Writing to Learn: Reading and Writing in STEM

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May 13, 2016

Objectives

- Define a “rhetorical approach” to STEM reading and writing
- Describe and practice techniques for assignment design that enact this approach
- Describe techniques for effective **response to student writers**—including peer review.
- Describe a long-standing science writing program that uses this approach in an inclusive environment

A Rhetorical Approach to STEM Reading/Writing

- Relies on tradition in science communication studies of analyzing (1) the argumentative structure of scientific articles and (2) differences in scientific writing for specialist and non-specialist readers (e.g., Bazerman, LaTour/Woolgar, Myers, Perrault)
- Focuses on analyzing purposes, audiences, genres, style, and graphics in science documents
- In teaching writers and readers of science, actively rejects the myth that the “data speak for themselves”

Goals for the Approach

- Help science majors become more savvy **readers** of any kind of science-related document: print, online, multimedia
- Help science majors become more organized and impactful **writer**s of science documents to diverse readers
- Help science majors become more savvy **consumers** and **producers** of science

Usefulness of this approach…

- By teaching students to see the rhetorical features of STEM writing, the approach helps all students see what science communication shares with all other types of communication, and how it differs.

- Recent attention in writing-in-disciplines research (e.g., Leki, Zawacki and Cox, Kruse, Wu, Hirsch) to the needs of English language learners shows importance of rhetorically-aware teaching.

- “Rhetorically-aware” STEM teaching includes meaningful reading/writing assignments and feedback on content and argument, not just on perceived language errors.

Heuristic for Critical Reading in Science

	Journal articles	Blogs, Reports, etc.	Popular science news
Purposes			
Audiences			
Types of Evidence			
Order of Information			
Tone and Style			
Graphic Elements			

Sample Assignment Based on the Heuristic:

Comparative Document Analysis

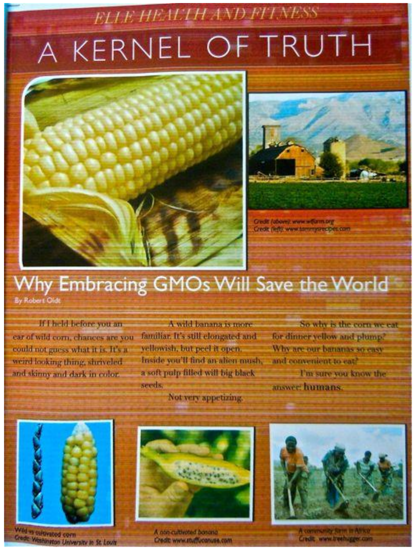
- "Compare three articles (on the same specific topic of your choice). One should be from a **peer-reviewed journal**, another from a **popular news publication**, a third from a **science blog or government report**"
- "Using the heuristic, identify the **purposes** and **audiences** for each article."
- "How do the writers of these articles use

  (1) types of evidence

  (2) order of information

  (3) tone and style, and

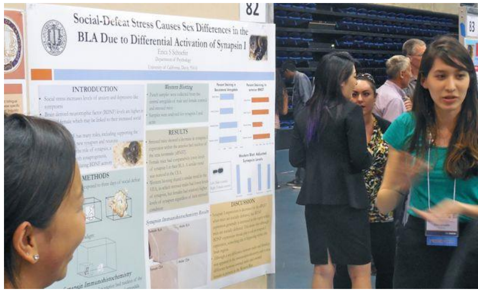
  (4) graphic elements



to achieve their purposes for their target audiences?"

Designing Rhetorically-Aware Assignments

- Purposes 



  What should the writer achieve or demonstrate or argue?

- Audiences

  Who are the readers? How can they use the writing?

- Genre and Format

  What expectations do the readers have for format and style? (E.g., standard science journal format? Research review? Poster?)

- Process

  Will there be a proposal? A first draft? Peer review?

Giving Feedback to Student Writers

- Prioritize feedback according to **main objectives** for (purposes of) the assignment (see handout).

