

# Factors Affecting Reaction Rate

*What does this really mean...*

“Things that speed up or slow down  
a reaction.”



# Why?

Many factors affect the rate of chemical reaction. In fact, some factors are so important that reactions don't appear to happen at all because they are so slow without proper conditions! These conditions include:

1. Temperature
2. Surface Area
3. Concentration of the reactants
4. Presence of a catalyst (or inhibitor)

# 1. Temperature



Temperature is a measure of the average energy of molecules.

The more energy molecules have, the higher the temperature.

When molecules have more energy, they move around more, bump into other molecules more, and therefore react faster.

Higher Temperature (hotter) = FASTER  
Rxn

Lower Temperature (colder) = SLOWER  
Rxn

Can you see that the molecules are actually moving faster with increased temperature?

<https://www.youtube.com/watch?v=7fqf7t-fOHI>

Think of water boiling – if you want to evaporate Liquid water into gaseous water (water vapor), you can make it happen faster by heating it ( you can see the steam go off as vapor. It will turn into vapor by itself – but it will take a long, long time without speeding it up with heat.



# Surface Area



Chemical reactions occur when and where atoms and compounds collide. SO...The more atoms and molecules there are to collide, the higher the reaction rate.

Surface area – how much of an object is exposed to it's surroundings.

SO... the more of the object that's exposed (like a powder instead of a small solid) – the more it can react with the things around it.

Think – if you put a chlorine puck in a pool – it takes a long time for it to be dissolved (maybe an hour or 2), BUT... If you sprinkle the same amount of chlorine, but in a powder form... it will dissolve into the pool within about 30 seconds



**Greater Surface Area = Fast rxn**  
**Smaller surface area = Slow rxn**

**Slow...**



**Fast!**



# Concentration



Concentration– how much solute (element or compound) is dissolved in solution.

For example: Pure HCl (Hydrochloric acid) is much more concentrated than diluted HCl (where I added a bunch of water to the strong solution and make it less potent).

Since there are more molecules per unit volume in high concentrations, there are more opportunities for molecules to collide and react.



If I put **pure** HCl on my right hand, and the diluted HCl on my left hand – which would start burning first?

Right...the Concentrated or pure HCl



# Concentration continued...

The higher the concentration = the faster the reaction occurs

The lower the concentration = the slower the reaction occurs



**Fast!**

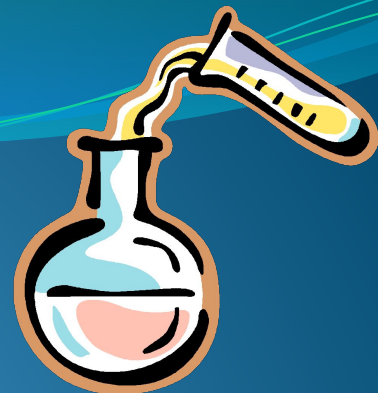
**High Concentration**



**Slow...**

**Low Concentration**

# Catalysts



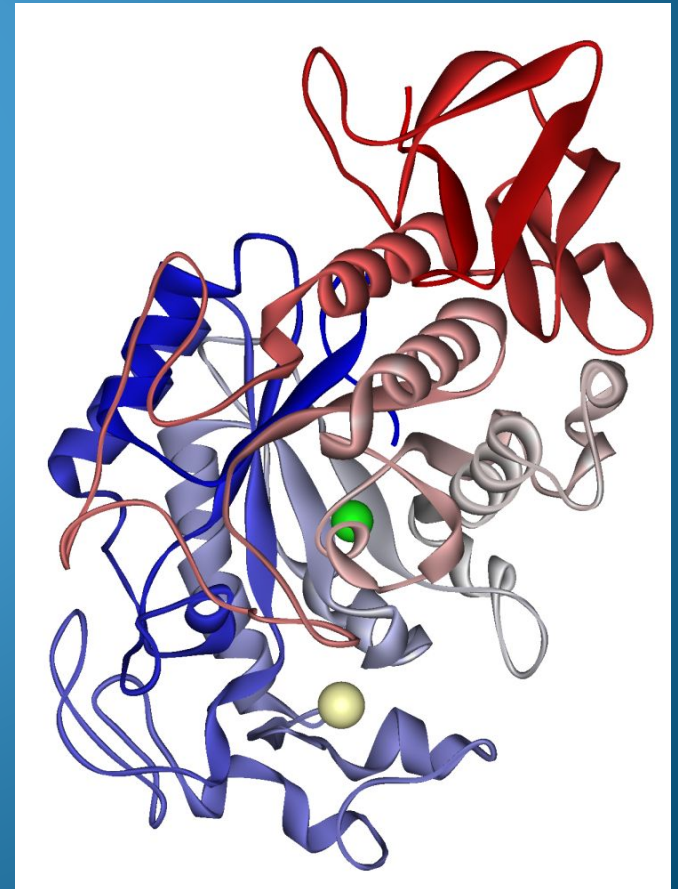
Catalyst– a chemical substance that is added to a reaction to speed it up! Another name for a catalyst is an enzyme (in biological systems).

The catalyst affects the reaction rate, but it **does not act as a reactant**.

How? They lower the energy needed to make the reaction go. So now... the reaction can occur more easily, and faster.

For example: Saliva contains an enzyme (catalyst) called salivary amylase – it speeds up the digestion of starches in your food.

## Salivary Amylase



# Inhibitor

Substance that **Slows down** a reaction

# Another type of Catalyst: Sodium Azide Pellets

**Sodium Azide pellets** are in air bags of all vehicles – they are used as a catalyst to make the airbag inflate very quickly (speed up the reaction hugely!)

**An airbag inflates in 0.027 seconds – that is how fast the reaction takes place!**







What is the airbag inflated with?

**Nitrogen gas.**

The reaction that makes an airbag inflate is:



**Nitrogen gas** fills the airbag, but **sodium** is also produced – if sodium reacts with water (in a person's mouth or eyes = very bad and caustic). So designers added other chemicals to react with Na and make it safe.

**It is very important for the airbag to inflate very quickly, and also deflate quickly too.**

**If the airbag does not deflate a bit before a person's head hits it – it is as hard as hitting the dashboard.**

**The surface area and amount of Sodium Azide is carefully calculated so that this reaction happens exactly on time.**

