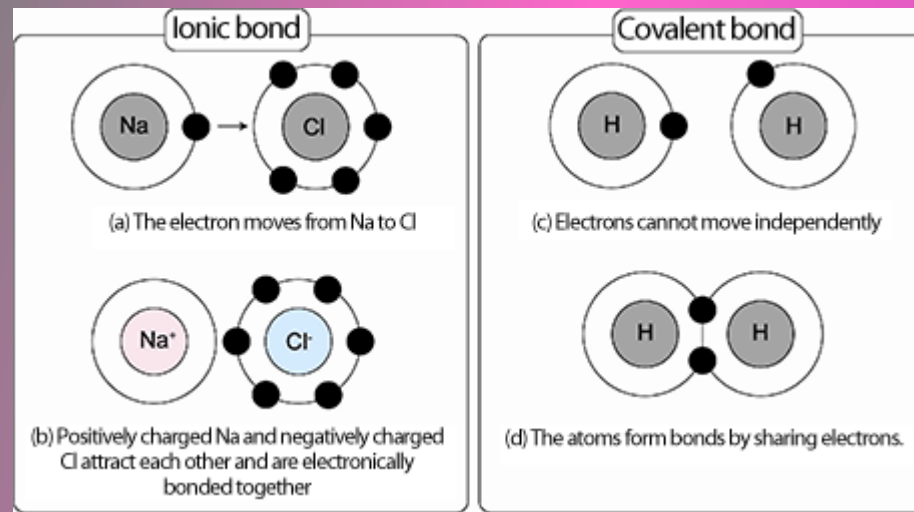
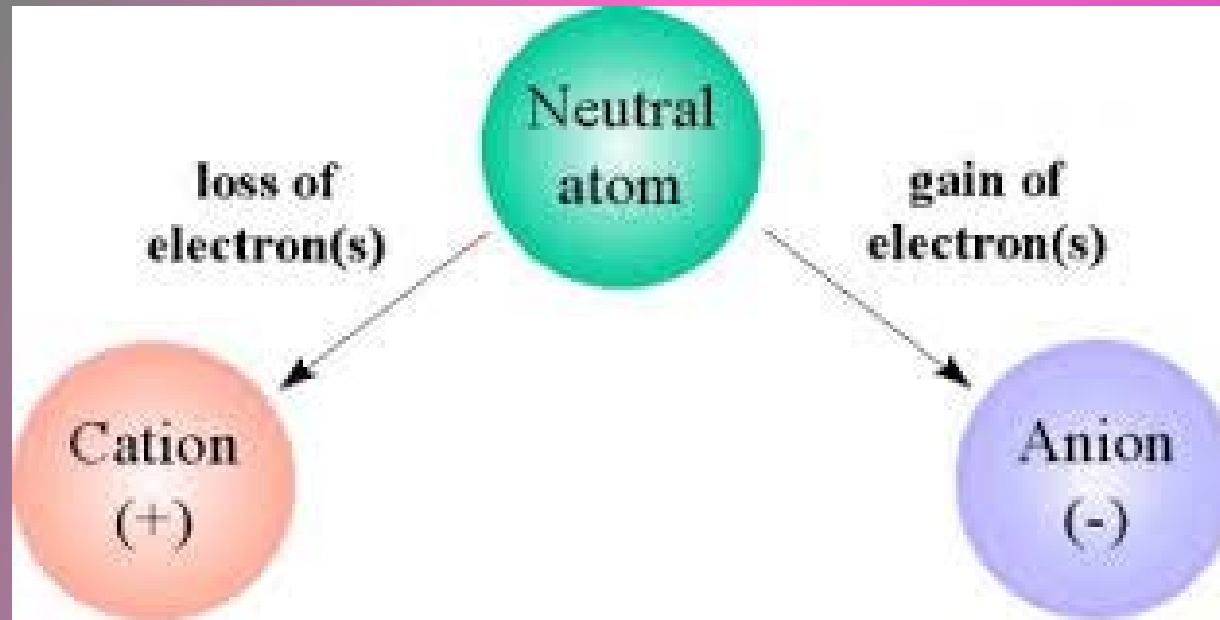


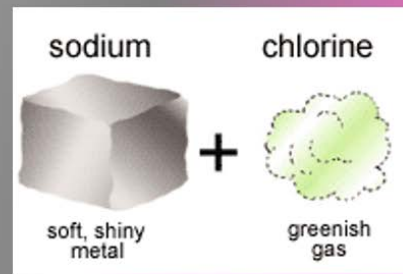
# How do Elements Combine to Form Compounds?



# ACTIVITY

- What is it made of?





Think about the calcium atom vs the calcium ion



# Compounds account for the huge variety of matter on Earth

All the compounds that exist on Earth are built from elements

- 118 elements are on the periodic table; only 80 commonly form compounds
- 10 million known compounds; billions of possible



Figure 2.22: Hydrogen and carbon alone can be combined in millions of ways to make compounds with very different properties.



