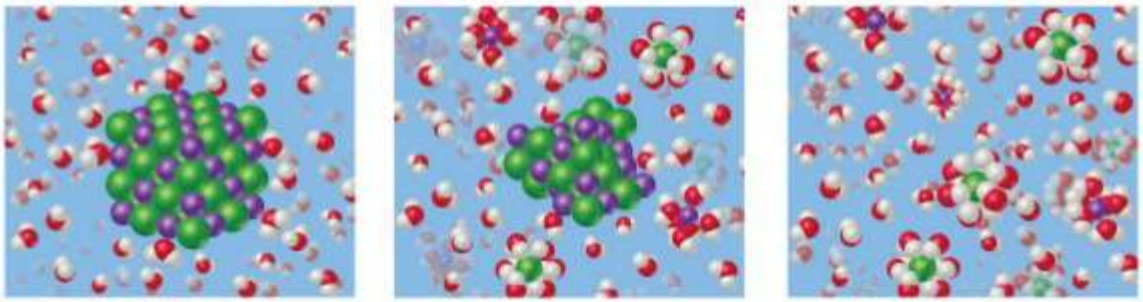
MAINIDEA

A solution forms when a solute or solutes and a solvent or solvents become evenly mixed.

How Does a Solution Form?

As a solution forms, the solvent pulls solute particles apart and surrounds, or solvates, them.

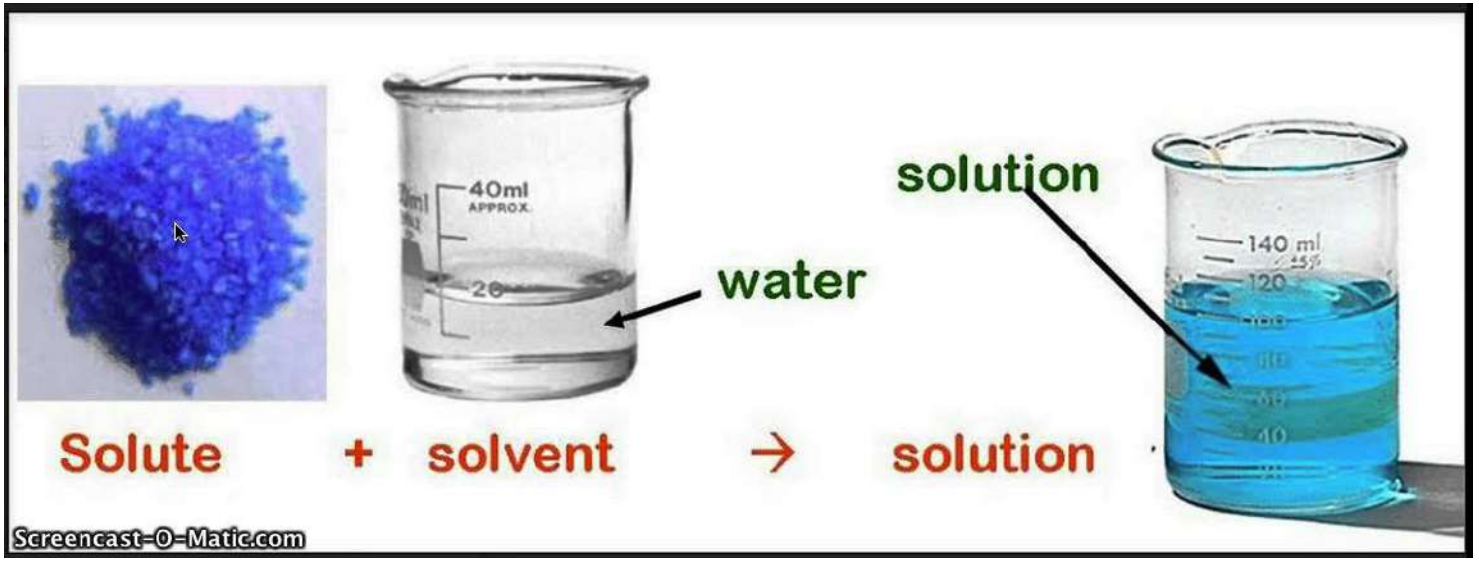


What is a solution?

- A solution is a homogeneous mixture, meaning it has the same composition through the mixture.

