



Figure 1.12 The phases of water and the phase changes

Evaporation

Evaporation occurs when energy from solar radiation hits the surface of water or land and causes liquid water to change state from a liquid to a gas (water vapour). The rate of evaporation depends upon:

- the amount of solar energy
- the availability of water (for example, there is more evaporation from a pond than from a grassy field).
- the humidity of the air; the closer the air is to saturation point, the slower the rate of evaporation
- the temperature of the air; warmer air can hold more water vapour than cold air.

Linked to this is the fact that all terrestrial plants lose water through **transpiration**. This is where water is transported from the roots of a plant to its leaves and then lost through pores on the leaf surface. Leaves also intercept rain as it falls, and this water can be evaporated before it reaches the soil.

As water evaporates it uses energy in the form of latent heat and so cools its surroundings.

Condensation

As air cools it is able to hold less water vapour. This means that if it is cooled sufficiently then it will get to a temperature at which it becomes saturated. This is known as the dew point temperature. Excess water in the air will then be converted to liquid water in the process of **condensation**. The water molecules need something to condense on. These can be tiny particles (smoke, salt, dust, etc.) that are collectively called condensation nuclei, or surfaces (leaves, grass

stems, windows, etc.) that are below the dew point temperature. If the surface is below freezing point then water vapour sublimates, changing directly from gas to solid in the form of hoar frost.

Condensation is the direct cause of all forms of precipitation.

- It takes place when the temperature of air is reduced to dew point but its volume remains constant. This occurs when:
 - warm moist air passes over a cold surface
 - on a clear winter's night heat is radiated out to space and the ground gets colder, cooling the air directly in contact with it.
- It also occurs when the volume of air increases but there is no addition of heat (adiabatic cooling). This happens when air rises and expands in the lower pressure of the upper atmosphere. This can occur when:
 - air is forced to rise over hills (relief or orographic effect)
 - masses of air of different temperatures and densities meet. The less dense warm air rises over the denser cold air (frontal effect)
 - localised warm surfaces heat the air above. This expands, becomes less dense and rises (convective effect).

Review questions

- 3 Rain, drizzle, snow, sleet and hail are all forms of precipitation. What are the key differences in their formation?
- 4 What are the similarities and differences in the formation of dew and hoar frost?

Cryospheric processes

Chapter 4 discusses in detail the two main **cryospheric processes** of **accumulation** and **ablation** (melting) on page 145, and slope processes on page 160.

It is thought that there have been five major glacial periods in Earth's history. The most recent started 2.58 million years ago and continues today; it is called the **Quaternary** glaciation. During this time there were:

- glacial periods when, due to the volume of ice on land, sea level was approximately 120 m lower than present and continental glaciers covered large parts of Europe, North America, and Siberia. This represents an interruption in the global hydrological cycle