

Responding to the age-old question: “Why do I have to take orgo?”

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Brandeis University



- Liberal Arts university
- Approximately 3,500 undergraduates and 1,500 graduate students
- Most undergraduates (approximately 75%) have two or more majors



Faculty in the Sciences

- Tenure Track Research faculty (most science faculty)
 - 12 month appointment
 - Run traditional research groups
 - Responsible for obtaining grant funding
 - Teach 1 course equivalent per year
 - Evaluated/promoted based on publications
- Non-tenure Track Contract faculty
 - 9 month appointment
 - Research is not required
 - Curricular and small research grants encouraged but not required
 - Teach 4/5 course equivalents
 - Evaluated/promoted based on educational developments, student evaluations, university service



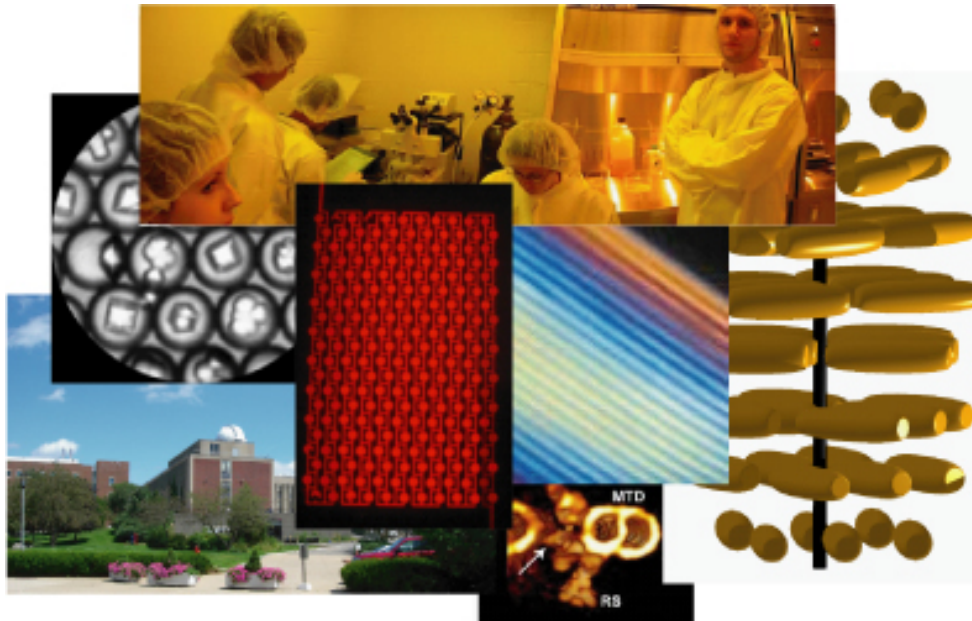
Intro Biology Laboratory

- Two semester sophomore-level introductory lab course
 - Fall: Cell Biology and Biochemistry
 - Spring: Genetics and Genomics
- Enrollment of approximately 250 students per semester
 - 75% intended life sciences majors
 - 85% intended pre-health
- Pre/Co-requisites
 - 1 year of general chemistry and lab
 - 1 year of introductory biology* (cell biology and genetics)
 - Suggested 1 year of Organic Chemistry with lab



Laboratory Redesign

- Project-based sequence
- Students work on project with unknown result
- Projects have medical relevance
- Projects are related to current research most of which is ongoing at Brandeis



Cell Biology/Biochemistry

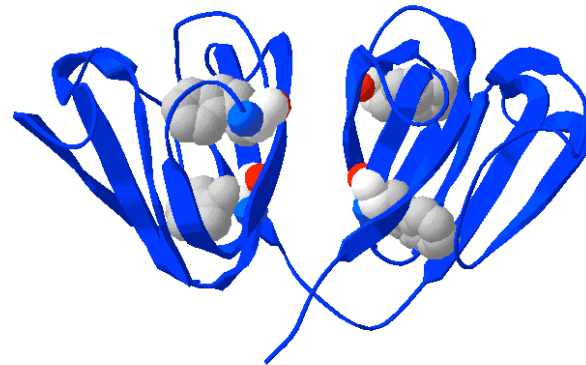
- Studying the stability of Human γ D crystallin: a protein implicated in cataract formation
- Over 30 new mutants created and characterized by Biol18 students



