



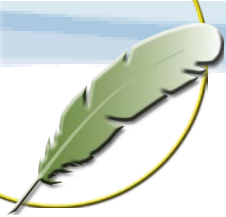
# Using Animal Sounds and Videos to Teach Physics: a Collaborative Curriculum Development Effort

Colleen McLinn

October 2, 2008



CORNELL LAB of  
ORNITHOLOGY



## Cornell Lab of Ornithology



“Interpreting and conserving the earth’s biodiversity through research, education, and citizen science focused on birds”

## Macaulay Library



The world’s largest  
archive of animal sounds  
and associated video.





## A Digital Rich Media Archive of Animal Behavior



DUE-332872

PI: Jack Bradbury



# Birds and Physics

## Facilitating K-12 Selection



### Pilot whales

Long-finned pilot whales, also known as blackfish, are highly social and vocal animals. In this recording, clicks, whistles, and several other vocalization types may be heard.

Catalog #110808 (3 minutes, 54 seconds) Paul J. Perkins [PLAY](#) [VISUALIZE](#)



### Weddell seal

Weddell seals make over 30 types of calls. Many of these sounds are used by adult males during the breeding season to defend breathing holes in the ice, presumably allowing them greater access to females.

Catalog #123436 (43 minutes, 30 seconds) Jeanette A. Thomas [PLAY](#) [VISUALIZE](#)



### Killer whales

These killer whales are feeding on herring by concentrating the school into a tight ball and then stunning the fish with a blow from their strong tails. Communication between the animals as well as the impact of their tails on the balls of herring may be heard.

Catalog #123122 (4 minutes, 3 seconds) Sofie Van Parijs [PLAY](#) [VISUALIZE](#)



### Harp seal

This harp seal pup is only a few days old; his mother will leave him on his own after about 12 days. Many pinniped mothers may use these calls to identify their own pup after being separated.

Catalog #123701 (1 minute, 16 seconds) Ilse C. Van Opzeeland [PLAY](#) [VISUALIZE](#)



### Marine animals

In this recording, many animals can be heard under the ice of Arctic waters. The long falling calls in this recording are adult male bearded seals attempting to attract a mate. Also heard are bowhead whales and beluga.

Catalog #112595 (14 minutes, 29 seconds) Donald K. Ljungblad [PLAY](#) [VISUALIZE](#)



The screenshot shows the Macaulay Library software interface. It features a central video player displaying a bird on a branch. Below the video is a spectrogram showing frequency over time. To the right, there are several settings panels: 'Settings' (Audio, Video, General, Waveform, Spectrogram), 'Info' (Macaulay Library, Catalog #, Species name), and 'Authoring' (Contrast, Brightness, Y-axis scale, Axis offset, Color, Power Spectrum, Save). The interface is powered by LiveStage.



DUE-0532786



## Purpose: Demonstrate meaningful uses of rich media



- Elementary
- Middle
- High School



## Approach: Strategic Partnerships

- Science content specialists
- Education and outreach specialists
- Teachers
- Students