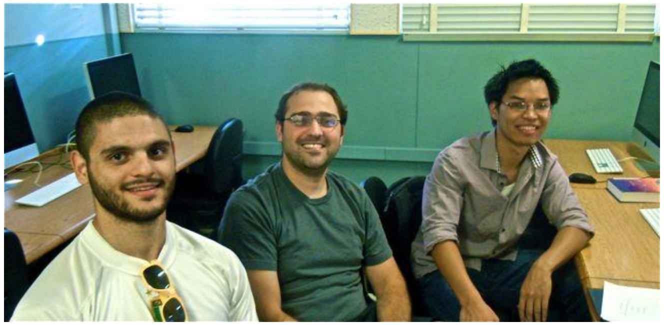
- Consider using a simple **rubric** (see handout) to ensure useful feedback.

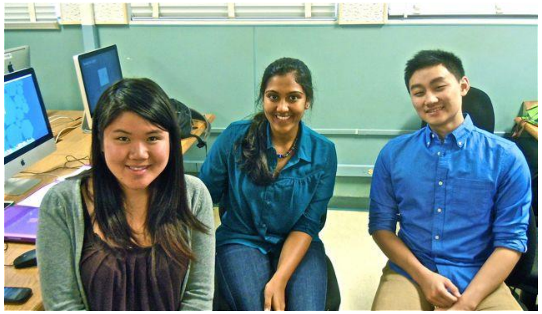
- Consider using rubric-driven **peer review** (see handout).

- Use feedback to promote real improvement through **revision** (as in the professional peer-review process).

UC Davis UWP 104E: **Writing in the Professions--Science**

- One of 20+ upper-level (jr-sr) courses in the University Writing Program taken to fulfill the upper-level writing requirement for all students
- One of 7 such courses popular with STEM majors (writing in biosciences, writing in health professions, writing in engineering, technical writing are among the other courses) http://writing.ucdavis.edu/course-information/writing-in-the-disciplines (Taken by 2000 students per year.)

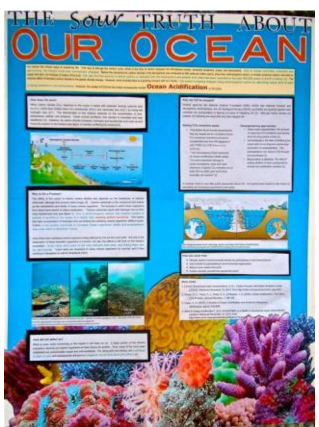


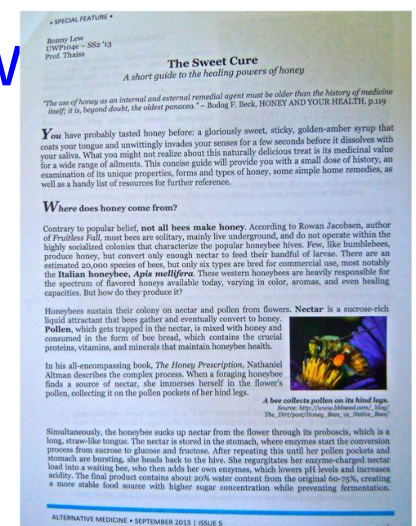


UWP 104E: **Writing in the Professions--Science**

- From course objectives: To introduce students to the rhetorical principles underlying…the major genres of scientific writing
- To teach students the rhetorical principles underlying effective scientific style

http://writing.ucdavis.edu/course-information/course-descriptions-1/uw




• SPECIAL FEATURE •

Bonny Lew
UWP104e – SS2 '13
Prof. Thaiss

The Sweet Cure

A short guide to the healing powers of honey

"The use of honey as an internal and external remedial agent must be older than the history of medicine itself; it is, beyond doubt, the oldest panacea." – Bodog F. Beck, HONEY AND YOUR HEALTH, p.119

You have probably tasted honey before: a gloriously sweet, sticky, golden-amber syrup that coats your tongue and unwittingly invades your senses for a few seconds before it dissolves with your saliva. What you might not realize about this naturally delicious treat is its medicinal value for a wide range of ailments. This concise guide will provide you with a small dose of history, an examination of its unique properties, forms and types of honey, some simple home remedies, as well as a handy list of resources for further reference.

Where does honey come from?