Normal vision



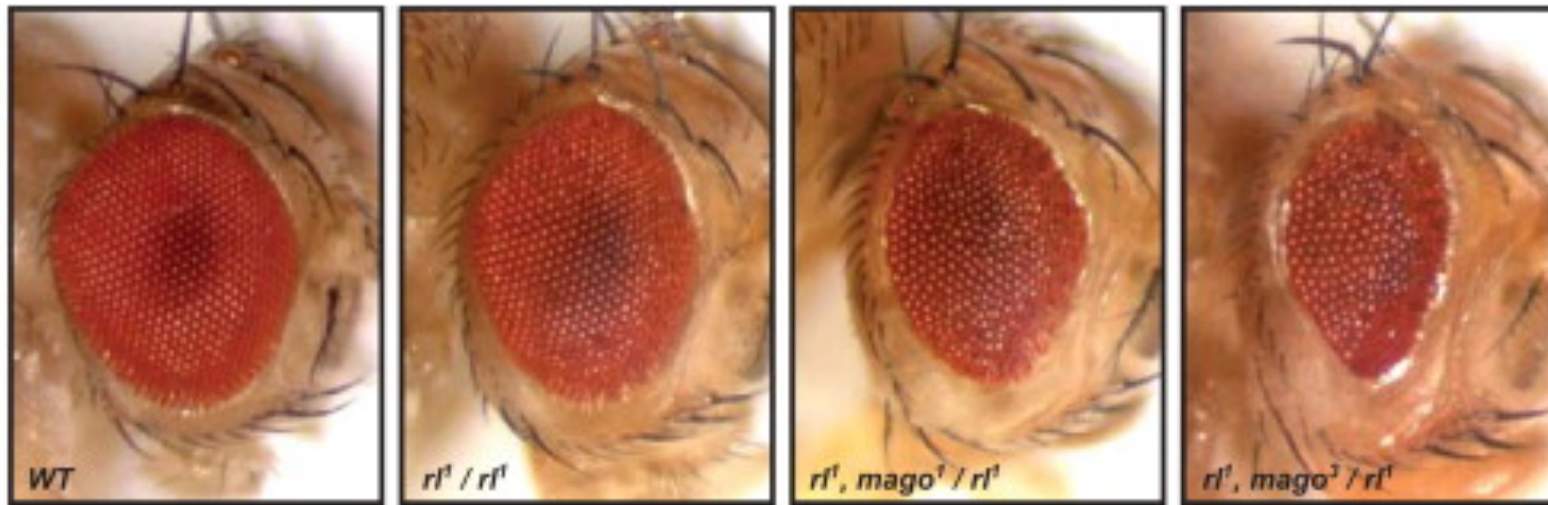
Vision through
a cataract



Genetics and Genomics

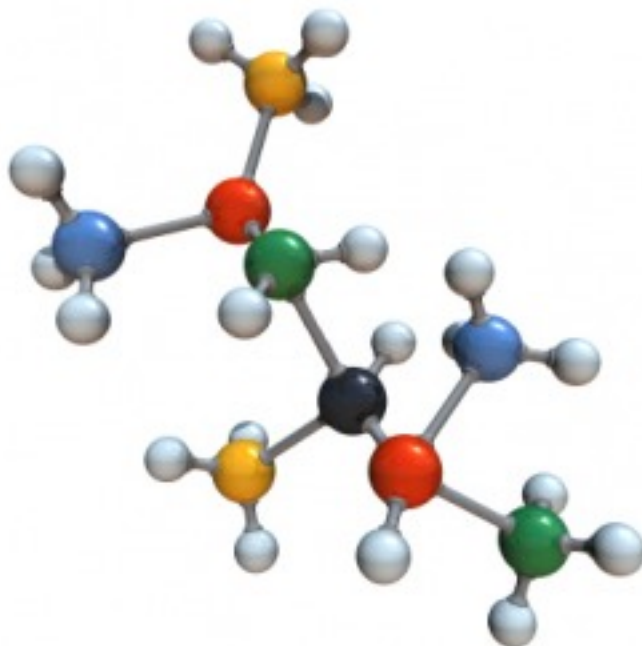


- Screening for enhancers and suppressors of *Ptpmeg*: A homology of a signaling protein implicated in human colon cancer development
- 8 new potential candidate genes were identified by Biol18

