

**Assessment Schedule – 2013**

**Earth and Space Science: Demonstrate understanding of processes in the atmosphere system (91414)**

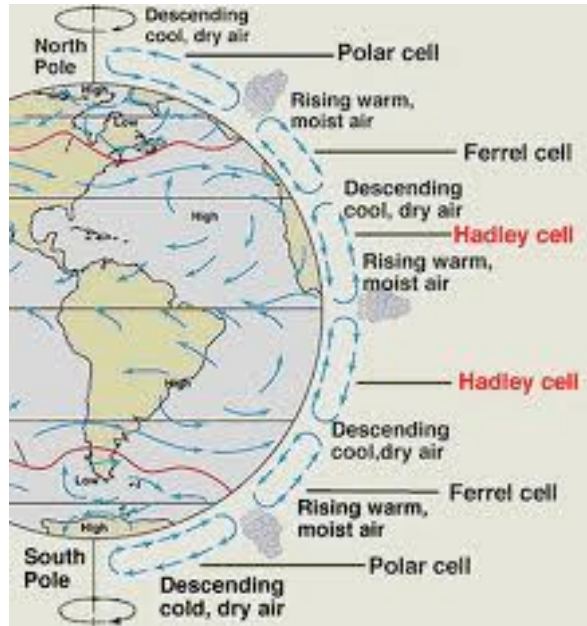
**Evidence Statement**

Question	Evidence	Achievement	Merit	Excellence
ONE	<p>Weather is the condition of the atmosphere at a particular place over a <b>short period</b> of time. Eg, on a particular day in Wellington, the weather is warm in the afternoon. But later in the day, when there are clouds blocking the Sun’s rays, the weather would become cooler.</p> <p>Climate refers to the weather pattern of a place over a <b>long period</b>, long enough to gather and record meaningful averages of weather data.</p> <p>Eg Wellington’s climate is a temperate climate, with an all-year-round absence of temperature extremes. Strong winds are a feature of Wellington’s climate.</p> <p>The West Coast has lots of / high rainfall (wet climate). Canterbury Plains has a low rainfall (dry climate).</p> <p>On the West Coast the (prevailing) winds come from the west over the Tasman Sea (Westerlies Winds), and having travelled over long distances of water / southern hemisphere ocean without crossing a land mass have picked up lots of water from the ocean and are water-laden. As the humid Westerlies hit the West Coast, they are forced up over the mountains of the Southern Alps. As they rise into lower pressure, the air expands and the temperature of the water-laden air drops, the water vapour condenses as very heavy rainfall. This results in the wet climate on the West Coast.</p> <p>Heat energy is released in this condensation, but the air gets colder as it rises and expands, and it moves up over the Southern Alps.</p> <p>The air that is being lifted will expand and cool (approx. 6°C per kilometre). This cooling of the rising moist air can lower its temperature to its dew point. This allows condensation, which releases energy to the atmosphere, of the water vapour contained within it, and hence the formation of a cloud. If enough water vapor condenses into</p>	<ul style="list-style-type: none"> <li>• Identifies the difference or gives examples that show the difference between weather and climate.</li> <li>• Identifies West Coast climate.</li> <li>• Identifies Canterbury plains climate.</li> <li>• Identifies energy changes.</li> <li>• Identifies the movement of air and / or water up the alps.</li> </ul>	<ul style="list-style-type: none"> <li>• Explains the difference between weather and climate.</li> <li>• Links heat energy changes to air movement.</li> <li>• Links movement of air up over the Alps to the water content.</li> <li>• Explains reasons for high moisture content in air arriving on West Coast.</li> </ul>	<ul style="list-style-type: none"> <li>• Discusses the local climates on the West Coast and Canterbury plains linking air movement over the Alps to energy changes and / or water content.</li> </ul>

	<p>droplets, these droplets may become large enough to fall to the ground as precipitation.</p> <p>The Westerlies lose their moisture when they rise to cross the Southern Alps. Once over the mountains, the cool air drops / descends into higher pressure, is compressed, so warms up. Any remaining moisture evaporates into the air (resulting in unique cloud formations, the nor'west arch), and hot dry winds result. On the eastern ranges and the Canterbury Plains, rainfall is much less than on the West Coast. The hot dry winds result in a much drier climate (and consequently weather.)</p>								
	<b>Not achieved</b>			<b>Achievement</b>		<b>Achievement with Merit</b>		<b>Achievement with Excellence</b>	
	NØ = no response or no relevant evidence.	N1 = 1 partially correct or stated point.	N2 = 1 point from Achievement.	A3 = 2 points	A4 = 3 points	M5 = 1 point	M6 = 2 points	E7 = Discussion logically presented but deficient in one minor point.	E8 = Fully developed discussion may include examples.

