

# Freshwater Systems

**“Water promises to be to the 21<sup>st</sup> century what oil was to the 20<sup>th</sup> century: the precious commodity that determines that wealth of nations.” – Fortune Magazine**

**“The wars of the 21<sup>st</sup> century will be fought over water.”  
– World Water Commission Chairman Ismail Serageldin**



# Freshwater Marshes

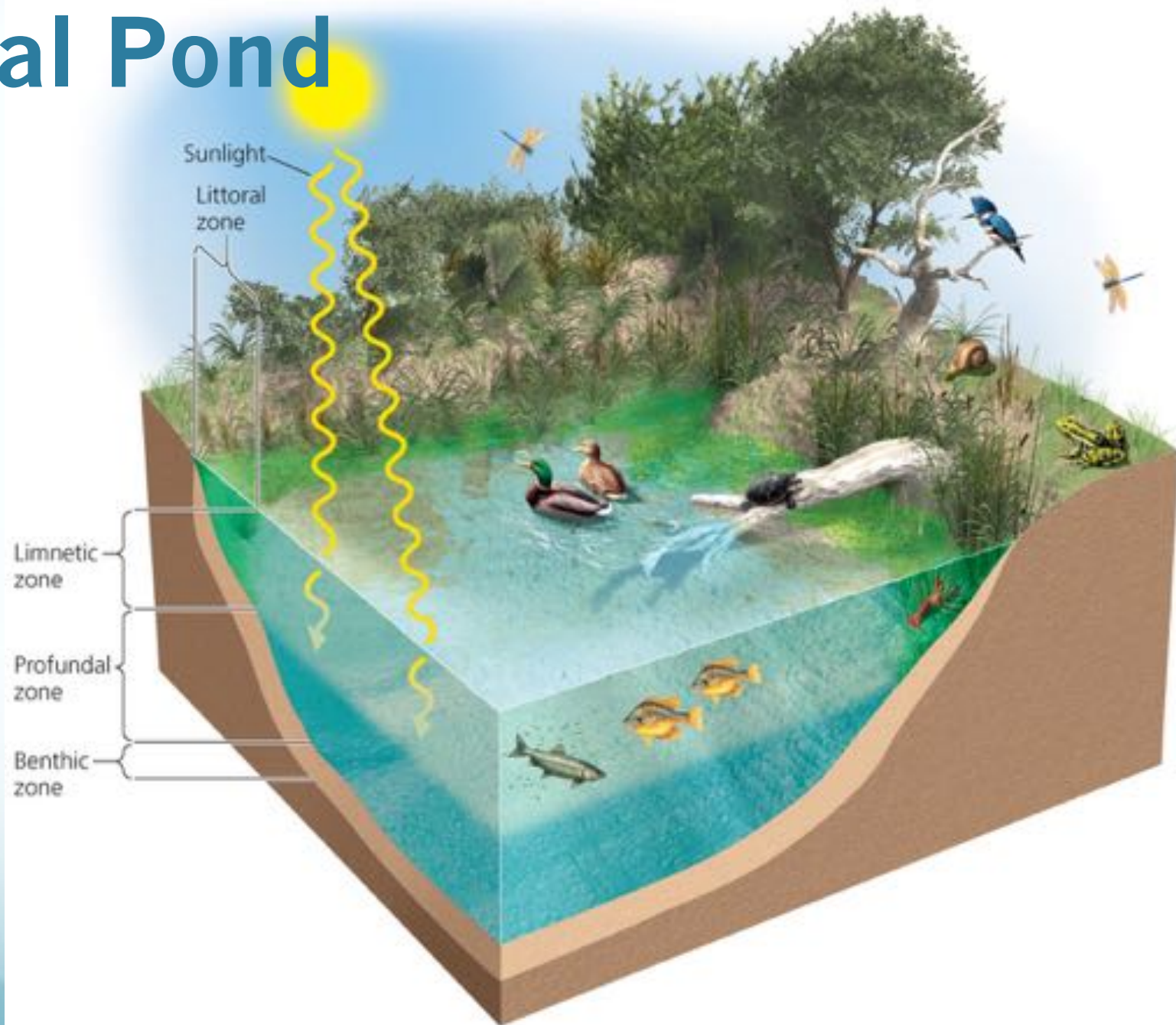


# Lakes and Ponds Are Ecologically Diverse

- Lakes and ponds are bodies of open, standing water
- **Littoral Zone:** Region ringing the edge of a water body
- **Benthic Zone:** Extends along the entire bottom of the water body
  - Home to many invertebrates
- **Limnetic Zone:** Open portions of the lake or pond where the sunlight penetrates the shallow waters
- **Profundal Zone:** Water that sunlight does not reach
  - Supports fewer animals because there is less oxygen



