

THE HYDROSPHERE



PART 1

Water, the most exciting substance on Earth

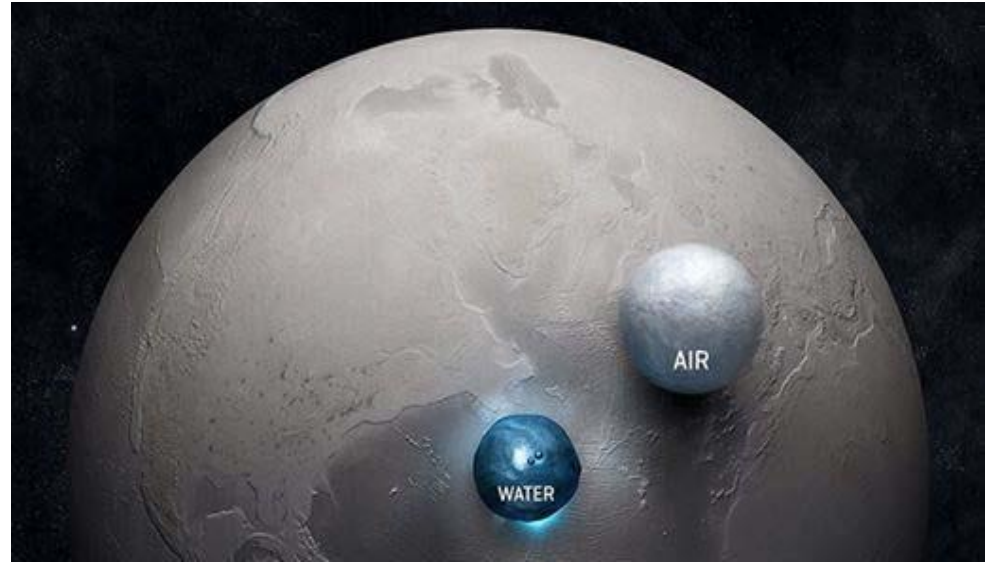
- Water is the only substance that naturally exists as solid and liquid and gas.



- Water is the substance that is necessary for any form of life as we know it.
- The Earth's liquid water constitutes the **hydrosphere**.

