

Using Groundwater Wisely Answer Key

1. What types of sediment/rock will allow for the fastest recharge of aquifers?
sediments/rocks with high permeability rates
2. Explain your answer.
Sediments with high permeability rates allow water to flow through easily. When water can flow through easily, precipitation can more easily recharge aquifers.
3. How certain are you about your claim based on your explanation?
Answers will vary.
4. Explain what influenced your certainty rating.
Answers will vary. Scientific evidence includes: permeable sediments allow easy flow of water and aquifers can be recharged by precipitation.
5. Similar amounts of precipitation fall in urban and non-urban areas. Why is a river in an urban area more likely than a non-urban river to flood during heavy rains and dry up during dry periods?
A river in an urban area is more likely to flood in heavy rains and dry up during dry periods because it receives more of its water from runoff and less from groundwater. In an urban area, much of the surface is impermeable. In a heavy rain, that means water runs along the surface and into rivers, leading to quickly flooded rivers. In a non-urban area, the same rain would be absorbed into the permeable ground surfaces, preventing such quick flooding of rivers. Because so much of urban area's surfaces are impermeable and prevent groundwater infiltration, there is less water to provide to the stream during dry periods. In a non-urban area, the stream is more likely to carry water even during dry periods because there is water in the ground, stored up from wetter periods.
6. Are aquifers that lie beneath urban areas recharged by rainfall?
no
7. Explain your answer.
Aquifers beneath urban areas are largely not recharged by rainfall because the surfaces are impermeable. Water that would otherwise infiltrate into the ground is forced to run off into rivers and streams, which may not allow the water to sit very long so that it can be absorbed into the ground to recharge aquifers.
8. How certain are you about your claim based on your explanation?
Answers will vary.

Using Groundwater Wisely Answer Key, continued

9. Explain what influenced your certainty rating.

Answers will vary. Scientific evidence includes: urban surfaces are impermeable, water cannot penetrate impermeable surfaces, and water runs off into other regions because of the impermeable surfaces. Students may state that there are grassy retaining pools that prevent water from running out of the area, so those could provide some recharge. Students may also note that some cities have moved to have pervious pavement to allow water to flow into the ground instead of along the surface.

10. Which area is recharged by its well?
rural area aquifer

11. Explain your answer.

The rural area aquifer recharges its aquifer because the surface and layers above the aquifer are permeable. Water can flow through the layers to recharge the aquifer. In the urban area, water is prevented from recharging the aquifer because the surface is impermeable.

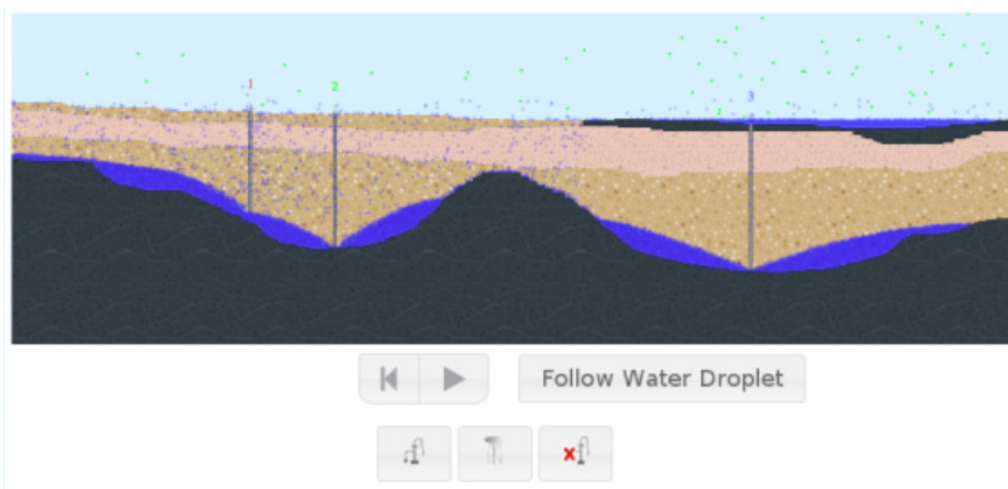
12. In which area was there more evaporation?
urban area

13. Explain your answer.

There was more evaporation in the urban area because there was more water on the surface. In the rural area, the water could infiltrate the ground, but in the urban area, water was stuck on the impermeable surface. The more water there is standing on the surface, the more likely is evaporation.

14. Insert a snapshot of the results. Describe how the aquifers changed.

Both aquifers dropped, but the urban aquifer dropped more. That's because it didn't get any flowback at all. The rural aquifer got some flowback because of the permeable surfaces.



Using Groundwater Wisely Answer Key, continued

15. Sustainable water use occurs when the withdrawals of water are equal to or less than the inputs of water. Which of the wells in this model showed sustainable water use?
rural flowback well
16. Explain your answer.
The only sustainable well is the one that gives back to its aquifer. Only the rural flowback well satisfies that condition. The rural well that was pumped to the city slowly depleted the rural aquifer. No flowback and recharge of the aquifer from which it came was allowed. The urban aquifer could not recharge its aquifer because the water was being pumped to a wastewater plant. Even if flowback was allowed, the surfaces are impermeable, preventing recharge of the underlying aquifer.
17. How certain are you about your claim based on your explanation?
Answers will vary.
18. Explain what influenced your certainty rating.
Answers will vary. Scientific evidence includes: specific reference to what happened in the model experiment and only permeable surfaces allow recharge of underlying aquifers. Students may state that the wastewater treatment plant could discharge to an area that would recharge the urban aquifer.
19. How could you use the treated wastewater to recharge the aquifer? Describe the path the treated wastewater would take to recharge the local aquifer.
Treated wastewater could be used to recharge the local aquifer by discharging the treated water into an area with permeable sediments that overlies the aquifer. The treated wastewater would flow through the permeable sediments and into the aquifer, from which it could be pumped again for use in homes and businesses. Of course, this is true only if the aquifer is unconfined. Otherwise, city officials could drill holes into the top of the confined aquifer to make it more permeable so that the treated wastewater could recharge the (formerly) confined aquifer.
20. Based on what you know about water flow, how would you solve this problem? What factors do you need to consider to make a decision? Who should get to use the water?
Answers will vary. Students should refer to issues with evaporation, permeability of sediments, recharge of local aquifers, different uses of water, and conservation/efficient use of limited water supplies.