# Typical Pond



# Check In Question #1: **Turn & Talk**

- The area of a lake that contains open water that does not receive sunlight is called the \_\_\_\_\_ zone.
- A. Littoral
  - B. Benthic
  - C. Limnetic
  - D. Profundal

# Check In Question #2: **Turn & Talk**

- Emergent vegetation such as cattails and reeds grow in the \_\_\_\_\_ zone of a lake.
- A. Aphotic
  - B. Limnetic
  - C. Benthic
  - D. Littoral
  - E. Profundal

# Lakes Vary in Their Nutrients and Oxygen

- **Oligotrophic** vs. **Eutrophic** Lakes and Ponds
- Eventually, water bodies fill completely in through the process of succession
- **Inland Seas**

# Oligotrophic Lakes and Ponds

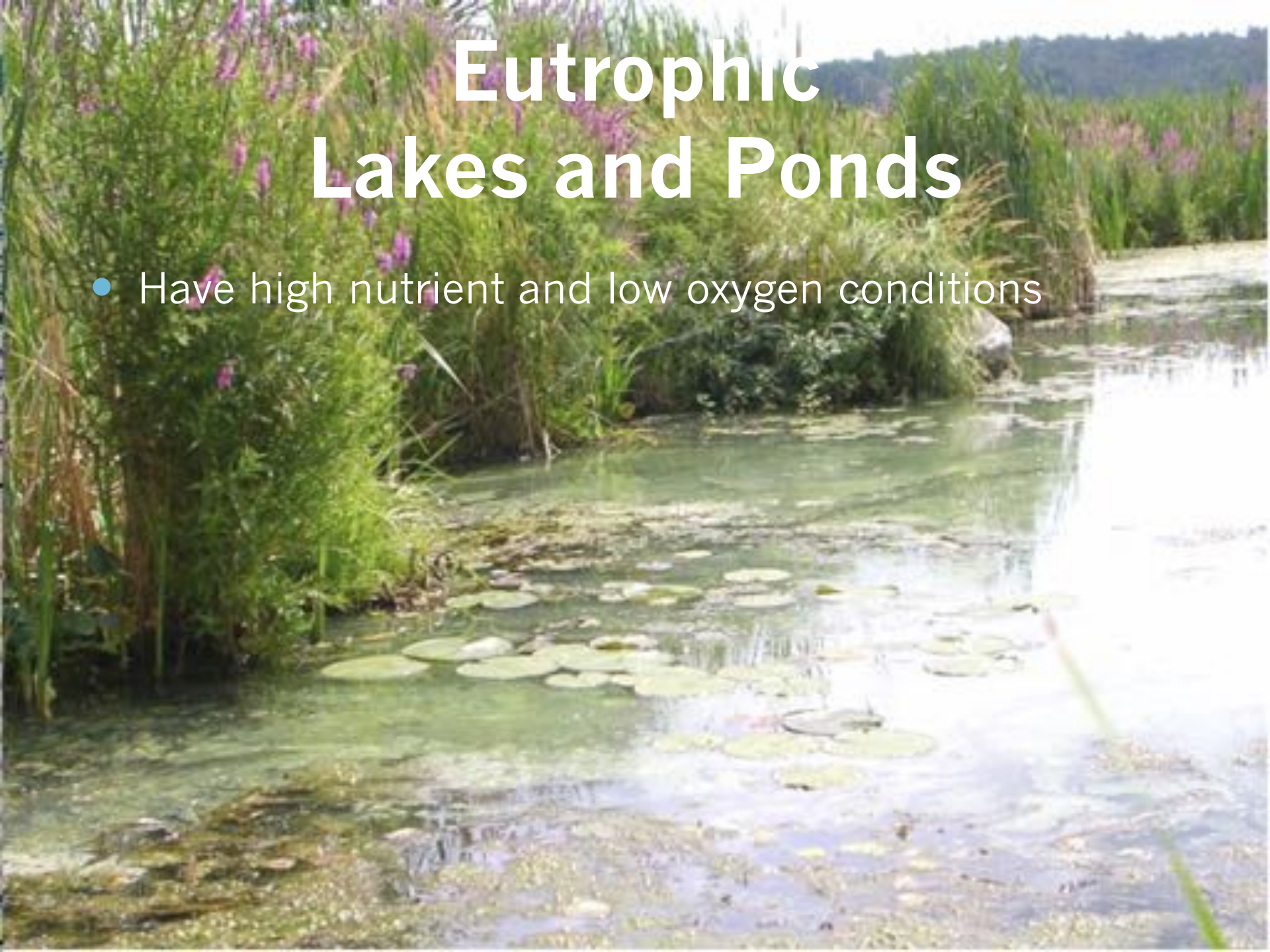
- Have low nutrient and high oxygen conditions





