Read Sections 2.1, 2.2, and 2.3 in the textbook before viewing the slide show.
Unit 6

• Atomic views in Greek times (2.1)

• 18\textsuperscript{th} Century Laws that led to atoms (2.2 – 2.3)
Atomic Views in Greek Times (2.1)

• Contrasting views between Leucippus/Democritus and Aristotle
  • All lived about 300-400 B.C.E.
  • Leucippus/Democritus favored the view that matter was composed of incredibly small particles called atoms.
  • Aristotle believed matter to be continuous – no small particles. This view held for over 2000 years.
Law of Conservation of Mass (2.2)

- Antoine Lavoisier (1743-1794) found through a series of experiments that in any chemical change matter is conserved.
- This is summarized in the Law of Conservation of Mass:
  - Matter is neither created nor destroyed in a chemical change
- Illustration on the next slide
Illustration of Law of Conservation of Mass

and

produce

35.0 g of zinc and 17.1 g of sulfur produce 52.1 g of zinc sulfide

Notice how the sum of the masses of the zinc and sulfur on the left is 52.1 g, the same as the mass of the zinc sulfide produced.
Law of Definite Proportions (2.3)

• Joseph Louis Proust (1754-1826) observed that all specimens of the same compound had the same chemical composition

• Summarized in the Law of Definite Proportions:
  • A compound always contains the same elements in certain definite proportions and in no other combinations

• Illustration on the next slide
Consider three experiments:

- 35.0 g of zinc and 17.1 g of sulfur produce 52.1 g of zinc sulfide
- 35.0 g of zinc and 50.0 g of sulfur produce 52.1 g of zinc sulfide and 27.9 g sulfur
- 45.0 g of zinc and 17.1 g of sulfur produce 52.1 g of zinc sulfide and 10.0 g zinc

Notice that the sum of the masses of zinc and sulfur on the left equals the sum of the masses of products on the right. The composition of the zinc sulfide is always the same, regardless of how much “extra” sulfur or “extra” zinc is put in.
A Further Illustration of the Law of Definite Proportions

• Water is a compound that consists of 8 parts by mass of oxygen for every 1 part by mass of hydrogen. Any sample of water will have that ratio. Consider the samples below.

<table>
<thead>
<tr>
<th>Sample #</th>
<th>Mass oxygen</th>
<th>Mass hydrogen</th>
<th>Mass oxygen/Mass hydrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85 g</td>
<td>10.6 g</td>
<td>8.0</td>
</tr>
<tr>
<td>2</td>
<td>0.36 g</td>
<td>0.045 g</td>
<td>8.0</td>
</tr>
<tr>
<td>3</td>
<td>21.5 g</td>
<td>10.0 g</td>
<td>2.15</td>
</tr>
<tr>
<td>4</td>
<td>1500 lb.</td>
<td>500 lb.</td>
<td>3.0</td>
</tr>
</tbody>
</table>

• Both samples 1 and 2 could possibly be pure water because they have the 8:1 oxygen/hydrogen ratio. Samples 3 and 4 could not possibly be water because they do not have the 8:1 oxygen/hydrogen ratio.
Law of Multiple Proportions (2.4)

• John Dalton (1803) extended Proust’s Law of Definite Proportions to recognize that atoms can combine in more than one ratio leading to:
  • The Law of Multiple Proportions:
    • Elements can combine in more than one set of proportions, with each proportion corresponding to a different compound.
  • Illustration on the next slide
Illustration of Law of Multiple Proportions

• As mentioned earlier, water is a compound that consists of 8 parts by mass of oxygen for every 1 part by mass of hydrogen. If the mass ratio is not 8 parts oxygen to 1 part hydrogen, the material being considered is not water.

• However, oxygen and hydrogen can also form a compound in which the ratio by mass of oxygen to hydrogen is 16:1 (this compound is hydrogen peroxide).

• Thus hydrogen and oxygen can combine in two ratios forming two distinct compounds. This is an illustration of the Law of Multiple Proportions.

• These fixed mass ratios ultimately led to John Dalton’s Atomic Theory – the topic of Unit 7.