

# Molecular Shuttles

Bianca Terminello

Chemistry Major

Ventura College

Andrew Merithew

Dr. Luke Theogarajan

Electrical and Computer Engineering

# Big Picture

- Creating a molecule that uses light energy to drive sodium across a cell membrane
- Sodium ions stimulate eye nerve cells
- Transfers light energy to chemical energy
- Applications in medicine to cure macular degeneration, and better renewable energy

# The Molecule

- The molecule is composed of three parts



Crown  
Anthraquinone

Porphyrin

Carotenoid

receives negative charge

receives light

receives positive charge

# My Research

- Centers on the **sodium transporter** and creating standards of different crown anthraquinone to be tested
- Forming **Carotenoid** from the starting material

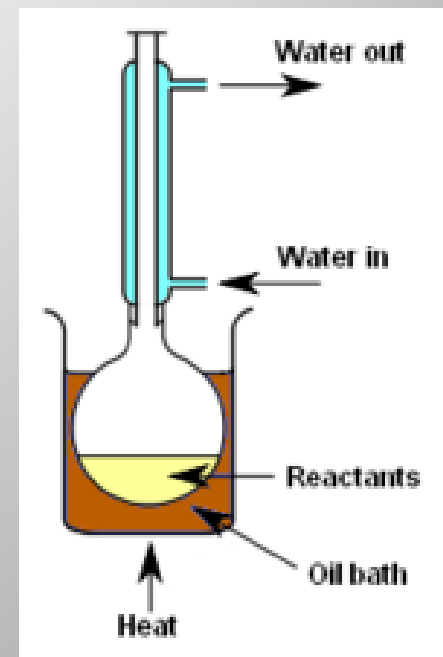
Crown  
Anthraquinone

Porphyrin

Carotenoid

# Experimental Methods

- Reactions are set up, and then purified using column chromatography
- Successful chemical yields are about 60-70%.
- Crown anthraquinone has low yields



Milton Beychok

# NMR

- NMR is short for Nuclear Magnetic Resonance Spectroscopy
- An electromagnetic pulse in a magnetic field causes particles to radiate energy back
- This radiated energy frequency is unique
- Can find structure of material



U.S. Department of Energy

# Overall Chemical Synthesis

From Starting Materials:

Anthraquinone

Chlorophyllin A  
Trisodium  
Copper Salt

Retinyl  
propionate

Porphyrin

Carotenoid

Crown  
Anthraquinone

Porphyrin

Carotenoid

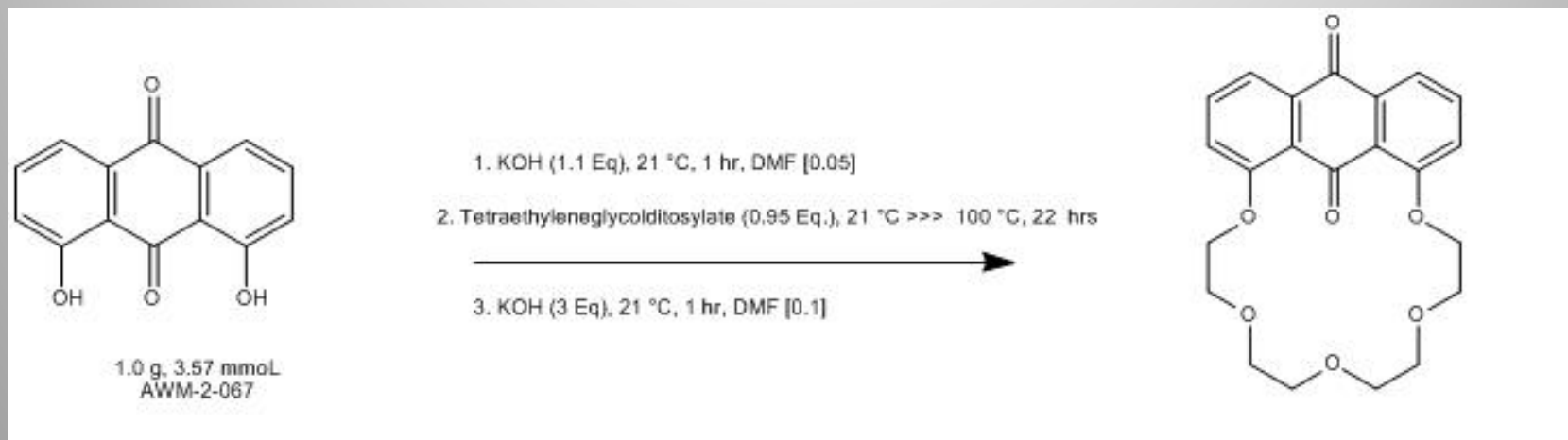
Crown  
Anthraquinone

Porphyrin

Carotenoid

Final Product

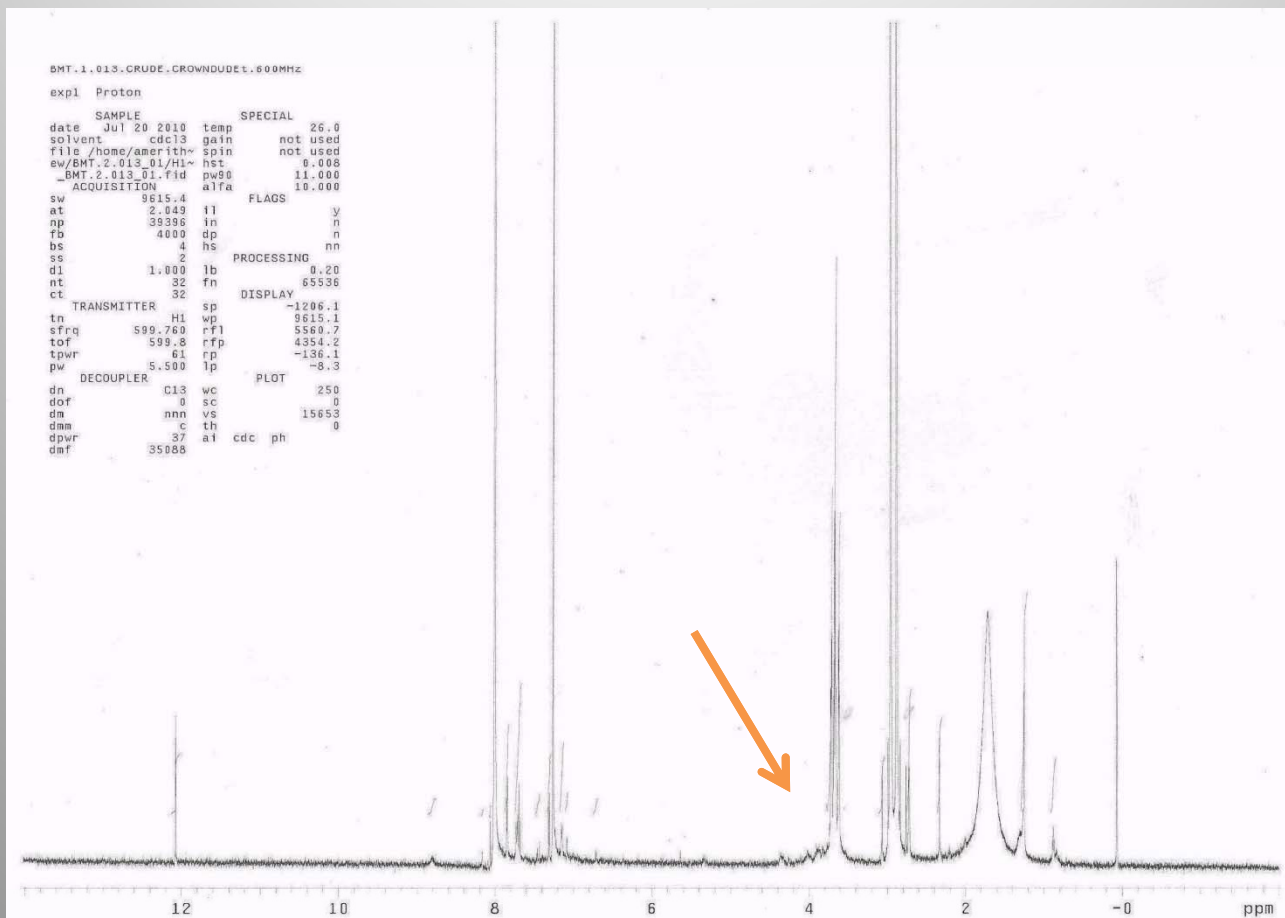
# Formation of 18 crown 6 Anthraquinone



- 18 refers to the number of atoms in the ring
- 6 is the number of Oxygen
- Size of the crown selective toward K<sup>+</sup>
- Standard for comparison

