Alexandra High School
Summa Diligentia Laboro

Grade 8
Geography
Climatology
Note Booklet

Introduction to Weather

The following is an extract from www.ace.ac.uk

Meteorology is the study of weather. Weather is caused by the movement or transfer of energy. Energy is transferred wherever there is a temperature difference between two objects. Many weather phenomena result from a transfer of energy that occurs via the movement of air in the atmosphere. This is known as convection.

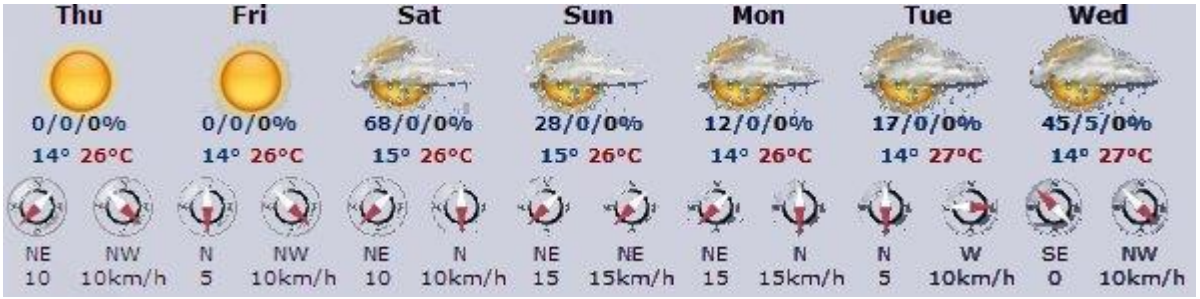
Air contains water vapor from the evaporation of liquid water sources on the Earth's surface, including oceans, lakes and rivers, and from evapotranspiration by plants. When air is moved about the Earth, either vertically when uplifted or horizontally as part of air masses, it may cool and release water vapor as condensation in the form of clouds and eventually rain and other forms of precipitation, which is returned to Earth. This cycle of evaporation, condensation and precipitation between the Earth and the atmosphere is known as the water cycle.

The physical transfer of heat and moisture by convective processes is the basis for the formation of many meteorological patterns and features, including anticyclones, depressions, fronts, monsoons, thunderstorms, hurricanes and tornadoes. Heat however, may also radiate directly from a hot object to a colder one, without involving the movement of air. Many small-scale weather phenomena are the result of this form of heat transfer, including dew, frost and fog.
Weather can be simply measured by observing and recording temperature, rainfall, pressure, humidity, sunshine, wind and cloudiness. It is also possible to identify and name different types of clouds, which are associated with different patterns of weather. Commonly observed cloud types include cirrus, cumulus, cumulonimbus and stratus. To make predictions and forecasts about what the weather will do in the future however, it helps to draw synoptic charts, composed of special weather symbols and isobars that reveal patterns of weather. The use of sophisticated technology such as weather radar and satellite imagery also assist with weather forecasting.

In the following sections we will be referring to weather and climate. Weather is the study of atmospheric conditions over a short period of time e.g. days or weeks. Climate is the study of atmospheric conditions over a long period of time (20-30 years) and is linked with seasons.

1) Weather

The weather conditions for Johannesburg, from the SAWS for a week in winter are given:



a) What information is given?

_____

_____

_____

2) Instruments used to record the weather at a weather station.

What do each of the following measure?

a) Thermometer - _____
b) Barometer - _____
c) Rain Gauge - _____
d) Weather Vane - _____
e) Anemometer - _____
f) Hygrometer - _____

Figure 1: Stevenson Screen

Give the name of the instruments below:



_____

3) Clouds

Clouds form when warm air rises and cools down enough for some of the water vapour in it to condense into tiny water droplets or ice crystals

There are two basic clouds types:

Cumulus- formed through upward movement of air, these clouds are usually heaped or puffy in appearance.

Stratus- when air cools enough to cause condensation but with no air movement. These clouds are usually low grey clouds bringing rain.

Clouds can also be classified based on their height.

