

# 18.2 Comparing Atoms



**Figure 18.8:** *How does one kind of atom differ from another?*



# How does one kind of atom differ from another?

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- Number of protons determines an element.
- Even if atoms bond or break apart, number of protons will always be the same.

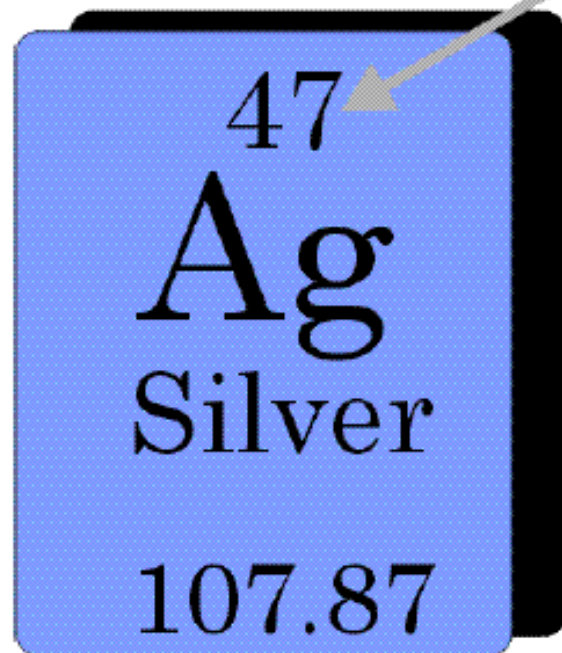
# What is the atomic number?



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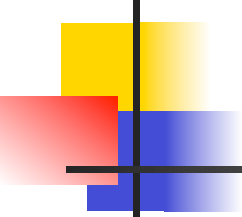
- Atomic number is number of protons an atom contains.
- Atomic numbers start at one, with hydrogen, and go up by ones until element 111, unununium.

Atomic number  
The number of  
protons



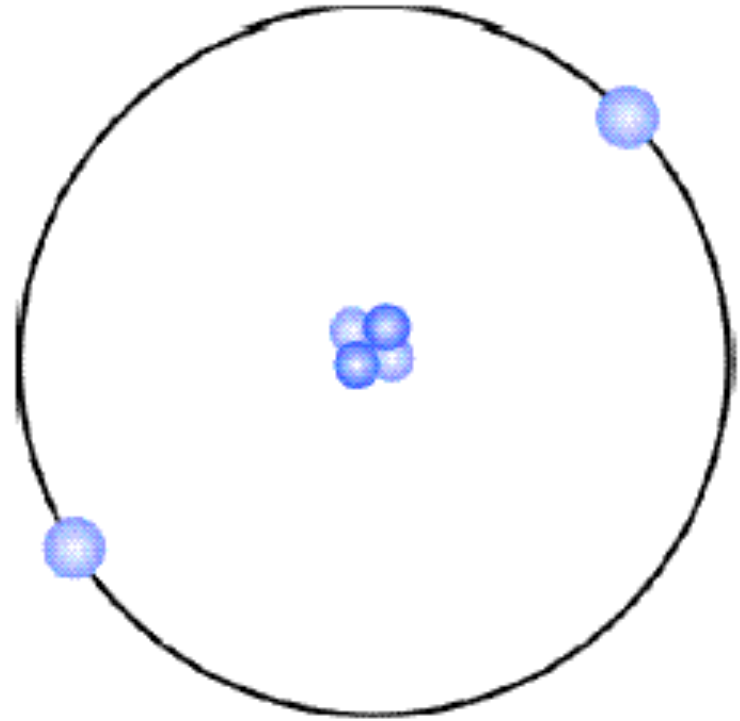
**Figure 18.9:** *Look at the periodic table in the back cover of this book. The atomic number tells you the number of protons in an atom.*

# MASS NUMBER



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- The mass number is equal to the total number of protons plus neutrons.



**Figure 18.12:** *This atom has 2 protons and 2 neutrons. What is the element? What is its mass number?*

# ATOMIC MASS

- Atomic mass is the average of all the known isotopes of an element.

