Properties of Liquids
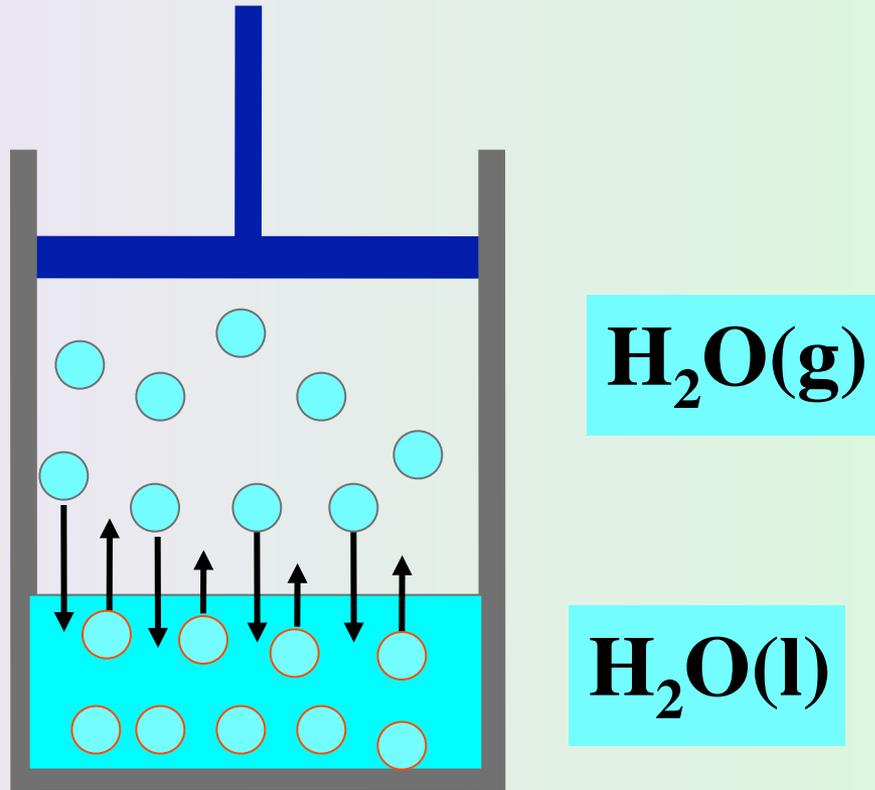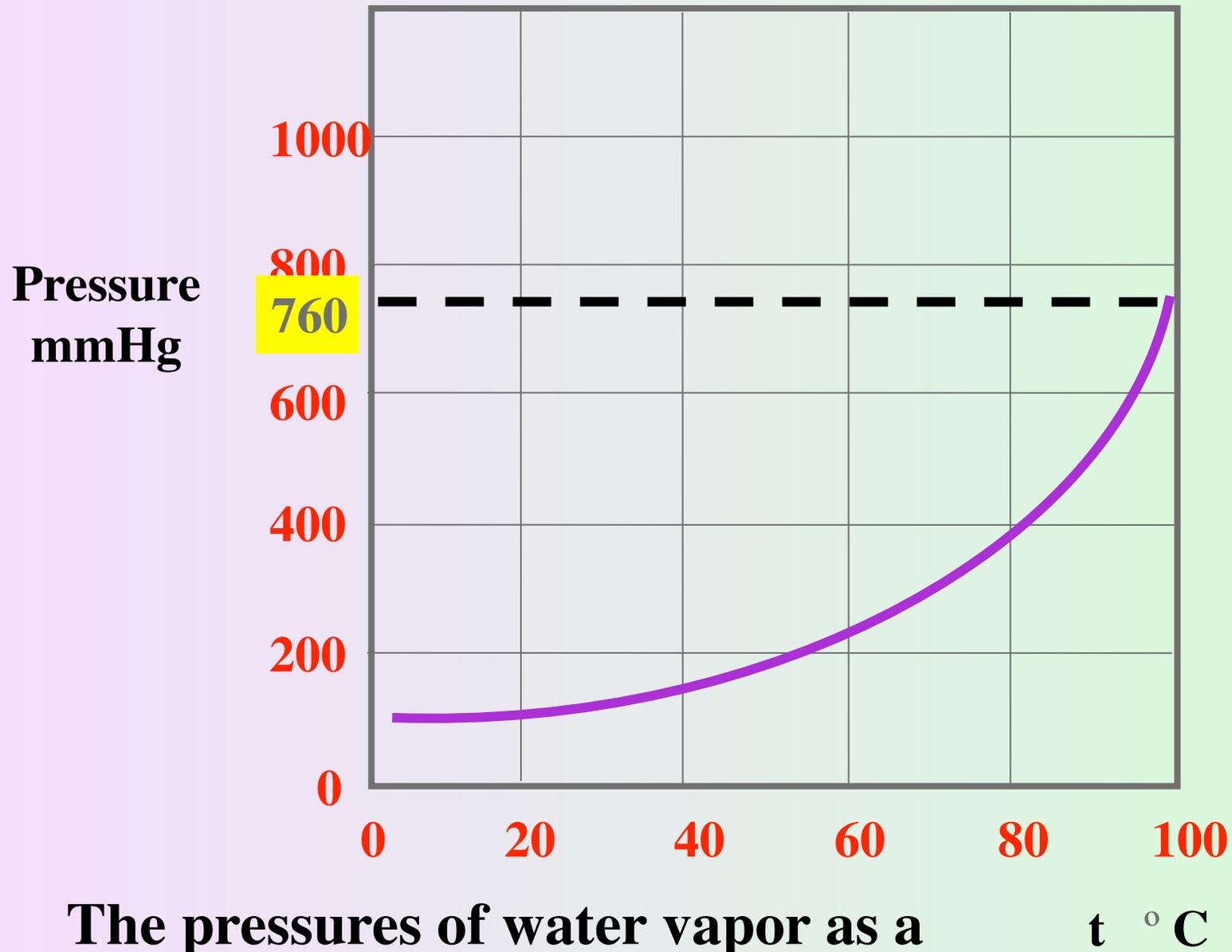
vapor pressure   surface tension

