

Collision Theory

- The collision theory states that atoms, ions, and molecules must collide to react.
- The theory explains why reactions occur and how the rates of chemical reactions can be modified.

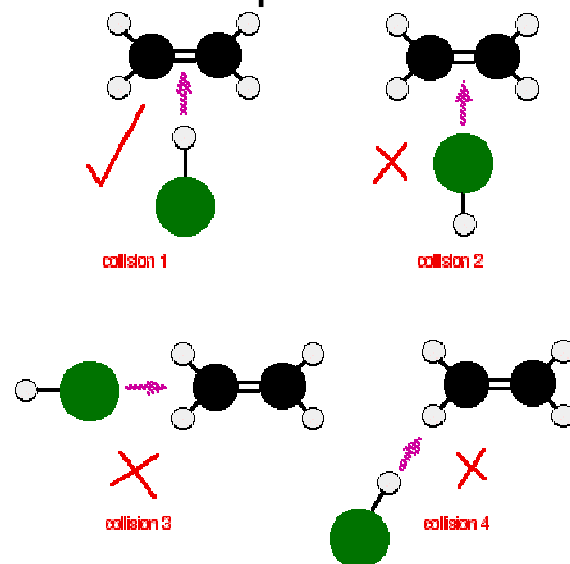
Collision Theory Summary

- Reacting substances (atoms, ions, or molecules) must collide
- Reacting substances must collide with the correct orientation
- Reacting substances must collide with sufficient energy to form the activated complex

Collisions

- The substances must collide to react
- However, despite the many collisions per second, only a small fraction of those collisions actually react
- There must be other factors involved....

Orientation of colliding molecules is important



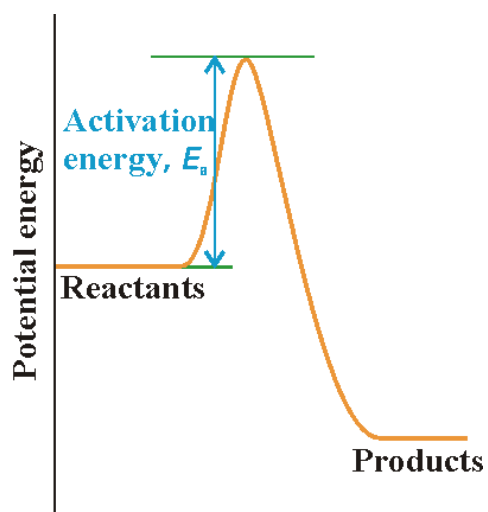
- When the substances collide in any way but the correct way, they just bounce off of each other
- When the substances collide just right, they may join together to form what is called an activated complex
- An activated complex is a temporary arrangement of atoms that may form products or break apart to reform the reactants

The Right Amount of Energy

- It is not only necessary for the substances to collide in exactly the right way, but they also need to have enough energy
- If there is not enough energy, the activated complex is not formed
- The minimum amount of energy that reacting particles must have to form the activated complex is called the **activation energy**

- If a reaction has a low activation energy then more of the collisions will have enough energy to react, resulting in a high reaction rate
- If a reaction has a high activation energy then less of the collisions will have enough energy to react, resulting in a low reaction rate

- We represent this activation energy on a potential energy diagram



Factors that Affect the Rate of a Chemical Reaction

- The nature of the reactants
- Surface area
- Concentration
- Temperature
- Catalyst

The Nature of the Reactants

- Some elements are more reactive than others

Surface Area

- Larger surface areas allow more molecules to collide per unit of time

Concentration

- Reactions speed up when the concentrations of reacting particles are increased
 - Particles must collide to react
 - More particles means more collisions

Temperature

- Generally, increasing the temperature increases the reaction rate
 - Increasing the temperature increases the kinetic energy of the molecules (they move faster)
 - More molecules can therefore collide with each other with enough energy to react

Catalyst

- A catalyst lowers the activation energy needed for the reaction to take place
- Since less energy is needed, more collisions will have enough energy to react
- Note: There is also a type of substance called an inhibitor which slows down a reaction