

Episode: The Roanoke Super Highway

EXPLORING NORTH CAROLINA

Taking the Pulse of a River



STANDARD COURSE OF STUDY CORRELATIONS:

Science, Grade 8, Goal 3: Understand the hydrosphere and local river basins; describe how humans affect the quality of water.

Earth Science, Goal 4: Investigate and analyze environmental issues and solutions for North Carolina's river basins, wetlands and tidal environments.

INTRODUCTION TO LESSON: Students will work in groups to “score” a river’s health based on an assortment of environmental indicators (supplied in a deck of custom cards).

BACKGROUND FOR TEACHER: The Roanoke River is an excellent case study of how river basins are protected and what challenges are involved in that effort. Many environmental components influence the health of river basins, including:

Biodiversity and Indicator Species: Scientists monitor certain indicator species to measure biological diversity and water quality in river basins. They typically study macroinvertebrates, but they also look at the diversity and quantity of fish species. The Roanoke River has more than 40 resident fish species and numerous anadromous fish species. **Anadromous fish** are marine species that swim up freshwater rivers to spawn. In North Carolina, these include striped bass, blueback herring, alewife, hickory shad and American shad.

Forest Health: Forests and **vegetated buffer zones** protect rivers from pollution and erosion. Vegetation helps prevent **sedimentation** by holding soil in place. Vegetation also helps to filter excessive nutrients and pollution in runoff, which can adversely affect water quality.

Flooding: River wetlands provide natural flood control. When wetlands flood, the floodplain works like a sponge to slowly absorb excess water that might harm communities downstream. Flooding also helps distribute nutrients to plants and other organisms in the floodplain. Dams can be helpful for flood control, but because they are managed for human purposes, they do not always release the same quantity or quality of water necessary to maintain the health of the **riparian flood zone**. Dams also can prevent anadromous fish species from reaching spawning grounds, which can result in decreased biodiversity in the river basin.

Pollution and Water Quality: Toxins and excessive nutrients are pollutants that can greatly influence water quality. **Point source pollution** can be traced to a central point or location, such as a factory. **Nonpoint source pollution** comes from diffuse sources within a river basin, such as lawns, farms, parking lots and roads. Runoff laden with excess nutrients (such as from fertilizer) can cause algal blooms, which can lead to fish kills. (As bacteria decompose the algae, they rapidly deplete the water of dissolved oxygen needed by fish.) Toxins in runoff can have acute effects (killing organisms immediately) or chronic effects (accumulating in the food chain).

MATERIALS

- ~ River Health Score Sheets (1 per student)
- ~ Sets of River Health Topic Cards (1 per group)
- ~ Tape
- ~ Colored printer paper or card stock: yellow, green, red, blue

PREPARATION

Prior to the lesson, make copies of each page of River Health Topic Cards using the color of paper specified. Cut them out and sort them (each set should contain a copy of every card). Also, visit the Web sites listed in *Additional Resources* to gather information about North Carolina's river basins (for “Elaborate” activity).

engage ➤ Ask students how people know if rivers are “healthy.” (*Responses might include: The water looks clean, there are lots of fish living in it, there is no trash.*) Tell them they will be learning about what factors influence whether a river is fit or unfit for humans, fish, wildlife and plants and then will work in groups to prepare “score cards” for rivers. [Show Chapter 3 of the video.](#)

explore ➤ Discuss the key indicators of a river’s health. It may be helpful to list key words on the board.

For a follow-along viewing guide for students, see Viewing Guide 3.

River photograph courtesy of N.C. Division of Tourism, Film and Sports Development.

Divide students into groups of threes or fours and hand out a River Health Score Sheet to each student.

Give each group a set of color-coded River Health Topic Cards.

Game Rules: Students place cards face down in stacks of like colors. Starting with the blue stack, students draw cards one at a time. The first student draws a card and reads it to the group. Based on the information on the card, the group decides a “health score” for the card on a scale of 1 to 4 (1= very poor health, 2= poor health, 3= good health, 4=excellent health). The student then writes the score on the topic card and tapes the card to his or her River Health Score Sheet.

