Natural Resources: WASEEM

Water

Air

Soil

Ecosystem

Energy

Minerals

Water

Water on Earth:
Oceans (70% of earth's surface)
Terrestrial aquatic systems

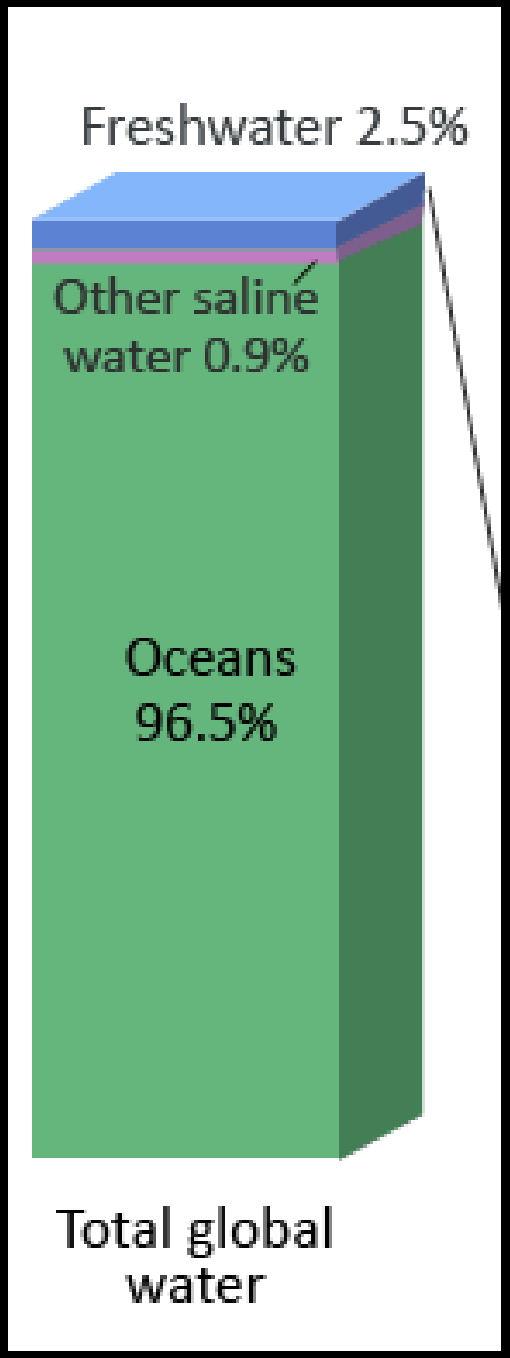
Is all water the same?

Salt Water: 97.5% of all water!

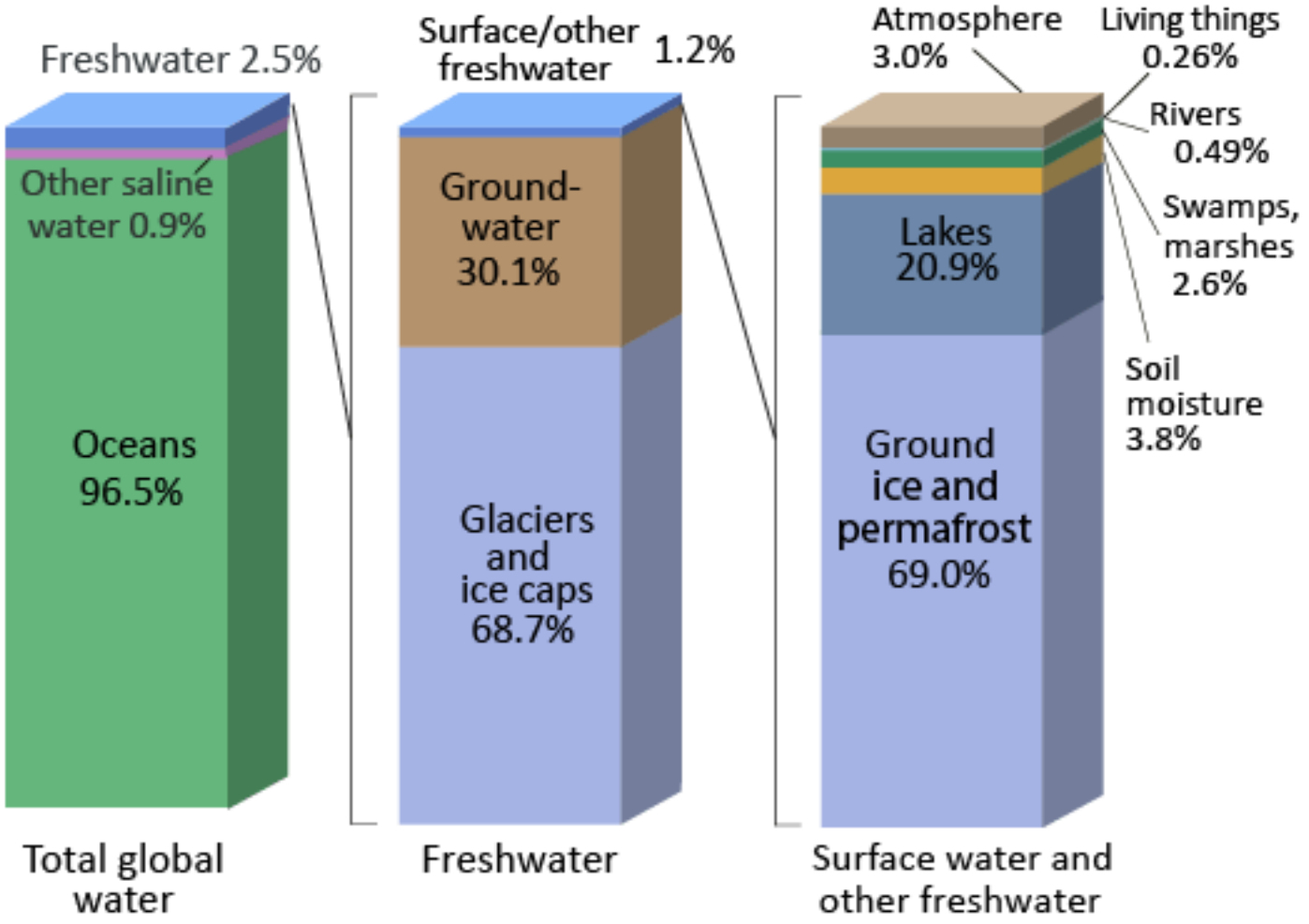
Oceans + Other salt water on land

Fresh Water: 2.5% of all water!

Vital for terrestrial biodiversity!



Where is the Earth's Fresh Water?



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources.
NOTE: Numbers are rounded, so percent summations may not add to 100.

Basis of Fresh Water on Earth

Hydrological Cycle

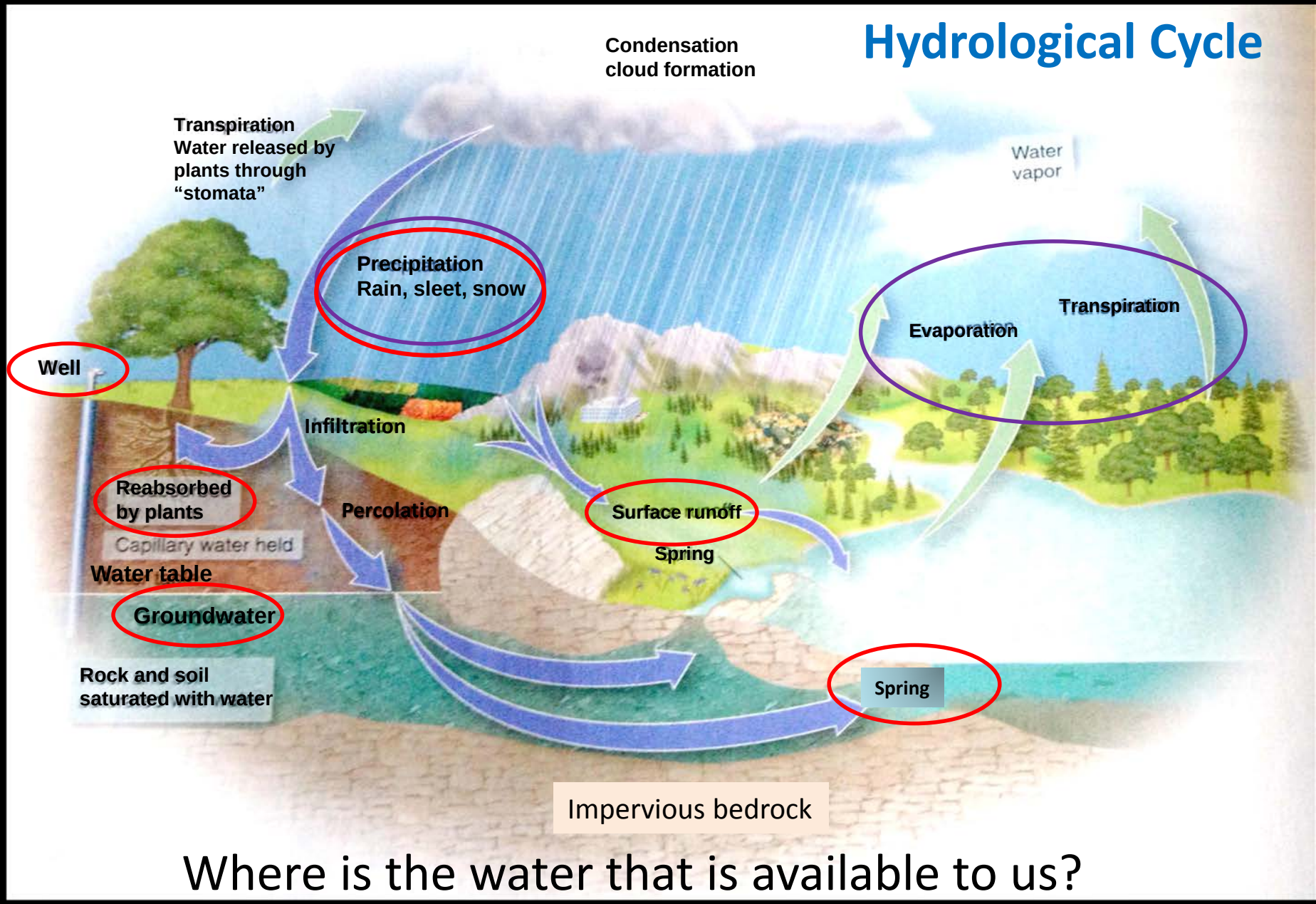
Hydrological Cycle = Water Cycle

- Why do you need to know?
  - List 3 reasons
- What do you need to know?
  - List 3 things