**Many of our teachers  
have asked us, “Isn’t  
there some way to  
combine biology and  
physics?”**



Monica Plisch  
Assistant Director of Education  
American Physical Society



# Birds and Physics

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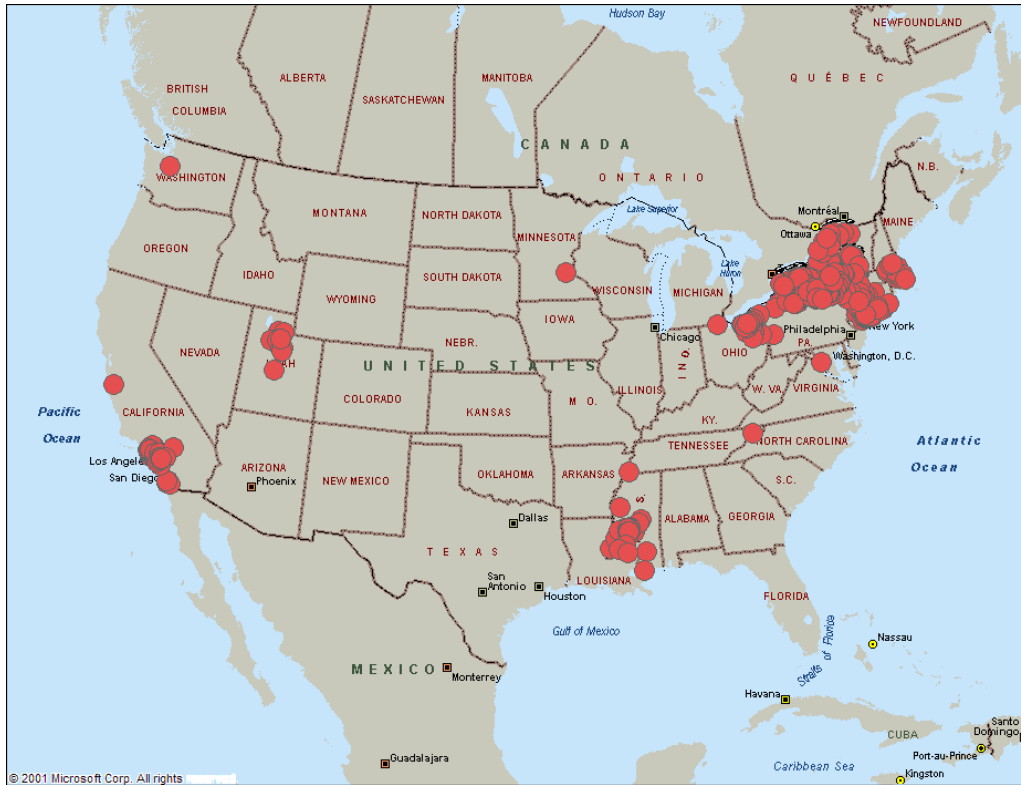
## Why study animal behavior?



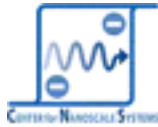


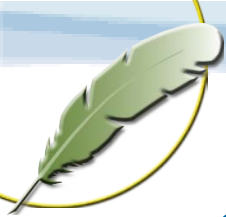


## Partnership with CIPT



- Lending libraries
- Downloadable lessons
- Workshops for teachers and students
- 700 Teachers
- 10 states and Singapore





## CIPT Lab Development Process

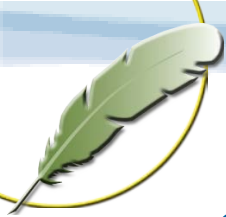
### Spring Year 1:

- Idea Meeting
- Refine Proposals
- Form Teacher-Scientist teams

### Summer Year 1:

- Show and Tell with prototypes





## CIPT Lab Development Process



Fall Year 1 -

Spring Year 2:

- Piloting in classrooms

Summer Year 2:

- Public debut at summer institute
- Available through lending library



## Partnership with WFL BOCES

- 25 component school districts in four counties in central New York
- Support services, science kit distribution, professional development

The screenshot shows the homepage of the Wayne-Finger Lakes Board of Cooperative Educational Services (WFL BOCES). The page features a blue header with navigation links for "Site Map" and "Contact Us", and a search bar labeled "Site Search : enter keyword here" with a "GO" button. The main banner area includes a large image of a group of people, a central logo, and the text "WAYNE-FINGER LAKES BOARD OF COOPERATIVE EDUCATIONAL SERVICES". Below the banner is a quote: "We recognize & support staff as our most important resource." The footer contains a navigation menu with links for "About Us", "Sites & Locations", "Departments & Services", "Component Districts", "WFL BOCES Initiatives", and "Publications". A "Quick Links" section at the bottom left includes "Welcome to W-FL BOCES" and "W-FL News".



