

Chapter 13  
**Chemical Kinetics: Clearing the Air**  
Learning Objectives

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To satisfy the minimum requirements for this course, you should be able to:

1. Understand the concept of reaction rates and be able to:
  - use the coefficients of a balanced chemical equation to express the rate of reaction in terms of the change in concentration of a reactant or product over time.
  - distinguish between instantaneous rates and average rates from a graph.
  - calculate average rate from tabulated numeric data.
2. Determine the rate law for a reaction from initial rate data and from a rate law be able to determine:
  - how reaction rate varies with change in reactant concentration.
  - the order of reaction with respect to each reactant.
  - the overall order of reaction.
  - the rate constant with units.
3. Recognize the integrated rate laws and be able to:
  - use integrated zero-order, first-order, and second-order rate laws to find the value of one variable, given values of the other variables.
  - explain the concept of reaction half-life and describe the relationship between half-life and rate constant for first-order and second-order reactions.
  - determine the order of the reaction from plots of concentration versus time,  $\ln(\text{concentration})$  versus time, and  $1/(\text{concentration})$  versus time.
4. Explain how reactions occur at the molecular level. Specifically:
  - explain the concept of activation energy and how it relates to the reaction rate including variation of reaction rate with temperature.
  - be able to interpret potential energy profiles and use them to determine the activation energy and potential energy changes for a reaction.
  - be able to use the Arrhenius equation (equation 13.29) to calculate a rate constant, activation energy, and frequency factor, including calculating rate constants at different temperatures (equation 13.30).
5. Interpret a reaction mechanism and:
  - identify the reaction intermediate(s) and catalyst(s), write the overall reaction, and determine the molecularity of each step.
  - describe the effect of a catalyst on the energy requirements for a reaction.
  - sketch a potential energy profile showing the activation energies for the forward and reverse reactions and show how they are affected by the addition of a catalyst.
6. NavApp: Chemical Warfare (see handout)
  - recognize selected classes of toxic agents of military importance: blister agents, (mustard, lewisite), nerve agents (sarin, VX), choking agents (chlorine, phosgene), blood agents (HCN), riot control agents
  - explain the mechanism by which sarin inhibits acetylcholinesterase