Question	Evidence	Achievement	Merit	Excellence
<p>TWO</p>	<p>The Westerlies are prevailing (usual) strong winds in the middle latitudes between 30 and 60 degrees latitude. They blow from the high pressure area in the equatorial and horse latitudes (junction between Hadley and Ferrel cells) towards the poles.</p> <p>They blow from the west to the east in both hemispheres, ie opposite to the Earth's rotation.</p> <p>They blow from the southwest in the Northern Hemisphere (ie direction from Equator to Pole) and from the northwest in the Southern Hemisphere, due to the Coriolis effect, caused by the rotation of the Earth.</p> <p>They blow in the regions of the atmosphere known as the Ferrel cells.</p> <p>The atmosphere has a circulation because of convection. At the Equator, where more of the Sun's heat is received, the air heats up, reducing its density. The hot air rises and at the top of the troposphere the air spreads towards the Poles in a convection cell. However, due to the rotation of the Earth, the Coriolis effect, there are in reality three convection cells.</p> <p><i>(The Hadley convection cell is closest to the equator, the Polar convection cell nearest the Poles. These two cells exist as a direct consequence of surface temperatures getting cooler as they move away from the Equator where the Sun's heat energy is greatest, as this is where the solar radiation per unit area is highest.)</i></p> <p>The Ferrel cell fits in between these two closed loop convection cells. However, it is not a closed loop convection cell as it does not have the heat source of the equator (Hadley cell) or the cold heat sink of the Poles (Polar cell) to drive a convection current. It is known as a 'zone of mixing' as the Westerlies winds are affected by passing weather systems such as the jet streams. The jet streams are narrow band high altitude winds flowing from the west to the east at the borders of the Ferrel cell.</p> <p>The Westerlies are strong winds, even more so in the</p>	<ul style="list-style-type: none"> <li>• Describes feature(s) of the Northern Hemisphere OR Southern Hemisphere Westerlies (direction and location).</li> <li>• Describes the Ferrel cell.</li> <li>• Describes a convection cell in terms of heat energy transfer or heat energy transport.</li> <li>• Describes a convection cell in terms of air movement.</li> </ul>	<ul style="list-style-type: none"> <li>• Explains features of the Northern Hemisphere OR Southern Hemisphere winds with links to the rotation of the Earth (Coriolis effect).</li> <li>• Links Ferrel cell air transport to other atmosphere air movement. (May refer to Hadley and Polar cells but not required).</li> </ul>	<ul style="list-style-type: none"> <li>• Compares the Northern Hemisphere and Southern Hemisphere Westerlies with links to: <ul style="list-style-type: none"> <li>rotation of the earth</li> <li>OR</li> <li>heat energy transfer.</li> </ul> </li> <li>• Discusses the role of the Ferrel cell in atmospheric heat transfer.</li> </ul>

Southern Hemisphere because there is less land in the mid-latitudes of the Southern Hemisphere to change the direction of the winds and slow them down. The Roaring Forties are some of the strongest Westerlies winds at the latitude of 40 to 50 degrees.

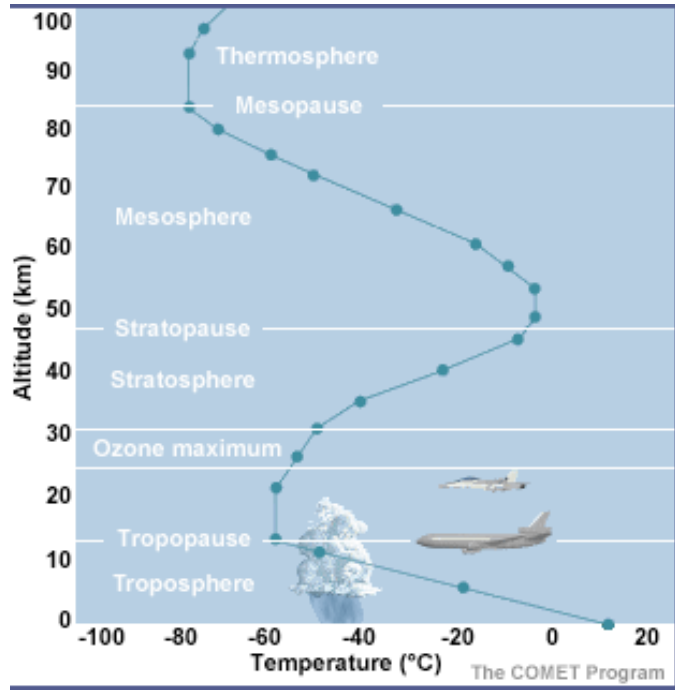


<http://scioly.org/wiki/images/a/a8/3cell.JPG>

Not achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ = no response or no relevant evidence	N1 = 1 correct statement	N2 = 1 point partially described eg partial description of Ferrel cell.	A3 = 1 point	A4 = 2 points	M5 = 1 point	M6 = 2 points (one may have lesser detail)	E7 = Both points discussed but with lesser detail.	E8 = Both points discussed but one may be in lesser detail.

