Abstract: Four experiments and/or activities were used to stimulate student interest in the arena of environmental science. Yeast was grown within a class period to demonstrate population growth. Soil samples, collected beforehand by students, were tested for nutrients and pH. The overflow of non-essential luxuries and non-recyclable packaging materials in our society was demonstrated through the “needs” and “wants” bag activity. Art was incorporated into the curriculum through a visit to a photography exhibit that depicted the recycling of ships. Varying classroom activities in the environmental science classroom made the teaching and learning experience feel more alive and vital to both the instructor and the student.

Key Words: environmental science, yeast, soil testing, pH, nutrient, recycling

Introduction

The following activities were successfully employed in my Ecology and the Environment course for non-science majors at St. Francis College. These exercises could be tailored to courses with similar goals, or serve as a springboard for further ideas for activities.

1. The use of yeast as an organism to introduce population growth.

Materials per student group:

1) 125 ml Erlenmeyer flask (250 ml flasks work as well; however, the experiment takes a little longer)
2) 1 pkg. baker’s yeast
3) 2 sugar packets
4) 1 piece of newspaper
5) large beaker or flask of warm water 40-45°C, dispense 50 ml into each flask
6) hot plate (optional) if you would like to have the warm water ready ahead of time

I needed something to demonstrate population growth and how it could be quite rapid. The majority of the non-science majors, that I have taught, have been resistant to terms such as “exponential growth” so I needed a system that would visually demonstrate a relatively rapid growth within a class period that I would not need to quantify. (Bacterial growth doesn’t occur rapidly enough to demonstrate significant changes during the class period, although inoculations can be done of bacterial cultures in front of the class, left overnight to incubate, and the “cloudiness” as evidence of bacterial growth can be shown to the students the next day.)

Yeast reproducing inside a flask and the subsequent production of carbon dioxide gas make a good demonstration of population growth and decline that can be demonstrated within the class period. This system can also lead to a discussion of global warming because of the carbon dioxide production.

The set-up for this experiment can be accomplished in the ten minutes that are usually available between classes, and it lends itself well to lecture classes of 30 or so. With larger classes, it could be conducted effectively with the help of student assistants. The limiting factor in this experiment is the temperature of the water, which should be quite warm, (40-45°C) but not scalding to the touch -- the yeast will not reproduce as quickly in cooler water. Between classes, I put a piece of newspaper down at each work site (students work in pairs) and place the flask, a package of Bakers yeast, and two sugar packets at each place. Just before class begins, I literally jog to the
nearest bathroom to obtain hot water, fill the flask with steaming water, and pour 50 ml into each of the student’s (and one control) flask. I instruct the students to add a package of yeast and two sugar packets to their flasks and swirl the contents. I point out to them that I am adding the yeast only to my flask. (Another activity that could be included is to have students make microscope slides of yeast.)

I then ask the students a series of questions to which they may or may not know the answers. I write the questions on the board and ask them to discuss them with their partners before volunteering answers.

1. What do they think will happen in their flasks? *(The yeast will grow.)*

2. What is the evidence of this growth? *(The gas production. It could be used also to demonstrate, in a separate experiment, that the correct temperature is necessary for yeast to grow, at a suitable rate.)*

3. What do they think will happen in my flask? *(Nothing.)*

4. Why? *(Because there is no sugar available -- it is a limiting factor in this case.)*

5. What are other limiting factors in this situation? *(Temperature, space, waste production.)*

6. What will happen over time to your experiment? *(It will experience a population crash.)*

7. What is the name for my flask and why is it used? *(A control. It is used to demonstrate, in this case, that yeast require sugar to grow.)*

These questions may lead you to think of other questions such as:

How have human utilized yeast in the past and/or present?

What would happen if you added another species of bacteria or yeast to the flask?

How has an increased production of carbon dioxide over time changed the world?

By the time the class has answered a few questions, the yeast should be producing carbon dioxide at a rate that can be seen by the students, and often the flask will bubble over, hence, the newspaper (Figure 1). At the end of the class, I save a few flasks so I can show the students the “population crashes” that have occurred over time.

![Figure 1. Yeast population growth experiment.](image)

The whole exercise takes around a half-hour. It is popular with the students as it is very visual, and it is a good lead-in to a lecture or discussion of population growth and/or population dynamics.