# Eutrophic Lakes and Ponds

- Have high nutrient and low oxygen conditions





# Inland Seas

- Large lakes that hold so much water, their biota is adapted to open water
- Ex: The Great Lakes



# Groundwater Plays a Key Role

- **Groundwater:** Any precipitation that does not evaporate, flow into waterways, or get taken up by organisms
  - Groundwater makes up one fifth of the Earth's freshwater supply
- **Aquifers:** Porous sponge-like formations of rock, sand, or gravel that hold groundwater
- **Zone of Aeration:** Pore spaces are partially filled with water
- **Zone of Saturation:** Spaces are completely filled with water
- **Water Table:** Boundary between the two zones
- **Aquifer Recharge Zone:** Any area where water infiltrates Earth's surface and reaches aquifers



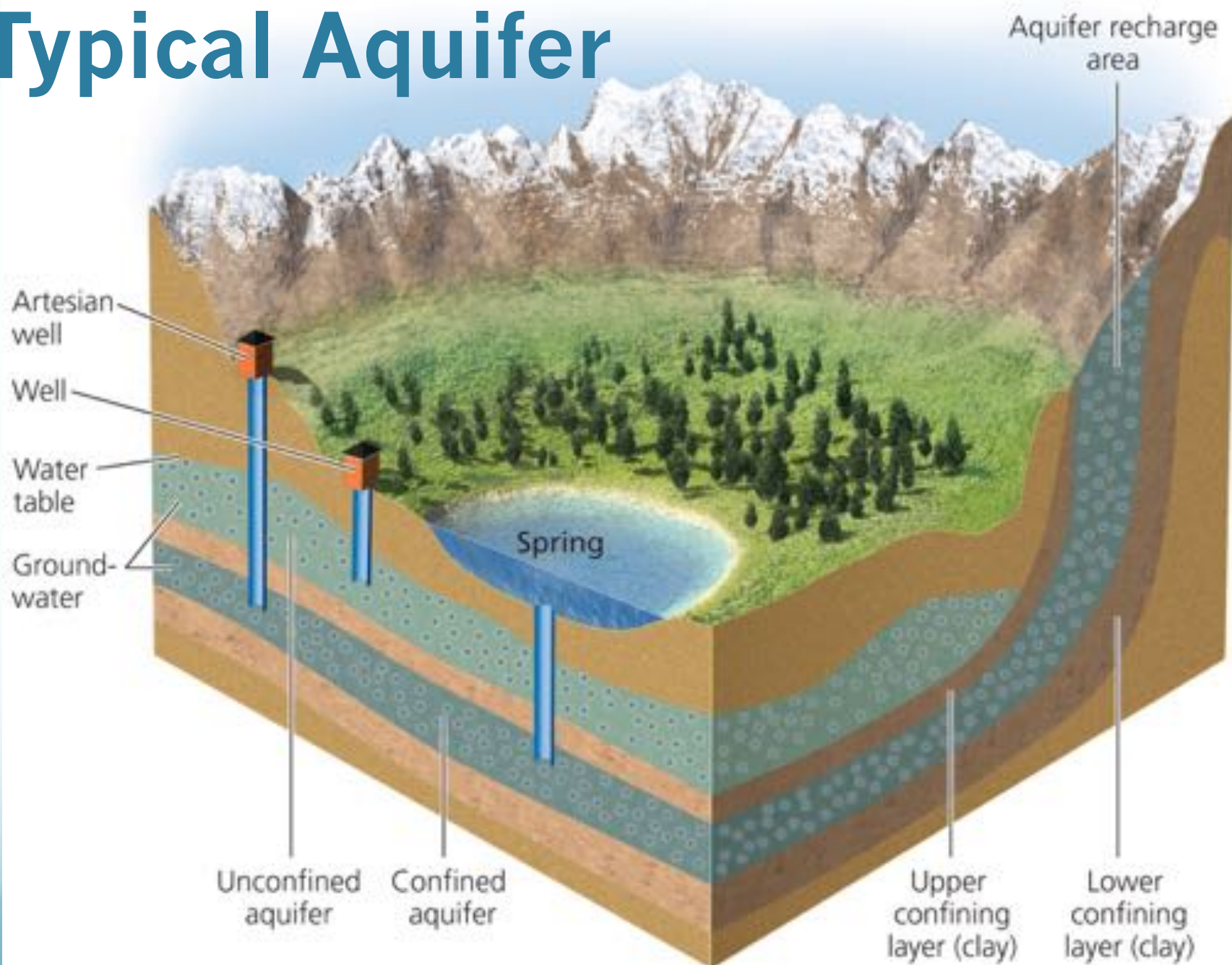
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# A Typical Aquifer



