Insect Myths: An Interdisciplinary Approach Fostering Active Learning

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Undergraduate curricula of many institutions of higher education include General Education Requirements (GERs). Most GER courses provide an overview of a given subject area to students who may have little experience and/or interest in the subject matter, which can present obstacles to achieving standards of proficiency. Generating and sustaining interest is critical, and teaching methods that emphasize interdisciplinary approaches may help students effectively weave course content into their current knowledge base.

At Washington State University, Insects, Science, and World Cultures (Entom 150) is a lower-division, GER science course designed for non-science majors and elementary education majors. Students enrolled in the course represent diverse backgrounds, interests, and academic majors. The content and pedagogy of Entom 150 are intended to address the needs and challenges of a heterogeneous student population.

Insects, Science, and World Cultures offers an interdisciplinary view of the global impact of insects on the arts, myths & legends, cuisine, medicine, scientific research, and agriculture. It emphasizes the role of insects and their products in various cultures around the world (historical and contemporary) and uses insects as a tool to examine topics of broad interest (e.g., nutrition and undernourishment in developing nations, biological control, pesticides, environmental issues, energy flow, insects as "recyclers," forensics, water quality, and insects as key indicator species). These topics are aimed at what is termed "civic scientific literacy" (Miller 2000). Trefil (2008) argues that general science education should provide a wide overview of the sciences, such that students will be able to engage meaningfully in contemporary civic issues.

GER science courses should not only provide a broad exposure to the sciences, but also attempt to teach students how to make interdisciplinary connections. Educators advocate this type of teaching strategy to enhance students' long-term recall (Osborne and Wittrock 1985) and "real-world" problem-solving skills (Sternberg 2008). This has particular relevance for scientific literacy, because public debate often marshals arguments grounded in both culture and science. Leading educators also argue for the importance of cultural literacy (Hirsch et al. 2002), and there is an extensive literature documenting the intersection of anthropology and entomology (Hogue 1987).

The "Insect Myths" unit of Entom 150 represents a melding of scientific and cultural literacy. The unit's activities require students to apply entomological knowledge toward the creation of a unique myth, thereby facilitating connections among entomology, anthropology, creative writing, art, and history. Because this approach enables students to make their own interdisciplinary connections, the pedagogy fosters *active learning*. This paper describes the specific approaches and activities we developed for the "Insect Myths" unit, and discusses student responses to the unit.

Teaching Methods

Activity #1: What is a Myth?

The purpose of the first class activity is for students to understand the concept and function of myths in human cultures. At the beginning of a 3-hour lab session, students view a brief slide presentation on the role of insects in Hopi and Navajo myth and culture, and how Australian Aborigines incorporated insects into their culture and art.[1] The presentation highlights the significance of the butterfly (Fewkes 1898, 1910, 1919), insect kachinas in Hopi culture (Colton 1959, Earle 1971, Wright 1977, Stoffolano and Wright 2005), and the role of insects in Navajo creation legend (Stephen 1930, Locke 1976, Zolbrod 1984) and dry paintings (Wyman and Bailey 1964). Other compelling myths are those of the Yurok and Wiyot tribes in northwestern California, which describe an intimidating creature responsible for imposing mortality upon humans, who otherwise would have remained immortal (Kroeber 1925, Essig 1934). The Yurok called it "wertspit, the locust larva," and the Wiyot called it "Spinagaralu," the locust larva, or sand cricket, and described it as a "dark, wingless insect that lives in the ground" (Kroeber 1905). Essig (1934) suggests that these creatures were likely Jerusalem crickets, and Powell and Hogue (1979) assert that "no other California insect inspires such awe." Its large size (up to 50 mm), bulbous

[1]We discuss the significance of insects in ancient Egyptian, Chinese, and Mimbres (American southwest) cultures in a separate unit.

abdomen, pronounced mandibles, and pale, bald head present a strangely human-like image (Powell and Hogue 1979). It is of little surprise that these widespread insects were feared and revered, which firmly established their place in tribal mythology.