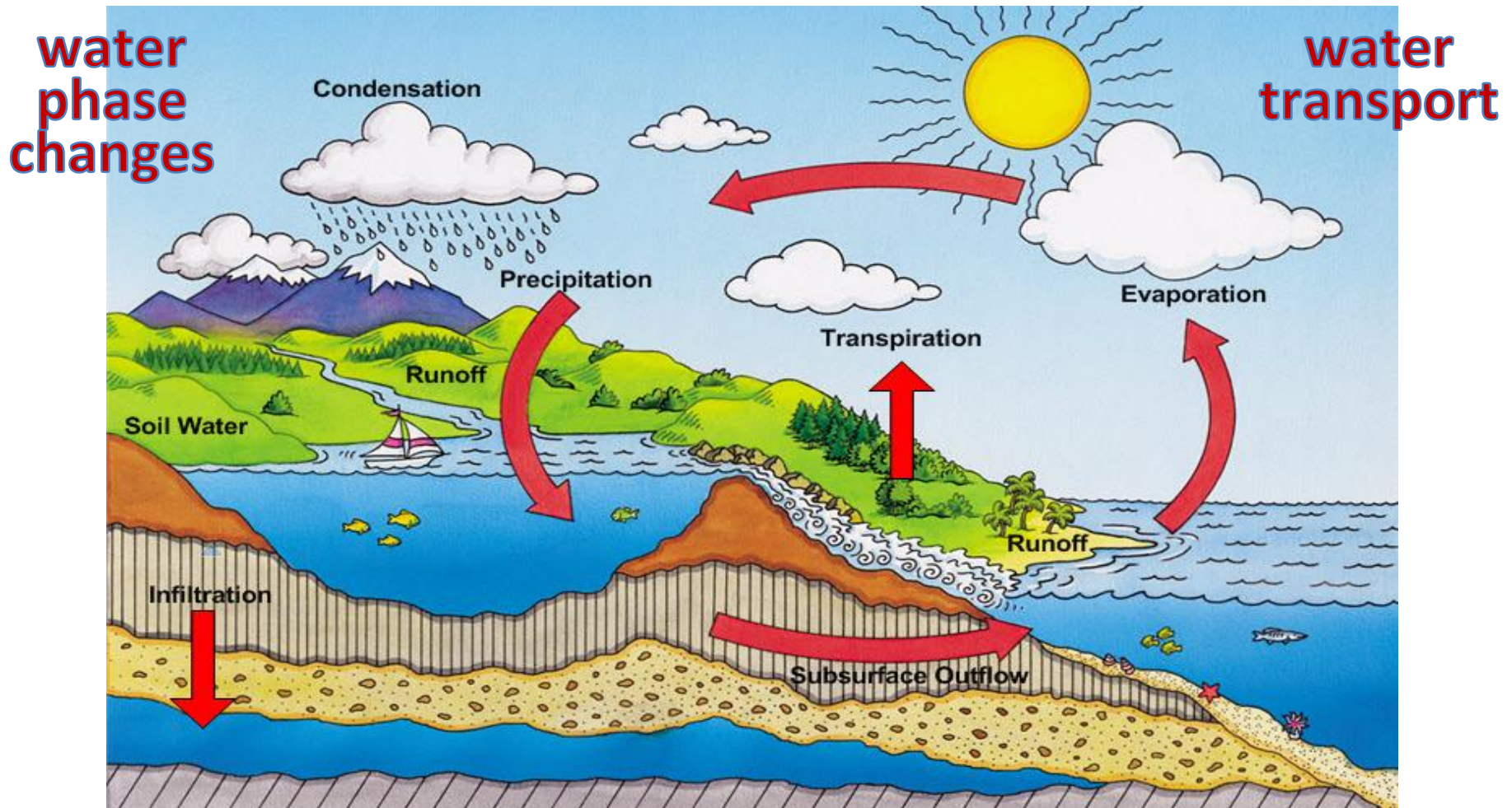
Water on Earth

- Total amount of water on Earth is **~1,386,000,000 cubic kilometers** (km³) or about 366,000,000 trillion gallons (which is NOT a lot...think *apple skin* 😊).
- Liquid water covers **71%** of the Earth's surface.



- Water is a **Heat Storage**: specific heat of water is 5-fold higher than that of stone or sand; sunlight penetrates deep into the water but only the surface of stone, clay, or sand.
- Water is constantly moving on, above and below the surface of the Earth through the **hydrologic (water) cycle** which involves water transport and phase changes by the following physical processes: *evaporation, transpiration, condensation, precipitation, surface runoff, and infiltration*.