# Check In Question #3:

## Turn & Talk

- Most of the precipitation that falls onto Earth's surface \_\_\_\_\_.
- A. Is already unusable because of acid rain
- B. Evaporates back into the atmosphere
- C. Either runs off to form rivers or filters down into underground aquifers
- D. Falls in the form of ice or snow
- E. Is taken up by plants or other organisms

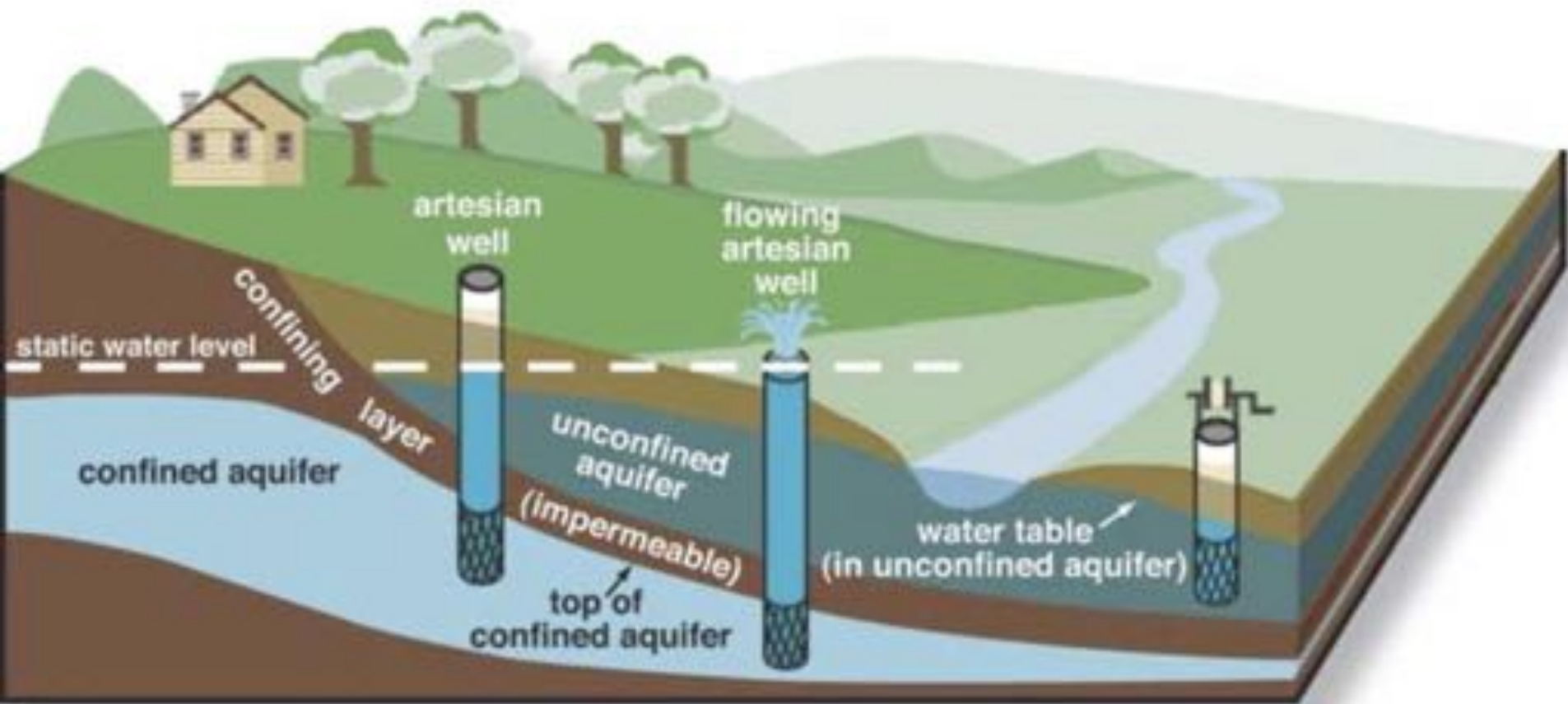
# Check In Question #4: **Turn & Talk**

- One-fifth of Earth's total freshwater supply is in \_\_\_\_\_.
- A. Ponds
- B. The Ocean
- C. Groundwater
- D. Estuaries
- E. The tundra

# Two Categories of Aquifers

- **Confined or Artesian:** Water-bearing, porous rocks are trapped between layers of less permeable substrate (i.e., clay)
  - Is under a lot of pressure
- **Unconfined Aquifer:** No upper layer to confine it
  - Readily recharged by surface water
- Groundwater becomes surface water through springs or human-drilled wells
- Groundwater may be ancient: the average age is 1,400 years