# Discussion

1. Distinguish between elements and compounds.
2. Compare the number of elements with the number of compounds on Earth.

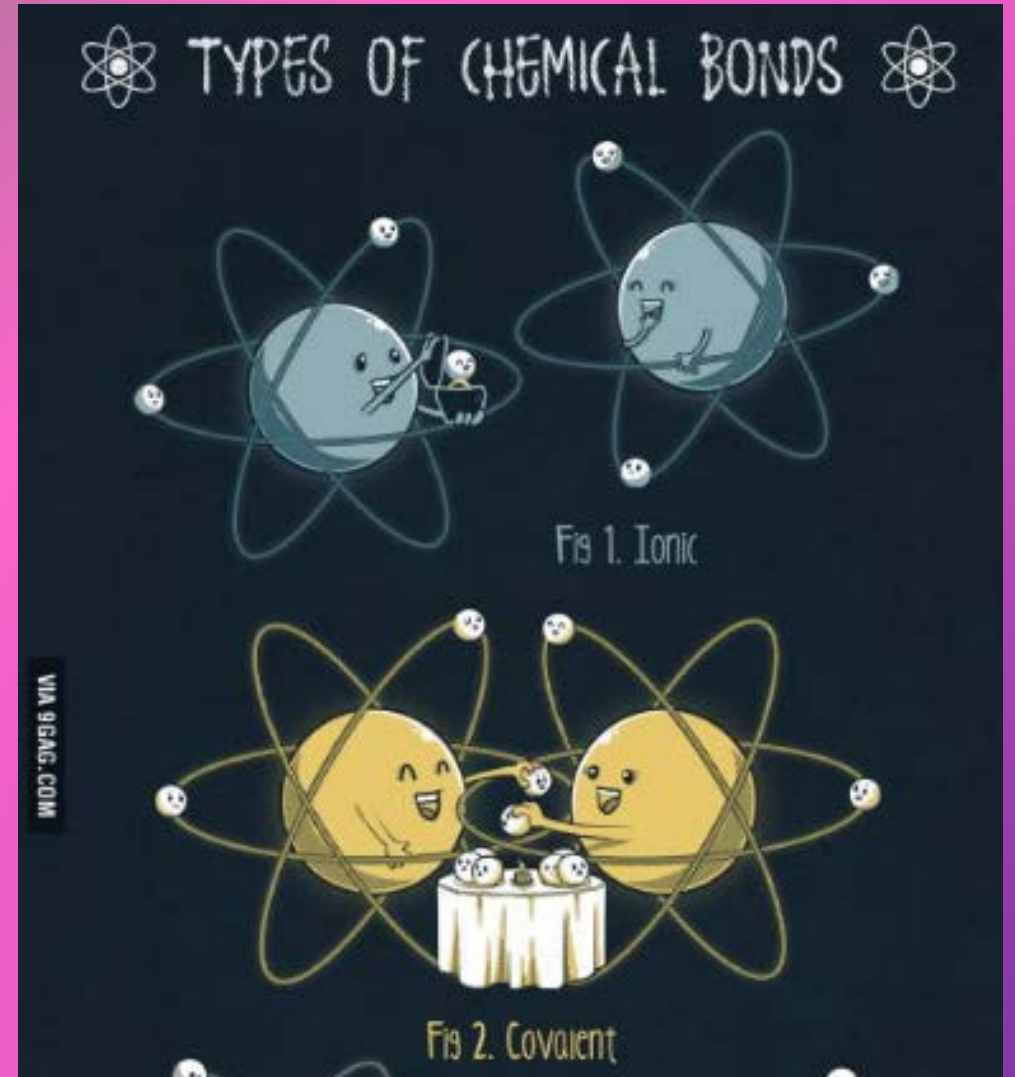
# Lab

- Comparing Atoms and Ions
  - In partners of 2, I have chosen for you so check the list



# Types of Compounds

- Ionic Compounds
- Covalent compounds

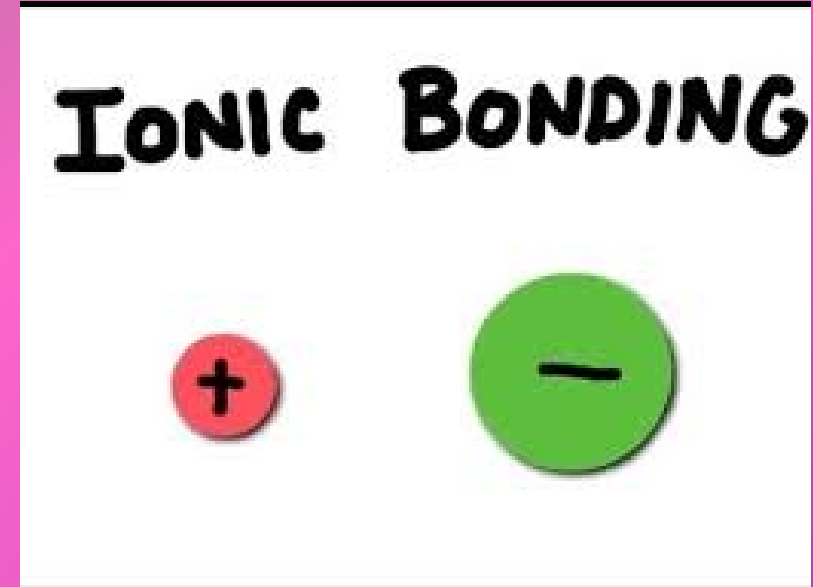




# Ionic compounds are made of ions

**Ionic compound:** a compound made of oppositely charged ions

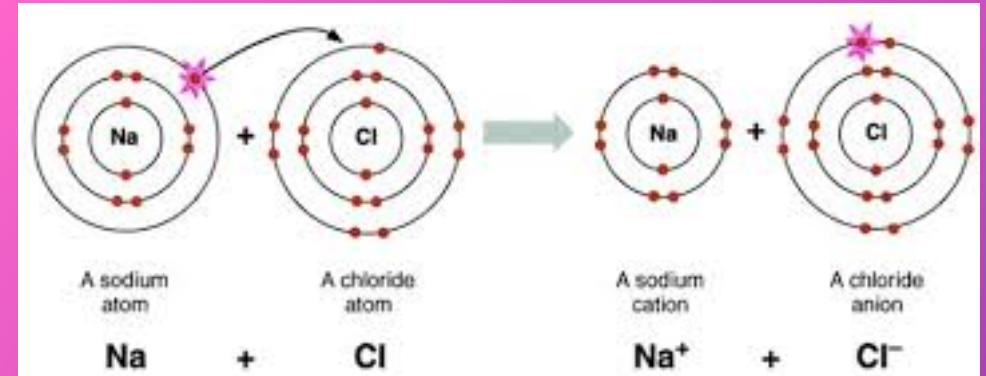
- Ions are held together with **ionic bonds** (a strong attraction between oppositely charged ions)
- Ionic bonds are very strong



