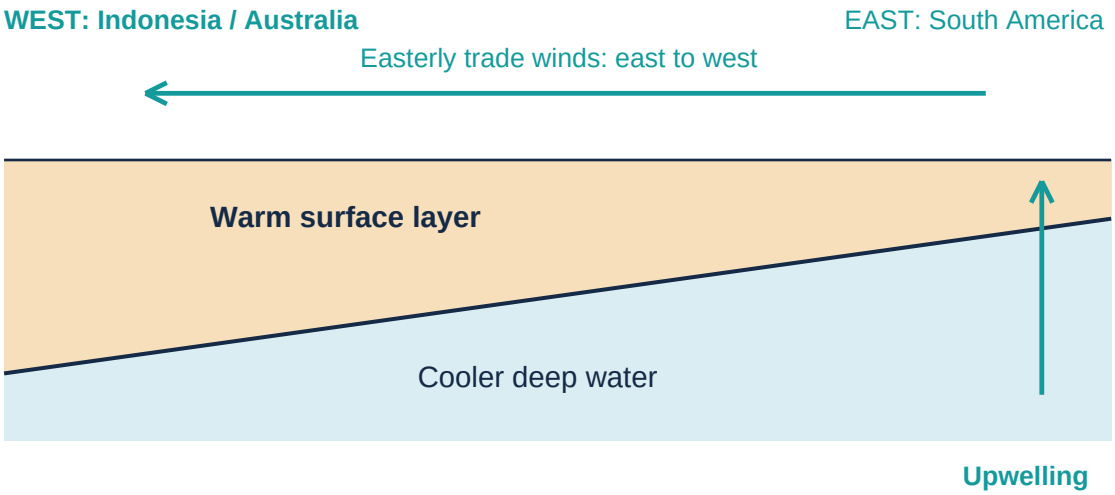
Start with the neutral Pacific

ENSO means El Niño-Southern Oscillation: a coupled ocean-atmosphere pattern in the tropical Pacific. El Niño is its warm phase, La Niña its cool phase; neutral conditions are the reference.

1. NEUTRAL CONDITIONS: WINDS PUSH WATER WEST



Dark sloping line = thermocline, the layer of rapid temperature change with depth. It is deeper in the west and shallower in the east. Schematic, not to scale.

2. CONNECT WATER, AIR AND FOOD WEBS

Trade winds collect warm surface water in the western Pacific. Rising air over this warm region supports clouds and rain. In the eastern Pacific, upwelling brings cooler, nutrient-rich water into the sunlit layer. Nutrients support phytoplankton, which feed marine food webs and productive fisheries.

3. AN IRREGULAR CYCLE, NOT THE FOUR SEASONS

ENSO events typically recur every 2-7 years rather than on a fixed schedule. Many episodes last about 9-12 months, but some persist for years. La Niña does not always follow El Niño. The Southern Oscillation describes linked atmospheric pressure changes; ocean temperatures and winds influence one another.

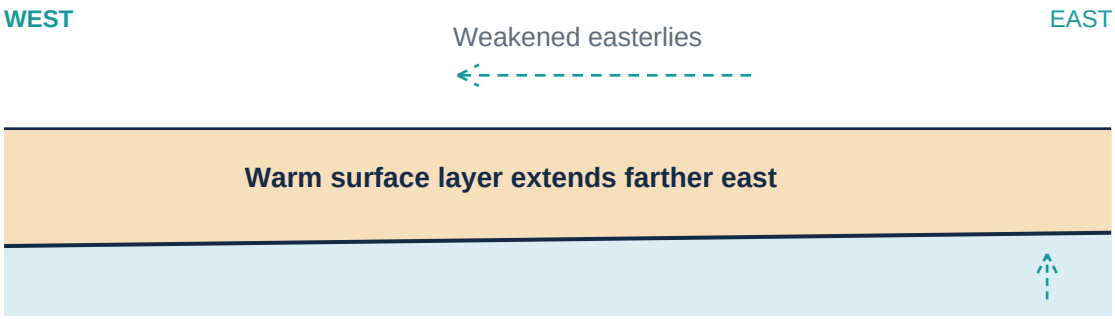
Neutral Pacific circulation and productivity: NOAA PMEL, What is El Niño?
Event timing: NOAA Ocean Today; coupled-system terminology: NOAA PMEL.