Next, students are organized into small groups, and each group is assigned a set of in-lab readings that illustrate cultural myths involving insects (and, in some cases, related arthropods or other animals). By design, readings derive from diverse sources (Table 1), including oral histories from the primary anthropological literature (*e.g.*, Beauchamp 1889, Batchelor 1894, Boas 1917), modern anthologies (*e.g.*, Mooney 1900, Erodes and Ortiz 1984, Bruchac 1992), and illustrated books for children or young adults (*e.g.*, Aardema 1975, Hamilton 1988, Rodanas 1991, London 1993, Max 1997, Pilling 1997) that are available for perusal during lab.[2] Some myths feature arthropods and highlight their characteristic behaviors, such as hymenopteran stinging (Clausen 1954), grasshoppers regurgitating (Speck 1935), spiders spinning webs (Kroeber 1905), and mosquitoes buzzing (Aardema 1975) or biting (Erodes and Ortiz 1984). Other myths serve as moral lessons (Rodanas

[2]We also provide a copy of Bruchac (1992), which features a map of the geographic location of native North American tribes, and an appendix with information on each tribe.

Table 1. Examples of arthropods featured in myths.

Name of Arthropod	Myth story/ Representation	Culture[1]	Reference(s)
ARANEAE			
Spider (Water Spider)	Why owls have eye rings and crows are black, origin of fire	Cherokee (NA)	Max 1997
Spider	Origin of sun, possum's tail, buzzard's color	Cherokee (NA)	Erodes & Ortiz 1984
Spider (Spider Woman)	Origin of the burrow	Hopi (NA)	Max 1997
Spider (Spider Grandmother)	Origin of earth and sky	Kiowa (NA)	Max 1997
Spider (Ananse)	Origin of blindness	Krachi (Togo)	Hamilton 1988
Spider (Ochoclonwa)	How humans learned to set traps for animals	Muskogee (NA)	Max 1997
Spider (Spider Woman)	Need for a well-balanced life	Navajo (NA)	Stephen 1930, Duncan 1996
Spider	Origin of webs to catch flies	Wishosk (NA)	Kroeber 1905
COLEOPTERA			
Beetle (*Eleodes*)	Origin of the Milky Way	Cochiti (NA)	Clausen 1954
Beetle grub (Wormwood)	Why they bore in wood (with mosquito)	Tahltan (BC)	Teit 1919
Firefly	Why firelights light up and are active at dark	Bellona Islanders (SI)	Kuschel 1975
DIPTERA			
Mosquito	Origin of mosquitoes	Ainu (Japan) Iroquois (NA) Tlingit (C) Gitksan (C)	Batchelor 1894 Beauchamp 1889 Erodes & Ortiz 1984 Kritsky & Cherry 2000
Mosquito	Why mosquitoes buzz in people's ears	West Africa	Aardema 1975
Tabanus affinis (Big Biter)	Protects fish from being over-harvested	Montagnais (C)	Capinera 1993
Tabanid (Moose-fly)	Governs fish, no wasting of fish	Naskapi (C)	Speck 1977
(Big Fly)	Teacher/helper, messenger of God	Navajo (NA)	Capinera 1993
Fly, maggot	Origin of death	Thompson Indians (NA)	Boas 1917
HYMENOPTERA			
Bee, hornet, wasp	Origin of sting	Algonquin (C)	Young 1903, Clausen 1954
Bee, wasp, snake	Origin of poison	Choctaw (NA)	Bruchac 1992
Yellowjackets	Origin of fire	Karuk (NA)	London 1993
LEPIDOPTERA			
Butterflies	Why there are butterflies (rebirth)	(Australia)	Pilling 1997
Butterfly (Itzapalotl)	Goddess of love, patron of warriors	Aztec (NA)	Ross 1997
Butterfly (Xochiquetzal)	Goddess of obsidian & knives	Aztec (NA)	Ross 1997
Butterfly (ap u nni)	Bringer of dreams	Blackfeet (NA)	Grinnell et al. 1899
Butterflies	Why butterflies are beautiful	Papago (NA)	Erodes & Ortiz 1984
Butterflies	Origin of butterflies	Papago (NA)	Bruchac 1992
ODONATA			
Dragonfly	Why dragonflies live near water and sleep at night	Bellona Islanders (SI)	Kuschel 1975
Dragonfly	Origin of dragonflies, messenger between God/man, respect for nature	Zuni (NA)	Rodanas 1991
Dragonfly	Importance of leading a balanced life	Navajo (NA)	Duncan 1996
ORTHOPTERA			
Grasshopper	Why grasshoppers spit	Algonquin, Penobscot (NA)	Young 1903, Speck 1935
Locust (Wunustcinde)	Origin of the world	Navajo (NA)	Stephen 1930
Sand Cricket	Origin of death	Wishosk (NA), Wiyot (NA)	Kroeber 1925
VARIOUS INSECTS			
Biting insects, grubs, bears, reptiles, birds,	Origin of venoms, human illness, disease	Algonquin (NA)	Young 1903
Biting insects, grubs, bears, reptiles, birds, plants	Origin of disease and medicine	Cherokee (NA)	Mooney 1900