## WFL BOCES Methods

- Recruit active or retired teachers with complimentary interests to work in teams and develop lessons
- Advised by science content specialist and education specialist
- Pilot lessons in own classrooms first
- Available on loan from science resource center; training/orientation offered as needed



## Guiding Principles

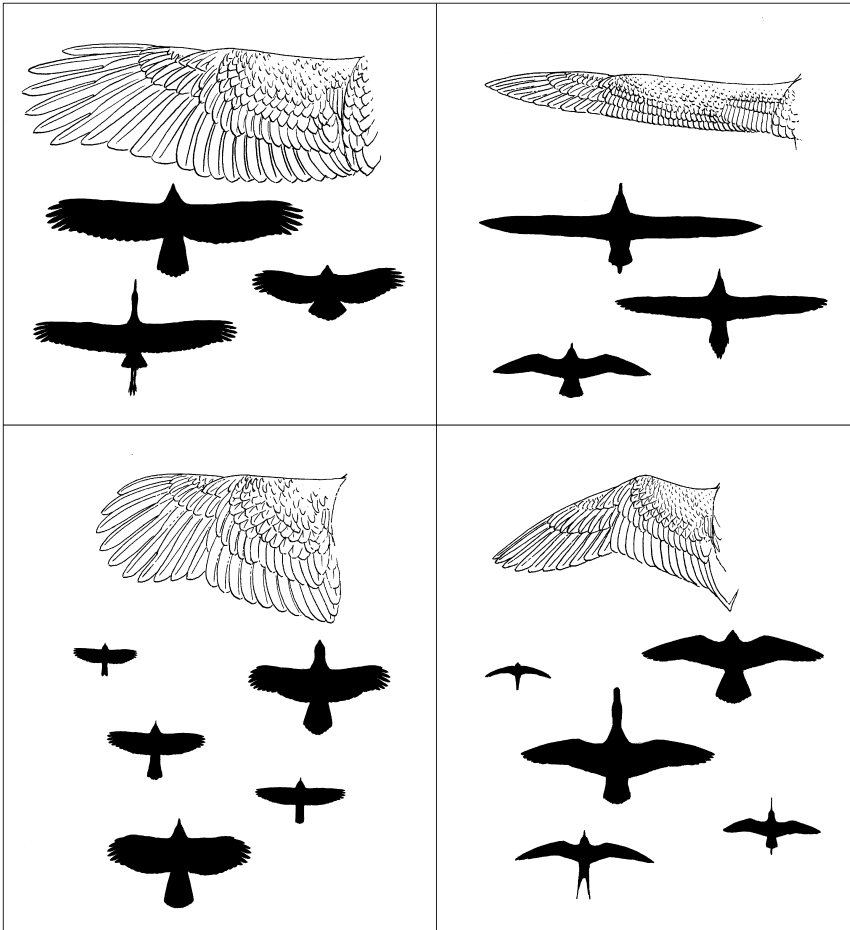
- Start with compelling questions about animals, the physics will follow!
- 5 E's instructional model
  - Engage
  - Explore
  - Explain
  - Elaborate
  - Evaluate



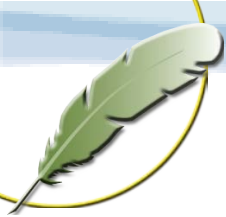
**Elementary examples:  
What are birds' physical  
adaptations and how  
does form relate to  
function?**



