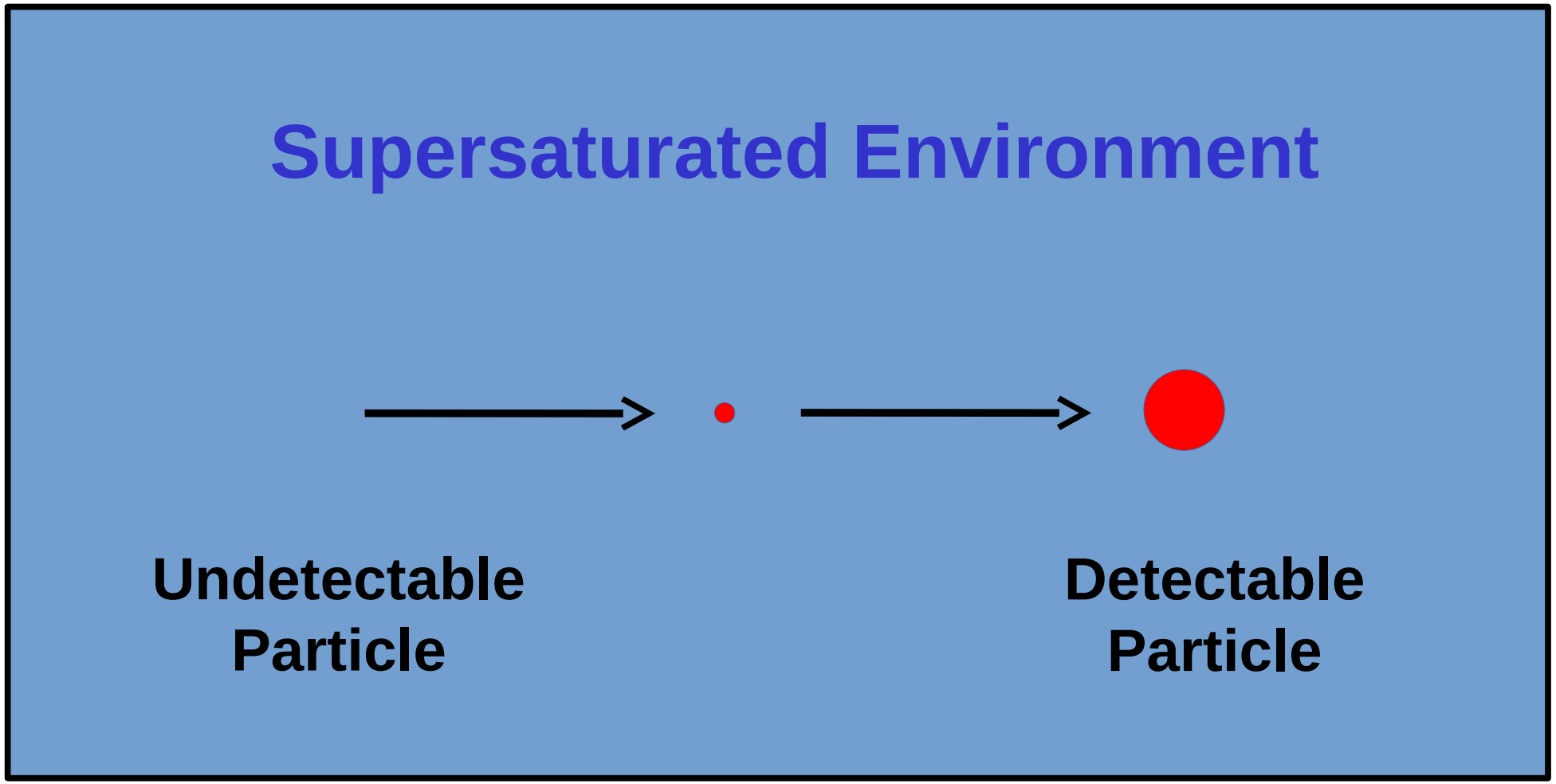
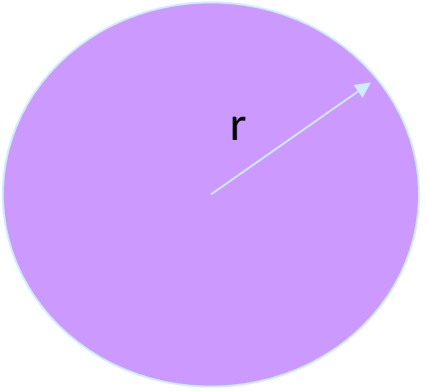
Droplet Growth



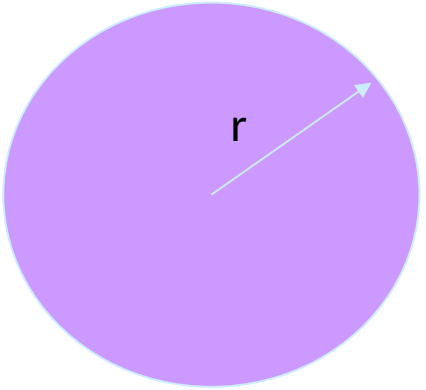
Factors Affecting Growth of Droplets

- Curvature Effect
- Solute Effect
  - Droplets grow when more water molecules at surface go into the droplet than escape from the surface.