Towering clouds:

Cumulus are thick, cauliflower-like clouds with dark, flat bases. These are usually fair weather clouds but can build up to become Cumulonimbus clouds. These are towering thunderstorm clouds that characterise a Highveld electric storm

Low clouds:

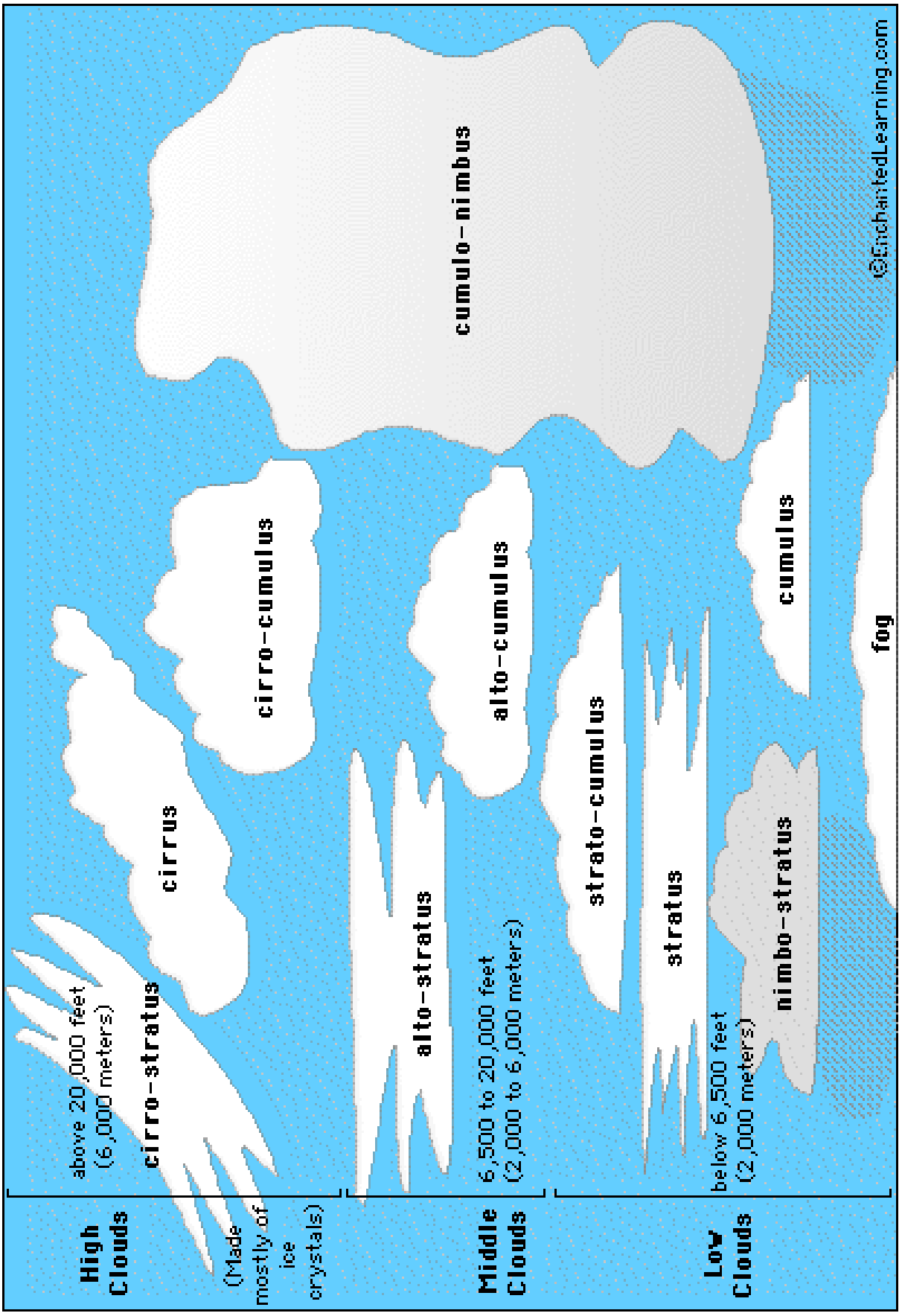
These are usually founds between the ground and 2 000m high. Stratus clouds with a dull, fog-like cloud that cause slow drizzle and nimbostratus clouds being thicker darker and bringing more rain are found at this height.

Middle Clouds;

These include the grey-bottomed altocumulus and thicker altostratus clouds which appear as sheet clouds. These occur at a height of 2 000m – 6 000m.

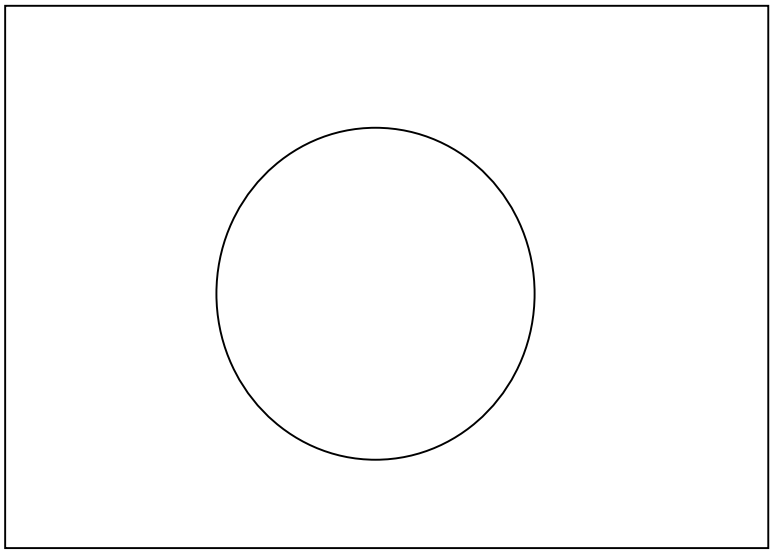
High Clouds;