Hydrological Cycle

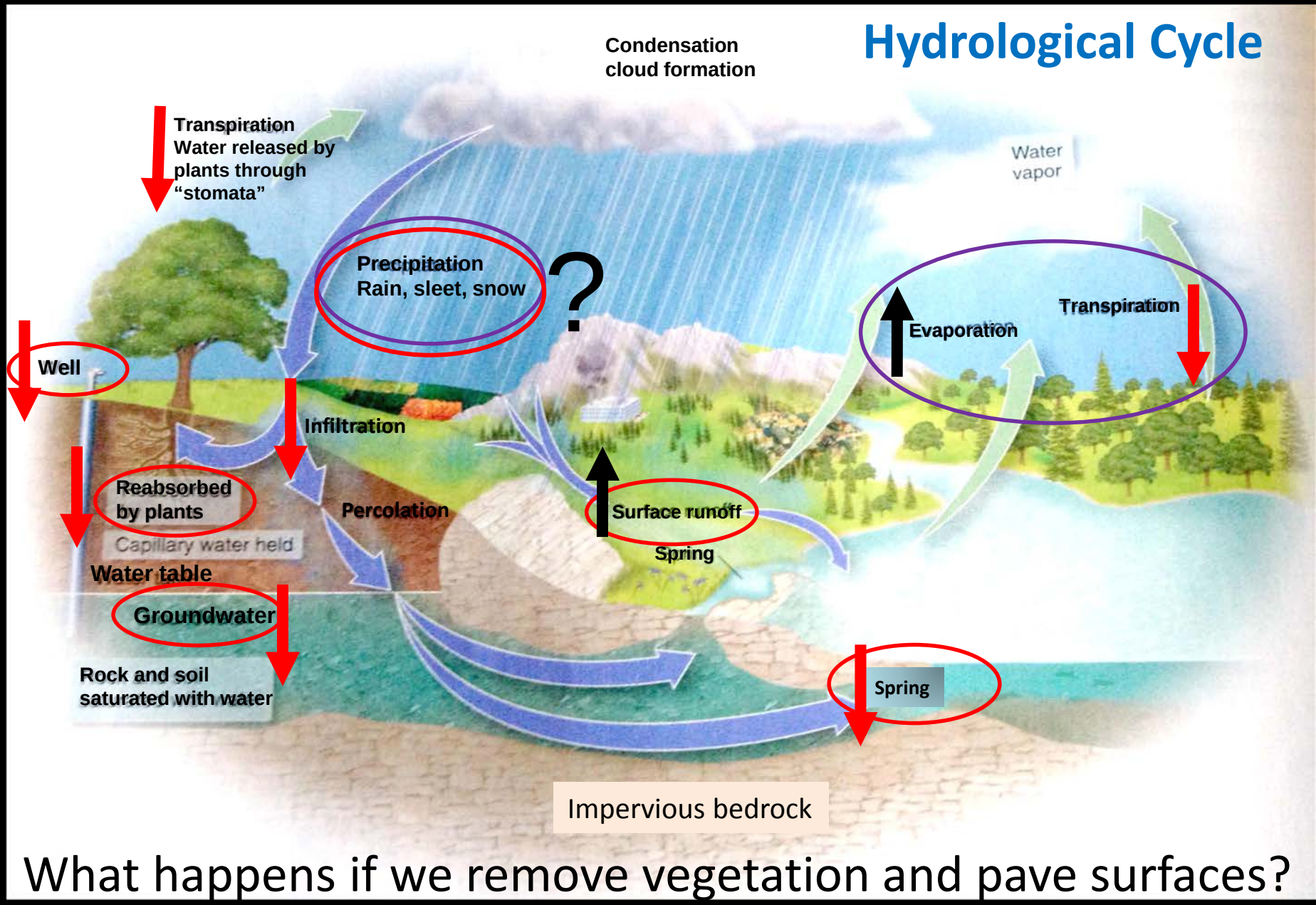
- Why do we need to know?
  - **Water is a finite resource**
  - **Fresh water is extremely rare and Crucial for life on land**
- What do we need to know?
  - **How does the water cycle work?**
  - **What are the critical components?**
  - **How are human activities impacting it?**
  - **Is there a problem?**
- Other reasons why we should care
  - **1 week: Time we can live without water**
  - **We share water resources with other life on land!**

Source of fresh water on land



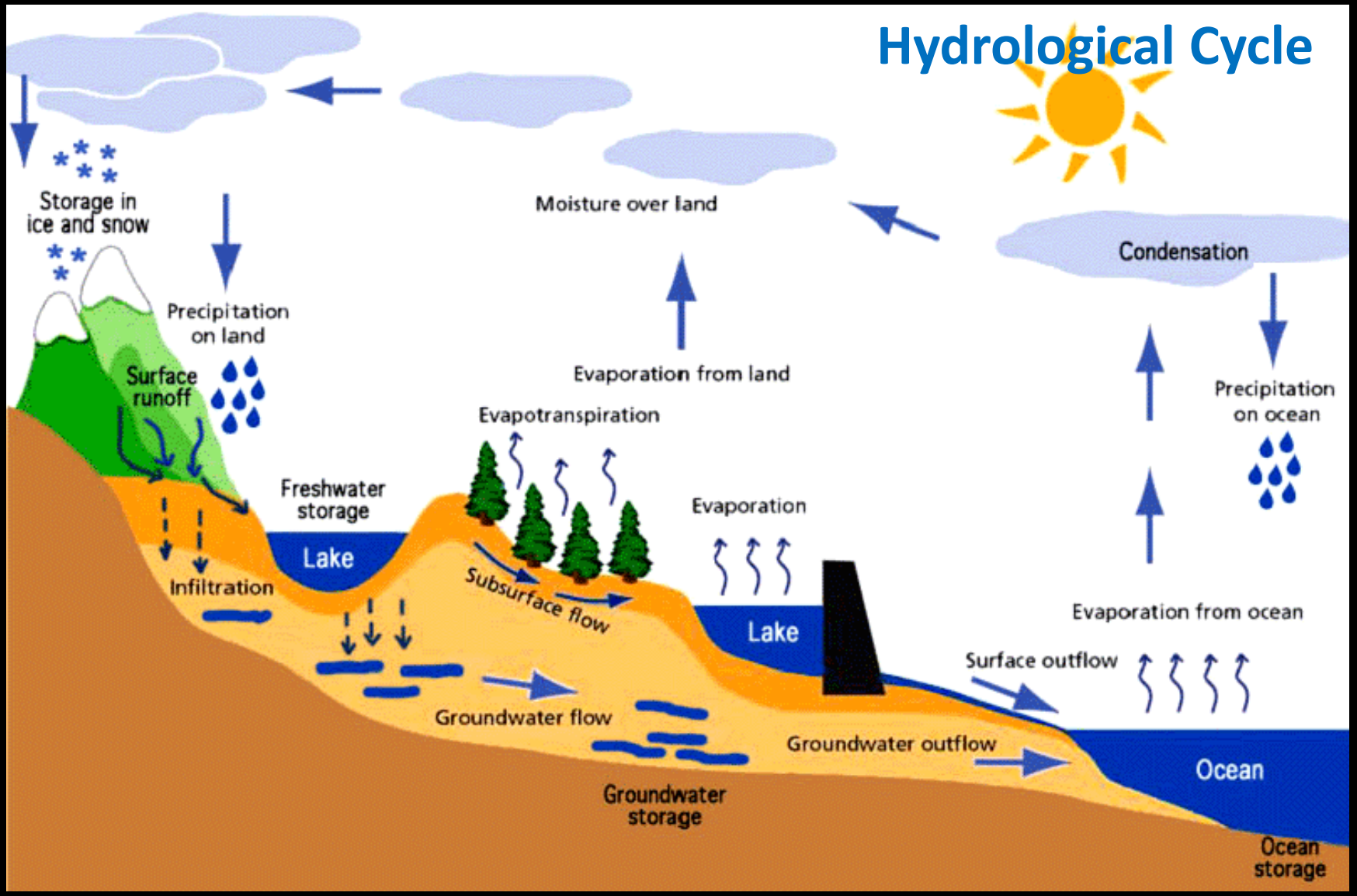
Where is the water that is available to us?

Source of fresh water on land



What happens if we remove vegetation and pave surfaces?