Contrary to popular belief, **not all bees make honey**. According to Rowan Jacobsen, author of *Fruitless Fall*, most bees are solitary, mainly live underground, and do not operate within the highly socialized colonies that characterize the popular honeybee hives. Few, like bumblebees, produce honey, but convert only enough nectar to feed their handful of larvae. There are an estimated 20,000 species of bees, but only six types are bred for commercial use, most notably the **Italian honeybee, *Apis mellifera***. These western honeybees are heavily responsible for the spectrum of flavored honeys available today, varying in color, aromas, and even healing capacities. But how do they produce it?

Honeybees sustain their colony on nectar and pollen from flowers. **Nectar** is a sucrose-rich liquid attractant that bees gather and eventually convert to honey. **Pollen**, which gets trapped in the nectar, is mixed with honey and consumed in the form of bee bread, which contains the crucial proteins, vitamins, and minerals that maintain honeybee health.

In his all-encompassing book, *The Honey Prescription*, Nathaniel Altman describes the complex process. When a foraging honeybee finds a source of nectar, she immerses herself in the flower's pollen, collecting it on the pollen pockets of her hind legs.

A bee collects pollen on its hind legs.
Source: http://www.bbbseed.com/_blog/The_Dirt/post/Honey_Bees_vs_Native_Bees/

Simultaneously, the honeybee sucks up nectar from the flower through its proboscis, which is a long, straw-like tongue. The nectar is stored in the stomach, where enzymes start the conversion process from sucrose to glucose and fructose. After repeating this until her pollen pockets and stomach are bursting, she heads back to the hive. She regurgitates her enzyme-charged nectar load into a waiting bee, who then adds her own enzymes, which lowers pH levels and increases acidity. The final product contains about 20% water content from the original 60-75%, creating a more stable food source with higher sugar concentration while preventing fermentation.

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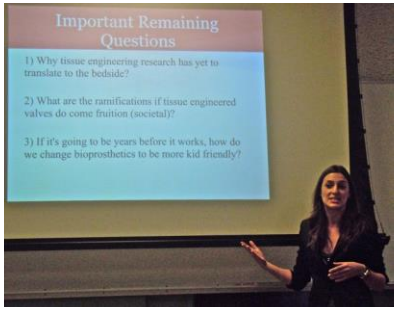
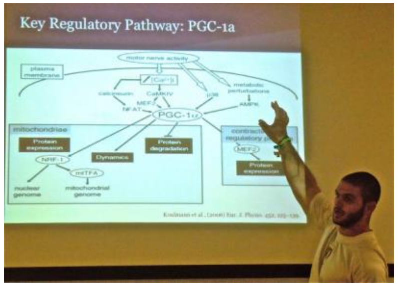
“Scaffolded” Science Writing Assignments

1. Writing and Science: Your History
2. Team Research Review (developed in stages throughout course)
3. Comparative Document Analysis
4. Popular Science Project (multimodal)
5. Oral/Visual Presentation of Team Research Review





- Assignments 2, 3, and 4 are all developed in stages based on the heuristic: proposal, first draft, peer review, revised draft (with “change memo”).

Continuous Assessment by Peers and Instructor

Rhetorical heuristic informs each stage of process:

1. Assignment description
2. In-class exercises
3. Request for proposals (RFPs)
4. Peer review forms
5. Change memos

Proposals, Drafts, and Revised Drafts of successive assignments provide ongoing data for measuring growth by each student in metacognitive understanding and application of rhetorical approach.

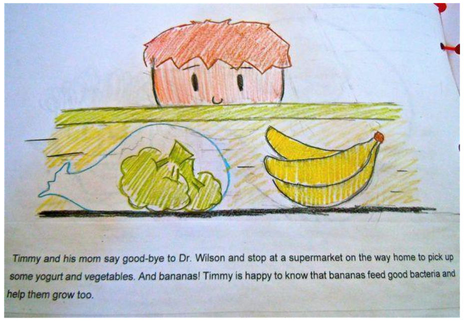
Comparative Document Analysis: Sample Topics (Spring 2014)

