

## Incorporating Student Ideas and Interests

The General Physics course at Colorado State University is largely populated by students in the life sciences. Most of these students are juniors and seniors with a wealth of background in the fields whose content we seek to integrate. We have started holding regular sessions with students to brainstorm possible topic areas for lecture and lab exercises. This has provided pedagogical benefits that go far beyond the identification and development of topic areas and has provided ideas for new strategies for the course.

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One Idea.

I like to use these talks to present one idea, one idea that anyone can simply implement. In this talk, I'll talk about how I set up a "salon" style event at which students gave me feedback and ideas for incorporating life science topics in the class.

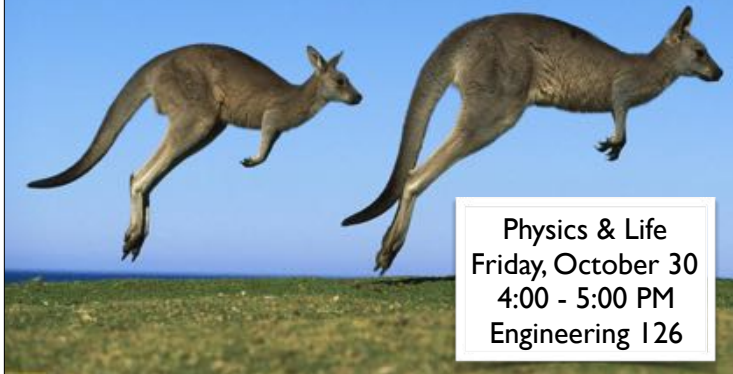


Day Job

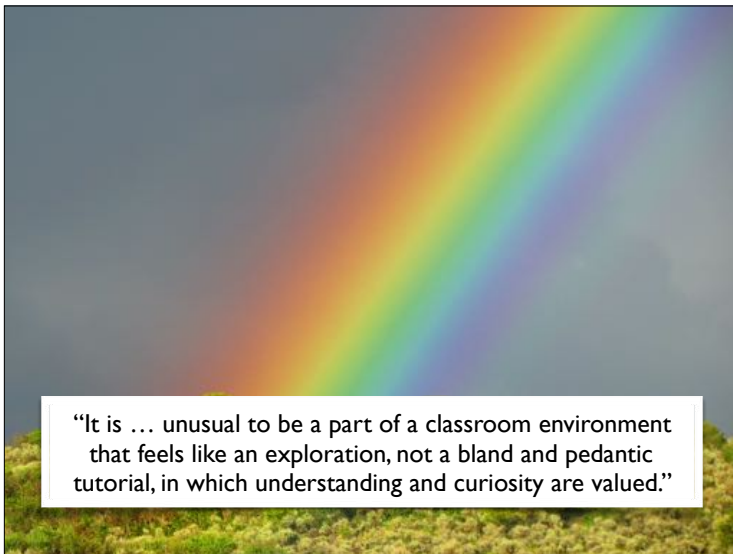
Folks think of me as the Little Shop of Physics guy, which I am, but my day job—what I get paid for—is teaching large intro classes.

## Energy & Efficiency

*How does energy efficiency determine the size, shape and structure of different animals?*



This is an invite to a Physics & Life session for students. The format was simple: We sat around a room and simply talked about ideas. I served as moderator.



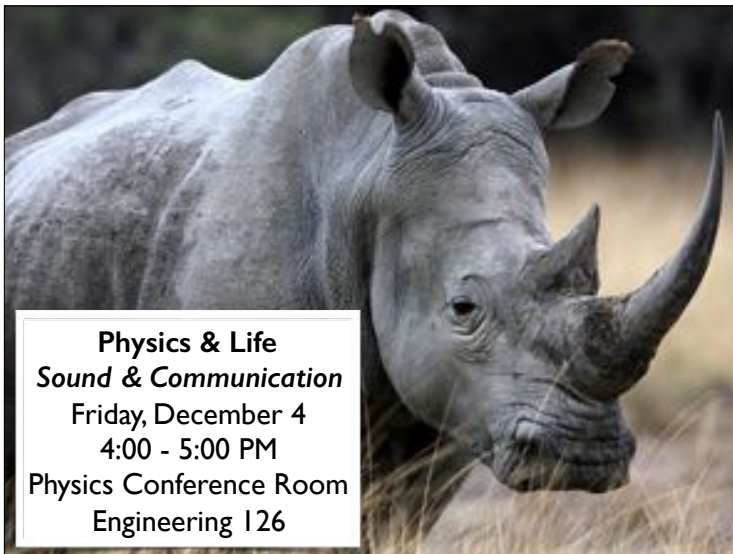
This is a quote from a student. I'd expected to get ideas from students, but I didn't expect the affective gains that I saw. The sessions were much appreciated by students, and they showed students that I cared about their interests and how to make the class better match them.