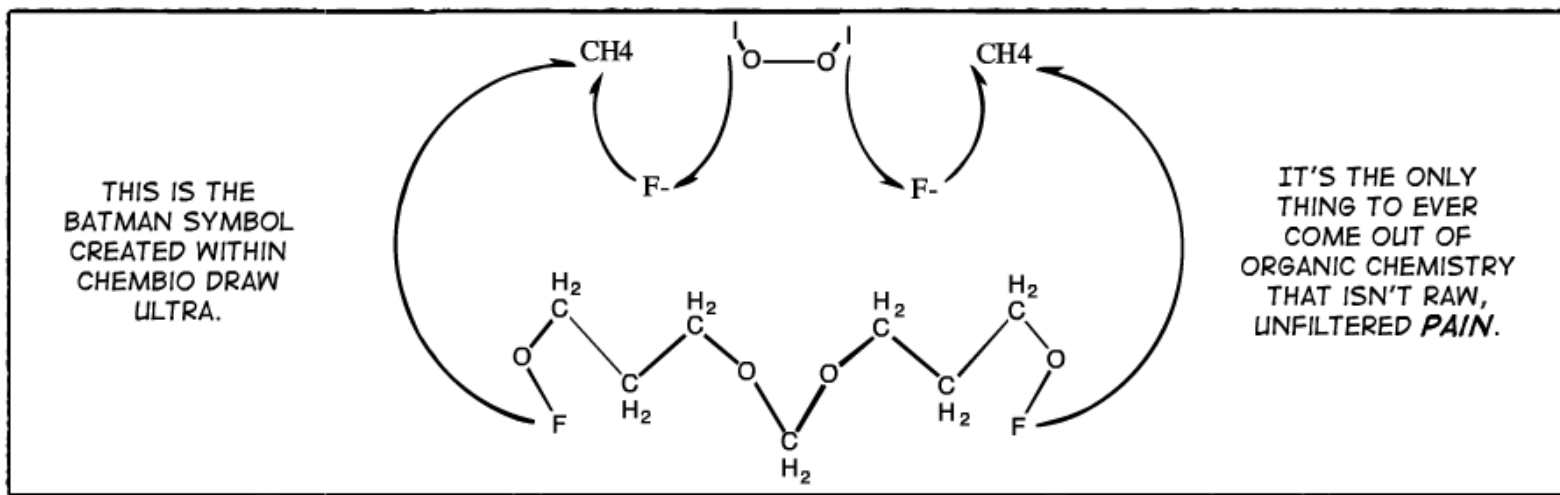


But what about ORGANIC?

- Historically, students were encouraged to take Biology and Organic their sophomore year
- As the Biology labs increased in depth, scope and intensity, students began to enroll in physics and biology their sophomore year.



But what about ORGANIC?



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But what about ORGANIC?

“...It’s easier to take Biology and Physics...”

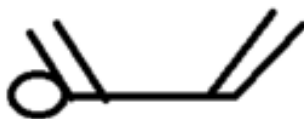
“Taking Biology and Organic is crazy!”

“Why would I want to hurt my GPA?”

“Dude, those people [who take bio and orgo] are
CRAAAAZY!”



ochem student



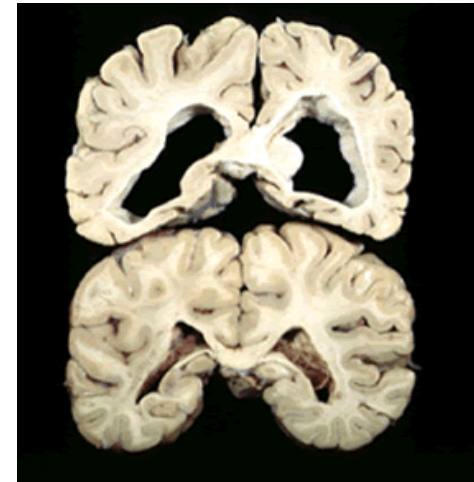
ochem student after
final (diene)
hahahaha...

What can we do?

Redesigning the introductory biology and organic chemistry laboratory sequence to create an interdisciplinary experience with medical relevance.