- Retrotransposons as a source of genetic variations among cells
- Conservation of gorillas in the wild and in captivity
- Curing osteoarthritis through regeneration of chondrocytes
- Epigenetic stress in offspring based on the stress of the parents
- Use of epigenetics in cancer therapy
- Effects of rodent maternal behavior on the gl receptors of offspring
- Effects of ecotourism on wildlife
- Relationship between telomere length and cellular aging

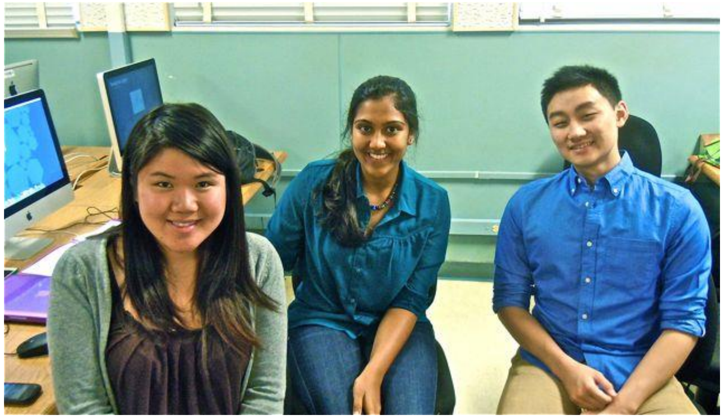
Assignment:
Popular Science Projec

- Individual projects mostly based on topics chosen for Team Research Reviews (TRR)
- Among TRR topics in latest iteration (Summer 13):
  - How, why, and where black holes are created
  - Honeybee colony collapse disorder
  - Radioembolization in treatment of liver cancer
  - Pre- and probiotics and fecal transplants for gut health
  - HIV as transport in gene therapy
  - Exercise regimen for mitochondrial growth
  - Stem cells for *in vitro* meat production

Popular Science Project



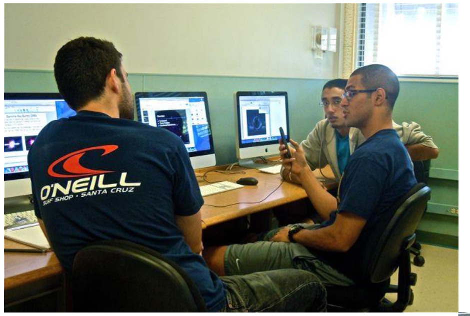
- **Task**: Each student chooses a focus/subject, a major purpose, a primary audience, appropriate language and graphics, and an appropriate genre/medium/venue



- **Success** depends on understanding and using classical and contemporary rhetorical theory (e.g., Aristotle, Burke, Miller, Turkle, Perrault)

Popular Science Project: Rhetorical Schema

- Earlier assignments and exercises teach students to analyze research journals and journalistic science texts for writers'…
  – purposes
  – audiences
  – types of evidence
  – order of information
  – tone/style
  – and graphic presentation.