These can reach heights of up to 17 000m and are made of mostly ice crystals. Cirrus clouds that look whispery of veil like are found here. They are usually very thin and sunlight is able to pass through them.



4) Wind

Wind is moving air. You cannot always see it but you can feel it and see the effects of wind. Air moves because of the difference in temperature from one place to another. When air get hot it rises and cold air moves in below it to take its place.



What do you think the air is doing around the world where it is warm and cold? Start by putting a W for warm and a C for cold.

Wind is measured using an anemometer, wind sock or wind vane. We record wind in kilometres per hour (km/h) or in Knots (knt). A knot is one nautical mile per hour.

Wind is named from the direction that is comes. Like most of us, we are called South Africans because that is where we come from. Wind is given the name from the compass direction it came from. We name the wind this way because we cannot exactly tell where the wind is going to go once it has passed us.

5) Temperature

The temperature is never the name day after day. Look at the following aspect of our atmosphere that affect temperature

1) Latitude - distance from the equator
2) Altitude – the higher you climb the colder it gets (snow on mountains)
3) Oceans – oceans regulate temperature and create on and off shore winds (we will do this in more detail on the next page)
4) Winds – warm winds increase temperature and cold winds cool temperature
5) Aspect – depending on what hemisphere you are located temperatures vary according to aspect of slop (either facing sun or away from sun)

We measure temperature using a thermometer and record the temperature in degrees Celsius (˚C). A healthy person's temperature is 37˚C.

LAND AND SEA BREEZES

Wind flows from _____ pressure to _____ pressure.

Pressure differences occur when the earth's surface is _____ by the sun.

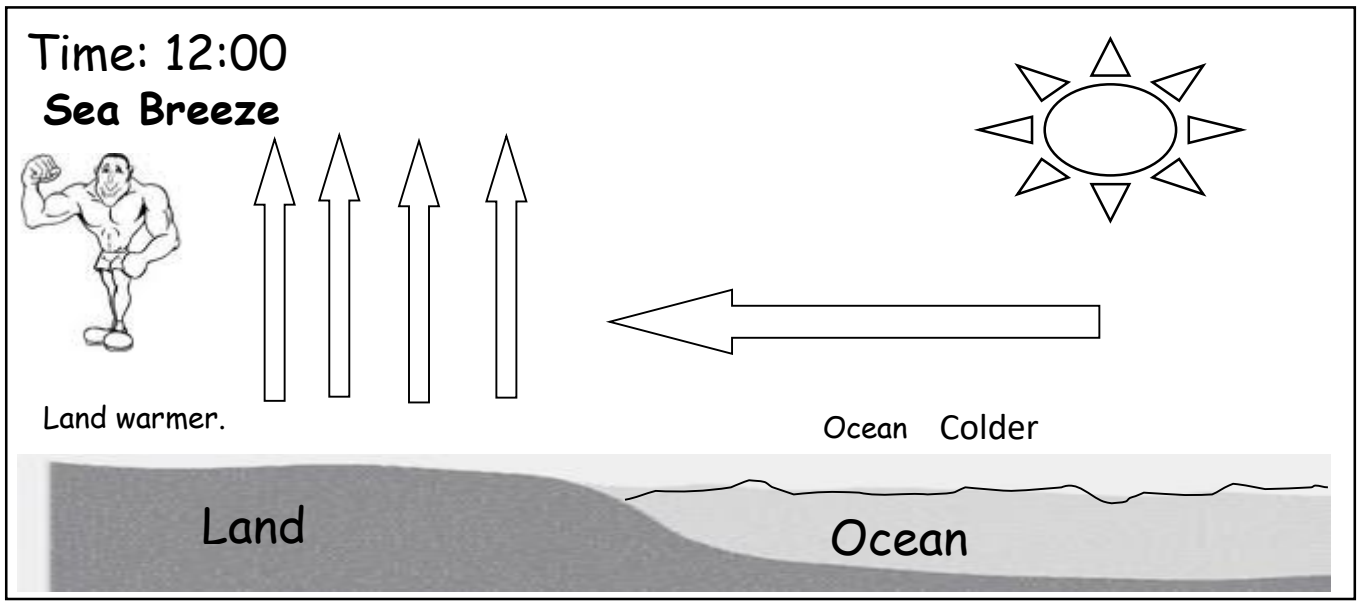
During the day, when the _____ comes up, the land gets _____ than the ocean.

