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LESSON:

Streamside Schematic

Summary: New long-term research of small streams shows that streamside vegetation and biological processes "in stream" help reduce pollutants that damage water quality. Students create and illustrate a diagram showing roles of various flora in minimizing runoff contamination.

EHP Article: "Streamside Solution," *EHP Student Edition*, June 2005, p. A156
http://ehp.niehs.nih.gov/docs/2005/113-3/forum.html#stre

Objectives: By the end of this lesson students should be able to:

1. explain the role of streamside vegetation and "in-stream" processes in the removal of common water contaminants,
2. list some causes of stream pollution and related environmental degradation,
3. describe and sketch types of plants that comprise a stream eco-system,
4. (optional) identify local plant species that inhabit stream areas.

Class Time: 2 hours or 60 min. if students do part as homework

Grade Level: 9–10

Subjects Addressed: Environmental Science, Biology, Ecology

Prepping the Lesson (30 minutes)

INSTRUCTIONS:

1. Read the article "Streamside Solution" and review the Student Instructions and Assessing the Lesson sections.
2. Determine whether students will be filling in the diagram with general plant names (e.g.., trees, woody vegetation) or species specific to a region (e.g., cypress, fire bush). If students will be using specific local or regional plant names, it may be necessary to locate some resources that provide these names and possibly photos to enhance students' ability to draw these on the Streamside Schematic.
3. If the assignment will be completed in class, provide colored markers or pencils for the students.

MATERIALS (per student):

- One copy of the article "Streamside Solution"
- One copy of the Student Instructions
- Colored pens or pencils
- Field guide or photos of local fauna (optional)

VOCABULARY:

Algal bloom
Catchment
Debris
Entomology
Phosphorus
Nitrogen
Sediment
Watershed

BACKGROUND INFORMATION:

Although a regular supply of nutrients is necessary for the survival of all organisms, high concentrations of nitrogen and phosphorus resulting from overapplication of fertilizer and/or sewage overflow can disturb the normal balance of energy consumption within a stream ecosystem. Large blooms of (sometimes toxic) algae can appear, using up the available oxygen in the water and causing fish and other plant life to die off. In the standard "hydrology cycle," the role of small streams has generally been downplayed. These minor tributaries' only role was thought to be carrying water to larger water bodies such as lakes. Contaminants that entered these small streams were thought to progress downstream without much chemical or biological transformation. Based on this prior assumption, environmental protection efforts have attempted to insulate large

drinking water catchment areas, or "watersheds," from development, while streams have been the subject of little environmental regulation. Research cited in "Streamside Solution" is just one more indication that protection of the whole stream ecosystem can provide a valuable buffer zone for the protection of water quality.

There is a growing understanding of the role that intact ecosystems play in protecting human health. One of the services that ecosystems provide to humankind is the natural filtration of ground and surface water. Many areas depend on surface water for drinking water supplies. In areas with excess nutrient runoff, algal blooms can release potent toxins into the water, toxins that are not adequately filtered by current water treatment processes. Research has shown an association between drinking water with algal toxins and increased rates of liver and colon cancer. Human activity has vastly increased the amounts of nitrogen and phosphorus entering the water, especially since the development of synthetic fertilizers in the 1950s. It is estimated that levels of phosphorus that reach marine waters from runoff are three times higher than "natural" or pre–synthetic fertilizer levels. Although phosphorus levels have begun to drop due to the removal of phosphorus from consumer products like detergent, it is estimated that nitrogen dumping will continue to increase.

RESOURCES:

Environmental Health Perspectives, Environews by Topic page. Choose Ecological Change, Natural Resources, Remediation (Air, Soil, and Water), Sustainable Development/Conservation, Water Pollution, http://ehp.niehs.nih.gov/topic

Stream Biology and Ecology, an excellent review of stream science, search under "Ecology," http://chamisa.freeshell.org

Green Facts, ecosystem change, protection. Search under "Ecosystems," http://www.greenfacts.org

Implementing the Lesson

INSTRUCTIONS

1. Hand out the article to students and allow them to read it.
2. Hand out the Student Instructions (including the Streamside Schematic Terms and the Streamside Schematic). The activity should be done individually. You may require students to research specific plant names to be used instead of the general terms, although no additional reading is necessary to properly place the general terms in the diagram.
3. If students will be filling in the plant names of local species, the teacher should give this instruction and provide either materials (such as a field guide) or resources for the students to find out these names on their own.
4. Discuss and summarize with the students what they have learned from this activity.