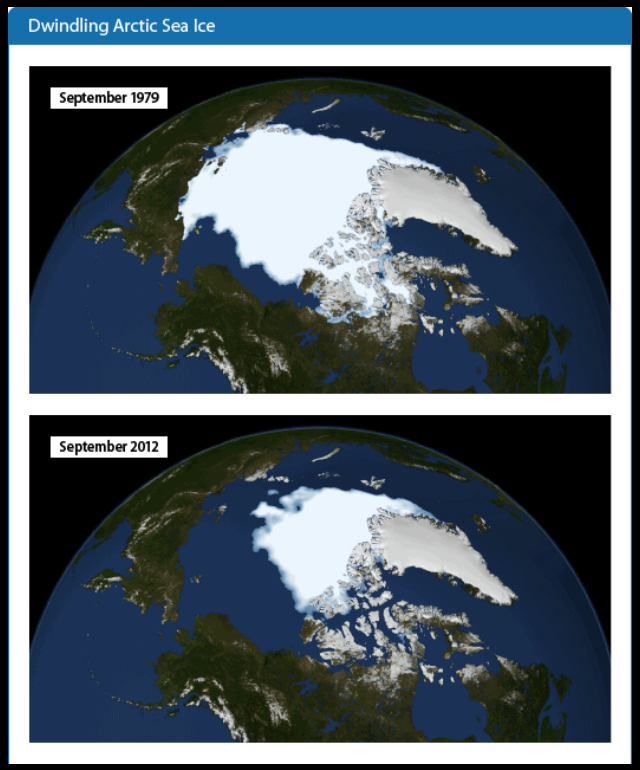
How Freshwater is Stored

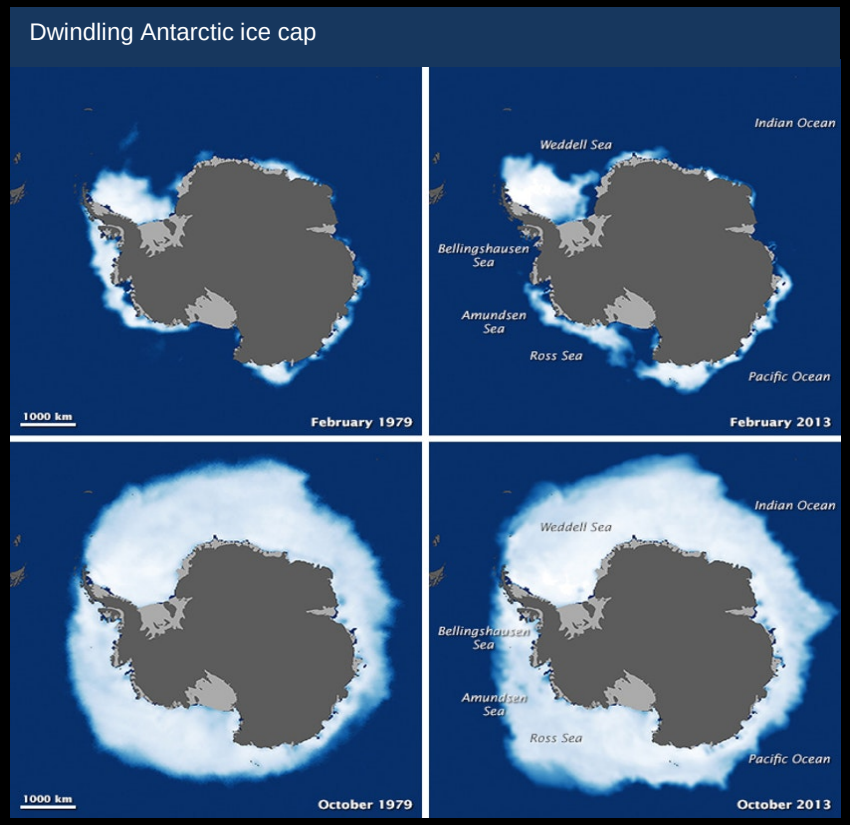


Natural Fresh Water Storage: Key terms

- Surface runoff
  - Water flowing above ground
  - Rivers and streams
- Ground water
  - Underground water that is held in the pores between rock and sand particles, between roots of vegetation
  - Can pool or flow underground
- Aquifer
  - Ground water that collects like a lake underground
  - Water table is the top surface of the aquifer. Springs occur when water table reaches ground level.
- Ice Caps
  - Frozen water on ocean or land at the poles (polar ice caps)
- Sea Ice
  - Water that freezes out of the ocean in very cold seas (e.g., Arctic Ocean and Southern Ocean)
  - Can pool or flow underground
- Glaciers
  - Snow fall accumulates on mountains and gets pulled down due to gravity (just like liquid water). But this solid water flows very slowly and is called a glacier
- Permafrost
  - Ground saturated with frozen water. Typically found in Tundras

Ice Caps and Glaciers





A 1921 view taken by George Mallory of the Main Rongbuk Glacier (left), on the northern slope of Mount Everest and a 2007 view of the same glacier taken by David Breashears, courtesy of GlacierWorks.

All images: Phys.org

What determines precipitation?

LATITUDE influences PREVAILING WINDS
Cooler Temperatures away from Equator
Earth's Rotation

ASPECT causes RAIN SHADOW
Mountains block winds, causing
The windward side to be wet
The opposite side to be drier

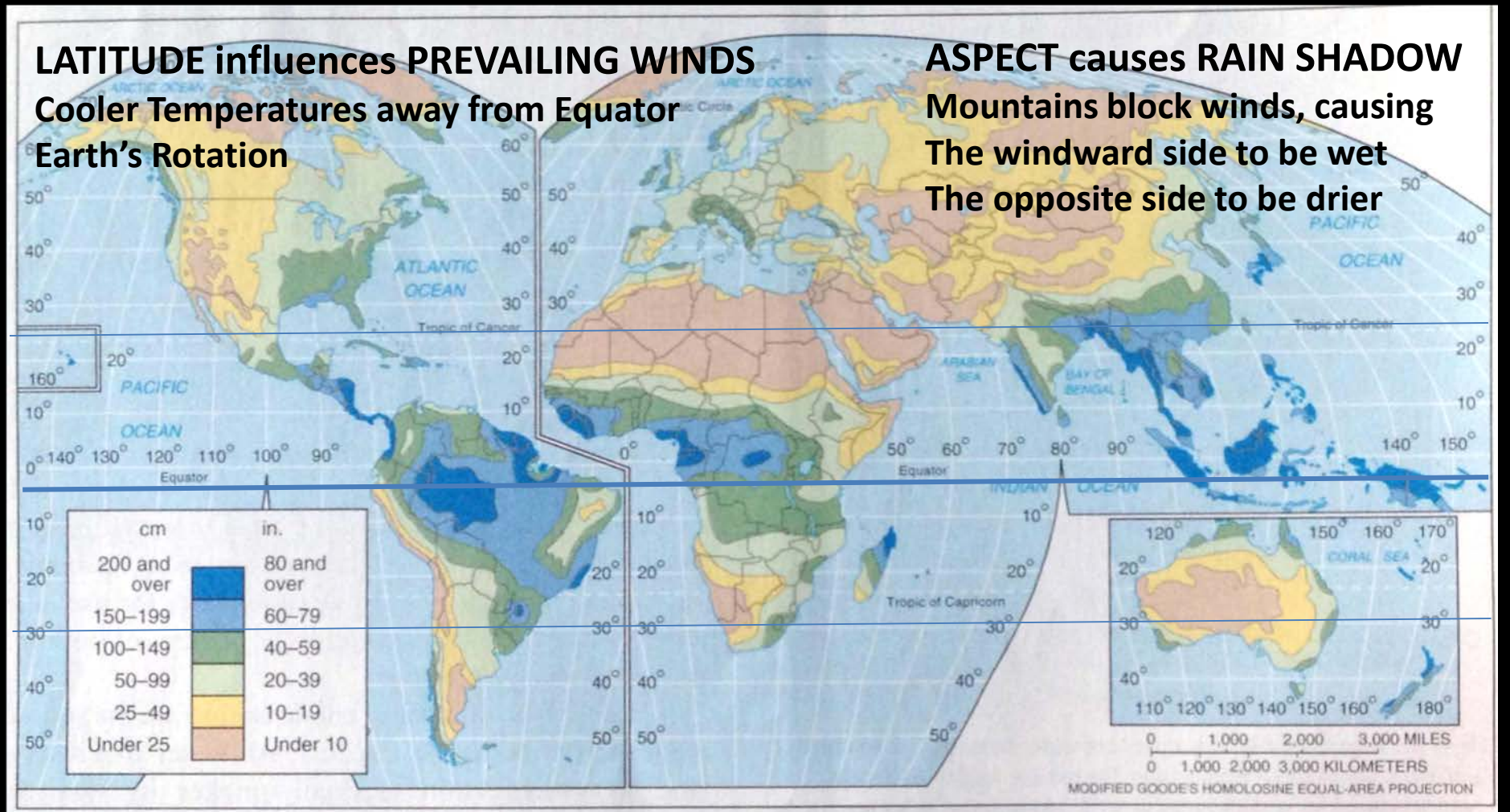


Figure 10–5 Global precipitation. Note the high rainfall in equatorial regions and the regions of low rainfall to the north and south. (*Source:* Robert W. Christopherson, *Geosystems: An Introduction to Physical Geography*, 5th ed., Pearson/Prentice Hall, 2005, Upper Saddle River, NJ.)

And, vegetation! E.g., Amazon Rainforest influences rain in Southern Brazil.

