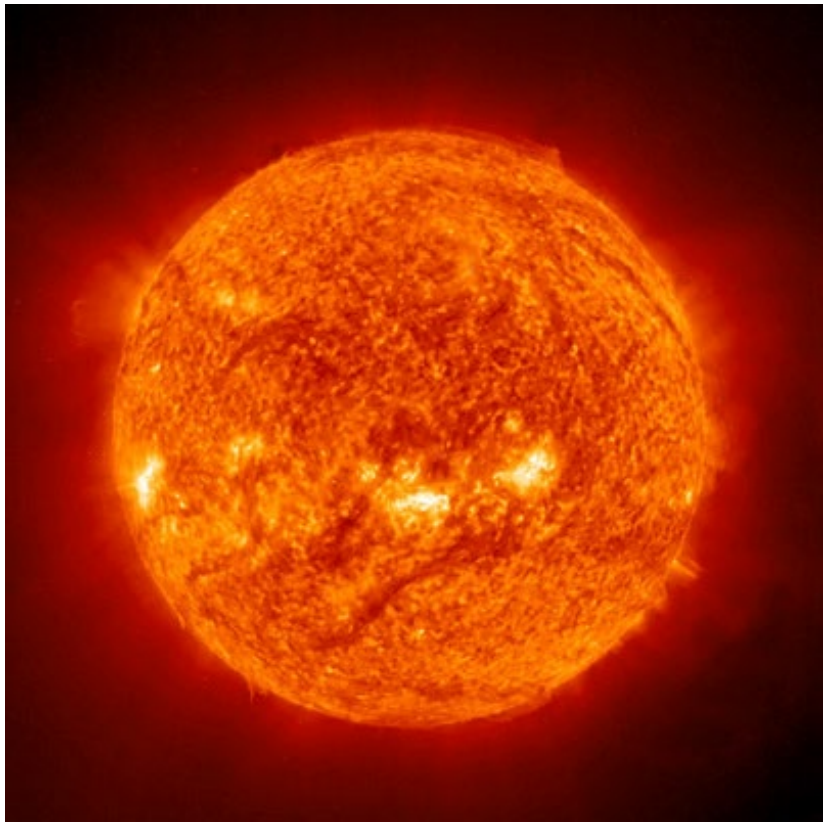
# Heat Transfer and Global Interactions

# What is heat transfer?

The Sun is the external source of energy for Earth.

Energy reaching Earth drives global interaction between the atmosphere and the surface creating wind and influencing ocean currents.

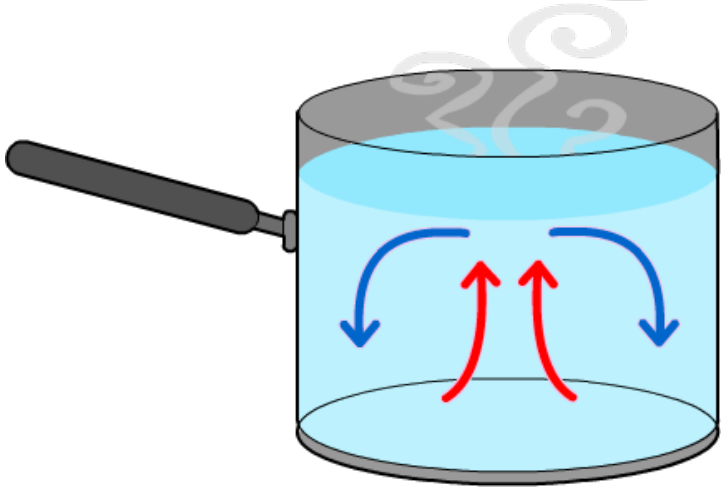


Heat is transferred by three main processes:

- **conduction**
- **convection**
- **radiation**

# Conduction, convection and radiation

**Convection** is the transfer of heat energy by the **movement of matter**. For example, in a saucepan on the stove there is a steady flow between the warm and cool sections of a fluid. This is a **convection current**.