viscosity

Vapor Pressure

The pressure exerted by a vapor in equilibrium with its liquid

$H_2O(g)$

$H_2O(l)$

The pressures of water vapor as a function of temperature.

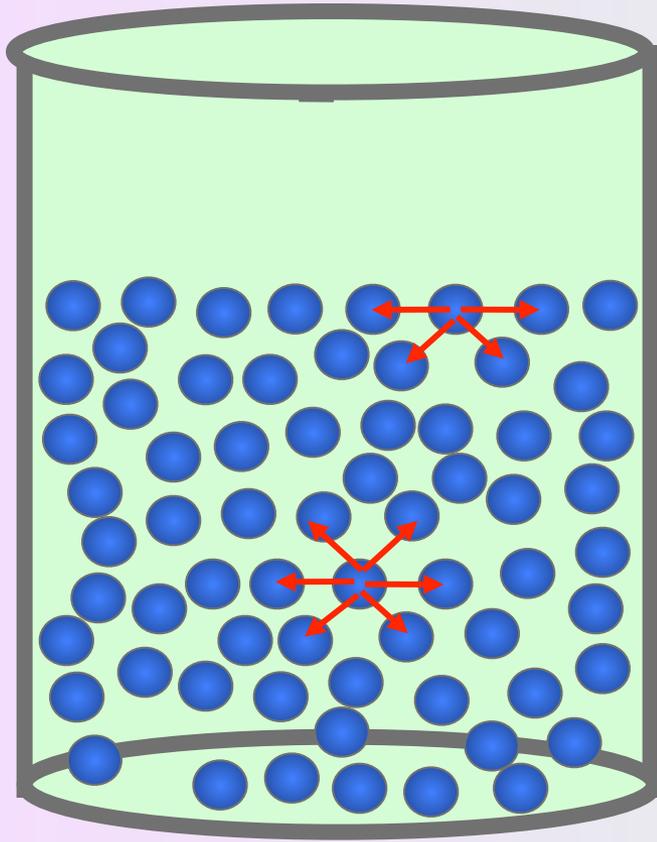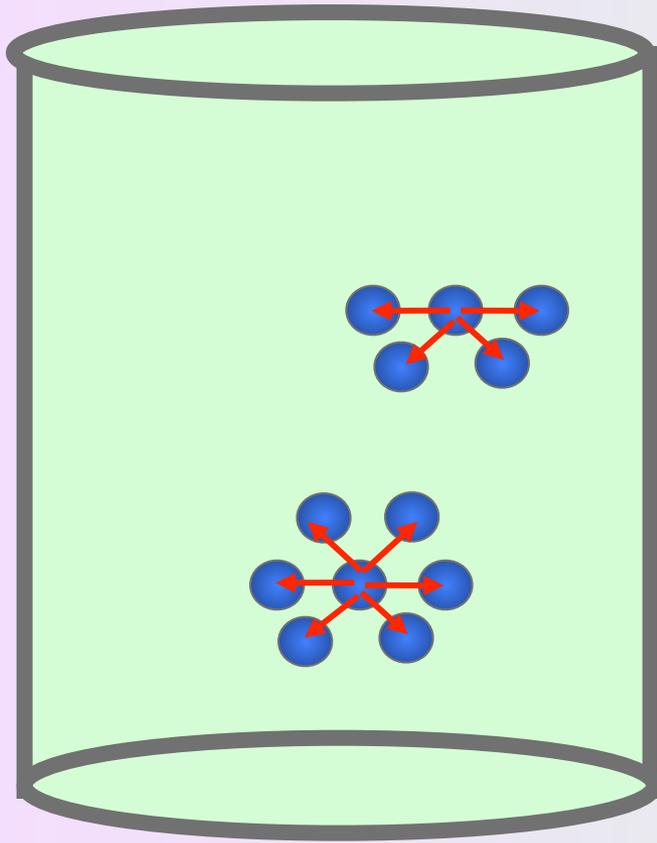| Temperature (°C)	Water Vapor pressure (mmHg)
20	17.54
25	23.76
30	31.82
35	42.18

Surface tension

the tendency of a liquid to minimize
its surface

or

the amount of energy needed to
stretch or increase the surface area

Intermolecular forces acting on a molecule in the surface layer of a liquid and the interior region of the liquid