After everyone in the group has drawn and discussed a blue card, the process is repeated for the other three stacks of cards.

When all the groups have finished filling out score sheets, each student averages his or her health scores to estimate the overall health of that river.

explain➤ Ask students to decide who in each group has the healthiest river and why. Ask them to decide which river in their group is least healthy and why. Have students from each group share their conclusions. Students should give details to support their reasoning. Discuss the conclusions with the class.

elaborate➤ Have students choose a river basin in North Carolina to research and create a brochure or poster on the health of the river to distribute in the community.



Striped bass photograph by N.C. Wildlife Resources Commission.

evaluate➤ Have students write a one- to two-paragraph summary of the health of their river based on the collective description of the river from the River Health Topic Cards. Paragraphs should include specific details from the topic cards. Collect the River Health Score Sheets and paragraphs to assess students’ understanding.

Teacher's Notes:

BEYOND THE CLASSROOM

- Arrange a day trip to the nearest major tributary in your river basin to observe biodiversity and water quality. Arrange for a representative of the N.C. Department of Environment and Natural Resources or a land conservancy group to meet your class to explore water quality issues firsthand.
- Arrange a trip to a water treatment plant or a sewage treatment facility to see how our society depends on river basins for our water needs.
- Have students research organizations doing wetlands conservation work in their river basin.

Additional Resources:

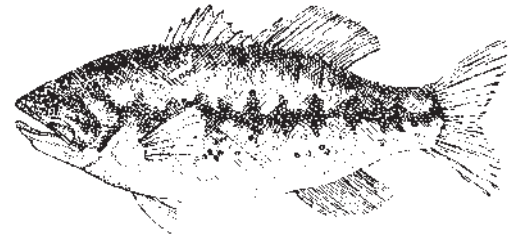
Discover North Carolina's River Basins, published by the N.C. Office of Environmental Education, is available for download at <http://www.ee.enr.state.nc.us/public/ecoadress/riverbasins/riverbasinbooklet150dpi.pdf>.

N.C. Office of Environmental Education Web site • <http://www.ee.enr.state.nc.us/ecoadress.htm> • Click on the interactive map to download brochures on each of North Carolina's 17 river basins.

Conservation Trust for North Carolina • <http://www.ctnc.org> • Links to land trusts doing conservation work in North Carolina.

Yellow Cards

Biodiversity and Indicator Species



A fish-consumption advisory is issued for numerous sections of your lower river basin due to the discovery of dioxin in certain fish. Dioxin is a toxic compound shown to have adverse health effects on humans and wildlife. It is a byproduct of industrial processes and can also be released by burning trash.

Health Score: _____

A strong effort has been made to restore the health of a section of your river in a large city. A recent study of fish shows a rebound in the populations of logperch, a federally endangered species.

Health Score: _____

PCB, a toxic chemical compound once used in electrical equipment, is found in fish in a major tributary in your river basin. The N.C. Department of Health and Human Services issues a health advisory that recommends limiting consumption of these fish.

Health Score: _____

A striped bass that was tagged by a wild-life biologist on your river in North Carolina is caught and released by a fisherman in Maine. Later, an angler in New Bern catches, reports and releases the same fish, demonstrating that it is returning to its spawning waters.

Health Score: _____

Your river has a total of seven dams between its headwaters and its mouth. These dams stop the migration of anadromous fish, thus decreasing the biodiversity in your river basin.

Health Score: _____

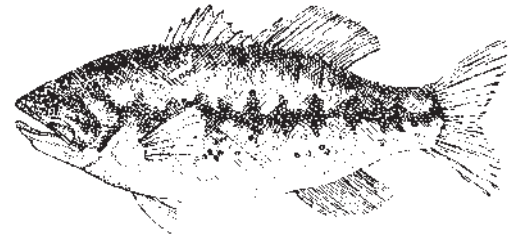
After years of restoration work, including efforts to improve water quality, larger populations of striped bass are being recorded in your lower river basin.

