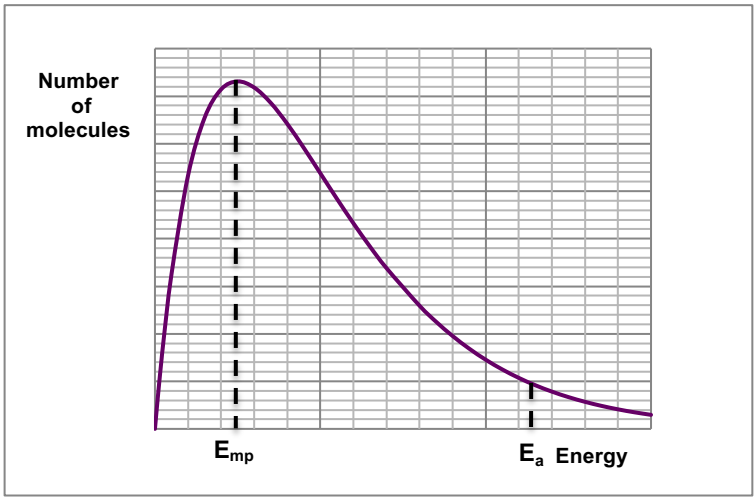
RATES OF REACTION BASICS

Rate of reaction

Definition:

- The rate of a chemical reaction is a measure of how fast a reaction takes place.
- It is defined as the **change in concentration of a reactant or product per unit time**.
- For example, in a reaction between magnesium and hydrochloric acid, the rate could be measured in terms of the change in concentration of the hydrochloric acid per second.

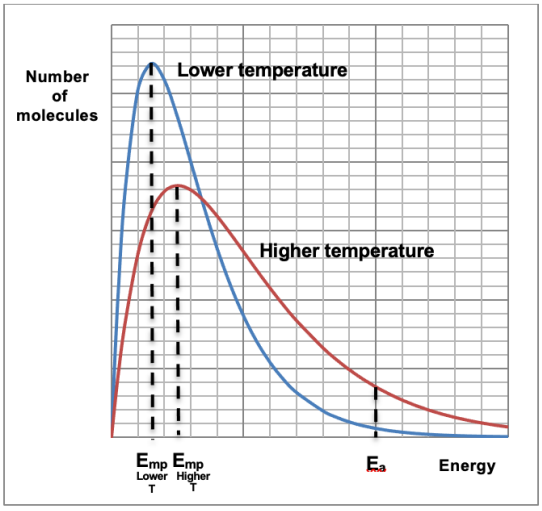
Maxwell-Boltzman distribution of molecular energies



- The particles in substance do not all have the same amount of energy.
- There are no particles with no energy (i.e. they all have some energy).
- The area under the curve represents the total number of particles.
- The peak of the curve gives the energy that more particles have than any other energy (sometimes labelled E_{mp}, i.e. most probable energy).
- The activation energy (E_a) can be shown on the axis. Often only a small proportion of molecules have energy greater than or equal to the activation energy.
- When particles collide with each other they gain or lose energy, and so the energy of each individual particle is constantly changing. This means that a particle that does not have enough energy to react may gain enough in a collision so that it can react in a further collision.

What is collision theory?

- For particles to react they must collide with sufficient energy to react and at the correct orientation.
- The minimum energy particles need to react is called the **activation energy**.

Factors affecting rates		
Concentration of solutions	The higher the concentration, the faster the reaction (unless that reagent is zero order)	Particles are closer together and so there are more frequent successful collisions
Pressure of gases	The higher the pressure, the faster the reaction (unless that reagent is zero order)	Particles are closer together and so there are more frequent successful collisions
Temperature	The higher the temperature, the faster the reaction.	Particles have more energy and so a greater proportion of the collisions are successful. The particles also move faster and so collisions are more frequent. Therefore there are more frequent successful collisions 
Surface area of solids	The more pieces a solid is broken up into, the greater the surface area (a powder has a massive surface area). The greater the surface area, the faster the reaction.	There are more particles exposed at the surface that can be collided with, and so there are more frequent successful collisions
Catalysts	A catalyst is a substance that increases the rate of a reaction but is not used up.	It provides an alternative route / mechanism with a lower activation energy and therefore a greater proportion of the collisions are successful.