The air above the land gets ____ too and is less dense, so it rises.

The air over the ocean is _____/more dense and falls, creating High pressure over the ocean.

The rising thin air creates Low pressure over the land.

A "**sea breeze"** develops from the _____ to the _____.

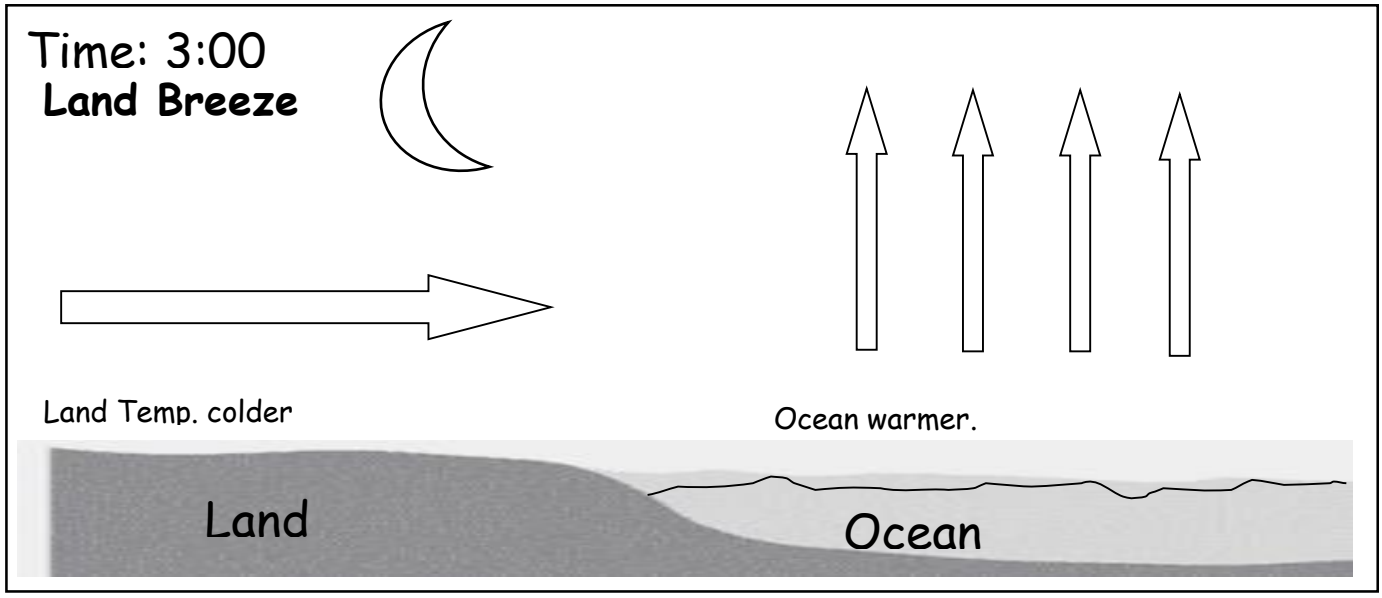


During the night, when the _____ is down, the land gets _____ than the ocean.

The air above the land gets _____ too and is denser, so it sinks.