# Formation of Ionic Compounds

Binary ionic compounds:

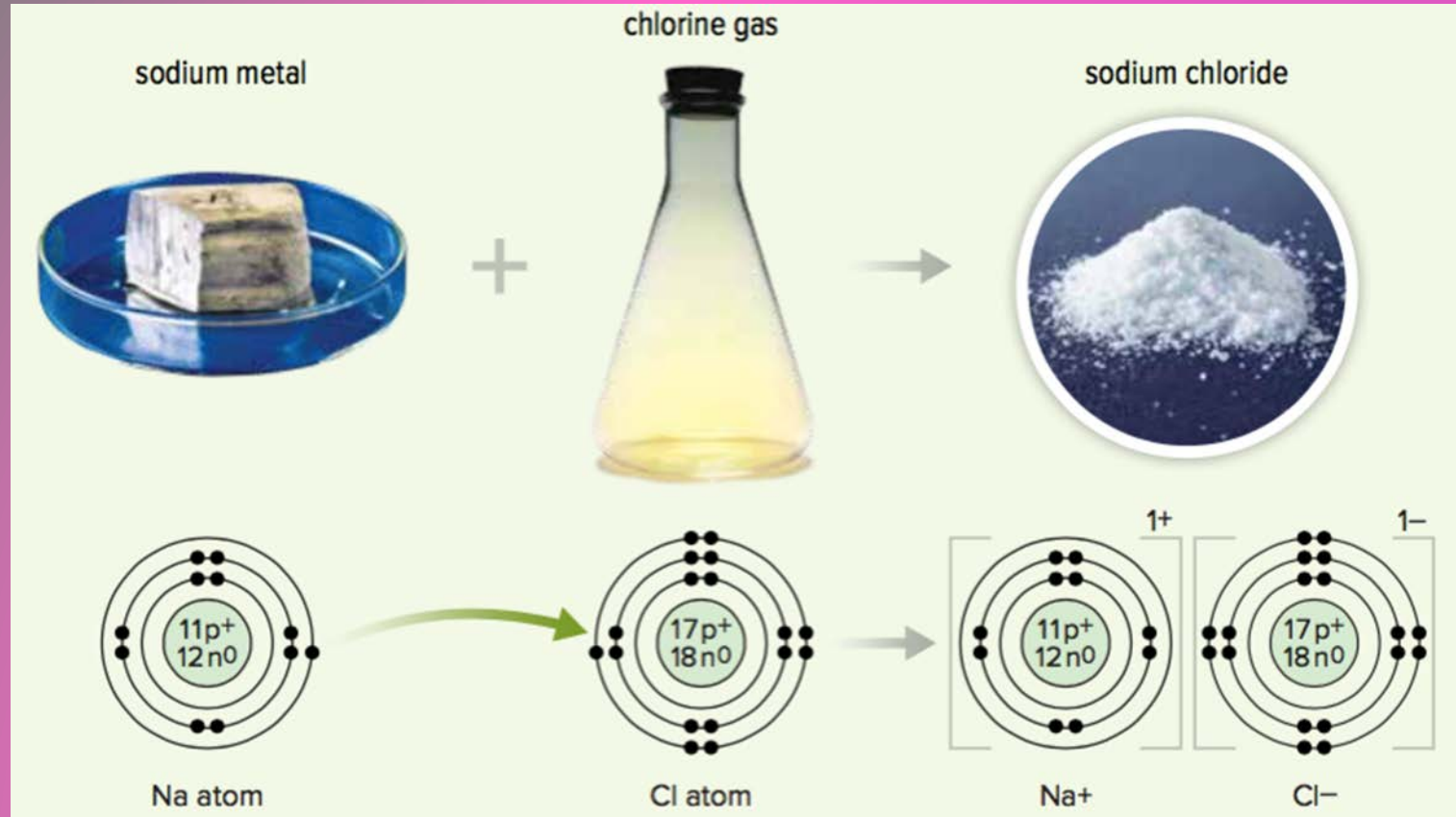
- Contain two elements (metal and a non-metal)
- Form when atoms of the metal element lose one or more electrons to atoms of the non-metal element
- Results in the formation of ions that have full valence shells
- Stability of a full valence shell drives the formation of compounds



# Example of an Ionic Compound

## Sodium chloride (salt)

- Sodium (metal) reacts with chlorine (gas)
- Forms when sodium atoms each transfer one electron to chlorine atoms
- Each sodium atom becomes positive ion ( $\text{Na}^+$ )
- Each chlorine atom becomes a negative ion ( $\text{Cl}^-$ )
- Valence shells of both the sodium ion ( $\text{Na}^+$ ) and chlorine ion ( $\text{Cl}^-$ ) are full



# The Structure of Ionic Compounds

- Ionic compounds consist of positive and negative ions arranged in regular repeating patterns called *lattices*
- Example: Sodium chloride
  - Sodium chloride crystals consist of sodium and chloride ions arranged in a lattice

