Poop to Power (Learning Experience #2)
Lesson Plan

Overview
In this learning experience students are challenged to consider the many variables that affect the disposal of chicken manure in a way that is good for water quality. Students will calculate the amount of manure produced by the Bay watershed's chickens, then design and set up a model of some of the variables that influence the actions of a farmer.

Lesson Essential Question: In what ways can farmers manage the manure produced by their chickens in a way that maintains good water quality?

Objectives
The 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, including road and land use maps.
- keep accurate, complete records in a journal.
- design an experiment that will test a hypothesis.
- communicate ideas and results to other team members and classmates.

Materials for *Poop to Power* (Learning Experience #2)
- One packet containing a copy of each of the following documents per group
  - *Nutrient Overload* (Student Sheet #1)
  - *Anaerobic Digester* Bacterial Burps (Student Sheet #2)
  - *What to Do with the Doo-Doo* Lab (Student Sheet #3)
- A packet containing the water quality testing student pages listed in the *Water Quality Testing Unit*

Target Grade Level: Grades 8-10

Subject Areas: biology, chemistry, mathematics, environmental science

Timeline

Teacher preparation: 30 minutes
Learning Experience: 90 minutes

Setting: Classroom, laboratory or computer lab

Skills: communicate to team and classmates; organize information; research from print materials and on websites; design a controlled experiment; perform water quality tests on specified samples

Vocabulary: anaerobic digester; biogas; methane; nitrates; phosphates; potash

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Procedure

1. Review with your students the quantities of chickens that must be raised in the Chesapeake Bay Watershed in order to meet the population's demands. Ask them to list in their journals everything that is needed to raise a chicken from fertilized egg to adult size. Make a list from their journals for the class. If no one suggests cleaning up the poop on a regular basis, remind them that, like humans, this is necessary if the flock is to remain healthy and the neighbors friendly.

2. Tell students that they will be working in a project team of three or four. Each team member will have a task: researcher (may have two of these), recorder, communicator. They all will be responsible for their team's work.

3. Ask teams to complete the questions in *Nutrient Overload* (Student Sheet#1). If the students' mathematical calculations are correct, they will have a good picture of the amount of manure that must be managed by chicken farmers in the Bay watershed. Ask several teams to contribute their answers to a class chart.

4. Facilitate a class discussion around the team answers to questions #3 and #4. Challenge students to think of their answers in terms of cost to the farmer. Are they, as consumers, willing to pay a bit extra for the chicken that they eat in order to improve manure disposal methods?

5. *Anaerobic Digester* (Student Sheet #2), explains the basic workings of an anaerobic digester similar to the one that is described in the news article at the beginning of this scenario. Ask students to review the graphic organizer with the members of their team and answer the questions. Instruct the students to write a sentence or two in their science journals about the connection between the need to dispose of chicken manure and the economics of farming.

6. The lab in *What to Do with the DooDoo* (Student Sheet #3), asks students to play the part of a chicken farmer who must make decisions about disposing of tons and tons of chicken manure from his or her farm warehouses. Students will practice their understanding of a controlled experiment and management of multiple variables as they design and carry out a study that will determine how a variety of environmental conditions affects the action of chicken manure fertilizer on farm fields. Depending on the amount of time and space that you have available, you may take this activity as far as the planning stage and ask your students to predict the results, or you may have them actually carry out their designs over several weeks.

7. Facilitate class presentations by student teams in which the members explain the team's experimental designs and their results, if appropriate. All team members should play a role in the group's presentation. During the presentations, the other teams should be encouraged to ask questions and critique (positive and negative) the designs.

8. Optional: Anaerobic digesters that dispose of manure and other farm waster are gaining in use by dairy and swine operations, especially due to increasing calls for control of agricultural sources of non-point source pollution of local waterways. Ask your students to investigate whether there are anaerobic digesters in use by local farms in your region. Providing students with opportunities to investigate use of various nutrient management techniques employed by local farms experiences could enhance the students' understanding of the connection between their personal dietary choices and water quality measures. Resources for guest speakers or information include, but are not limited to: inviting an agricultural agent (county extension agent or staff from your local USDA Soil Conservation Service) or a virtual field trip or a presentation by farmer(s) who are employing the use of anaerobic digesters as a tool for managing manure created by livestock.