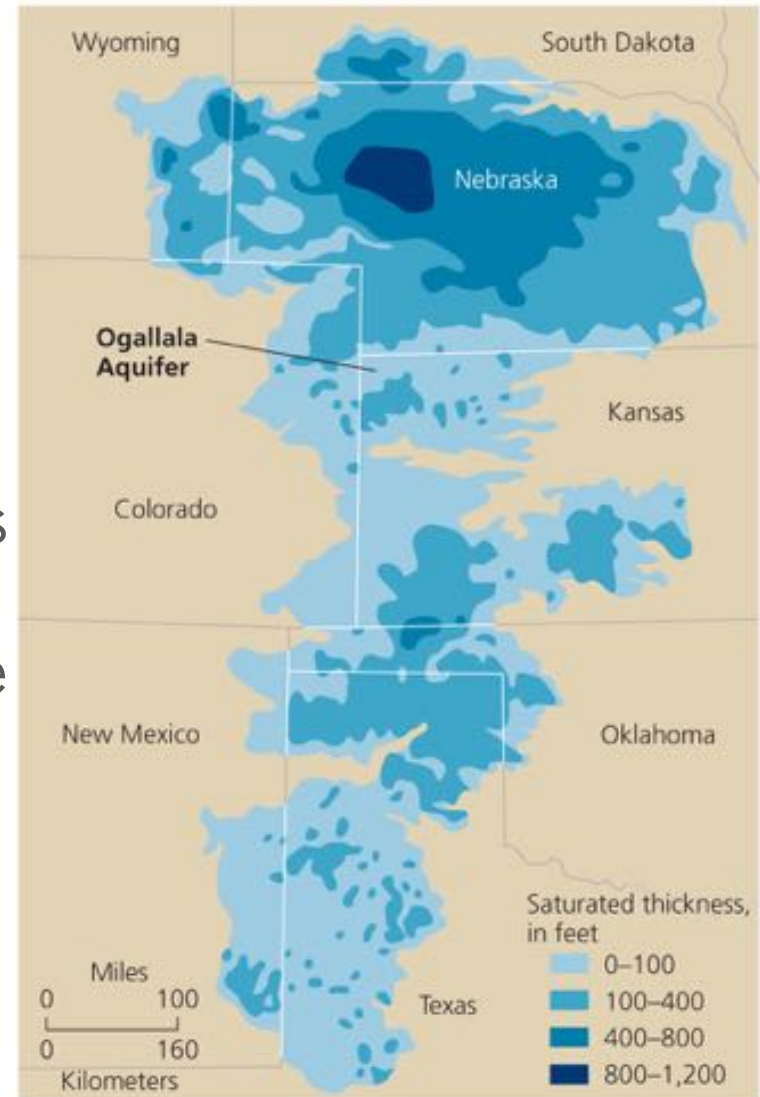


# Check In Question #5: **Turn & Talk**

- A confined aquifer is defined as \_\_\_\_\_:
- A. An aquifer that traps porous rocks between layers of less permeable substrate
- B. An aquifer that traps porous rocks under one layer of less permeable substrate
