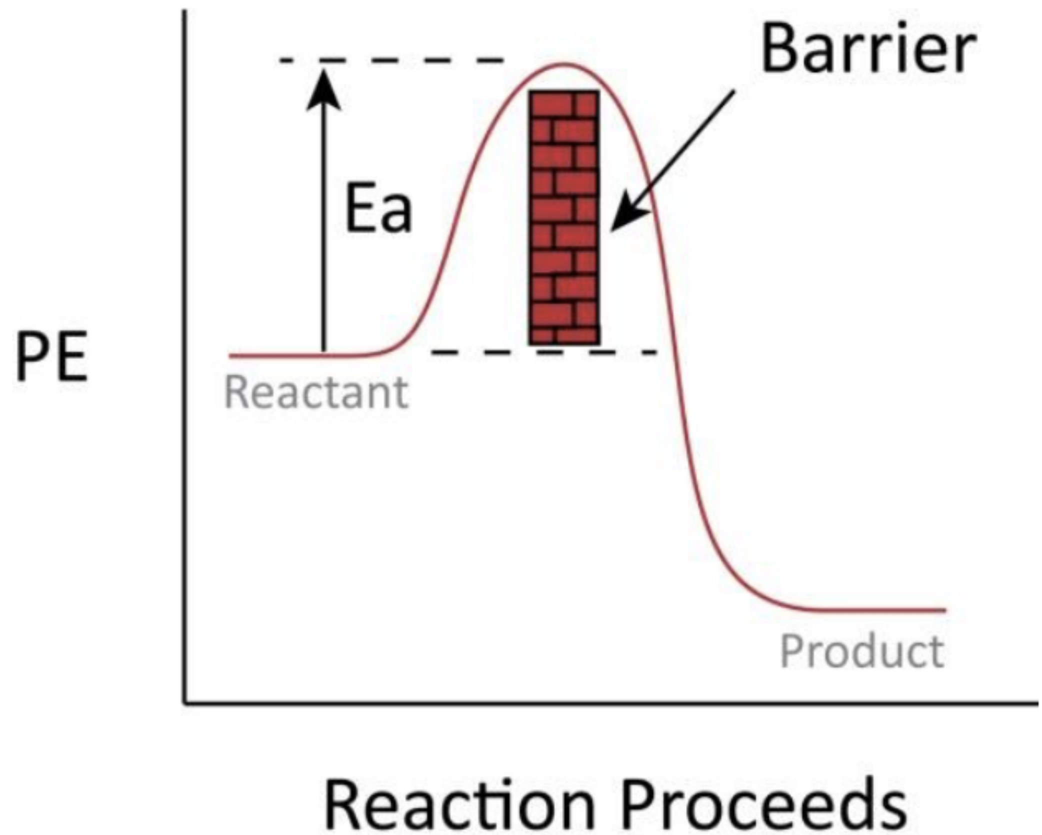
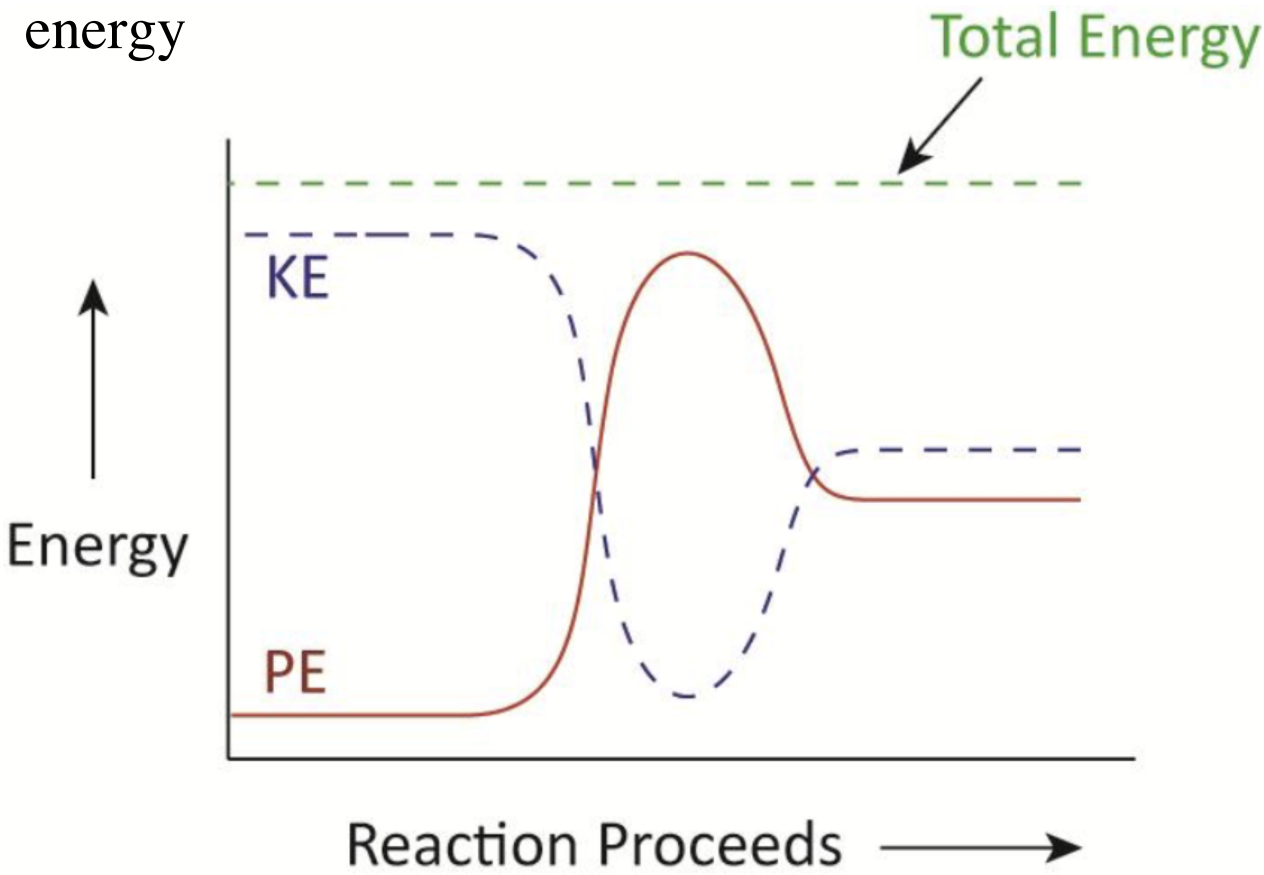
Activation Energies

