

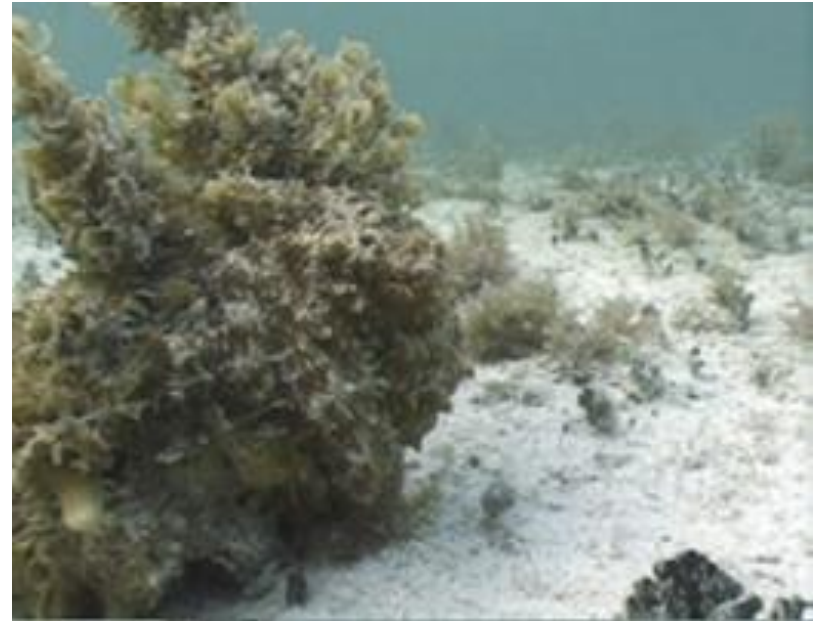
Optical Properties of Cephalopod Skin

Erzsebet Vincent
Viva Horowitz
Professor David Awschalom
Physics Department

EUREKA, UCSB
25 August 2011

Chameleons of the Sea

- Cephalopods: octopuses, squid, and cuttlefish
- Skilled at camouflage
 - Dynamic chromatophores
- Real-world applications?
 - Adaptive optical technology?
 - Dynamic camouflage
 - Filters or display screens



Chameleons of the Sea

- Cephalopods: octopuses, squid, and cuttlefish
- Skilled at camouflage
 - Dynamic chromatophores
- Real-world applications?
 - Adaptive optical technology?
 - Dynamic camouflage
 - Filters or display screens



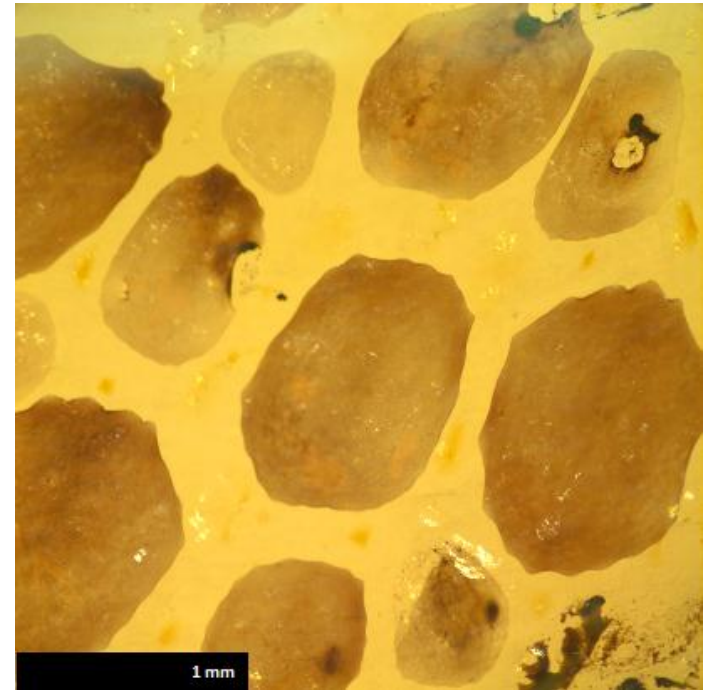
Chameleons of the Sea

- Cephalopods: octopuses, squid, and cuttlefish
- Skilled at camouflage
 - Dynamic chromatophores
- Real-world applications?
 - Adaptive optical technology?
 - Dynamic camouflage
 - Filters or display screens