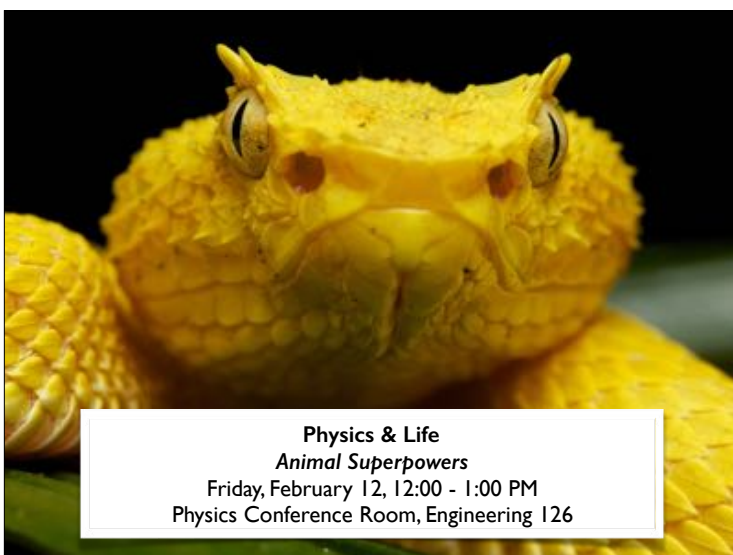
Here are some of my notes, showing ideas that students presented and discussed.



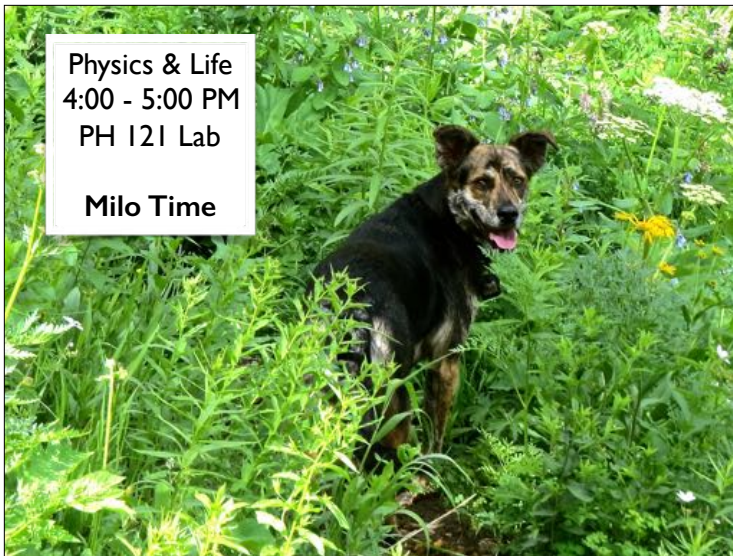
I got to hear how students talk about certain concepts, such as energy and free energy. I could then match my class presentations to how they speak about the concepts. The students in the class are in the biological sciences, for the most part. The way they discuss concepts is a reflection of how they talk about things in their classes. So this helped me present information coherently with other disciplines.



Another invite, with a specific topic.



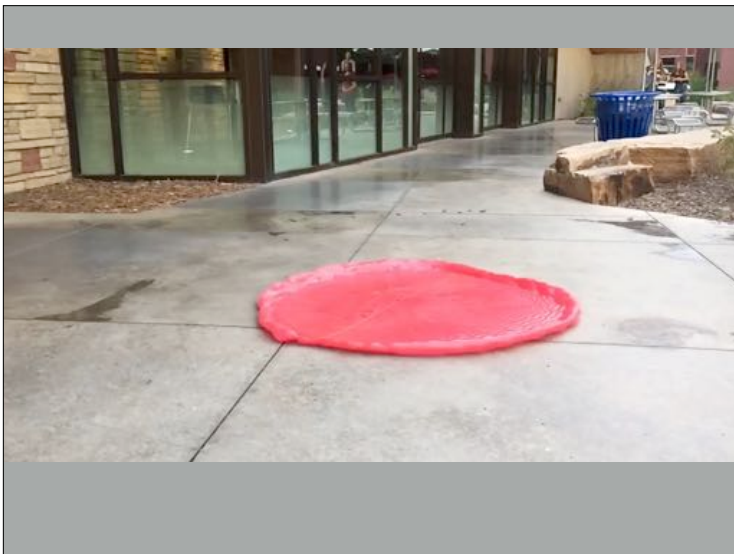
More effective were wide open topics like this. Question: What are things that animals can do that, truly, are superpowers? I got a lot of great discussion on this.