Scope: College Board AP Environmental Science CED, Topic 4.9, p. 88.

Compare the two ENSO phases

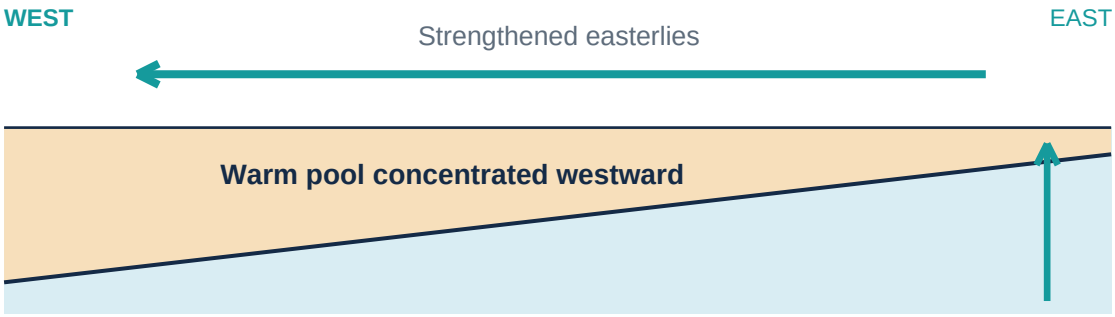
Warm and cool mean departures from the usual sea-surface temperature for that region and season, especially in the central and eastern equatorial Pacific. The whole ocean does not change uniformly.

1. EL NIÑO: WEAKER TRADE WINDS



Eastern thermocline deepens; cold, nutrient-rich water reaches the surface less effectively. Central/eastern surface waters become warmer than usual.

2. LA NIÑA: STRONGER TRADE WINDS



Eastern thermocline is shallower; stronger upwelling helps cool the surface. Central/eastern surface waters become cooler than usual.

Both sketches use west-left / east-right orientation. Pale orange = warmer upper water; blue = cooler deeper water; dark line = thermocline. Upward arrows indicate upwelling. These are simplified mature-phase patterns, not maps of every event.

Thermocline depth and phase development: NOAA Climate Prediction Center.
Stronger easterlies and upwelling: NOAA PMEL, La Niña FAQs.

Scope: College Board AP Environmental Science CED, Topic 4.9, p. 88.

Regional changes, global effects

Shifts in tropical rainfall and atmospheric heating alter circulation and storm tracks far beyond the Pacific. ENSO changes the likelihood of weather patterns; it does not guarantee a particular storm or drought.

1. TYPICAL TENDENCIES: ALWAYS NAME THE REGION

REGION / SEASON	EL NIÑO	LA NIÑA
Indonesia / parts of Australia	Often drier; drought and fire risk can increase.	Often wetter; flooding risk can increase.
Southern U.S. winter	Tends to be wetter; southern storm track favored.	Tends to be warmer and drier.
Pacific Northwest winter	Often warmer and drier.	Often cooler and wetter.

Impacts vary with event strength, season and geography. Opposite phases often favor contrasting patterns, but are not exact mirror images everywhere.

2. EL NIÑO CAN DISRUPT FISHERIES NEAR PERU

Less nutrient supply > Less phytoplankton production > Less food for fish > Potential decline in catches

A possible pathway, not a prediction for every species or fishery.

3. READ A TEMPERATURE ANOMALY CORRECTLY

Anomaly = observed temperature minus the reference average for the same place and season. Example: 26.5°C - 24.0°C = +2.5°C, meaning warmer than average, not an absolute temperature of 2.5°C. One local reading does not diagnose ENSO; scientists monitor sustained, large-scale ocean and atmospheric changes.

Regional rainfall patterns: NOAA PMEL, La Niña FAQs; NOAA Ocean Today.
Marine food webs and fisheries: NOAA Ocean Service, What are El Niño and La Niña?

Scope: College Board AP Environmental Science CED, Topic 4.9, p. 88.