Faculty-student matchmaking session: summer research in the biological sciences

January 14, 2019
SSS 114

Sandy Chang, MD/PhD
Associate Dean of STEM Education and Undergraduate Research

Performing cutting edge research is an integral component of Yale's undergraduate education

Yale Summer Fellowships

Yale College First Year Summer Research Fellowships

- Supports10-12 weeks of natural science research in Yale labs. Fellowships pay $430/week., max 10 weeks funded.
- Last year, 83% first years received funding.
- As part of their research experience, students participate in a weekly class called “Entering Research”
- Fellowships due March 7.

STARS Summer Research fellowship

- Supports 30 rising sophomores doing 10 weeks of research in Yale labs. All expenses paid, plus $2,500 stipend.
- Last year 20% of students who applied received this fellowship.
- Students must first identify a mentor (Jan 28th). Selected students have to submit a proposal (Feb 27).

Yale College Dean’s and Rosenfeld Research Fellowships

- Supports sophomores and juniors doing research in Yale labs. Fellowships pay $430-450/week, max 10 weeks funded.
- Last year, 60% sophomores and juniors received funding.
- Fellowships due Feb. 21.

Student-Faculty Matchmaking

- Students pick two potential mentors for further interactions.
- Faculties choose the students they want to mentor, and work with them to craft a good research proposal.
- Students who do not match with mentors, and faculties who do not get students should contact me for an additional round of matching (electronically).
- For students on financial aid, you can use your domestic summer award (DSA) to help fund your summer research. Check "yes" on the DSA box in the fellowship application.
- Much more info at https://science.yalecollege.yale.edu/

Faculty sciences

Bergwitz Lab information

Lab Head (top photo third from left):

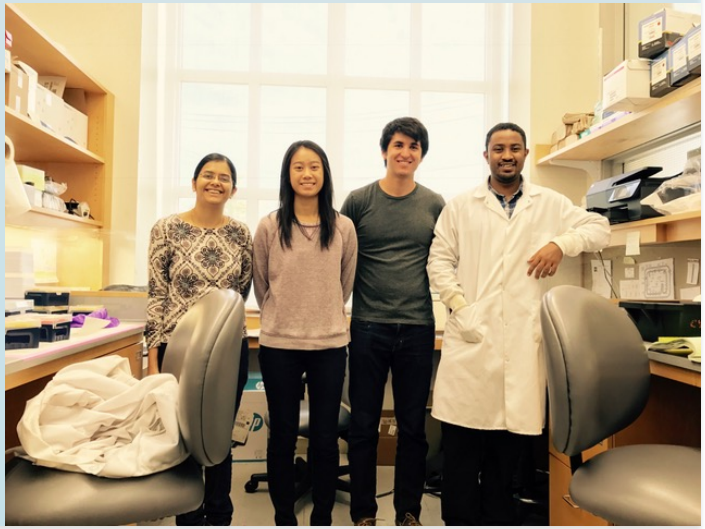
Clemens Bergwitz, M.D.

website:

http://medicine.yale.edu/lab/bergwitz/

Associate Professor of Medicine
Yale University School of Medicine
Section Endocrinology and Metabolism
Anlyan Center (TAC), Office S117, Lab S110
1 Gilbert Street
New Haven, CT06519

Work Phone: 203-737-5450
Work Fax: 203-785-5535
email: clemens.bergwitz@yale.edu



Summer projects 2019

Our research focuses on inborn errors of phosphate metabolism and the endocrine regulation of phosphate homeostasis with emphasis on the metabolic and homeo-static effects of phosphate.

<u>Students will independently conduct one the following projects (2-3 slots available):</u>

- Determine bioavailability of dietary phosphate in mice (RNA extraction from mouse gut&kidneys, qRT-PCR based gene expression analysis)
- Determine ATP content and mitochondrial function in skeletal muscle lacking phosphate-transporters (cell culture, seahorse assays, luciferase-based ATP/ADP measurements in cells and muscle tissues)
- Determine mineral metabolism of mice lacking phosphate transporters in skeletal muscle or bone cells (ELISA and colorimetric assays to measure blood phosphate, FGF23, urine phosphate and creatinine)
- Determine the function of mutant phosphate transporters (adenoviral transduction of cells and life mice followed by Western blot analysis to measure transporter protein expression)
- Translational research to improve care of patients affected by Hereditary Hypophosphatemic Rickets with Hypercalciuria (HHRH) (review patient records with referring physicians, genotyping PCR and GENEIOUS software analysis of Sanger sequencing reads)