Solutes and Solvents

- A solution contains one substance dissolved in another.
- The substance being dissolved is the **solute**, the substance in which a solute is dissolved is the **solvent**.



How Solutions Form

Solutes and Solvents

Nonliquid solutions

- Solutions can be liquid, but they can also be gaseous or solid.
- All mixtures of gases are solutions.
- Solid solutions are also called alloys – mixtures of elements that have metallic properties.

Solid Solutions

solid

Alloys: uniform mixtures of a metal with other metals or elements

Examples: **Brass (copper and zinc)**
Bronze (copper and tin)
Steel (iron, carbon and other metals)

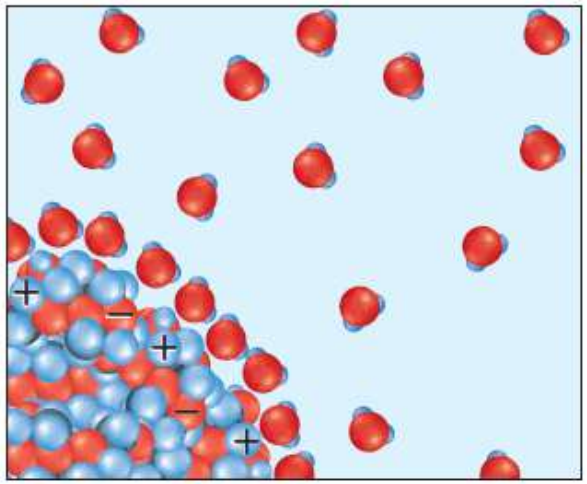
Hint!! If you know it is a metal, but it is not an element on the Periodic Table it must be ....

An Alloy!

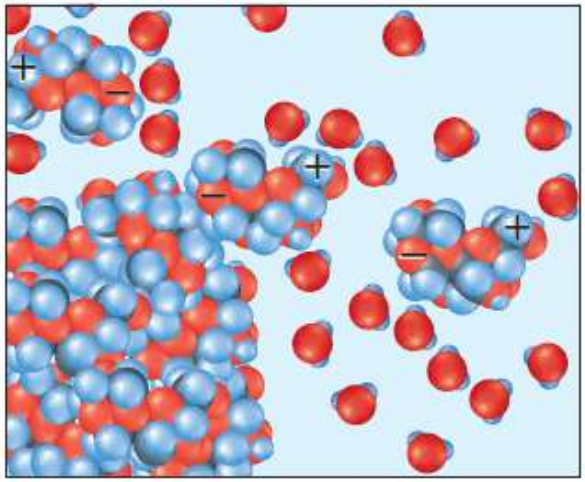
How Substances Dissolve

How it happens

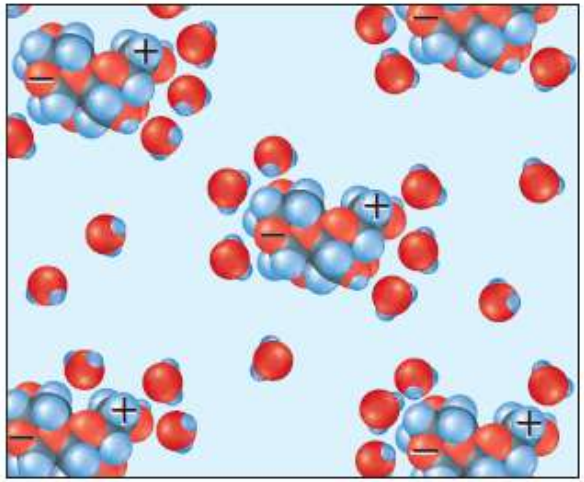
- The dissolving of a solid in a liquid occurs at the surface of the solid.
- Water makes a good solvent because of its polarity.



Step 1 At the surface of the sugar crystal, oppositely charged parts of the sugar and water molecules attract each other.



Step 2 Because the water molecules are moving in the liquid, they pull sugar molecules away from the crystal.



Step 3 Water molecules and sugar molecules continue to spread out until a homogeneous mixture forms.

How Substances Dissolve

Dissolving liquids and gases

- Gases dissolve into liquid similarly to solids
- Liquid and gas particles move more freely than solids.
- The movement spreads solutes evenly throughout the solvent, resulting in a homogenous solution.

