Using Superstitions and Sayings to Teach Experimental Design

Mariëlle H. Hoefnagels

Departments of Botany/Microbiology and Zoology
University of Oklahoma
Norman, OK 73019
Telephone 405-325-5705
hoefnagels@ou.edu

Mariëlle Hoefnagels earned her doctorate in botany and plant pathology from Oregon State University. She is an assistant professor in the Departments of Botany-Microbiology and Zoology at the University of Oklahoma, where she teaches nonmajors biology, nonmajors microbiology, and mycology. This exercise is further described in: Hoefnagels, Mariëlle H. and Rippel, Scott A. 2002. Using Superstitions and Sayings to Teach Experimental Design in Beginning and Advanced Biology Classes. *American Biology Teacher* (in press).

Reprinted From: Hoefnagels, M. 2003. Using superstitions and sayings to teach experimental design. Pages 325-327, in Tested studies for laboratory teaching, Volume 24 (M. A. O'Donnell, Editor). Proceedings of the 24th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 334 pages.

Abstract

The goal of this mini-workshop was to present a simple, intuitive exercise in which students at all levels of biology education can practice with the concepts and terminology of experimental design. In this activity, groups of students are each assigned a different superstition or saying, which serves as the hypothesis to be tested. Each group designs an experiment to test its assigned hypothesis. Then, as an exercise in peer review, each group evaluates the experiment designed by another group.

Introduction

Beginning biology students may be intimidated by science and may benefit from a way to "ease into" experimental design. This exercise is intended to teach biology students the unfamiliar terminology of experimental design in a familiar context: superstitions and sayings. The inspiration for the exercise was the idea that if students intuitively understood the concept they were trying to test, they would focus on *how* to test the hypothesis rather than if the hypothesis was *right.* Students can subsequently apply the concepts they learn in this exercise to experiments more directly related to biology.

Target Student Population

I use this exercise in my nonmajors biology class (enrollment = 80) at the University of Oklahoma; my colleague Scott Rippel has used it as an experimental design refresher in a junior-level biochemistry course at the University of Texas at Austin. It could also be modified for use in high school biology classes.

Sample schedule for a 75-minute class session

- 30 minutes: introduce exercise, show movie clip*, introduce experimental design terminology (hypothesis, independent variable, dependent variable, standardized variable, control, and replication, all in the context of the experiments described in the video clip).
- 20-25 minutes: allow groups of 4-8 students to design experiments. See **Table 1** and **Sample Handout 1.** Each group should have a different hypothesis printed on Sample Handout 1.
- 15 minutes: peer review of another group's experiment. See **Sample Handout 2**, which should be printed on the back of the paper shown in Sample Handout 1.
- 5 minutes: response to peer review (bottom of Sample Handout 2).

* I use a 10-minute clip describing the discovery of a B-vitamin deficiency as the cause of a disease called pellagra (*A Science Odyssey: Matters of Life and Death*, 1998, PBS Home Video). This video clip is useful because of its historical interest and because most students have not heard of the disease and therefore have no preconceived ideas about what the cause of pellagra might be. Any short clip illustrating a scientific discovery would work; Scott Rippel uses a clip from *Monty Python and the Holy Grail* (1991, Columbia TriStar Home Video)!

Table 1. Superstitions used for practice with experimental design.

- An apple a day keeps the doctor away.
- Eating chocolate causes zits.
- Shaving your legs makes the hair grow back more densely.
- A knife placed under the bed during childbirth will ease the pain of labor.
- Drinking coffee will stunt a child's growth.
- If you swim right after eating, you will get cramps.
- If you catch a falling leaf on the first day of autumn, you will not catch a cold all winter.
- If you go outside when your head is wet, you'll catch a cold.
- A red ribbon placed on a child who has been sick will keep the illness from returning.
- A half onion placed under the bed of a sick person will reduce the fever.
- Feed a cold, starve a fever.
- Break a mirror and you will have seven years of bad luck.
- Spit on a new bat before using it for the first time to make it lucky.
- If you blow out all the candles on your birthday cake with the first puff you will get your wish.
- The spouse who goes to sleep first on the wedding day will be the first to die.

Sample Handout 1: Experimental Design

Full names of students designing experiment:

_____

_____

Use this side of this sheet to design an experiment that tests the following superstition:

An apple a day keeps the doctor away.

Your design can be in the form of a list or written description, but it must be readable enough that others can evaluate it. Include all the following elements *in as much detail as possible*:

- independent variable(s)
- control
- dependent variable(s) and how you'll measure it/them
- the most important standardized variables
- replication (sample size)

Sample Handout 2: Peer Review Form

Full names of students reviewing experiment:

_____

_____

Your group's evaluation of the experiment: Does it adequately test the stated hypothesis? Are the variables (independent, dependent, and standardized) and control appropriate and described in sufficient detail? Is the sample size sufficient? For each of these questions justify your answer. What improvements to the design can you suggest?

_____

To the group designing the experiment: use this space for your response to the above evaluation comments.