- C. An aquifer with porous rocks resting on bedrock
- D. An aquifer with no upper layer

# The Ogallala Aquifer

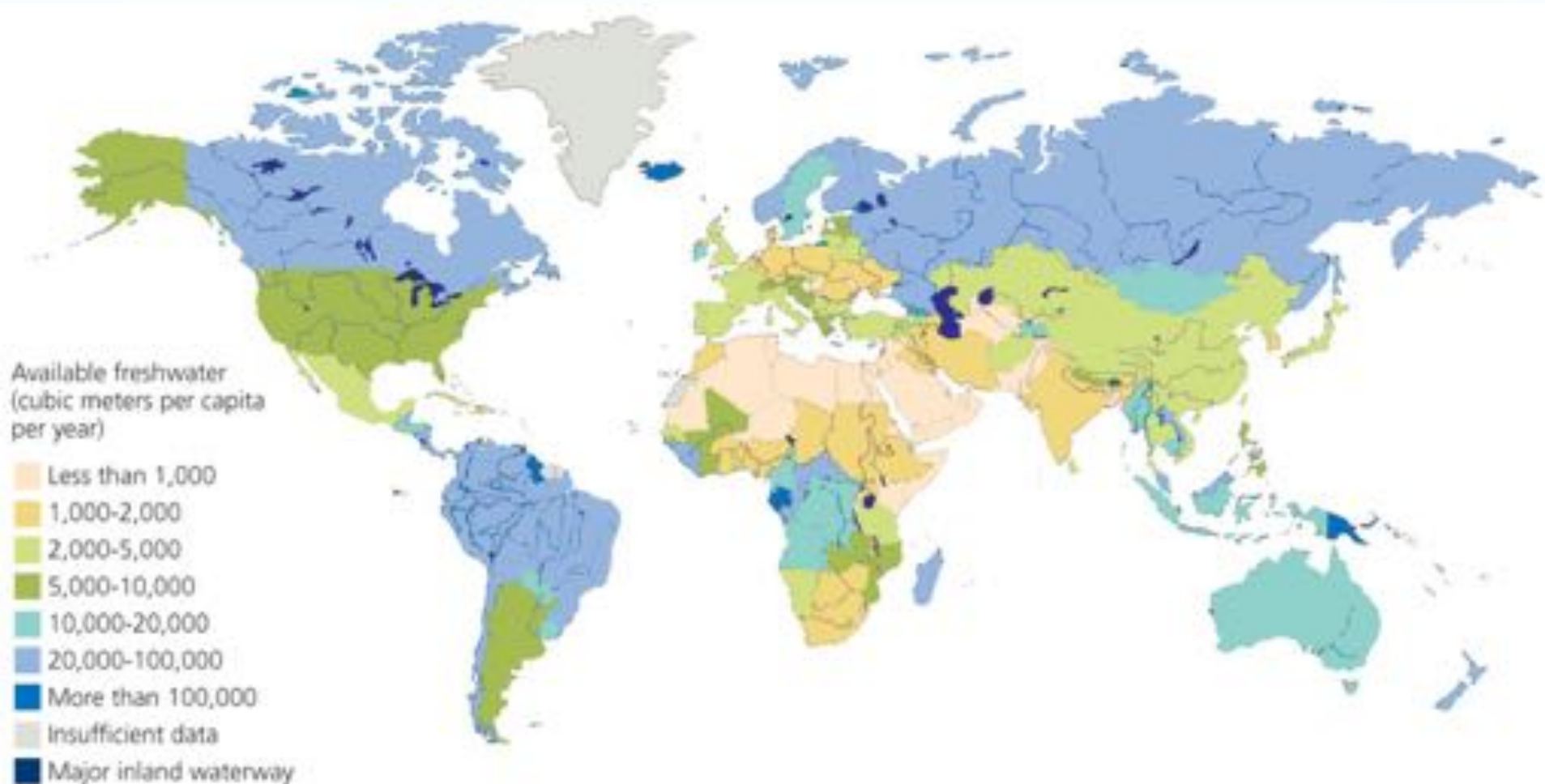
- The world's largest known aquifer
- Underlies the Great Plains of the U.S.
- Its water has allowed farmers to create the most bountiful grain-producing region in the world