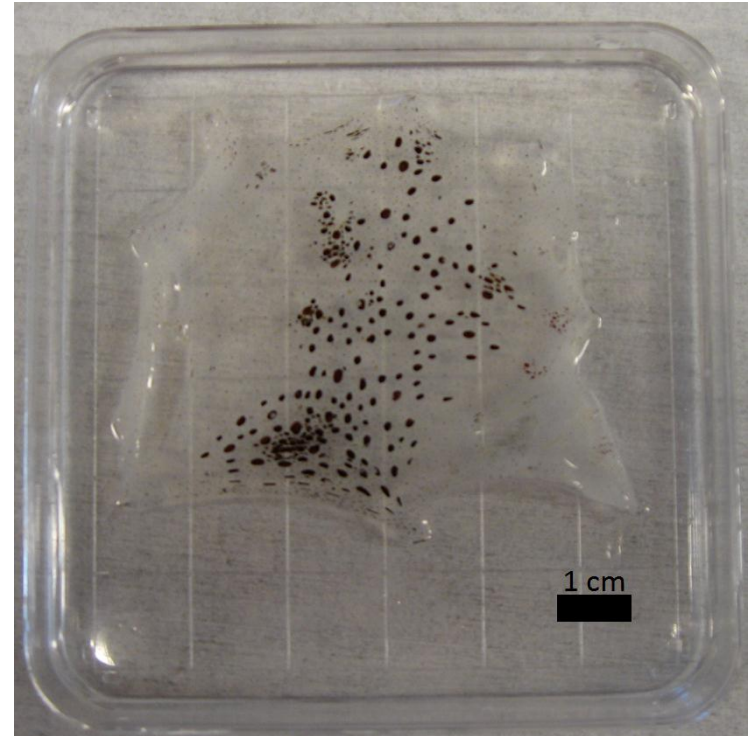
My Project: An Inquiry Into a Unique Material

- Characterize skin optical properties
 - Optical absorption
 - Fluorescence spectra at a variety of excitation wavelengths
 - Photoluminescence used to look at skin's structures