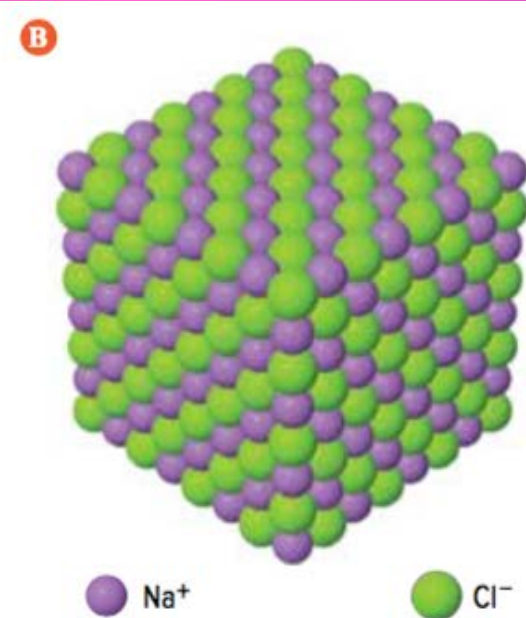


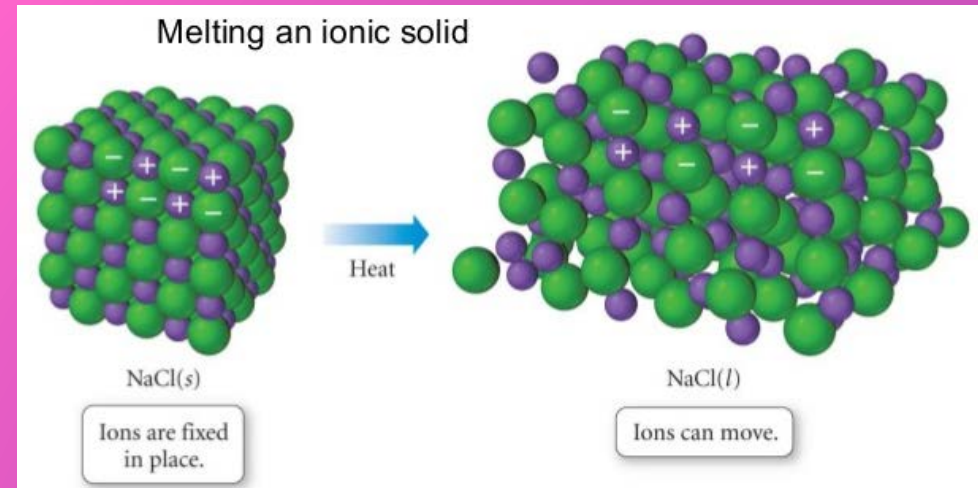
Figure 2.24: A) Cubic structure of sodium chloride crystals. B) Sodium chloride crystals consist of sodium and chloride ions arranged in a repeating pattern.



# Properties of Ionic Compounds

Ionic compounds have high melting points

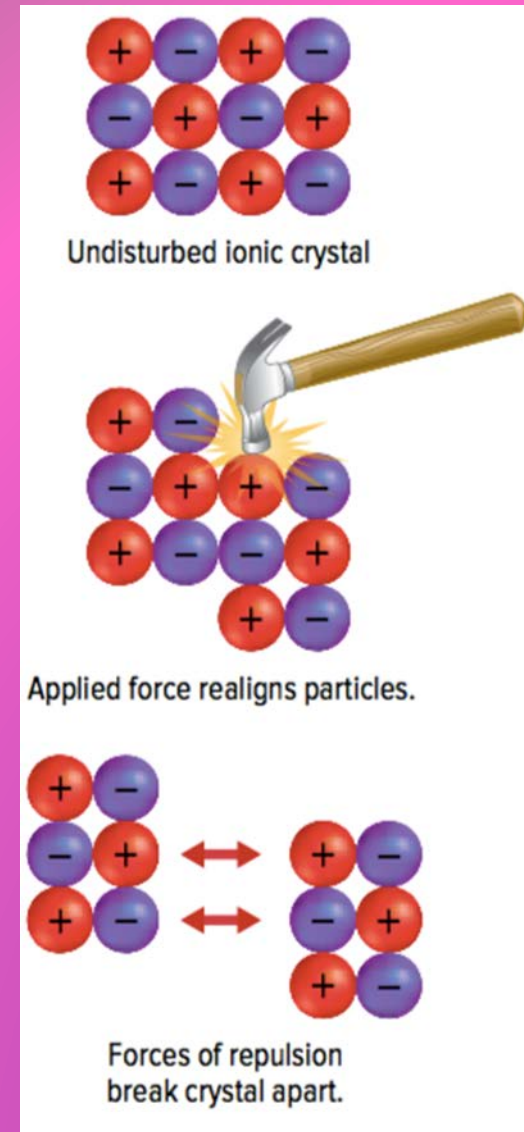
- Melting requires breaking ionic bonds: the strong forces holding the ions together in the lattice structure
- A large amount of energy is required to break ionic bonds
- Example: Melting point of sodium chloride is  $801^{\circ}\text{C}$