**Radiation** is the transfer of heat energy by **electromagnetic radiation**. For example, energy from the Sun travels to Earth by electromagnetic waves.

**Conduction** is the transfer of heat energy by **direct contact**, or from particle to particle. For example, a spoon in a bowl of soup becomes warmer because the heat from the soup is conducted along the spoon.

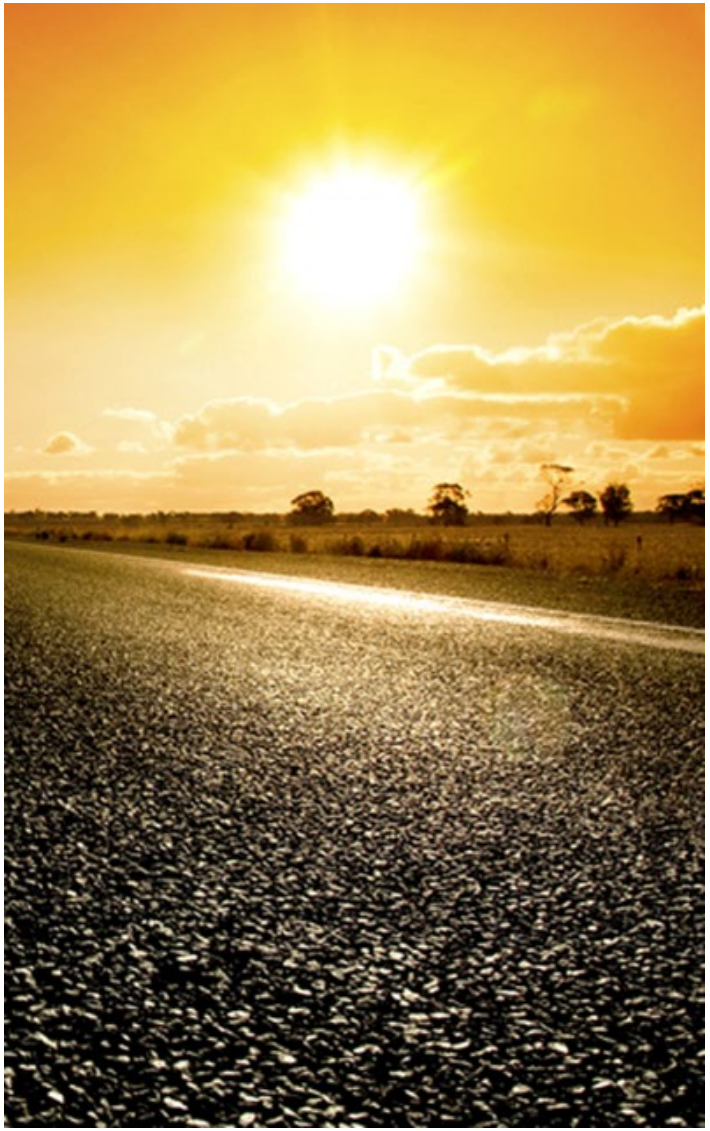
# Identifying heat transfer

# Differential heating

Radiation from the Sun does not hit Earth everywhere at the same time and in equal amounts.

This means that some places receive more heat while others receive less heat. This is known as **differential heating**.

Many factors, such as altitude and latitude, affect the amount of radiation reaching an area.