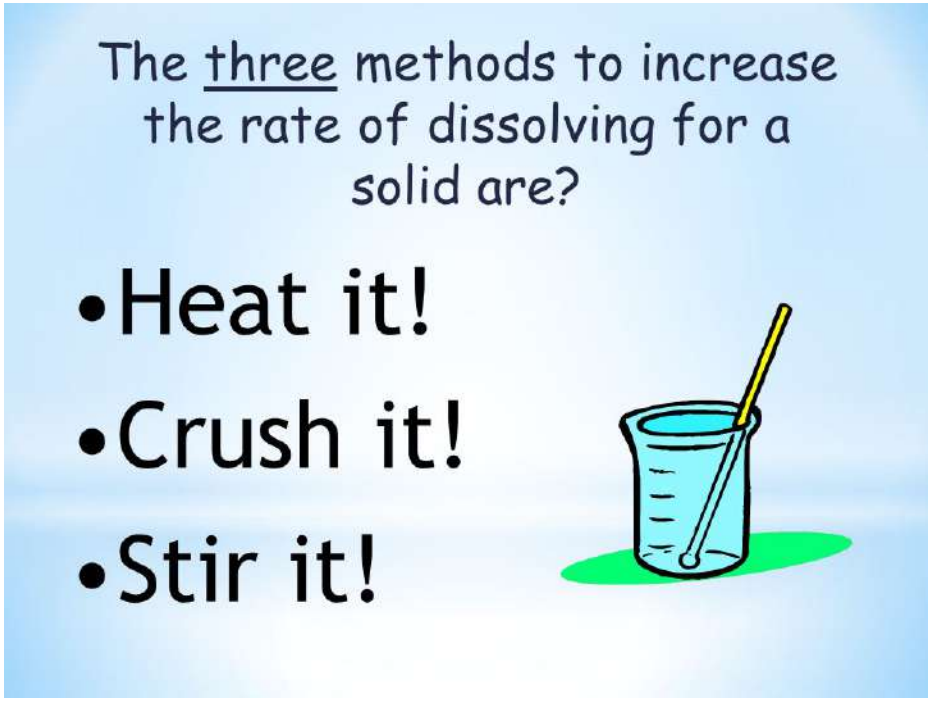
How Substances Dissolve

Dissolving solids in solids

- Solid particles move very little, and the motion is not enough to spread particles evenly throughout a mixture.
- Solid metals are first melted and then mixed together.

Rate of Dissolving

- The three of the most effective techniques for increasing the rate of dissolving are:
  - Stirring
  - Increasing surface area:
  - Increasing temperature



Factors affecting the rate of dissolving

- Temperature – increasing the temperature speeds up the rate of dissolving
- Agitation – stirring speeds up the rate of dissolving
- Particle size – smaller particles dissolve faster than large particles (surface area)