NOTES & HELPFUL HINTS:

- It is important to note to students that only 20–30% of the studied nutrients were broken down by the various processes described. Minimizing nutrient runoff remains key to protecting surface water quality.
- This assignment could be done in conjunction with a field experience at a local stream or as a follow-up to a unit on a specific stream or water-based ecosystem.
- Alternatively, the class as a whole could create a bulletin board display of the streamside schematic, even using photos to illustrate various plant types and runoff sources.

Aligning with Standards

SKILLS USED OR DEVELOPED:

Communication (note taking, oral, written—including summarization)
Comprehension (listening, reading)
Tables and figures (creating, reading)

SPECIFIC CONTENT ADDRESSED:

Unifying Concepts and Processes Standards

- Systems, order, and organization
- Evolution and equilibrium
- Form and function

Life Science Standards

- Interdependence of organisms
- Matter, energy, and organization in living systems

Science in Personal and Social Perspectives Standards

- Personal and community health
- Natural resources
- Environmental quality
- Natural and human-induced hazards

NATIONAL SCIENCE EDUCATION STANDARDS MET:

Plan an inquiry-based science program

- Develop student understanding, and nurture community of science learners
- Work within and across disciplines and grade levels

Guide and facilitate learning

- Support inquiries when interacting with students
- Model inquiry, curiosity, openness to new ideas and data, and skepticism

Ongoing assessment of teaching and student learning

- Use multiple methods, and systematically gather data about student understanding and ability
- Report student achievements and opportunities to learn

Create learning environments that provide time, space, and resources for learning science

- Structure time to allow extended investigations
- Create a setting that is flexible and supportive of inquiry
- Make tools, materials, media, and resources available to students
- Use resources outside of the school
- Engage students in designing a learning environment

Develop communities of science learners that reflect the intellectual rigor of scientific inquiry, and attitudes and social values conducive to scientific learning

- Give students a voice in decisions, and require students to take responsibility for the learning of all members of the community
- Nurture collaboration among students

Actively participate in the ongoing planning and development of school science program.

- Participate in decisions concerning the allocation of time and other resources to the science program

Assessing the Lesson

Since the processes described in this article are not yet clearly understood in great depth, teachers should allow flexibility in interpreting the Stream Schematic Terms described in this article and where they are placed on the Schematic. The main point to look for is an understanding of the multilayered system which maintains nutrient balance for the long-term survival of the stream's flora and fauna. Even things which seemingly would have little to do with water quality (such as branches and fallen leaves) actually do appear to have a role in the stream ecosystem.