2. Soil testing

I always thought that learning about soil would be too boring for this class. However, Ruth Beattie of the University of Kentucky demonstrated otherwise. I attended a workshop that she conducted in June, 2000 at Clemson University titled, “Bringing the laboratory into the lecture hall” (Beattie, 2001). She gave us zip-lock bags with spoons, soil test kits, and film canisters and had us test soil for the presence of various nutrients. I bought some Rapitest™ soil test kits from a local nursery and repeated a similar version of the exercise with my students. The kits come with some mixing containers, but you will need to provide beakers, water (tap is fine), test tubes, spoons, and droppers. The students were asked to bring in soil samples and some of each sample was mixed with water in a beaker. We allowed 10 minutes for the soil to settle (the tests work better if you wait longer) and tested some of the liquid for nitrogen, potassium, phosphorus, and pH. The kits come with pre-measured chemicals in capsules, so they are very easy to use. A chart was drawn on the board with the headings: name of student, N, K, P and pH. The students filled in the different qualitative values (low, medium or high) for each nutrient, and the pH was recorded. The values were estimated by comparing the color of the soil/water mixture against the various colored charts available. The kit comes with a chart that suggests which type of plants can grow in which type of soil, so the students were asked to plan a sample garden utilizing their soil. As Ruth says, the students tend to become possessive of and quite interested in their soil!

3. “Needs” and “wants” bag

I got the idea for this exercise from the Instructor’s Resource Manual (Ostiguy, 2000) with the Nebel and Wright textbook “Environmental Science:
the Way the World Works” (Nebel and Wright, 2000). (This manual is provided to the instructor upon text adoption.) This activity always gets a few laughs from the students. I fill a large plastic shopping bag with “junk” from my apartment or office -- souvenirs, small trophies, cheap jewelry, air refreshener spray, deodorant, gum, meat tenderizer, a Frisbee, CD, paper bag, paper cup, Styrofoam meat packing tray, toys, newspaper, flyers, aspirin, comb, make-up, lotion, paper, ribbon, and, of course, a hair dryer. I have the students take turns holding up the various items, and I ask, “Is this item a “need” or a “want”? Most students correctly reply that each item is a “want”, although a few still insist that deodorant is a “need”! We then make a list of “needs” and “wants” on the board. We also have a list of “secondary needs”, and on that list we put many of the “want” items because they are needed as a result of our culture -- newspapers and combs are commonly cited examples. Individual items in the bag can also lead to further discussion, such as: air refresheners are actually a component of indoor air pollution, many of our foods have excess packaging that is non-biodegradable and Styrofoam and plastic wrap are non-recyclable. Hair dryers and other items such as computers and CD players require energy to run them resulting in pollution (burning fossil fuels). The whole point of this exercise is to show the students how much people in developed countries consume, waste, and pollute in their everyday use of commercial goods. People in developing countries make less money than we do, and consequently buy fewer of the non-biodegradable or non-recyclable goods.

4. Integrating art into the curriculum.

Last semester, St. Francis College displayed a temporary art exhibit of photographs “Shipbreaking” by Robert Bailey in the college art gallery. This exhibit happened to coincide with the publication of an article “The Shipbreakers” by William Langewiesche in the August, 2000 issue of the Atlantic Monthly (Langewiesche, 2000). Both the article and the exhibit contained photographs of people from India and Bangladesh doing the dirty, backbreaking work of shipbreaking, which is the recycling of ships. The students visited the exhibit during class time and were directed to write a paragraph describing what they saw in one photograph (there were twenty or so in the exhibit), and how it made them feel about the connection of the photographic subject to the environment.

I typed each of the paragraphs with a different font and made a booklet of the students’ writings. This was presented to the photographer whom I invited to come to the college to give a talk about his exhibit. Mr. Bailey became interested in Bangladesh, when, as a young boy, he read about the intensive flooding that killed 100,000 people. He wondered how this could actually have occurred and he vowed to visit Bangladesh one day. He lived in Bangladesh for a month while photographing, and was able to tell some poignant stories about these peoples’ lives. (Ironically, Bangladesh has recently been in the news again with accounts of flooding that killed thousands.) The students, in this way, were exposed to two points of view; that of the author of the Atlantic Monthly article who felt the people were being gravely exploited by those in the developed countries (from my notes), and that of Robert Bailey, who felt that these people experienced a dignity in their work, even though they suffered hardships.

Other material that I have used for my classes has been derived from museum exhibits--notably the solar energy exhibition titled “Under the Sun: An Outdoor Exhibition of Light” at the Cooper Hewitt National Design Museum (1998), and the permanent Hall of Biodiversity exhibit at the American Museum of Natural History. Past assignments for this course have also included a self-paced trip to the Brooklyn Botanic Garden.

Conclusions

I find that my teaching gets a little stale if I don’t have these “classroom props”-- as one of my students has coined them--which include easy experiments or activities in which students can participate, visits to museums and galleries, and outside speakers. It adds a little color and refreshment to these classes that we teach semester after semester by introducing a new activity, face and/or point of view -- and the students appreciate it.

Literature Cited


