



Crystallization, Syrups and Browning reactions

SUGAR CHEMISTRY





Magic of Sugar

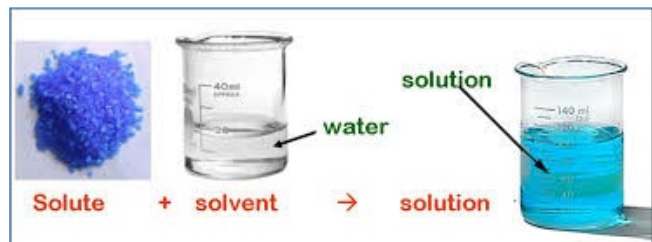
Working with sugar demands an understanding of:

- **solubility**
- phase change (especially crystallization)
- **elasticity**



Solubility

Solubility is the ability of one substance, called a **solute**, to dissolve **homogeneously** in another substance, called the **solvent**.





Solubility Limit

In the majority of cases in cooking, there is a **solubility limit**:

- a maximum amount of solute that can be dissolved in a given amount of solvent.
 - **saturated solution**
- the solubility limit increases with **temperature**.
- different limits for different solute and solvent combinations



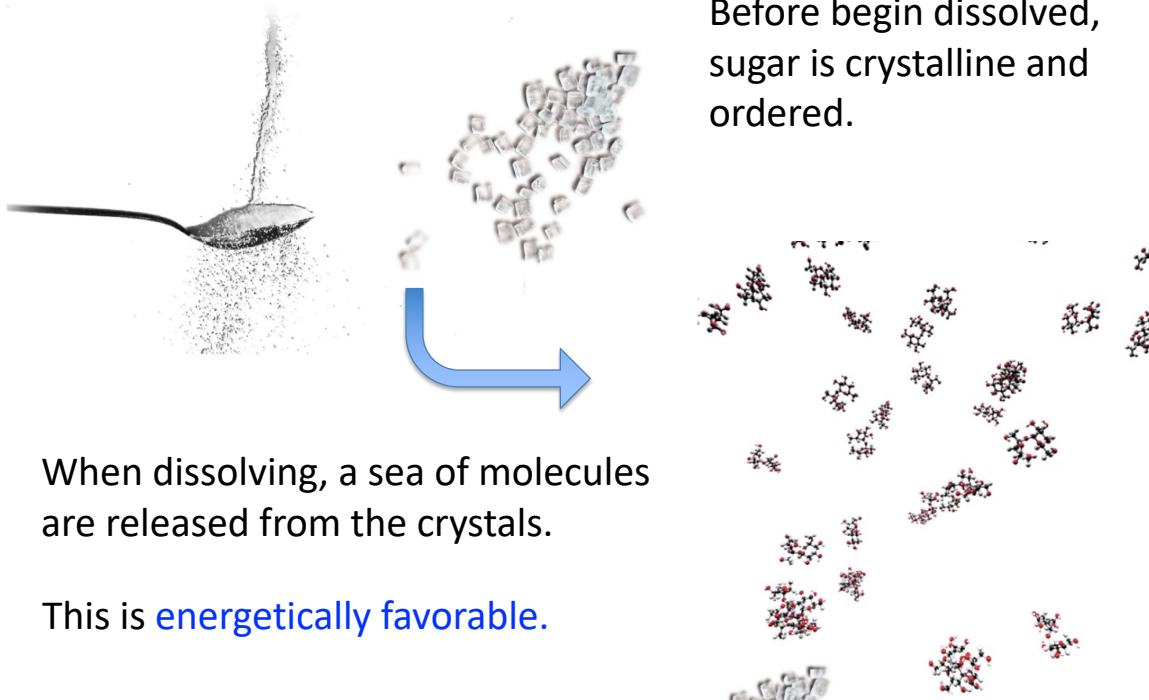
At room temperature:

- salt's solubility limit is $\frac{1}{3}$ g per gram of water
- sugar's solubility limit is **2** g per gram of water



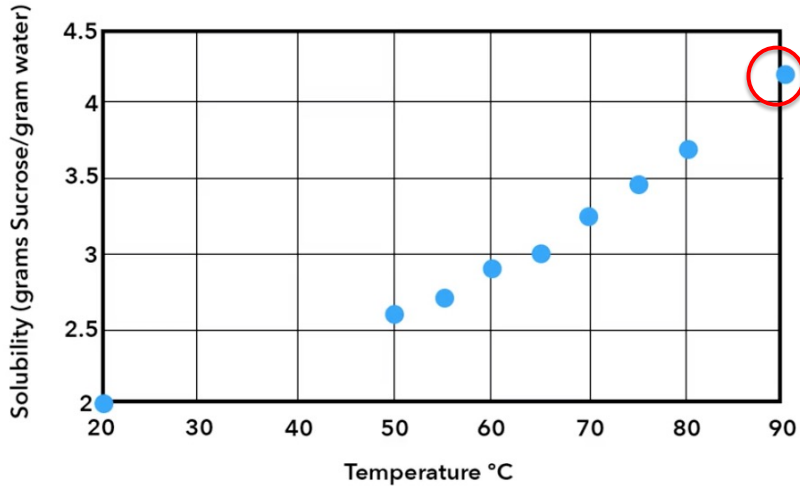
What happens when you dissolve sugar?