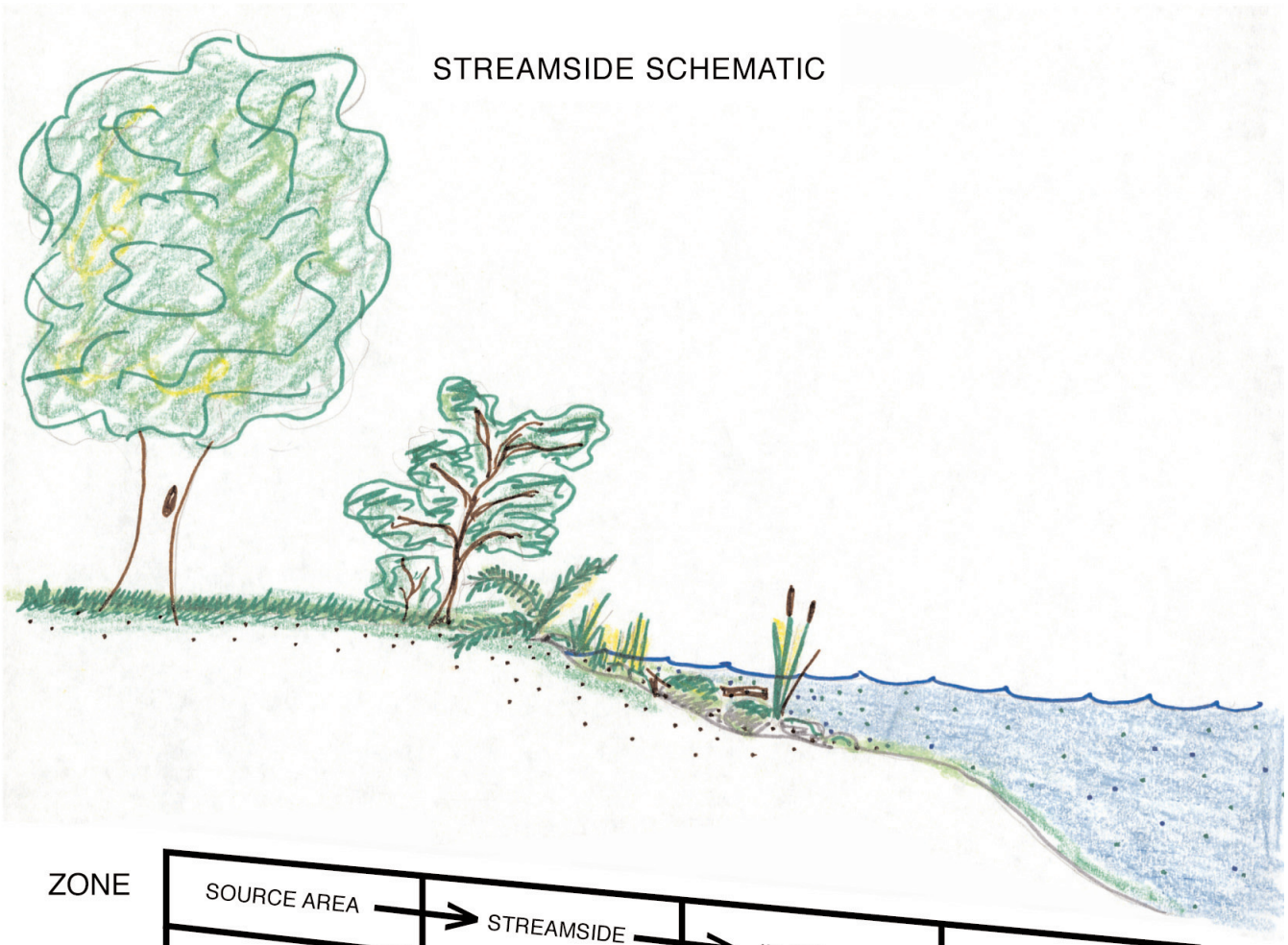
Streamside Schematic Answer Key

- Zones should be placed in the diagram as follows from left to right: Upland Source Area, Streamside, In Stream, Large Water Body

Processes (Flora) should be arranged as follows:

- Upland Source Area: e, i (trees, crops, sod)
- Streamside: a, b, d, f, h (trees, woody vegetation, ferns, grasses, moss, soil microbes)
- In Stream: c, h (algae, moss, rushes, water microbes)
- Large Water Body: g (algae, water microbes)

See sample for correctly completed and illustrated Streamside Schematic:



ZONE	SOURCE AREA →	STREAMSIDE →	IN-STREAM →	LARGE WATER BODY
PROCESSES	e, i	a, b, d, f, h	c, h	g
FLORA	Trees, crops, sod	Trees, woody vegetation, ferns, grasses, moss, soil microbes	Algae, moss, rushes, water microbes	Algae, water microbes

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Student Instructions: Streamside Schematic

Step 1: Read the article "Streamside Solution," *EHP Student Edition*, June 2005, p. A156.

Step 2: Using the Streamside Schematic Terms below, fill in the boxes of the "Streamside Schematic" on the next page with the processes that may occur in each zone. More than one term can go in a given box.

Step 3: Illustrate your diagram by drawing in the appropriate types of plants (flora) above each labeled zone where they would appear.

Streamside Schematic Terms (in random order)

Processes:
a) Soil microbes fix metals, break down nutrients
b) Vegetations' roots limit erosion
c) Debris slows water flow
d) Shade provided
e) Sewage overflows
f) Leaves, branches dropped
g) Low surface-to-volume ratio limits biochemical activity
h) Organic material consumed by microbes, transforming nitrogen and phosphorus
i) Addition of nitrogen and phosphorus onto pasture, lawn

Flora:
Crops
Soil microbes
Moss
Trees
Algae
Sod (lawn grass)
Woody vegetation
Rushes
Ferns
Grasses
Water microbes

National Institute of Environmental Health Sciences
Community Outreach & Education Program

STREAMSIDE SCHEMATIC