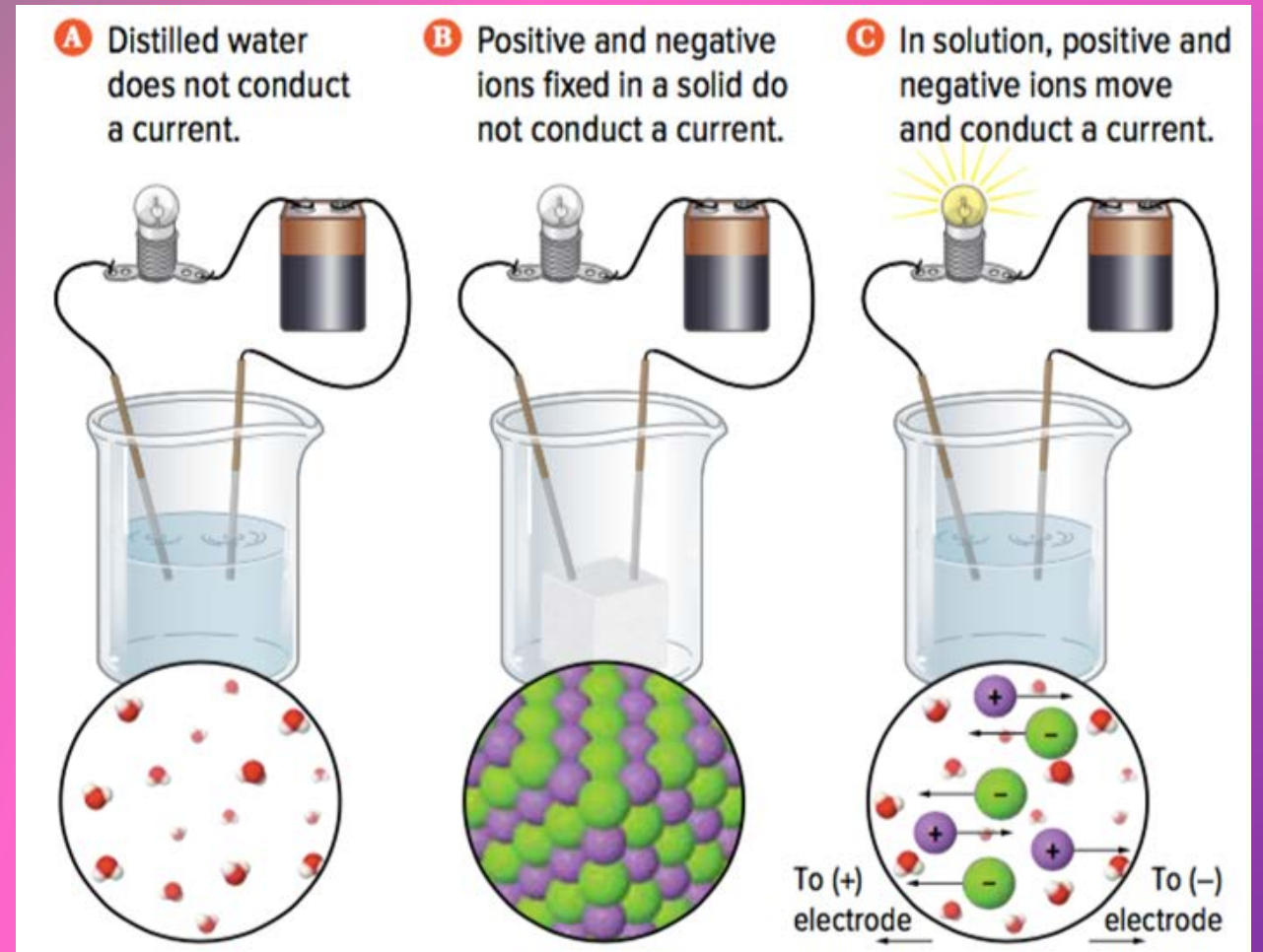
Ionic compounds are hard and brittle

- Ionic solids are hard because ionic bonds are very strong
- When enough force is applied, ions will shift
  - Causes ions with the same charge to be close together
  - Results in repulsive forces that break the solid apart



Ionic compounds conduct electric current when liquid or dissolved

- Electric current: the flow of charged particles
- Solid form: do not conduct electric current since ions are held rigidly in place
- Dissolved or liquid form: ions are free to move, and can conduct electric current



# Discussion

1. What is an ionic bond?
2. Describe the formation of magnesium oxide from magnesium and oxygen. Draw the Bohr Diagram for before and after
3. Binary ionic compounds form when which two types of elements react?

# Covalent compounds are made of molecules

- **Covalent bond:** a strong attraction between atoms that forms when atoms share valence electrons
- **Covalent compound:**
  - Made of molecules
  - **Molecule:** a particle made up of two or more neutral atoms (usually non metals) bonded together by covalent bonds

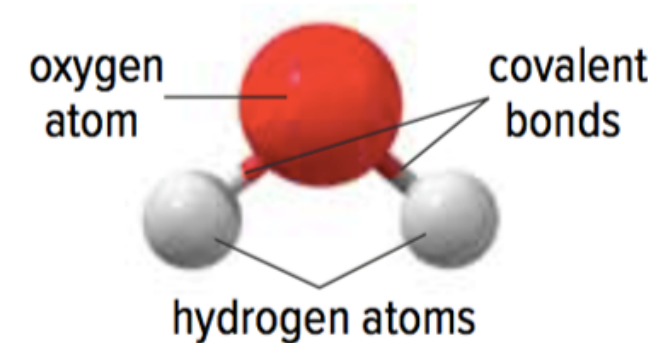
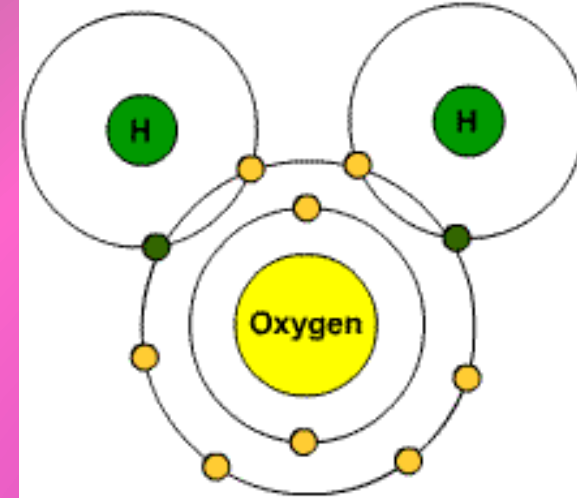


Figure 2.27: Water molecules consist of two hydrogen atoms bonded to one oxygen atom.