World Average Annual Precipitation

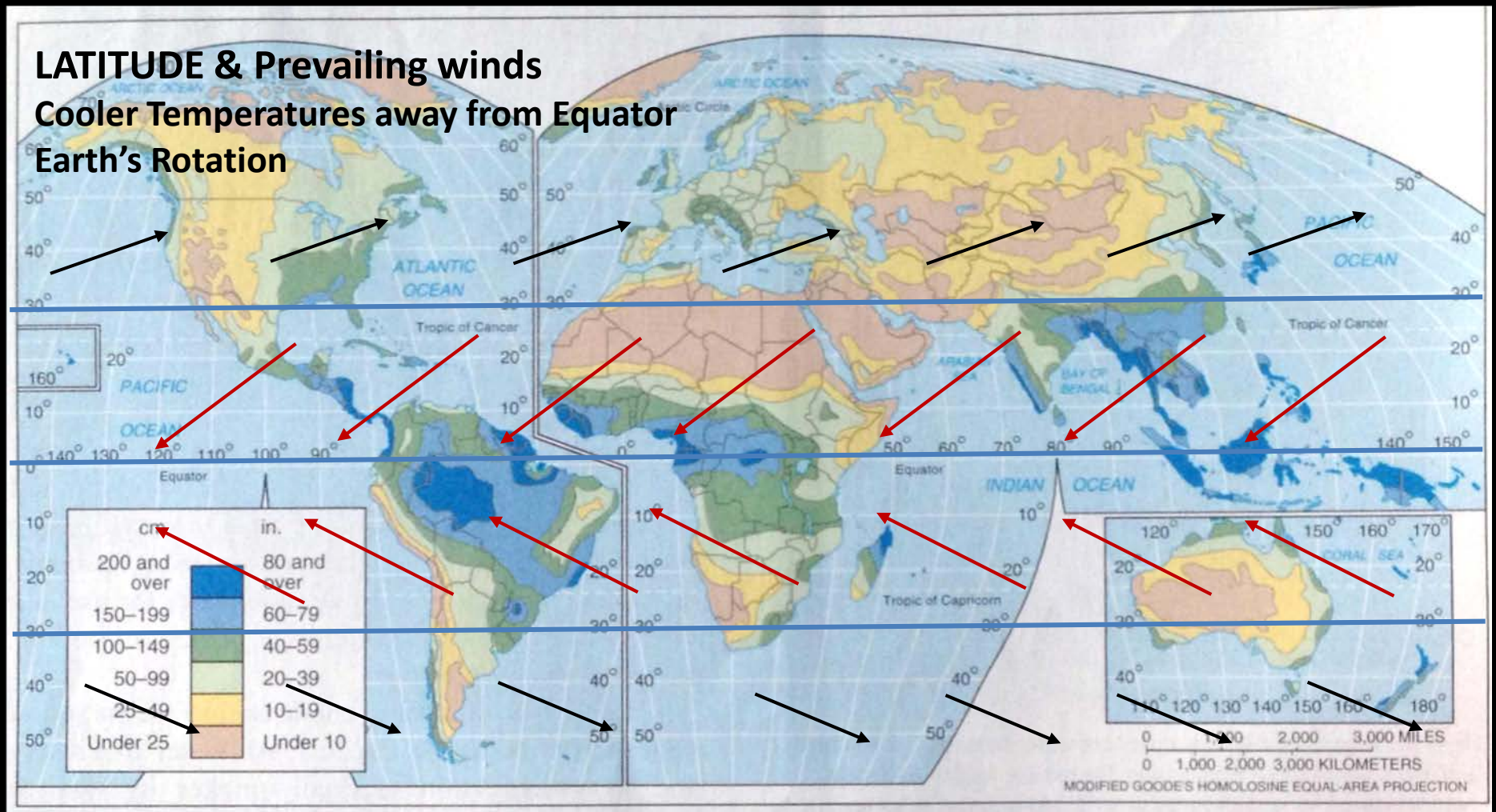
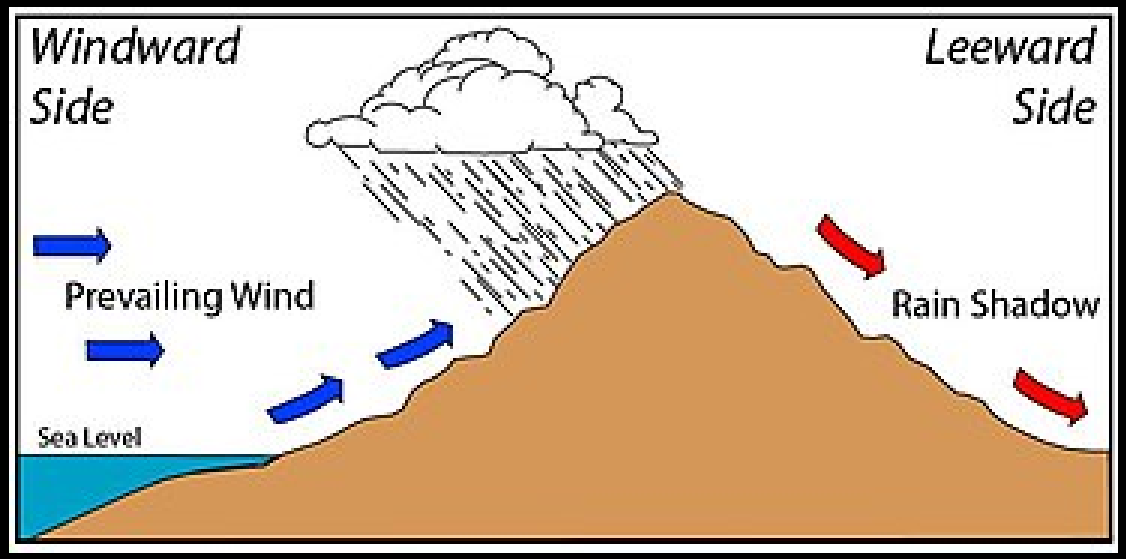


Figure 10–5 Global precipitation. Note the high rainfall in equatorial regions and the regions of low rainfall to the north and south. (*Source:* Robert W. Christopherson, *Geosystems: An Introduction to Physical Geography*, 5th ed., Pearson/Prentice Hall, 2005, Upper Saddle River, NJ.)

Prevailing Winds

- Permanent wind patterns
- Determine climate
- Depend on Latitude and proximity to oceans or large lakes

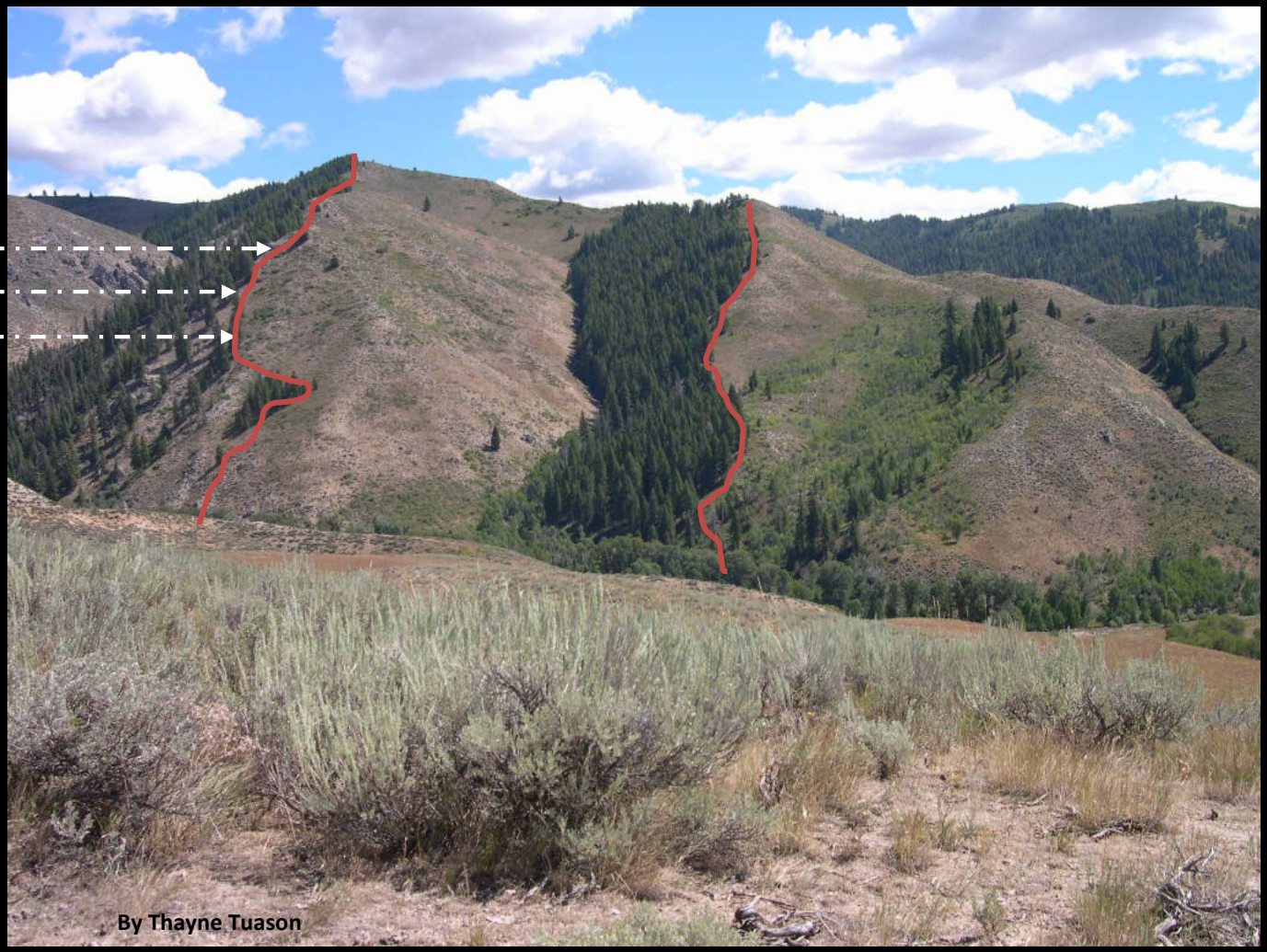


Aspect

- Direction that a mountain slope faces
- Windward vs Leeward
- Facing the sun, or in the shadow

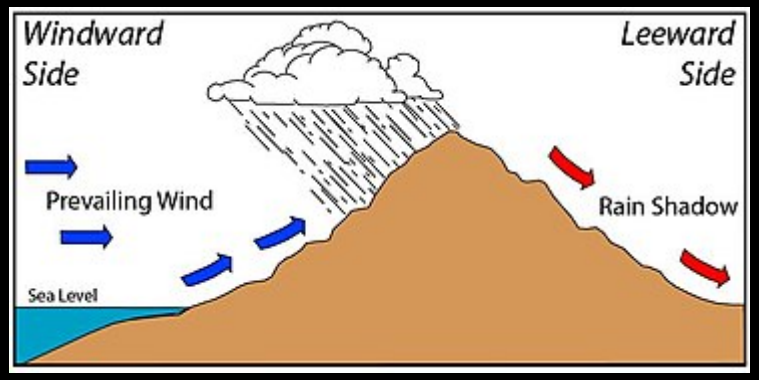
Aspect

Prevailing moisture bearing winds, North-facing slopes



Key terms

- Prevailing Winds
  - Long-standing upper atmosphere winds that are generated by Earth's rotation. NOT the day-to-day wind determined by weather in the lower atmosphere
- Aspect
  - The direction that a mountain slope faces
    - If it faces the Sun (facing south in the N. Hemisphere), the heat causes more evaporation from the soil. Soil moisture not enough to support trees.
    - If it faces towards moisture bearing prevailing winds (windward side), condensation occurs and the slope receives enough precipitation to support trees. The region on the opposite side (leeward side) is much drier.



