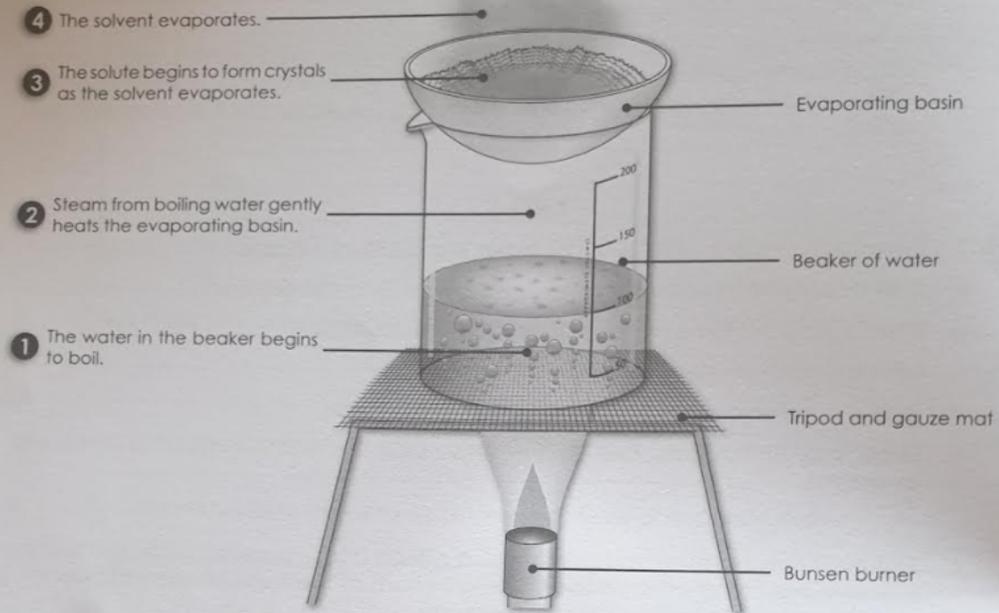


## Separating Solutions

Although a solution is a mixture, the solute cannot be separated from the solvent by filtration. The solute will simply pass through the filter paper.

### Evaporation - Separating a Solid Dissolved in a Liquid



### Separating a Mixture using Evaporation

**Aim:** To separate a solute from a solvent in a solution using evaporation.

**Equipment:** Copper sulfate solution, 250 mL beaker, heatproof mat, an evaporating basin, Bunsen burner, tripod, gauze mat.

- Method:**
1. Set up the Bunsen burner, tripod and gauze mat. Don't place the Bunsen burner under the tripod yet.
  2. Add approximately 50 mL of hot water to your beaker and place it on top of the tripod, on the gauze mat.
  3. Add enough copper sulfate solution to quarter fill the evaporating basin.
  4. Carefully place the evaporating basin on top of the beaker.
  5. Light your Bunsen burner. Open the air hole and gently push the Bunsen burner under the tripod.
  6. Heat the solution until most of the solvent has been evaporated and crystals of solute are forming.
  7. Turn off your Bunsen burner.



**Observations:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1. Outline two factors that affect the speed of evaporation (i.e. how can the speed of evaporation be increased?).

(a) \_\_\_\_\_  
(b) \_\_\_\_\_

## An Ocean of Salt - Table Salt Production at Lake Grassmere

Sodium chloride, common table salt, is essential to human life. Our bodies contain up to 450 grams of salt and we need to take in a few grams each week to stay healthy. The growth of industry has increased the demand for salt, both for direct use and as a raw material for producing other chemicals.

Over half of New Zealand's salt is produced at Lake Grassmere in Marlborough. Salt is produced by evaporating and concentrating the salt found in sea water.

### Concentrating the salt

Sea water containing 3.5% salt (35.0 g of salt for every litre of water), is pumped into Lake Grassmere. Wind and sun evaporate the water, increasing the salt concentration. When the salt content in the lake has increased to 5% the brine is transferred to a series of large concentration ponds. *Brine* is the name given to any salty solution.

When the brine has increased to 25% salt, it is called a saturated solution. At this point around 90% of the original sea water has evaporated. The solution is then pumped from the concentration ponds into deep holding ponds, where it is held over winter.