Mentorship

Jan-Feb 2019: Help with applications for summer student scholarships

June-August 2019: Provide written protocols and one-on-one supervision by PI or postdoc during 12 week summer internship, which enables students to independently conduct a small project, which will - if successful - earn them a co-authorship in a line of research that is close to publication

Sept 2019: Opportunity to continue independent research on a 12-hr/week basis during the semester

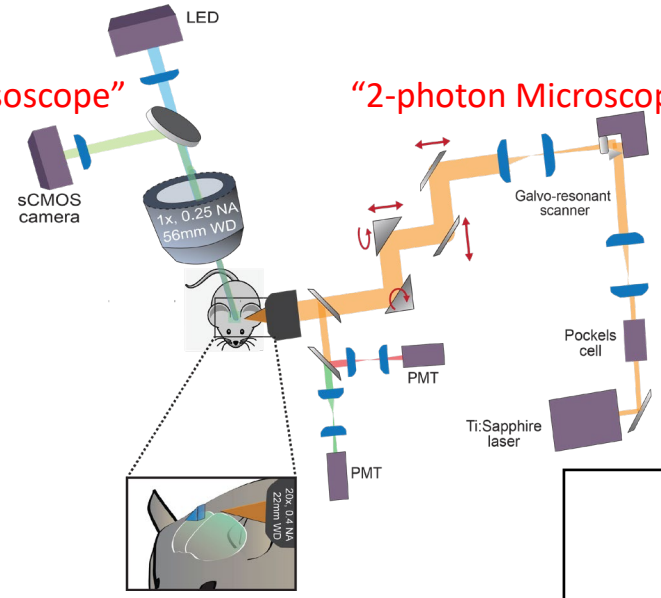
Track record 2014-2018: 10/10 undergraduate students received scholarship funding, 9/10 students published (3 in peer-reviewed journals, 1 as lead author, 9 abstracts in international conferences), 9/10 students continued in the semester or returned next summer (3 senior thesis, 1 postbachelaurate, 6 semester projects, see Lab website for names and contact info).

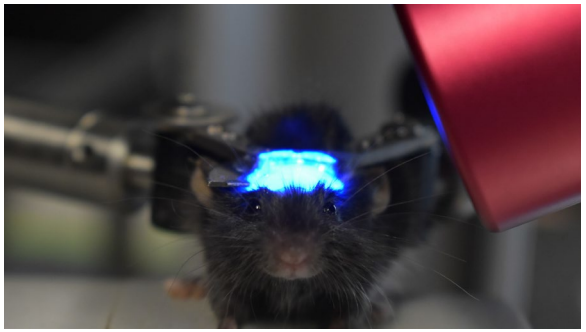
Imaging neuronal activity in the rodent brain

Laboratory of Michael Crair
Laboratory of Michael Higley

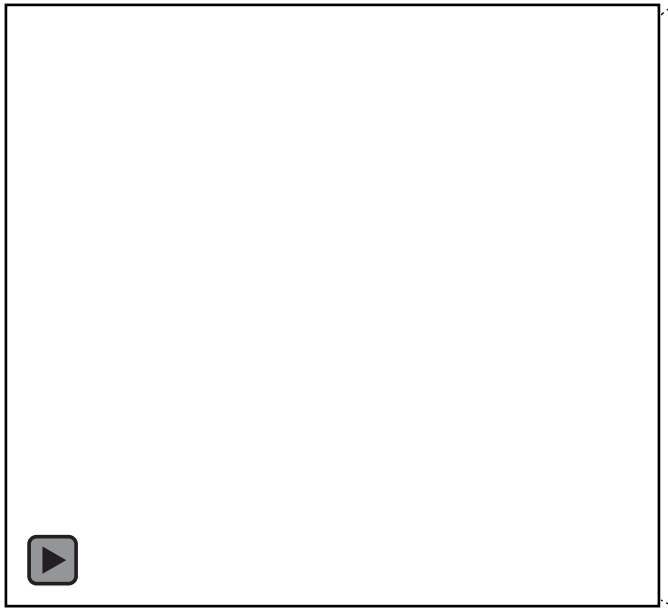
"Mesoscope"

