Topic 4b

OCEAN CURRENTS, TIDES

Objectives

At the end of this topic you should be able to:

- Give an outline of major world ocean currents
- Describe surface and deep currents
- Discuss upwelling and down welling currents
- Describe ocean tides
- Explain the role of ocean currents

Ocean Currents

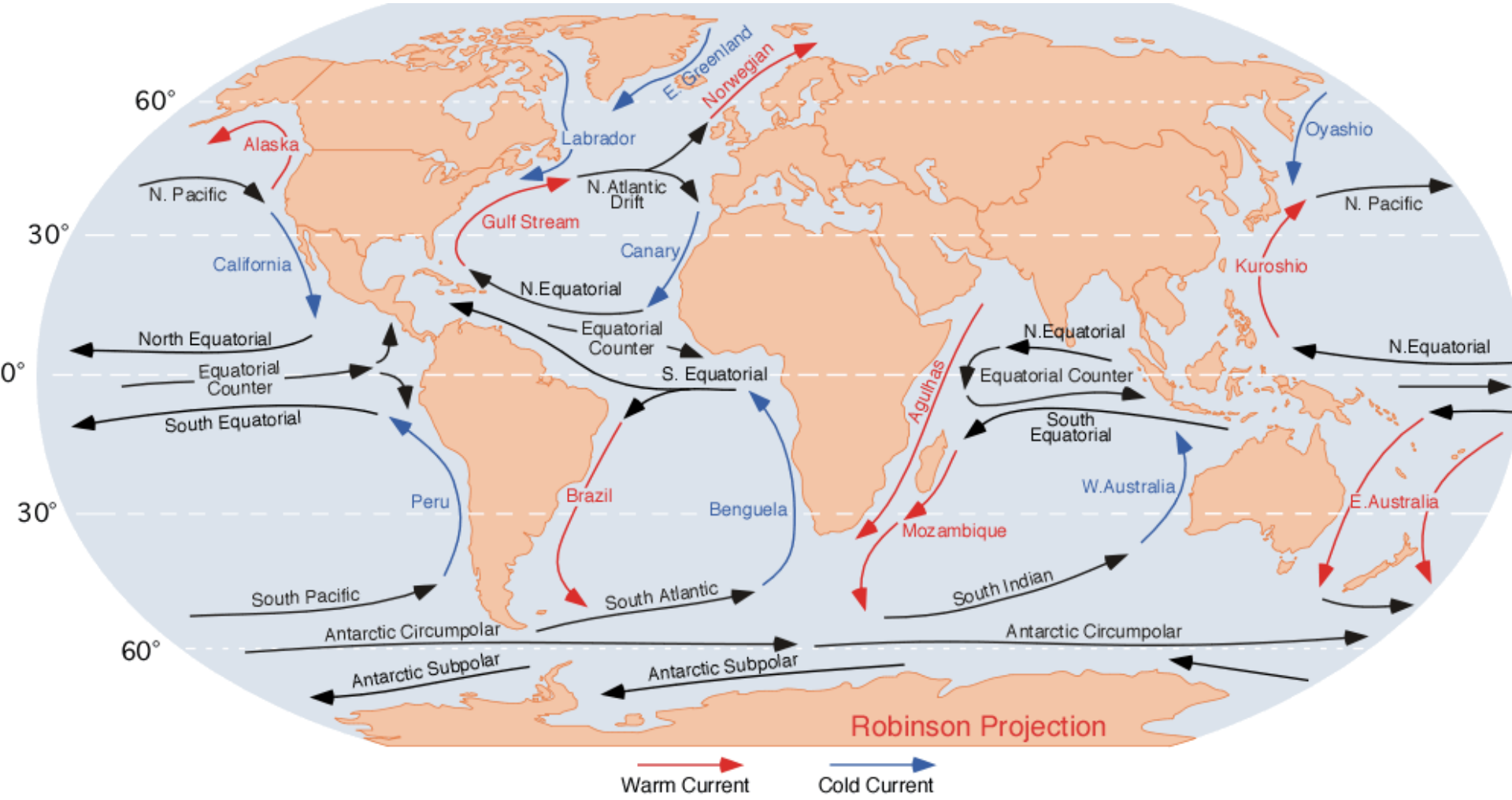
- Currents are water movements driven by forces such as
  - wind,
  - tides, and
  - water density.
- Water density is determined by temperature and salinity.
- Cold sea water is **dense** whereas fresh water is **lighter** than salty water.
- Currents keep our oceans in constant motion.
- **These currents play an important role in the distribution of surface living organisms.**
- However, wind action does not penetrate below 200m depth and these surface currents have little influence on the large scale movement and mixing of sea water.
- Currents move large amounts of water great distances.

