

# El Niño & La Niña – Teacher Notes

Changing conditions in the atmosphere and hydrosphere influence both weather and climate. What is the difference between weather and climate? Weather refers to day-to-day changes whereas climate describes seasonal changes over years.

We shall be searching for scientific information regarding a major influence on Australia's climate. What key words would you use to search for information

What key words would you use to search for information about this? Australia's climate, meteorology, Bureau of meteorology, BoM,

Materials per student

- Access to the Internet and library reference books
- A copy of your school's directions on writing a bibliography for references



#### ENSO

Australian weather patterns are influenced by **ENSO** (El Niño Southern Oscillation). ENSO describes a cycle of atmospheric and oceanic temperature change over the Pacific Ocean. The name "El Niño", or boy child, comes from Peruvian fishermen who recognised that sometimes warm water would arrive along their coast in time for Christmas celebrations. In their language "El Niño" means the little boy. The converse, when warm water moves towards the eastern coast of Australia, is called "La Niña" or little girl. Weather patterns oscillate between El Niño and La Niña in an irregular cycle.



#### La Niña

Driven by density, cold water from southern polar region travels northwards at great depth as part of the Global Conveyor Belt described in elsewhere in this package. Running northwards from Chile to Peru it is called the Humboldt Current and has one of the world's richest and most diverse marine ecosystems. These waters move very, very slowly and are rich in nutrients gained in the Antarctic Ocean. Surface waters near the Equator are however heated by the sun and lie in a distinct layer above the cold current. The sharp interface between warm and cold is called the "**thermocline**". Warm less dense surface waters are easily moved by prevailing Trade Winds from the east. Moisture carried in wind (convection currents) above the warm water produces rainfall for either the eastern Australian coastline or for the Pacific coast of South America including Ecuador, Peru and Chile. The changing conditions of the cycle also influences weather, its effects influencing climate as far as India to the west of the International Date Line and east to the tornado belts of the United States of America.

Our Bureau of Meteorology has daily updated information on ENSO at: <u>http://www.bom.gov.au/climate/enso/</u> An excellent North American perspective on this phenomenon can be found at

http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html.

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### El Niño

Under El Niño conditions less warm water flows towards Australia. Because winds are weak most of the warm water and the rain bearing air above them will remain away from the Australian coast. On the tropical western coast of South America the increased volume of warm surface water depresses rising nutrient rich cold currents reducing fishing stocks. The quantity of fertiliser produced from sea bird droppings is also reduced as these birds feed on marine life.

Effects in Eastern Australia	Pacific Ocean	Effects in South America
and Indonesia		
Droughts	Warm surface waters	More rain (April-October)
Agriculture restricted	extend towards Peru 🔪	Flooding near the equator
Fires frequent		Good for agriculture
		Upwelling of cold nutrient
	Trade winds weaken	rich seawater supressed
		Low fertiliser production
	4	Poor fishing

#### La Niña

Under La Niña conditions trade winds strengthen and more warm water and moist wind flows towards Australia. Sea level can be up to one metre higher at the Eastern Australian coast than in Peru. Eastern Australia experiences more rain and cyclone events, whilst the converse occurs in Peru.

Effects in Eastern Australia and Indonesia	Pacific Ocean	Effects in South America
Rain and cyclones Good for some agriculture Flooding Mosquito borne disease increase	Warm surface waters extend towards Australia Trade winds strengthen	Less rain Poor agriculture Upwelling of cold nutrient rich seawater returns Good fishing Good fertiliser production

Records in rocks, sediments, corals and tree rings indicate that this irregular two to seven year cycle is not a recent phenomenon. It has been influencing our climate for over 10,000 years and probably longer. Proxy data because these changes have not been observed or measured directly but can be inferred.

### The effect of ENSO on Western Australia

Warm water forced over by the Trade Winds forces its way between Indonesia and Australia into the Indian Ocean and south down the coast of Western Australia. ENSO variation affects the Leeuwin Current, which flows southwards down our coast bringing warm nutrient poor water. Under El Niño conditions Western rock lobsters larvae are carried further offshore and adult lobsters are smaller and take longer to mature. In La Niña times inshore larval transport is assisted and whale shark



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movement changes. Some coral bleaching has been attributed to increased water temperatures also.

#### The effect of enhanced global warming on ENSO

Our climate is influenced by variation in heat exchange between the hydrosphere and the atmosphere resulting from the interaction of cooling deep waters and warming surface waters. It is difficult to predict the effect of a warming climate on this phenomenon. Warming will of course affect polar waters decreasing the rate of production of cold nutrient rich, fertilising waters moving north and weakening trade winds. Some researchers have suggested that warming has already produced "El Niño Modoki", a different form of ENSO created weather pattern resulting in more variability within each year and an overall decrease in rainfall. They suggest Modoki events have a greater impact on Australian weather than El Niño.

#### Notes: Predicting El Niño and La Niña events

Factors controlling oscillation between El Niño and La Niña are complex and are only beginning to be understood. Both events and consequences are highly variable and difficult to predict. The ability to plan in advance to offset the effects of drought, fires and a change of food stocks would be a tremendous advantage for those who live on either side of the Pacific. Many models have been created but none to date are sufficiently accurate as too many factors are involved in tipping the balance in one direction or the other.