*Phase transformation heat treatment

Kinetics&Thermodynamics

Branch of Chemistry that studies reaction rates and reaction mechanisms
(i.e. how a reaction occurs, how fast it goes and the G changes that occur)

Measure a reaction rate 2 ways

- The rate (speed) at which the reactant is consumed
- The rate (speed) at which the product is formed

The rate is determined by the change in concentration per unit time

- Concentration is expressed in (M)olarity
  - [HCl] = 0.5M

Rate of Reaction and Collision Theory

In order for a chemical reaction to occur effective collisions must happen randomly between species so the bonds of the reactants can be broken and reformed into products.

Effective Collisions:
result in
breaking or forming a bond

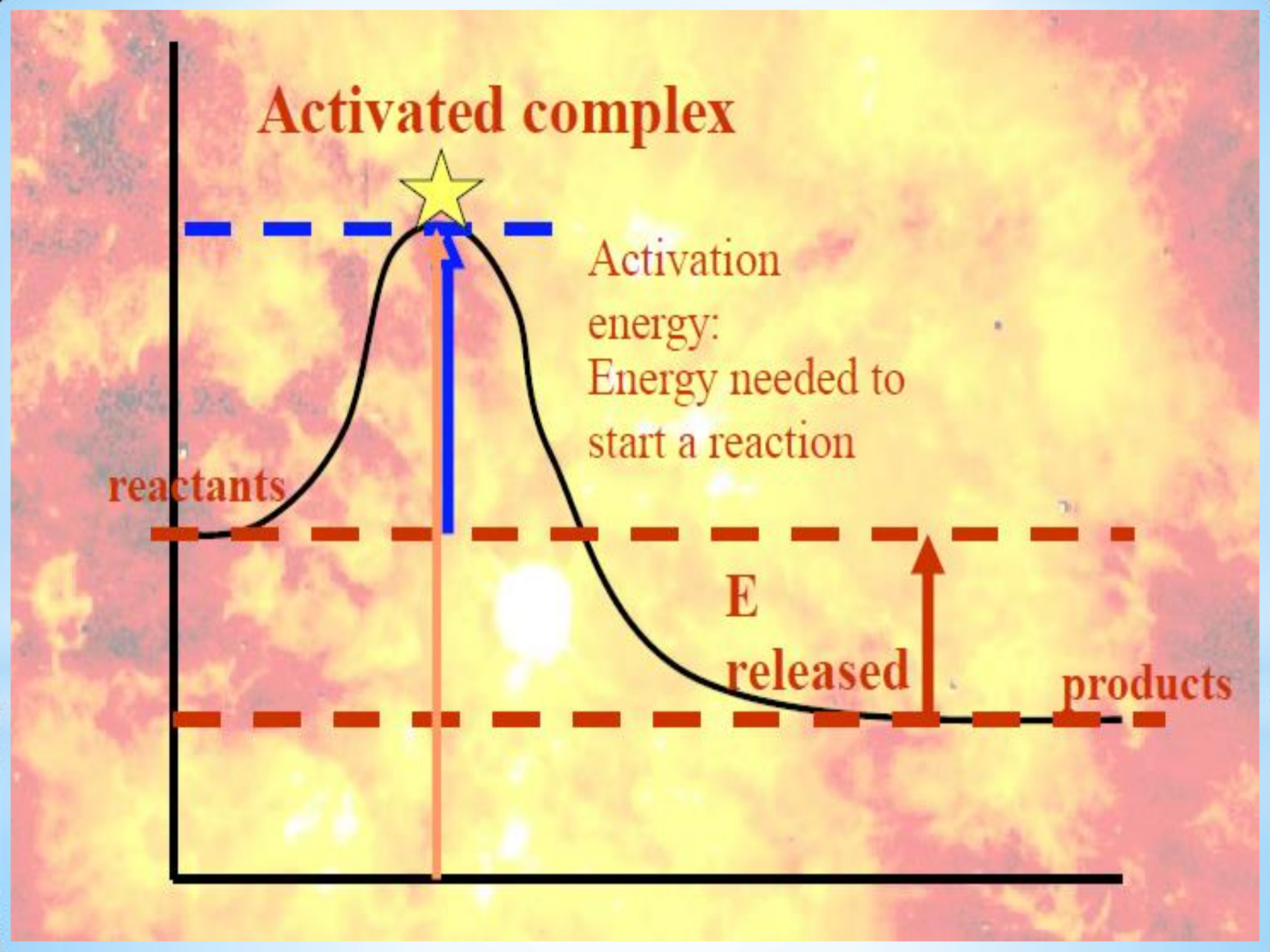
Species:
Ions
molecules or atoms

Collisions are only effective if

- **they have enough kinetic energy to form products**
- **this minimum amount of kinetic energy is activation energy**

