# A6. How do ocean currents form?

### Aim

- To describe how the Sun and Earth's rotation causes currents.

### What to do

- Read pages 59 - 62 of your textbook and the page opposite to answer the questions below.

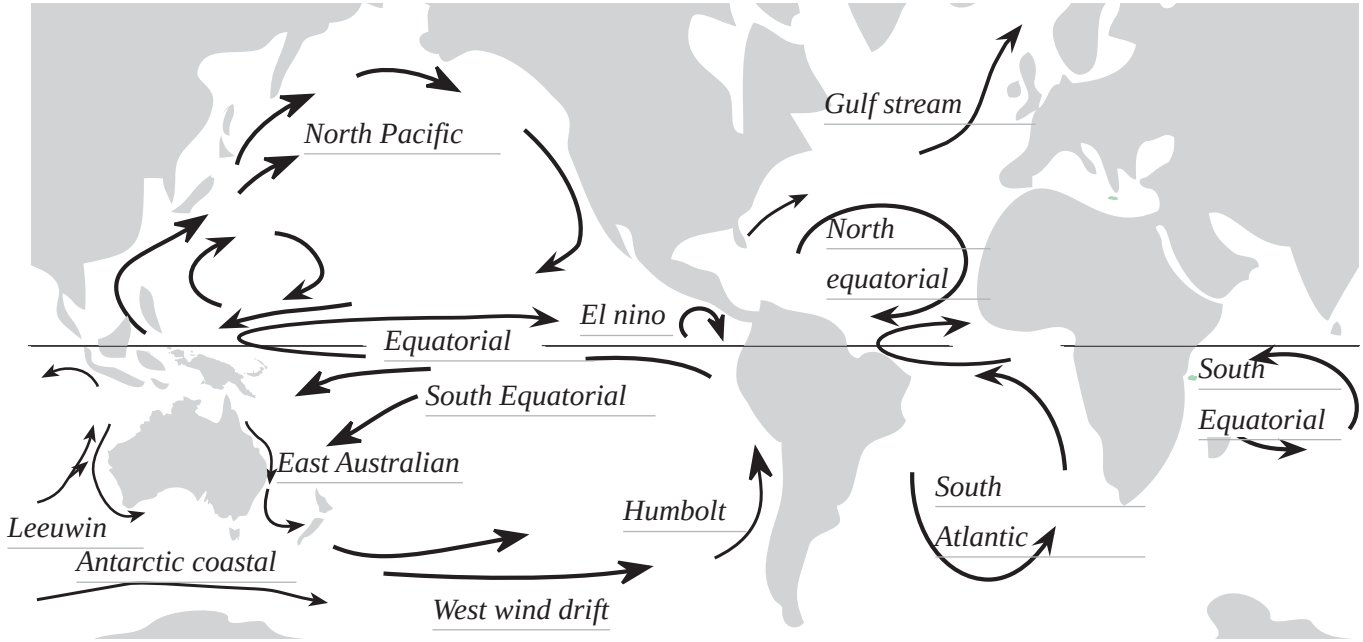
### Questions

Q1. Explain the two effects the sun has on ocean currents.

*First, it heats the atmosphere, creating winds and moving the sea surface through friction. This sets up the trade winds creating the large ocean currents.*

*The second is to alter the density of the ocean surface water directly by changing its temperature and/or its salinity. This can result in the water column becoming unstable, setting up density-dependent currents,*

Q2. Complete the map of the world below marking in the Pacific, Atlantic and Indian Oceans and identifying the following currents - *North Pacific, El Niño, Leeuwin, Antarctica, West wind drift, Humbolt, East Australian, Gulf Stream, Equatorial, North Equatorial, South Equatorial, South Atlantic.*




Q3. Explain how thermohaline circulation occurs, state what it controls and explain what it is responsible for.

*Thermohaline circulation occurs when cold water sinks at the poles and warm water rises at the equator*

*Thermohaline circulation controls the vertical distribution of temperature and salinity in oceans*

*It is responsible for vertical water movements that ventilate deep ocean water masses in a large scale oceanic circulation called the ocean conveyor belt.*

Q4. Define the term geostrophic current and explain their significance for Australia.