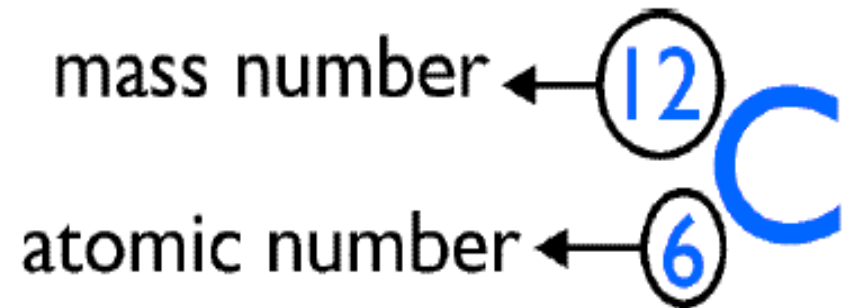
Atomic mass  
increases by amounts  
greater than one



**Figure 18.10:** *The difference between the atomic number and atomic mass is due to the number of neutrons.*

# What are isotopes?

- **Atoms of the same element that have different numbers of neutrons.**

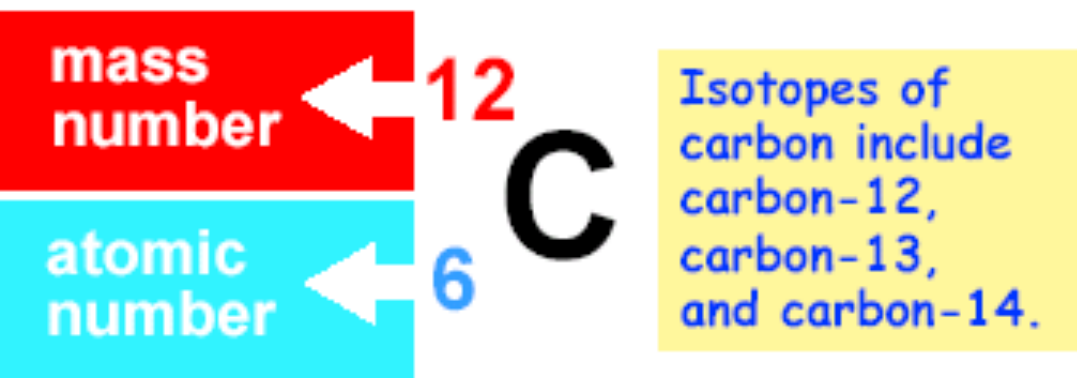


**Figure 18.11:** *The isotope notation for carbon-12.*

# Isotopes

## Mass Number and Atomic Number

An atom of carbon-12 has 6 protons (the atomic number is 6), 6 neutrons, and 6 electrons.



How many neutrons are present in an atom of carbon that has a mass number of 14?

Find the numbers of neutrons:  
The mass number is the number of protons ( $p$ ) plus the number of neutrons ( $n$ ).

- 1 You are asked for the number of neutrons.
- 2 You are given that it is carbon-14. Carbon has 6 protons.
- 3 The relationship is  $n + p = \text{mass number}$
- 4 Solve for  $n$ .  
 $n = \text{mass number} - p$
- 5 Plug in numbers and get answer.  
 $n = 14 - 6 = 8$

There are 8 neutrons in a carbon-14 nucleus.



# What holds the nucleus together?



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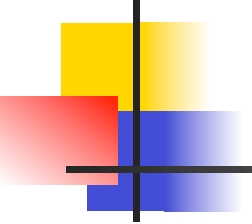
- **The nucleus contains positive protons and neutral neutrons. It stays together because of a force stronger than the repulsion of the protons, the strong nuclear force.**

