# Kinetics

**Unit:** Kinetics

### Knowledge/Understanding:

* collision theory
* reaction rate
* rate laws
* order of a reaction

### Skills:

* determine reaction order

collision theory: molecules must collide in order to react. Collision converts kinetic energy of molecules (temperature) into enthalpy (heat energy), which is used to start the reaction by breaking chemical bonds in the reactants.

reactants: the compounds consumed in the chemical reaction

products: the compounds created by the chemical reaction

intermediates: compounds produced by a reaction and consumed by a later reaction in a multi-step process.

effective collision: leads to formation of products

ineffective collision: does not lead to products

mechanism: the details of how molecules collide with how and in what order and orientation in order for the reaction to take place.

enthalpy: the sum of the kinetic and potential energy of the molecules. (Kinetic energy is the energy due to motion and is measured by temperature. Potential energy is the energy of the chemical bonds.) Enthalpy can be converted to heat, and *vice-versa.*

reaction coordinate: a diagram that shows energy *vs.* progress of a chemical reaction.



activation energy (ΔEact): minimum kinetic energy needed for a collision to produce the transition state (and therefore proceed to form products).

enthalpy of reaction (ΔHrxn): the difference between the enthalpy of the products and the enthalpy of the reactants. The enthalpy change is what produces or consumes heat in a chemical reaction.



 (Potential)

 (Progression of Reaction)

In order for a reaction to initiate, molecular collision must occur between the reactants. Not every collision will result in a successful reaction occurring however, as two requirements must be met.

1. The molecules must collide with enough KE to reach the activation energy of the transition state.
2. The molecules must meet in the correct orientation to facilitate the formation of an activated complex (highly unstable, higher energy state, intermediate molecule).

Ex: H2 (g) + I2 (s) → 2HI (s)

Variables that influence reaction kinetics:

1. Catalysts: a substance that speeds up a reaction by lowering the activation energy (ΔEact) of the rate-limiting step.
2. Reactant Concentrations: Increases probability of collisions by increasing the number of molecules present in solution.
3. Temperature: Increases probability of collisions and likelihood of obtaining activation energy by increasing the KE of molecules present in solution.
4. Strength of Intramolecular Forces: Weak bonds require lower activation energy to break during the formation of the activated complex.
5. Molecular Shape: The less steric hindrance present, the easier it is to form the activated complex.
6. Surface Area: Increases the probability of molecular collision between reactants.