1. The existence of a minimum energy requirement before a molecule can react means that there is a "barrier" to overcome



ACTIVATION ENERGY (Ea) = the minimum amount of energy required for reactants to form the activated complex

2. When reactant molecules approach each other during a chemical reaction, they slow down and their kinetic energy is converted into potential energy

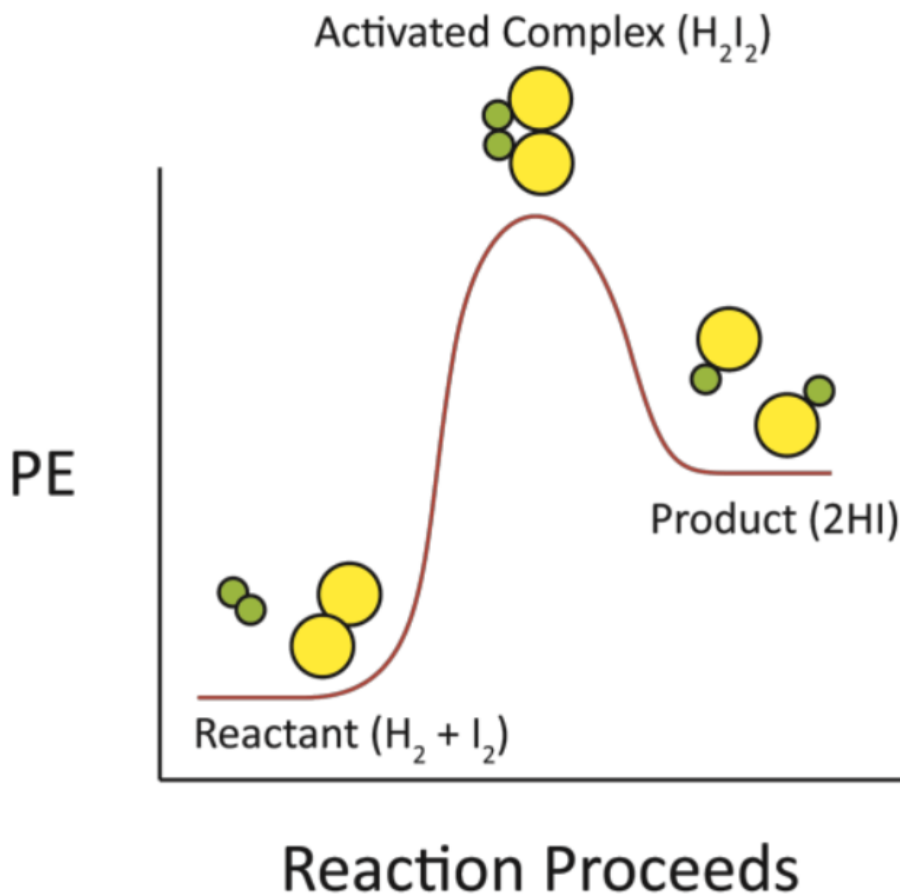


- if the molecules gain enough PE, bonds can be broken and new bonds made and an ACTIVATED COMPLEX is formed