"2-photon Microscope"

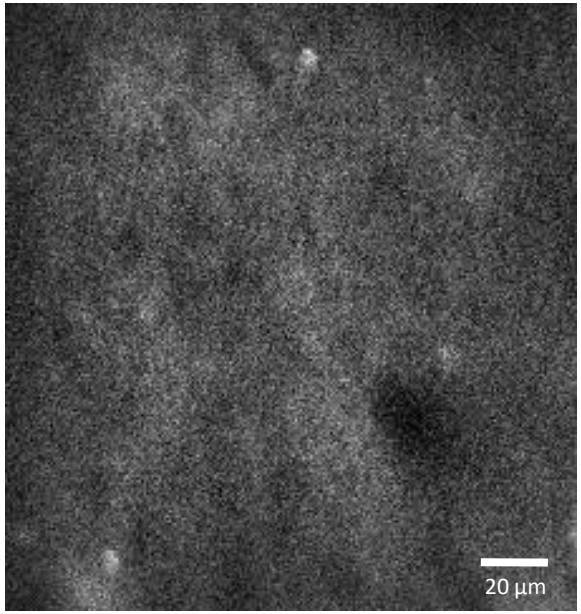




"GCaMP6-expressing mouse"



Mouse neocortex



Layer 2/3 Somatosensory Cortex

Presented by Daniel Barson
daniel.barson@yale.edu

Laboratory of Michael Crair
Department of Neuroscience
michael.crair@yale.edu
https://medicine.yale.edu/lab/crair/

Major Research Questions:

- How does spontaneous activity instruct the formation of sensory maps in the brain?
- How do sleep and other behavioral states contribute to the development of cortical circuits?
- How are different genetically-defined classes of neurons integrated into cortical circuits?
- How is the connectivity and function of neural circuits disrupted in neuropsychiatric disorders such as autism and schizophrenia?

Undergraduate Research Projects:

- Mesoscopic imaging of neural activity in mouse models of neuropsychiatric disease
- Virus-based anatomical tracing of developing brain circuits
- Analysis and computational modeling of cortical network dynamics based on recorded activity

Current students: Luke Newell (NSCI major, development of cortical modulation by behavioral state)
Seneca Oxendine (NSCI major, disruption of cortical activity in autism mouse models)

Laboratory of Michael Higley
Department of Neuroscience
m.higley@yale.edu
higleylab.org
@mjhigley

Major Research Questions:

- How are excitatory and inhibitory synaptic input integrated by single neurons?
- How are different types of neurons wired into large-scale networks?
- How do neurons and circuits in visual cortex mediate sensory perception and behavior?
- How is the connectivity and function of neural circuits disrupted in neuropsychiatric disorders such as autism and schizophrenia?

Undergraduate Research Projects:

- Implement novel genetic strategies for creating new mouse disease models
- Fluorescent imaging of neuronal structure across development and in disease
- Analysis of behavior in mouse models
- Fluorescent imaging of neural activity *in vivo*
- Analysis and computational modeling of cortical network dynamics based on recorded activity

Current student: Natasha Zaliznyak (MBB major, viral methods for genetic labeling of single neurons)

Enrique M. De La Cruz and his Awesome Research Team

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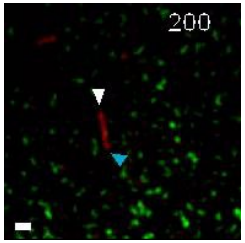
Actin filament assembly and cell motility



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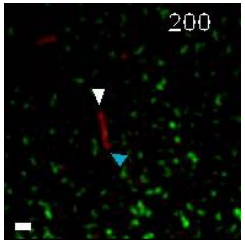

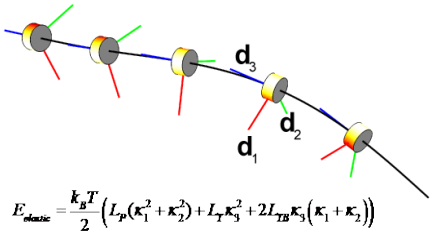

$$E_{elastic} = \frac{k_B T}{2}\left(L_P(\kappa_1^2 + \kappa_2^2) + L_T\kappa_3^2 + 2L_{TB}\kappa_3(\kappa_1 + \kappa_2)\right)$$

