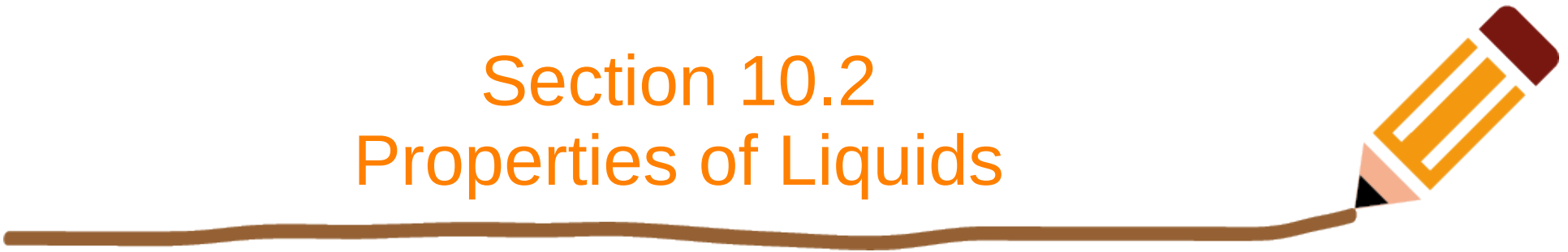
# Section 10.2
# Properties of Liquids



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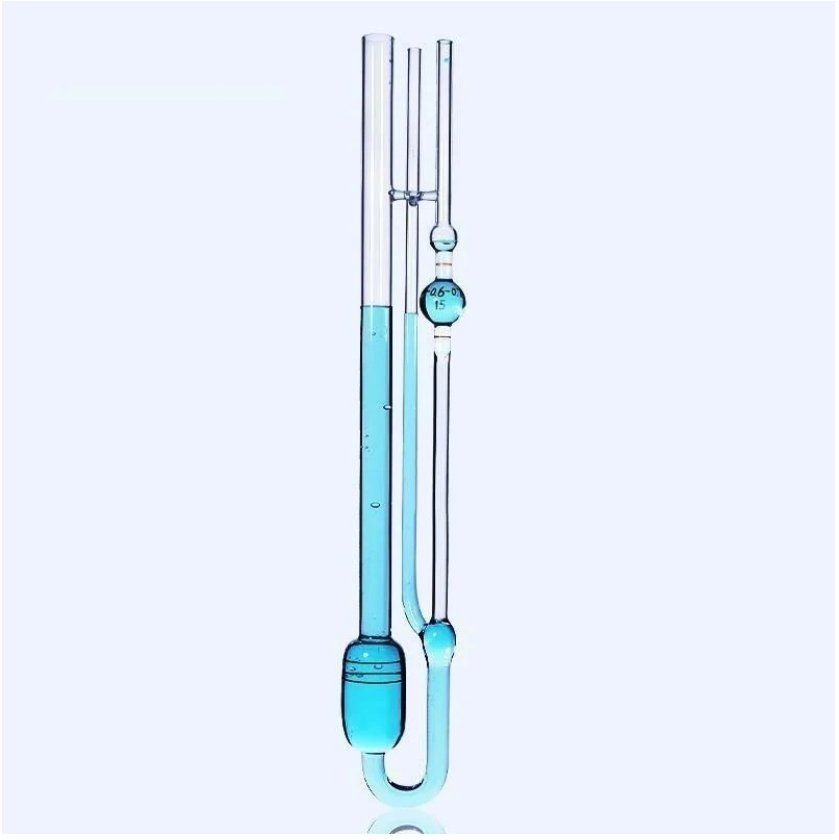
# Learning Objectives

- Distinguish between adhesive and cohesive forces
- Define viscosity, surface tension, and capillary rise
- Describe the roles of intermolecular attractive forces in each of these properties/phenomena

# Viscosity

- Viscosity is a measure of a liquid's resistance to flow.
- Low viscosity liquids include: water, gasoline, or acetone
- High viscosity liquids include: honey, motor oil
- It is measured in a number of ways
  - Rotating a spindle in a liquid and measuring the force required to maintain a certain rpm
  - measuring the amount of time it takes for the liquid to pass through a thin tube.

# Viscometers



# Viscosities of Common Substances

| Substance | Formula | Viscosity (mPa·s) |
|---|---|---|
| water | $H_2O$ | 0.890 |
| mercury | Hg | 1.526 |
| ethanol | $C_2H_5OH$ | 1.074 |
| octane | $C_8H_{18}$ | 0.508 |
| ethylene glycol | $CH_2(OH)CH_2(OH)$ | 16.1 |
| honey | variable | ~2,000–10,000 |
| motor oil | variable | ~50–500 |