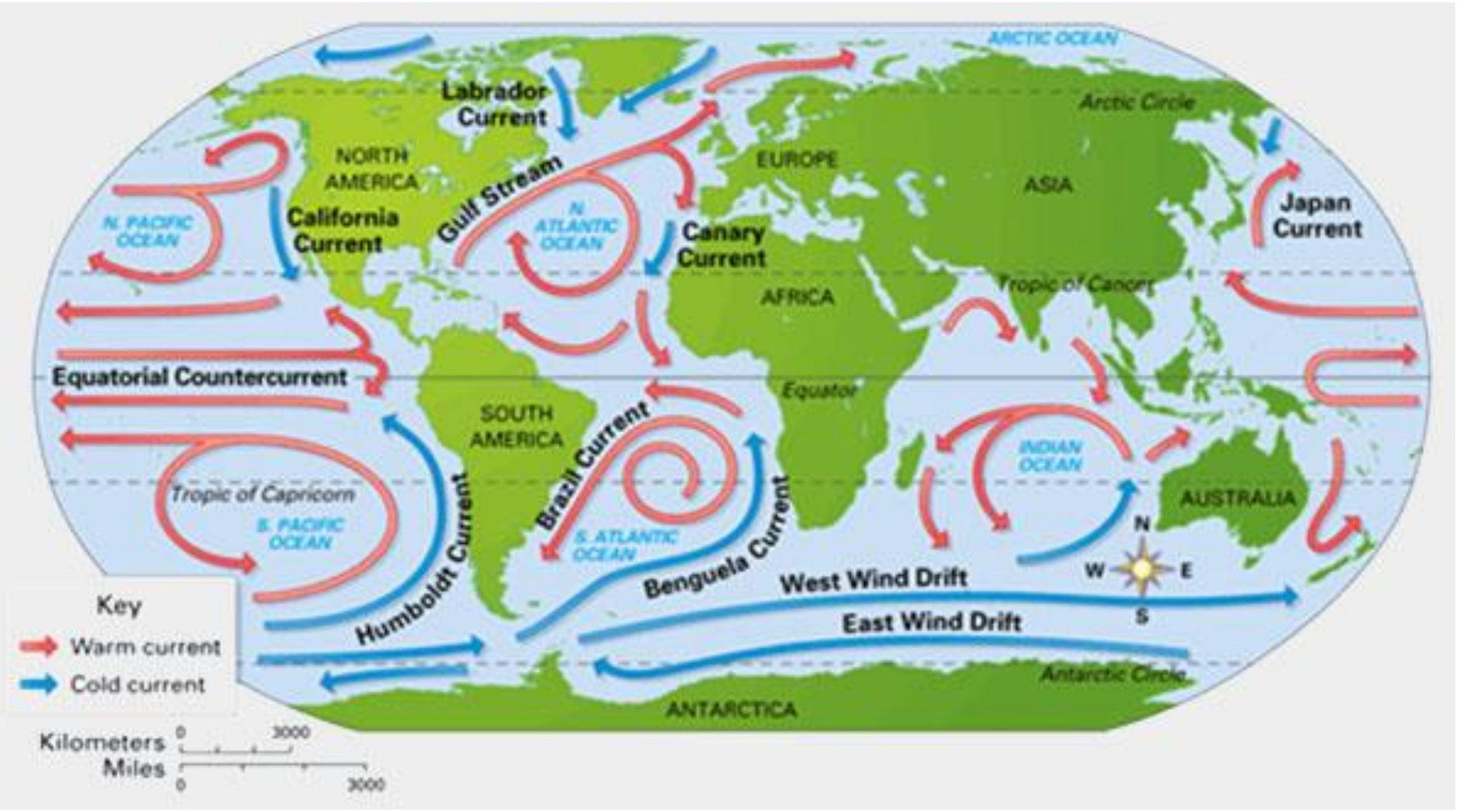
- Ocean currents can be broadly divided into two categories:

1. Surface currents: affect surface waters and are driven by wind belts and affect 10% of the ocean water.

- **The seven major surface currents are the:**
  - West Wind Drift (or the Antarctic Circumpolar Current)
  - East Wind Drift
  - North Equatorial currents
  - South Equatorial currents
  - Peru Current
  - Kuroshio Current
  - Gulf Stream

Major ocean currents of the world. Red arrows indicate warm currents, while cold currents are displayed in blue



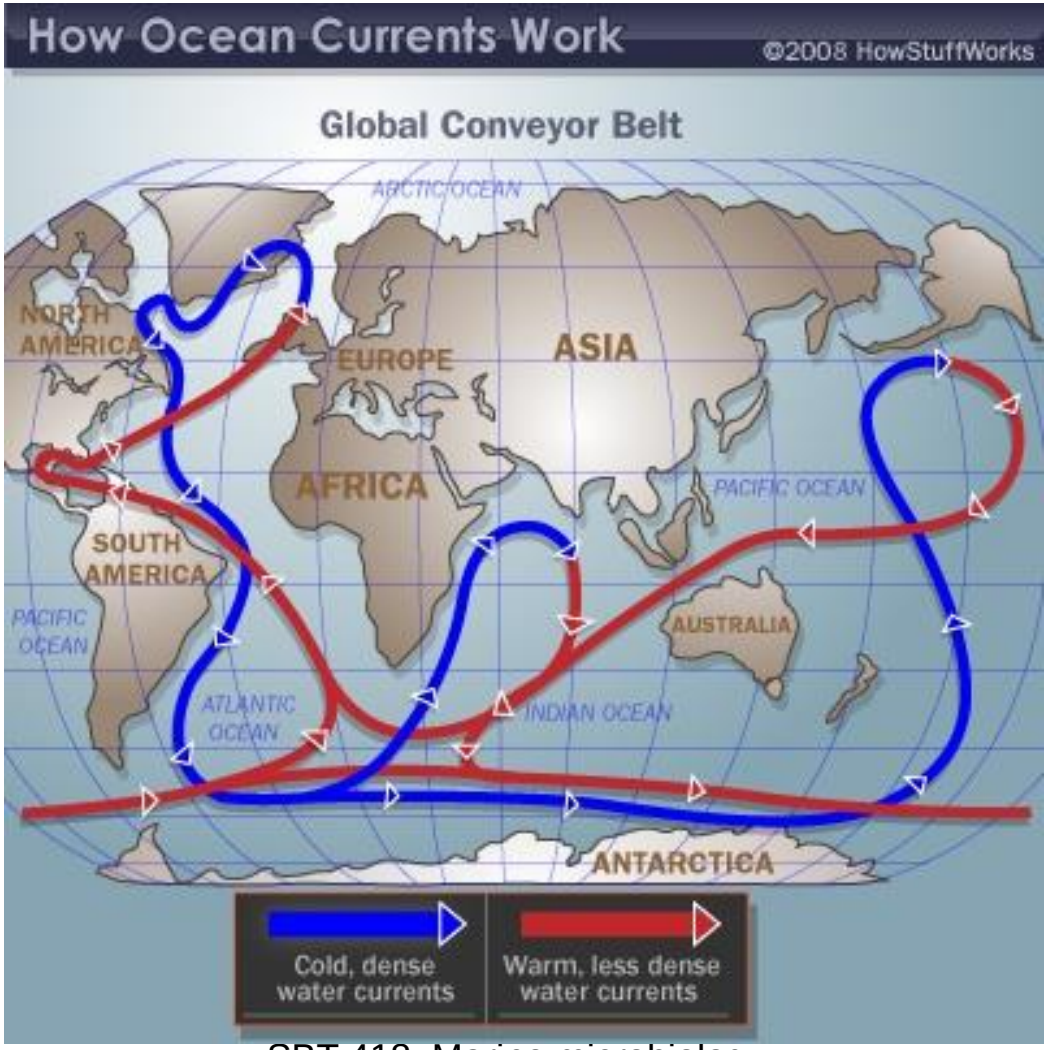

ARCTIC OCEAN
Arctic Circle
Labrador Current
NORTH AMERICA
EUROPE
ASIA
Japan Current
N. PACIFIC OCEAN
California Current
Gulf Stream
N. ATLANTIC OCEAN
Canary Current
AFRICA
Tropic of Cancer
Equatorial Countercurrent
Equator
SOUTH AMERICA
Brazil Current
INDIAN OCEAN
AUSTRALIA
Tropic of Capricorn
S. PACIFIC OCEAN
S. ATLANTIC OCEAN
Humboldt Current
Benguela Current
West Wind Drift
East Wind Drift
N
W
E
S
Antarctic Circle
ANTARCTICA
Key
Warm current
Cold current
Kilometers 0 3000
Miles 0 3000

- These currents flow in large rotating loops called **gyres**.
- In the **Northern Hemisphere**, gyres spin in a clockwise direction, and in the **Southern Hemisphere**, gyres spin in a **counter** clockwise direction.
- This is because of Earth's spinning rotation and is called the **Coriolis Effect.(read further on this)**
- **Large surface currents are mainly driven by winds that blow year round**.

2. Deep currents:

- Affect deep waters, are driven by density differences and affect 90% of ocean water.
- They are **larger and slower** than surface currents.
- The major currents in the sea as a whole are caused by changes in the density of certain surface water masses.
- The currents are generated because of the shape of the **sea bed-resulting** in upwelling and downwelling.

Thermohaline circulation/currents;water density depends on its temperature (thermo) and salinity (haline)



Ocean currents categories

Longshore currents-

- This current is caused when waves strike the beach at an angle.
- The front part of the wave hits the shallow water first and slows down.
- The rest of the wave bends as it comes onto the shore creating a current that parallels the beach.

Rip currents

- They are a potentially dangerous effect of Longshore currents.
- Rip currents, sometimes called rip tides, can happen when longshore currents, which move parallel to the beach, bounce seaward because of a change in the bottom's structure.
- Swimmers need to be careful in areas where rips can occur as they can be carried out to sea with this flow of water.
- Swimmers caught in this current should swim parallel to the shore until they are out of the rip current.