[1]BC = British Columbia, C = Canada, NA = North America other than British Columbia or Canada, SI = Solomon Islands.

1991) and may use insect (Cherry 1993) or human (Capinera 1993) behavioral traits as colorful examples. Still other myths provide explanations for celestial, cosmic, or earthly phenomena, such as the origin of the Milky Way (Clausen 1954), the earth and sky (Max 1997), human disease and illness (Mooney 1900, Young 1903), and death (Boas 1917).

For each assigned reading, the groups record the following information on a worksheet: name of the culture from which the myth derives, featured organism(s), culture's name(s) for the organism(s) if provided in the reading, summary of the myth, and what the myth explains. Once all groups have completed their myth readings, they report their findings orally to the class. We then ask the class to reflect upon the information and discuss what constitutes a myth, i.e., how this literary genre is defined. This query prompts a variety of answers, the purpose of which is to help students realize that before they can write their own myths (the second activity in the unit), there must be agreement on what a myth *is*. We then share with them three scholarly definitions for "myth" (The Columbia Encyclopedia 1950, New Larousse Encyclopedia of Mythology 1972, Leach 1984), pointing out that experts differ in their views, as might experts in any field. The goal of this exercise is to help students progress in their thinking from a position of "dualism" (the notion that there is only one correct, authoritative view or opinion, and all others are wrong) to one of "multiplicity" (the acceptance of and ability to cope with uncertainty and diversity in world views). These positions represent early intellectual transformations in one's journey through college as described in the classic Perry scheme (Moore 2001). At the end of the exercise we provide students with a "working definition" of a myth (Box 1), to guide them in the creation of their myths (activity #2).

SUMMARY SHOWING THE TOTAL NUMBER OF TALES WHICH EXPLAIN THE VARIOUS PHENOMENA LISTED ABOVE.

CELESTIAL OR COSMIC.		EARTHLY OR LOCAL.	
Phenomena.	*Number of Tales.*	*Phenomena.*	*Number of Tales.*
Sun	18	Mankind	15
Moon	20	Plants	17
Stars	19	Animals	45
Milky Way	3	Death	14
Constellations	14	Fire	6
Day and night	5	Topography	174
Seasons	5	Echo	1
Clouds	2	Human traits	58
Thunder	11	Animal traits	356
Weather	10	Plant traits	32
Snow	1	Tribal groups	14
Tides	3	Tribal traits	28
Earthquakes	1	Languages	6
Sky	6	Culture	81
Land	13	Customs	15
Water	7	Ceremonies	191
Total	138	Total	1053

Fig. 1. Scanned image from Waterman (1914) listing types of natural phenomenon explained by myths.

Activity #2: Creating an Insect Myth

For this activity, which begins during the lab session, we assign each pair of students one insect that will serve as the basis for their myth. Our list of assigned insects includes: caddisfly, praying mantis, monarch butterfly, death-watch beetle, drugstore/cigarette beetle, house/dust mite, green lacewing, mantispid, flea, mayfly, dance fly, water strider, and aphid-tending ant. Each pair is given a one-page handout highlighting the insect's natural history and a few striking aspects of its biology, ecology, behavior, etc. Using a provided worksheet, the student pairs are prompted to list aspects of their insect's natural history that they find

Box 1. Working definition of a myth

Working definition of a myth*

A myth:

is a story that explains or relates the origin of a natural phenomenon, cultural belief, or tradition. It often answers a fundamental question (*e.g.* How was the world made? Why does the sun/moon move across the sky? Where do souls go after death?). Myths may justify existing social systems and/or account for traditional rites and customs, including cosmological and supernatural traditions of a people, their gods, heroes, cultural traits, and religious beliefs.