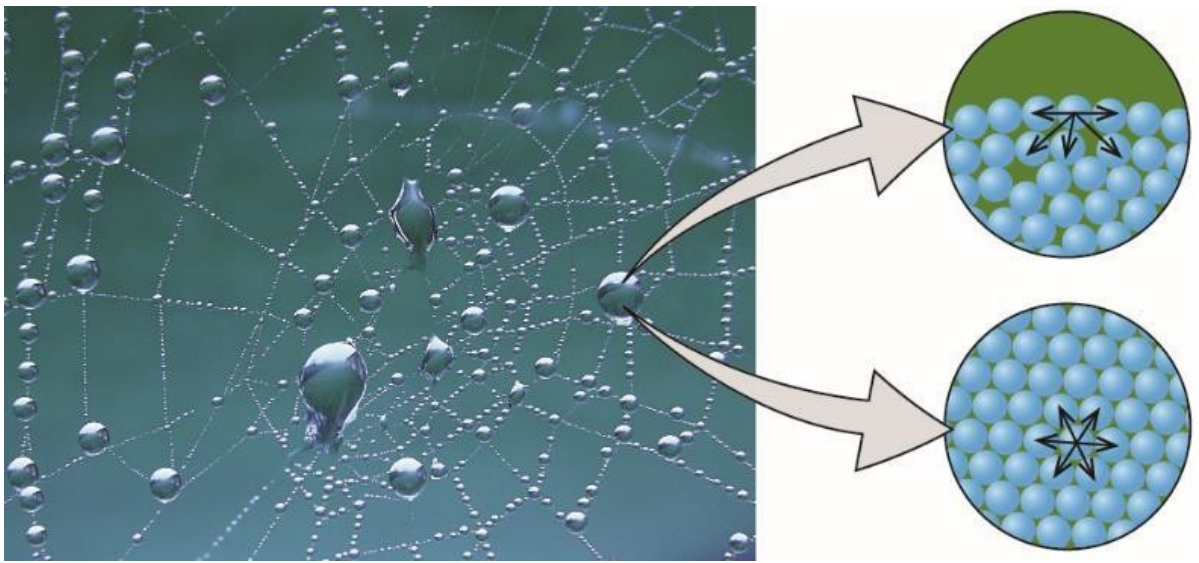
**Table 10.2**

# Cohesives Forces vs. Adhesive Forces

- **Cohesives Forces** are attractive forces between *identical molecules.*
- **Adhesive Forces** are attractive forces between *different molecules.*
- Both of these types of forces are the result of intermolecular forces.

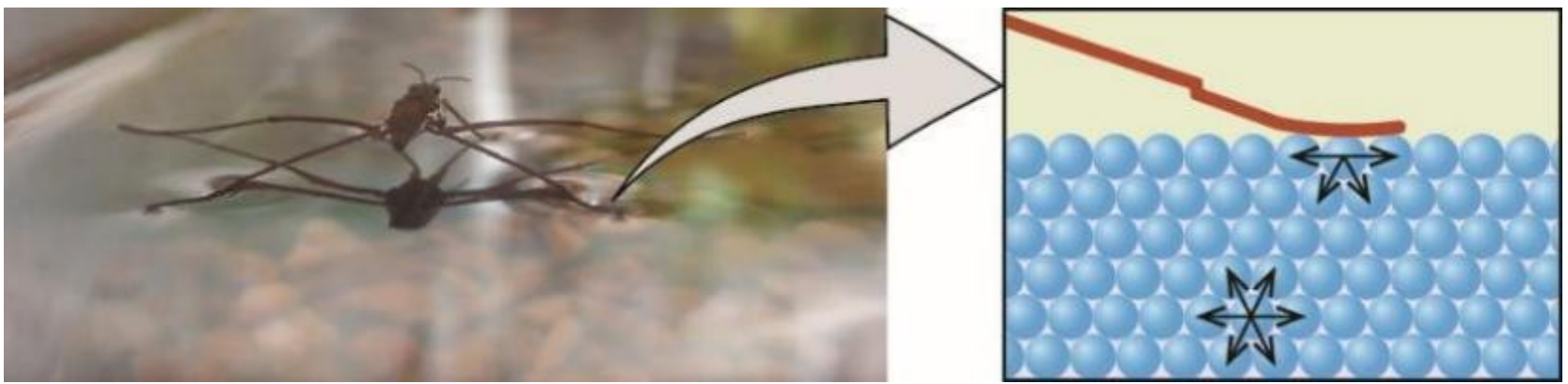
# Surface Tension

- **Surface tension** is defined as the energy required to increase the surface area of a liquid, or the force required to increase the length of a liquid surface by a given amount.