*They are currents caused by a sloping sea surface and create regions of different pressure.*

*They are significant because they push large amounts of water towards Australia.*

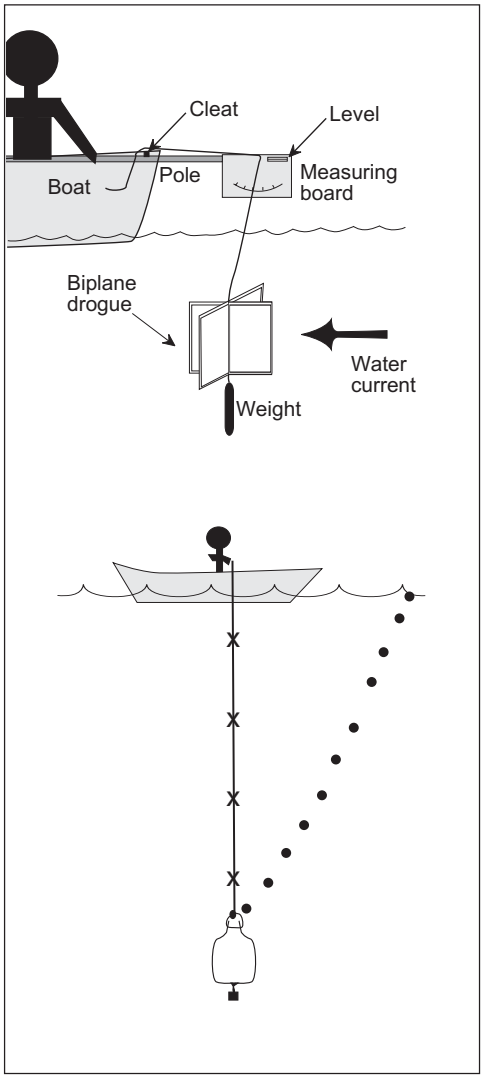
Q5. Describe how the Earth's rotation can cause currents to move.

*It causes currents to flow clockwise in the northern hemisphere and anticlockwise in the southern hemisphere. This sets up large oceanic gyres.*

Q6. Define the term Coriolis force.

*It is the force that drives water faster as it moves away from the equator.*

## Field Work A - Suggested answers




***Questions***

Q1. List equipment used to make simple field measuring equipment.

*Electrical tape, empty plastic bottle , old broom stick, drill, divers weight 11 metres venetian blind cord, coloured materials (for flag), watch with second hand handbearing compass, two oranges*

Q2. Describe how you could measure current in a river or estuary.

*Make a map of the area.*

*Now tie 10 metres of cord to a drink bottle.*

*Select a place such as a jetty where the current is running and you can launch your drogue.*

*Lower the drogue into the water and tell your partner to time how long it takes for the drogue to run out to the full length of the 10 metres of rope on a prearranged signal.*

*When a partner is ready, release the drogue and observe what happens.*

*Use the hand bearing compass to determine the direction of the current.*

*Using the formula*

*Speed = distance / time*

*calculate the speed of the current and record it. Repeat the experiment twice and average your results.*

Q3. Complete the results table for the river/estuary opposite.

Q4. Describe how you could measure current on an open beach.

*Pace out 5 stations, 15 metres apart on the beach.*

*At a prearranged signal you cast two oranges into the sea - one close in the other as far out as you can throw and the timekeeper starts the watch.*

*Then follow the two oranges and any variations. It the orange comes in, you should throw it out again.*

*After one minute the timekeeper signals and mark the position of your orange in the sand opposite where the orange is.*

*After two, three, four and five minutes, record data accurately*

Q5. Complete the results table for the beach opposite and draw a map of your study area.

Q6. Describe any other method you could use on the beach or in an estuary.