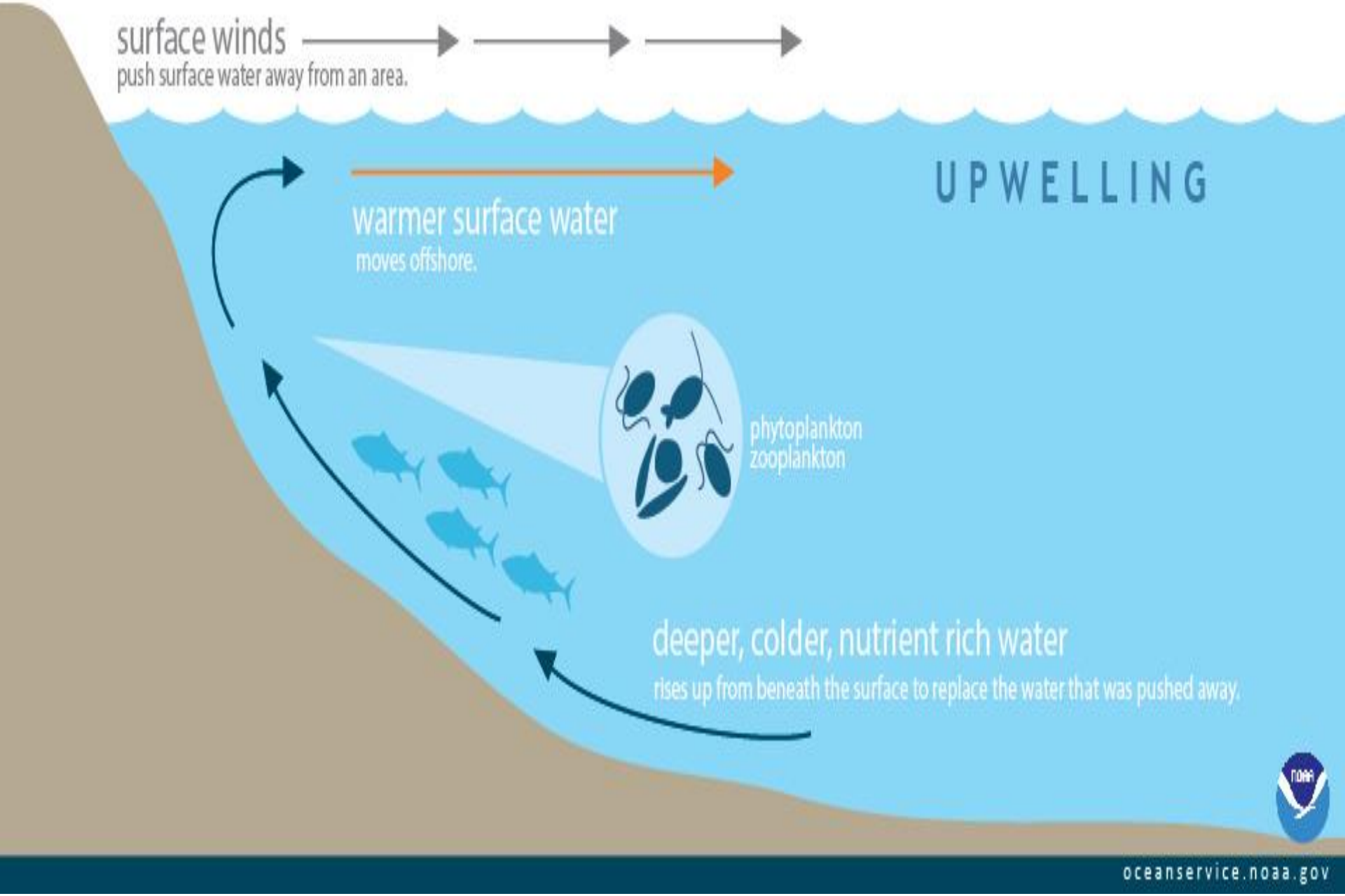
Vertical currents-

(i) Coastal upwelling

- Happens when winds blowing offshore (or toward the ocean) push water away from the shore.
- Deep, colder water rises to replace the water that has been blown out into the ocean.
- This cold water from deep the ocean floor brings many nutrients to the surface.

Why do you think this water has so many nutrients?