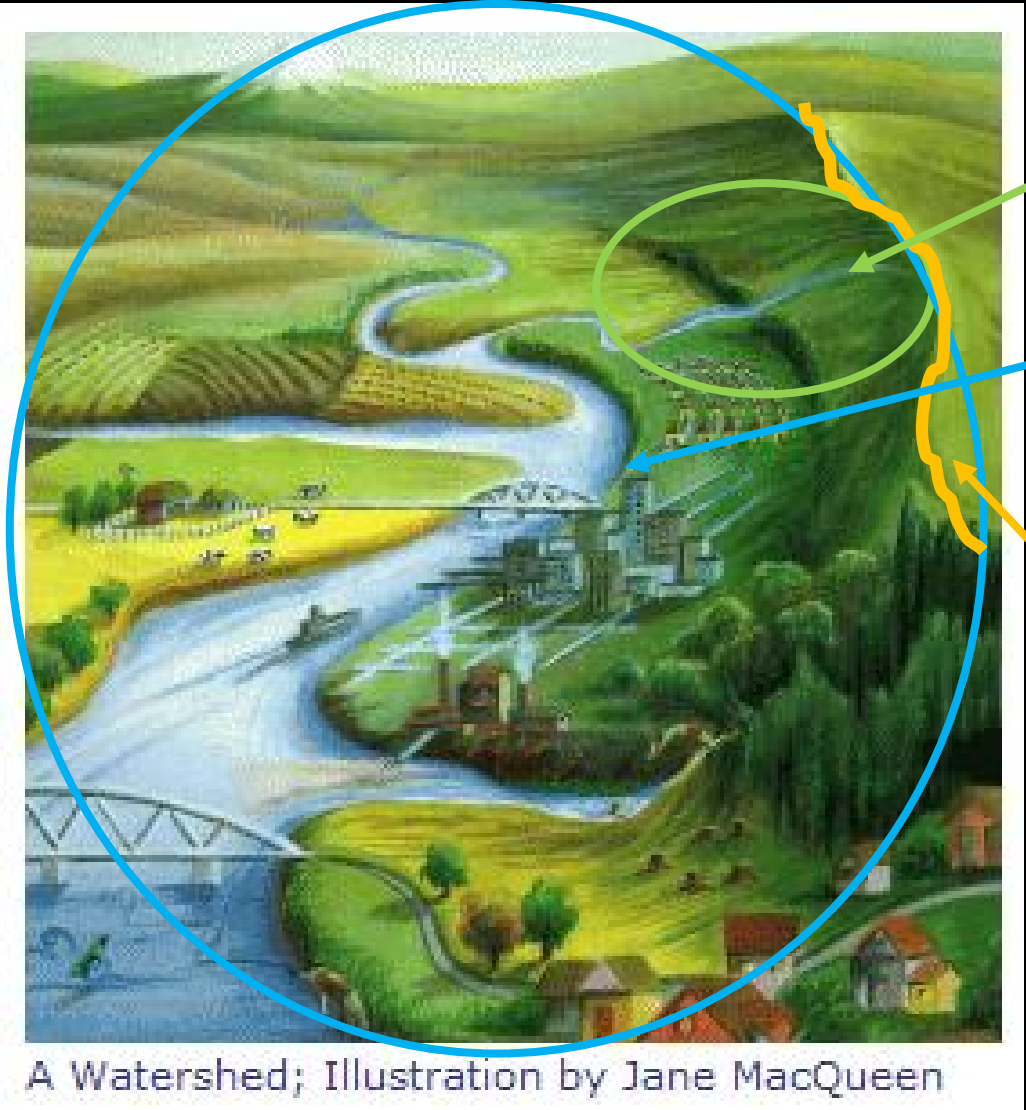
Hawai'I
Right side is windward
Left side is leeward

What happens to precipitation?

- Collects in a water basin
  - A geographical area shaped like a basin or trough
  - Geographical area is also called a Watershed
- Water basin contains both ground water and surface waters
  - At the bottom of the basin are rivers & streams, lakes, aquifers

Watershed or Water basin

Area of land that drains into a water body such as river, lake, ocean.



Each small stream has its own watershed

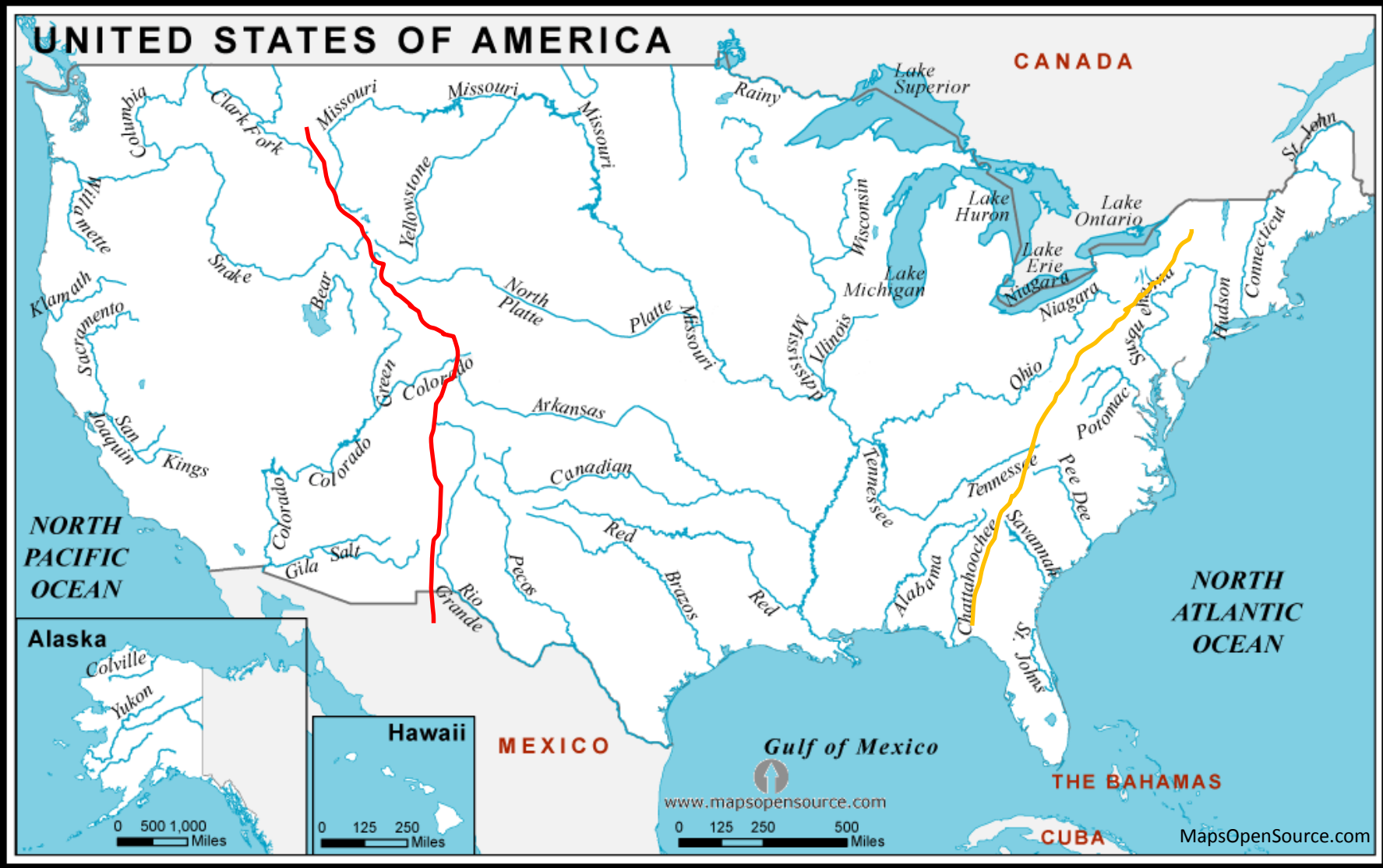
When a stream joins another, the two watersheds merge

Water divides determine Watersheds. Two sides of a Water divide drain into different watersheds