Once in a while, I had sessions in which I just brought my dog in and let folks play with him. These were informal sessions at which students talked about their lives, their concerns. I got a lot of good ideas from them about the class.

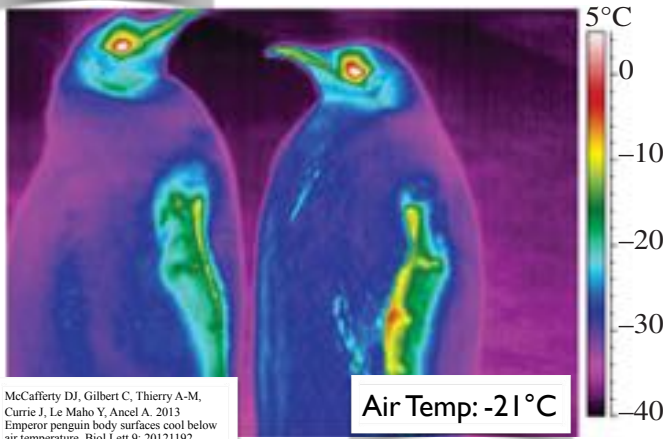
64. **||||** The maximum energy a bone can absorb without breaking is surprisingly small. For a healthy human of mass 60 kg, experimental data show that the leg bones of both legs can absorb about 200 J.
- BIO**
- From what maximum height could a person jump and land rigidly upright on both feet without breaking his legs? Assume that all the energy is absorbed in the leg bones in a rigid landing.
  - People jump from much greater heights than this; explain how this is possible.
- Hint:** Think about how people land when they jump from greater heights.

For instance, I changed the homework due date from Wednesday to Friday and started addressing things folks had seen on the homework in class, using this teachable moment.



Video of balloon hitting the ground – a lot of elastic energy storage.

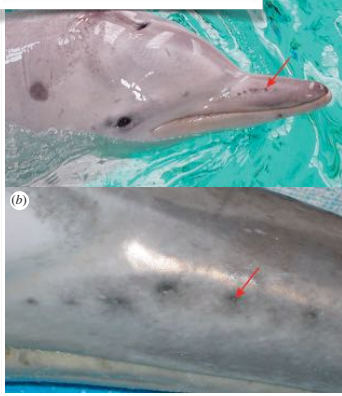
### Chilly Penguins



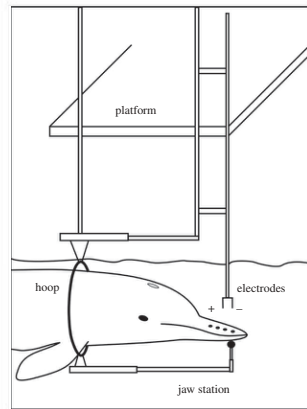
McCafferty DJ, Gilbert C, Thierry A-M, Currie J, Le Maho Y, Ancel A. 2013 Emperor penguin body surfaces cool below air temperature. *Biol Lett* 9: 20121192.

Example of topic students told me about: Emperor penguins can have feathers that are colder than the air temperature due to radiation.

### Sensitive Dolphins



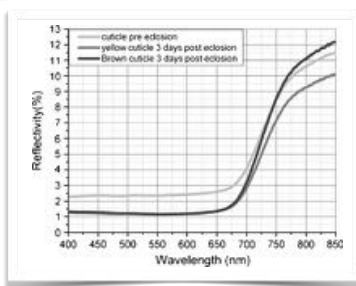
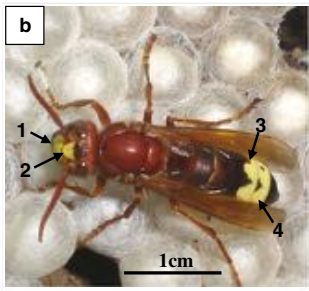
N. U. Czech-Damal et al., Electrorception in the Guiana dolphin, *Proc. R. Soc. B* (2012) 279, 663–668



Field strength: 0.05 V/m

A dolphin that senses electric field.s Vibrissal crypts—normally have hairs, that sense motions in the water. But they lose the hair, keep the sensors.

### Solar-Powered Hornets



Marian Plotkin & Idan Hod & Arie Zaban & Stuart A. Boden & Darren M. Bagnall & Dmitry Galushko & David J. Bergman, Solar energy harvesting in the epicuticle of the oriental hornet (*Vespa orientalis*), *Naturwissenschaften* (2010) 97:1067–1076

Doing chemical work like in the liver. Structures overlying the pigment reduce reflection, increase absorption.



Questions?

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