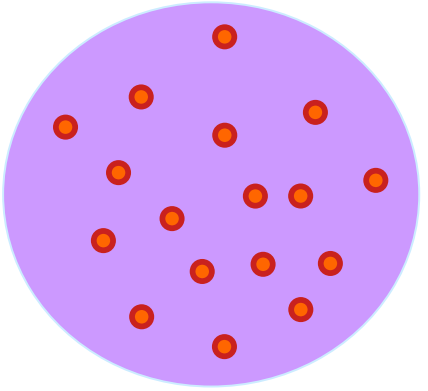
Effect of Curvature

- Effect of curvature is to enhance the equilibrium vapor pressure by a factor of 1/r.
- Small droplets have a difficult time to keep from evaporating.
- This is the primary reason for the fact that large aerosols make better cloud concentation nuclei (CCN).



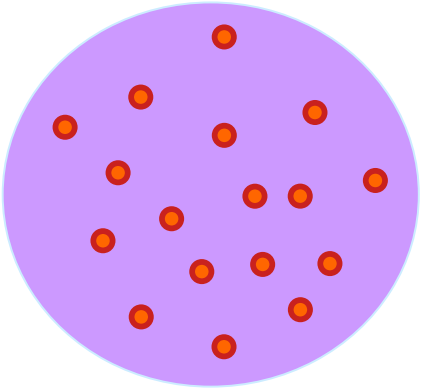
Solute Effect on Droplet Growth

- Effect of dissolved substances in the water is to lower the vapor pressure required for equilibrium.
- The more concentrated the dissolved substance, the greater the depression of the equilibrium vapor pressure.
  - Saltier droplets need less supersaturation to survive.



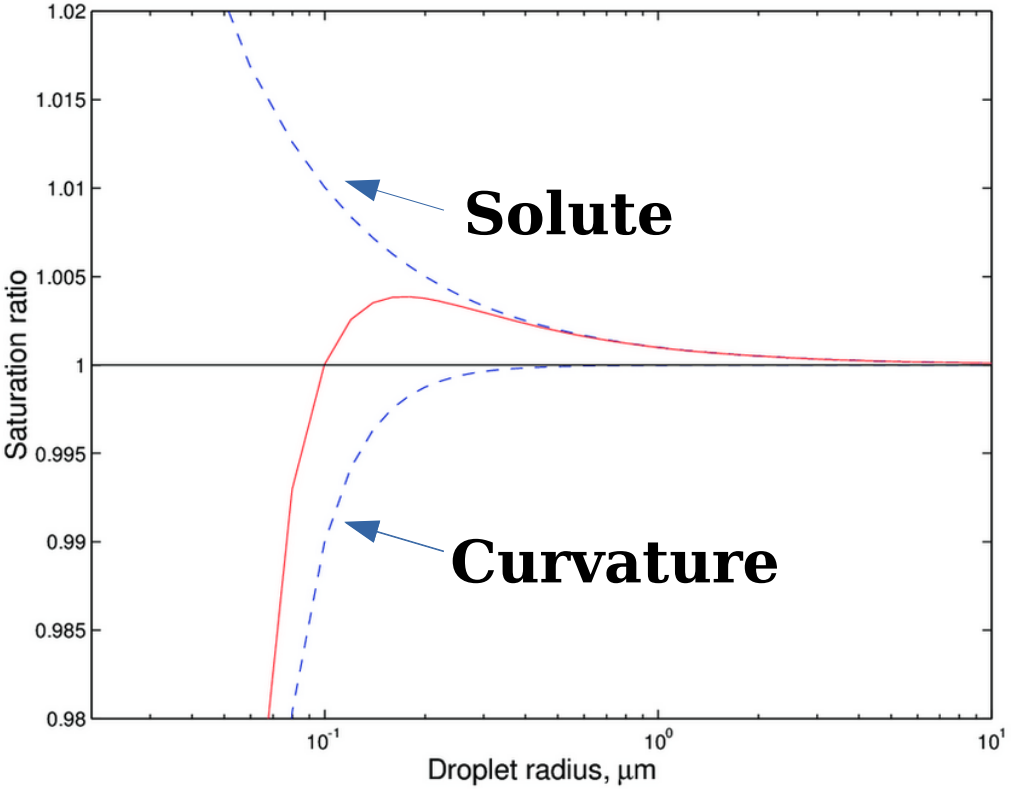
Growing Droplet Salt Concentration

- As water begins to condense on the soluble particle, the concentration of salt is very high.
- As more and more water vapor condenses (the bigger the droplet gets), the more dilute the solute becomes and the smaller the solute effect becomes.



