Assessment Schedule – 2015

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

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE	**Wind belts** Wind is the movement of air caused by the uneven heating of the Earth by the Sun. Differences in atmospheric pressure generate winds. The region of Earth receiving the Sun's direct rays is the Equator. Here, air is heated and rises, leaving low pressure areas behind. Moving to about thirty degrees north and south of the Equator, the warm air from the equator begins to cool and sink. Between thirty degrees latitude and the Equator, most of the cooling sinking air moves back to the Equator. The air movements toward the Equator are called trade winds – warm, steady breezes that blow almost continuously. The Coriolis effect makes the trade winds appear to be curving to the west. If the Earth was not spinning the air mass would travel directly south to north, south of the equator and north to south, north of the equator. The Coriolis effect (Earth's spinning west to east) appears to deflect the wind (air mass) movement to the left (anticlockwise) in the southern hemisphere. The opposite effect occurs for the trade winds north of the Equator. The Coriolis effect of the Earth's rotation is greatest at the poles. (Conservation of angular momentum). The polar easterlies form when the atmosphere/air mass over the poles cools. This cool air then sinks and spreads over the surface. As the air flows away from the poles, it is turned to the west (to the left or anticlockwise) by the Coriolis effect. Because these winds appear to begin in the east, they are called easterlies.	• Describes the cause of winds. E.g., air mass movement across Earth's surface. • Describes the polar easterlies. • Describes the trade winds. • Describes how the Coriolis effect deflects winds.	• Links the variation in temperature or pressure to the trade winds. • Links the variation in temperature or pressure to the polar easterlies. • Links the Coriolis effect to the trade winds and / or the polar easterlies.	• Links the temperature / pressure variations and the Coriolis effect to the movement of both the trade winds and the polar easterlies. • Compares and contrasts the causes of both the winds.

Not Achieved			Achievement		Merit		Excellence	
N0 = no response; no relevant evidence.	N1 = 1 partial point.	N2 = 1 point from Achievement.	A3 = 2 points.	A4 = 3 points.	M5 = 1 merit point explained.	M6 = 2 merit points explained.	E7 = Excellence point with minor omissions	E8 = Excellence point fully explained.

Q	Evidence	Achievement	Merit	Excellence
TWO	**Climate Change** Carbon dioxide that stays in the atmosphere is one of the most important gasses for controlling Earth's temperature. Carbon dioxide gas absorbs a wide range of energy—including infrared energy (heat) emitted by the Earth—and then re-emits it. The re-emitted energy travels out in all directions, but some returns to Earth, where it heats the surface. Rising concentrations of carbon dioxide are warming the atmosphere. The increased temperature results in higher evaporation rates and a wetter atmosphere, which leads to a cycle of further warming. Water vapour concentrations in the air are controlled by Earth's temperature. Warmer temperatures evaporate more water from the oceans, expand air masses, and lead to higher humidity. Cooling causes water vapour to condense and fall out as rain, sleet, or snow. When the water vapour condenses in the atmosphere, it releases latent heat energy, which increases atmospheric temperatures. Water vapour is a powerful greenhouse gas, so an increase in water vapour might be expected to produce yet more warming through an enhanced greenhouse effect. This warming should further enhance evaporation, producing more water vapour, and leading to a "positive feedback loop" of more and more warming... and eventually to a "runaway greenhouse effect". However more water vapour in the air is likely to cause more clouds to form. The presence of clouds, reflects a lot of the incoming solar radiation back into space (the albedo effect). Increased cloudiness would be expected to reduce the amount of solar radiation reaching our planet's surface, and would provide a cooling effect. Thus an increase in water vapour, and hence cloudiness, might actually serve as a "negative feedback loop" that would "put the brakes on" global warming. So while carbon dioxide contributes less to the overall greenhouse effect than water vapour, scientists have found that carbon dioxide is the gas that sets the temperature. Carbon dioxide controls the amount of water vapour in the atmosphere and thus the size of the greenhouse effect. Rising carbon dioxide concentrations are already causing the planet to heat up. At the same time that greenhouse gases have been increasing, leading to a projected rapid increase in global temperatures. (Average global temperatures have risen 0.8 degrees Celsius since 1880) Adapted from refefence: http://earthobservatory.nasa.gov/Features/CarbonCycle/page5.php	• Describes how the increase in CO_2 results in increased temperatures. • Describes how increased water vapour results in increased temperatures. • Describes positive feedback loop / runaway effect of increasing CO_2 or water vapour. • Describe changes in weather events as a result of CO_2 or water vapour increase in the atmosphere.	• Explanation of how CO_2 leads to an increase in atmospheric temperature. • Explanation of how water vapour leads to an increase in the atmospheric temperature. • Explanation of how climate trends are affected by CO_2 and water vapour increase in the atmosphere.	• Discussion links the increase of both CO_2 and water vapour to climate change (increased global temperatures). • Discussion of how water vapour works as in a positive feedback loop.

