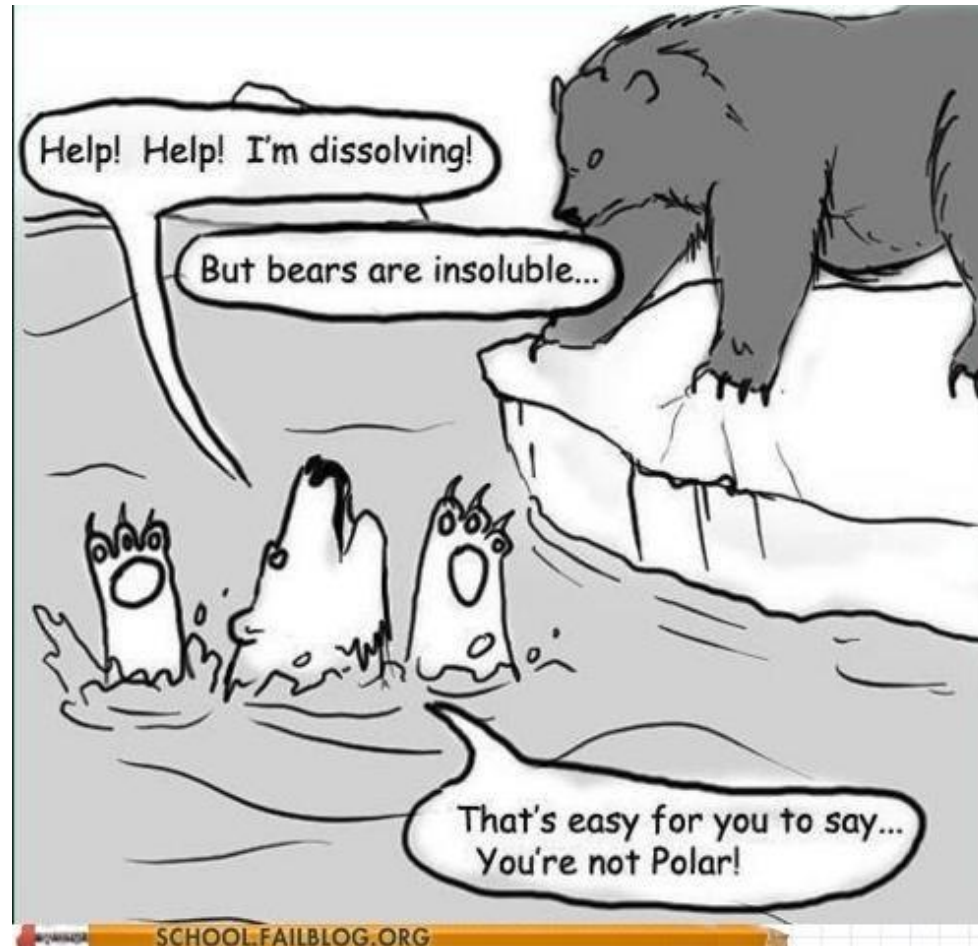


Solubility Equilibrium

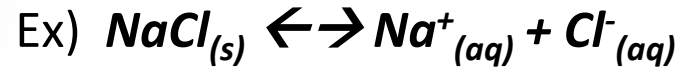


Outcomes:

- Write solubility product expressions (K_{sp}) from balanced equations for salts with low solubility.
- Solve problems involving K_{sp}

Solution Equilibrium...

When a solution is **SATURATED**, there is an **EQUILIBRIUM** between the **DISSOLVED SOLUTE** and **SOLID SOLUTE** particles.



This is a **DYNAMIC EQUILIBRIUM** since the **RATE** of dissolving = **RATE** of crystallization.

The Solubility Product (K_{sp}):

- Some substances that were thought to be **INSOLUBLE** in water, were later found to be **SLIGHTLY** soluble.
- These substances will form a **SATURATED** solution quickly and develop a solution **EQUILIBRIUM**

Solubility Constant (K_{sp})

Example:



The **EQUILIBRIUM LAW** would be:

$$K_{eq} = \frac{[\text{Ag}^+][\text{Cl}^-]}{[\text{AgCl}]}$$

The amount of **AgCl** is **CONSTANT** (a **SOLID**), so...

$$K_{eq} = [\text{Ag}^+][\text{Cl}^-]$$

We can replace the constants with a new constant **K_{sp}**, the **SOLUBILITY PRODUCT CONSTANT**.

$$K_{sp} = [\text{Ag}^+][\text{Cl}^-]$$

Solubility Constant (K_{sp})

In general, for any ionic compound dissolving:



The **SOLUBILITY PRODUCT** is:

$$K_{sp} = [A^+]^a [B^-]^b$$

Notes on K_{sp}:

- Is **TEMPERATURE** dependent (**25°C** is the normal K_{sp}).
- Applies only in a **SATURATED** solution at **EQUILIBRIUM**.

K_{sp} Examples:

1. Write the dissociation equation and K_{sp} expression for calcium phosphate.
2. At equilibrium, the concentration of calcium ions and phosphate ions are $1.3 \times 10^{-5} \text{M}$, calculate K_{sp}.

Solubility:

- **SOLUBILITY** and **SOLUBILITY PRODUCT** are two **DIFFERENT** things.
- **SOLUBILITY** is the **MAXIMUM AMOUNT** of **SOLUTE** that can dissolve in a certain amount of **SOLVENT**.
- **SOLUBILITY PRODUCT** is an **EQUILIBRIUM CONSTANT**.
- If we know the solubility (mol/L or g/L) of a substance, we can find K_{sp} (and vice versa)

Solubility & Ksp Examples:

1. The solubility of PbF_2 is 0.466g/L. Find the Ksp.
2. The solubility of BaSO_4 is 9.09×10^{-4} g per 100mL of solution Calculate the Ksp of BaSO_4 .

Solubility & Ksp Examples:

3. Find the solubility of magnesium hydroxide in g/L if $K_{sp} = 8.9 \times 10^{-12}$

Try these ones:

1. If the solubility of lead(II) chloride is 4×10^{-5} g/100ml, calculate K_{sp} .

Try these ones:

2. Calculate the solubility of silver chromate in mol/L and in g/L if its $K_{sp} = 1.5 \times 10^{-12}$.