A myth may:

- invoke supernatural events and gods
- contain elements of a legendary and fabulous nature
- be associated with religious ceremonies
- illustrate geographical, historical, anthropological knowledge
- explain characteristics of plants, animals, and other life forms

*Excerpted from: The Columbia Encyclopedia (1950), New Larousse Encyclopedia of Mythology (1972), and Leach (1984).

Box 2. Student guidelines for writing myths.

Myth guidelines:

1. Your goal is to use some aspect of your insect's natural history to explain a natural phenomenon, life form, humankind's place in the world and/or society, *etc*.
2. Keep in mind the definition and function of a myth as you create your own. Be sure that your final version falls into this literary genre and meets the criteria listed in the grading rubric (Box 3).
3. Remember: All human cultures have made observations about natural phenomena, events, organisms, *etc*. Examples include the heavens (*e.g.*, planets and their movements, earth (*e.g.*, 24-hour cycle, seasons), natural physical phenomena (*e.g.*, storms, tides, weather), and natural history of organisms.
4. You may give your insect special "powers" such as speech, reason, *etc*., provided that you follow the guidelines outlined here and in the grading rubric.
5. You are encouraged to generate ideas by perusing illustrated books in lab, and those in the children and youth sections of the public library. Illustrations in your myth must be your own creation. Be sure that they are representative of your insect and myth, and fit them appropriately within the narrative.
6. You will submit a draft of your myth for feedback (see course syllabus for date).
7. The final version of your myth will be graded based on criteria given in the grading rubric (Box 3).
8. As part of our class's community outreach effort, you will be reading your myth to pre-school aged children in a childcare facility on campus (see syllabus for date).

Box 3. Myth grading rubric.

1) **Insect identified (common and/or scientific name provided) and depicted accurately (15%)**
- Insect identified in a confusing manner and not depicted accurately (0 pts.)
- Insect identified, but explained / depicted with limited accuracy (8 pts.)
- Insect identified and explained / depicted with adequate accuracy (12 pts.)
- Insect identified and explained / depicted with outstanding accuracy (15 pts.)

2) Natural phenomenon/social system/cultural practice, etc., explained accurately (15%)
- Explanation of natural phenomenon inaccurate (0 pts.)
- Natural phenomenon explained with limited accuracy (8 pts.)
- Natural phenomenon explained with adequate accuracy (12 pts.)
- Natural phenomenon explained with outstanding accuracy (15 pts.)

3) Illustrations (all original) included, one of which may be on cover page (15%)
- No illustrations (0 pts.)
- Illustration(s) present, but show little time or effort expended (5 pts.)
- Acceptable illustrations (3 total) included (12 pts.)
- Outstanding illustrations (3 or more) included (15 pts.)

4) Overall creativity of myth concept (20%)
- Myth concept predictable, lacking creativity (0 pts.)
- Myth concept marginally creative, clever and/or engaging (10 pts.)
- Myth concept adequately creative, clever and engaging (15 pts.)
- Myth concept outstandingly creative, clever and engaging (20 pts.)

5) Composition, style, grammar, *etc.* (10%)
- Myth poorly written and/or lacking in some major way(s) grammatically or stylistically (0 pts.)
- Myth lacks logical flow, is confusing; errors are numerous (4 pts.)
- Myth logically composed; errors minimal to moderate (8 pts.)
- Myth extremely well composed, logical, and professional; without error (10 pts.)

6) Overall visual presentation of myth (20%)
- Visual presentation careless, unacceptable (0 pts.)
- Visual presentation poor (10 pts.)
- Visual presentation adequately neat and acceptable (15 pts.)
- Visual presentation outstanding (20 pts.)