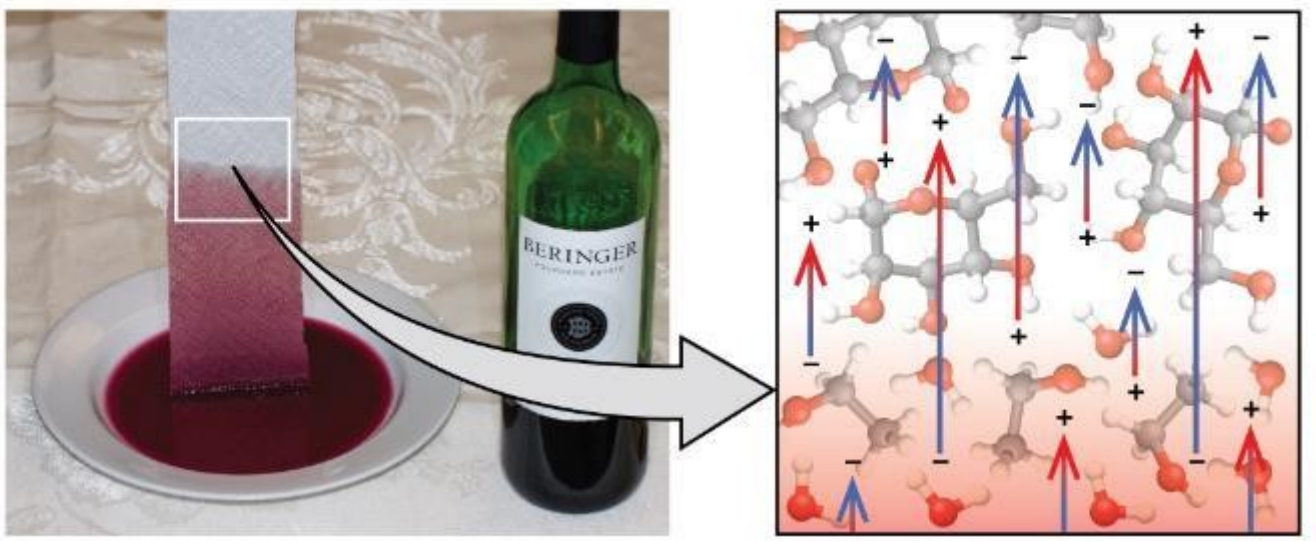
# Surface Area Continued

- Surface tension results in a sort of “skin” on the outside of a liquid as it requires force to distort the geometry of the liquids surface.



# Capillary Action

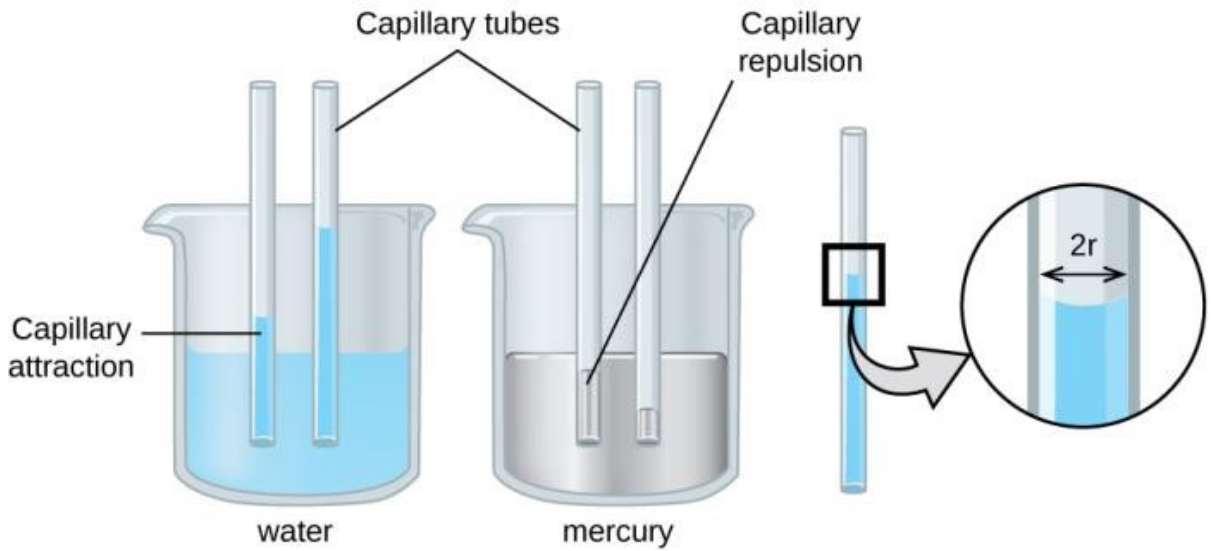
- Adhesive forces cause a phenomenon called capillary action.
- Attractive forces between a liquid and surface will cause a liquid to “climb” up a container wall or “wick” up into a material.



# Calculating Capillary Rise

- We can calculate the degree of capillary rise. There are a few more variables here than you may be used to.

$$h = \frac{2T\cos\theta}{r\rho g}$$



# Conclusions

- Cohesive forces will cause a liquid to attract itself causing droplets, surface tension, and negative capillary rise.
- Adhesive forces will cause a liquid to be attracted to surfaces causing positive capillary rise and wetting of surfaces.
- Both cohesive and adhesive forces are caused by intermolelcular forces.