Not Achieved			Achievement		Merit		Excellence	
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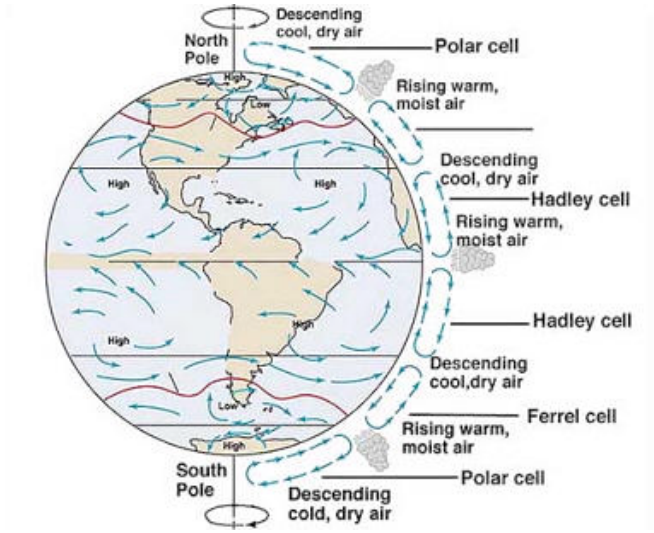
Q	Evidence	Achievement	Merit	Excellence
THREE	The circulation of air masses in the atmosphere is driven by the rotation of the earth and the incoming energy from the Sun. Air masses circulate in each hemisphere in three distinct cells, which help transport heat energy from the Equator to the Poles. Air mass movement is driven by the energy from the Sun at the surface as warm air rises and colder air sinks. The circulation of air mass closest to the equator is the Hadley Cell. This air mass rises at or near the Equator rapidly due to the intensity of the sun's radiation on this part of the Earth's surface. This creates a low pressure zone around this region of the Earth's surface, and certain extreme weather events (e.g. thunderstorms, cyclones). The rising air mass spreads and cools moving in higher altitudes until falling in the region of 30 degrees north or south of the Equator. This falling air mass creates an area of high pressure and subsequently moves across the Earths surface back toward the Equator or towards the higher latitudes (60 degrees North and South). This is a closed cell. The rising air mass at the Equator contains large amounts of water vapour. The latent heat for the evaporation process originates from solar radiation. As it rises and cools, the water vapour condenses to release this heat into the atmosphere / air mass. The air mass carries the heat energy heat away from the Equator at high altitude. Polar cells lie between the Poles and 60 degrees North and South. These are closed cells. Cold, dense air descends over the Poles and the cold air is circulated towards the equator along the Earth's surface. The air from the Poles rises at 60 degrees latitude and some of this air returns to the poles at altitude completing the Polar Cell. The Ferrel Cell lies between the Hadley and Polar cells (30 to 60 degrees latitude). Some of sinking air mass at 30 degrees North continues travelling northwards along the Earth's surface towards the Pole. This air is still warm as it has originated from the Equator, and at 60 degrees latitude, approaches cold air moving down from the Pole. This causes the warm air mass to rise with some mixing taking place between the two air masses. This is known as the Polar Front, where weather events can originate. At higher altitudes part of the air mass moves towards the Pole carrying heat energy with it. The heat energy is the result of condensing water vapour (latent heat) that originated from the equator. The remaining air mass moves back towards the Equator. The Ferrel Cell is an open cell relying on the closed Polar and Hadley Cells. It is the link in the transportation of heat energy from regions of intense heating at the Equator (insolation) to regions of the Earth's surface where the effects of solar radiation are far less intense, the Poles.	• Description of the Hadley Cell. (Annotated diagram accepted.) • Description of the Polar Cell. (Annotated diagram accepted.) • Descriptions of the Ferrel cell as the result of the other two cells. (Annotated diagram accepted.) • Description of how the convection cells transport heat.	• Explanation of the interaction between the three cells. (Annotated diagram accepted.) • Explanation of the interaction of the three cells in regard to the transport of heat.	• Discussion of how the three cells interact with each other and how this interaction results in the transport of heat around the globe.

	 http://www.dannyzeff.com/schooltoolsclassic/enviro/wind.h2.jpg			

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 19	20 – 24