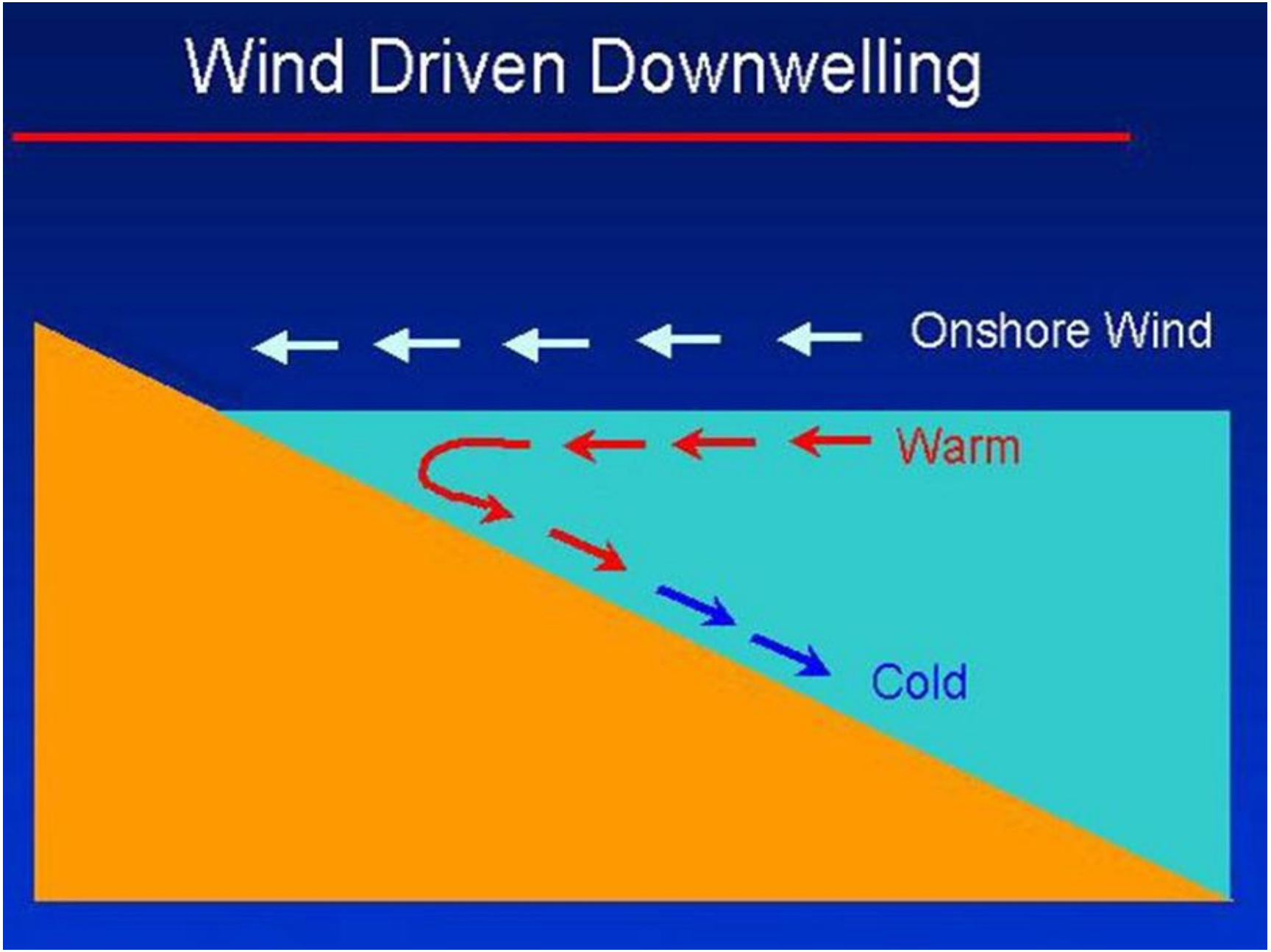
- Dying organisms and faecal matter fall to the ocean floor.
- As they decompose (rot), nutrients are released, but few organisms are there to use the nutrients.
- They remain trapped on the ocean floor until an upwelling pushes them to the surface.
- Plankton blooms usually follow coastal upwellings because of the abundant nutrients that come with it.


surface winds
push surface water away from an area.
UPWELLING
warmer surface water
moves offshore.
phytoplankton
zooplankton
deeper, colder, nutrient rich water
rises up from beneath the surface to replace the water that was pushed away.
oceanservice.noaa.gov