Every inch of land belongs to a watershed. Everyone lives in a watershed

Continental Scale Water divides

Major Rivers of the US



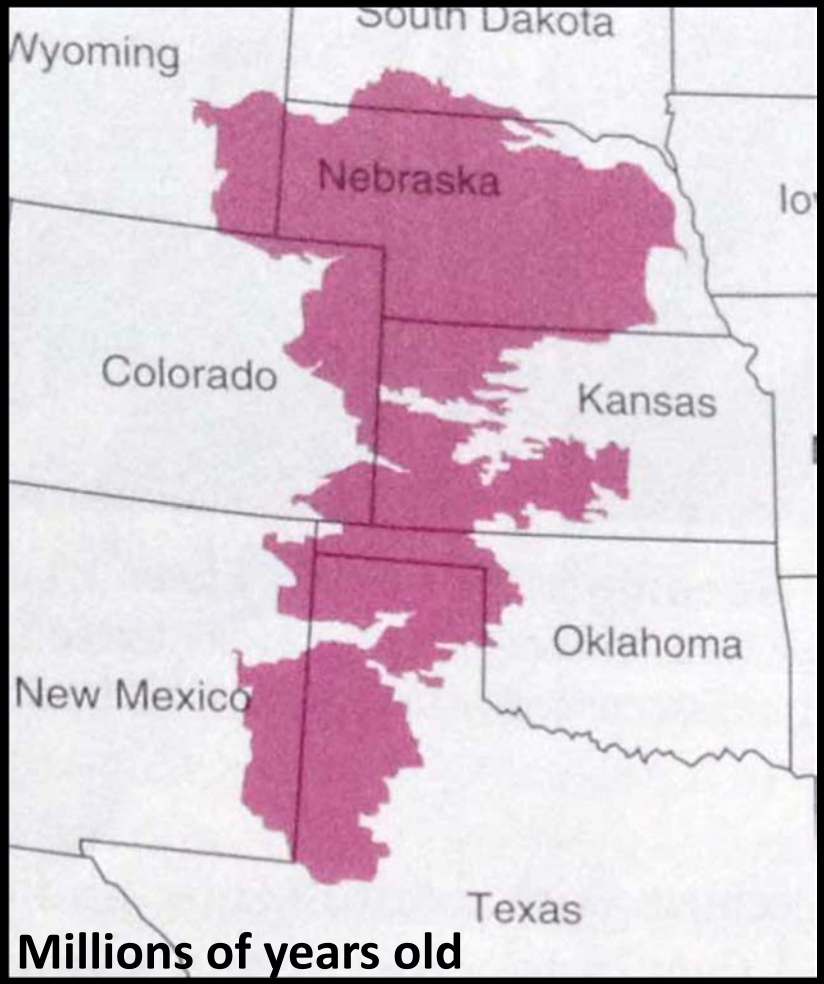
Watershed Key terms

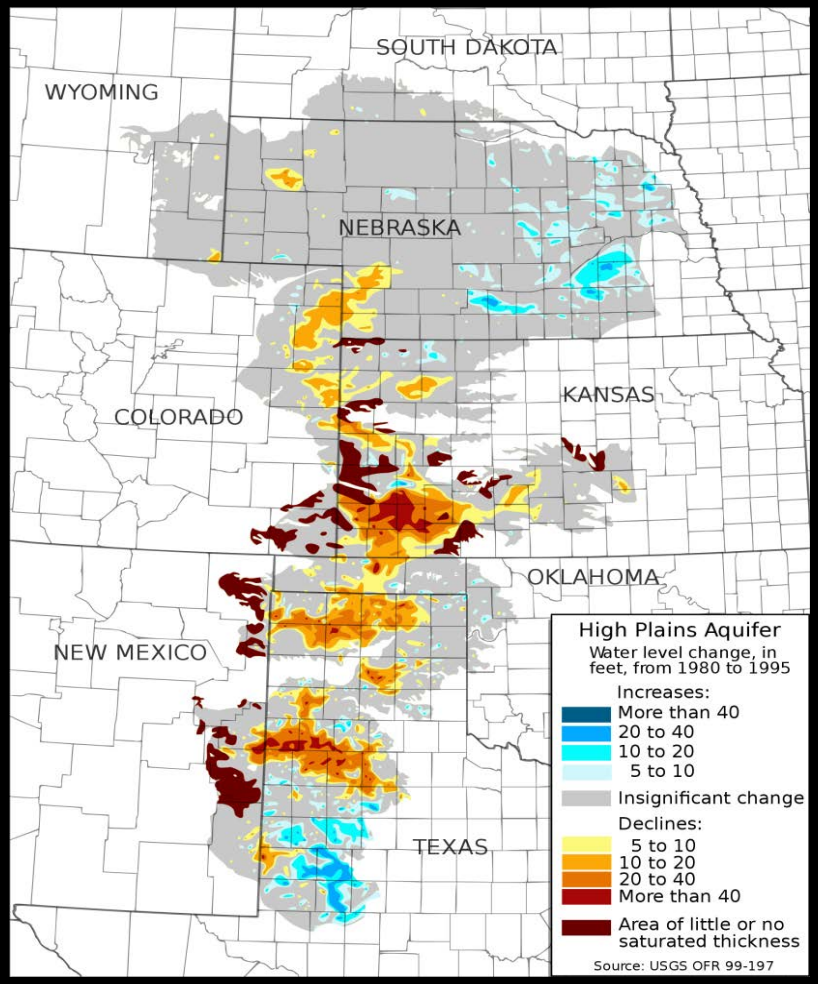
- Watershed
  - An area of land surrounded by a high ridge where all the water collects into a single water body. This happens due to gravity – water flows downhill.
- Water basin (same as watershed)
- Water divide
  - Usually a mountain ridge. Water flows in opposite directions on the two sides of the ridge. The water is divided and flows into two separate funnels.
  - E.g., all precipitation that falls on the East of the Appalachian Mountain range flows into the Atlantic Ocean. All the precipitation that falls on the West side of this mountain range flows into the Gulf of Mexico.

Groundwater

E.g., The Ogallala or High Plains Aquifer

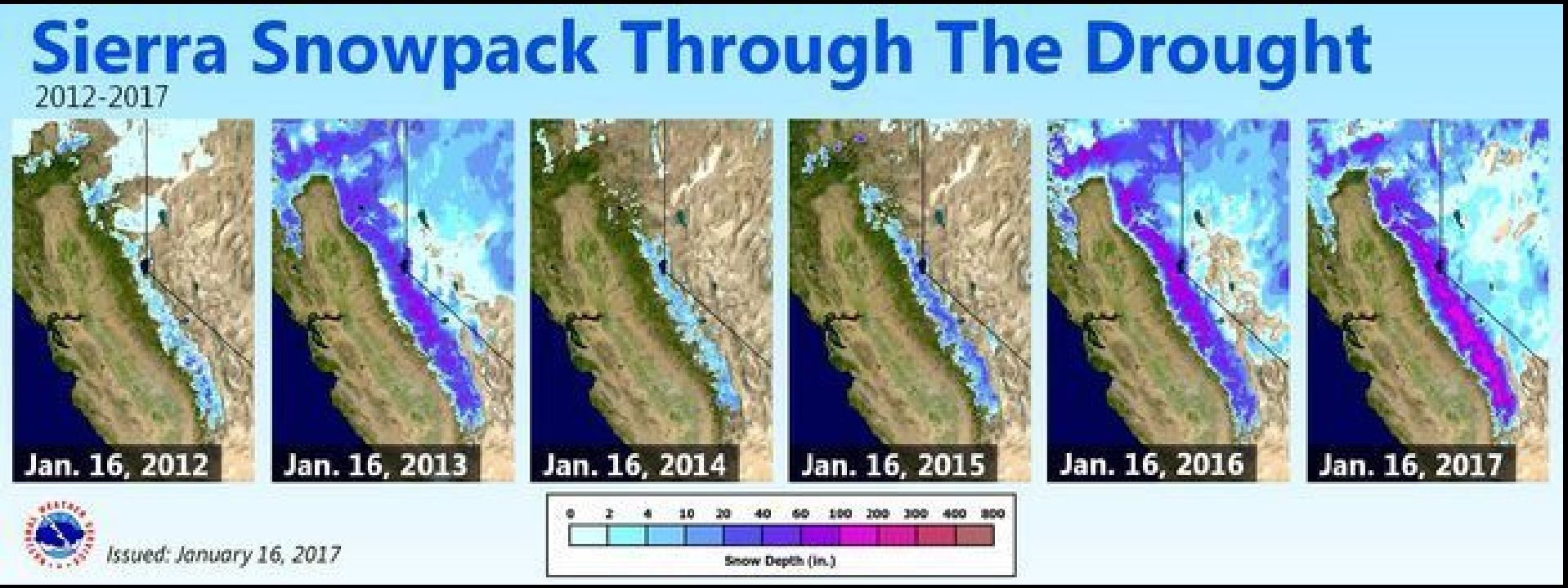
The largest Groundwater Source in the US





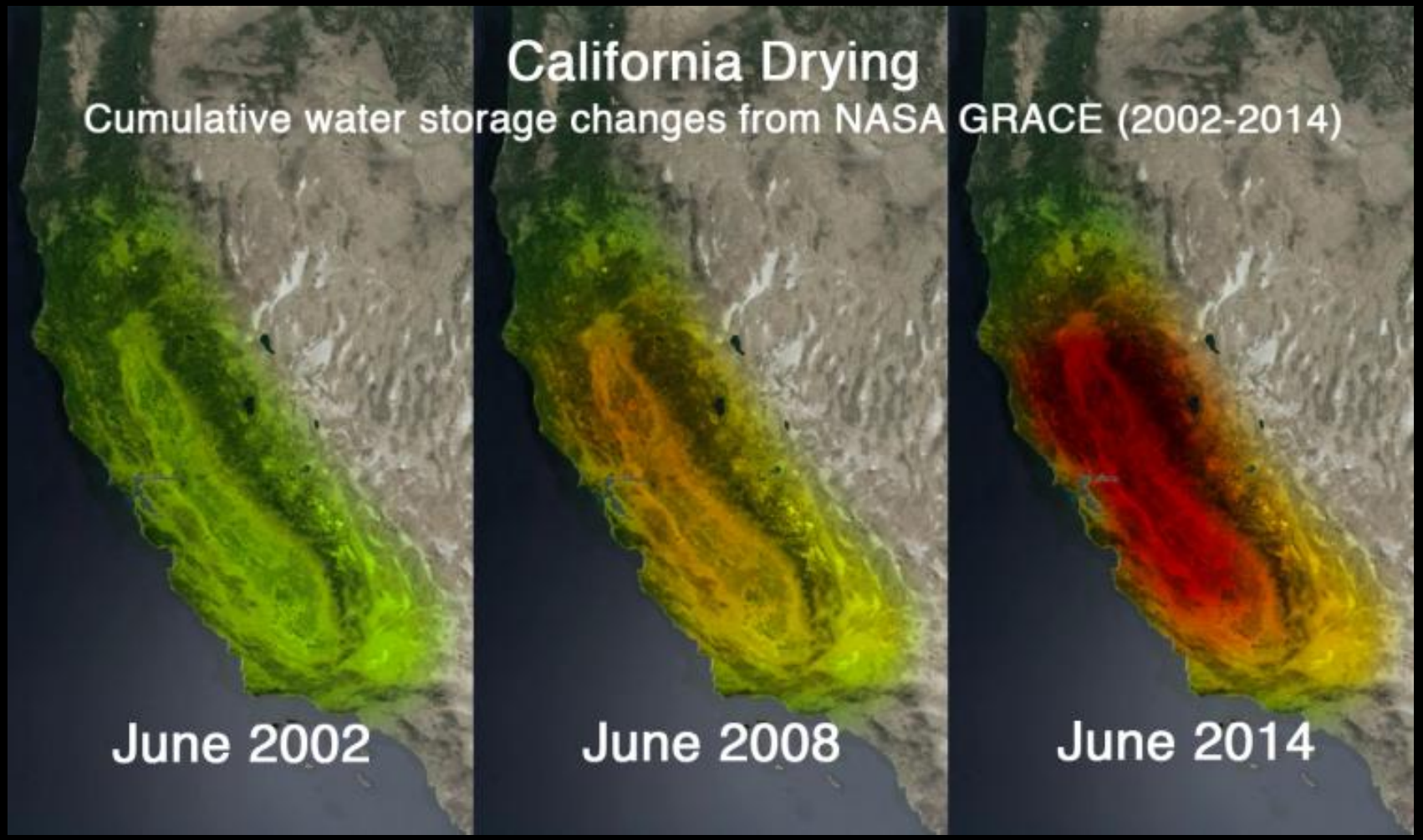
What happens if we use ground water faster than it is replenished?

