was developed by Antoine and Marie-Anne Lavoisier in the 1700s.
  - Mass of reactants = mass of products

Writing and Balancing Chemical Equations



- **The simplest form of chemical equation is a word equation.**
  - **Potassium metal + oxygen gas → potassium oxide**

Arrow means "produces."

Reactants appear on left side of arrow.

potassium metal + oxygen gas → potassium oxide

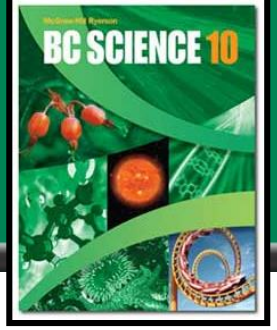
Products appear on right side of arrow.

Plus sign on left side means "reacts with."

Plus sign on right side means "plus."

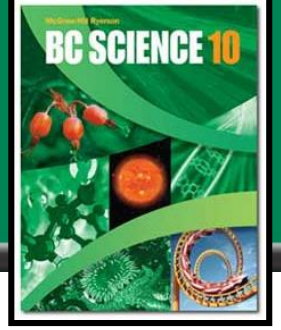
See page 206

Balancing continued

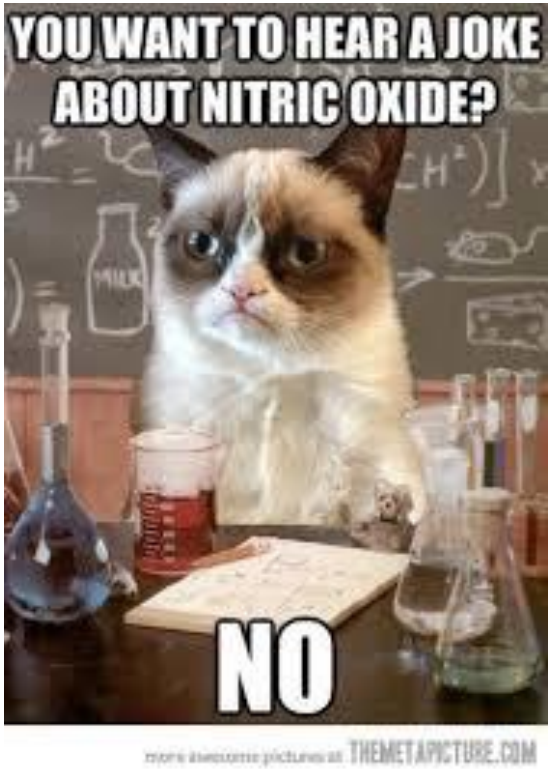


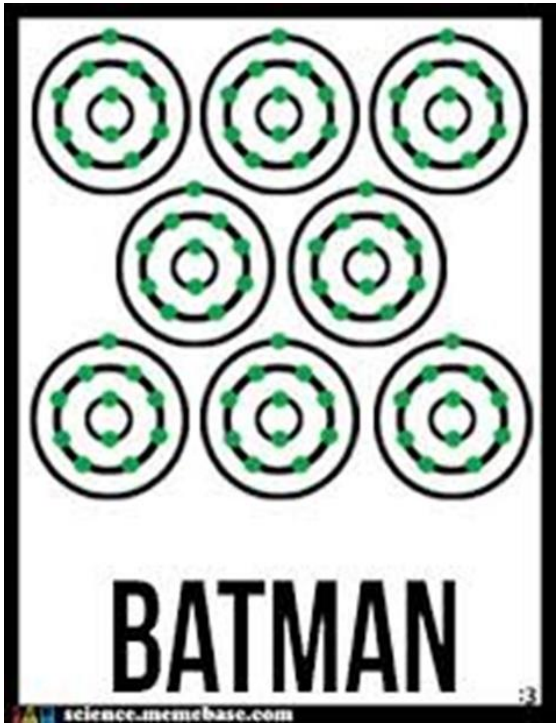
- **A skeleton equation shows the formulas of the elements/compounds.**
  - **A skeleton equation shows atoms, but not quantities of atoms.**
    - $K + O_2 \rightarrow K_2O$
    - **Needs to be balanced**
- **A balanced chemical equation shows all atoms and their quantities**
  - **Balancing ensures that the number of each atom is the same on both sides of the reaction arrow.**
  - **Always use the smallest whole-number ratio.**
    - $4K + O_2 \rightarrow 2K_2O$
    - **4:1:2**
    - **4 molecules of K react with one molecule of O_2 to produce two molecules of K_2O**
    - **Can "double" the recipe**