Question	Evidence	Achievement	Merit	Excellence
THREE	<p>The atmosphere is a layer of gases surrounding the Earth and is retained in place by the Earth’s gravity. The layer of the atmosphere closest to Earth is the troposphere, which is 11 km thick. Most of the <b>mass</b> of the atmosphere (75–80%) is in this layer. The next layer is the stratosphere, which extends above the troposphere to 50 km above Earth.</p> <p><b>Composition:</b> The gas composition of the atmosphere is collectively known as air, which has three main gases – nitrogen, oxygen and argon accounting for 99% of the mass of dry air. The other gases are in very small amounts and are known as trace gases. Water vapour (H<sub>2</sub>O(g)) is found closest to the surface of the Earth. In addition, the stratosphere is where the ozone layer is found. This contains ozone gas O<sub>3</sub>. The thickness of the ozone layer at the base of the stratosphere has seasonal and geographical variations, eg during spring time over southern NZ and Antarctica there is an ozone layer “hole” of decreased layer thickness. Air capable of supporting life of terrestrial plants and animals is naturally found only in the troposphere.</p> <p><b>Temperature:</b> The troposphere is mostly heated by energy transfer from the surface of the Earth, so the lowest part of the troposphere is where weather is found due to convection currents in the atmosphere there. As the altitude increases, the temperature drops as you go up through the troposphere.</p> <p>In the stratosphere however, the presence of the ozone layer of gases, which absorbs ultraviolet radiation, heats the stratosphere to a temperature above that of the top of the troposphere. Temperature here increases with altitude in contrast to the troposphere, where it decreases with altitude.</p> <p><b>Density:</b> The atmosphere becomes thinner and thinner (gas particles further and further apart) and less dense – fewer gas particles per unit volume – with increasing altitude.</p> <p>The highest density of gases in the atmosphere is at the surface of the Earth at sea level. Even in the Himalayan mountains and at the top of Mt Everest, the highest mountain on Earth, the air</p>	<ul style="list-style-type: none"> <li>• Describes gas composition of stratosphere or troposphere.</li> <li>• Describes temperature of stratosphere or troposphere.</li> <li>• Describes density of stratosphere or troposphere.</li> <li>• Describes aerosols as scattering or reflecting light or heat / radiation / UV.</li> <li>• Describes aerosols in ozone depletion or cloud formation.</li> <li>• Describe Troposphere as having weather.</li> </ul>	<ul style="list-style-type: none"> <li>• Explains reason for differences in gas composition of stratosphere and troposphere.</li> <li>• Explains reason for temperature differences of stratosphere and troposphere.</li> <li>• Explains density of stratosphere and troposphere through link to altitude.</li> </ul>	<ul style="list-style-type: none"> <li>• Compares and contrasts stratosphere and troposphere, showing links between two of composition of gases and / or temperature and / or density and / or aerosols.</li> </ul>

	<p>density is much less than at sea level, due to the increased altitude. This decrease in density continues through all layers of the atmosphere with increasing altitude, ie highest density at bottom of troposphere and decreases as you rise up through the troposphere, stratosphere and beyond to space.</p> <p><b>Aerosols:</b></p> <p>Aerosols are minute particles suspended in the atmosphere. When these particles are sufficiently large, we notice their presence as they scatter and absorb sunlight. Their scattering of sunlight can reduce visibility (haze), and redden sunrises and sunsets.</p> <p>Aerosols interact both directly and indirectly with the Earth’s radiation budget (energy) and climate. As a direct effect, the aerosols scatter sunlight directly back into space. As an indirect effect, aerosols in the lower atmosphere (troposphere) can modify the size of cloud particles, changing how the clouds reflect and absorb sunlight, thereby affecting the Earth’s energy budget.</p> <p>Aerosols can also act as sites for chemical reactions to take place. The most significant of these reactions are those that lead to the destruction of the ozone layer. During winter in the Polar Regions, aerosols grow to form stratospheric clouds. The large surface areas of these cloud particles provide sites for chemical reactions to take place, which ultimately lead to the destruction of ozone in the stratosphere. Evidence now exists that shows similar changes in stratospheric ozone concentrations occur after major volcanic eruptions, like Mt Pinatubo in 1991, where tonnes of volcanic aerosols are blown into the atmosphere.</p> <p>The additional reflection caused by pollution aerosols is expected to have an effect on the climate comparable in magnitude to that of increasing concentrations of atmospheric gases. The effect of the aerosols, however, will be opposite to the effect of the increasing atmospheric trace gases – cooling instead of warming the atmosphere.</p>			
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	<b>Not achieved</b>			<b>Achievement</b>		<b>Achievement with Merit</b>		<b>Achievement with Excellence</b>	
	N0 = no response or no relevant evidence	N1 = 1 point from Achievement.	N2 = 2 points from Achievement.	A3 = 3 points	A4 = 4 points	M5 = 1 point	M6 = 2 points	E7 = Discusses links but with less detail.	E8 = Fully discusses at least two links.

**Judgement Statement**

	<b>Not Achieved</b>	<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
<b>Score range</b>	0 – 6	7 – 12	13 – 18	19 – 24