

**Nebraska Department of Natural Resources**  
**Stream Simulation 2: Effects of Groundwater**  
**Pumping on Streamflow**

**KEY**

Read the introduction screen, click OK, and complete the Tutorial for Stream Simulation 2. Click Next until you Exit Tutorial, then answer the following questions. You may turn the Tutorial Mode back on at any time to assist with explanations, as well as reference your Word Bank.

After exiting the tutorial mode, be sure the drop down in the top right corner of the screen says **Gaining Stream** and then answer the following questions.

1. Does a pump have any effect on water interactions if it is turned off?
  - a. Yes
  - b. **No**
2. When the pump is turned on, the water table \_\_\_\_\_ and the stream depth \_\_\_\_\_.
  - a. decreases/increases
  - b. increases/decreases
  - c. decreases/remains unchanged
  - d. **decreases/decreases**
3. According to the simulation, which has a greater effect on the water table, a pump near the stream or a pump far from the stream?  
**Answer: Near Pump**
4. According to the simulation, which has a greater effect on the stream depth, a near pump or a far pump?  
**Answer: Near Pump**
5. When the stream depth decreases from pumping, this is known as \_\_\_\_\_.
  - a. Recharge
  - b. Baseflow
  - c. **Depletion**
  - d. Precipitation

6. Experiment moving the pump slider between **Near** and **Far** in the simulation. Make sure the **pump** is set to **on**. What effects does the pump having on groundwater flow?

*Answer: Students should indicate that the baseflow of the aquifer shifts from gaining to losing when the pump is moved close to the stream. The direction of the baseflow reverses when the pump is too close.*

*Use the drop down arrow in the top right corner of the screen and select **Losing Stream**. Read the introduction screen, click OK, then Turn On the Tutorial Mode in the top right corner of the screen. After you complete the Tutorial Mode, answer the following questions.*

7. When the pump is turned on, the water table \_\_\_\_\_ and the stream depth \_\_\_\_\_.

- a. decreases/increases
- b. increases/decreases
- c. decreases/remains unchanged
- d. **decreases/decreases**

8. If the water table falls below the streambed, the stream is then \_\_\_\_\_.

- a. Gaining
- b. Losing
- c. **Disconnected**
- d. At equilibrium

9. Which causes depletion at a faster rate, a pump near the stream or a pump far from the stream?

*Answer: Near pump*

*Use the drop down arrow in the top right corner of the screen and select **Disconnected Stream**. Read the introduction screen, click OK, then Turn On the Tutorial Mode in the top right corner of the screen. After you complete the Tutorial Mode, answer the following questions. Keep in mind a stream can be naturally disconnected or it can become disconnected as a result of groundwater pumping.*

10. When the pump is turned on, the water table \_\_\_\_\_ and the stream depth \_\_\_\_\_.

- a. decreases/increases
- b. increases/decreases
- c. **decreases/remains unchanged**
- d. decreases/decreases

11. Explain what happens when a stream is disconnected and the effect of pumping on streamflow.

Answer: The pump is withdrawing water from the aquifer, but the aquifer isn't connected to the stream. Therefore, there is no noticeable effect on streamflow as all impacts are to the aquifer.

Use the drop-down arrow in the top right corner of the screen and select **Transient Stream** and then answer the following questions.

12. Extraction means *the action of taking out something using force*. In the groundwater pumping simulation, extraction refers to taking water out of the aquifer via pumping. No extraction is occurring when the slider in the top left is set to **off**. While off, the stream in this simulation is \_\_\_\_\_.

- a. Losing
- b. **Gaining**
- c. Disconnected
- d. At equilibrium

13. Experiment moving the slider between **Low** and **Very High** for pumping volume. Explain what happens to the streamflow and connectivity.

Answer: Students should indicate that the water table decreases. When the extraction becomes "high", the water table decreases, and connectivity has the potential to be lost between the stream and the aquifer. Baseflow also switches direction away from the stream at "medium" extraction. Students can put anything down that they notice, but an emphasis on connectivity and baseflow should be noted.

14. Based on your answers in this section, define a Transient flow.

Answer: Answers can vary widely but should have some emphasis on the streamflow and baseflow interactions changing (gaining, to losing, to disconnected) over time.

15. Background: At Pumpkinseed Creek in western Nebraska, farmers' water availability has severely declined over the past 50 years due to a combination of substantial groundwater use and drought, thereby negatively changing the creek's connectivity to the aquifer. The disconnection has decreased streamflow and water availability for wildlife, recreation, and irrigation. Farmers have adapted their management decisions to conserve water.

You are a farmer in the middle of the irrigation season who wants to irrigate your crops. You will need to install groundwater pumps to use water from the aquifer. The aquifer is associated with a Gaining Stream. As a farmer who is conscious of hydrological effects, you want to minimize depletion and maintain stream connectivity.

How will you accomplish that goal? Be sure to emphasize groundwater extraction (number of pumps used) and the location of the pumps used. Based on what you've learned from these simulations, describe all of the effects your pumping will have on the stream. *Your answer should be in paragraph form.*

**Answer:** Students should emphasize the fact that pumps located closer to the streams have more depletive/negative effects on stream interactions than those located further away. Their other point of emphasis should be the level of extraction, that more pumps will cause a higher rate of depletion and could cause the stream to become disconnected.