# Wind currents

# Coriolis effect

# Global wind currents

The global pattern of wind currents can be shown by the **three cell model** of air circulation. This shows:

**convection cells** (formed due to differences in high and low pressure)

deflected winds (due to the Coriolis effect)

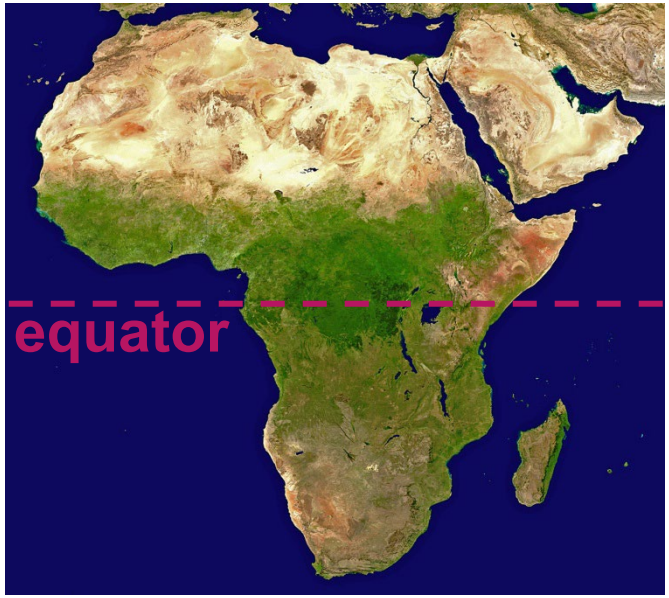
This forms three main wind patterns in each hemisphere.

# Climate zones

Wind circulation patterns, along with other factors, contribute to the location of different climate zones.

Convection cells at the equator, called **Hadley cells**, create areas of high and low pressure associated with the **trade winds**. Low pressure at the equator results in **high rainfall** – forming Africa's equatorial rainforests.

High pressure areas occur around 30 degrees north and 30 degrees south latitudes. These areas see **very low annual rainfall** – forming the arid land of the Sahara and Kalahari deserts.



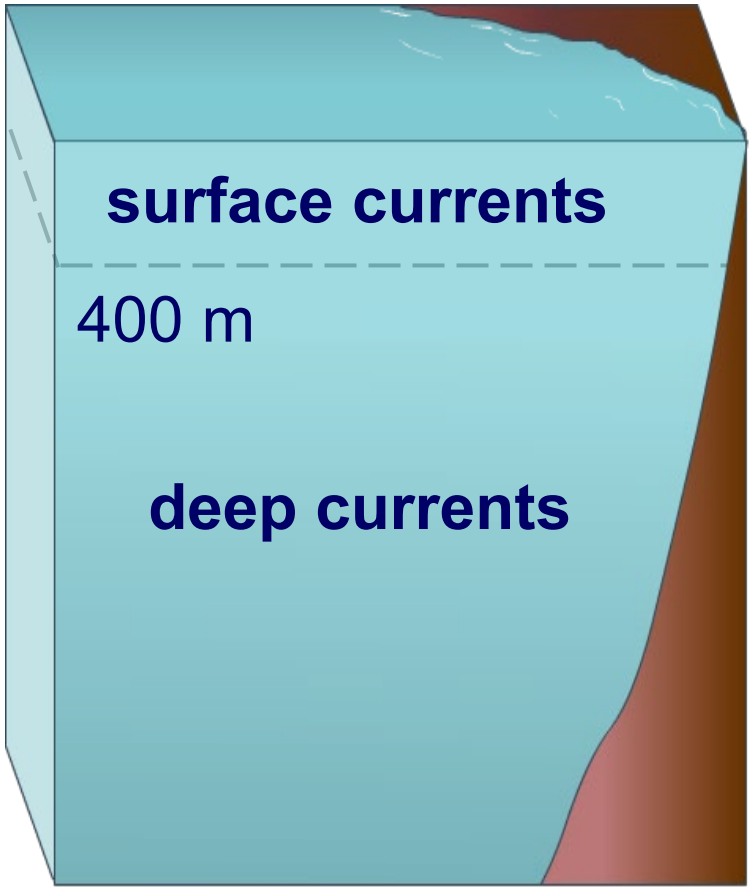
# True or false?

# Ocean currents

Heating of the Earth's surface and atmosphere by the Sun also drives convection within the oceans, producing ocean currents.