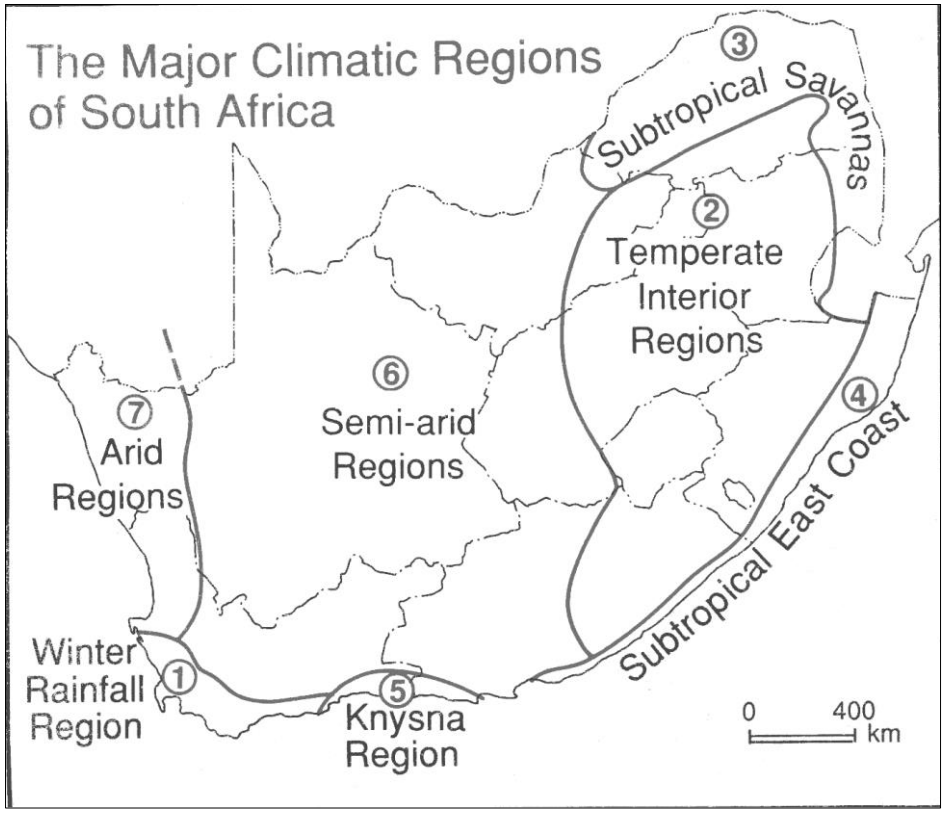
As the air over the ocean is _____ /less dense it rises.

The sinking dense air creates a High pressure over the _____ whilst the rising air creates a Low pressure over the _____. A "land breeze" develops from the _____ to the _____.



6) Climatic Regions

Below is a map of the Major Climatic Regions of South Africa:



Colour each region in the following colours:

1. Blue
2. Light Brown
3. Dark Brown
4. Light Green
5. Dark Green
6. Orange
7. Red

Use your Atlas (p12)to briefly describe the typical climate experienced by each region and give an identifying feature. The first has been done for you.

1. <u>Winter rainfall region:</u> T˚ – warm in Summer, cool in Winter

   Rain – substantial amount in Winter

   Fynbos, Cold Fronts

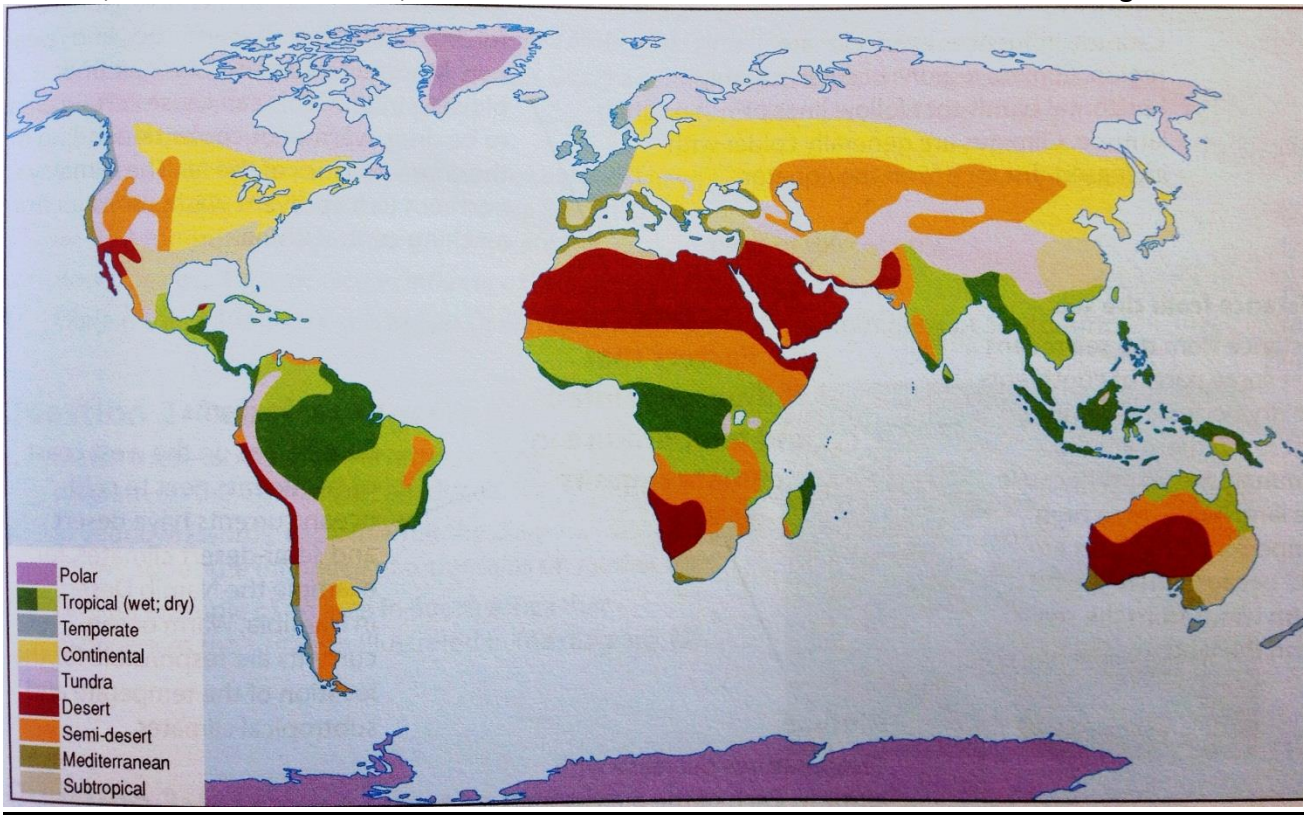
2. _____
   _____
   _____
   _____
3. _____
   _____
   _____
   _____
4. _____
   _____
   _____
   _____
5. _____
   _____
   _____
   _____
6. _____
   _____
   _____
   _____