# Covalent Bonds: Tug of War

Covalent bonds are similar to a game of tug of war

- Each team (atom) tries to pull the rope (shared electrons) toward itself
- Neither side wins, and the bond is the rope that connects them

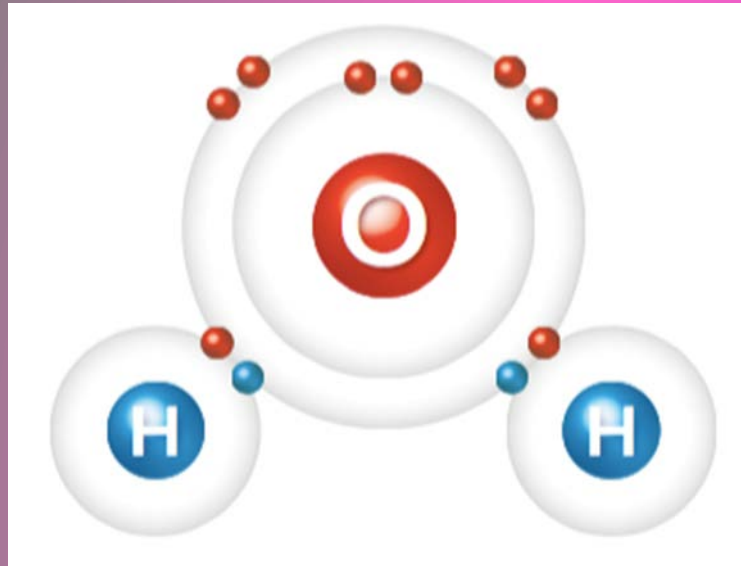




# Achieving Stability by Sharing Electrons

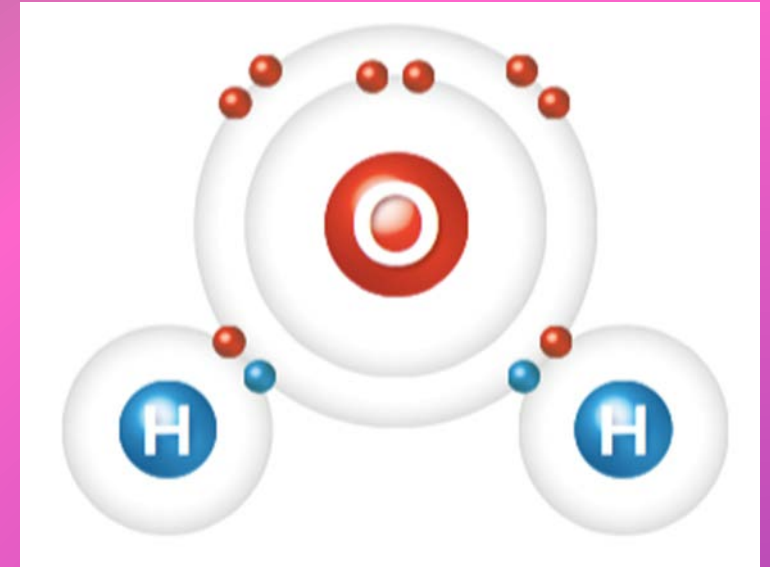
Formation of a covalent compound is based on achieving stability with a full valence shell

- Instead of transferring electrons (ionic) Non-metals in covalent compound share electrons to get a full valence shell



# Example: Water

- Covalent bond is formed from a single pair of shared electrons
  - Each hydrogen atom contributes a single electron to the shared pair of electrons
  - Each oxygen atom contributes a single electron to the shared pair of electrons
- Hydrogen atoms achieve a full valence shell of 2 electrons
- Oxygen atom achieves a full valence shell of 8 electrons



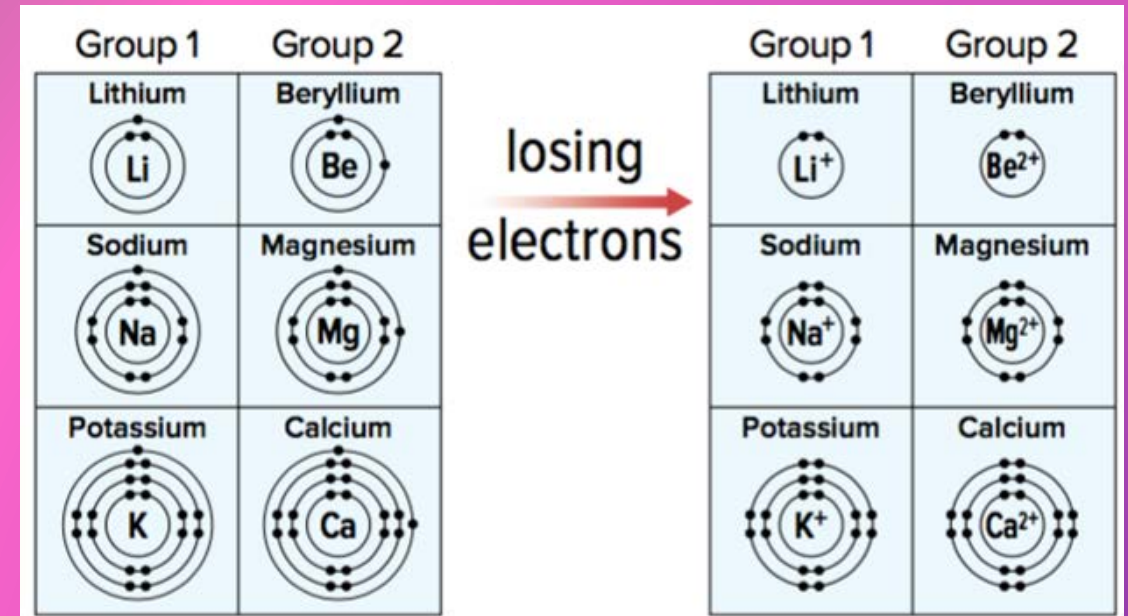
# Three Ways That Atoms Become Stable (Achieve a Full Valence Shell)