In October of each year the six-monthly salt-making process begins. The saturated solution is pumped from the deep holding ponds into shallower crystallisation ponds. The salt forms crystals on the bottom of these ponds as the water evaporates over the summer.

### Harvesting

In March, when the salt is ready for harvest, the unwanted minerals (called 'bitterns') are pumped from the crystallisation ponds into the sea. Unseasonable rain during harvesting can mean that no salt is harvested. Usually only 50 millimetres of rain falls during the autumn harvest period, and as rainwater is less dense than brine, it forms a surface layer that can be removed.

After the crystallisation ponds are drained, mechanical harvesters work for about five weeks scooping up the crystallised salt crust or 'cake', that varies in thickness from 25 to 100 millimetres. The salt is loaded onto trucks and taken to the washery. There, it is washed with saturated brine to remove mud and other impurities. The salt is then stacked in huge piles. After it has been crushed and sieved to produce similar-sized grains, it is sent to be packaged and sold.

Source: Carl Watland: 'Salt - Salt making at Lake Grassmere', Te Ara - the Encyclopedia of New Zealand.



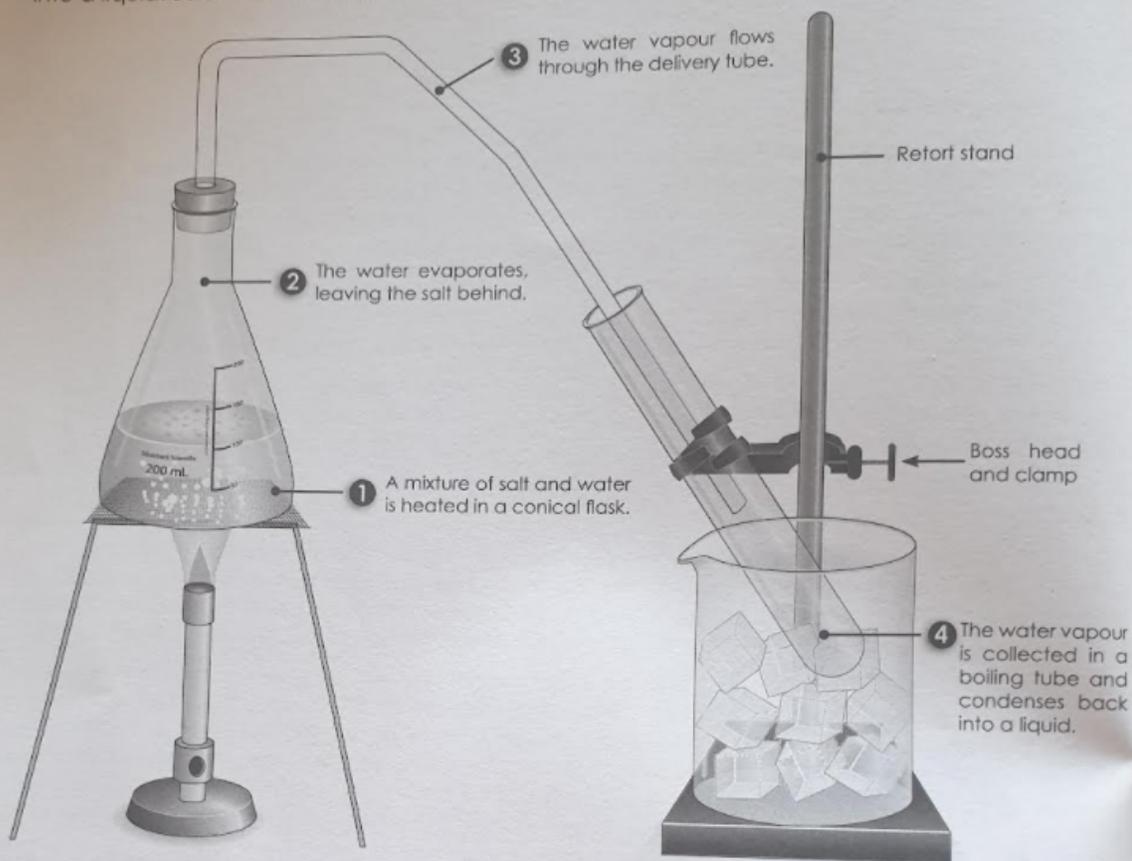
- Use the information from the reading to put the following stages of salt production into the correct order. The first stage and the last stage have been done for you.

