

Rye Ergot and Witches: a cooperative learning approach for life cycle and metabolism of *Claviceps purpurea*

Resource Type: Curriculum: Classroom

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Abstract

Students write a critique of a paper published in *Science*. The paper examines a historical event, the Salem witch hunts of 1692. The author strongly suggests that the afflicted girls who testified at the trials were the victims not of witchcraft but rather of ergot poisoning. Students use a reprint of the paper; the play, *The Crucible* by Arthur Miller; and various scientific references to learn about the life cycle and metabolism of *Claviceps purpurea*. This knowledge provides background for analyzing the methods used by scientists to investigate problems.

Activity

Invitation for User Feedback. If you have used the activity and would like to provide feedback, please send an e-mail to MicrobeLibrary@asmusa.org. Feedback can include ideas which complement the activity and new approaches for implementing the activity. Your comments will be added to the activity under a separate section labeled "Feedback." Comments may be edited.

INTRODUCTION

I present this assignment early in the semester following my lectures about eukaryotic microbes. A minimum of two discussion hours are required to introduce the class to the historical Salem witch trials and a possible correlation between those events and the life cycle and physiology of a plant pathogen. An additional hour is needed for students to review each other's writing. After completing this activity, students will be familiar with the life cycle and metabolism of *Claviceps purpurea*. They will have an increased awareness of the requirements for a good hypothesis. To a scientist, a good hypothesis makes predictions that can be tested.

Background.

The prerequisites for Basic Microbiology are General Genetics and Cell Biology. Most of my students (juniors and seniors majoring in the Biological Sciences or Science Education) have completed one Writing Intensive course.

PROCEDURE

Materials.

1. A general microbiology textbook. We use **Prescott, L. M., J. P. Harley, and D. A. Klein**. 2002. Microbiology, 5th ed. WCB/McGraw-Hill, Burr Ridge, Ill.
2. On reserve at the University library:
 - A reprint of **Caporael, L. R.** 1976. Ergotism: the Satan loosed in Salem? *Science* **192**:21-26.
 - Copies of the Arthur Miller play *The Crucible*. (**Miller, A.** 1959. *The crucible*. Bantam Books, Inc., New York, N.Y.) This edition includes Arthur Miller's notes. (Used copies of various editions are available for \$4 to \$7 at local textbook outlets.)

Student Version.

In 1953, at the height of the McCarthy period in the United States, the great American playwright Arthur Miller published his prize-winning play, *The Crucible*. The play is based on the Salem witch trials of 1692. The tragic result of those proceedings was nineteen people hung, one crushed to death, four deaths in prison, and 100 people jailed. Although witch trials were frequent in Europe during the sixteenth and seventeenth centuries, it wasn't until 1976 that Caporael presented the first evidence that the Salem witch trials followed an outbreak of rye ergot. Based on our class discussion and the references provided, write a paper of not more than five pages (1,500 words) discussing the relationship between the Salem witch trials and fungal diseases.

Include the following in your paper:

- A description of bewitchment as understood in Salem, Massachusetts, in the summer of 1692.
- The symptoms of ergot poisoning.
- The life cycle of *Claviceps purpurea*.
- The relationship between *C. purpurea* and psycho mimetic drugs.
- A critique of the evidence presented by Caporael to explain the abnormal behaviors that led to the witch trials.

Keep in mind! Your critique is the most important part of this assignment! Does the evidence support the hypothesis Caporeal presents? If so, explain why it does. If not, why not? As you develop your critique, consider: What are the requirements of a good hypothesis? Have those requirements been met?

You will want to cite references in your paper. Please make your citations using either the form used in a scientific journal or the form required by the Modern Language Association.

About grading, your grade for this assignment will be determined approximately as follows:

- 20% Technical aspects of writing such as grammar, spelling, usage, and punctuation.
- 20% Scientific presentation of the life cycle and metabolism of *Claviceps purpurea*.
- 20% Discussion of the relationship between ergot poisoning and abnormal behavior.
- 10% Summary of the evidence presented by Caporeal in her paper.
- 30% Your critique of the evidence!

If your paper gives me Writing Rage in the wee hours of the morning, I will make sure you receive proper attention from a tutor in the Campus Writing Program. Of course, you are welcome to receive help from the writing tutor at any time during the semester. If your theme contains an adequate, organized explanation of the topics I asked you to include, you will receive a good grade. As usual, ability to write well will be an advantage. In order to receive a top grade your work must not only be adequate, well organized, and technically correct; your analysis must be thoughtful and original.