- Metal atoms can lose electrons to achieve a full valence shell
- Non-metal atoms can gain electrons to achieve a full valence shell
- Non-metal atoms can share electrons with other non-metal atoms to achieve a full valence shell

# Metal atoms lose electrons

Metals can lose electrons to achieve a full valence shell

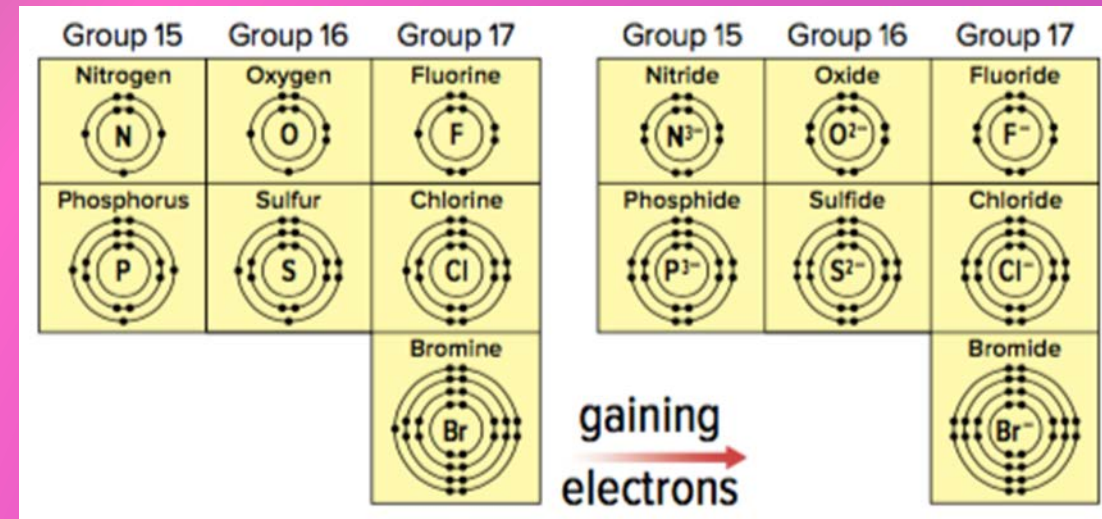
- Form positive ions because they lose electrons
- Retain the same number of protons in the nucleus
- Example:
  - Group 1 metal ions have a 1+ charge because they have lost one electron
  - Group 2 metal ions charge: 2+
  - Group 3 metal ions charge: 3+



# Non metals gain electrons

Non-metal atoms can gain electrons to achieve a full valence shell

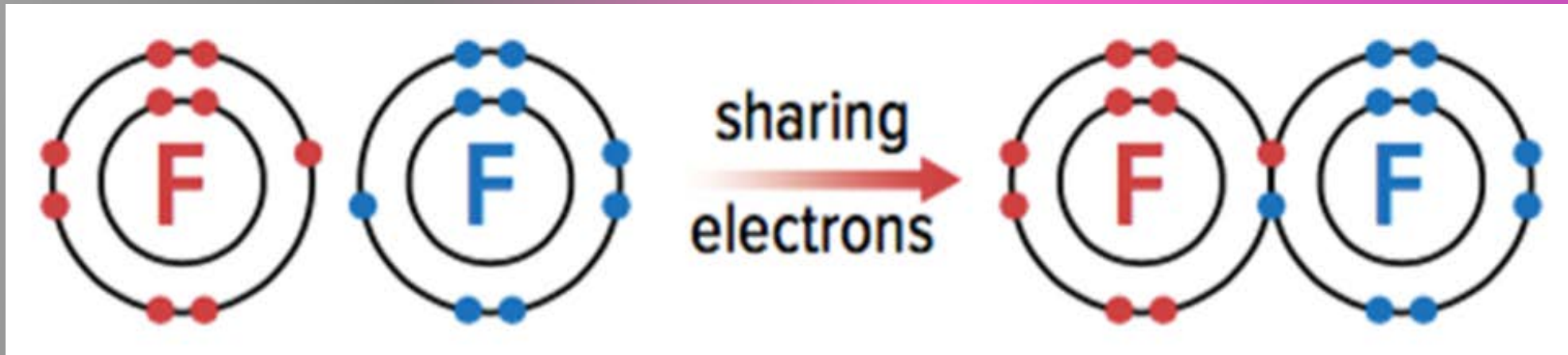
- Form negative ions because they gain electrons
- Non-metal ions end in *-ide*
- Example:
  - Group 17 non-metals ion charge is 1- because they have gained one electron
  - Group 16 non-metal ions charge: 2-
  - Group 15 non-metal ion charge: 3-