Climate Regions

The Earth can be divided up into different regions based on the climate of an area. These areas are usually based on precipitation, humidity, temperature and the wind experienced through the year. Man has been classifying areas according to the weather it experiences as far back as the First and Second century. Later the Greeks divided the Earth into three main regions: Frigged, Temperate and Torrid. These would represent the different areas such as Polar, Sub-tropical and Tropical.
Today we classify the earth into nine different climate regions:

- Tropical
- Subtropical
- Temperate
- Desert
- Semi-desert
- Continental
- Polar
- Mediterranean
- Tundra
- High mountain (Alpine)

The climate regions are mainly influenced by their distance from the equator but are also affected by altitude, distance from the sea, ocean currents and relief. Let's look at each climate region in more detail.



Tropical Climate

A Tropical climate can be located between the tropics at 25^{o} North and South. Tropical climate regions typically have high average temperature due to them being close to the equator. There are two types of Tropical Climates: a wet tropical climate and a dry tropical climate.
A *wet tropical climate* is typically closer to the equator, such as the Amazon in Brazil. The temperature range is low and they experience rainfall throughout the year. This means that they experience one season

through the year and can expect to receive about 2 000 mm of precipitation in a year. The main type of vegetation in this area is a rainforest.
The name *dry tropical climate* can be misleading in that it also experiences high temperatures through the year but receives its rainfall in a particular season and not all year round. Large areas of West Africa have a dry tropical climate region.

There are more species of plant and animals in the Amazon than in any other environment.

Subtropical Climate

A Subtropical climate is similar to that of a dry tropical climate but can be found further from the equator. They are typically found between 20^{o} - 40^{o} North and South and on the eastern side of the continent. A Subtropical climate region experiences two main types of seasons: summer and winter. The average summer temperature is 20 ^{o}C and the winter temperature is 15 ^{o}C.
Rain typically falls throughout the year in this region but often has a summer maximum. The total amount of rainfall is above 1 000 mm and therefore, it can be a good area to grow crops. The climate does suit broad-leaved trees and shrubs but most of the area is cleared for crop farming and livestock. The Kwa-Zulu Natal coastline is a good example of this climate region.

Temperate Climate

Temperate climates are mild and do not have very high or low temperatures through the year. They are typically located between 40^{o} and 65^{o} North and South of the equator. The average yearly temperature is 10 ^{o}C with an annual rainfall of 1 400 mm. This region experiences most of its rainfall in winter. The United Kingdom is a good example of this climate region.

Desert Climate

A desert is an area that receives less than 250 mm of rainfall in a year. This means that there is a greater amount of evaporation than precipitation. The vegetation in deserts is very sparse and requires little to no water for survival. There are two types of deserts: hot deserts and cold deserts.

Hot deserts experience high temperatures of over 50 ^{o}C during the day and can drop close to freezing at night. The Sahara Desert in North Africa is the world's largest hot desert.
Cold deserts experience very little rainfall and have little to no vegetation. The Antarctic is the largest cold desert and although it may be covered with ice it is still classified as a desert based in its rainfall of less than 250 mm.

Semi-desert Climate

This area receives between 250 mm and 500 mm of annual rainfall. They are usually found on the borders of hot deserts and drought is common in the area. The vegetation is spaced out and drought-resistant usually with dry land between shrubs.
The Kalahari region in Southern Africa is a good example of a semi-desert climate.