There are two circulation systems in the ocean:

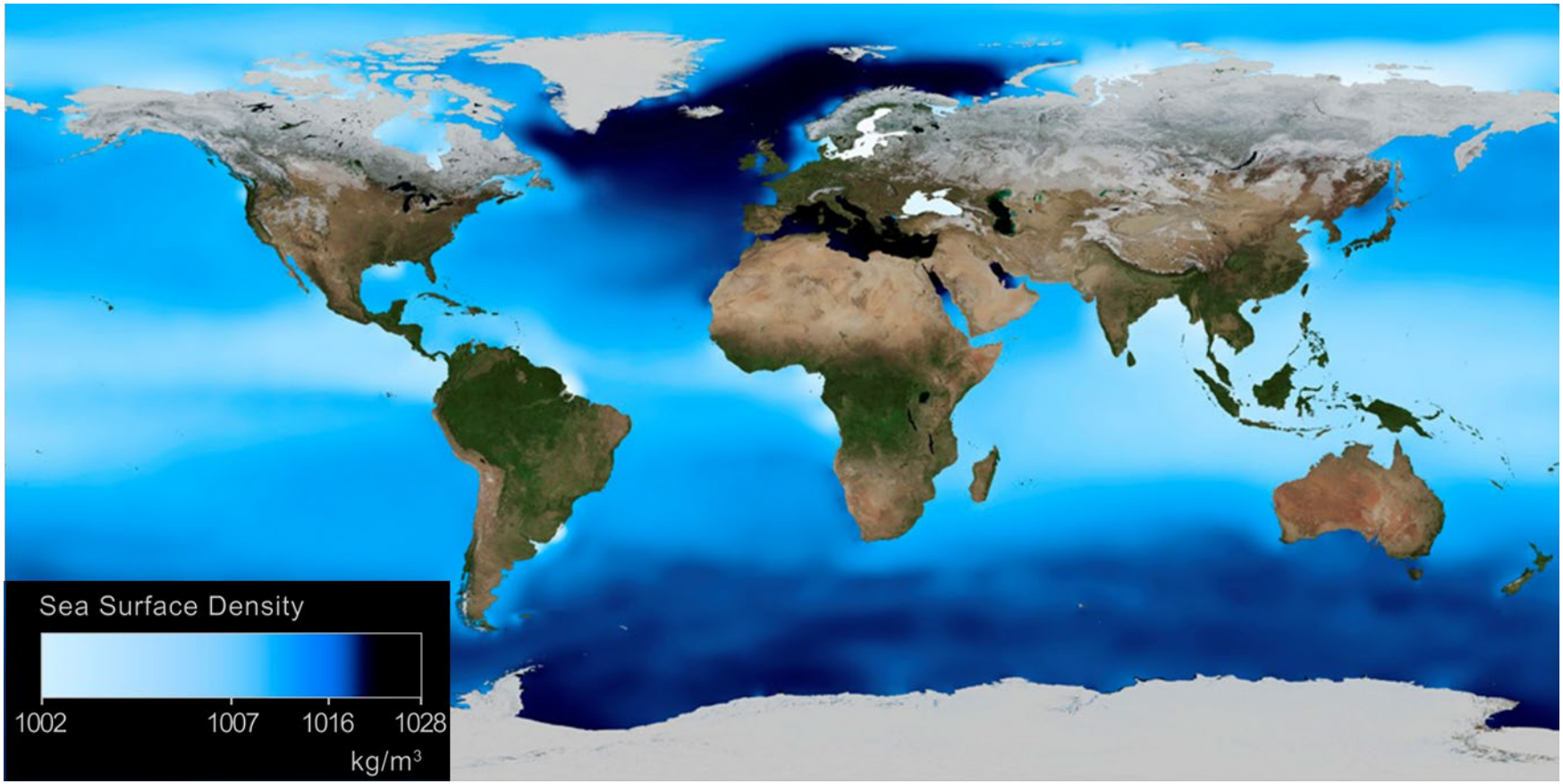
- **surface currents** – this occurs in the upper part of the ocean. This involves just the top 10% of the water in the ocean.
- **deep currents** – this occurs below 400 meter depth.