Instructor Version.

Our Basic Microbiology course is part of the University's Writing Across the Curriculum program. After completing the required English Composition course, our undergraduates must complete two additional courses that are writing intensive. One of these courses is in the student's major. Courses labeled Writing Intensive by the Writing Board include a minimum of ten standard pages, subject to rewriting of a first draft, as well as peer review. Writing assignments must account for at least 30% of the course grade.

I introduce the class to rye ergot and witches early in the semester, shortly after the lectures about eukaryotic microbes. The class is given a few weeks to complete the background research before the first draft is due for peer review. We complete our peer review in 30 to 60 minutes during a laboratory period. (The students decide how much time is needed.) Students exchange drafts with their lab partners, usually teams of two or four. Students have a week following the peer review session to prepare for professor review. I return the first drafts a week after I receive them. It takes me an average of 20 minutes per paper to review the rough drafts and an average of an additional 20 minutes per paper to review the final copy and assign a grade.

Timeline for completion of the assignment.

Week of the semester	Activity
1	Hand out procedure as part of the course syllabus during the first lecture and describe it briefly Obtain written permission from the students for their participation in peer review and sharing of anonymous revised drafts
2	Present overview of eukaryotic biology
3	Give detailed presentation of the historical and scientific background
4	Students turn in first draft for peer review
5	Students turn in first draft for professor review
6	Return professor's review to students
7	Students turn in revised copy for professor grading
8	Return graded revision to students

Safety Issues. None.

ASSESSMENT AND OUTCOMES

Suggestions for Assessment.

I assign grades, sometimes with advice from teaching assistants. The technical aspects of writing have not been a problem. I have referred only five students to the writing tutor. The overwhelming majority receive grades of B (80% to 89%). The actual grade depends to a large extent on completeness and organization of the material presented. The difference between a "B" and an "A" is the critique of the evidence presented by Caporeal. Some students describe the evidence and accept the hypothesis without further consideration. Others say the hypothesis may be correct but do not discuss their reservations. Discussions of the circumstantial nature of the evidence are presented in about 20% of the papers. Occasionally a student will raise the question of whether or not there are other historical reports of witch hunts that may be linked to ergot poisoning. I lead a class discussion about grading when I return the final copies. Students are also provided with anonymous photocopies of a few of the best papers.

Field Testing.

I have used this activity during three different semesters with about 110 students total. Students are asked to evaluate the writing assignments as part of the course evaluation. On a rating scale of 1 to 5 (5 is the highest), the writing portion of the course received high marks from students. More importantly, students are asked what they liked and did not like about the writing assignments, as well as how this part of the course can be improved. The most frequent comment about Theme I was, "Rye ergot and witches was fascinating and fun; no improvement needed." Only one student said this activity was boring. A colleague in the Writing Program presented this activity to a conference for writing faculty. She reported that it was favorably and enthusiastically received.

SUPPLEMENTARY MATERIALS

No supplementary materials are required, but students and teaching assistants often find the following resources of interest.

There are many fine websites dealing with:

- Agricultural aspects of the plant pathogen (especially check websites for American and Canadian Departments of Agriculture).
- Medical use of ergot.
- The life cycle of *Claviceps purpurea*.
- Social and historical aspects of the Salem witch trials.
- The play, *The Crucible*.

A few suggested resources:

- Many American and Canadian Department of Agriculture and Agriculture Experiment Station websites provide useful information about plant pathogens and plant diseases, including ergot. For example:
www.agric.gov.ab.ca/pests/diseases/63010120.html
- General plant pathology websites:
<http://www.apsnet.org/education/LessonsPlantPath/ergot/Top.htm>
- Information about ergot alkaloids:
<http://www.people.vcu.edu/~asnedden/The%20Ergot%20Alkaloids.pdf>
- Information about theatrical productions of *The Crucible* as well as the 1996 film version and how to obtain it:
<http://www.socialstudies.com>
- Review of the 1996 movie *The Crucible* by Arthur Miller:
<http://www.sojo.net/index.cfm?action=magazine.article&issue=soj9707&article=970732c>
- The Salem Witch Trials - Documentary Project Archive and Transcription:
<http://etext.lib.virginia.edu/salem/witchcraft/>
- A VHS version of the 1996 movie, *The Crucible* (Arthur Miller participated in writing the screenplay) is available from Amazon.com.
- A book: **Matossian, M. K.** 1989. Poisons of the past. Yale University Press, New Haven, Conn.