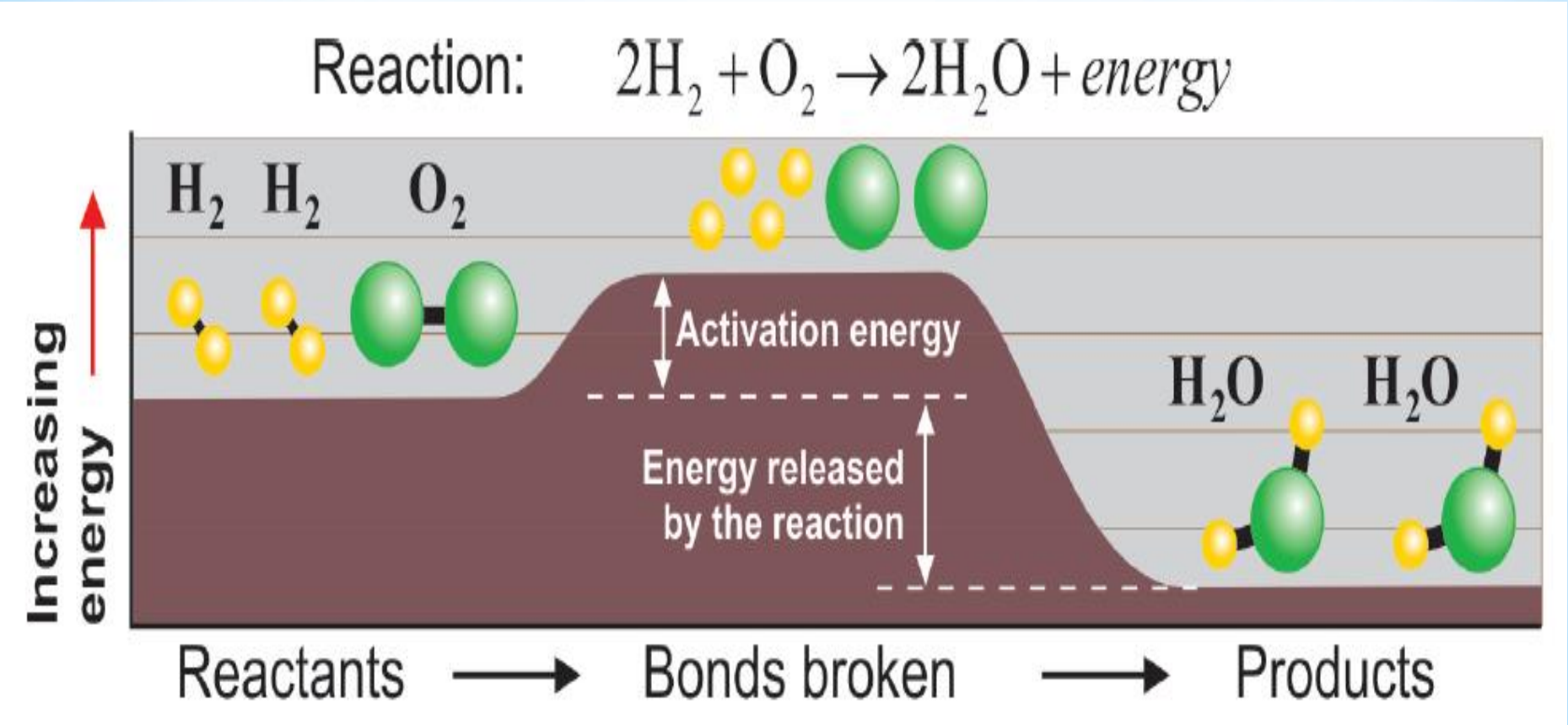
Energy necessary to start a reaction and the molecules must be in the proper orientation

- **During a chemical reaction . . .**
- **The effective collisions result in temporary unstable particles with high potential energy**
- **activated complexes**


Activated complex
Activation energy: Energy needed to start a reaction
reactants
E released
products