# Surface circulation

# Ocean water density

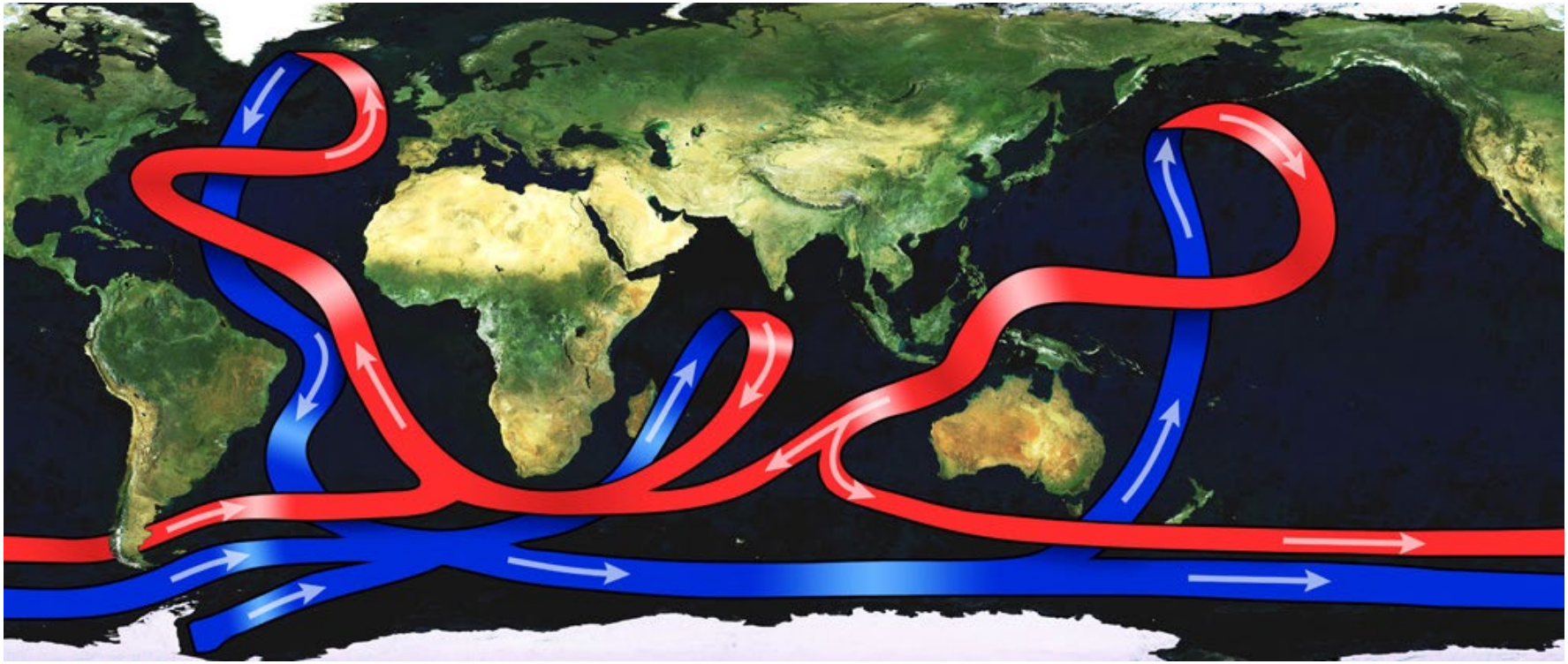
The density of ocean water varies due to differences in **temperature** and **salinity**. The dark blue areas show the regions of higher density.



# Thermohaline circulation

Water at the poles is very cold and ice formation causes the water to become salty. This dense water sinks, starting a deep current that moves water throughout the world's oceans.

This is often called the **global ocean conveyor belt**.



# How much do you know?