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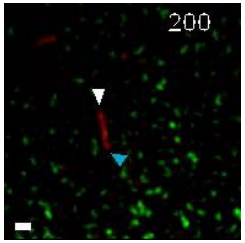

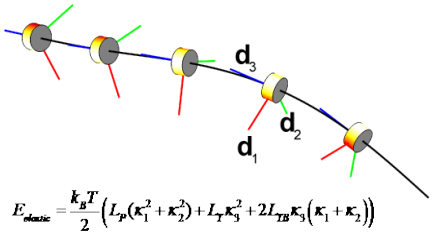

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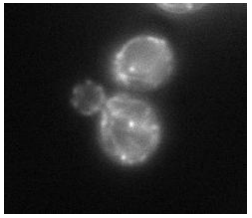

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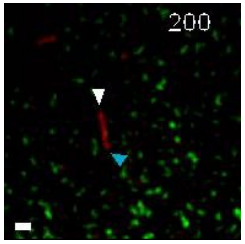
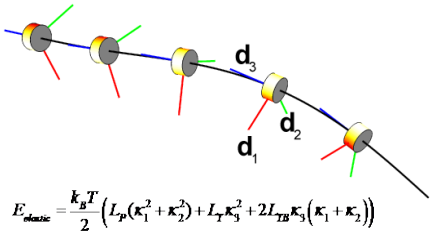
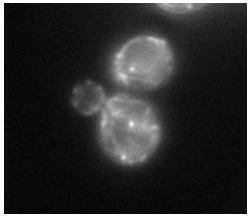
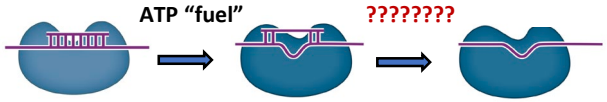






RNA helicase enzymes



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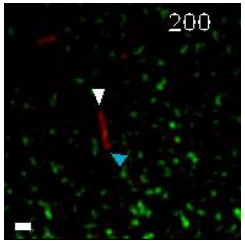

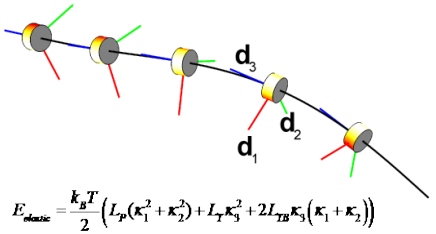

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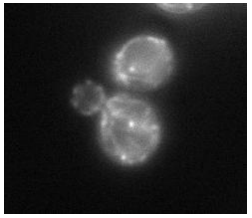

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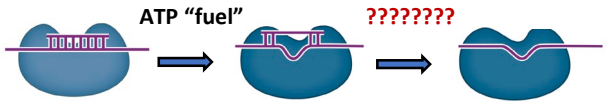

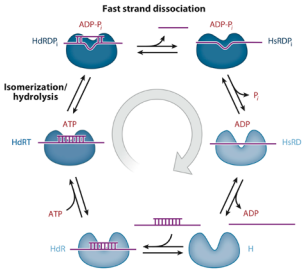

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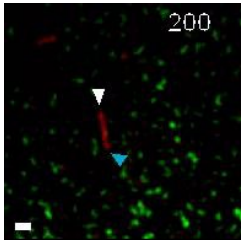

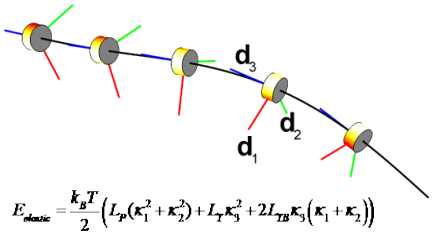

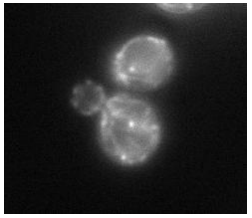

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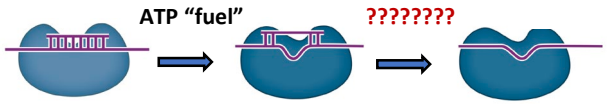

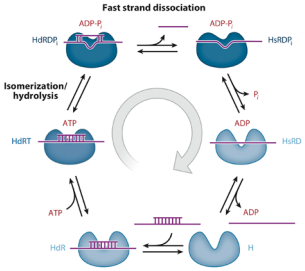

NPP signaling enzymes

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M.D./Ph.D.

