to other factors that may be influencing streamflow and mussel growth.

Findings

How does mussel growth change in times of high and low flow? How do you know based on the data in figure 17?
The data in figure 17 show a lot of negative numbers during high streamflow in the unregulated rivers. Eight out of nine are negative for the Sipsey River and one out of three are negative for the St. Francis River. These data suggest that mussels' growth is slower during times of high streamflow.

What did the scientists find out about the relationship between regulated and unregulated rivers and mussel growth? (Hint: Review figures 13 and 17.)
Unregulated rivers showed two different things. In the Sipsey River, there was faster mussel growth in times of low streamflow and slower mussel growth during times of high streamflow. In the St. Francis River, there was a strong, positive relationship between mussel growth and hydrologic reversals. In the regulated river, no relationships could be found.

Read the descriptions of the rivers in figure 13. Do you think any of these river characteristics could influence mussel growth? What do you think the scientists might suggest as the next steps to take after this research?
The large scale agriculture and watershed diversion projects could have an impact on the mussels. The presence of dams and reservoirs may also impact mussel growth. The scientists might suggest looking at more mussels and other rivers.

Discussion

Do you think it is important to study the impact of streamflow on mussels? Why or why not?
Students will have individual answers to these questions. Students should support their answer with logic and examples from the article. Students should realize that mussels are important parts of bottomland forest ecosystems. Mussels provide a variety of benefits to the ecosystem. Therefore, it is important to understand mussel growth and the ecosystem that best supports their growth.

What are the advantages and disadvantages of dams on our rivers? Discuss with your classmates.
Students will have individual answers for this question. From the article, students should be able to discuss the impacts of dams on the growth and success of freshwater mussels. For other advantages or disadvantages, students may discuss recreation access (i.e., fishing, boating, swimming, etc.), flood control, drinking water access, loss of natural processes, power generation, or increased carbon emissions.

TIMED TRAVEL

Introduction

Why does stream or river water temperature vary across a 24-hour period?
Students will have individual answers to this question. They should, however, realize that nighttime water temperatures are often cooler than daytime temperatures.

Imagine that you are going camping over the weekend. You will be sleeping in a tent. The average daily air temperature across 24 hours will be 45 °F (7.2 °C). Do you think it would be more helpful for you to know how the

air temperature will vary across the 24-hour period? Why or why not?
Students will have individual answers to this question. They should realize, however, that knowing whether the nighttime temperature will be, for example, 25, 30, or 40 degrees Fahrenheit and knowing the minimum and maximum temperatures would help them plan for their trip.

Methods

Explain in your own words how the experiment was controlled so that any observed differences in fry emergence and condition would most likely be related to water temperature patterns.
Students will have different ways to describe the experiment. They should note at least a few of the following procedures to control the experiment: Adult Chinook salmon were collected within a 2 month period and from the same area of the river; eggs were collected at the same time and under controlled conditions at the hatchery; the chambers were constructed the same and all were heated by a similar heater. The same measurements were used for each chamber. The only difference between the chambers was the temperature patterns. Therefore, any observed differences in fry emergence would most likely be related to the different temperature patterns.

What were the scientists trying to discover in this experiment?
Students will have different answers to this question. They should realize, however, that the scientists wanted to discover whether a variable daily temperature affected the timing of Chinook salmon fry emergence differently than a constant daily temperature.

Findings

Based on the scientists' results, what would you conclude about the relationship between water temperature variability and Chinook salmon development?
Students will have individual answers to this question. Some will have more insight into the impact of temperature variability. Students should understand, however, that variability in water temperature impacted the timing of fry emergence.

Look at figure 14. What do you notice about fry emergence from this figure?
Students will have individual answers to this question. They should, however, notice some of the patterns evident in this figure. For example, fry in different but stable water temperature emerged at about the same accumulated temperature units. When the temperature varied to a high of 13°C, fry had accumulated many fewer TU at emergence. When exposed to seasonal variation and seasonal as well as daily variation, fry emerged after accumulating similar TU.

Discussion

If you were teaching young scientists how to study fish emergence, what would you teach about considering water temperature variability?
Students will have individual answers to this question. They should, however, recognize that young scientists should be aware of and consider water temperature variability when they study fish development.

Do you think the results of this research are convincing? Why or why not?
Students will have individual answers to this question. They should, however, note that so

much of the variation was controlled in this study's design, that any changes in when fish emerged would almost have to be the result of the differences in water temperature. Therefore, students should feel that the results of this research are convincing.

UNDER WHERE?

Introduction

Does water flow underground in your region? Why do you think so?
Students may not know this answer. However, if students realize that water flows underground in a desert and emerges in some areas as an oasis, they should induce that water flows underground in the region they live.

What is surprising about figure 5? *Students should be surprised at the extent of underground aquifers across the United States.*

Do you think other areas across the planet have aquifers? Why or why not? *Students will have individual answers to this question. They should reason, however, that if the United States has extensive underground aquifers, other regions across the planet also have extensive underground aquifers.*

If you have not read "Thinking About the Environment," do so now. Using the information in "Thinking About the Environment" and in the "Introduction" as clues, how do you think the scientists answered their first research question?
Students should guess that the scientists used chemistry to answer their first question.

Methods

Why did the scientists sample catchments at two different elevations?
Students should realize that to answer their question about the amount of snow and rain contributing to streams, the scientists had to sample from areas that had much snowfall and from areas that did not have much snowfall.

Look at figure 14 and reread its caption. Why do you think an air line was connected to the sampler?
Students will have individual answers to this question. Encourage them to think about trying to suck water through a straw from a jar of water that is otherwise airtight. They should realize that air is needed to pump liquid out of a closed container.

Findings

What force is at work in the underground movement of water? Explain how this force affects underground water movement.
The force is gravity, which exerts a downward pull on objects. Gravity is at work when water runs downhill on the ground's surface. It is also at work when water infiltrates into the ground and percolates. Gravity causes water to run downhill, even when it is underground. Gravity causes water to move downward and fill crevices in between gravel and rocks until it hits bedrock. Gravity causes water to flow in aquifers because of the continual downward supply of water from above.

Read the last sentence in the "Findings" section. Based on this finding, what do you think was the answer to the scientists' second research question? (Hint: See the end of the "Introduction" section, page 110.)
Students will have individual answers to this