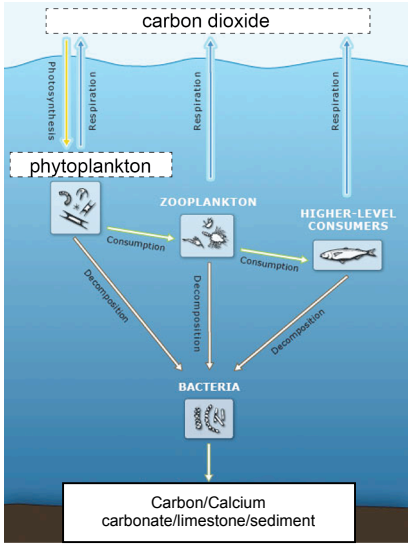
Assessment Schedule – 2014

Earth and Space Science: Demonstrate understanding of processes in the ocean system (91413)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE	Surface currents are mostly caused by the wind because it creates friction as it moves over the water. This friction then forces the water to move in a spiral pattern, creating gyres. In the northern hemisphere, gyres generally move clockwise (the Alaskan gyre moves in a counterclockwise direction) and in the southern, they move counterclockwise. The speed of surface currents is greatest closer to the ocean's surface, and decreases at about 100 metres below the surface. Because surface currents travel over long distances, the Coriolis effect also plays a role in their movement and deflects them, further aiding in the creation of their circular pattern. The movement of the toys is from the currents in the ocean, and not from the waves in the ocean. Waves transport energy but not matter; matter can only be moved by the currents. The bath toys got cycled in the North Pacific gyre, which flows in a clockwise direction and then some of the toys moved into the Alaska current (which moves in a counterclockwise direction). This took the toys across the Pacific Ocean and up the coast of America to the beaches of Alaska. This journey took only 10 months to complete. Some of the toys have cycled around the North Pacific gyre and been deposited at other locations in America. The toys that ended up on the beaches near Tacoma have cycled around the North pacific gyre or the Alaska gyre / current once or more, before making it to land 4 years after the event.	• Description of surface circulation in the northern hemisphere as generally clockwise AND anticlockwise in southern hemisphere. • Description of Coriolis effect as deflection due to rotation of earth. • Identifies factors that contribute to **surface** circulation (heat, wind, Coriolis effect, friction, land masses). • States surface currents move matter. • Describes waves transport energy through matter.	• Explanation of how surface circulations / gyres form. (Links Coriolis effect to clockwise in northern hemisphere.) • Explanation of how oceans move matter. • An explanation of how the bath toys ended up in Alaska and Tacoma.	A discussion that links the ocean circulation and the mechanism of movement to the locations where the bath toys have been located. (Links wind, currents and matter to the movement of toys.)

	NØ = no response or no relevant evidence	N1 = correct idea about ocean currents	N2 = 1 partial point from Achievement	A3 =1 point	A4 = 2 points	M5 = 1 point	M6 = 2 points	E7 = detailed discussion (one minor error)	E8 = fully detailed discussion linking circulation to the movement of the ducks

TWO	The biological pump removes carbon dioxide from the surface water of the ocean, changing it into living matter, and distributing it to the deeper water layers.  Source: http://www.teara.govt.nz/files/di-5932-enz.jpg Plankton are a very important part of ocean life. The carbon dioxide in the atmosphere is in balance with carbon dioxide in the ocean. During photosynthesis, plankton remove carbon dioxide from sea water. This allows the oceans to absorb additional carbon dioxide from the atmosphere. If less plankton existed, atmospheric carbon dioxide would increase. Plankton fix carbon in the form of organic molecules and calcium carbonate platelets and shells. Phytoplankton also affect carbon dioxide levels in the oceans when they die. As some phytoplankton sink, zooplankton eat them and bacteria decompose both types of plankton and some carbon is released as CO_2. The calcium carbonate platelets and shells sink to the bottom of the ocean floor. Other dead phytoplankton sink to the ocean floor too. The carbon in the phytoplankton is soon covered by other material sinking to the ocean bottom. In this way, the oceans act as a sink, a place to tie up global carbon, which otherwise would accumulate in the atmosphere as carbon dioxide. If the oceans heat up, this will affect the upwelling in the oceans. There will be less upwelling as the ocean layers will become more distinct, and mixing between the layers will decrease. If this happens there will be less nutrients being brought up to the surface water and therefore less food for the plankton to consume. This will decrease	• A description of biological pumps. • A description of how biological pumps move carbon. • A description of how the carbon moves via photosynthesis through the food chain. • A description of how carbon is stored in the ocean floor. • A description of how a decrease in the number of plankton would affect the biological pump. • Describes an effect on the biological pump when phytoplankton decreases, eg increasing atmospheric carbon dioxide.	• An explanation of how the biological pump removes carbon (word or symbol equations required). • An explanation of how the biological pump stores carbon (limestone / calcium carbonate formation). • An explanation of how a decrease in the number of plankton would affect the biological pump.	A discussion of how the biological pump cycles carbon and how a decrease in the number of plankton would affect this cycling. (includes carbon removal, storage, effect on food chain and atmosphere / surface water increase in carbon / carbon dioxide)