# Non metals share electrons

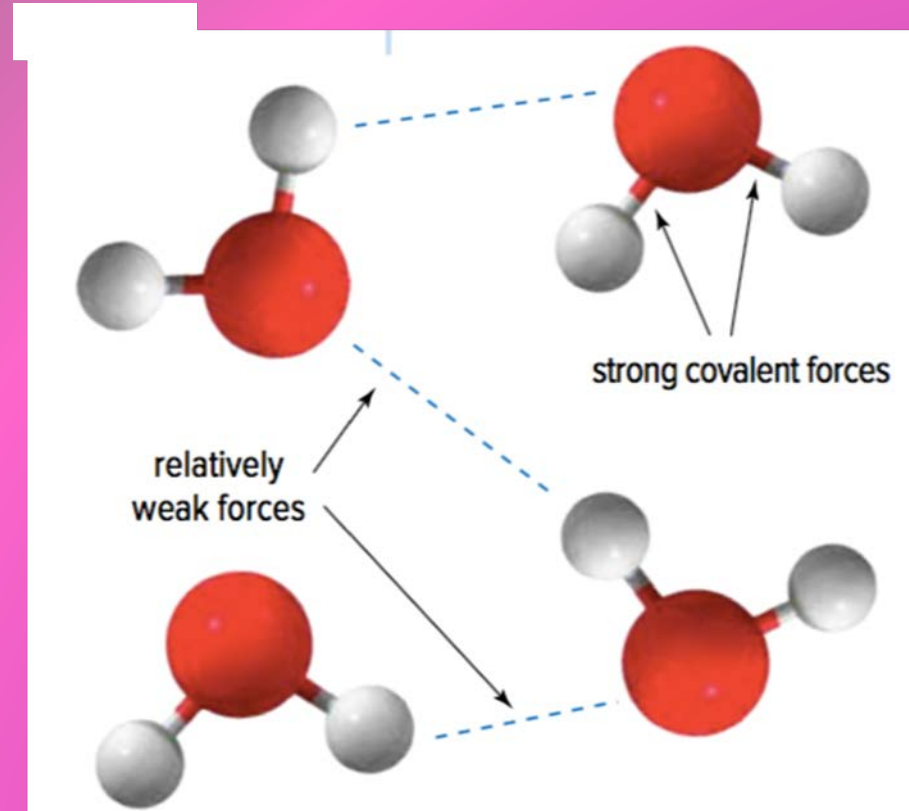
- Non-metal atoms can share electrons with other non-metal atoms to achieve a full valence shell



# Properties of Covalent Compounds

Have low melting points:

- Forces holding atoms together in a molecule are strong
- Bond that attract molecules to one another are relatively weak; therefore, not as much energy is needed to “break” the weak bond melt at low temperatures



# Covalent Compounds

- Relatively soft: Weak forces between molecules mean that it's easier for molecules to move and shift
- Poor conductors: covalent compounds do not have free electrons, and they are poor conductors of electric current and heat



Figure 2.32: Covalent compounds are poor conductors of electric current. This makes them useful as insulating covers for computer cables.

# Discussion Questions

1. What type of bond is formed when two non-metal atoms share electrons?
2. What is a molecule?
3. Why do covalent compounds tend to have low melting points?

# Covalent bonding also occurs in elements: HOFBrINCl

Seven elements are made up of molecules held together with covalent bonds in their natural state

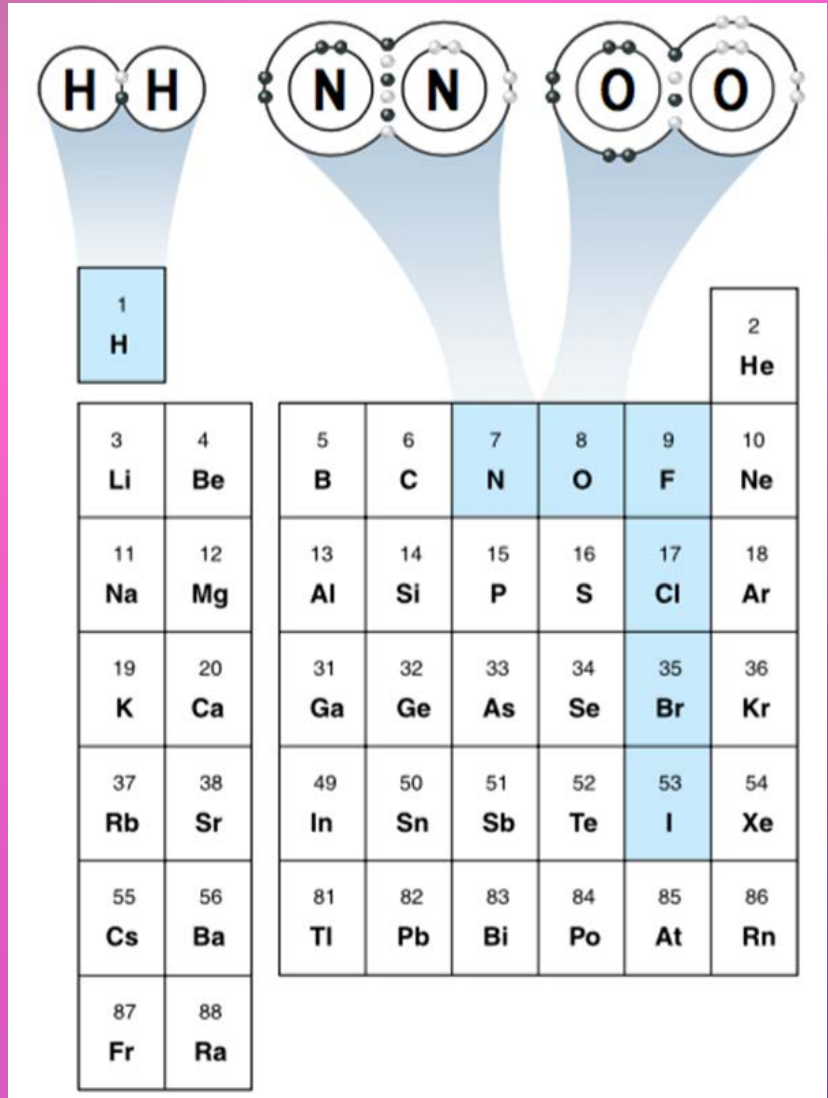
- These elements are known as Diatomic (two atoms)
- They do not exist alone, they are either bonded to itself or another atom.





# HOBrINCl

- $\text{H}_2$ ,  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$ : Two atoms share one electron in a covalent bond
- $\text{O}_2$ : Two atoms share two pairs of electrons to form two covalent bonds (*double bond*)
- $\text{N}_2$ : Two nitrogen atoms share three pairs of electrons to form three covalent bonds (*triple bond*)



1 H						2 He	
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra						

# Time out

- Pg 87-88, 90-92

