The development and implementation of public outreach in the context of a NSF CAREER Award

Matthias Brewer

University of Vermont

What initiated this outreach effort?

NSF Broader Impacts Review Criteria:

> The *Broader Impacts* of a proposed activity are important considerations in advancing the NSF Mission: *"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes"* (NSF Act of 1950).

Faculty Early Career Development Program (CAREER Award):

> *Foundation-wide activity that offers … awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations. Such activities should build a firm foundation for a lifetime of leadership in integrating education and research.*

Steps taken months before grant due:

1) Sought advice from colleagues about educational component:

Steps taken months before grant due:

1) Sought advice from colleagues about educational component:

"Make it real" (i.e. it is important to take seriously)

Steps taken months before grant due:

1) Sought advice from colleagues about educational component:

"Make it real" (i.e. it is important to take seriously)

"Everyone proposes to develop a course"

Steps taken months before grant due:

1) Sought advice from colleagues about educational component:

"Make it real" (i.e. it is important to take seriously)

"Everyone proposes to develop a course"

"Should have some form of measurable outcomes"

Steps taken months before grant due:

1) Sought advice from colleagues about educational component:

"Make it real" (i.e. it is important to take seriously)

"Everyone proposes to develop a course"

"Should have some form of measurable outcomes"

"Should have some tie to research…

but does not need to be directly related"

Steps taken months before grant due:

1) Sought advice from colleagues about educational component:

"Make it real" (i.e. it is important to take seriously)

"Everyone proposes to develop a course"

"Should have some form of measurable outcomes"

"Should have some tie to research…

but does not need to be directly related"

"Propose something you want to do because we'll expect you to do it!"

Educational Topic Identified

Green Chemistry!

- Hot topic
- Something I'm interested in
- Aligns well with UVM's mission
- Easy to add to curriculum

Green Chemistry outreach?

Brainstorming about potential outreach opportunities

- What would have impact?
- What is realistic/possible?

Green Chemistry outreach?

Brainstorming about potential outreach opportunities

- What would have impact?
- What is realistic/possible?

- Partner with a local science center to develop outreach materials
  - Who to partner with?
  - Who would develop/present materials?
  - What materials to develop?

Green Chemistry outreach?

Brainstorming about potential outreach opportunities

- What would have impact?
- What is realistic/possible?

- Partner with a local science center to develop outreach materials
  - Who to partner with?

    ECHO Center

    - contacted 1 month before grant due
  - Who would develop/present materials?

    Students
  - What materials to develop?

    ?????

Selling the idea

Info about ECHO included in grant:

- Only science center in area
- Broad reach into the Vermont and Upstate New York communities
- Over 150,000 visitors per year
- Have programs in place to reach disadvantaged citizens through an “open-door” program that makes the science center accessible to all
- Dedicated to educating the community on environmental issues; green chemistry falls nicely inline with their mission
- Employ trained outreach specialists who have expertise in making science accessible to a general audience

Other selling points:

Budgeted $7000 for two undergraduate students to work on the project.

Grant is funded!

Grant is funded!

Panic attack!

“Propose something you want to do because we’ll expect you to do it!”

-NSF Program Officer

Implementing the outreach component

To Do (by summer of 3rd year):

1) Find students to work on project

2) Figure out what to present and how to present it

Implementing the outreach component

To Do (by summer of 3rd year):

1) Find students to work on project (Easy: Just had to ask my class!)

Eliza Aresnault – Chemistry major planning to go into secondary ed!

Michelle Borsavage – Education major focusing on science in secondary ed!

2) Figure out what to present and how to present it (Harder!)

Green chemistry + General public on vacation = Boredom (if not done right)

Gauging the level (must be approachable to wide age range)

Needs to be done with limited resources

Implementing the outreach component

To Do (by summer of 3rd year):

1) Find students to work on project (Easy: Just had to ask my class!)

Eliza Aresnault – Chemistry major planning to go into secondary ed!
Michelle Borsavage – Education major focusing on science in secondary ed!

2) Figure out what to present and how to present it (Harder!)

Green chemistry + General public on vacation = Boredom (if not done right)
Gauging the level (must be approachable to wide age range)
Needs to be done with limited resources

Met with ECHO Staff in October 2009 to focus some ideas:

Need to find topic general public will be aware of
Less emphasis on the molecular details, more emphasis on the concepts
Teach through real life examples

Topic Identified!

Biodegradable plastics: Green Chemistry in action!

- Of current interest to many people
- Can discuss Organic Chemistry in a context familiar to public
- Great way to introduce Green Chemistry concepts and principles
- Promotes chemistry in a positive light (solving an environmental problem)
- Environmental implications pairs well with ECHO'S mission

How it was presented!