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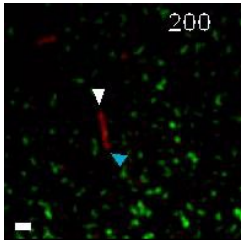

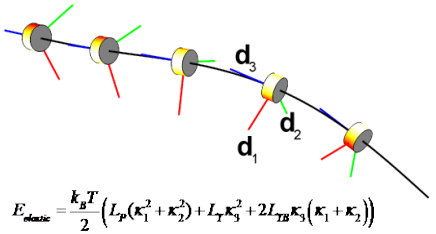

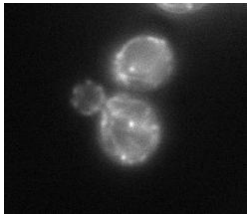

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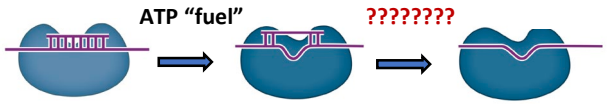
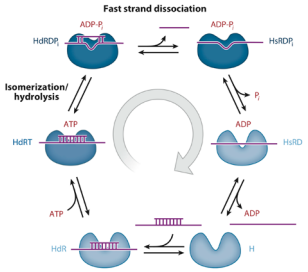
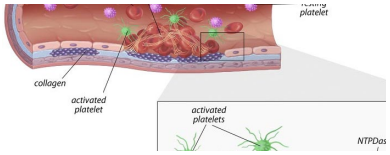


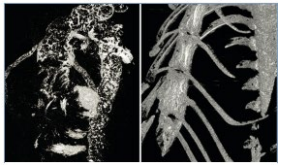


NPP signaling enzymes

Demetrios Braddock M.D./Ph.D.



Blood clotting



Calcification of heart and vessels

What could you do with us this summer?

Marisa Michalchik

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ENPP7 – a lipid cleaving enzyme in your gut

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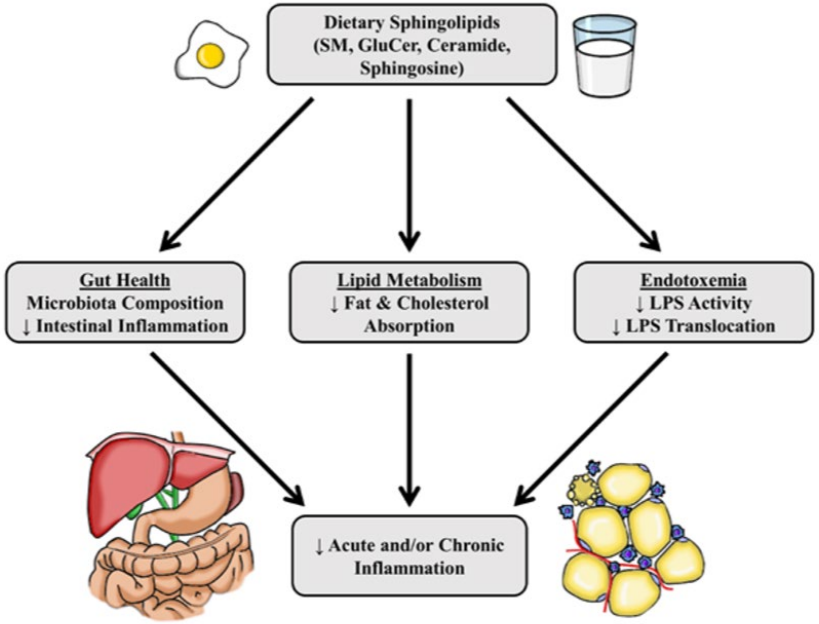