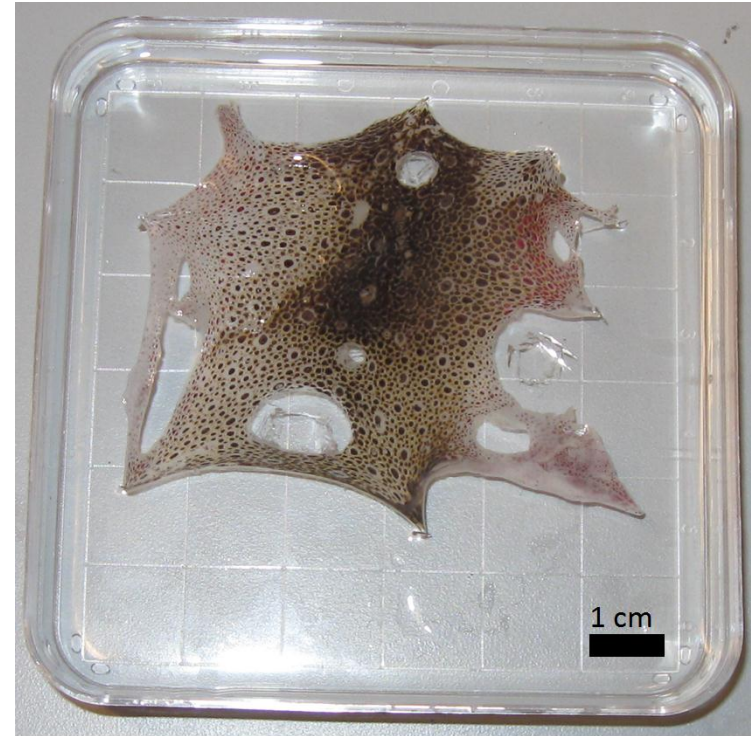
Preparation of Slides

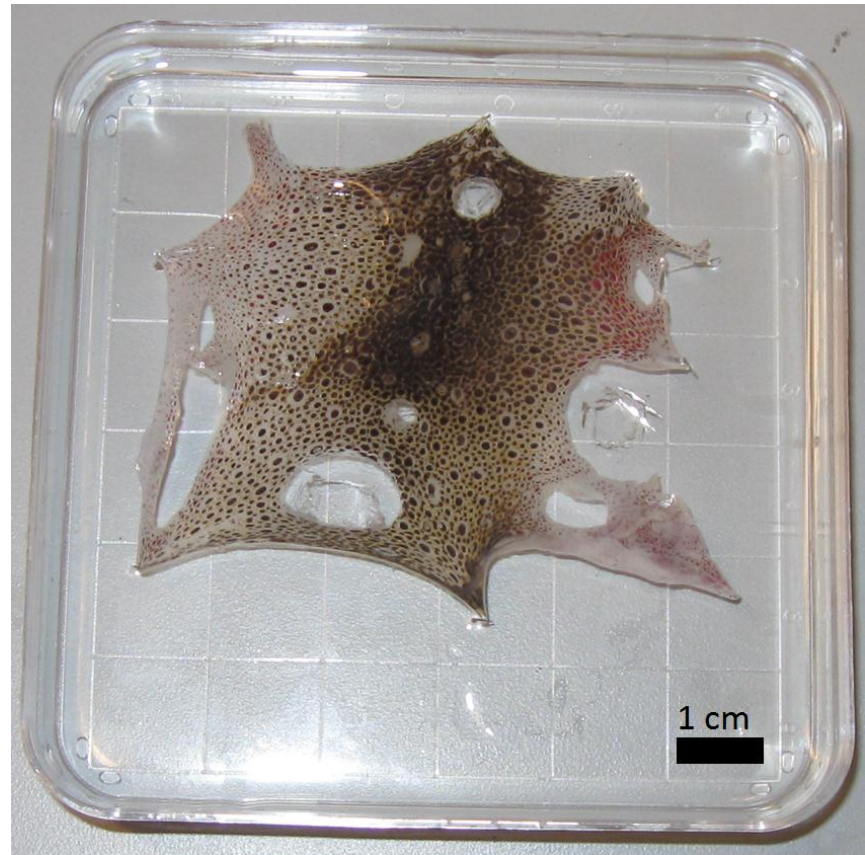
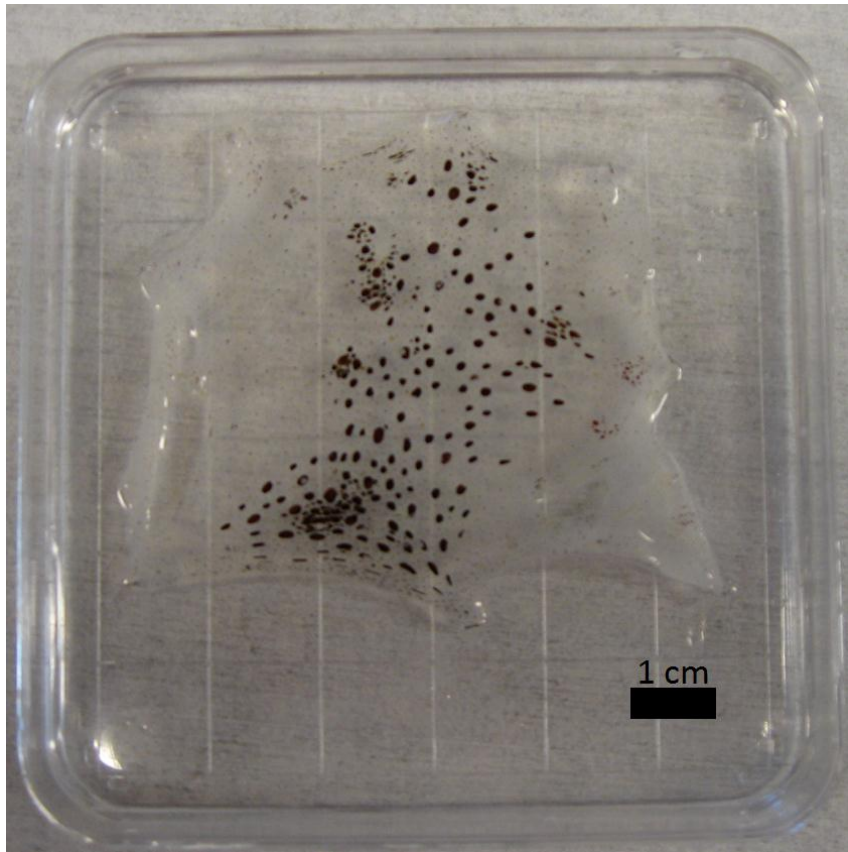
- Remove skin from squid
- Pin down and bathe in artificial sea water
- Excise pieces that contain chromatophores
- Mount on slides with a few drops of artificial sea water and possibly KCl



