# Rates of Reaction

## Rates of Reactions

The rate of all chemical reactions is determined by the collision theory:

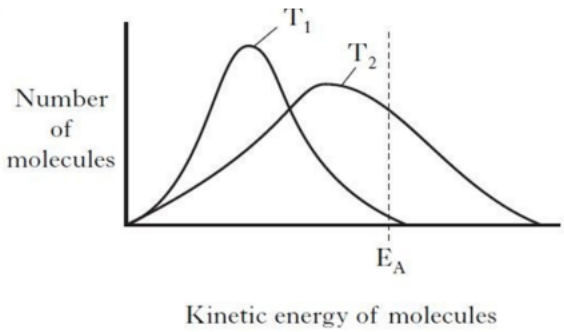
1. Particles must collide with energy **greater** than the **activation energy**
2. Particles must also collide at the **correct orientation.**

Activation energy is defined as the **minimum energy** required for successful collisions to be possible.

The following factors will have an impact on Successful Collisions:

1. **Temperature**

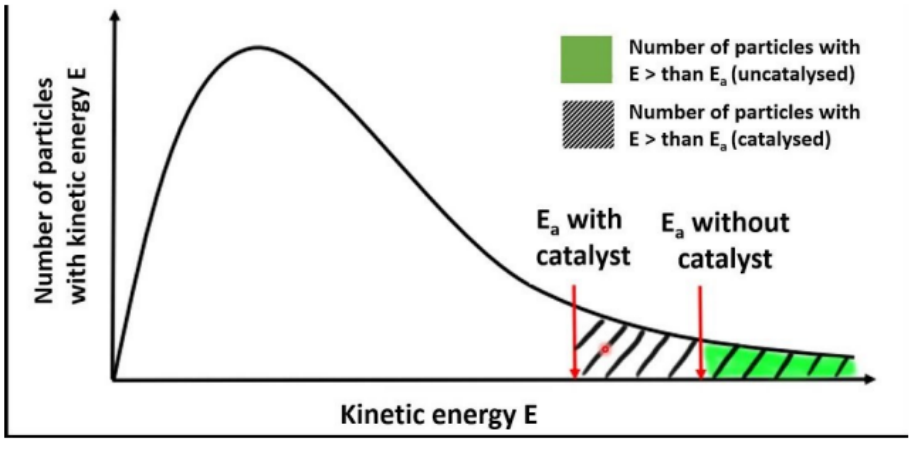
Temperature is a measure of the average kinetic energy of particles.
A small rise in temperature is enough to double the rate of a reaction.




At $T_1$ the area under the curve beyond the activation energy is small. Increasing the Temperature $T_2$ increases the area under the curve beyond the activation energy. This means that there is an increased number of particles with sufficient energy to successfully collide.

## 2. Catalyst

A catalyst speeds up the rate of a reaction by lowering the activation energy. This means that more particles will have energy beyond the new activation energy so the likelihood of successful collisions increases.



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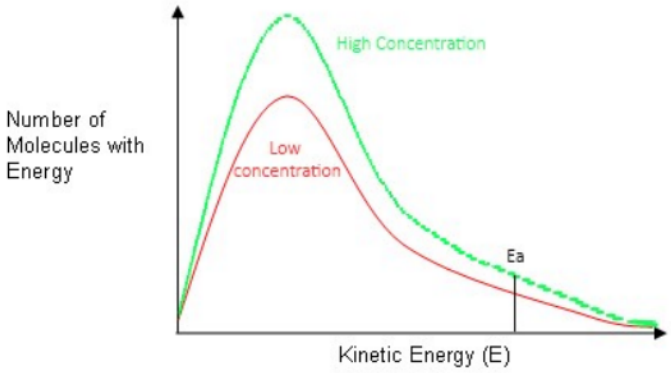
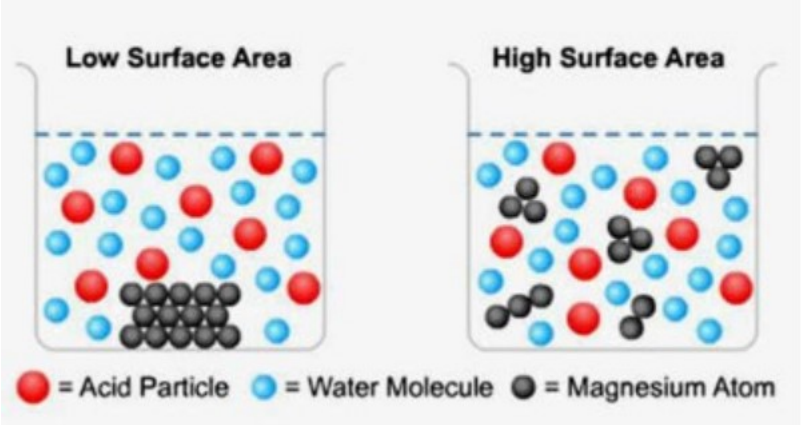
### 3. Concentration

The concentration of particles can affect the rate of a reaction by increasing the number of particles across the range of kinetic energies, therefore there will be a greater likelihood of successful collisions as more particles have energies beyond the activation energy.




### 4. Particle Size

Decreasing the particle size will provide a larger surface area thus increasing the opportunities for successful collisions




Reaction rates must be controlled in industrial processes. If the rate is too low then the process will not be economically viable; if it is too high there will be a risk of explosion. The rate of reactions can be determines experimentally to produce data to calculate the relative rate.

$$\text{Relative rate} = \frac{1}{\text{time}} \qquad \text{Units : } s^{-1}$$

$$\text{Time} = \frac{1}{\text{Rate}}$$