*Activation Energy

*_Activation energy_ is the energy needed to begin a reaction and break chemical bonds in the reactants.



factors that determine the rate of reaction

1. The nature of the reactants
2. The temperature of the system
3. The concentration of the reactants

Increasing the pressure (GAS)

4. Surface area of the reactants
5. The use of a catalyst

Nature of the Reactants

- **Reactions between *ionic* substances happen very quickly**
- **Reactions between *covalent* substances tend to happen slowly**
- **Solutions (aq)react faster than solids**
- **Liquids react faster than solids**

Temperature of Reactants

- **Usually, an increase in temp. increases the rate chemical reactions** ***WHY?***
- **If you increase temperature of the system, the KE of the particles increases, and *effective collisions are going to happen more often***

Concentration of Reactants

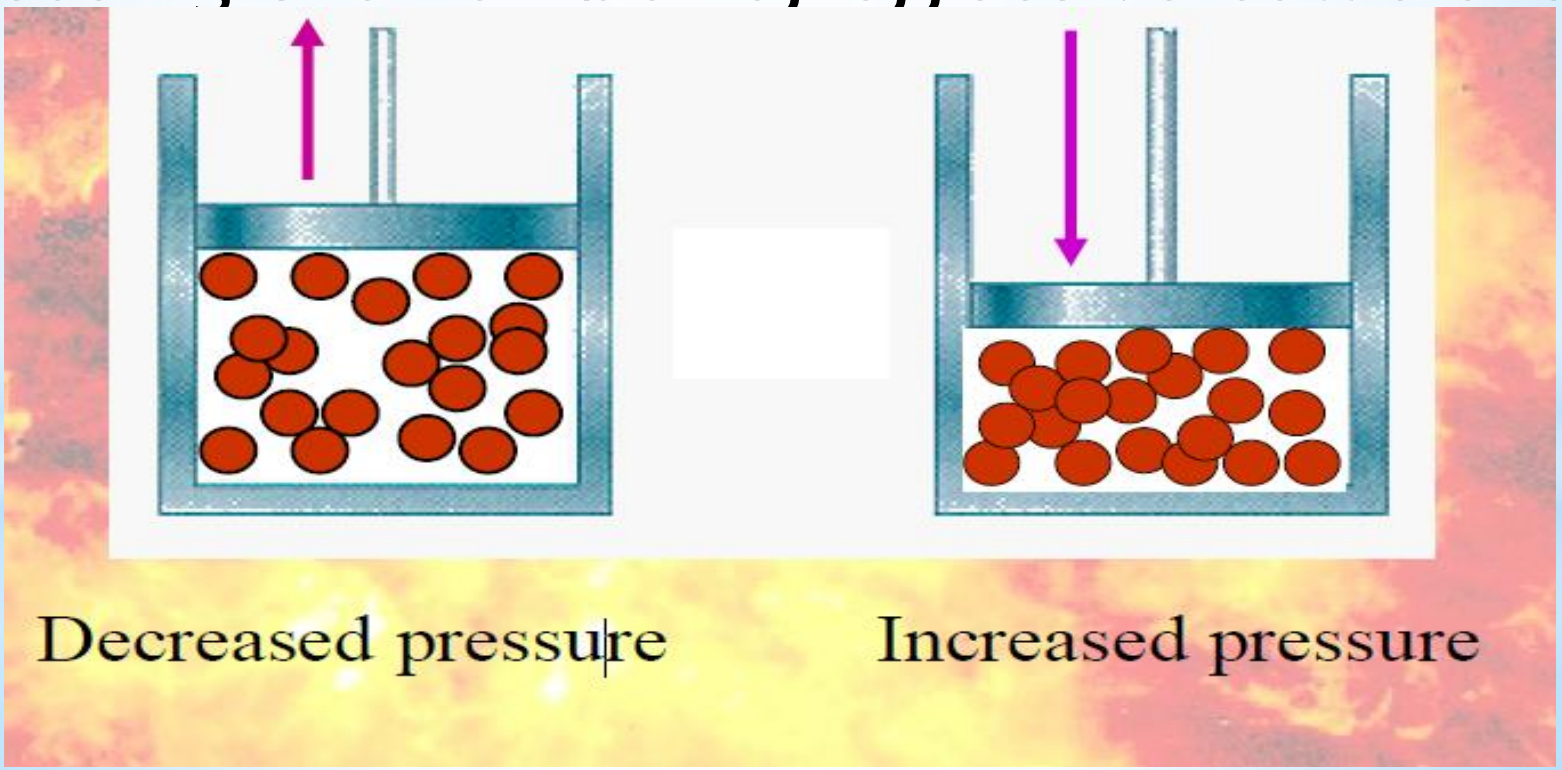
- **An increase in the concentration of the reactants will increase the rate of reaction**