Preparation of Slides

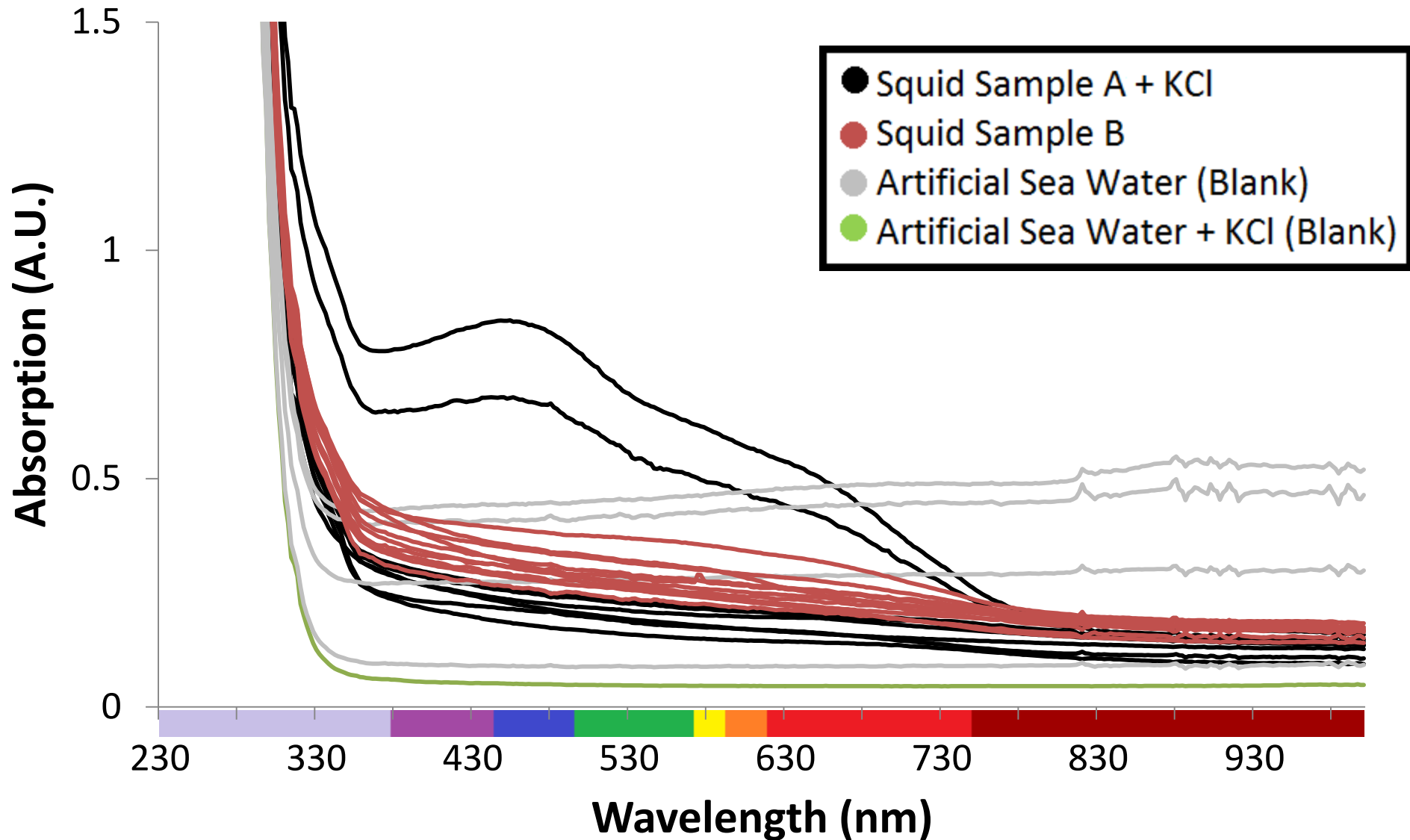
- Remove skin from squid
- Pin down and bathe in filtered sea water
- Cut out pieces that contain chromatophores
- Mount on slides with a few drops of filtered sea water and possibly KCl