Time OUT

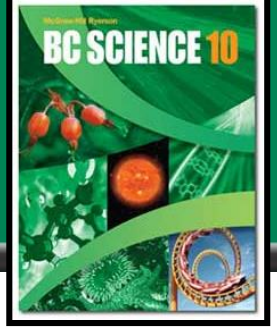


- **Reading Check pg 207 (all)**

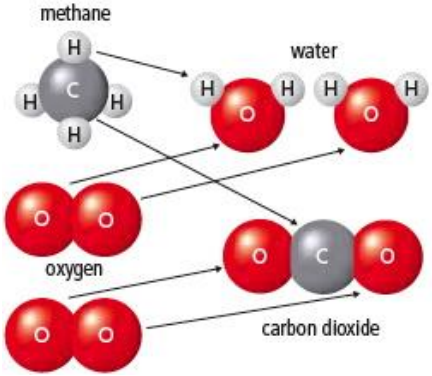




Counting Atoms to Balance an Equation



- **Using the law of conservation of mass, we can count atoms to balance the number of atoms in chemical equations.**
  - **Word equation:** methane + oxygen → water + carbon dioxide
  - **Skeleton equation:** $CH_4 + O_2 \rightarrow H_2O + CO_2$
    - **To balance the compounds, take note of how many atoms of each element occur on each side of the reaction arrow.**



  - **Skeleton equation:** $CH_4 + O_2 \rightarrow H_2O + CO_2$

    1 carbon, 4 hydrogen, 2 oxygen → 1 carbon, 2 hydrogen, 3 oxygen

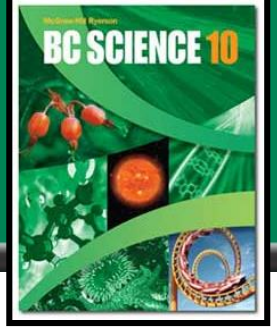
The same number of atoms must be on each side.

  - **To balance, attempt to find values that equate atoms on both sides**
  - **Balanced equation:** $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$

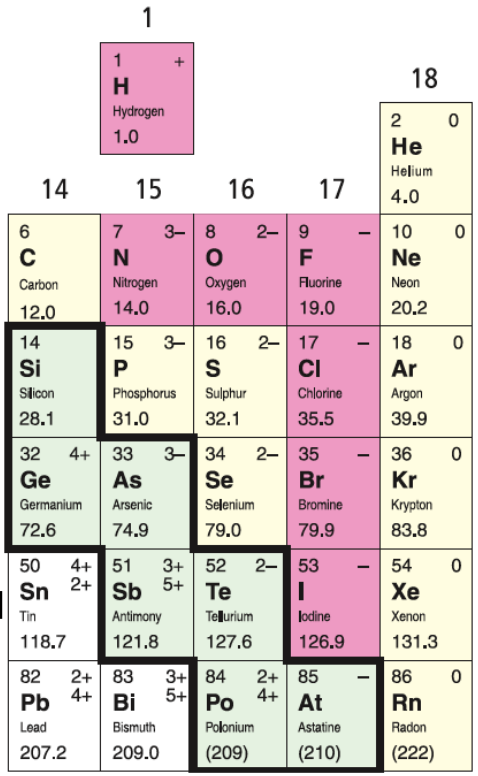
    1 carbon, 4 hydrogen, (2×2) oxygen → 1 carbon, (2×2) hydrogen, (2×1)+2 oxygen

See Page 207

Hints for Writing Word Equations

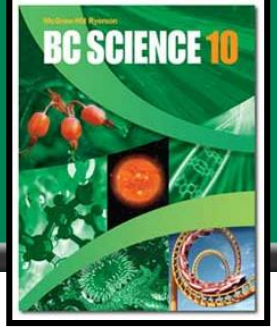


- **Word equations require careful examination to be written correctly.**
  - **The chemical symbol is used for most elements not in a compound.**
    - **Be careful of diatomic and polyatomic elements such as O_2, P_4 and S_8.**
    - **The "special seven" are all diatomic elements**
      - **Make a 7 on periodic table except for hydrogen**
      - **Known as the "gens" …..why?**
      - **H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2**
  - **Memorized Several common covalent molecules containing hydrogen that have common names that you should know.**
    - **For example, methane = CH_4, glucose = $C_6H_{12}O_6$, ethane = C_2H_6, ammonia = NH_3, water H_2O**



See page 208

Strategies for Balancing Equations

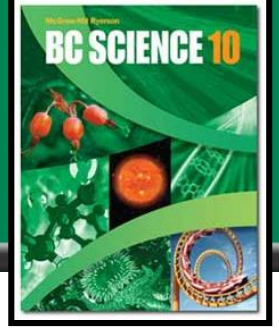


- **Balance chemical equations by following these steps:**
  - **Trial and error will work but can be very inefficient.**
  - **Balance compounds first and elements last.**
  - **Balance one compound at a time.**
  - **Only add coefficients; NEVER change subscripts.**
  - **If H and O appear in more than one place, attempt to balance them LAST.**
  - **Polyatomic ions (such as SO_4^{2-}) can often be balanced as a whole group.**
  - **Always double-check after you think you are finished.**

See pages 209 - 211

Take the Section 4.3 Quiz

Lets try some!



- **Practice Problems pg 211 all**
- **Workbook Pages 77-79 odds**