California's Surface Water Storage
The Sierra Snowpack



Varies depending upon winter precipitation

California's Ground Water Storage



Difficult to restore – using up faster than can be replenished

The California Water Story

Video: 16min, Department of Water REsources

- The next 4 slides supplement the material in the video
- They show how water has been utilized in California

California's Watershed

- How has it been altered?
  - Dams
  - Channeled flows
  - Overdraft of groundwater
  - Loss of vegetation
  - Loss of wetlands
  - Urbanization and Impervious surfaces
  - Pollution due to runoff

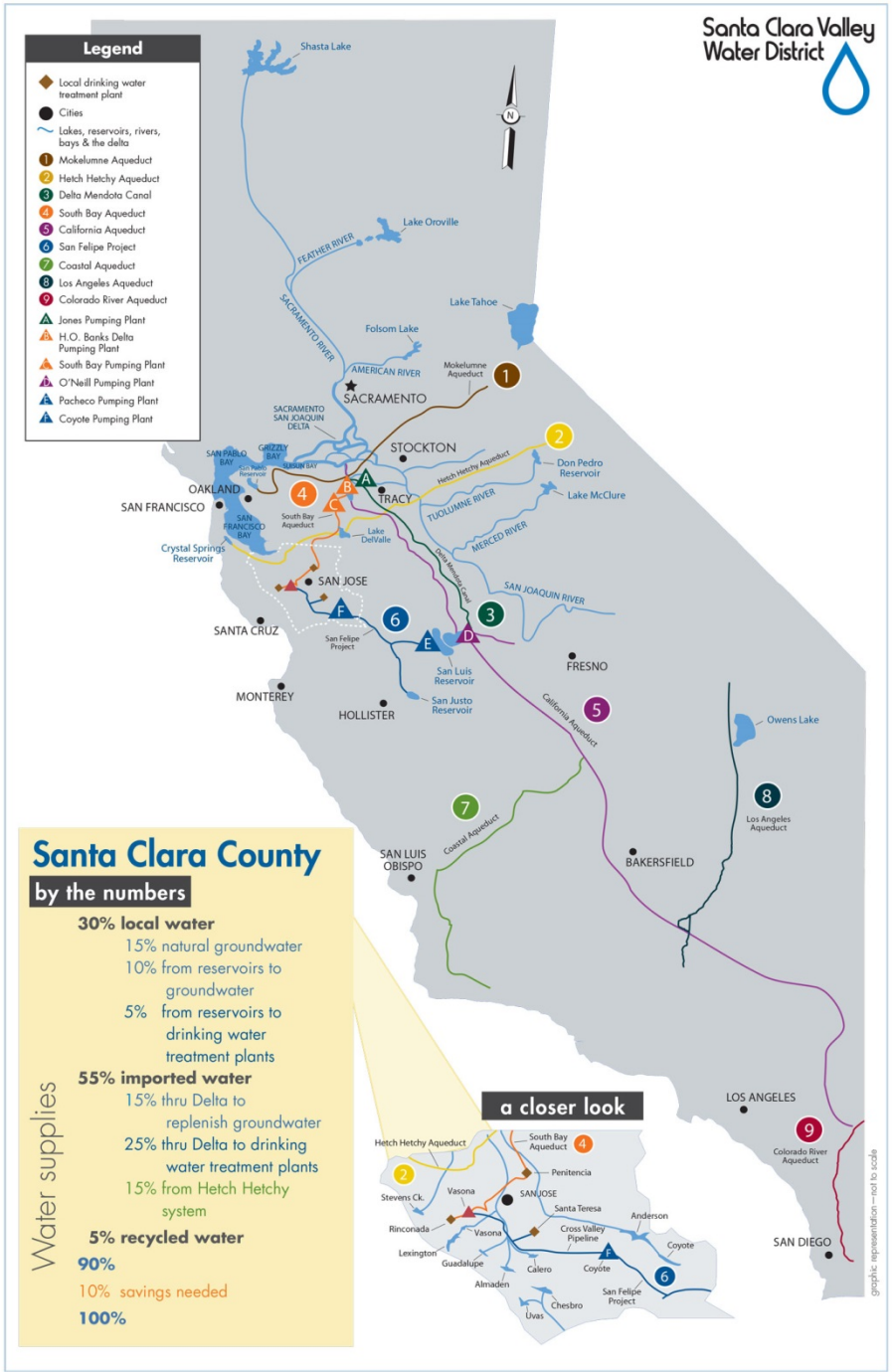
What impact does this have?

Dams Under the Jurisdiction of the State of California

Water Transportation

Documentary "Cadillac Desert" shows history of water use in California

Where does our water come from?



How is water treated and supplied by cities

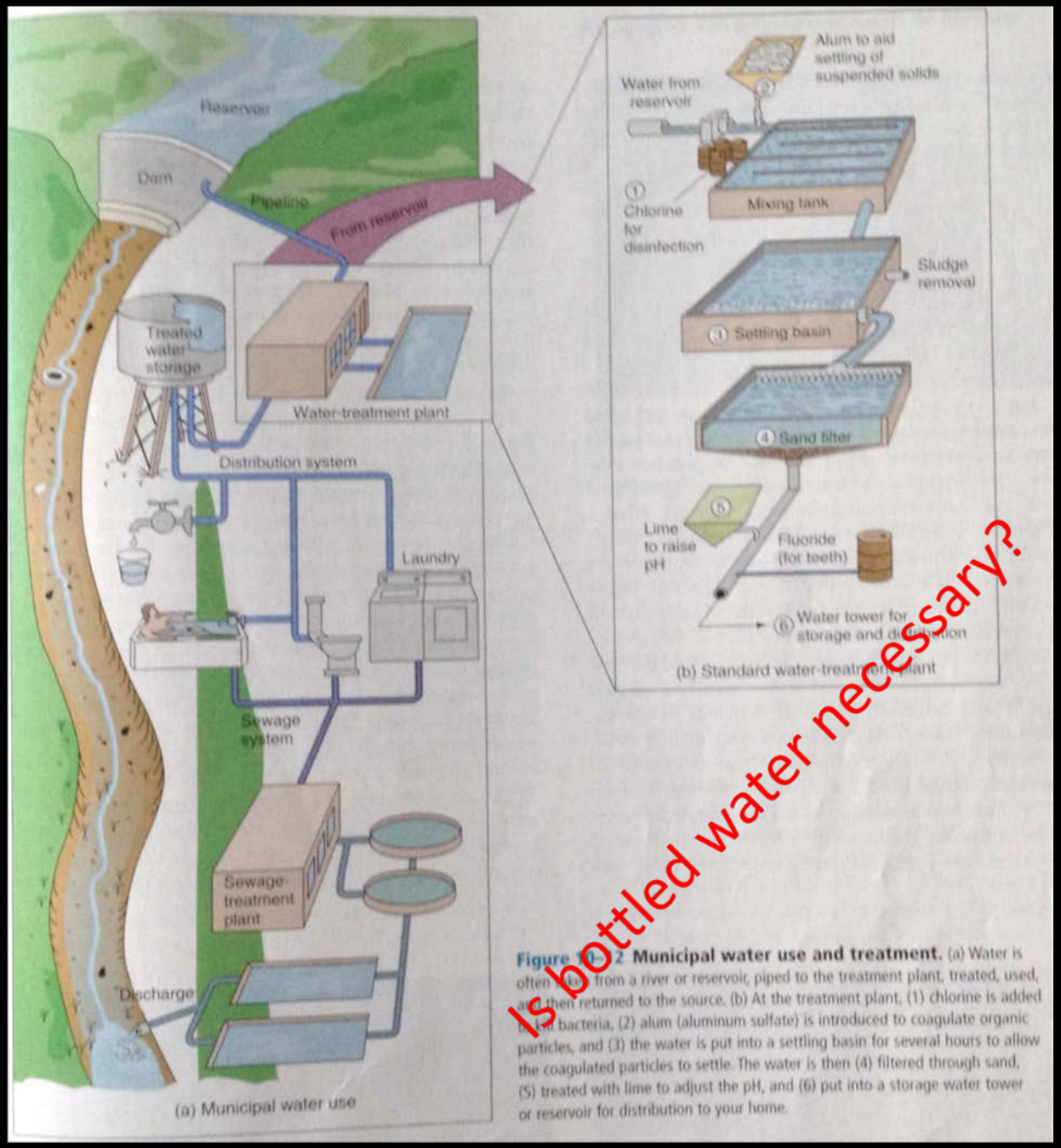
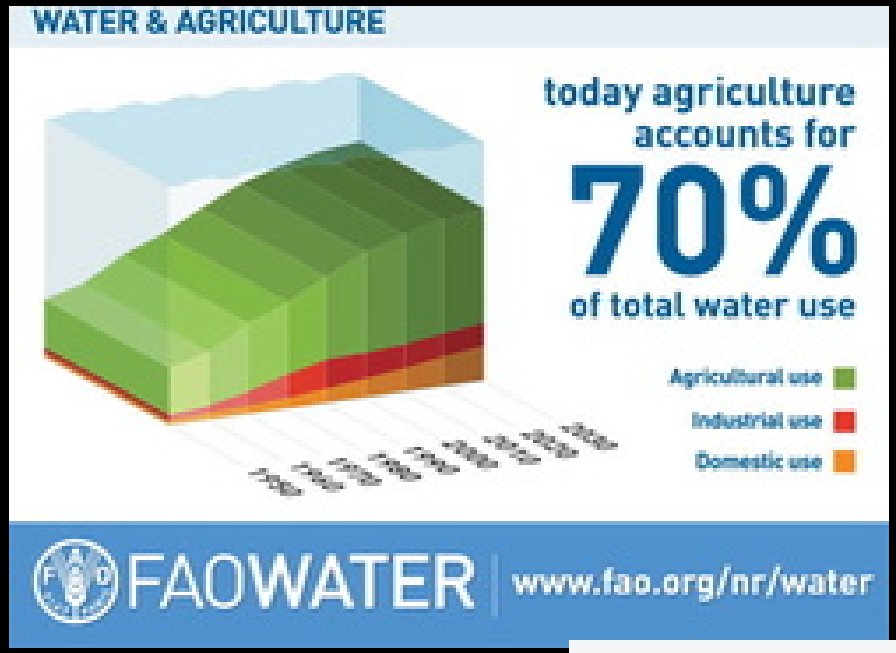


Figure 17.12 Municipal water use and treatment. (a) Water is often taken from a river or reservoir, piped to the treatment plant, treated, used, and then returned to the source. (b) At the treatment plant, (1) chlorine is added to kill bacteria, (2) alum (aluminum sulfate) is introduced to coagulate organic particles, and (3) the water is put into a settling basin for several hours to allow the coagulated particles to settle. The water is then (4) filtered through sand, (5) treated with lime to adjust the pH, and (6) put into a storage water tower or reservoir for distribution to your home.

Is bottled water necessary?