Workbench

How it was presented!

Workbench Panels

What is green chemistry?

Green chemistry is the use of a set of 12 principles that reduce the generation of hazardous substances in the design, manufacture, and application of chemical products.

The first principle of green chemistry is that waste prevention is better than waste clean-up.

Two volunteers pick up trash off a beach on Peirce Island in Portsmouth, N.H.

Goals of green chemistry include:

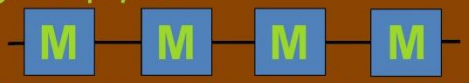
- reducing energy used in chemical synthesis
- reducing or eliminating toxic byproducts
- employing the concept of atom economy in chemical reactions

What are scientists researching?

Biodegradable Plastics

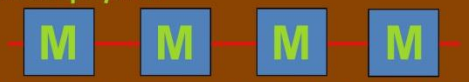
Biodegradable plastics are made of *polymers*, which are chains of repeating sub-units, called *monomers*: M

A non-degradable polymer:



The black links represent carbon-carbon bonds, which are not easily broken down by bacteria. This polymer will last in the environment for a very long time, potentially hundreds of years.

A biodegradable polymer:



The red links represent carbon-oxygen bonds, which are weaker than carbon-carbon bonds. Bacteria are able to break these bonds and use the resulting individual monomers as food.

Are biodegradable plastics the best solution?

Pros:

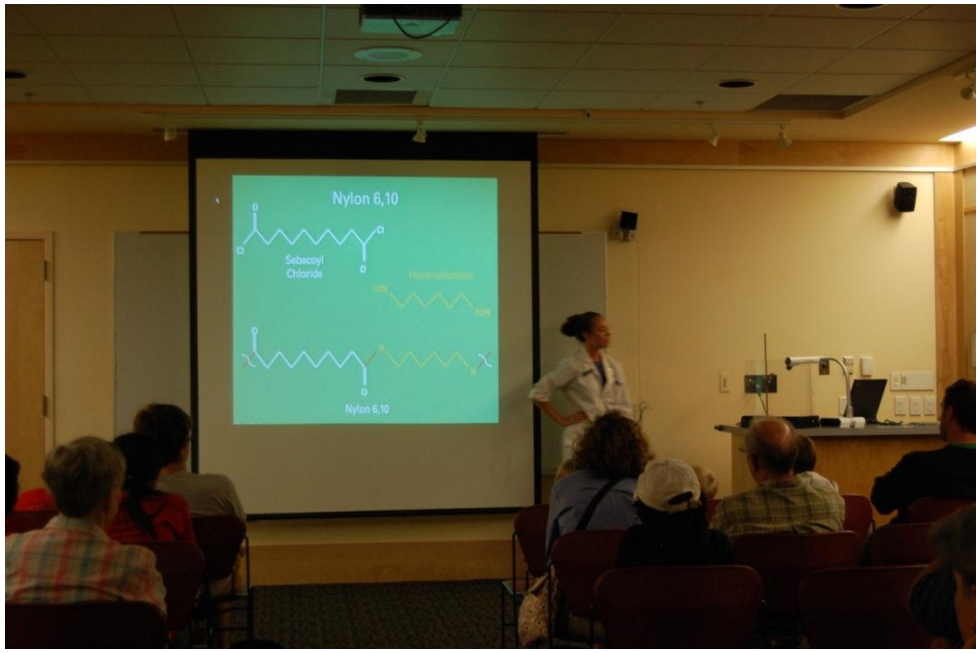
- They do not persist in the environment
- Fewer hazardous reactions are used in their synthesis
- They can be used for a variety of applications (i.e. grocery bags, eating utensils)

Cons:

- CO_2, a greenhouse gas, is a byproduct of degradation
- Landfill environments do not always allow for complete degradation
- They are less resilient than common plastics to harsh conditions (i.e. heat, moisture)

How it was presented!

Daily Presentations by Michelle and Eliza!



Including a demonstration and group participation!

How it was presented!

Plastic Garden

How it was presented!

Meet the Scientist

Presentation
Demonstration
Take home project

Summary

ECHO Center had over 45,000 visitors while our exhibit was on display!

Approximately 400 people directly interacted with Eliza and Michelle at the workbench and over 50% were under 18

Approximately 250 people attended the presentations over the course of the summer

Initially out of my comfort zone…but in the end quite fun and gratifying!

Eliza and Michelle have a great resume builder and are both now pursuing careers in teaching!

Funding provided by: NSF