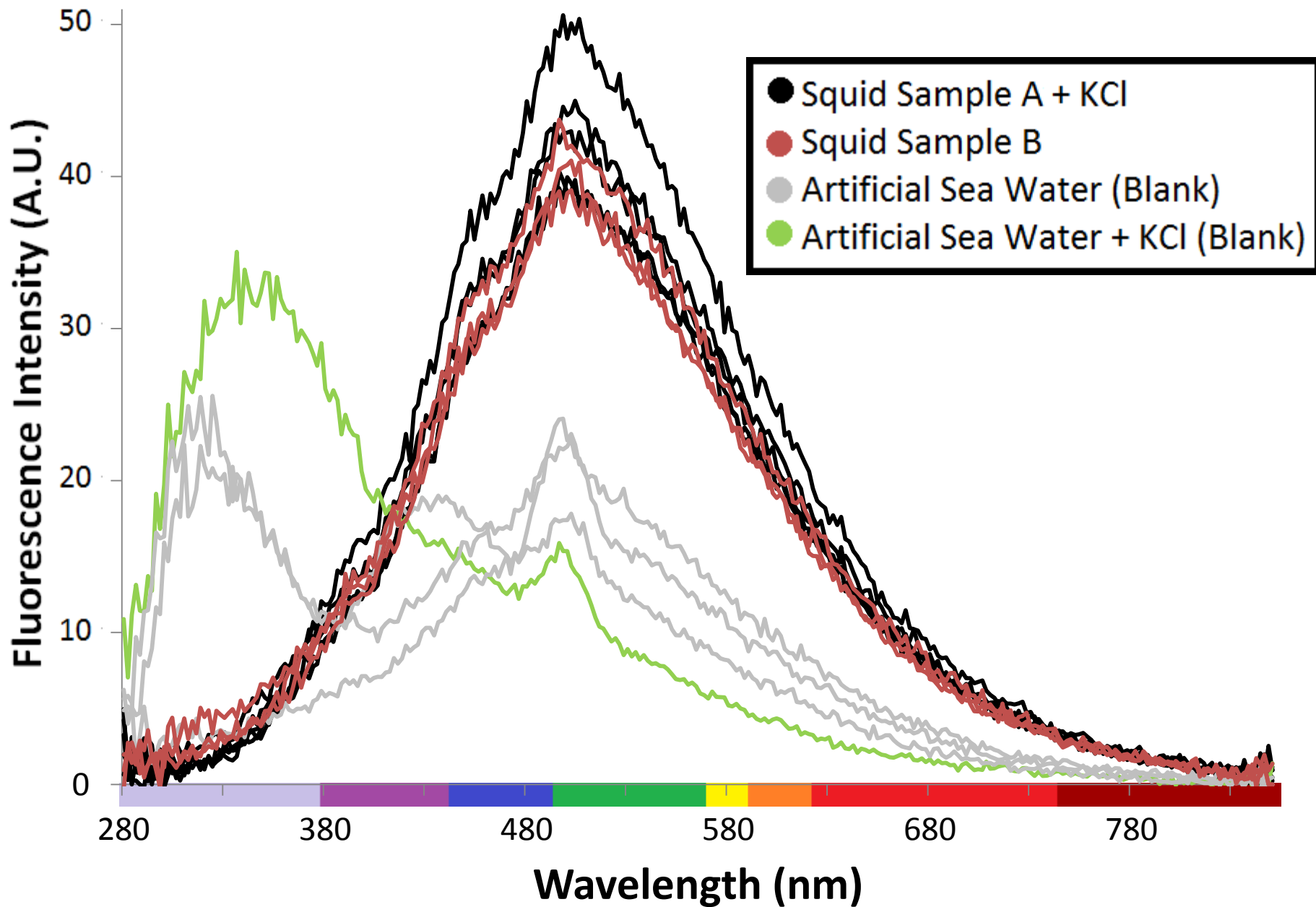


+KCl →

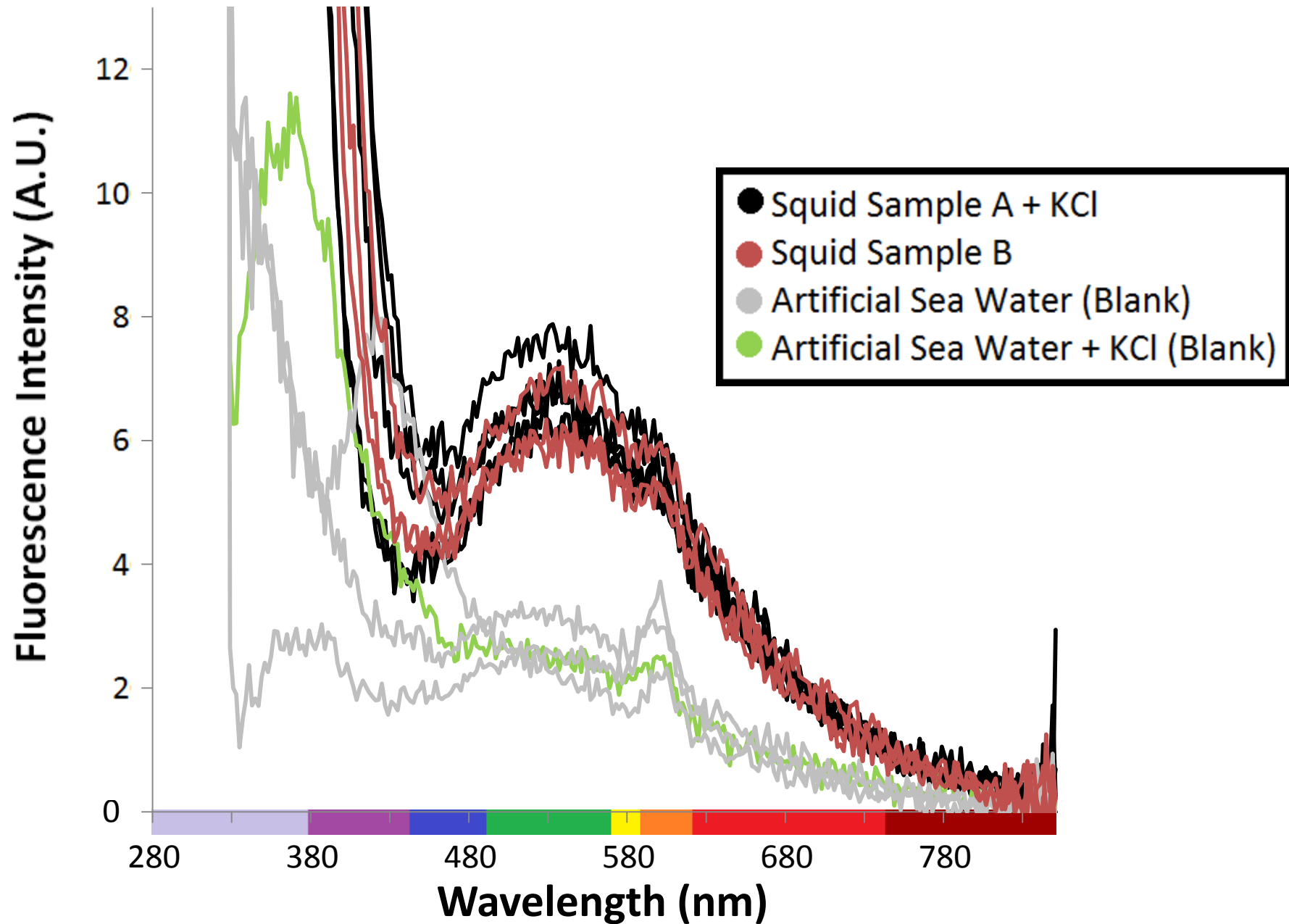
Absorption of Squid Samples vs. Blanks



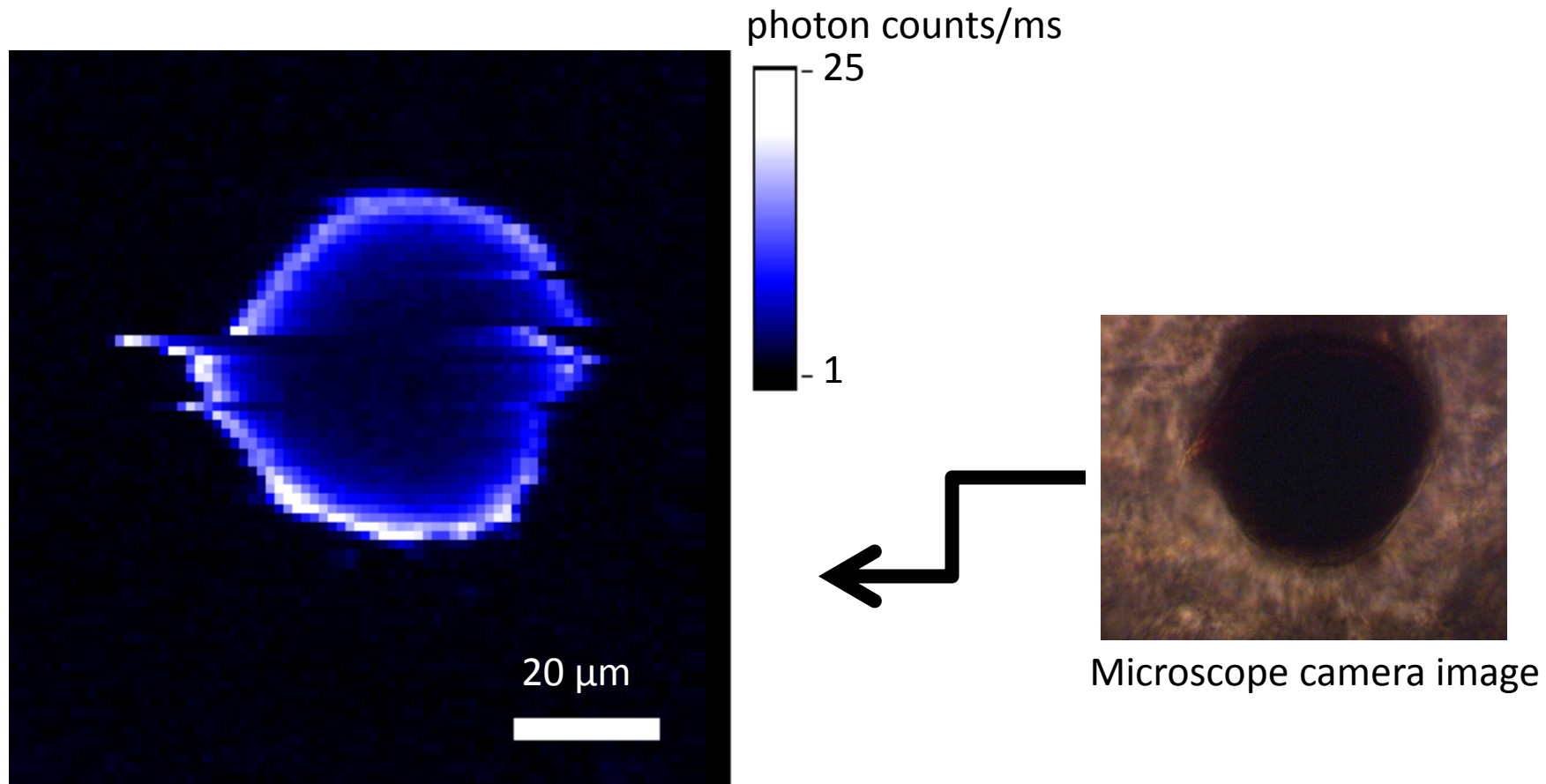
Fluorescence with Excitation at 250nm



Fluorescence with Excitation at 300nm



Confocal Photoluminescence of Chromatophore



- Image created using a 532nm excitation laser
- Repeated with 550nm pulsed laser and attained similar results

Results

- Distinct absorption spectrum