## Wing shapes and flight styles







## Beaks as simple machines



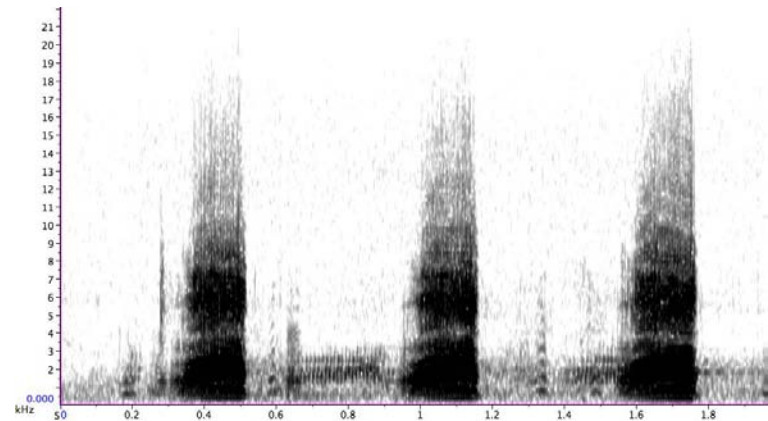
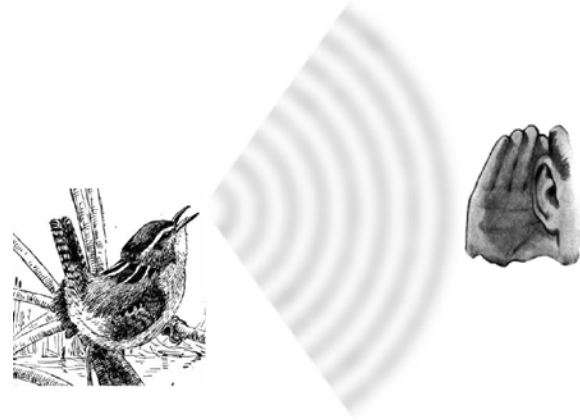


**Middle school example:  
How do animals convey  