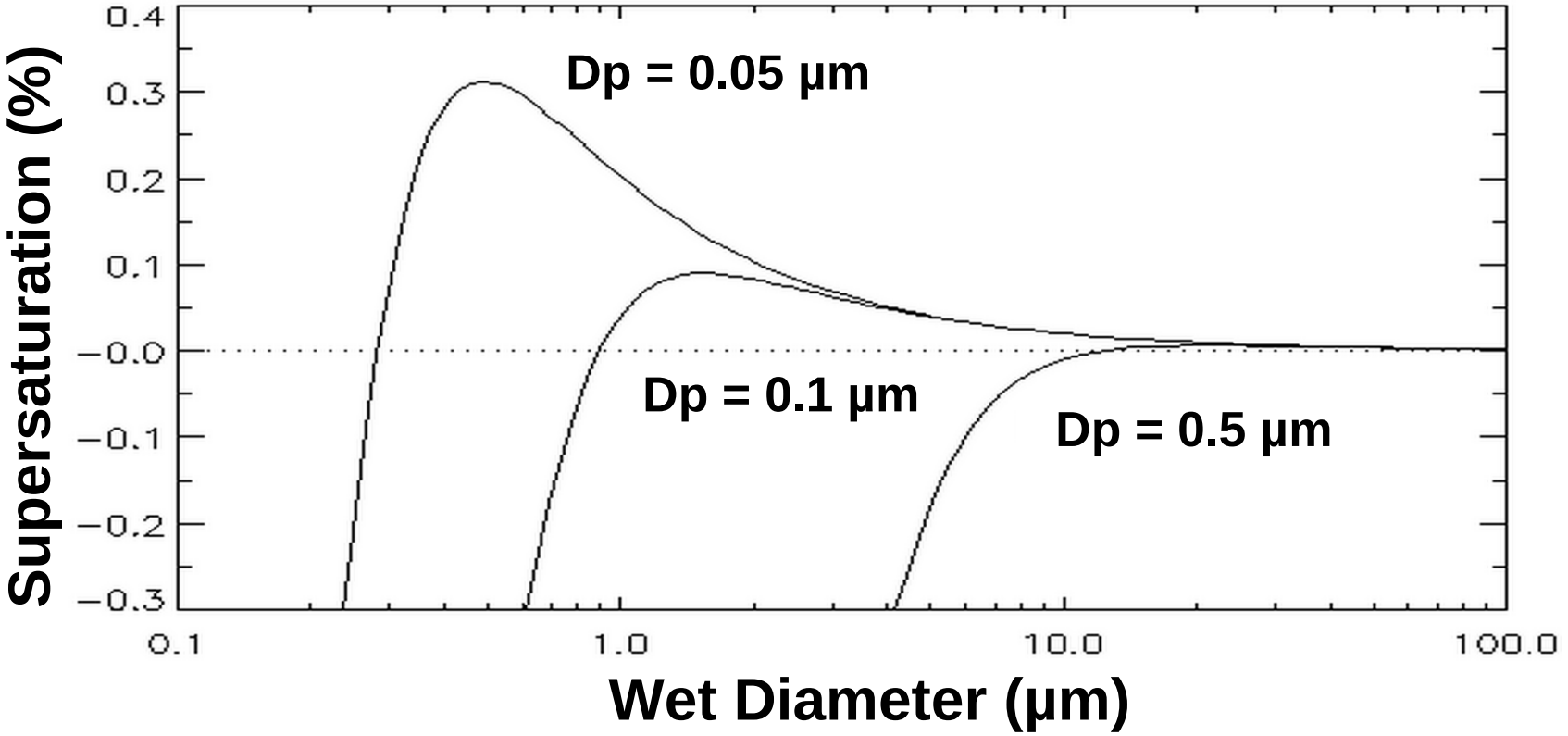
Equilibrium around a Small Droplet

- Combining the Three Effects
  - Clausius-Clapeyron Relationship
    - Temperature
  - Curvature Effect
    - Radius of the Droplet
  - Solute Effect
    - Characteristics of the Cloud Condensation Nucleus



Köhler (Koehler) Curves

- Families of curves showing the effects of curvature and solute on the vapor pressure required for equilibrium.



Droplet Growth in Cloud Formation Process

- Rising air expands and cools.
- Relative humidity increases.
- Hygroscopic, soluble, and large cloud condensation nuclei (CCN) activate.
- Drops grow.
- Relative humidity continues to increase past 100 % and more droplets form.
- Droplets exceed critical size and continue taking up available water vapor even supersaturation decreases.
- Relative humidity starts decreasing back toward 100 % and no new droplets are formed.