# Water Is Unevenly Distributed Across Earth's Surface

- Different regions possess vastly different amounts of groundwater, surface water, and precipitation
- Many areas with high population density are water-poor and face serious water shortages





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# Water Is Distributed Unevenly In Time, Too

- Monsoon seasons bring concentrated storms
  - Half a region's annual rain may fall in a few hours
- People erect dams to store water



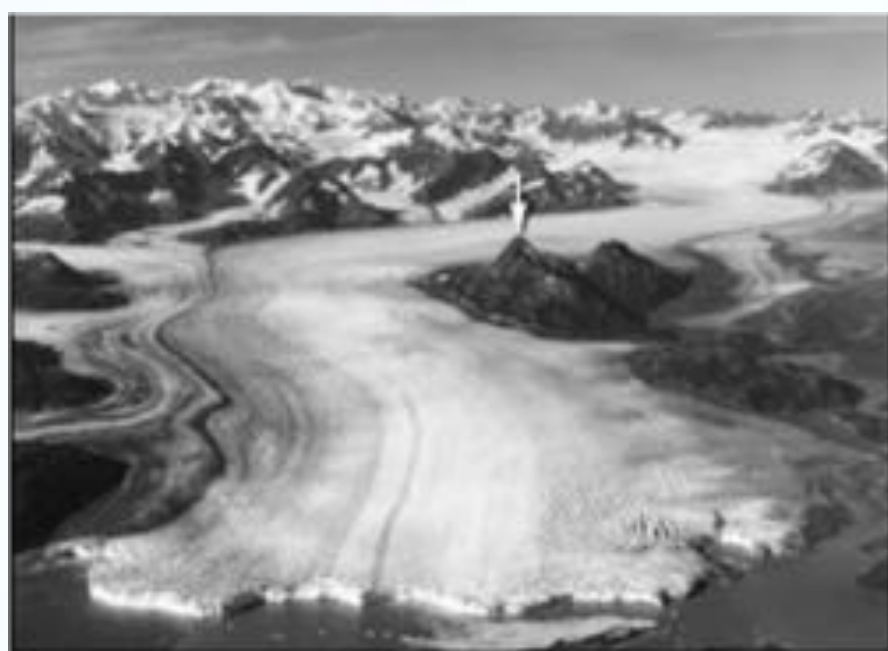
# Climate Change Will Cause Water Shortages

- Climate change will cause
  - Altered precipitation patterns
  - Melting glaciers
  - Early season runoff
  - Intensified droughts
  - Flooding
- Increasing probability that there will be still less water for more people



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Columbia Glacier c. 1980



Columbia Glacier 2005



Arapaho Glacier 1898



Arapaho Glacier 2003



# Glacier National Park: Before/After





# Review Question: **Turn & Talk**

- Why are sources of fresh water unreliable for some people and plentiful for others?



# Review Question: **Turn & Talk**

1. Discuss possible strategies for equalizing distribution of water throughout the world. Consider supply and transport issues.
2. Have our methods of drawing, distributing, and storing water changed very much throughout history?
3. How is the scale of our efforts affecting the availability of water supplies?