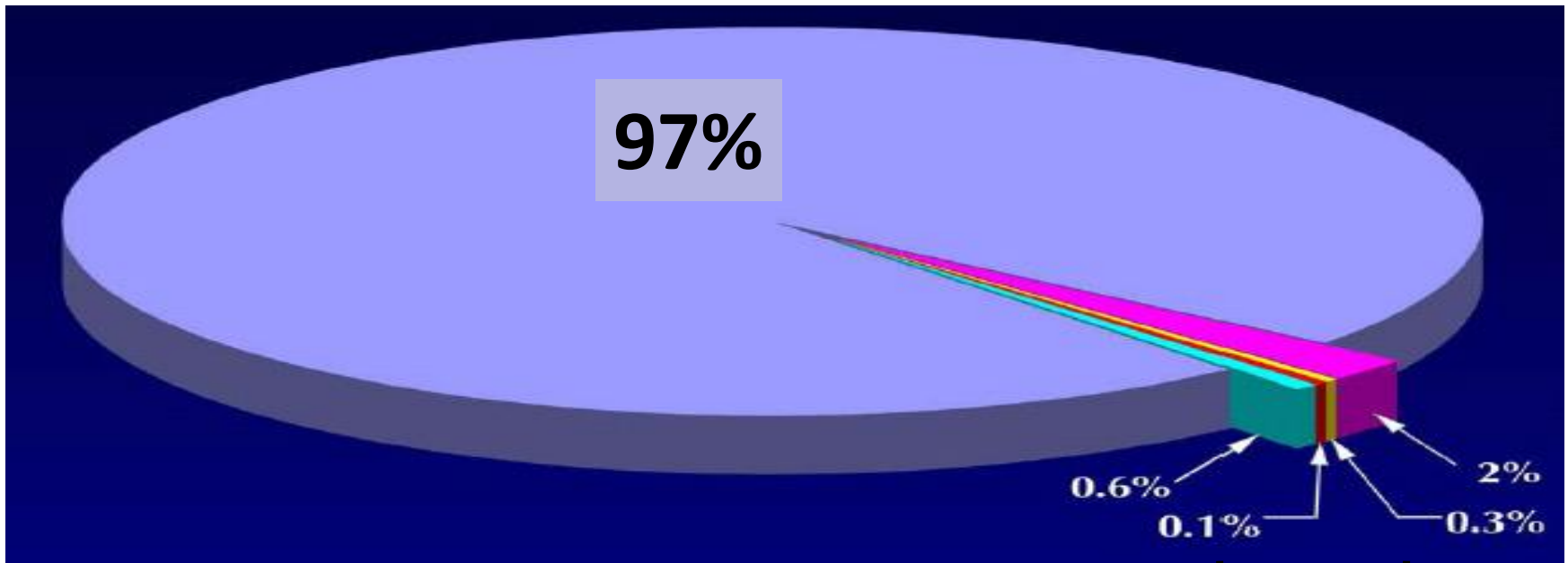
The Hydrologic (Water) Cycle



The water cycle is **driven by the Sun** and involves the exchange of energy in the form of heat.

Distribution of Water on Earth

- 97% of water on Earth is salt water: oceans and seas.