Continental Climate

Continental climate regions are typically found in the Northern hemisphere between 30^{o} and 60^{o} North. Some maps will show a small area in South America as having a Continental Climate but this is not always the case.
Rainfall is typically between 500 mm and 1 250 mm per year. The summer seasons are short and the area is dominated by long cold winters. Summer temperatures can rise to above 20 ^{o}C and drop to 0 ^{o}C (freezing point) in winter.

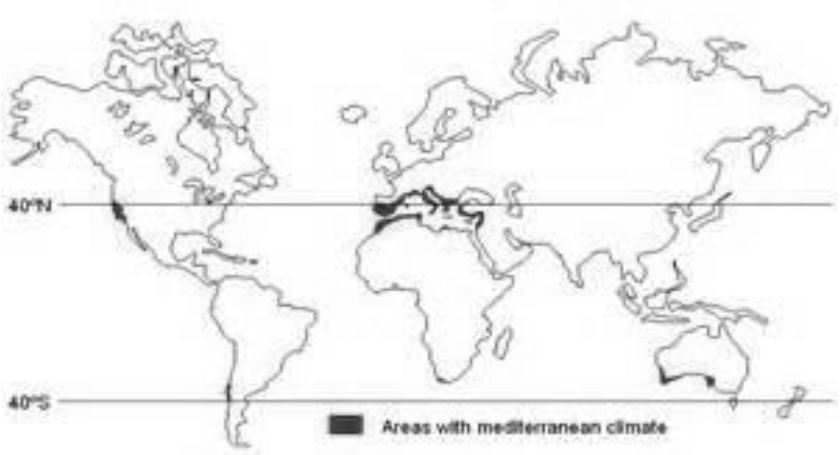
Polar Climate

Areas that are close to the North and South Pole experience Polar Climate conditions. These areas experience two distinct seasons, although summer in much shorter than winter. During the summer season the area will receive long periods of faint sunlight that can help lift the daily temperatures.

During the long winter season, there may be only a few hours of sunshine and the average temperatures can be well below freezing. Temperatures as low as – 40 ^{o}C have been recorded. It is estimated that no month in the Polar Climate experiences an above freezing temperature.
The Polar Climate also receives very little, if any rainfall, and is often classified as a desert.

Mediterranean Climate

This climate is named after the conditions that are typical of the Mediterranean Sea. The climate is mild and has warm summers and cool, wet winters. The average summer temperatures can reach over 20 ^{o}C and between 10 ^{o}C – 15 ^{o}C in winter. The annual rainfall is between 400 mm and 600 mm during the winter season.
The plant life has adapted to long dry winters by having waxy or hairy leaves and can store water in bulbous roots or fleshy stems. Cape Town is a good example of a Mediterranean Climate Region.



Tundra Climate

The Tundra Climate is predominantly found between 60 ^{o} and 75 ^{o} North and South. Average temperatures in summer can be between 2 ^{o}C and 12 ^{o}C. A tundra climate has at least one month with an average temperature above freezing. The higher average temperatures in summer allow for the snow to melt and more vegetation to become visible.

There are no trees that grow in this climate and it is dominated by shrubs, grasses and mosses. The lower soil is always frozen and marsh or swamp areas are common. The region receives between 100 mm and 400 mm of precipitation in summer, most of which is snow.

High Mountain (Alpine) Climate

High Mountain climate regions have a similar climate to Polar Regions. This is because of the high altitude. The region has cold temperatures and is usually covered with snow for the majority of the year.

Use the World Climate map from "*New Secondary School Atlas for South Africa"* to answer the following activity:

Activity 1 (35 marks)

1. Name the 6 broad climate regions? (3)
2. What is the average annual rainfall for Bahrain? (1)
3. Which country has the lowest average temperature? Give a reason for your answer. (2)
4. Which country receives the highest annual rainfall? (1)
5. In which season does Hankou receive the majority of its rainfall? (1)
6. What climate region does Singapore belong to? Explain your answer. (4)
7. What climate region does Eismitte belong to? Explain your answer. (4)
8. Explain the main differences between a Polar Climate region and a Tundra Climate region. (3)
9. In which climate would you prefer to live in? Explain your answer. (2)
10. Draw a mind map to show the factors that influence rainfall and temperature in climate regions. Use the following headings: (14)

- Latitude
- Ocean currents
- Distance from sea
- Mountains
- Altitude

Activity 1 (22)

1) How many climate regions are there? (1)

2) In which climate region do you live? (1)

3) Which side of South Africa experiences more rain? (1)

4) What does "temperate" mean? (1)

5) Name the three different rain fall regions. (3)

6) Fynbos (bushes such as the protea) can survive through summer droughts, but need winter rainfall. Where do you think this vegetation will grow in South Africa, explain your answer. (2)