Before begin dissolved, sugar is crystalline and ordered.





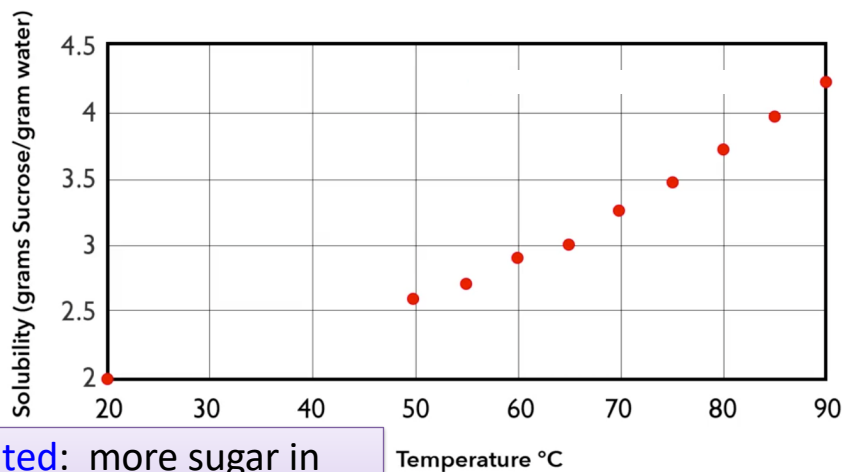
Solubility as a function of temperature.



Note: you can dissolve more than 4 g of sucrose in 1 gram of near boiling water.



What happens when you cool a heated sugar solution?



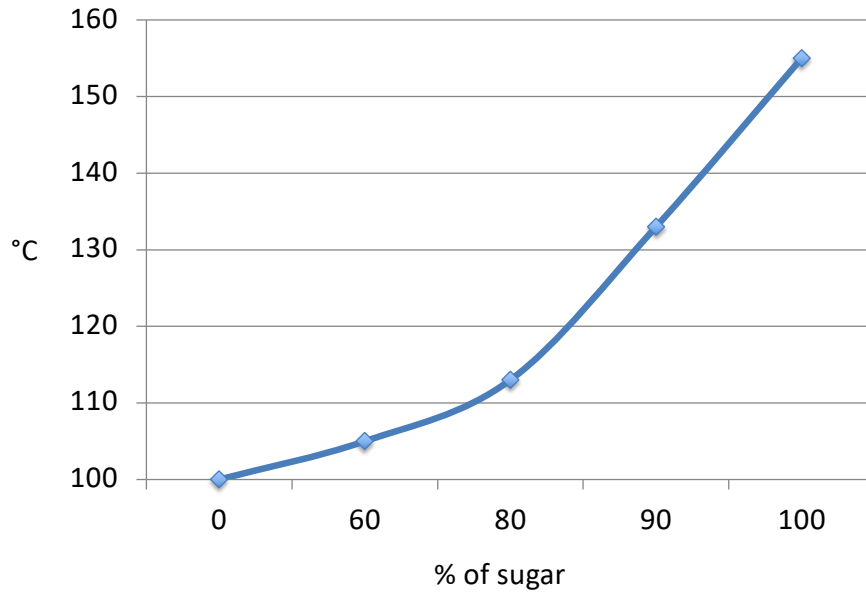
Super-saturated: more sugar in solution than equilibrium can support

Cooled solution is more concentrated (has more sugar) than it should at that temperature.



Temperature is SOOOOO important.

Boiling point of sugar/water depends on **how much sugar is in solution.**



Temperature is SOOOOO important.





Chapter 13: Sweets – Chocolate & Candies

Table 13-2 Candy Temperature		
SYRUP'S BOILING POINT AND SUGAR CONCENTRATION	TYPE OF CANDY	SYRUP'S BEHAVIOR
215° F–234° F 101° C–112° C sugar concentration: 80%	Sugar syrup, fruit liqueur, some icings	Thread Stage: The liquid sugar can be pulled into brittle threads between the fingers.
234° F–240° F 112° C–115° C sugar concentration: 85%	Fudge, pralines.	Soft-Ball Stage: A small amount of syrup dropped into chilled water forms a soft, flexible ball, but flattens after a minute in your hand.
242° F–248° F 116° C–120° C sugar concentration: 87%	Caramels	Firm-Ball Stage: Forms a firm ball in ice water that will not flatten when removed from the water, but remains malleable and flattens when it is squeezed.
250° F–268° F 121° C–131° C sugar concentration: 92%	Nougat, marshmallows, toffee, gummy candy.	Hard-Ball Stage: Forms a hard ball in ice water, which holds its shape on removal.
270° F–290° F 132° C–143° C sugar concentration: 95%	Taffy.	Soft-Crack Stage: As the syrup reaches this low moisture content stage, the bubbles on top become smaller, thicker, and closer together. When dropped into ice water, the syrup separates into hard but pliable threads that bend slightly before breaking.
300° F–310° F 148° C–154° C sugar concentration: 99%	Lollipops and other hard candies	Hard-Crack Stage: This is the highest possible cooking temperature for a candy. Because there is almost no water left in the syrup, syrup dropped into ice water separates into hard, brittle threads that break when bent.