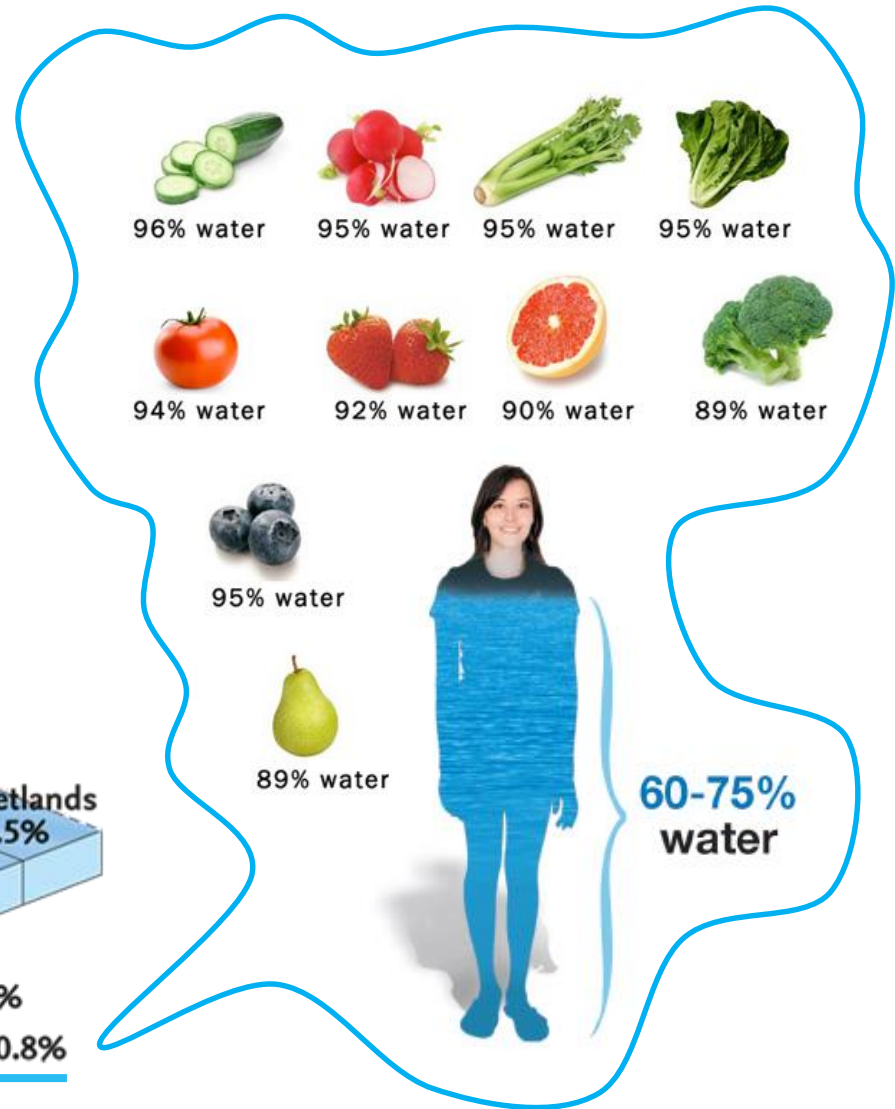
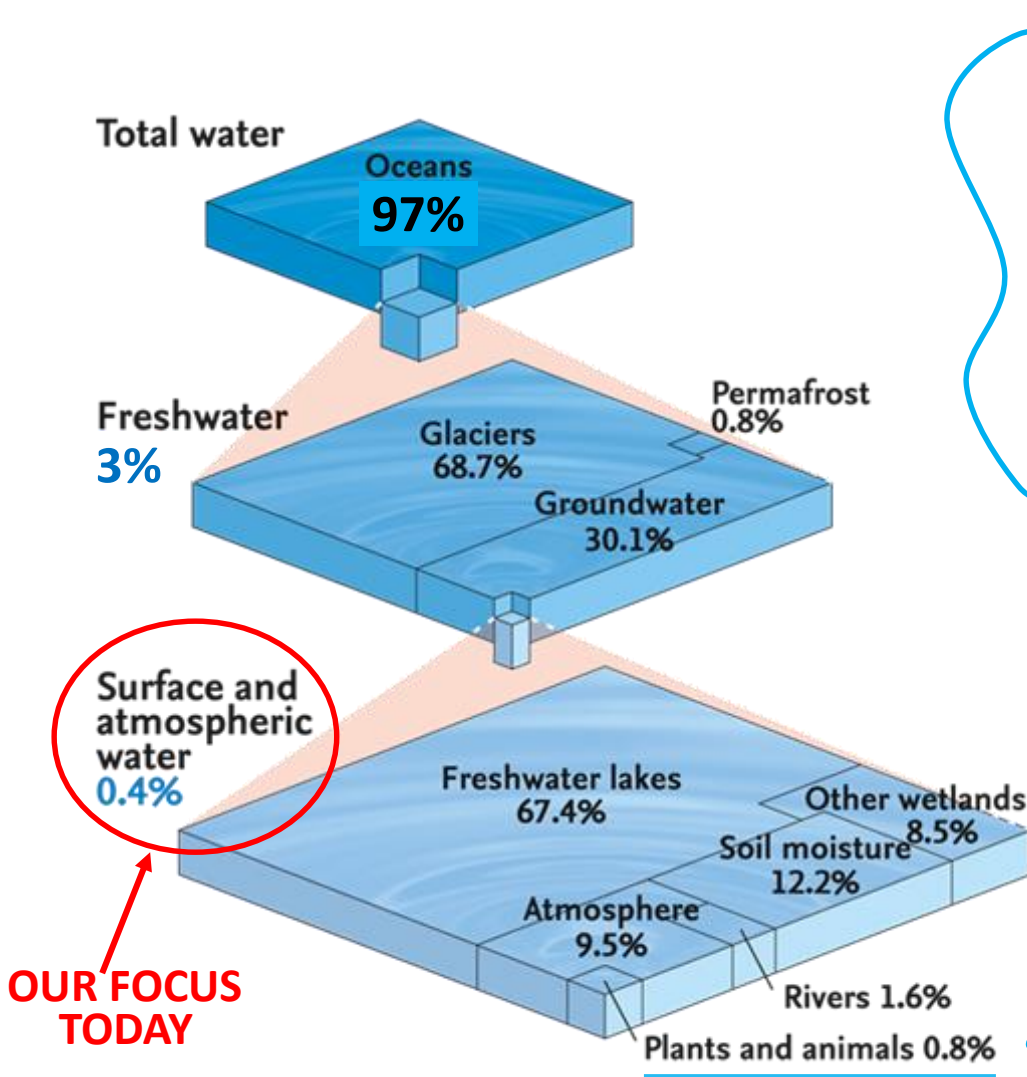
- 3% of water on Earth is fresh water:

- ice and snow (glaciers and polar caps)
- groundwater (aquifers)
- clouds and water vapor (atmospheric water)
- rivers and lakes
- living beings 😊



Where is my Water?