7) Format (5%) (double-spaced; ca 18 point font; 350-500 words with count on last page)
- Not followed (0 pts.)
- Followed but with many errors (2 pts.)
- Followed with few errors (4 pts.)
- Followed according to established guidelines (5 pts.)

most interesting or unusual. Next, they are reminded of the "working definition" of a myth (Box 1) and asked to list at least two readily observable phenomena that might be "explained" by some specific aspect(s) of their insect's natural history. To help the pairs, we provide a summary table of natural phenomena (Fig. 1) and guidelines for writing their myth (Box 2).

We emphasize to students that the final version of their myth should demonstrate their comprehension of their insect's natural history, their ability to write creatively, carefully, and with scientific accuracy, and the overall visual presentation of the myth. These elements are weighted accordingly in the grading rubric (Box 3), which we hand out and discuss with students at the close of the 3-hour lab session. About three weeks after the myth lab, we schedule a 50-min class period as a follow-up session, providing feedback on the students' work in progress. We use the grading rubric both as an assessment tool for the required draft of their myth, and as an evaluative tool to assign a grade to the final version.

An excellent example of a student-generated myth, "A Caddisfly's Generosity" (2005), explains that humankind first learned how to build shelters from caddisflies (Fig. 2). In this myth, a snail-case caddisfly ("Helio," Helicopsychidae) teaches a shell-less snail the art of making a shelter out of silk and tiny stones. The snail passes the story on to a caveman (Fig. 3), suggesting he consult with "Lepto," a leptocerid caddisfly who knows how to construct shelters out of sticks and pieces of wood. The caveman learns from the leptocerid how to build a shelter (Fig. 4), and from this point on, humankind is no longer confined to caves. The story incorporates caddisfly biology, taxonomy, some clever humor, and (importantly) a mythological explanation of the origins of human architecture, thereby satisfying key elements of the grading rubric.

Evaluation and Discussion

The myth unit fosters one of the stated learning outcomes for Entom 150: students will practice and demonstrate skills in information literacy, creative thinking, symbolic reasoning, and written and oral communication. The introductory slide presentation, on insects in Hopi and Navajo culture, prepares students for the subsequent lab activities on insect myths of indigenous peoples. Lab activity #1 requires students to (1) select relevant information from various myth readings, (2) repeat it in their own words, (3) generate links between the new information (the myths) and information they possess from prior learning (the phenomena the myths explain), and (4) develop and share descriptions of the newly acquired concepts (i.e., summarize and present the myths to the class), thereby constructing meaning. These steps align with the first four steps of the Generative Learning Model (GLM) (Osborne and Wittrock 1985), which describes the step-wise process by which people learn. Lab activity #2 completes the remaining two steps of the GLM, by having students (5) practice skills associated with the new information and obtain feedback (i.e., write a draft of a myth and have it assessed with the rubric), and (6) connect the new conceptual myth framework to as many conceptual frameworks as possible (e.g. Entomology, creative writing, art, cosmic and earthly phenomena, social systems, culture, etc.).

In 2003 and 2005, we asked students to respond anonymously to five prompts aimed at rating the myth lab activities. For the first three prompts, we used a Likert scale of 1 to 5 (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). The last two prompts were open-ended queries: "What did you like about lab, and why?" and "What didn't you like, and why?" Likert responses for both years suggest that the lab activities aligned well with the introductory lecture on Hopi and Navajo cultures (prompt #1), that the activities were clear to the students (prompt #2), and that they