*Students own answers*

## Field Work B - Suggested answers

### *In a river or estuary*

Description of what happened

Data and calculations

*Length of rope*

*Time to run length out*

*Speed of current*

*(Distance/time)*

*Direction of current*

***Questions***

1. How fast was your current?

   *Students own answers*

2. In what direction did it go?

   *Students own answers*

3. What causes currents?

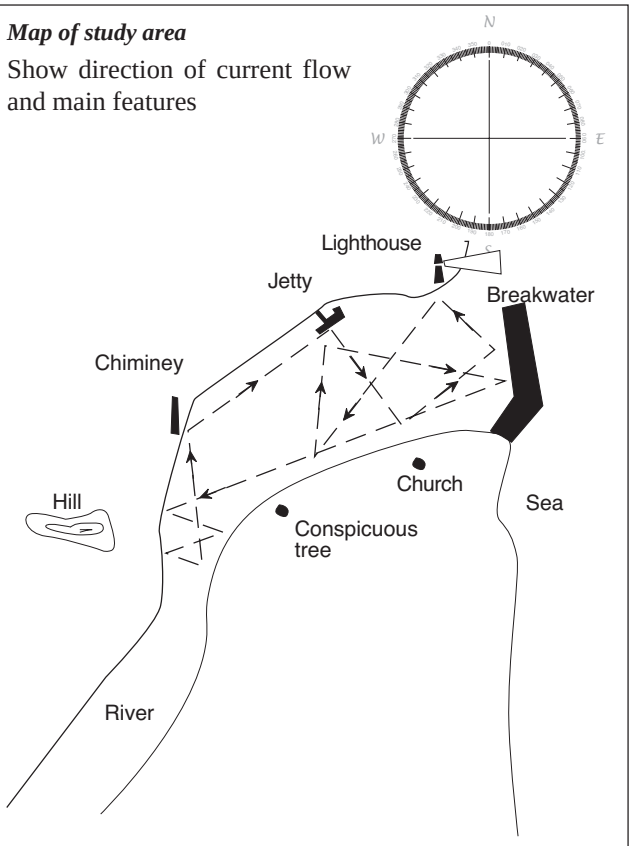
   *Students own answers*

4. Do you think currents will change during the day and if so what could cause these changes?

   *Tides, low pressure systems*

***Map of study area***

Show direction of current flow and main features




### *On a beach*

***Questions***

1. Which direction did the current flow?

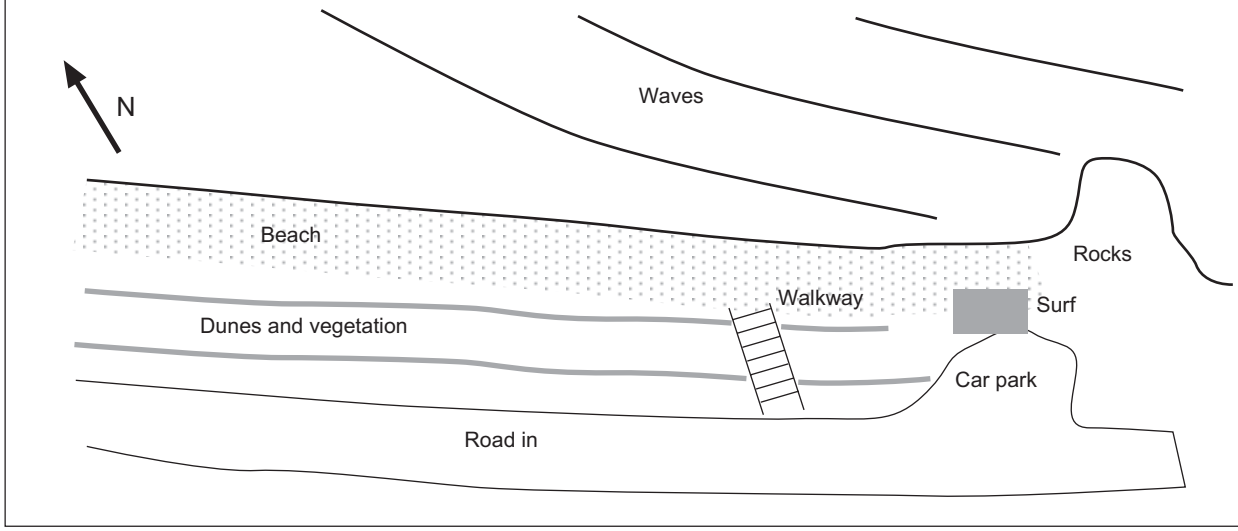
   *Students own answers*

2. Which orange travelled faster - inshore or far out?

   *Students own answers  the ones in closest should travel faster*

***Map of study area***

Show north and main features of beach



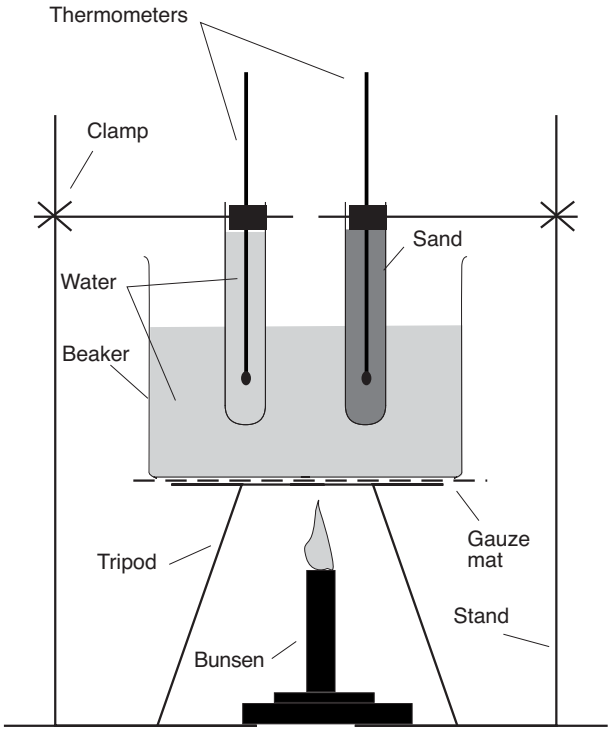
# *Lab 3 How do offshore winds occur?*

### *Aim*

To observe the effects of temperature on land and water.