Freshwater Distribution on Earth



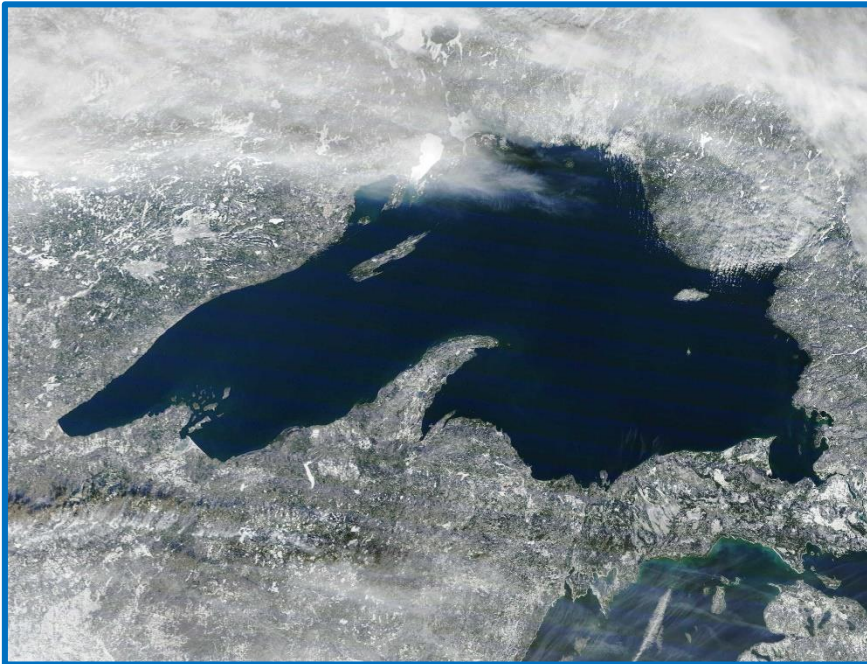
Surface Freshwater: Lakes

Lake is a body of water of considerable size contained on a body of land. The *largest enclosed inland body of water* on Earth by area is the **Caspian Sea** (surface area of 371,000 km²/ 143,200 sq mi and a volume of 78,200 km³/ 18,800 cu mi). **Is it a lake or a sea?..**

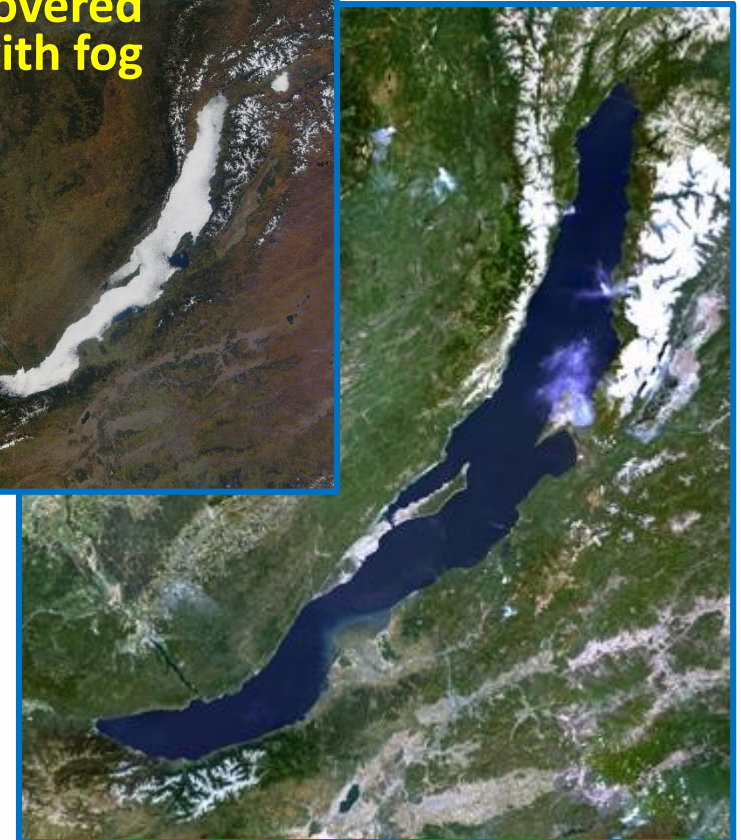


- The Caspian Sea was once a part of the Thetis Ocean.
- It became landlocked ~5.5 million years ago.
- The Caspian Sea has **low average salinity** (about a third of the salinity of most seawater).
- Its **shallow northern part is almost completely freshwater** due to the current inflow of Volga and Ural rivers.

