What Happens When it Gets There? (Learning Experience #2)
Lesson Plan

Overview
Students research the steps used in a modern wastewater treatment plant to remove sediments, nitrates and phosphates prior to the water for their homes is released into a receiving waterway. Groups will research the structure and function of a septic tank, then compare it to the process and effectiveness of a wastewater treatment plant.

Lesson Essential Question: How are pollutants removed from wastewater before it is released into a waterway?

Objectives
Students will:

- work productively as a part of a project team.
- use a variety of resources to investigate the background information necessary for this project.
- research and summarize information about how wastewater is treated in their region.
- discover the cost of various forms of wastewater treatment.
- design and present a summary of their research to their classmates.
- keep accurate, complete records in a journal

Materials needed for *What Happens When it Gets There*

- A packet containing one copy of each of the following documents per group:
  - *Primary, Secondary and Tertiary* graphic organizer sheet (Student Sheet #1)
  - *Removing Nitrogen and Phosphorus* graphic organizer sheet (Student Sheet #2)
  - *Septic System* graphic organizer sheet (Student Sheet #3)
  - Student instructions for *What Happens When it Gets There?*
- Notebooks or small binders or folders to be used as journals (one per student)
- Computer with internet access for each group.
- Chart paper and markers

Grade Level 8-12

Subject Areas
Environmental science, government, language arts, economics, chemistry

Timeline
Teacher preparation: 60 minutes
Learning Experience: 90-120 minutes

Setting
Classroom, library or computer lab, field trip to a wastewater treatment plant (optional), school lab (if making the sedimentation tank model)

Skills
Research in print materials and on websites, organize information, communicate to team, present information to classmates

Vocabulary
Anaerobic bacteria, drainfield, effluent, impervious, nitrogen, phosphorus, primary, secondary, sediment, sewage treatment, septic system, sludge, stormwater, tertiary, wastewater

*** Optional Introduction to the Learning Experience**

You may introduce Learning Experience #2 with a model of a sedimentation tank similar to those used today in the primary treatment of municipal wastewater. If students conduct water quality tests on samples from the model, they will discover why this earliest form of wastewater treatment became inadequate when population in the Chesapeake Bay watershed doubled from the 1950's through the present day. Current state and federal regulations require removal of most pollutants before treated water is released into waterways and estuaries. Directions for constructing the model are included on the website. Instructions for water quality tests are found in the *Water Quality Tests Unit.*

Advance Preparation Needed

- **Make copies of the student sheets listed, one for each project team.**
- **Provide chart paper and markers or access to technology that will allow students to present their ideas to their classmates.**
- **Arrange for a field trip to a local wastewater treatment plant if possible. Collect water samples for water quality testing.**

Procedure

1. Post the essential questions for the scenario and for Learning Experience #2 at the top of a piece of chart paper. You will add the class answers for Learning Experience #2 at the end of the activity.

2. Introduce this learning experience by asking students to respond to the following question in their science journals:
   - *What do you think should happen to water between the time it leaves the sink or toilet at home and when it enters the groundwater or a local waterway that people use for drinking or recreation such as swimming or fishing?*

3. Assign students to project teams of three or four members. Each team member should have a task: researcher (may have two of these), recorder, communicator. Grouping students with a variety of abilities will promote peer teaching and differentiation of instruction.

4. Ask students to share their answers to the question #2 with the members of their team. This is a good time to have students construct a model of a sedimentation tank and test its effectiveness. Teacher and student procedures and student data sheets for this optional, but recommended, activity can be located on the website.

5. Direct the teams to research the processes that occur in a typical municipal wastewater treatment facility. Students will discover the reasons for each of the primary, secondary and tertiary procedures as the group completes provided in *Primary, Secondary and Tertiary* graphic organizer (Student Sheet #1). Remind your students that sometimes contact with a person who has expertise in a subject is a good source of information. The recorder in each team should keep track of the information found and cite the sources of the information.

6. Instruct students to learn at least one technique that is used to remove excess nitrogen and phosphorus from the treated effluent before it is released into a waterway. This information will be recorded in *Removing Nitrogen and Phosphorus* graphic organizer (Student Sheet #2).

7. Students will discover the workings of on-site septic systems and compare them to the procedures followed in a municipal sewage treatment plant. This information will be recorded on the *Septic System* graphic organizer (Student Sheet #3).

8. If class time is limited, steps 5, 6 and 7 may each be assigned to only one or two teams with each team reporting its findings to the rest of the class.

9. Contact the municipal sewage treatment plant in closest proximity to the school and request a copy of the plant's most recent operating budget. Each team should calculate the cost of wastewater treatment per person or per household per year and discuss actions that could be taken by their local government and individual homeowners to potentially reduce the cost to all stakeholders. The learning experience will culminate in a writing assignment with the group's action plan clearly stated in one of the following formats: a letter to their local governing body or a letter to the editor of the local newspaper.

Additional Resources for the Learning Experience:

Chesapeake Bay Foundation	http://www.cbf.org/
Chesapeake Bay Program	www.chesapeakebay.net/
Environmental Protection Agency	http://cfpub.epa.gov/npdes/home
MD Department of the Environment	http://www.mde.state.md.us/Pages/Home.aspx
NOAA	http://www.noaa.gov/
USGS	http://ga.water.usgs.gov/edu/wwvisit.html

Local and Regional Resources

- representatives from a local or regional wastewater treatment facility
- representatives from a local government or taxing authority
- representatives from a local company that installs and services septic systems
- representatives from a state's environmental quality agency
- representatives from a local sanitary engineer