### *Equipment and materials*

- 500 mL beaker half-filled with water
- 2 test tubes filled with equal amounts of dry sand and water
- 2 thermometers tight fitted in rubber stoppers, 1 in each test tube
- bunsen burner, tripod, gauze mat, matches
- bench protector, 2 retort stands, bossheads and clamps




### *What to do*

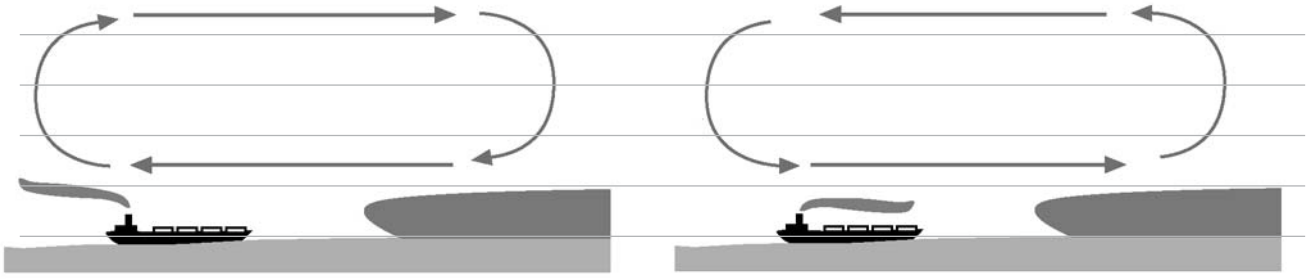
1. Set up equipment as in the illustration opposite.
2. Read and record temperatures of sand and water (time = 0)
3. Light bunsen and heat beaker over a low flame for 10 minutes, reading temperatures of sand and water every 2 minutes.
4. After 10 minutes, turn off bunsen and lift both test tubes from water.
5. Allow to cool and read both temperatures every 2 minutes for 10 minutes.
6. Draw a line graph of temperature versus time, comparing the sand and water data on the one graph. Note: Put the time (in minutes) on the horizontal axis.
7. Now read page 74 - 75 of your textbook and answer the questions below.

### *Questions*

Q1. Write up your experiment under the headings aim, method, results and conclusion on the page opposite.

