Lesson 1

A low pressure system over an area can cause rain and strong winds! The table below gives us some examples of low pressure systems over an area.

Severe storms over South Coast
Largest hailstones ever recorded
Flooding sweeps Mozambique
Snowstorm traps mountain climbers
100 km winds in desert
Lightning destroys forest

Lesson 1 objectives

- Upon completion of this unit you will be able to:
- describe high and low pressure systems and identify them on a map
- describe the weather associated with high and low pressure systems

Global Pressure Systems

Namibia is situated more or less between 17°S and 30°S. The direct rays of the sun are falling on the Equator, resulting in high temperatures. The air above the Equator is warmed up and it starts to ascend (rise). As it rises, the air becomes colder. Cold air has the tendency to descend (sink). Namibia is situated in the area where the air descends.
Fact 1: When air is heated it expands, because the molecules move further away from each other. This causes the air to become less dense (lighter) than the surrounding air and the air starts to ascend (rise).

Fact 2: When air cools it contracts, because the molecules move closer together. This causes the air to become denser (heavier) than the surrounding air and the air starts to descend (sink).

Fact 3: Warm air will flow from warm to cold areas and cold air will flow from cold to warm areas. When air on the ground is heated, it expands, get less dense and starts to rise, causing a low pressure to form, as happens over the equator. When the air in the atmosphere cools down, it becomes denser and heavier and start to sink, causing a high pressure to form between the latitudes of 17°S and 30°S (where Namibia is situated). These circular movements of air are called convection currents. Air will always move as wind from an area of high pressure to an area of low pressure. From the information, it is clear that our country's weather and climate is greatly influenced by this subsiding air, also called a high pressure system.

Low Pressure System

Let us now look at high and low pressure systems in more detail, such as how they develop, how air moves within these systems and how this air movement influences temperature and climate.

A low pressure system or cell

- Low pressure systems are also called cyclones or depressions.
1. At A warm air is heated, it becomes less dense and it starts to rise. Because it is moving away from the surface of the earth, there will be less pressure. So A will have a low pressure.
2. Warm rising air will form clouds.
3. Clouds will lead to rain.
4. At B the air pressure is higher, so air will Flow from B to A.

Low Pressure System Continue

The rising air starts a clockwise spiralling movement, causing the air to move from the outside to the inside. Because warm, rising air is less dense, it can hold a lot of water vapour. As it rises it will start to cool down and condensation will take place, resulting in cloud formation. Therefore, a low pressure system is always associated with the possibility of rain, except along the coast. To see an animated movement of the low pressure system, click on the button "Click here" under the Heading "Animation of Low Pressure Cell"

High pressure weather

1. Warm air is rising at A and starts to cool down.
2. Cool air becomes denser and heavier and is forced aside.
3. The cold, sinking air is pressing down on the surface over B and causes pressure at B to rise.
4. High pressure occurs at B.
5. No water vapour
condenses and no clouds form. The sky is clear.

A high pressure system or cell (anti-cyclone)

<table>
<thead>
<tr>
<th>Anticyclone from above</th>
<th>Anticyclone from the side</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Anticyclone from above" /></td>
<td><img src="image2" alt="Anticyclone from the side" /></td>
</tr>
</tbody>
</table>

This descending air starts an anti-clockwise spiralling movement, causing the air to move from the inside to the outside. Because this dense, subsiding air cannot hold water vapour, a high pressure system is normally associated with clear (cloudless) skies and no rain.

**Air Rotation**

A low pressure system will always be next to a high pressure system. Air (wind) will always move from a high (H) to a low (L) pressure.

The bigger the difference in air pressure between a L and a H, the stronger the wind will blow. This can cause very violent storms, like hurricanes and tornadoes.
Influence of Pressure Systems

The influence of pressure systems on the climate and weather of Namibia

We will now briefly discuss specific weather systems that influence our weather and climate in Namibia and Southern Africa. The map shows South Africa and Namibia’s latitude position between 17°S and 35°S.

Now let’s see the difference between the position of the pressure cells during winter and summer in the southern hemisphere.

What happens during winter?

During winter, the Atlantic High Pressure System (AHPS) moves in a northeastern direction, closer to the continent and covers a much smaller area of the Atlantic Ocean. The Indian High Pressure System (IHPS) moves in a north-western direction, closer to the continent and also covers a much smaller area of the Indian Ocean, making conditions for rain to form less favourable.

While these two high pressure systems move northwards, the mid-latitude cyclones come closer to the southern part of the sub-continent, resulting in winter rains over the Cape
peninsula. These rainy conditions can sometimes spread as far as Keetmanshoop, causing severe cold and rainy conditions which can lead to livestock losses.

What happens during summer?

During summer, the Atlantic High Pressure System (AHPS) moves in a south-western direction covering a huge area of the cold Atlantic Ocean. The air immediately above the ocean is also cold, which is not favourable for rain to form, resulting in dry conditions on the western part of the sub-continent.

The Indian High Pressure System (IHPS) moves south-eastwards covering a huge area of the warm Indian Ocean. The air immediately above the ocean is also warm which is favourable for the formation of rain. The anti-clockwise movement of the IHPS transports moist air into the eastern part of the subcontinent from where it spreads over the biggest part of southern Africa, making conditions favourable for rain to form.