Greatest Lakes



#1 in size: Lake Superior,
Canada/USA, One of the Great Lakes
area: 82,414 km² (31,820 sq mi)
depth: 406 m (1,332 feet)
volume: 12,100 km³ (2,900 cu mi)

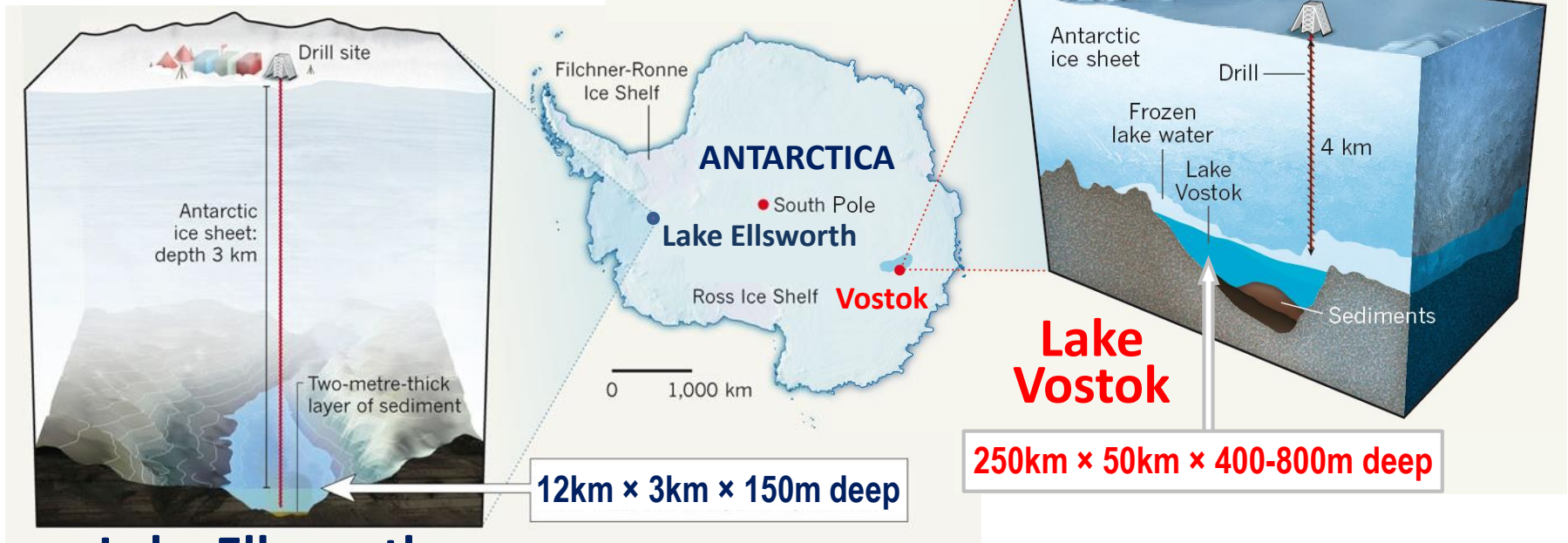


#1 in depth/fresh water
volume: Baikal, Russia
area: 31500 km² (12200 sq mi)
depth: 1,637 m (5,371 feet)
volume: 23,600 km³ (5,700 cu mi)

Subglacial Lakes of Antarctica

Antarctica is home to 387 subglacial freshwater lakes.

(not to scale)