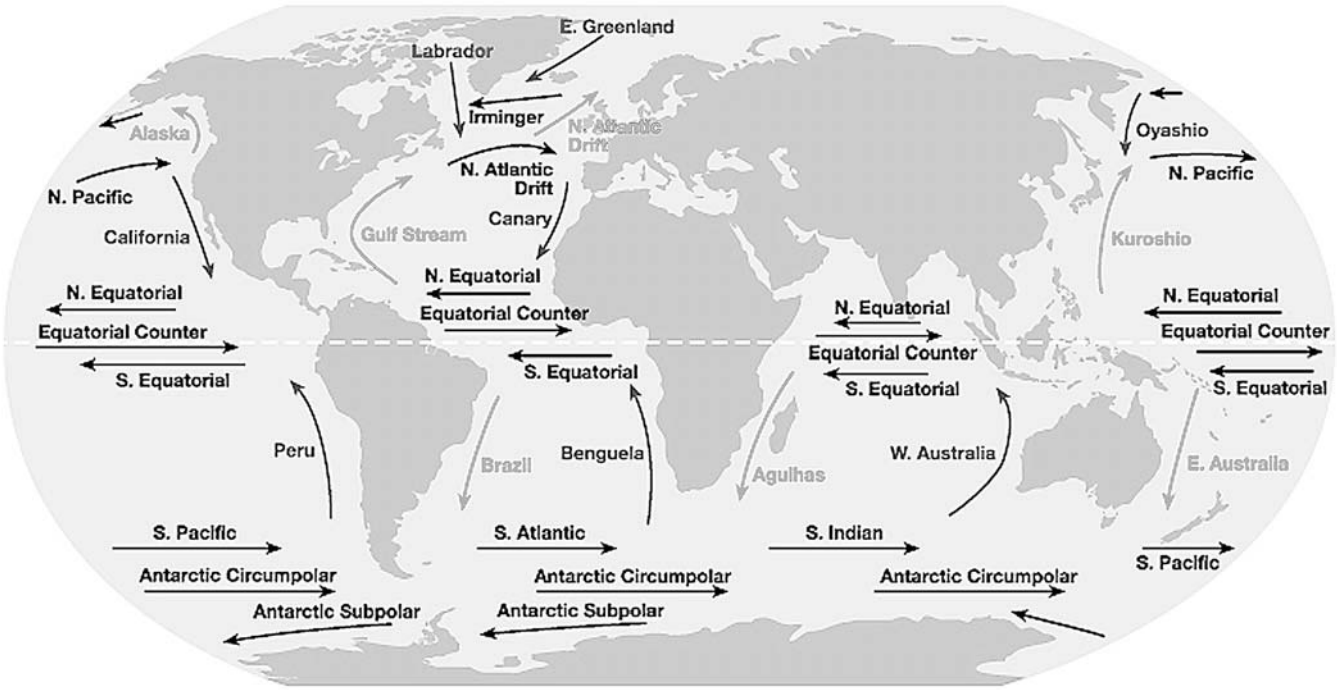
Q2. Which heated up and cooled down the fastest?

Q3. Explain how offshore winds occur and relate this to the above experiment. Complete the illustration below to illustrate your answer.



Q4. List three important oceanographic features about winds (see pages 74 - 75 of your textbook)

# *Factsheet - World currents*




Important currents

Arctic Ocean

* East Greenland Current
* Norwegian Current
* Beaufort Gyre (water or ice flow)
* Transpolar Drift (water or ice flow)

Atlantic Ocean

* Angola Current
* Antilles Current
* Baffin Island Current
* Benguela current
* Brazil Current
* Canary Current
* Cape Horn Current
* Caribbean Current
* East Greenland Current
* Falkland Current
* Gulf Stream
* Guinea Current
* Labrador Current
* Lomonosov current (a deep current)
* North Atlantic Current
* North Brazil Current
* Norwegian Current
* Portugal Current
* South Atlantic Current
* Spitsbergen Current
* West Greenland Current
* West Wind Drift

Pacific Ocean

* Alaska Current
* Aleutian Current
* California Current
* Cromwell current (a deep current)
* East Australian Current
* Equatorial Counter Current
* Humboldt Current (or Peru Current)
* Kamchatka Current
* Kuroshio Current (or Japan Current, Kuro Siwo)
* Mindanao Current
* North Equatorial Current
* North Pacific Current (or North Pacific Drift)
* Oyashio Current (or Oya Siwo)
* South Equatorial Current
* West Wind Drift

Indian Ocean

* Agulhas Current
* East Madagascar Current
* Equatorial Counter Current
* Indonesian Through-flow
* Leeuwin Current
* Madagascar Current
* Mozambique Current
* Somali Current
* South Australian Counter Current
* South Equatorial Current
* Southwest and Northeast Monsoon Drift (or Indian Monsoon Current)
* West Australian Current
* West Wind Drift

Southern Ocean

* Antarctic Circumpolar Current
* Weddell Gyre
* Tasman Outflow