



Water Reservoirs and Residence Time

Use the data to compare where Earth's water is stored and how long it stays there.

Name _____ Date _____

Reservoir	Volume (km ³)	Percent of total
Oceans, seas, and bays	1,338,000,000	
Ice caps, glaciers, and permanent snow	24,064,000	
Groundwater	23,400,000	
Ground ice and permafrost	300,000	
Lakes	176,400	
Soil moisture	16,500	
Atmosphere	12,900	
Swamp water	11,470	
Rivers	2,120	
Living things	1,120	
Total		

Source: approximate values reported by the U.S. Geological Survey (after Shiklomanov, 1993).

Residence time is the average time a water molecule stays in a reservoir: residence time = volume ÷ flow rate in (or out).

1. Add the volumes to find the total. Then calculate each reservoir's percent of the total (to 3 significant figures).

2. About 505,000 km³ of water falls as precipitation each year. Calculate the residence time of water in the atmosphere in days.

3. Rivers discharge about 40,000 km³ to the oceans each year. Calculate the residence time of water in rivers in days.

4. About 425,000 km³ evaporates from the oceans each year. Estimate the residence time of ocean water in years.

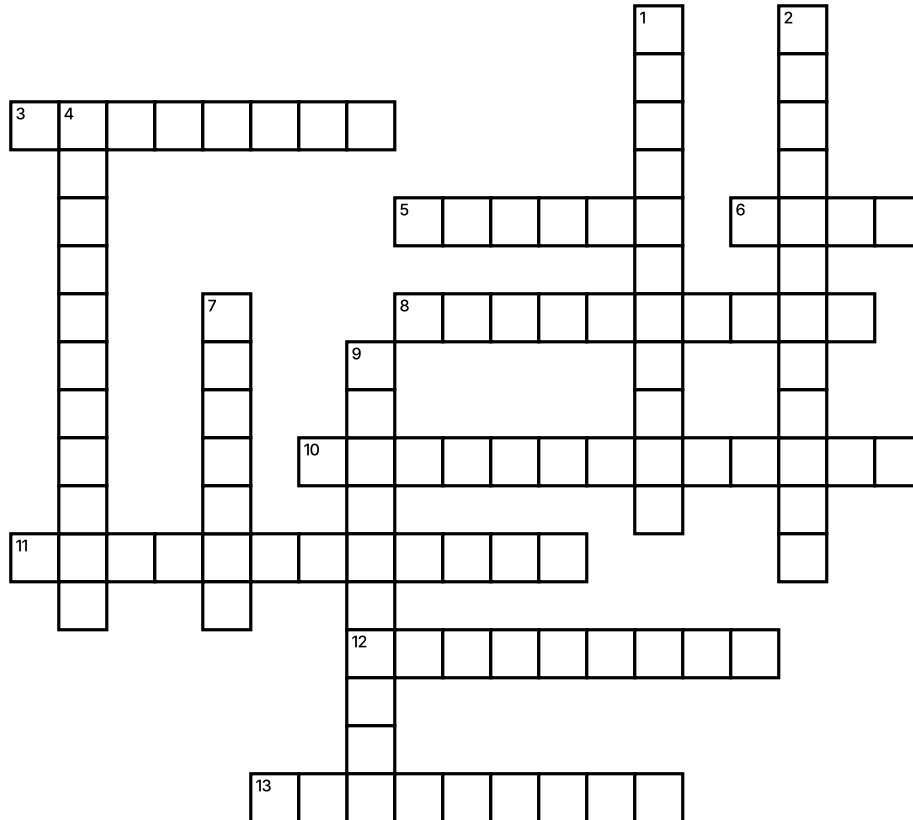
5. Use residence time to explain why a pollution spill in the Missouri River reaches St. Louis intakes quickly, but polluted groundwater can take decades to clean.



Earth Systems Crossword

Complete the crossword using hydrologic cycle and Earth systems vocabulary.

Name _____ Date _____



Across

- 3 A result that amplifies or dampens the change that caused it (8)
- 5 How much sunlight a surface reflects (6)
- 6 The rate at which water moves between reservoirs (4)
- 8 The frozen parts of Earth, such as ice sheets and permafrost (10)
- 10 Release of water vapor from plant leaves (13)
- 11 Change of water vapor to liquid, forming clouds (12)
- 12 In the water cycle, any place water is stored for a time (9)
- 13 Land area that drains to a common outlet (9)

Down

- 1 All of the water on, under, and above Earth's surface (11)
- 2 The movement of water from the surface into the soil (12)
- 4 Change of liquid water to vapor using energy from the sun (11)
- 7 A rock or sediment layer that stores and transmits groundwater (7)
- 9 Ground that stays frozen for two or more years (10)



For teachers

Grade 9 Answer Key

Accept reasonable answers that are supported by evidence.

Water Reservoirs and Residence Time

Total: **1,385,984,510 km³** (about 1.386 billion km³)

- Oceans, seas, and bays: 96.5%
- Ice caps, glaciers, and permanent snow: 1.74%
- Groundwater: 1.69%
- Ground ice and permafrost: 0.0216%
- Lakes: 0.0127%
- Soil moisture: 0.00119%
- Atmosphere: 0.000931%
- Swamp water: 0.000828%
- Rivers: 0.000153%
- Living things: 0.0000808%

Atmosphere: $12,900 \div 505,000 = 0.0255 \text{ yr} \times 365 \approx \mathbf{9.3 \text{ days}}$. Rivers: $2,120 \div 40,000 = 0.053 \text{ yr} \approx \mathbf{19 \text{ days}}$.

Oceans: $1,338,000,000 \div 425,000 \approx \mathbf{3,148 \text{ years}}$ (about 3,000 years).

Rivers turn over in weeks, so a spill moves downstream fast; groundwater residence times range from years to thousands of years, so contamination lingers.

Earth Systems Crossword