information through  
variations in their  
sounds?**



## Frequency, duration, amplitude

Angry	Warning
Sad	Nervous

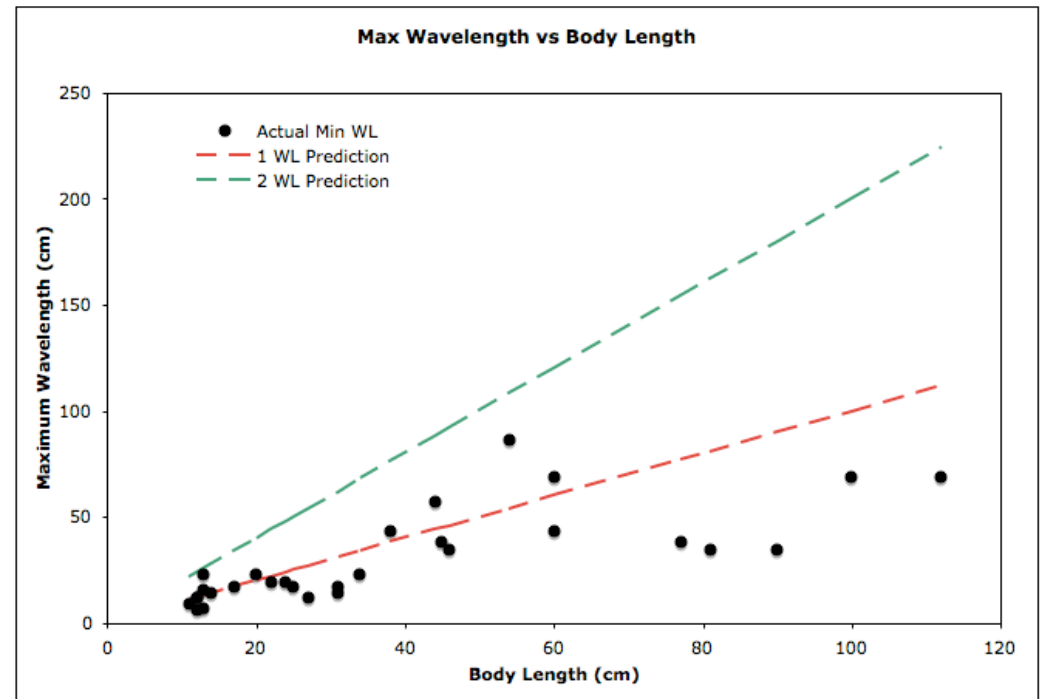
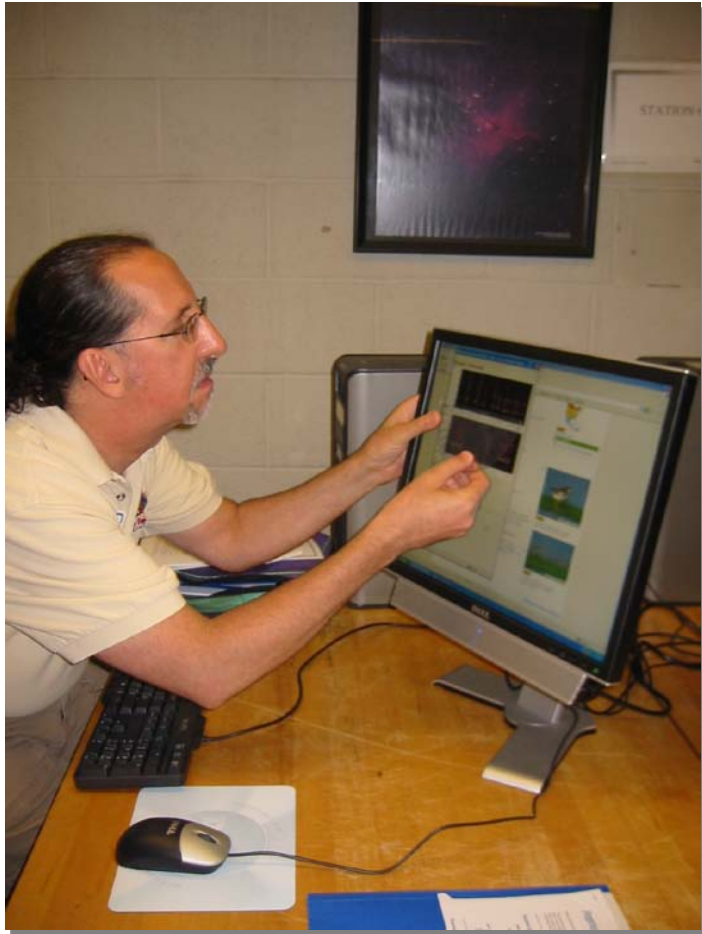