Intermolecular forces acting on a molecule in the surface layer of a liquid and the interior region of the liquid

Easier for an individual molecule to escape to the gas phase from the surface of a liquid than the interior

What affects surface tension?

High surface tension is related to strong intermolecular forces

    Water: 73 dynes/cm

        principal intermolecular force is hydrogen bonding

    Octane(C_8H_{18}): 22 dynes/cm

        principal intermolecular force is induced dipole- induced dipole
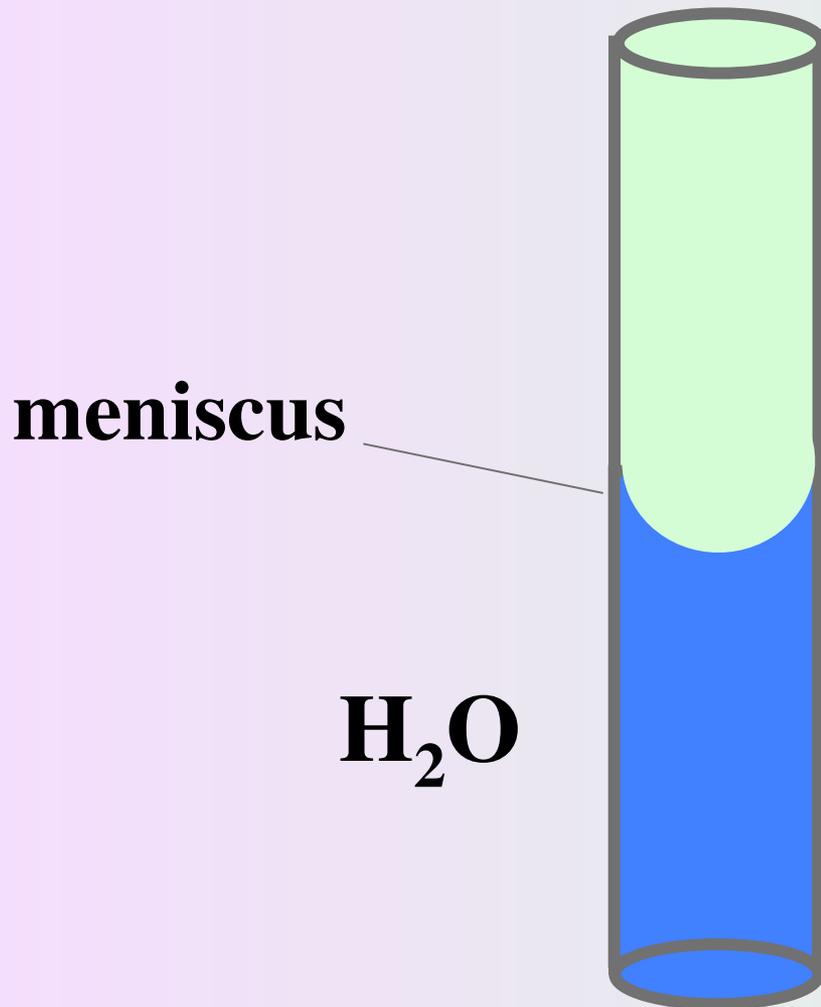
Capillary Action