Upwelling zones

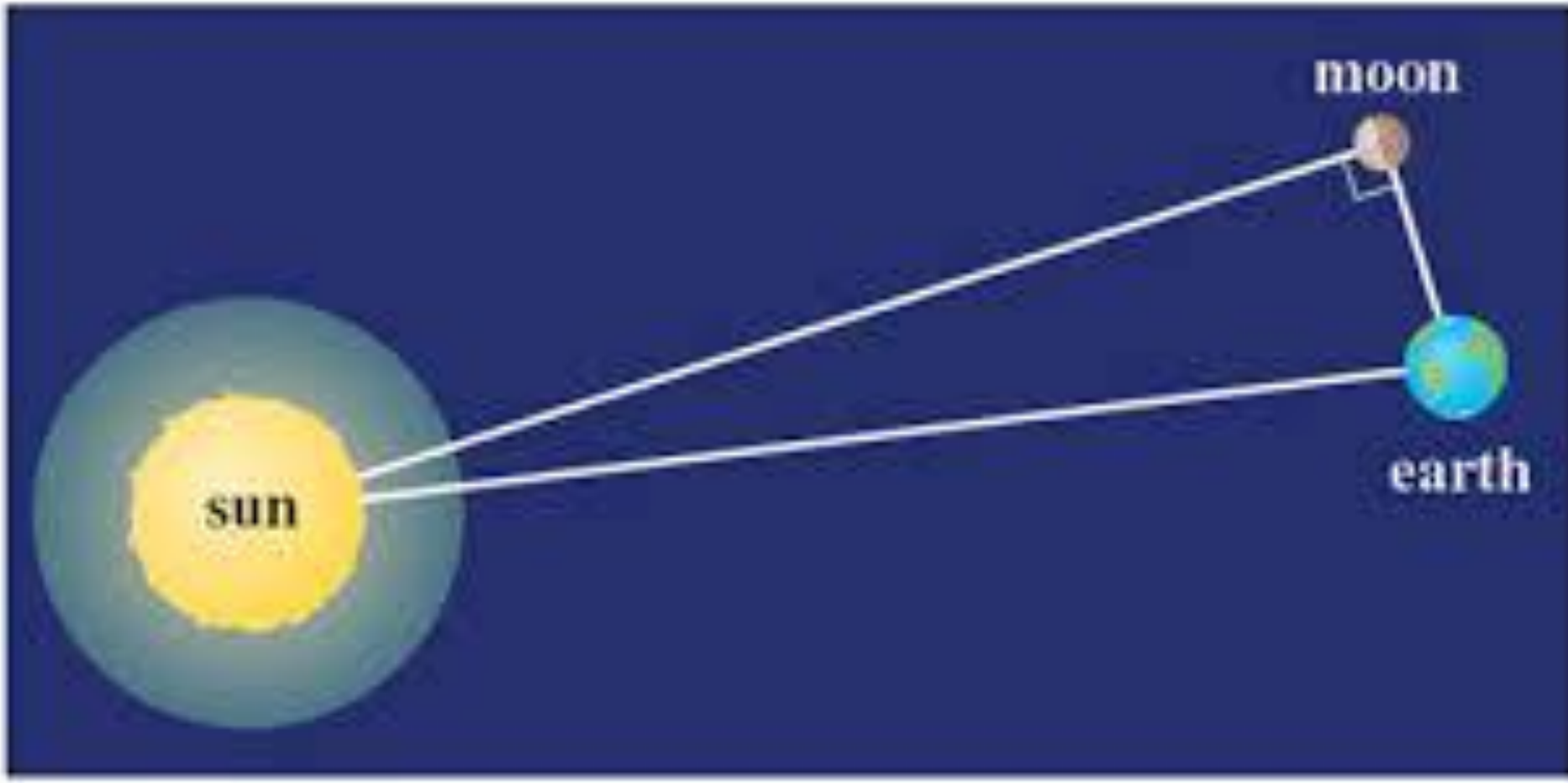
(ii) Downwelling

- Happens when onshore winds (or winds blowing toward the shore) push water toward the coast.
- This drives the near shore surface water down and away from the coast.


Wind Driven Downwelling
Onshore Wind
Warm
Cold

Tides/ Tidal currents

- Tides are the periodic motion of the waters of the sea due to changes in the attractive forces of the Moon and Sun upon the rotating Earth.
- Movements of water brought about by gravitational pull of the moon and to a lesser extent by the gravitational pull of the sun
- The principal tidal forces are generated by the moon and sun.
- However, the moon is the main tide-generating body.
- This is due to its greater distance, the Sun's effect is only 46% of the moon's. **(check you tube videos)**

