4-4: Nonmetals, Inert Gases, and Semimetals

8th Grade Physical Sciences
Nonmetals

• A nonmetal is an element that lacks most of the properties of a metal.

• Most nonmetals are poor conductors of electric current and heat.

Carbon
Nonmetals

- Solid nonmetals are dull and brittle.
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Nonmetals

- Four nonmetals are gases at room temperature.
- Two that you breathe are Nitrogen (N) and Oxygen (O).
Nonmetals

- Carbon (C), iodine (I), and sulfur (S) are solids at room temperature.
- Bromine (Br) is the only nonmetal that is liquid at room temperature.
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Physical Properties

- Summary: nonmetals are
  1. Dull (not shiny)
  2. Brittle (not malleable or ductile)
  3. Insulators (poor conductors)

OPPOSITE OF METALS
Chemical Properties

- Atoms of nonmetals usually gain or share electrons when they react with other atoms.
Chemical Properties

- Nonmetals usually only share electrons with other nonmetals when they react.
Group 14-17

- Groups 14-17 are a mix of metals and nonmetals.
- Group 14, called the **Carbon Family**, has carbon at the top – the only nonmetal.
- This family gains or shares 4 electrons.
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Group 14-17

- Most fuels we burn contain carbon, like coal, gasoline, natural gas, and wood.
- All life is made of complex carbon molecules.
Group 14-17

- Group 15 is the **Nitrogen Family**.
- This family contains two nonmetals, nitrogen and phosphorous.
- They react by gaining or sharing 3 electrons.
• Nitrogen occurs in pairs, as N\textsubscript{2}. The atmosphere is 80% nitrogen.

• When elements exist in pairs, we call them diatomic molecules.

• Nitrogen is not very reactive. Bacteria can use N\textsubscript{2} to make nitrogen compounds — fertilizer (Ammonia — NH\textsubscript{3})
Phosphorous is more reactive than nitrogen, so it is not found alone in nature.
Group 14-17

- Group 16 is the Oxygen Family.
- This family contains three nonmetals, oxygen, sulfur, and selenium.
- They react by gaining or sharing 2 electrons.
Like $N_2$, $O_2$ (oxygen) is a diatomic molecule you are breathing now.

Sometimes it forms a triatomic molecule called ozone ($O_3$).

$O_2$ reacts with just about everything – called oxidation.
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Group 14-17

• It is the most abundant element in the earth’s crust (quarts - $\text{SiO}_3$)
• Sulfur is the other common element.

• Rotten eggs smell because of a sulfur compound that forms.

• Sulfur is used in the manufacturing of rubber bands and tires.
Group 14-17

- Group 17 is the Halogen Family.
- This family contains fluorine, chlorine, bromine, iodine, and astatine.
- They react by gaining or sharing 1 electron.
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Group 14-17

- Halogen means “salt forming”.
- They are very reactive, and uncombined elements are dangerous to humans.
- Fluorine even burns with powdered glass.
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Group 14-17

- Chlorine is also very dangerous.
- Small amounts are used to kill bacteria and keep pools clean.
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Group 14-17

- Halogenes, when combined, are safe.
- Samples: Salt (NaCl), Fluoride Toothpaste, Calcium Chloride (CaCl).
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**Group 18 – Inert Gases**

- Group 18 contains inert gases.
- Inert gases don’t usually react to make compounds.
- They tend to be unreactive.
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Group 18 – Inert Gases

- These are also called noble gases.
- Neon lights use these gases – even though they may have argon or other gases in them.
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**Group 18 – Inert Gases**

- All inert gases are in the earth’s atmosphere – in small amounts.
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Group 1 – Hydrogen

- Hydrogen is in a class of its own.
- It is the simplest atom.
- 90% of the universe is hydrogen, but only 1% of earth is hydrogen.
Semimetals

- **Semimetals** lie between the metals and the nonmetals.
- They have properties of both metals and nonmetals.
- All of them are solids at room temperature.

Germanium (Ge)
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Semimetals

- They conduct electricity under certain conditions, but not others.
- We call these semiconductors – they are used to make computer chips and transistors.

Silicon (Si) Wafer

Semiconductor
Nonmetals have properties opposite of metals.
They are brittle, dull, and bad conductors.
They gain or share electrons when they react.
Halogens are dangerous to human health when alone, but in compounds, they can be tasty, like “salt – NaCl”.
Inert gases don’t react with anything – used in neon lights.
Semimetals have properties of metals and nonmetals – used for computer chips.