ACTIVATED COMPLEX = high E, unstable arrangement of atoms which occurs when reactants are in the process of rearranging to form products (reaction intermediate)

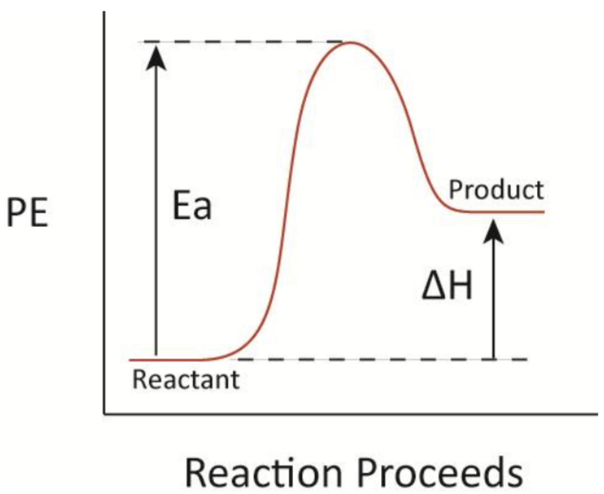
- after the reaction occurs, the newly formed molecules repel each other and speed up
- PE is then converted to KE as the product molecules move away from each other

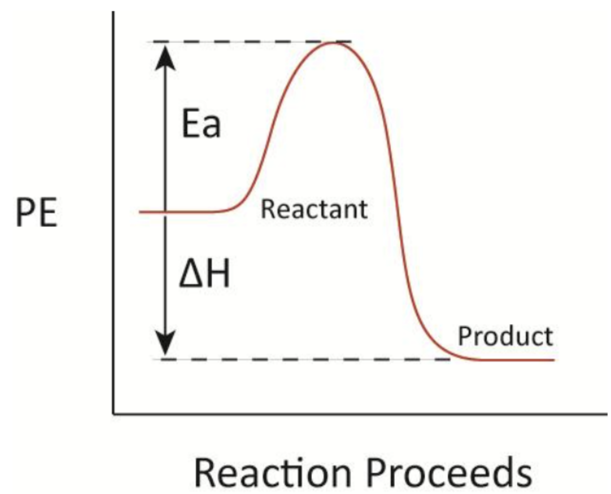
Total Energy = PE + KE



- on the PE diagram, the reactants are assumed to collide with **ideal geometry**
- if the molecules do not have ideal geometry, the reaction can still take place but it reflected as an **increase in activation energy**

- consider the PE diagrams for an endothermic and exothermic reaction
  - > Activation Energy (Ea) = energy difference between reactant and activated complex
  - > Change in Enthalpy (ΔH) = energy difference between reactant and product