Health Score: _____

 Cut along dotted lines.

Green Cards

Vegetative Buffer Zones



Numerous new construction sites are located along a river in your upper river basin. Poor construction site practices result in muddy runoff and sedimentation in tributaries downstream.

Health Score: _____

A North Carolina land conservation group acquires 10,000 acres along your river. The group pledges to preserve the land as forest and wildlife habitat.

Health Score: _____

A paper company sells 2,000 acres of timberland to private developers. The paper company had been using the land for long-term timber farming, but the land may now be developed, increasing runoff and erosion in your watershed.

Health Score: _____

A state university is working with farmers and developers to replant native trees in vegetative buffer zones along creeks and headwaters in your river basin.

Health Score: _____

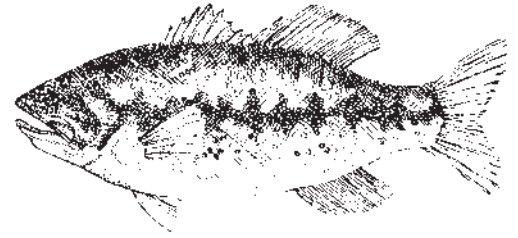
Two cities in your watershed become designated as "Tree City USA" sites. They are now part of the growing urban forestry movement that is helping to preserve green space and prevent runoff in urban areas.

Health Score: _____

 Cut along dotted lines.

Red Cards

Pollution



A large city in your watershed works to improve water quality. Water in your river, which is downstream of the city, is now much cleaner than in past years—due to lower levels of human and animal wastes and more tightly regulated industrial discharges.

Health Score: _____

New state regulations require pollution control along roadways. Enforcement of the regulations protects wildlife by reducing the amount of roadside trash that enters streams through stormwater drains.

Health Score: _____

Fertilizers from farm runoff cause an algal bloom in your river. As the algae die off, oxygen-consuming bacteria break down the algae. This causes a fish kill due to decreased dissolved oxygen in the water.

Health Score: _____

Poultry farmers and hog farmers in your river basin are required to reduce and treat raw animal waste before it is allowed to flow into the river.

Health Score: _____

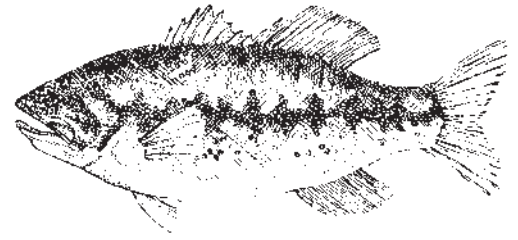
Your river is designated as a National Wild and Scenic River by the federal government. This designation will prevent future dam construction and ensure that water quality is maintained in the designated sections.

Health Score: _____

 Cut along dotted lines.

Blue Cards

Dams and Flooding



A new dam is built on your river. Hydroelectric power from the dam helps to address increased demand for electricity. However, the dam disrupts the natural flooding process that helps distribute nutrients in the river's floodplain.

Health Score: _____

A new management plan has been put in place for three dams along your river. This plan provides for improved drought management and flood control. It also improves water quality downstream and helps migratory fish species by providing fish passages and spawning releases.

Health Score: _____

Drought in your river basin leads to lower water levels. Because of less water, pollution from factories, farms and cities is more concentrated.

Health Score: _____

Due to historic flooding and low rates of development, the lower floodplain of your river basin is relatively untouched. These conditions provide important habitat for migratory birds and other wildlife, including black bears, bobcats and foxes.

Health Score: _____

Dams on your river have altered the volume and cycles of flooding. Due to decreased flooding in your lower river basin, beech and birch trees are starting to replace cypress and tupelo trees, which need standing water for three-fourths of the year.

Health Score: _____

 Cut along dotted lines.

Name _____ Teacher _____
Date _____ River Score _____

River Health Score Sheet

Dams and Flooding

Biodiversity and Indicator Species

Pollution

Vegetative Buffer Zones



River photograph by N.C. Wildlife Resources Commission.