- Clearly distinguishable emission patterns when excited at 300nm and 250nm
- Chromatophores appear to fluoresce much more than the rest of the skin when excited at 532nm and 550nm

What's Next?

- More PL measurements using different excitation wavelengths
- Impacts of polarization, intensity, and interference of light, as well as of pressure
- Pigments
- Preservation

What I've Learned

- How to use a variety of instruments and techniques, including how to dissect a squid
- How important inventive critical thought is to research
- A mistake or dead end in research isn't the end of the world
- The effort that goes into an innovative investigative project...
- ...and how rewarding results are

Acknowledgements

- My mentor Viva Horowitz
- David Awschalom
- Arica Lubin, Kari Moran, and EUREKA
- William Koehl, Lee Bassett, Joe Heremans, and the rest of the Awschalom Group
- DARPA
- Daniel DeMartini, Claudia Gottstein, and Livia Mezei
- The Hanlon Group at Marine Biology Lab and the Hu Group at Harvard

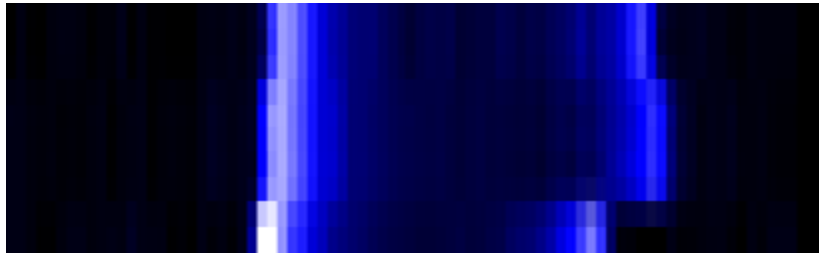
Questions?



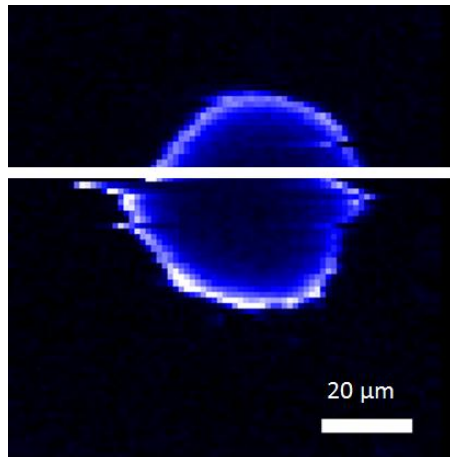
References

- **Roger Hanlon (Pictures on Slide 2-4)**
 - Hanlon, R. (June 5 2007). Cephalopod dynamic camouflage. *Current Biology*, Vol 17 No 11, R400-R404.

Are the Chromatophores Fluorescing?



- At first it looks like only the edges are bright, and that the center is dark



- Cross-section shows the center as being brighter than surrounding skin
- So yes, even the center is fluorescent