Because the movement of the Kalahari High Pressure system is more complicated (it moves up and downwards) we will not discuss its movement.

Lesson 1 Summary

- High pressure cells form when air in the atmosphere cools down, becomes more dense and starts to descend to the surface of the earth.

- Low pressure cells form when air on the surface heats up, becomes less dense and starts to rise.

- Air in high pressure systems (H) or anti-cyclones moves anti-clockwise from the inside to the outside (in the southern hemisphere) and is associated with clear skies.

- Air in low pressure systems (L) or cyclones moves clockwise from the outside to the inside (in the southern hemisphere) and is associated with the possibility of rain.

- Air (wind) will always move from a high to a low pressure system.
Temperature, rainfall and air pressure are indicated on climatic maps by a process called interpolation.

Lines connecting places with the same air pressure are called isobars.

Lesson 2

I don’t want to work for the Weather Bureau! There are so many maps – maps for pressure systems, maps for isobars, isotherms and isohyets. Don’t the people there get confused with all the maps they have to use for weather forecasts?

No, not at all! All the information about weather is actually shown on just one map! It is called a synoptic weather map.

We are now going to look at synoptic weather maps in this lesson. Before you continue have a look at the objectives first.

Synoptic Weather Maps

Meteorologists must record weather on a daily basis. All this data (readings) for Namibia is then sent to the Weather Bureau in Windhoek, where it is converted into graphs, tables and maps. Satellite photographs taken from space are also sent to the Weather Bureau. These satellite photographs are very important because they provide valuable information regarding cloud cover. All this information is then indicated (summarised) on a synoptic weather map, which is then used to make weather forecasts.

How to Read a Synoptic Weather Map

<table>
<thead>
<tr>
<th>What is the meaning of all the little symbols on the weather map? It doesn’t look like weather to me!</th>
<th>In order to be able to show all the information on the map, the Weather Bureau must use symbols to indicate the different weather conditions.</th>
</tr>
</thead>
</table>
| How to read a synoptic weather map  
Each weather station is indicated with a circle, as shown in the Figure below.  
Weather conditions for Figure 1  
Max temperature = 23 °C  
Dew point = 16 °C  
Cloud cover = 2/8 or 25%  
Wind direction = NE  
Wind speed = 25 knots  
Precipitation = drizzle |  
Maximum temperature → 23  
Dew point → 16  
Wind direction  
Wind speed  
Type of precipitation  
Station  
Cloud cover |
How to read a Weather Station Model

Wind speed is indicated by a line drawn off the wind direction line. A long feather (line) represents 10 knots and a short feather is 5 knots. If only one feather is indicated, but it is at the end of the wind arrow, for example, it indicates 10 knots. If only one feather is indicated, but it is a short distance away from the end, for example, it means 5 knots.

The wind blows in the direction from the feathered end towards the circle.

Cloud cover is indicated by the shading inside the circle. Figure 2 shows how different shading is used to indicate different types of cloud cover.

Precipitation (rain) is indicated on the right side of the model (circle), only if any precipitation was measured. Figure 3 shows the symbols used for precipitation.

Temperature is indicated on the left side of the model. The maximum dry bulb temperature at 8 a.m. is indicated at the top left and the dew point temperature at the bottom left. Minimum temperatures are not shown on the model. If there was no dew point, only the maximum temperature will be indicated.

<table>
<thead>
<tr>
<th>1 octa</th>
<th>2 octas</th>
<th>3 octas</th>
<th>4 octas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 cloud</td>
<td>2/8 cloud 25%</td>
<td>3/8 cloud</td>
<td>4/8 cloud 50%</td>
</tr>
<tr>
<td>5/8 cloud</td>
<td>6 octas</td>
<td>7 octas</td>
<td>8 octas</td>
</tr>
<tr>
<td>7/8 cloud 75%</td>
<td>overcast 100%</td>
<td>poor visibility e.g. smoke</td>
<td></td>
</tr>
</tbody>
</table>

Symbols to indicate cloud cover in eighths (octas)

- rain
- drizzle = fog
- snow
- thunderstorm
- showers

Symbols representing types of precipitation
On synoptic maps you will also see lots of lines called isobars (see Figure 4). Isobars connect all places with the same air pressure. High pressure cells are indicated with the letter H in the middle of the cell and low pressure cells with the letter L in the middle.

Fronds

A front is the border between huge masses of cold and warm air.

In figure 5 you can also see these symbols:

These represent ‘fronds:

a) rounded frills show the leading edge of a warm front
b) sharp ‘teeth’ show the leading edge of a cold front

Lesson 2 Summary

- All weather conditions are summarised on a synoptic weather map.
- The different conditions are indicated with symbols on a station model.
- Synoptic weather maps also show isobars and cold and warm fronts.
• The amount of cloud cover is recorded by using symbols which represent the fractions (eighths) of the sky covered by clouds.

• This measurement is done in oktas; for example if 3/8 of the sky is covered by cloud, it is expressed as 3 oktas. Okta means eight (8).