BECAUSE . . . *effective collisions are going to happen more frequently*

Increasing GAS concentration

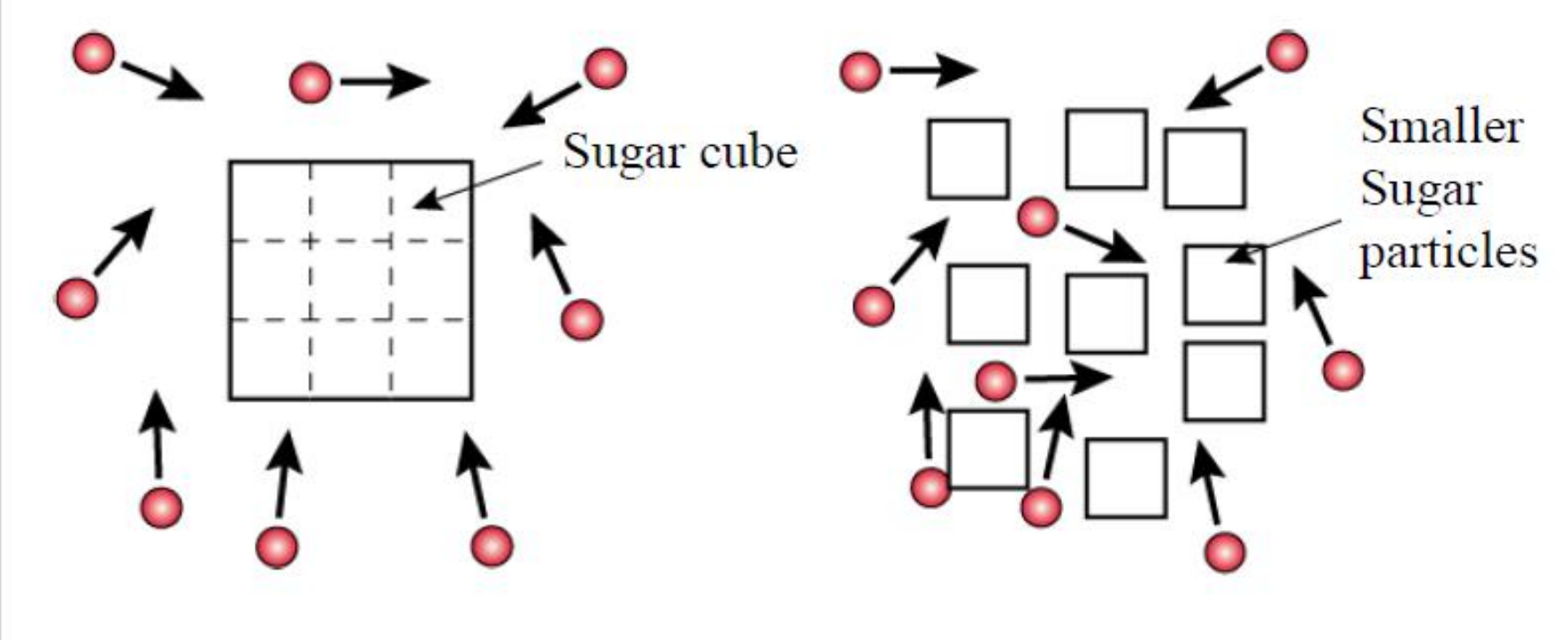
- Increasing pressure will increase the rate of reaction IF at least one of the reactants is a gas …. WHY?
- the molecules move closer together

increasing the number of effective collisions



Surface Area and Reaction Rate

•Increasing the surface area of the reactants will increase the rate of reactions



Increased surface area allows more of the reactant to be exposed . more *effective collisions* to happen

Potential Energy Diagrams PE is stored in the bonds of a substance. Using PE diagrams we can study the THERMODYNAMICS of substances involved in reactions.

Enthalpy and ΔH

- **The change in PE of a reaction is called Enthalpy**
- **Enthalpy is measured by ΔH**

$$\Delta H = H(products) - H(reactants)$$