Global Water Use

US Water Use

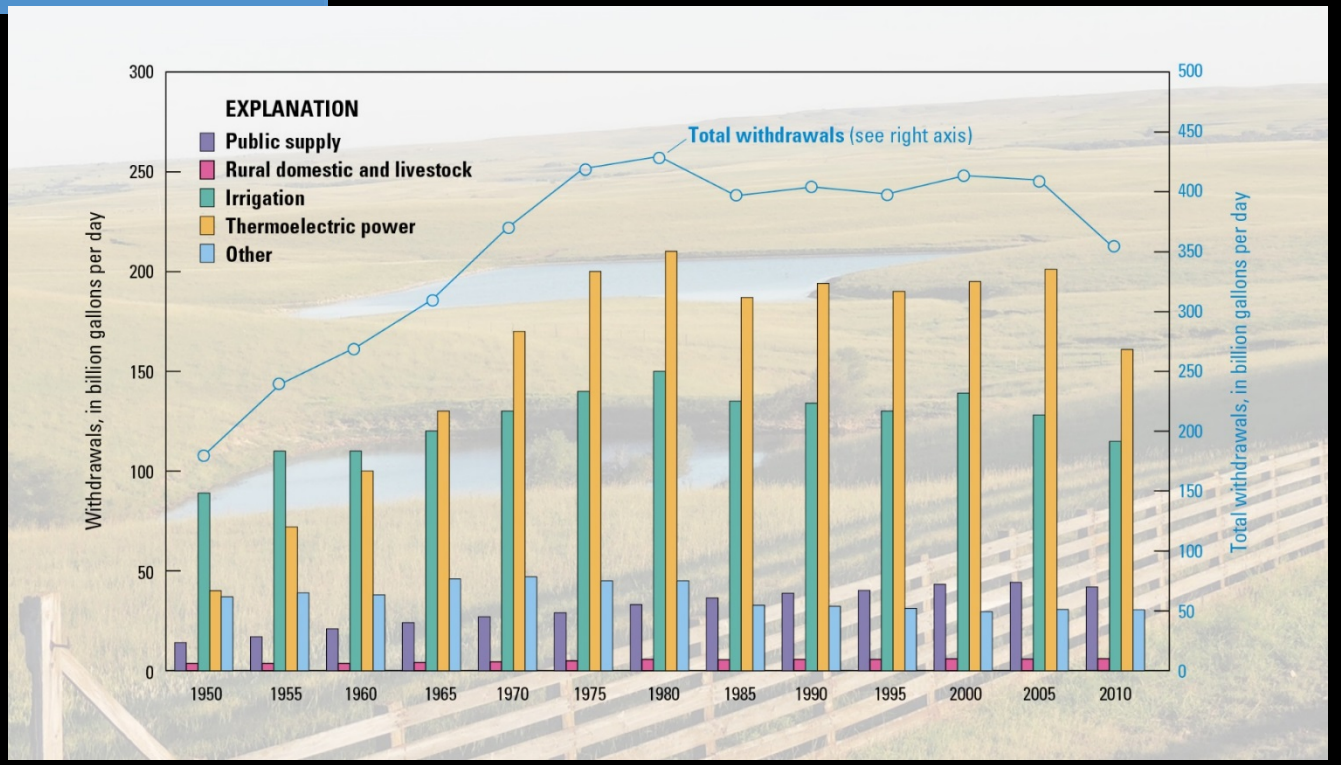
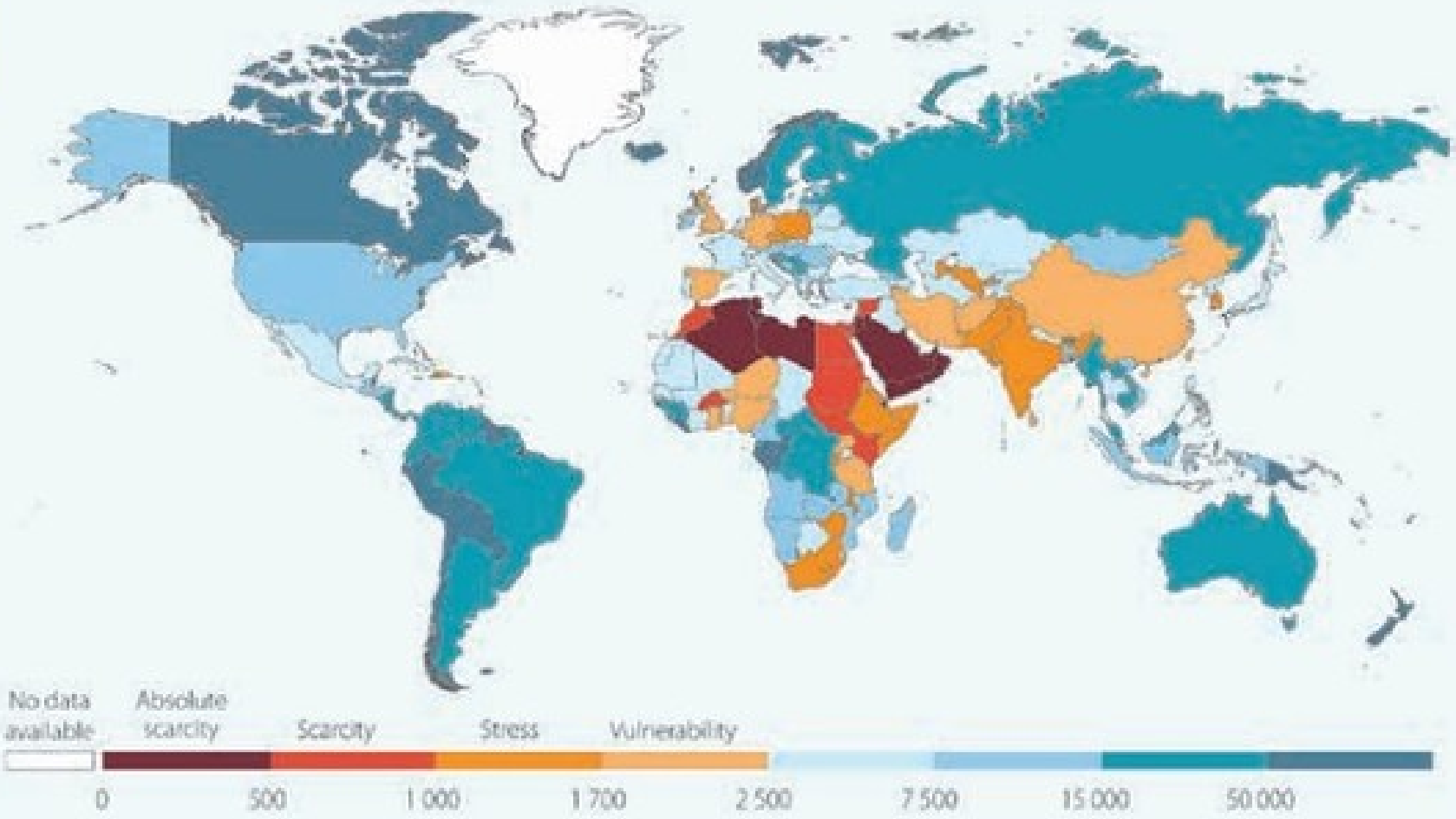


FIGURE 1.1

Total renewable water resources per capita (2013)

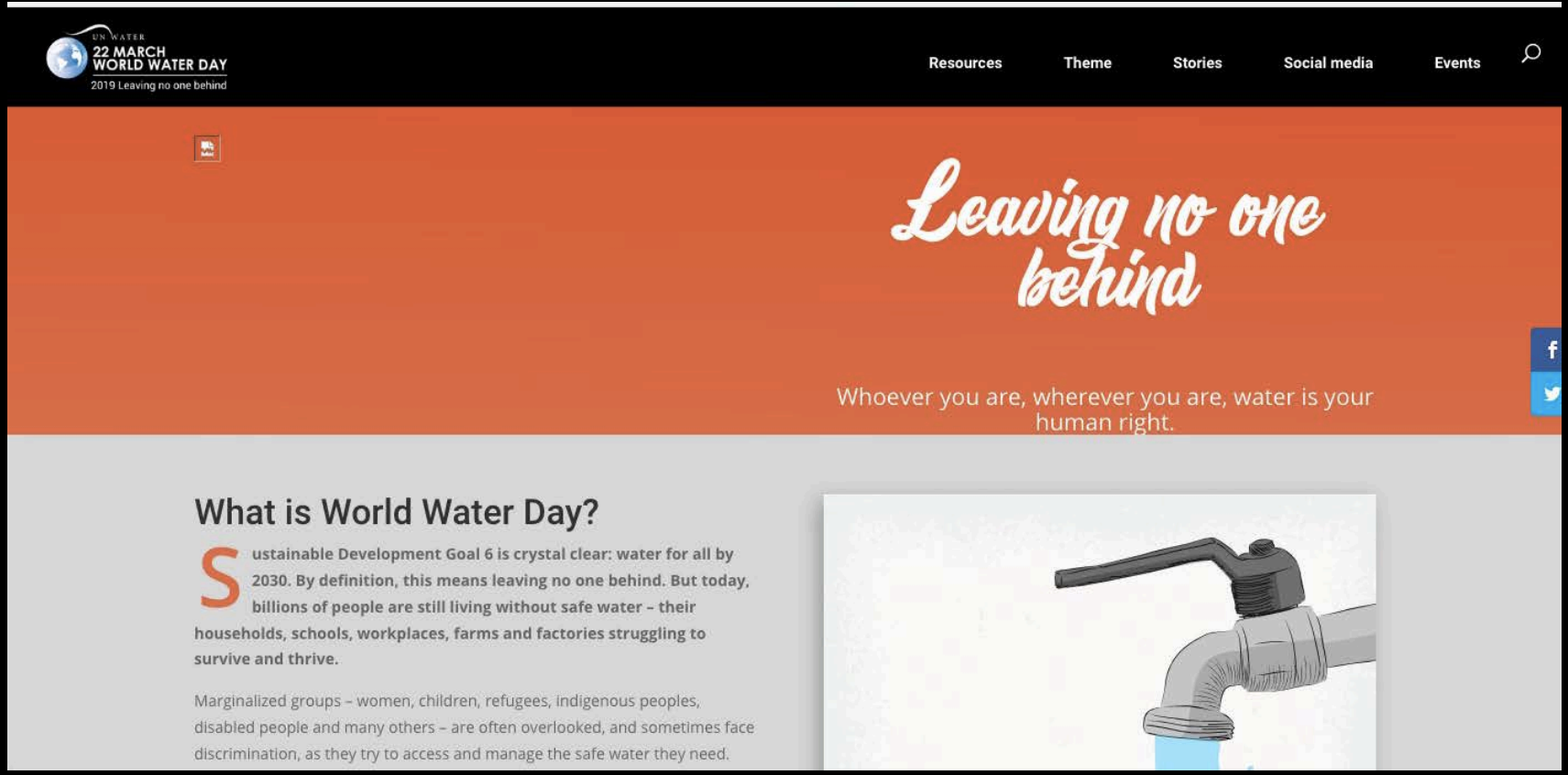


Note: The figures indicate total renewable water resources per capita in m³.

Source: WWAP, with data from the FAO AQUASTAT database. (http://www.fao.org/nr/water/aquastat/main/index.stm) (aggregate data for all countries except Andorra and Serbia, external data), and using UN-Water category thresholds.

Right to Water is a Human Right

https://www.worldwaterday.org/



Watersheds in Santa Clara County