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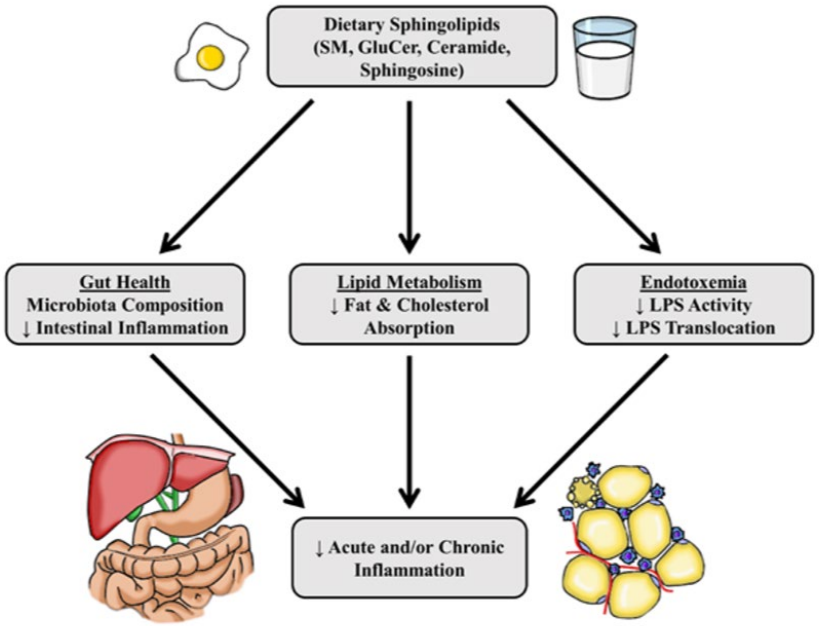

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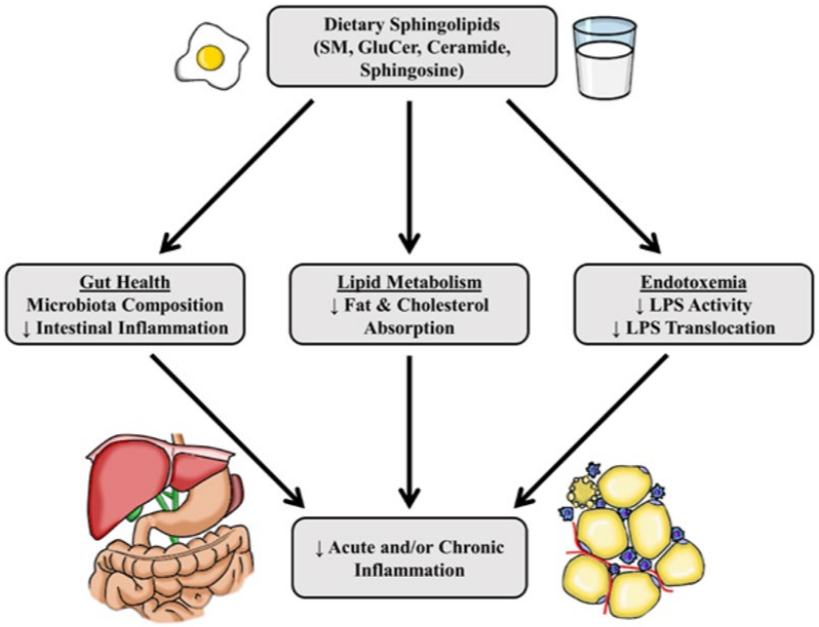