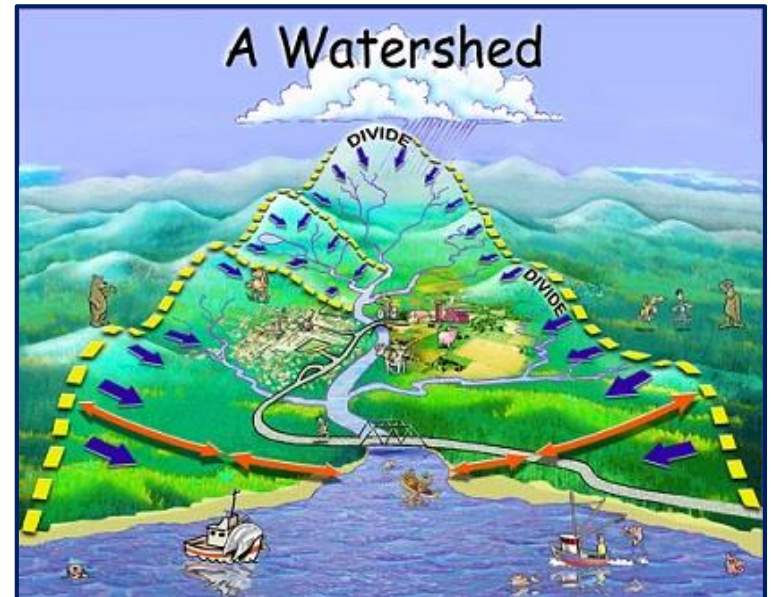
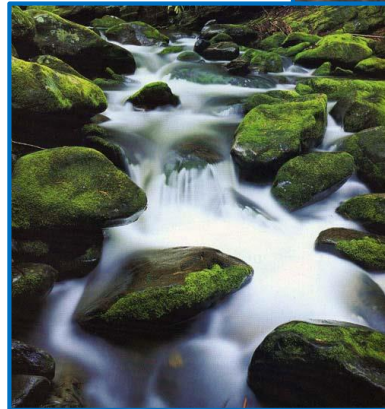
Lake Ellsworth

2012: an attempt to drill into **Lake Ellsworth** using hot-water drilling technique faced **technical difficulties**; project called off.

1998-current: research drilling into **Lake Vostok** by Russian team; in 2012 the **longest ever ice core of 3,768 m** was obtained and **lake surface reached**; **samples of lake water were taken** in 2013 (found contaminated) and 2015.

Surface Freshwater: Rivers and Streams

- **River** is a large channel along which water is continually flowing down a slope; it is made of many *streams* that come together.
- **Stream** is a small channel along which water is continually flowing down a slope; it is made of small gullies.
- **Watershed** is an area that drains into a smaller river or stream.
- **River Basin** is an area that drains into a *large river*; larger river basins consist of many interconnected watersheds.



Longest River: Nile, Africa

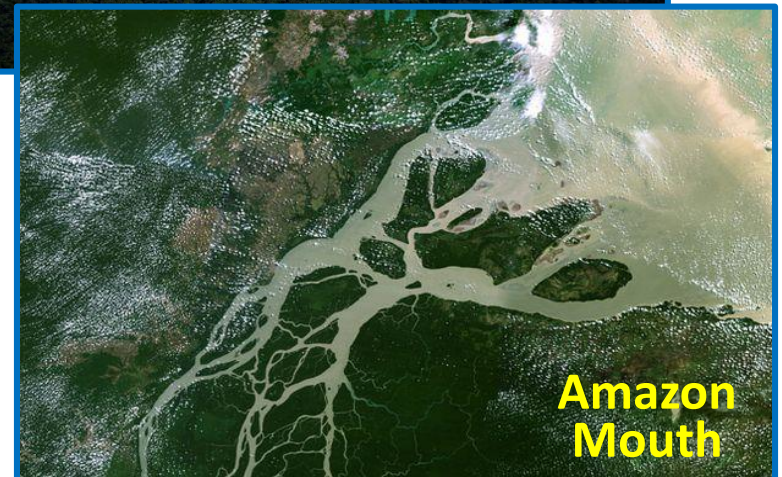
The Nile River is ~6,650 km (~4,130 miles) long, generally considered the **longest in the world**; it is located in northeastern Africa, and flows into the Mediterranean Sea. The drainage basin of the Nile covers about 10% of the area of Africa.



The Nile Delta, where the river spreads out and drains into the Mediterranean Sea, is **one of the world's largest river deltas** covering 240 km (150 mi) of the coastline - and is a rich agricultural region. The Nile has been the lifeline of civilization in Egypt since the Stone Age.