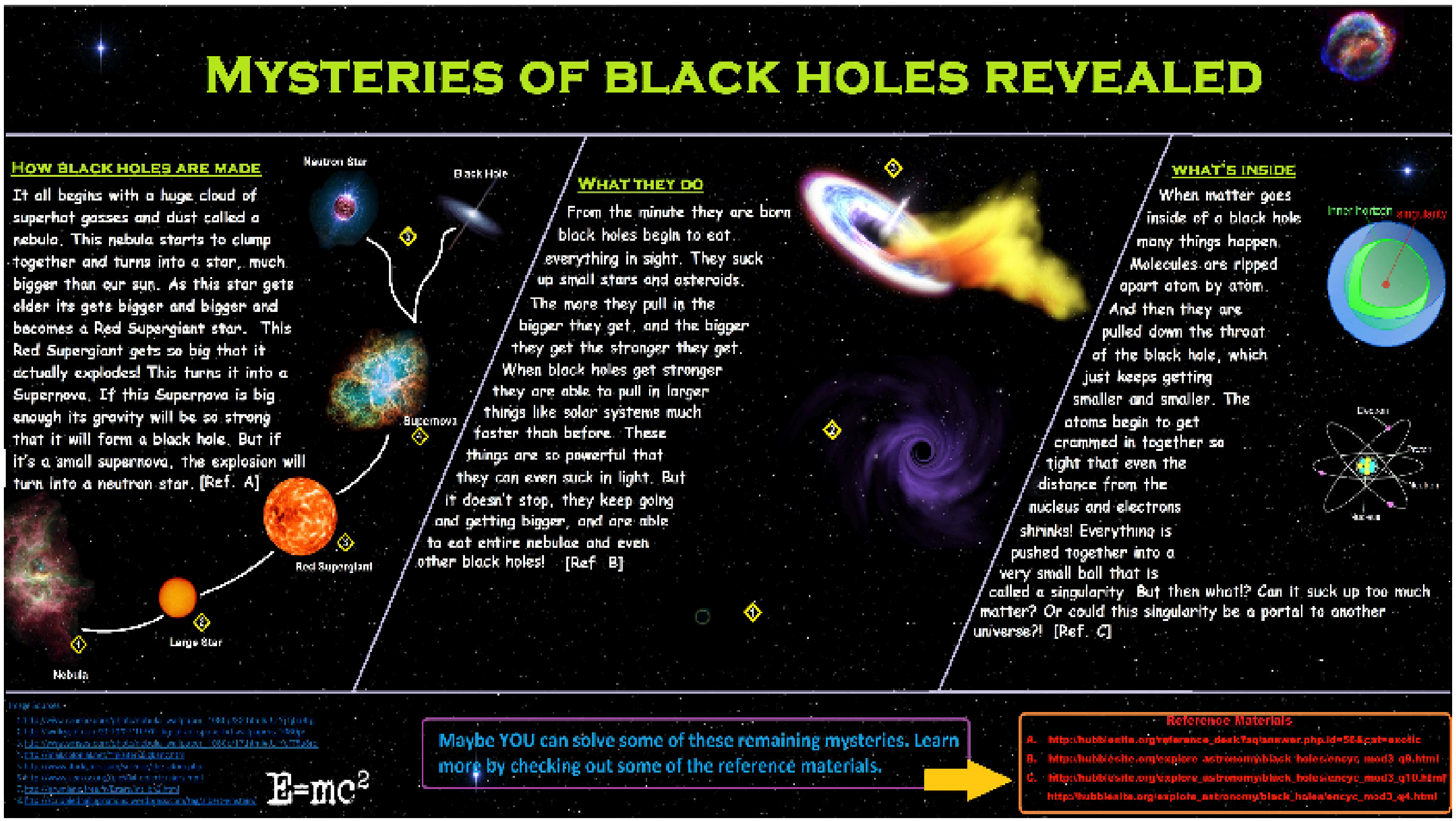


- Students use this learned rhetorical schema to create and explain their essays, websites, phone apps, posters, brochures, videos, powerpoints, etc.

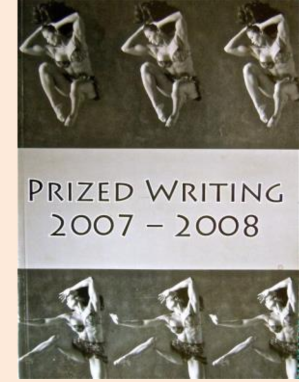
A Few Sample Projects…

- T.F. (neurobiology/physiology/behavior major) creates a pamphlet and slide show to **help parents of children in UCD autism study** understand the goals and methods—and long-term value—of the multi-year research.
- T.C. (microbiology major) creates website, including video narrative clips, to help **sufferers from GI infections** accept the idea of **fecal transplants** as a treatment option.
- J.L. and H.D. (aerospace engineering majors) create posters to teach **museum goers**, from teenagers to adults, basic principles of **dark matter and black hole formation.--------->**