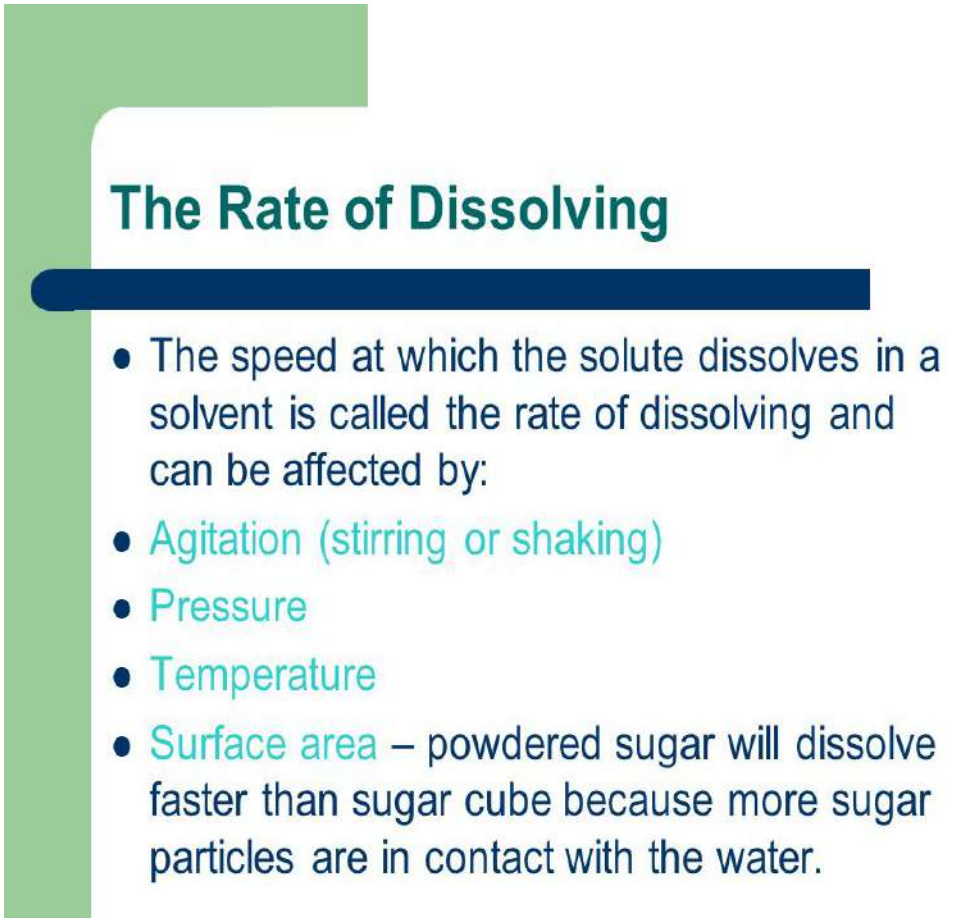
Rate of Dissolving

Stirring

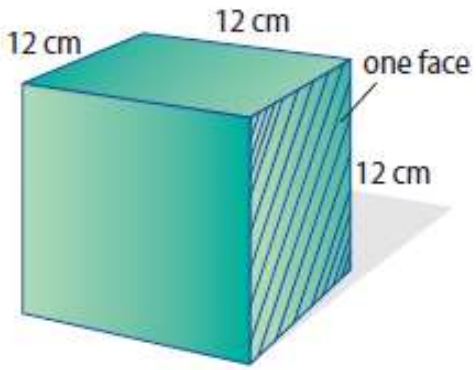
- Stirring moves solvent around, bringing more solvent into contact with the solute.

Surface Area

- Breaking a solid into pieces provides more surface area.
- More surface area allows for more solvent to come into contact with more solute.

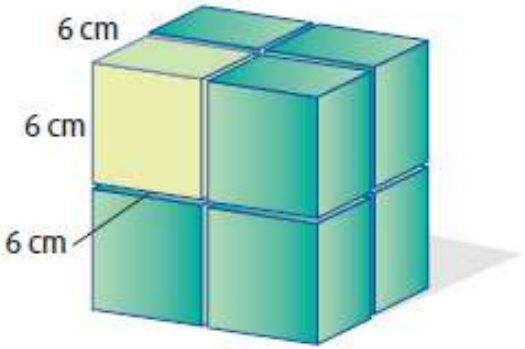


Rate of Dissolving



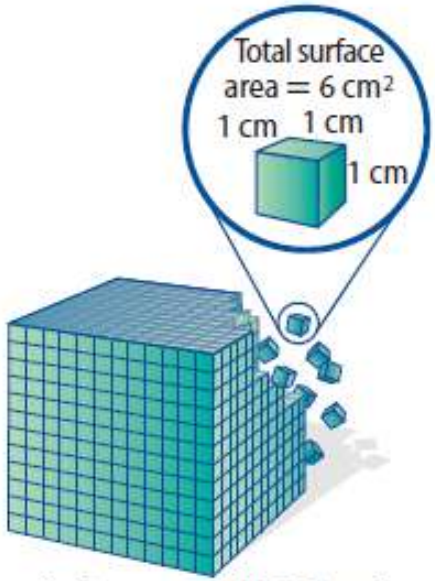
Surface area = 864 cm^2

A face of a cube is the outer surface that has four edges. A cube has six faces of equal area.



Surface area = 1,728 cm^2

Pull apart the cube into eight smaller cubes of equal size. You now have a total of forty-eight faces.