is a manifestation of surface tension

an example is water rising in a narrow tube

two forces (**cohesion** and **adhesion**) are involved

Cohesion: is the attraction between molecules of the liquid

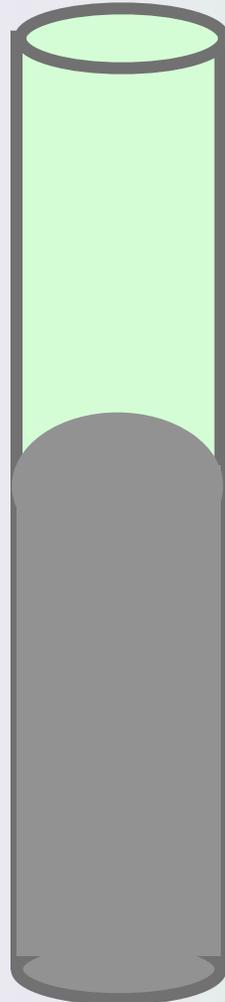**Adhesion** : attractive forces between the liquid and the glass

Capillary Action

meniscus

adhesive forces are stronger than the cohesive forces

H_2O

Capillary Action

Hg

cohesive forces are stronger than the adhesive forces

viscosity

a measure of a liquid's resistance to flow

Viscosity of some common liquids at 20° C

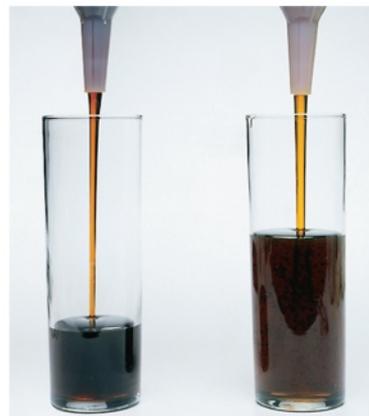| liquid	Viscosity*
H_2O	1×10^{-3}
$HOCH_2CH_2CH_2OH$	1.5
$CH_3CH_2OCH_2CH_3$	2×10^{-4}

*units are Newton seconds per square meter (N s /m²)

Viscosity

- Resistance of a liquid to flow is called **viscosity.**

- It is related to the ease with which molecules can move past each other.

- Viscosity increases with stronger intermolecular forces and decreases with higher temperature.

SAE 40
higher number
higher viscosity
slower pouring

SAE 10
lower number
lower viscosity
faster pouring

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TABLE 11.4 • Viscosities of a Series of Hydrocarbons at 20 °C		
Substance	Formula	Viscosity (kg/m-s)
Hexane	$CH_3CH_2CH_2CH_2CH_2CH_3$	3.26×10^{-4}
Heptane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	4.09×10^{-4}
Octane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	5.42×10^{-4}
Nonane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	7.11×10^{-4}
Decane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	1.42×10^{-3}

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Intermolecular Forces