Sample Projects…

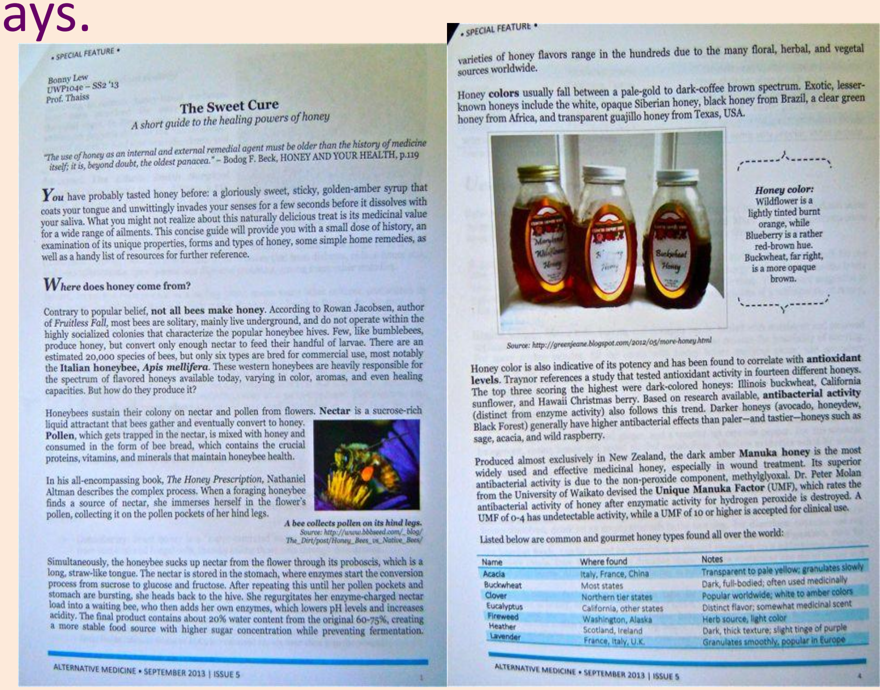


A Few More…



- A.R. (biochemistry major, pre-med) writes a personal essay about his care of his immigrant grandfather dying of cancer, and what he learns about diagnosis and doctor-patient relations. He bases his style on that of Atul Gawandi and wants to publish in our annual magazine of undergrad scientific essays.

- B.L (environmental toxicology major), whose team is studying colony collapse disorder, writes an essay for a journal of alternative medicine to promote the varying therapeutic benefits of honeys from diverse plants.



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• SPECIAL FEATURE •

varieties of honey flavors range in the hundreds due to the many floral, herbal, and vegetal sources worldwide.

Honey **colors** usually fall between a pale-gold to dark-coffee brown spectrum. Exotic, lesser-known honeys include the white, opaque Siberian honey, black honey from Brazil, a clear green honey from Africa, and transparent guajillo honey from Texas, USA.

Honey color: Wildflower is a lightly tinted burnt orange, while Blueberry is a rather red-brown hue. Buckwheat, far right, is a more opaque brown.

Source: http://greenjeane.blogspot.com/2012/05/more-honey.html

Honey color is also indicative of its potency and has been found to correlate with **antioxidant levels**. Traynor references a study that tested antioxidant activity in fourteen different honeys. The top three scoring the highest were dark-colored honeys: Illinois buckwheat, California sunflower, and Hawaii Christmas berry. Based on research available, **antibacterial activity** (distinct from enzyme activity) also follows this trend. Darker honeys (avocado, honeydew, Black Forest) generally have higher antibacterial effects than paler—and tastier—honeys such as sage, acacia, and wild raspberry.

Produced almost exclusively in New Zealand, the dark amber **Manuka honey** is the most widely used and effective medicinal honey, especially in wound treatment. Its superior antibacterial activity is due to the non-peroxide component, methylglyoxal. Dr. Peter Molan from the University of Waikato devised the **Unique Manuka Factor** (UMF), which rates the antibacterial activity of honey after enzymatic activity for hydrogen peroxide is destroyed. A UMF of 0-4 has undetectable activity, while a UMF of 10 or higher is accepted for clinical use.

