Up to now...

- There are 3 types of **subatomic** particles – protons, neutrons & electrons
- The # of protons is called the **atomic #**
- **# of protons** (atomic #) *defines the element*
- **Neutral atoms** have the exact same number of **protons as electrons**

Nervous? – watch the “counting particles” video
NOTES:
There are two different naturally occurring types of chlorine atoms, represented by Cl-35 and Cl-37.
➢ *What is the difference between these two?!*

<table>
<thead>
<tr>
<th>Element</th>
<th>Mass Number</th>
<th>Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cl-35</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>Cl-37</td>
<td>37</td>
<td>20</td>
</tr>
</tbody>
</table>

Isotopes = *Same element with different numbers of neutrons!*

So... What are three things that are the *same* between atoms that are isotopes?
1. *Same # protons (same element!)*
2. *Same atomic number*  
3. *Same # electrons*  

What are two things that are different?
1. *# of neutrons*  
2. *Mass number*  

Remember:
★ 1. The number of **protons** defines the **element**.
★ 2. The number of **neutrons** determines which **isotope** of a given element you have.
1. **Atomic Mass**: We calculate the **weighted average of the masses of all isotopes of an element**.

   - **Atomic Mass**
   - **Mass Number**

   - Floating text: “% natural abundance”

2. Look at a **Periodic Table**. Atomic mass is given to a number of decimal places. This is because, in most cases, there are a number of naturally occurring isotopes.

   - Mostly C-12
   - Some C-14

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**Tutorial on Classroom**

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**AVERAGE atomic mass**

**atomic #**
SchoolTool analogy

• 80% grades
  – 75
  – 72

• 20% grades
  – 95
  – 98
  – 90
  – 91

Average will be closer to... 70s
2. Look at a **Periodic Table**... Atomic mass is given to a number of decimal places. This is because, in most cases, there are a number of naturally occurring isotopes.

![Periodic Table](image)

**Example #1:**
A natural sample of C (atomic mass = 12.011 amu) is a mixture of C-12 (98.89%) and C-14 (1.11%).

Carbon's atomic number is **6**, has an average atomic mass of **12.011** amu, and carbon's most common isotope has a mass number of **12** amu.

Therefore, the most common type of carbon atom has **6** protons, **6** neutrons and **6** electrons. Another naturally-occurring isotope of carbon is C-14, but it is rare in comparison to the amount of C-12 in nature.
Example #2:

A natural sample of N is a mixture of N-14 and N-15. Based on the atomic mass given on the periodic table, which isotope of nitrogen is more abundant?

\[
\begin{align*}
\text{N-14} & \quad \text{Avg atomic mass} = 14.0067 \\
\text{N-15} & \\
\end{align*}
\]

N-14 must be more abundant