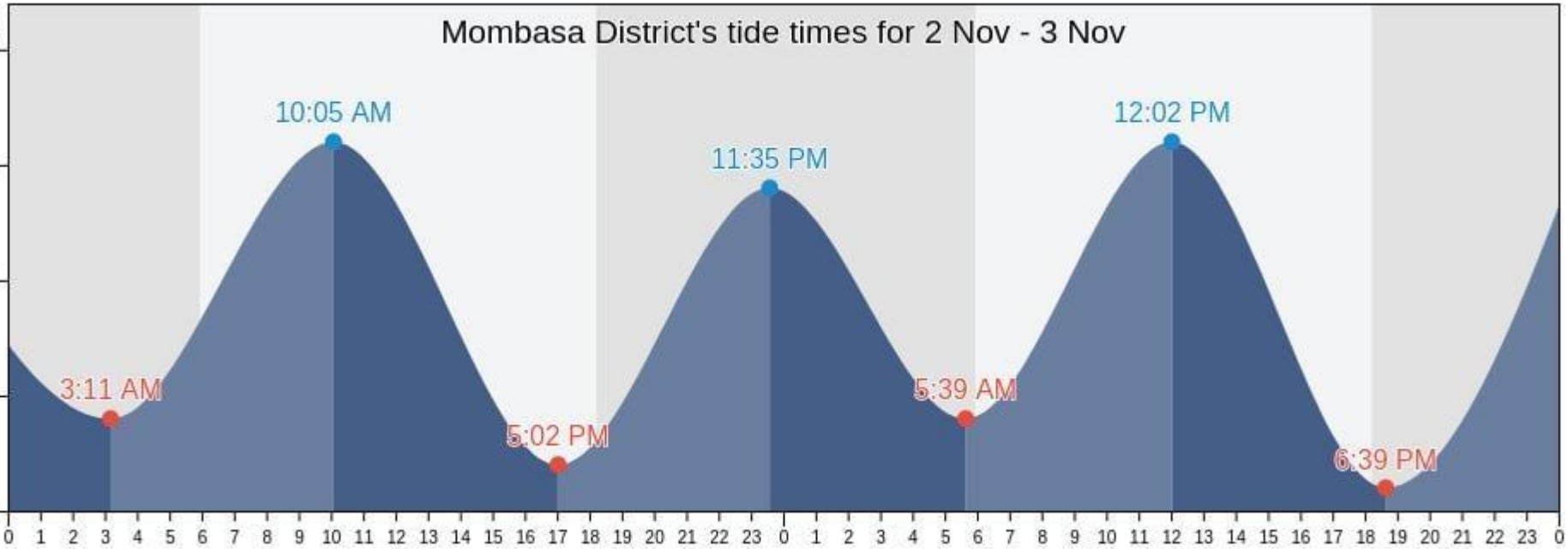

moon
earth
sun

Tides: Classification of tides

- Tides are classified (according to the characteristics of the tidal pattern) as one of three types:
- **Semidiurnal**-here are two high and two low waters each tidal day(every 6 hours), with relatively small differences in the respective highs and lows.
- **Diurnal-**only a single high and single low water occur each tidal day. Tides of the diurnal type occur along the northern shore of the Gulf of Mexico
- **Mixed-**the tide is characterized by a large inequality in the high water heights, low water heights, or in both. There are usually **two high and two low waters** each day, but occasionally the tide may become diurnal.
  - Such tides are prevalent along the Pacific coast of the United States and in many other parts of the world.

- At most places the tidal change occurs twice daily.
- The tide rises until it reaches a maximum height, called **high tide** or **high water** and then falls to a minimum level called **low tide** or **low water.**
- The period at high or low water during which there is no apparent change of level is called **stand**
- The difference in height between consecutive high and low waters is the **range**.
- Tides can measure up to 12m and other eg. Mediterranean have a tidal range of only a few cm.

Example of a tide table for Mombasa Nov. 2022(neap and spring tides)



Tidal Inundation

Individual Home work

1. How do tides affect marine life?
2. How do tides affect human life?
3. (i) What are red tides?

   (ii)What causes them?

   (iii) Where are they prevalent?