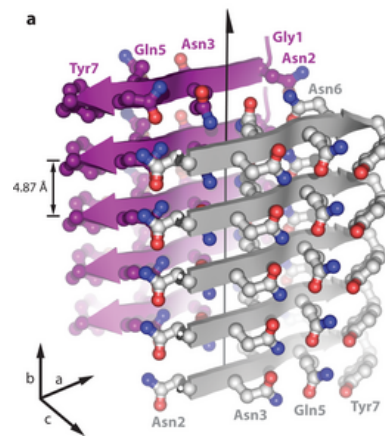
Studying Huntington's Disease

- Over 30,000 people in US have Huntington's Disease
 - Uncontrolled mood swings
 - Violent movements
 - Inevitable death in 1-5 years
- Caused by [CAG] repeats in the HTT gene
- Encode for polyQ repeats
- Individuals with >36 Q form Huntingtin's aggregates in the brain and experience neuron apoptosis
- No treatment



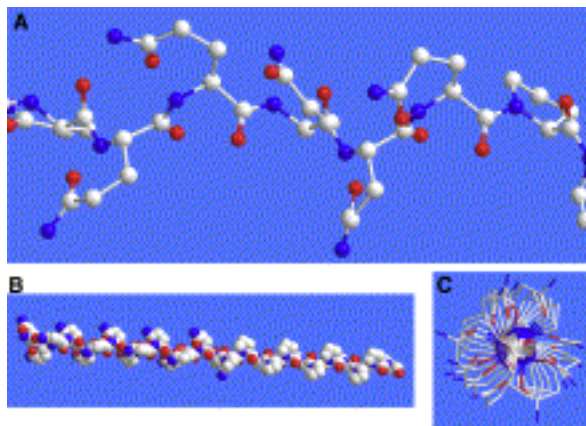
The human brain, showing the impact of HD on brain structure in the basal ganglia region of a person with HD (top) and a normal brain (bottom).

<http://kobiljak.msu.edu>

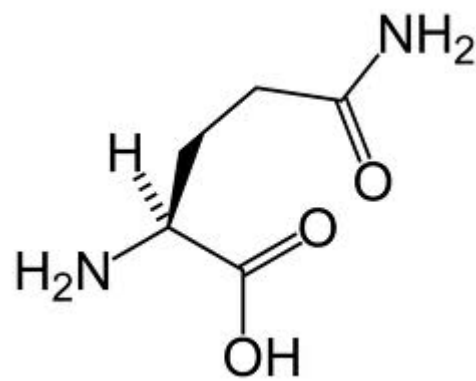
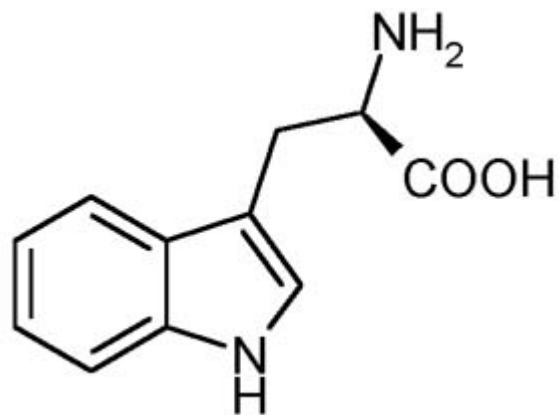
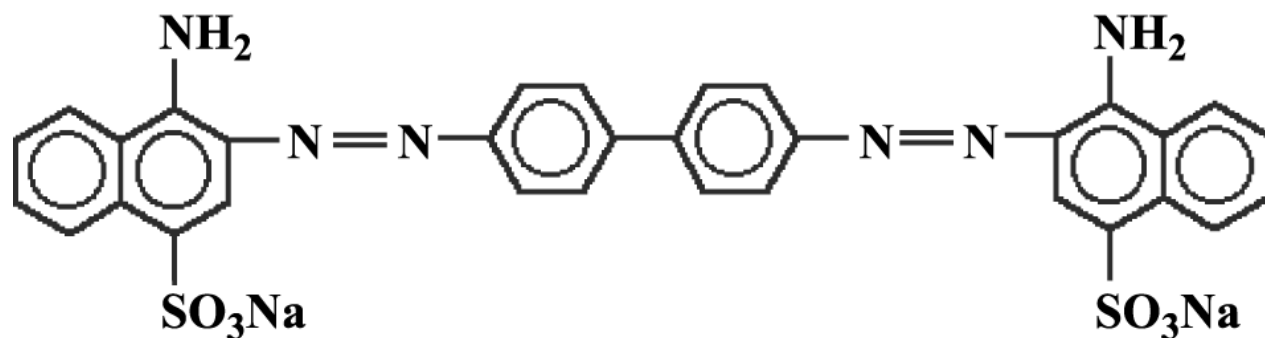


What can students do in orgo?