	the numbers of plankton, which will in turn decrease the effectiveness of the biological pump. This would have a great effect on the carbon cycle, as less carbon would be stored by the oceans and deep sea sediments, which would increase global atmospheric CO_2. An increase in ocean temperatures would also lead to a decrease in gas (O_2/ CO_2) solubility, which could also lead to a decrease in plankton.			

	NØ = no response or no relevant evidence	N1 = 1 correct idea about the biological pump (eg correctly labelled diagram)	N2 = 1 partial point from Achievement	A3 = 1 point	A4 = 2 points	M5 = 1 point	M6 = 2 points	E7 = detailed discussion (one minor error)	E8 = fully detailed discussion linking nutrient levels to the biological pump

THREE	During El Niño events, the trade winds weaken and there is a decrease in surface air temperature, leading to a rise in sea surface temperature in the eastern equatorial Pacific, and a reduction of "upwelling" off the South American west coast. The supplies of nutrient-rich water off the South American coast are cut off, due to the reduced upwelling. One oceanic process altered during an El Niño year is upwelling, which is the rising of deeper colder water to shallower depths. Because of the frictional stresses that exist between ocean layers, surface water is transported at a 90 degree angle to the left of the winds in the Southern Hemisphere, 90 degrees to the right of the winds in the Northern Hemisphere. This creates ocean currents that transport the surface water away from the coast of South America. Nutrient-rich water rises from deeper levels to replace the surface water that has drifted away and these nutrients are responsible for supporting the large fish population commonly found in these areas. The effectiveness of upwelling and its ability to support abundant sea life is greatly dependent upon the depth of the thermocline. Thermoclines are gradients in the ocean that are a result of a large temperature difference between the mixed layer and the deep layer. Because the surface temperature of the oceans increases during El Niño conditions, this increases the temperature gradient, allowing a deeper thermocline to form. The thermocline is deeper and flatter overall (making average sea level of the eastern Pacific higher than normal). A deeper thermocline limits the amount of nutrients brought to shallower depths by upwelling processes, greatly reducing the year's fish crop.	• A description of how El Niño forms. • A description of how El Niño affects: the thermocline OR the transport of energy OR the transport of nutrients. • A description of how El Niño conditions affect the fish numbers, eg during El Niño there will be less fish / a decrease in upwelling. • A description of a thermocline as a rapid change in temperature/barrier between mixed and deep layers	• An explanation of how El Niño affects: • the thermocline OR the transport of energy OR the transport of nutrients. • An explanation of how El Niño affects the fish numbers (less upwelling so less nutrients therefore less fish).	• Discussion of how El Niño affects: the thermocline AND the transport of energy OR the transport of nutrients. • How this links directly to the numbers of fish off the coast of South America. (**Not** fish move away.)

	NØ = no response or no relevant evidence	N1 = 1 correct idea about El Nino	N2 = 1 partial point from Achievement	A3 = 1 points	A4 = 2 points	M5 = 1 point	M6 = BOTH points	E7 = Discussion of El Nino effect AND link to fish numbers with minor error.	E8 = Full discussion of both points.