# How are electrons arranged in atoms?

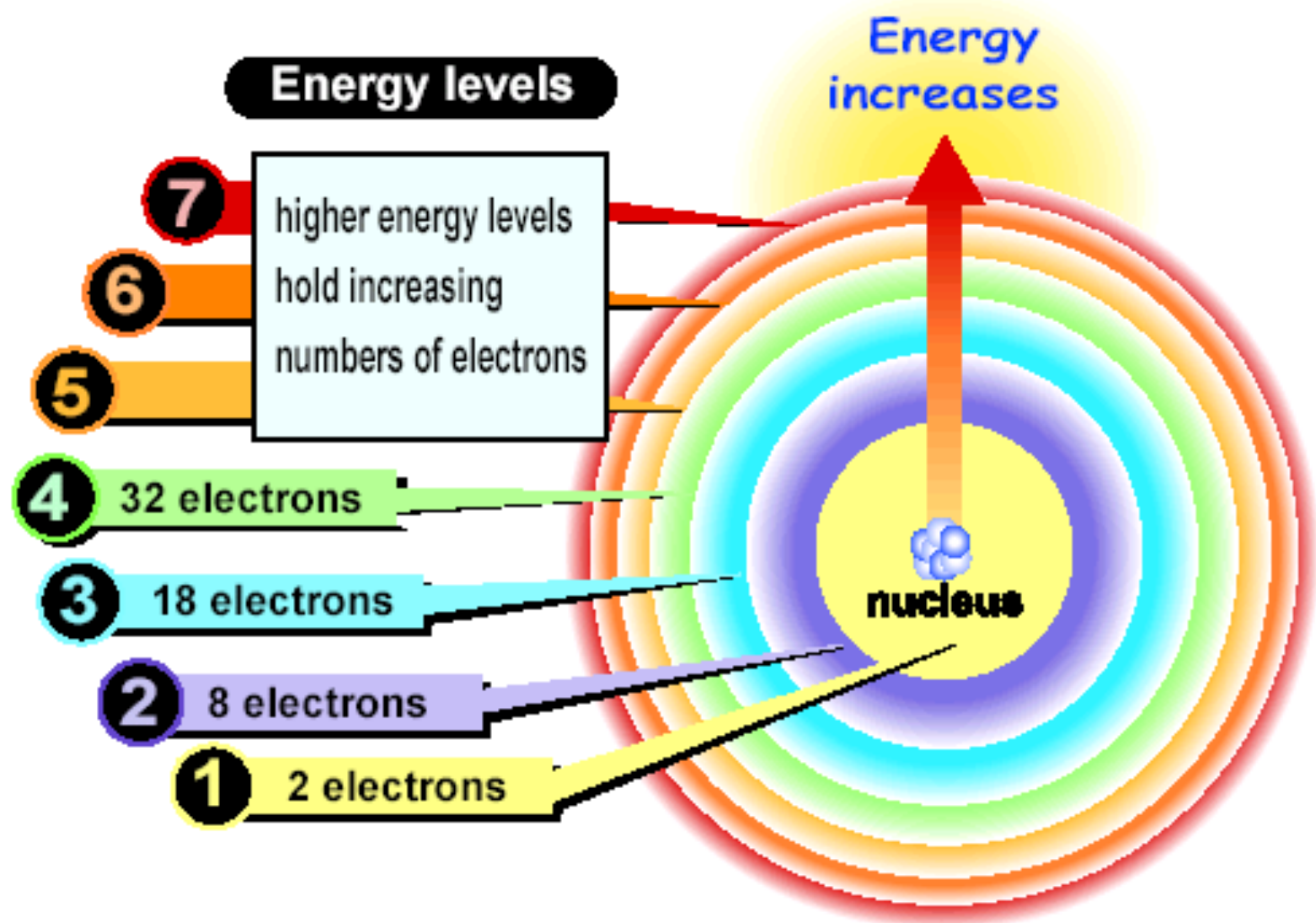


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- **Electrons (e<sup>-</sup>) are arranged into energy levels (E.L.), that hold a specific number, within the electron cloud.**
- **The farther e<sup>-</sup> are away from the nucleus, the higher the energy state.**

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- **Electrons can absorb energy to “jump” to a higher E.L. When they fall back to their normal level, they release light in a characteristic frequency.**
  - **Energy levels can overlap and are subdivided into orbitals.**

# Energy Levels in an Atom



Electrons occupy energy levels around the nucleus. The farther away an electron is, the more energy it possesses.