Process	Stage of production
Sea water pumped into Lake Grassmere	1
Crushing and sieving	
Washing with brine	
Concentrating ponds	
Crude salt is made	
Re-crystallising	
Crystallising ponds	
Deep storage ponds	
The salt is packaged and sold	9

- Explain why salt harvesting at Lake Grassmere only occurs at the end of summer. \_\_\_\_\_  
\_\_\_\_\_
- Define the term *brine*: \_\_\_\_\_
- Calculate how many grams of salt would be found in a litre of saturated salt solution.  
\_\_\_\_\_

## Distillation - Separating a Solid Dissolved in a Liquid

Evaporation is a simple technique for separating a solid dissolved in a liquid. However, what if we want to collect the solvent as it evaporates and condense it back into a liquid. Scientists call this process *distillation*.



### Separating a Mixture using Distillation

**Aim:** To separate a solute from a solvent in a solution using distillation.

**Equipment:** A solution of saltwater, conical flask, heatproof mat, a delivery tube and bung, Bunsen burner, tripod, gauze mat, retort stand, boss head and clamp, boiling tube.

**Method:** 1. Set up the equipment as shown in the diagram.



2. Add approximately 50 mL of saltwater to your conical flask.

3. Light your Bunsen burner. Open the air hole and gently push the Bunsen burner under the tripod.

4. Heat the solution until most of the solvent has been evaporated. Turn off your Bunsen burner.

**Observations:** \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

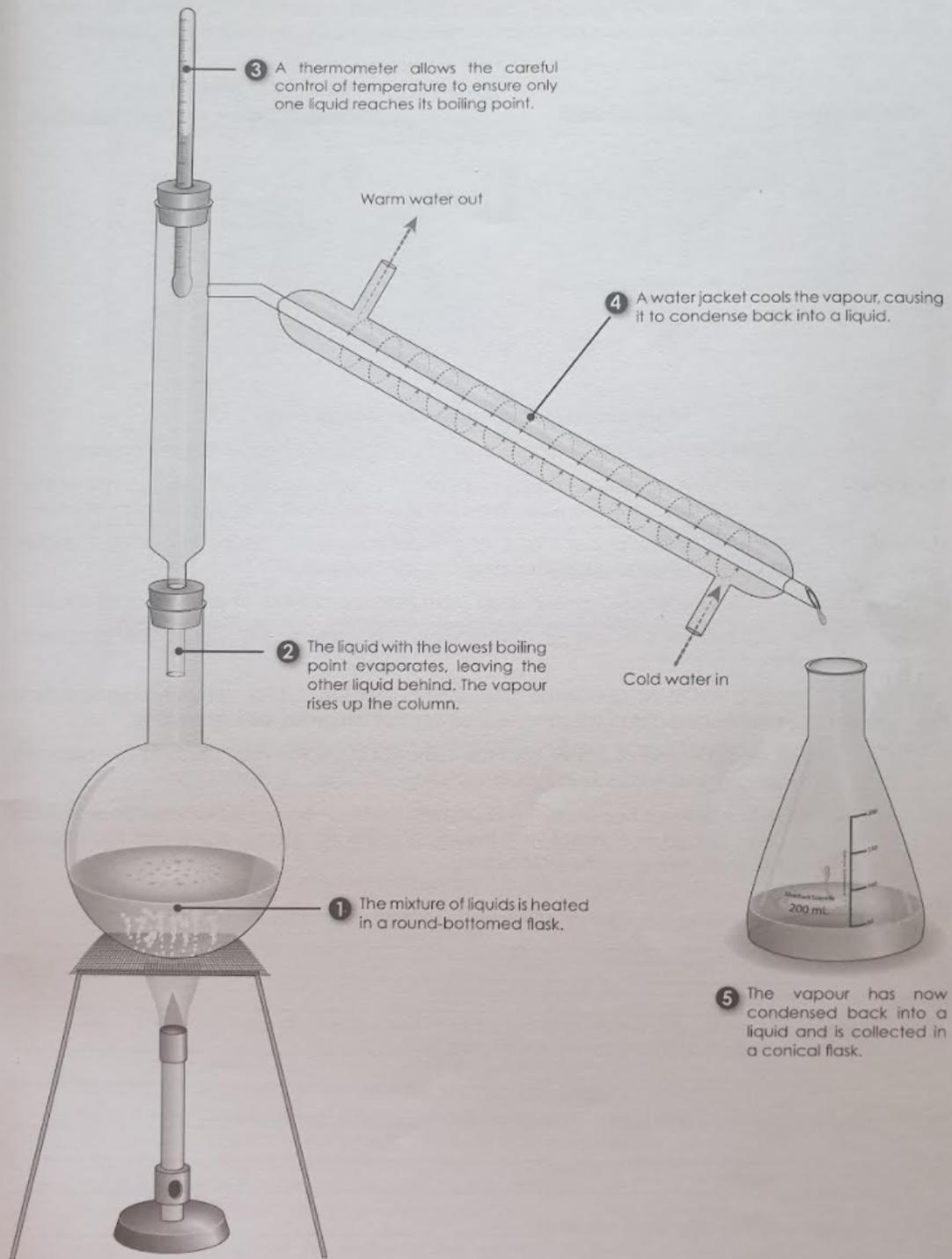
1. Name and describe the process occurring in the:

(a) conical flask. \_\_\_\_\_  
 \_\_\_\_\_

(b) delivery tube. \_\_\_\_\_  
 \_\_\_\_\_

## Understanding the Liebig Condenser

The Liebig condenser (named after Justus von Liebig) is a piece of laboratory equipment used to separate two liquids, when one liquid has a different boiling point than the other.



1. What is the scientific word for the process occurring at:

**1**

\_\_\_\_\_

**4**

\_\_\_\_\_

## Answers

### Separating a Mixture using Evaporation

**Aim:** To separate a solute from a solvent in a solution using evaporation.

**Equipment:** Copper sulfate solution, 250 mL beaker, heatproof mat, an evaporating basin, Bunsen burner, tripod, gauze mat.

**Method:** 1. Set up the Bunsen burner, tripod and gauze mat. Don't place the Bunsen burner under the tripod yet.



2. Add approximately 50 mL of hot water to your beaker and place it on top of the tripod, on the gauze mat.



Copper compounds are poisonous

3. Add enough copper sulfate solution to quarter fill the evaporating basin.

4. Carefully place the evaporating basin on top of the beaker.

5. Light your Bunsen burner. Open the air hole and gently push the Bunsen burner under the tripod.

6. Heat the solution until most of the solvent has been evaporated and crystals of solute are forming.

7. Turn off your Bunsen burner.

**Observations:** As the water boiled, the steam heated the evaporating basin causing the copper sulfate solution to evaporate. As the water left the basin, small crystals of solid copper sulfate were left deposited around the basin.

1. Outline two factors that affect the speed of evaporation (i.e. how can the speed of evaporation be increased?).

(a) Temperature (higher temp = faster evaporation).

(b) Surface area (greater surface area = faster evaporation).

1. Use the information from the reading to put the following stages of salt production into the correct order. The first stage and the last stage have been done for you.

Process	Stage of production
Sea water pumped into Lake Grassmere	1
Crushing and sieving	7
Washing with brine	5
Concentrating ponds	2
Crude salt is made	8
Re-crystallising	6
Crystallising ponds	4
Deep storage ponds	3
The salt is packaged and sold	9

2. Explain why salt harvesting at Lake Grassmere only occurs at the end of summer. Salt production only occurs during summer to decrease the chance of rain diluting the brine solution or dissolving the salt crystals.

3. Define the term *brine*: The name given to a salty solution.

4. Calculate how many grams of salt would be found in a litre of saturated salt solution.

25% solution = 250 grams of salt per litre.

burner.

Observations: The solution boils and steam can be observed moving up the conical flask. Water drops form in the delivery tube and run into the beaker. White crystals form in the conical flask.

1. Name and describe the process occurring in the:

- (a) conical flask. Evaporation is occurring here as the Bunsen burner heats the solution and the water changes from a liquid to a gas.
- (b) delivery tube. Condensation is occurring here as the gaseous water cools and changes back into a liquid state.

1. What is the scientific word for the process occurring at:

- ① Boiling/Evaporation
- ④ Condensation