**High school example:  
How are animals like  
speakers?**

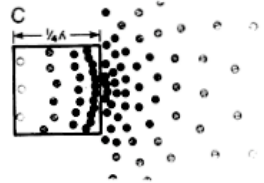
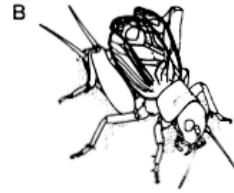
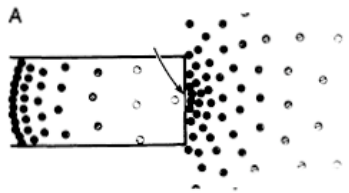


## Body size and wavelength





## Body size and wavelength





**High school example:  
How are feather colors  
formed?**



## Light Waves and Feather Color

Examples of Interference in Nature



Peacock Feather

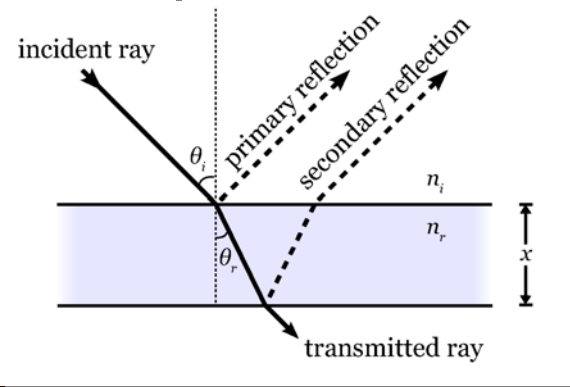
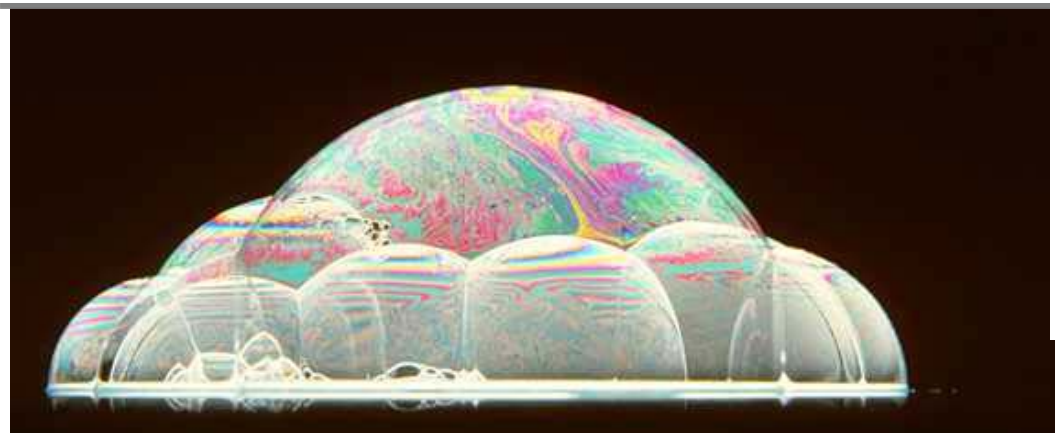


Abalone Shell



Iridescent Opal

Figure 9







## Light Waves and Feather Color





**“I like this lab because it combined chemistry, biology, physics, and math. Just like the real world.”**

11th grade student



## Benefits

- Teachers involved in content creation: so actually lessons they need and want
- Tied tightly to standards: so could actually be adopted during year
- Lasting partnerships with much revision and testing
- Flexible and low-cost or free: adopt one lesson or whole unit



## Benefits

- Emphasizes connections among disciplines
- Cutting-edge and authentic science content
- Conceptual introduction to math and graphical representations
- Use of technology and rich media supports visual mental models



## Challenges

- Knowing where to start
- Striking the right balance of physics and biology
- Distance and ability to meet/check-in
- Keeping current on cutting-edge science
- Accurately representing complex, real-world situations with physical models
- Massive amount of equipment, prep, construction, storage



## Challenges

- Many roles for science content and education experts--also two bosses
- Teachers often wedded to how they “normally” teach (abstract concepts and equations before concrete examples)
- “I already have a lab on this.”
- “If it’s not in the standards I won’t do it.”
- Inconsistent writing styles/abilities
- Planning for technology hurdles or snafus



# Lessons Learned and Recommendations

- Tap into existing outreach groups (lending libraries, teacher professional development programs)
- Find the *right* partners (grade level, location, quality standards, similar goals)
- Evaluate teachers carefully--have submit sample lessons
- Present united front and talk among science and education partners often



# Lessons Learned and Recommendations

- Be careful about timing--use school breaks
- Schedule regular check-ins
- Milestone deadlines and payment at intervals
- Expectations for feedback/turn-around time
- Use wiki/website to organize versions and share ideas or comment on drafts





# Lessons Learned and Recommendations

- Budget appropriately, and don't buy equipment in bulk until you've extensively tested it
- Allow plenty of time for initial research, idea generation, revisions
- Clear expectations about lesson format
- Expect/hire editors to get drafts in desired style and format
- Recruit help with construction of prototypes and equipment



**Thanks!**

[birds.cornell.edu/macaulaylibrary](http://birds.cornell.edu/macaulaylibrary)



## Panel Discussion

- Your Questions????



## Panel Discussion

- Which technologies and media show the best promise for teacher adoption and classroom integration?





## Panel Discussion

- How did technical limitations such as available computer equipment and platforms affect your decisions?
- How were partners trained to use the digital tools? Was there resistance, and if so, how was it overcome?
- What design challenges did you face in creating learning environments with digital library resources, and how did you address them?