11th Grade: Chemistry

1) Introduction: Service-learning is an excellent way to teach Science. Service-learning emphasizes a "hands-on" experiential approach as a means of connecting academic learning to real-world applications. This approach is an effective way of engaging students in scientific concepts, which can sometimes seem abstract. Service-learning brings students into direct contact with real-world community problem-solving and by framing the scientific method as a problem-solving tool itself, students can begin to see the impact science has on the world around us.

2) Definition of service-learning:
Service-learning is a form of teaching and learning that engages students in meaningful service activities in their schools and communities as part of the standard academic curriculum. Integrated into (but not limited to) the school day, service-learning connects young people with structured activities that address human and community issues, and that provide opportunities for increased student academic engagement, civic responsibility, personal and social development and the acquisition of critical thinking skills.

The following concepts are central to good service-learning practice. Evidence of these elements as well as their alignment with Pennsylvania state standards and the School District's promotion/graduation requirements are key to model practices.

- **Student voice in choosing, developing and implementing a project:** Service-learning works best when students are involved in something relevant and meaningful to them. Encourage student participation and sharing of responsibility in all aspects of a project.
- **Identification of genuine need:** The "community" identifying the need can be the class, the school, the neighborhood, a community partner, the city, etc. Goals for addressing problem have the support of designated community and clearly defined goals.
- **Mutual benefit for students and community partner(s):** Students acquire knowledge and skills, and in return contribute a short or long-term solution to the problem. Sensitivity to needs and/or limitations of all parties is important.
- **Sustained student involvement:** Length of project can vary but should span a minimum of 8 weeks. Projects with greater richness and complexity may last a semester or an entire school year.
- **Rigorous, multidisciplinary research:** Projects should meet content standards in at least two academic disciplines and demonstrate writing and research competence. Research can explore root causes/effects, potential solutions or public policy related to the problem.
- **Ongoing reflection:** Reflection activities should occur throughout the project. They reveal cognitive and affective learning and can incorporate speaking, writing and/or multimedia strategies.
- **Assessment of student learning and project impact:** Evaluates academic, personal and social development as well as whether stated community need has been

met/addressed. Rubrics and other authentic assessment tools are preferred.

- **Culminating presentation:** Presentations or exhibitions of learning allow students to demonstrate what they have learned for the benefit of others, including community partners.
- **Final celebration:** Positive change and collaboration is hard work! Acknowledge and celebrate the contributions and accomplishments of all who were involved.

3) Sample Project Description

A sample project description is included for your convenience. This particular project is not required, however, it is designed to fit the core curriculum for this subject and it reflects a common issue or problem in many of Philadelphia's communities. Teachers are encouraged to transform this project and take it in new directions.

Waste Management: Pennsylvania is one of the largest importers of trash. Trash from other states fills our landfills. Yet, research has shown that landfills are not safe for long-term waste disposal. Landfills leak toxic chemicals into our air and water.

Students will research the chemical processes at work in landfills (3.4.12 A-B, 3.6.12 A), everything from the decomposition of various forms of waste, the release of gases from the landfill, and the contamination of ground water caused by the landfill. The landfill will be a focal point from which to engage students in the course content, i.e. chemistry.

As students study the problems inherent with waste management, they will work with a local health, environmental, and neighborhood-based groups to design and implement a waste reduction plan (3.1.12, 3.2.12 C-D, 3.8.12). This may take several forms such as a school- or community-wide recycling program, the creation of a school-wide compost system, an educational campaign aimed at reducing household waste, or the planning of an Earth Day celebration. Students may do a combination of the above ideas or implement their own.

4) Suggested Lessons/Activities:

Situating Students in the Problem

- What happens to the trash we throw away? Where does it go and how does it get there? Perhaps take students on a trip to a local landfill.

Research

- What happens inside a landfill? How do materials decompose? What does and what doesn't? What are the strengths and weaknesses of the different types of landfill liners (3.6.12 A, C)? How does methane gas is converted into energy? What is the process by which leachate is treated to drinking water standards (3.5.12 D)? What makes a good site for a landfill (3.5.12)?
- Explain all the chemical processes at work in landfill.
- Study "Trash to Energy Technology". Some questions to consider are (not necessarily in this order):
    - What is an integrated waste system?

  - Why do we need so many methods of disposal?
  - What are the pros and cons of each method?
  - How are the various waste facilities managed?
  - What government entities oversee the various facilities?
  - How are the facilities permitted?
  - What is the criterion for permitting the facilities?
  - How are methane and leachate produced?
  - What is the water and air quality is area where waste facilities reside in comparison to areas that don't have these facilities?
- What public policy solutions have been put forth with regard to landfills? Why are there competing ideas? (3.2.12 A) How have they changed over time?

Creating a Solution

- This will be specific to the type of pollution and contamination your students identify. They may want to focus on overall waste reduction (i.e. conservation and/or recycling) or they might want to focus on a particular hazardous material such as batteries or computer monitors.

Assessment

- Involve students in determining if their intervention is successful. (3.7.12 B)

5) Sample Rubric

Rubrics can be used at all steps of the service-learning process. Each activity can have its own rubric, and you can use a cumulative rubric to assess student work at the end of the project. Here is a sample rubric that covers a trip to a local landfill. This rubric was created on Rubistar, a free web-based program which can be found at http://rubistar.4teachers.org.

See attached

6) Multidisciplinary Connections

Math – calculations of decomposition rates,
English – report writing; oral presentations
Social Studies – How have our methods for waste disposal changed over time? How has our increasing knowledge of chemical processes led to changes in landfill design and construction?

7) Where to get more info?

Environmental Protection Agency: http://www.epa.gov
Pennsylvania Department of Environmental Protection: http://www.dep.state.pa.us/

8) Local Partners:

ActionPA: http://www.actionpa.org
Cobbs Creek Environmental Education Center: http://www.nlreep.org/ccceecevent.htm
Delaware Valley Earth Force: http://www.earthforce.org/delval/

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This curriculum insert was developed by Hillary Aisenstein, Director of the Philadelphia Higher Education Network for Neighborhood Development (PHENND), as part of a collaborative effort between the School District of Phildelphia and several local community-based service-learning organizations, designed to integrate service-learning with the new core curriculum.