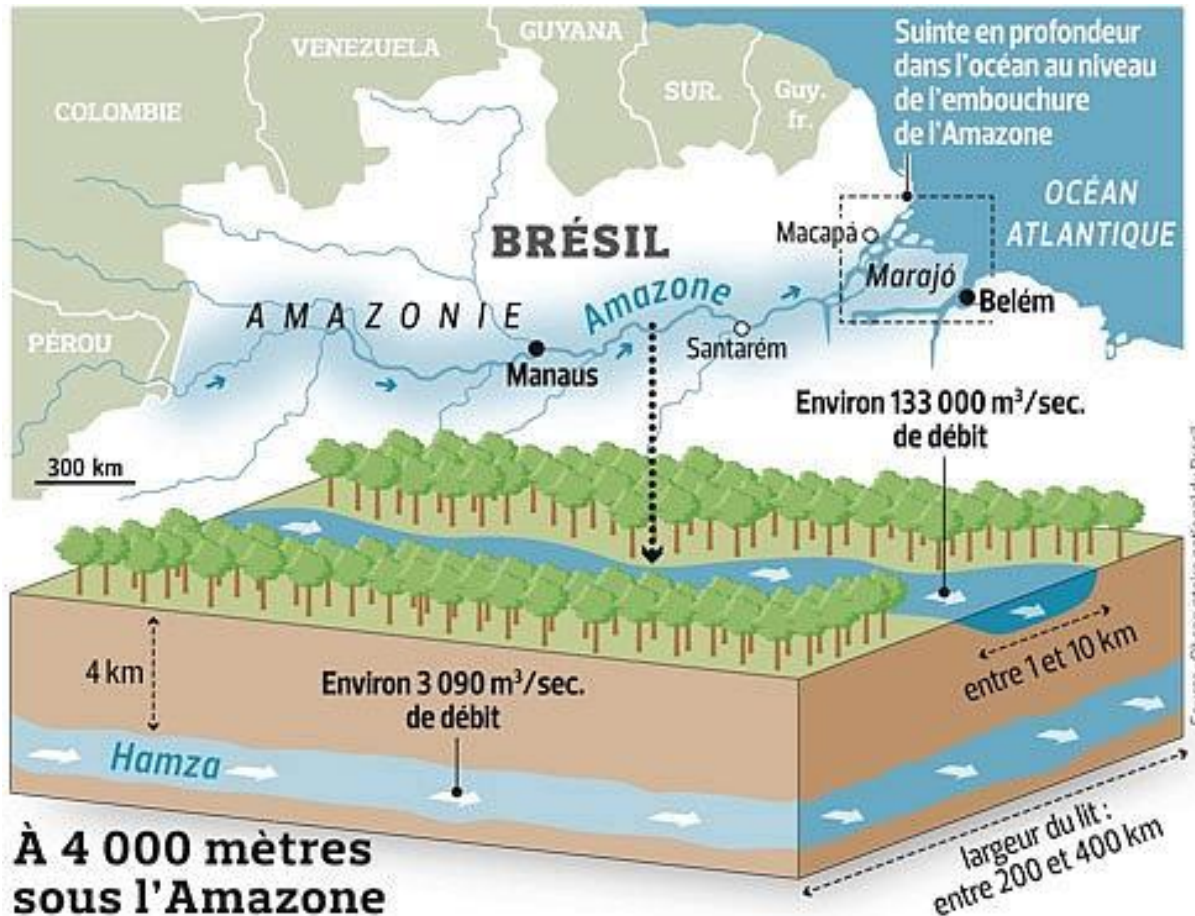
Amazon River Basin

The **Amazon River** in South America is the **largest river by the discharge of water** and also the **second longest river** in the world (~6400 km). The **Amazon Basin**, the **largest drainage basin** in the world, covers about 40% of South America, an area of approximately 7,050,000 km² (2,720,000 sq mi). It drains from west to east, flowing into the Atlantic Ocean.



Rio Hamza (slowly flowing aquifer)

The Amazon River has an **underground “twin sister”** named **Hamza** (*discovered in 2011*)! It runs for a length of 6,000 km (3,700 mi) at a depth of nearly 4,000 m (13,000 feet).



Except for the flow direction, the rivers have very different characteristics:

- **flow speed** - it is **5 m/s (16 feet/s)** in the Amazon and **less than 1 mm/s (0.039 in/s)** in the Hamza
- **width** - the Amazon is **1 km (0.62 mi) to 100 km (62 mi)** wide, the Hamza is **200 km (120 mi) to 400 km (250 mi)**, much wider

Largest Rivers in the USA

Mississippi: 2,340 mi (3,770 km)

Missouri: 2,540 mi (4,090 km)



Mississippi River
"Birdfoot" Delta