- Synthesize polymer molecules of variable length to interfere or promote PolyQ aggregation
- Techniques involved
 - Synthesis
 - Purification
 - Purity/concentration analysis
 - Structure determination using NMR



What can students do in orgo?



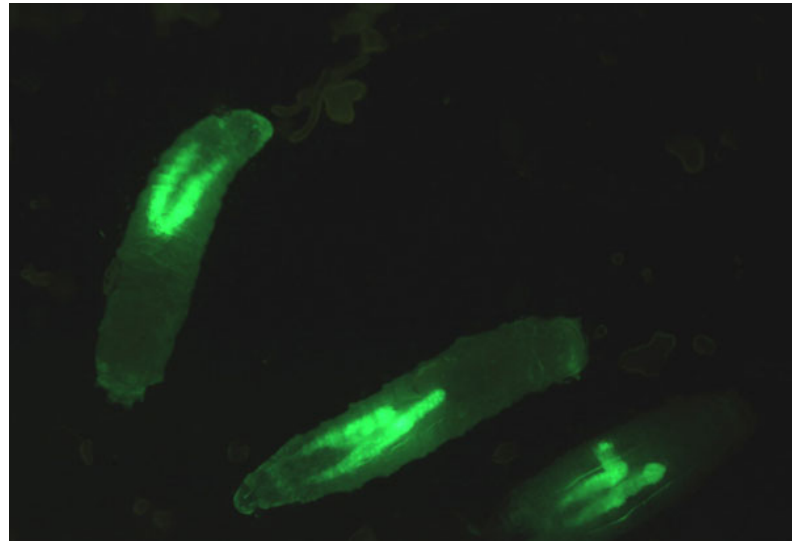
What can students do in Bio?

- Cell biology/Biochemistry (*in vitro* studies)
 - Analyze effect of polymer inhibitor on PolyQ peptide
 - What is a peptide? Why do we use it?
 - Dilutions and concentration determination
 - Fluorescence spectroscopy
 - Light scattering
 - Rates of reactions
 - AFM and fiber formation



What can students do in Bio?

- Genetics/Genomics (*in vivo* studies)
 - Analyze effect of polymer inhibitor on PolyQ expressing *Drosophila* (Q22, Q48, Q108)
 - What is a model/recombinant organism? Why do we use it?
 - Dilutions and concentration determination
 - *Drosophila* crosses
 - Fluorescence microscopy
 - Life span analysis



Results so far

- 3 years of organic synthesis, >30 polymer inhibitors have been created
- 3 years of *In vitro* studies, 27 different reaction series
- Currently in week 2 of the *Drosophila* cross....



Most flies are dead...

...But that's real science!

Student Response



“This is so cool!”

“Can I test my own inhibitor?”

“Do you really think anything I make in orgo is pure enough NOT to kill something that’s alive?”

“...Hold up, KC. If curing [Huntington’s] was so easy, wouldn’t everyone be doing this???!?”

Positive Outcomes

- Students are exposed to same material from a both a chemical and biological perspective
- Increased student engagement
 - Formalized assessment is ongoing
- Increased student awareness of importance of organic
 - Formalized assessment is ongoing
- Increased student interest in taking the two courses together
 - In 2011-12, 80% of students took both organic and biology simultaneously



Negative Outcomes



- COST!
- Course time constraints
- Students not taking the two classes together are at a conceptual disadvantage
- Weaker students are being forced to take a “harder path”
- Could this lead to a demotivation of our historically weaker populations?

Where are we going?

- Formalized assessment and dissemination
- PolyQ Behavioral assays in *C. elegans*?
- HIV RNA-peptide inhibition?
- Can we include physics, too?



Acknowledgements

- Jason Pontrello, Assistant Professor of Chemistry



- The Orgo Lab Staff
- The Biolab Staff