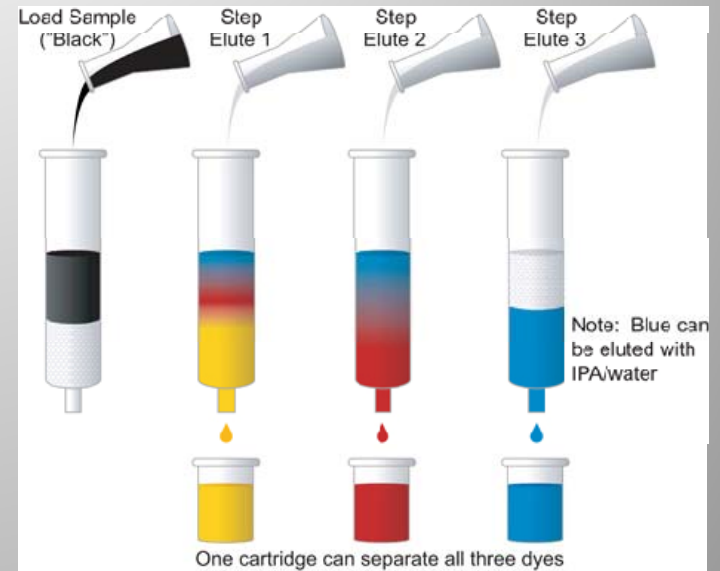


# NMR of Crude Reaction Mixture



# Chromatography

- A way to separate out the “other” part of a reaction
- Separates based on affinity to mobile phase (liquid)
- Fractions are collected & analyzed by NMR



waters.com

# Reaction 2

From Starting Materials:

Anthraquinone

Chlorophyllin A  
Trisodium  
Copper Salt

Retinyl  
propionate

Porphyrin

+

Carotenoid

Crown  
Anthraquinone

+

Porphyrin

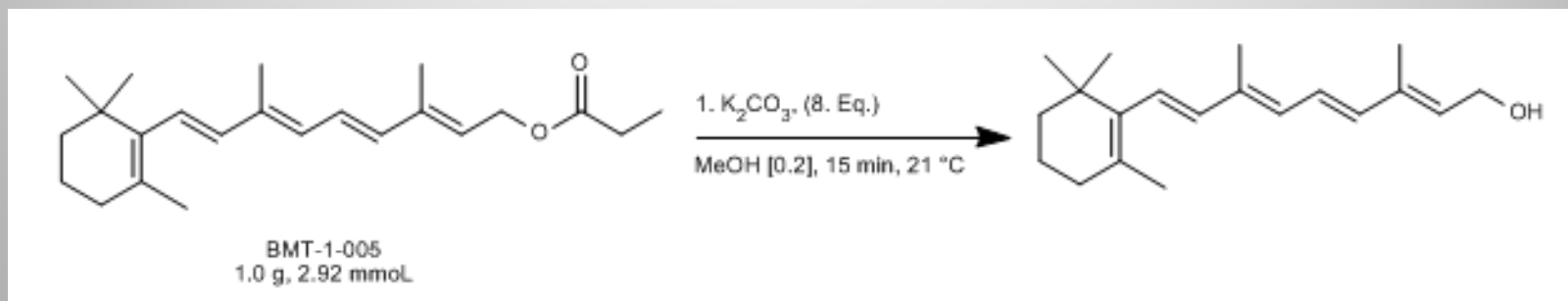
Carotenoid

Crown  
Anthraquinone

Porphyrin

Carotenoid

# Formation of All-trans Retinol



- The product is all trans retinol
- Features mild conditions, safer, selective
- Financially advantageous

# Future research/Summary

- Created standard of crown anthraquinone
- Created starting materials
- Continuing research
  - Create other standards of the crown anthraquinone
  - Couple the molecule
  - Biological and physical tests

# Acknowledgements

I'd like to thank everyone who made this internship possible including:

Dr. Arica Lubin, Dr. Jens-Uwe Kuhn, Dr. Nick Arnold, Dr. Luke Theogarajan, Andrew Merithew, Mike Collazo, all the other interns, and my friends, family and teachers who made this possible

Questions?

# Thin Layer Chromatography