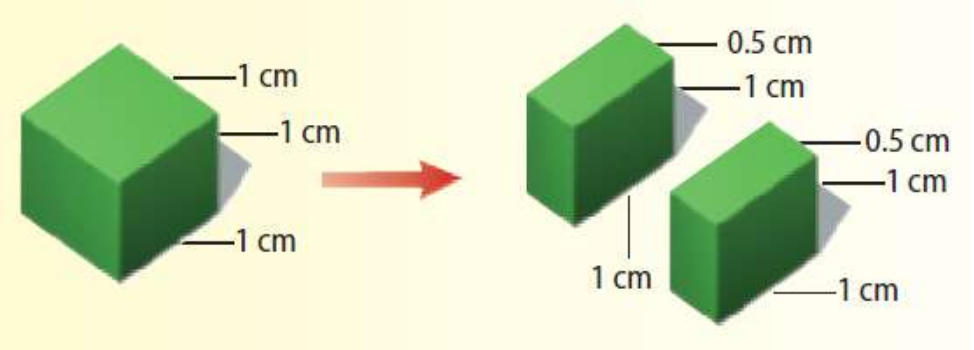
Surface area = 10,368 cm^2

If you divide the cube into smaller cubes that are 1 cm on a side, you will have 1,728 cubes and 10,368 faces.

CALCULATE SURFACE AREA

Problem

Suppose the length, height, and width of a cube are each 1 cm. If the cube is cut in half to form two rectangular pieces, what is the total surface area of the new pieces?



Response

ANALYZE THE PROBLEM

KNOWN

length = l = 1 cm

height = h = 1 cm

width = w = 0.5 cm

UNKNOWN

Total surface area of the two new pieces

SOLVE FOR THE UNKNOWN

- Set Up the Problem

The rectangular solids each have six faces.

Surface area front and back = $\mathbf{2(h \times w)}$

Surface area left and right = $\mathbf{2(h \times l)}$

Surface area top and bottom = $\mathbf{2(w \times l)}$

Surface area of one piece =

$$\mathbf{2(h \times w) + 2(h \times l) + 2(w \times l)}$$

Total surface area =

Number of pieces × Surface area of one piece

CALCULATE SURFACE AREA

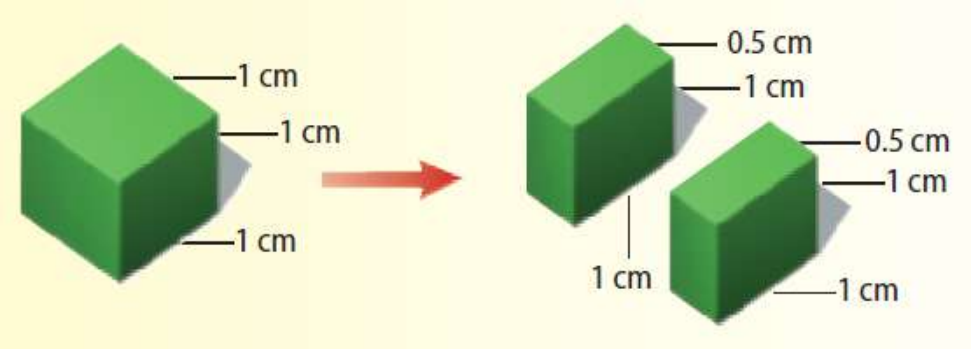
SOLVE FOR THE UNKNOWN

- Solve the Problem

Surface area of one piece =

$2(1\text{ cm} \times 0.5\text{ cm}) + 2(1\text{ cm} \times 1\text{ cm}) + 2(0.5\text{ cm} \times 1\text{ cm}) = 4\text{ cm}^2$

The total surface area of the two new pieces = $2(4\text{ cm}^2) = 8\text{ cm}^2$



EVALUATE THE ANSWER

Total surface area of the original cube = $6(w \times h) = 6(1\text{ cm} \times 1\text{ cm}) = 6\text{ cm}^2$

Dividing the cube in two increased the surface area, which is reasonable.

Rate of Dissolving

Temperature

- Increasing the temperature of a solvent speeds up the movement of its particles.
- This increase causes more solvent particles to bump into the solute. As a result, solute particles break loose and dissolve faster

Rate of Dissolving

Controlling the process

- Each technique, stirring, increasing surface area, and heating, is known to speed up the rate of dissolving by itself.
- When two or more techniques are combined, the rate of dissolving is even faster.
- Knowing how much each technique affects the rate allows for precise control of dissolving solutes.