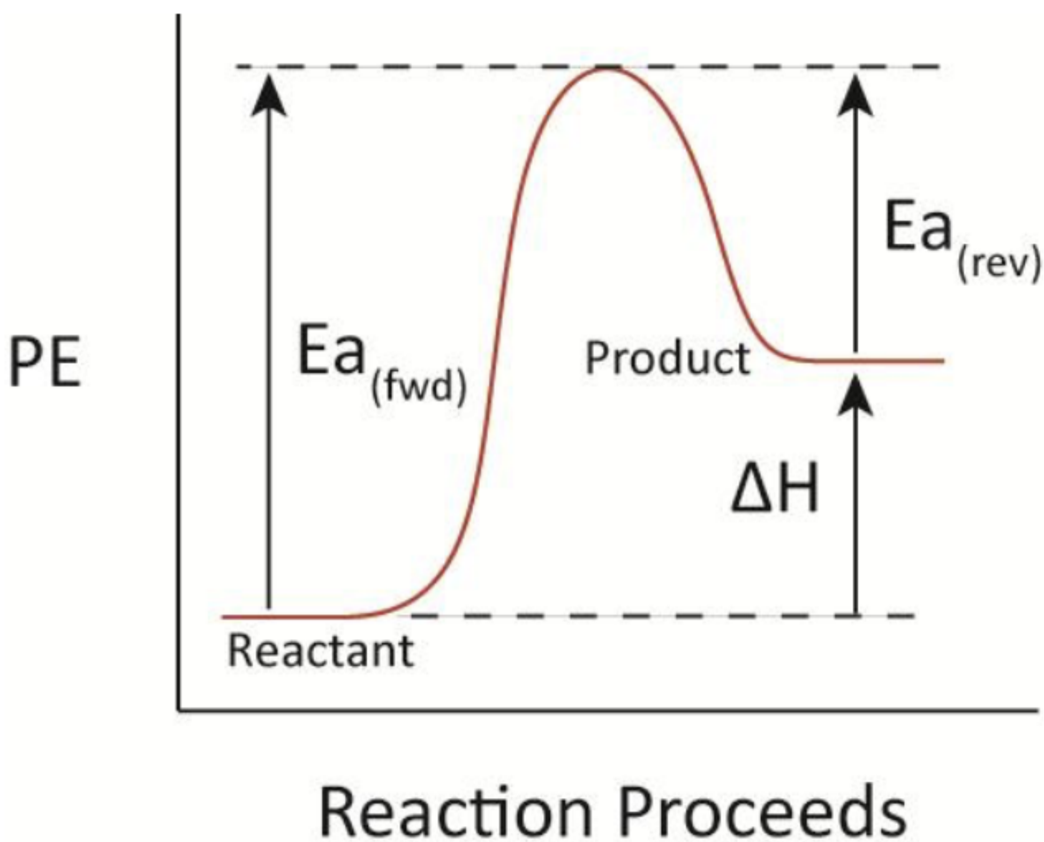


- for a reversible reaction

$$\text{Reactant} \leftrightarrows \text{Product}$$

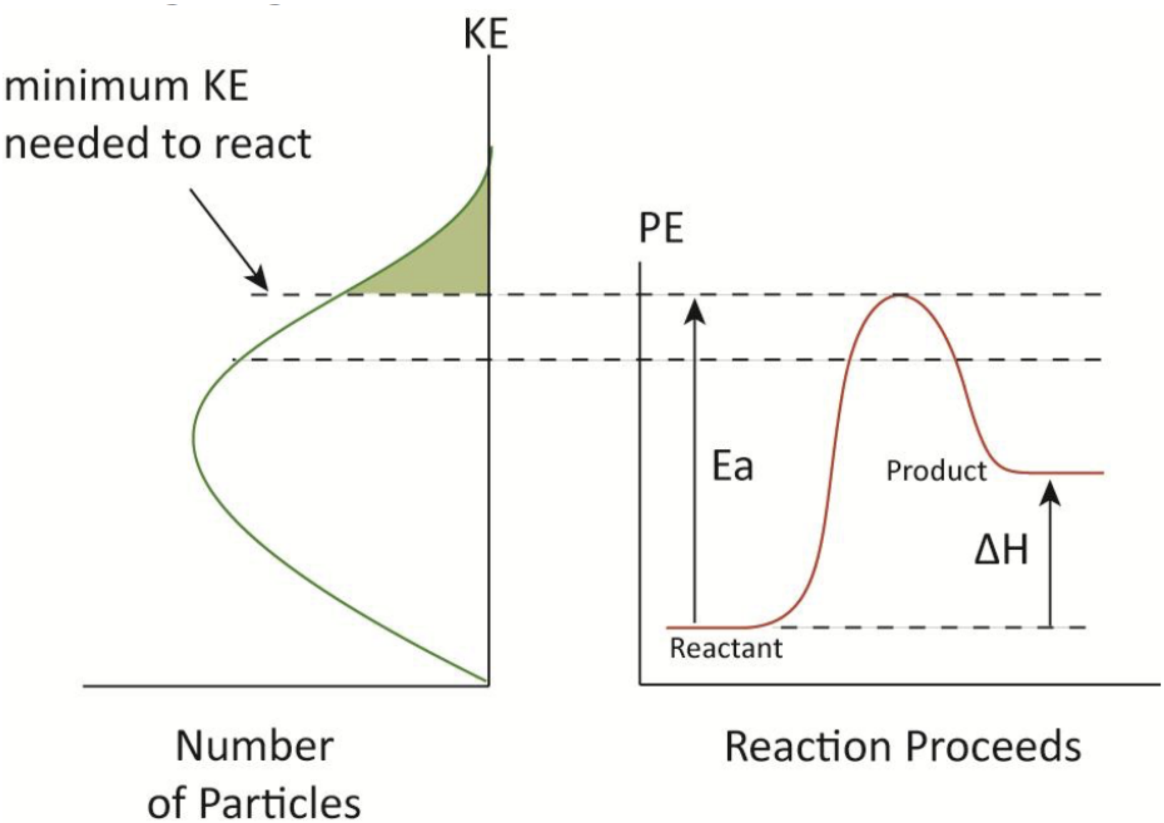
> $Ea_{(fwd)}$ refers to the activation E for the forward reaction (reactant to activated complex)

> $Ea_{(rev)}$ refers to the activation E for the reverse reaction (products to activated complex)



- the rate of a reaction can be related to the activation energy of the reaction

Consider the following diagram:



A relationship can be seen when we compare the KE distribution to a PE diagram:

- Ea very high - few molecules will have enough energy to react, reaction rate will be low
- Ea low - more molecules will have enough energy to react, reaction rate will be high

The higher the activation energy, the slower the reaction rate and vice versa.