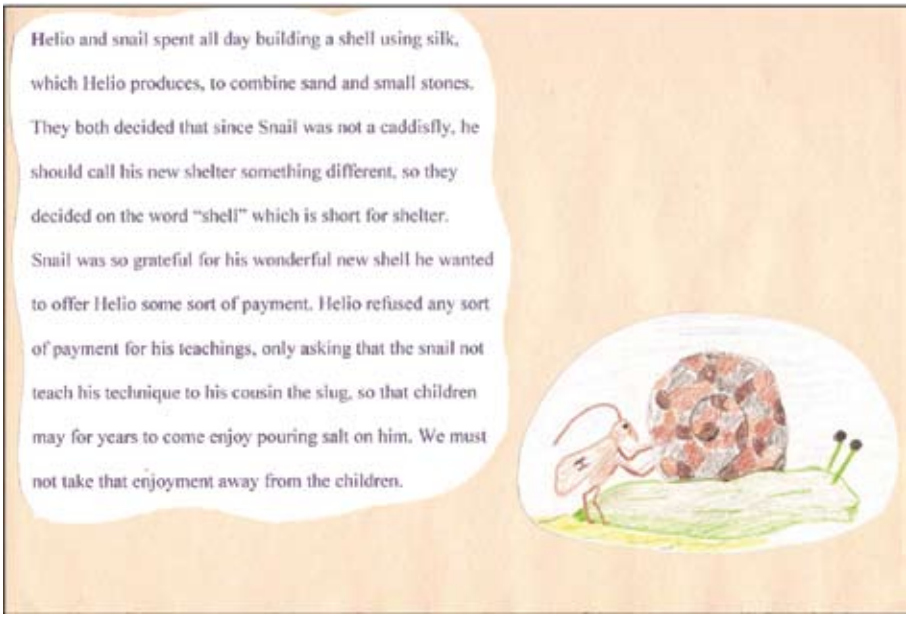

Fig. 2. Excerpt from "A Caddisfly's Generosity," an original myth written and illustrated by Pat Bennett and Josh Duin, two former students in Entom 150.

Fig. 4. Picture from "A Caddisfly's Generosity," showing "Lepto" the caddisfly teaching the caveman how to build shelters out of wood.

understood the assignment (creation of myth) (Table 2).

Regarding what they liked about lab (prompt #4), students most commonly responded that they liked reading, hearing, and telling about the various myths because they found them interesting, fun, and different. Regarding what they didn't like about lab (prompt #5), in 2003, half of the students complained about time constraint, and four students indicated that they had no complaints. In comparison, in 2005, fewer students complained about the length of the lab, and seven left the prompt blank or wrote "nothing." In 2005, our college generated student course evaluations for Entom 150, with an array of questions designed to measure various constructs. Student responses regarding the learning environment construct were favorable (59% strongly agree, 39% agree), as were those regarding the critical engagement construct (45% strongly agree, 45% agree). These data provide further evidence that students appreciate the interdisciplinary, active learning approaches employed in the course.

Students typically were extremely engaged by the creative aspect of this unit and earn high grades for their myths. We have been impressed by their imagination and inventiveness—some have invested considerable time into crafting a book that will be appealing to young readers (creating pop-up books or books with moveable parts). This indicates yet another connection the students often make, which is that making the myth audience-specific can enhance comprehension of the myth's message. We find the follow-up class period (about three weeks post-lab) to be critical to their success, as the greatest difficulties students encounter have to do with scientific accuracy, often regarding their insect's natural history. It is sometimes a challenge for students to reconcile a good story with the particular biology of their assigned insect. As a result, some students either take excessive artistic liberties with the biological facts, or perhaps fail to incorporate enough biology.

The myth unit culminates when student pairs read their original, illustrated insect myths aloud to pre-school children in an on-campus daycare facility. For their efforts, our students receive community outreach credit, an activity coordinated through the university's campus engagement office. Staff at the daycare facility are very appreciative of the visit by our students, and our students greatly enjoy the opportunity to get out of the classroom and share the fruits of their labor with enthusiastic youngsters.

Fig. 3. Picture from "A Caddisfly's Generosity," depicting the snail telling a caveman about his newly constructed shell.

Table 2. Summary statistics of anonymous student responses to myth lab activities.

Survey prompt	2003 ($\bar{x}$ ± SD) (n)	2005 ($\bar{x}$ ± SD) (n)
1) Lab exercise matched introductory lecture.[1]	4.50 ± 0.65 (14)	4.63 ± 0.65 (13)
2) Lab exercise was clear, you knew what you were supposed to do, and all materials needed were available.[1]	4.50 ± 0.65 (14)	5.00 ± 0.00 (13)
3) Assignment(s) was explained well and matched what we've done in lecture/lab.[1]	4.64 ± 0.63 (14)	5.00 ± 0.00 (13)
4) What did you like about lab? Why?	Reading, telling, hearing, learning; fun, different (14)	Interesting, fun; reading, hearing; learning on own (14)
5) What didn't you like about lab? Why?	Lengthy, insufficient time (7)	Lengthy (4); group work (1); stories are unrealistic (1)

[1]Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.

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