Teaching Notes

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**Course Information**

Department: **Biology**

Level: **Lower**/Upper Undergraduate (select one)

Course type: Lab/Lecture/**Both** (other, please describe) (select one)

Students: **Majors**/Non-majors (select one)

Number of Students: **~20-30**

Detailed course information

* BIO 1120 Organisms, Populations, and Systems (for Biology Majors)
* Typical class size: 24
* We taught this case study (CS) in three successive sessions of ~35-45 minutes each, as part of daily activities in a studio format course that meets 3x weekly for 2 hr. 20 min.
* We used this CS during the second third of the semester, a few days after starting a unit on plant biology, ecology, and evolution. Students are also engaged in lab experiments testing various hypotheses with *Manduca sexta* larvae during this time.

**Module Information**

Original Module Name: **How Many More Thymes?**

Link to Original: <https://qubeshub.org/qubesresources/publications/923/1>

[Adapted Module Name: (if applicable)

Link to Adapted Module: <https://qubeshub.org/qubesresources/publications/1201/1>

Modified Module Name:

Files associated: (ie. Class Worksheet, Summative Quiz, Lecture Powerpoint, etc)

* **Bergamotene—alluring and lethal for Manduca sexta** (2017, April 20) retrieved 17 February 2019 from <https://phys.org/news/2017-04-bergamotenealluring-lethal-manduca-sexta.html> (phys.org news article summary of peer-reviewed research)
* **Bergamotene Student Focus Questions** (reading questions for phys.org news article)
* **Answer Key for Bergamotene Student Focus Questions**
* **How Many More Thymes & Herbivore Defense Case Study Slides** (Complete PowerPoint presentation for 3-day case study including modified slides from the original case study plus new slides for our adaptations)

**Modification Learning Goals**

* Use detailed observations of phenotype to predict chemotype in thyme plant varieties.
* Explain how and why interactions among ecological factors (e.g., pollination and herbivorous predation) might differentially affect plant evolution (e.g., terpene production in leaves and flowers).
* Design reasonable experiments when presented with new ideas or variables, including careful hypothesis development and solid plans for data collection and analysis.

**Teaching Notes**

**DAY 1**

Homework completed before class includes watching the first two Thyme CS videos *(Don’t Eat the Plants* and *Mediterranean Vegetation - How Plants Survive)* and submitting online responses to the first set of video questions included with the original CS.

1. Thyme plant observations (~20-25 min); students really enjoyed this, but warn those with hay fever allergies to use caution when handling or smelling plants:
   1. Purchase 5-6 thyme plants with different chemotypes (CT)
   2. Divide students into 5-6 groups for 2-3 minute observations of each plant variety
   3. Distribute a different plant to each group, then switch every 2-3 minutes until all varieties have been observed by each group per PP slide directions:
      1. Record your observations for:
         1. Thyme variety name
         2. Growth habit (branching pattern, leaf type, relative leaf size, relative plant height)
         3. Overall scent of plant
         4. Leaf texture
         5. Scent of a crushed leaf (crush only 1-2 leaves per group per plant)
         6. Other observations?
         7. SAVE your observations for reference!

NOTE: we bought 6 plants from Mountain Valley Growers, Squaw Valley, CA; you’ll need to waive the warranty if you’re ordering outside their normal shipping/planting time for your area. Our plants arrived well-packaged and in great condition despite freezing temps. We set them up in a lab under a red/blue LED plant light and provided light watering for the 2 weeks preceding the lab. 5 of 6 plants were still healthy 6 weeks after the lab and will likely survive transplanting and future use. Known and/or suspected chemotypes are listed in parentheses for each plant that we ordered.

<https://www.mountainvalleygrowers.com/Thyme.htm>

Mint thyme (A?)

Juniper thyme (T/C, U?)

English thyme (T/C)

Lemon thyme (G)

Lavender thyme (L)

PA Dutch Tea thyme (U?)

1. Briefly review student responses to video questions with class (~5-10 min).
2. Cover CS slides, #1-11 in originally published CS resources (~10-15 min).

*Adaptation note*: Our modified slides are included as part of this publication.

**DAY 2**

Homework completed before class includes watching the third Thyme CS video *(Plant Defenses Against Herbivory)* and submitting online responses to the corresponding video questions included with the original CS.

1. Review student responses to video questions (~5 min)
2. Resume and finish CS slides starting at #12 in originally published CS (~35-45 min)

**DAY 3**

Homework completed before class includes reading the Phys.org New article: *Bergamotene - alluring and lethal for Manduca sexta (2017, April 2019)*

[*phys.org/news bergamotene article*](https://phys.org/news/2017-04-bergamotenealluring-lethal-manduca-sexta.html)and submitting online responses to reading questions.

*Adaptation note*: Article PDF, reading questions handout, and answer key are provided.

1. Have students work in groups of 4-6 to compare responses to questions #1-4 (~ 5 min). Ask groups to select a prepared spokesperson to share final responses with the class.
2. Ask 1-2 groups to share their response to Q #1; discuss briefly as a class and then repeat for Q #2-4 (~10 min total).
3. Post the following question on the board or PP slide, and have students work in groups (~10-15 min):
   1. Re-read the last paragraph of this article. State 3 possible environmental factors that might affect local adaptations in *Nicotiana attenuata.* (This ties back in with ideas studied in Thyme CS)
   2. Outline a reasonable experiment designed to test the ability of just one of those environmental factors to cause a localized adaptive response in *Nicotiana attenuata*. Include your hypothesis, rationale, and independent and dependent variable(s).
4. Ask each group share their ideas (2-3 minutes per group); make brief notes on the board during presentations. Then ask students to vote on the “most fundable study”, and ask several students to support their votes during final class discussion.

*Adaptation note*: our students have been thinking about and applying concepts of good experimental design since early in the semester, and this CS adaptation is designed to provide another practice and peer evaluation opportunity.

**Additional Comments:**

We liked this addition to the Thyme CS and plan to use this adaptation again in future semesters, and to share it with colleague teaching this course.

From Sheryl: We considered adding an allelopathy activity to the Thyme CS (lettuce and onion seeds competition experiments with another short paper to read/discuss), but didn't have space in the schedule. This could provide some nice, student generated data to work with and I'll probably include it next time. This would give students another chance to practice hypothesis generation and experimental design strategies. I would piggy-back these brief experiments with coverage of plant growth & development, and extra seedlings could be dissected for stereoscope and compound microscope observations.