Listed below are common and gourmet honey types found all over the world:

Name	Where found	Notes
Acacia	Italy, France, China	Transparent to pale yellow; granulates slowly
Buckwheat	Most states	Dark, full-bodied; often used medicinally
Clover	Northern tier states	Popular worldwide; white to amber colors
Eucalyptus	California, other states	Distinct flavor; somewhat medicinal scent
Fireweed	Washington, Alaska	Herb source, light color
Heather	Scotland, Ireland	Dark, thick texture; slight tinge of purple
Lavender	France, Italy, U.K.	Granulates smoothly, popular in Europe

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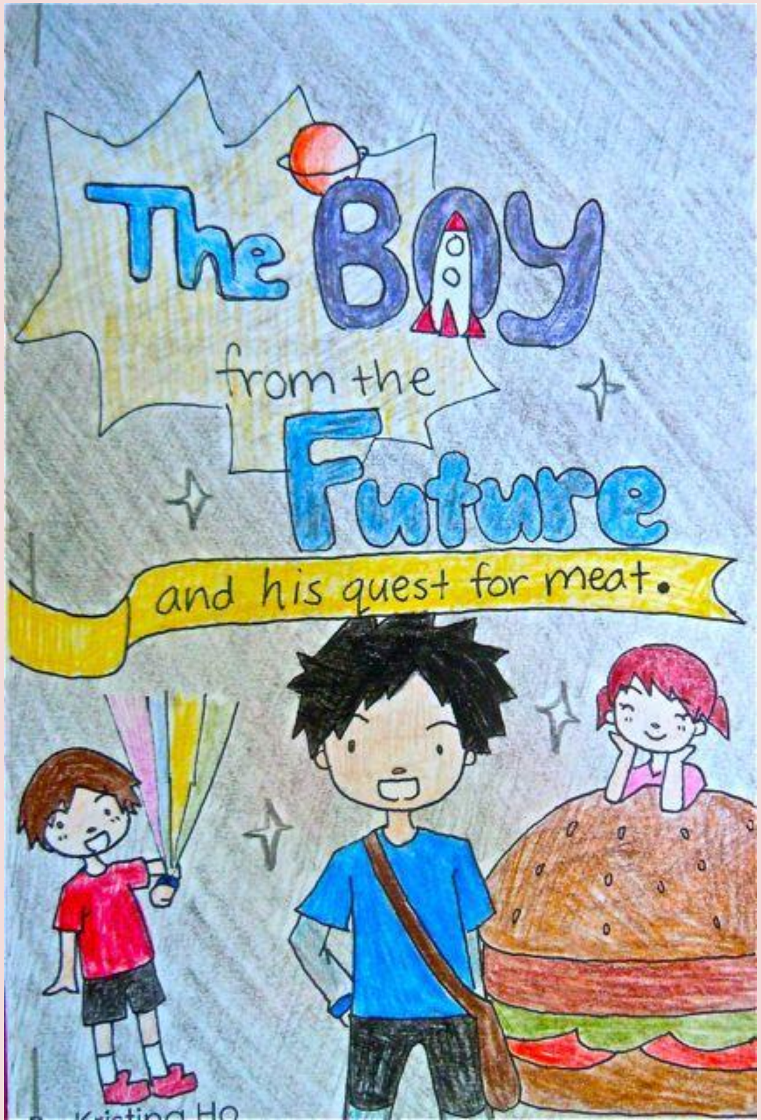
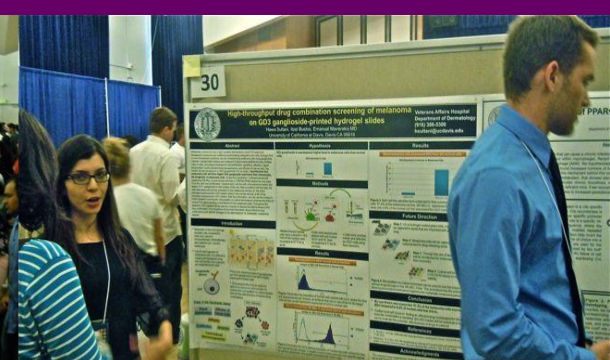
K.H. (animal biology major) rekindles her love of art and blends it with her love of science to create a children's book on the prognosis for cultured stem-cell meat and its environmental advantages.



Popular Science Project: Impacts on Transfer/Transformation of Learning

- Changes students' attitudes to the relationship of writing and science—expands appreciation, definitions, and possibilities
- Rhetorical focus pushes students to think of effects of science beyond school, into the future
- Links learning and scholarly expression with multimedia tools of social networking and community building



For further investigation…

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UC Davis University Writing Program http://writing.ucdavis.edu

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