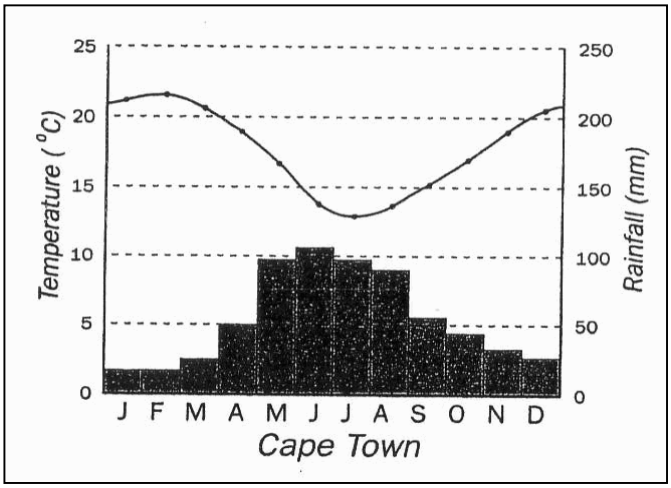
7) Forests needs more than 800mm of rain throughout the year to flourish. Where a forest would grow in South Africa, explain your answer. (2)

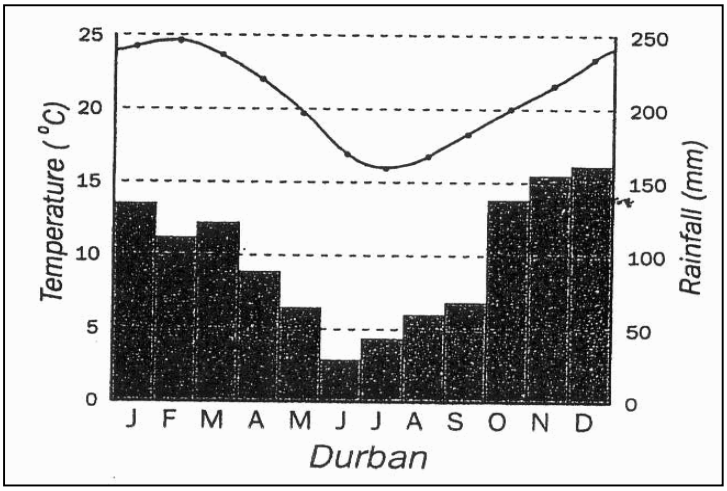
8) Based on the climate region that the Northern Cape experiences, explain why there is very little population there. (1)

9) In which climate region would you want to live, explain your answer. (2)

10) List four factors in the boxes below which influence the climate of a region and give a short reason/ diagram to explain why it does. (8)

7) Climate Graph





A climate graph shows two sets of information at the same time.

1- _____

2- _____

Activity 2 (7)

Use the two climate graphs to answer the questions that follow

1) In which season does Cape Town receive the majority of its rain? (1)

2) What is the highest average temperate for Durban? (1)

3) Which month receives the least amount of rainfall in Durban? (1)

4) Which climate region does Cape Town fall into? (1)

5) Identify what would be similar or different from a climate graph of Johannesburg to that of Cape Town or Durban, explain your answer? (3)

Activity 3 (10)

Use the data given in the table below (courtesy of the South African Weather Service) to draw a Climate-graph for Johannesburg. The columns you need to use are *in italics.*

Remember to include:

- Heading
- Horizontal axis – months of the year (½cm for each month)
- Left vertical axis – label Precipitation (mm) (scale 1cm : 10mm)
- Right vertical axis – label Temperature (˚C) (scale ½cm : 1˚C)

Month	Temperature (° C)				Precipitation		
	Highest Recorded	*Average Daily Maximum (Red)*	*Average Daily Minimum (Green)*	Lowest Recorded	*Average Monthly (mm) (Blue)*	Average Number of days with >= 1mm	Highest 24 Hour Rainfall (mm)
January	35	*26*	*15*	7	*125*	16	188
February	34	*25*	*14*	6	*90*	11	56
March	32	*24*	*13*	2	*91*	12	92
April	29	*21*	*10*	1	*54*	9	50
May	26	*19*	*7*	-3	*13*	3	70
June	23	*16*	*4*	-8	*9*	2	31
July	24	*17*	*4*	-5	*4*	1	17
August	26	*19*	*6*	-5	*6*	2	21
September	31	*23*	*9*	-3	*27*	4	62
October	32	*24*	*11*	0	*72*	10	110
November	33	*24*	*13*	2	*117*	15	65
December	32	*25*	*14*	4	*105*	15	102
Year	**35**	***22***	***10***	**-8**	***713***	**99**	**188**