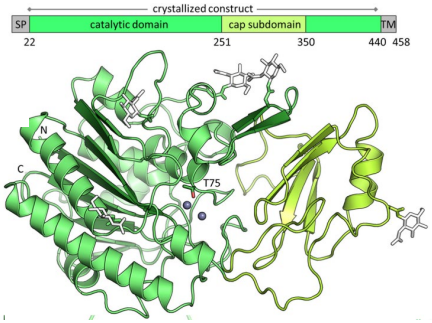

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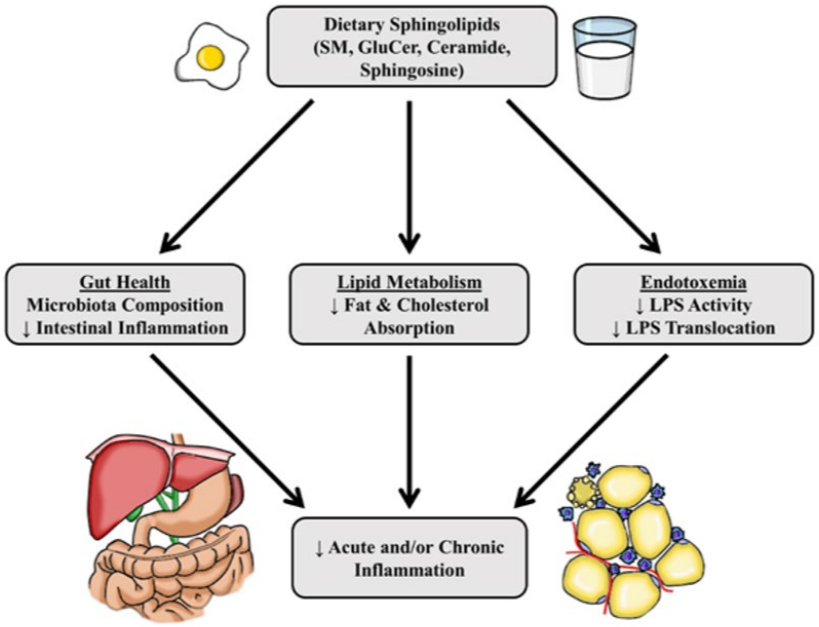

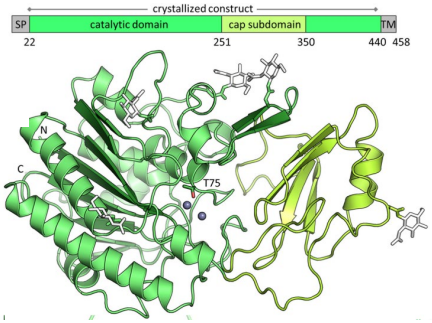

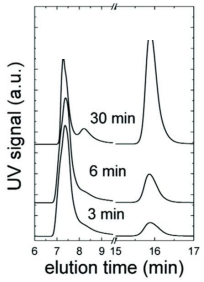

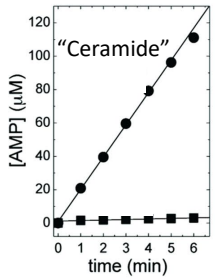

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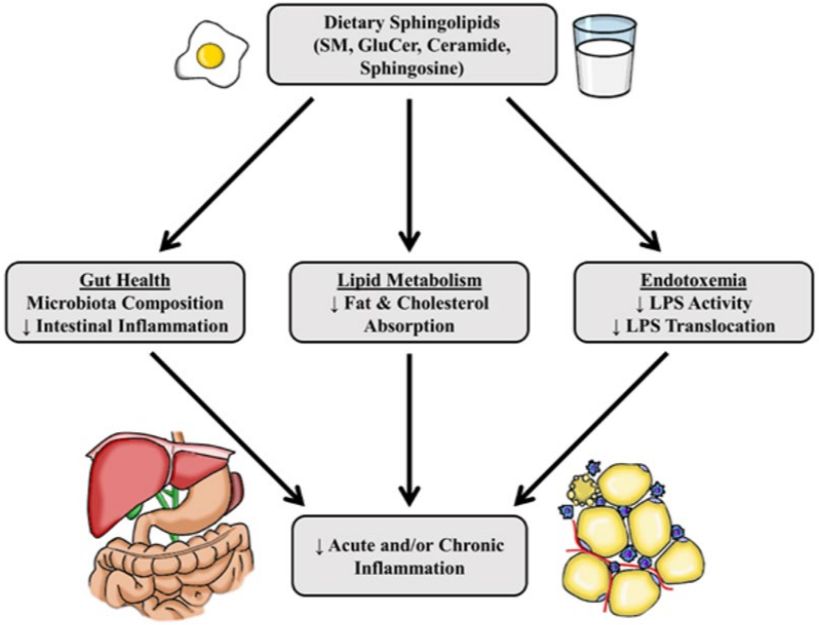

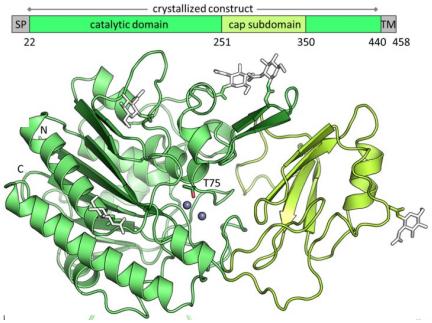

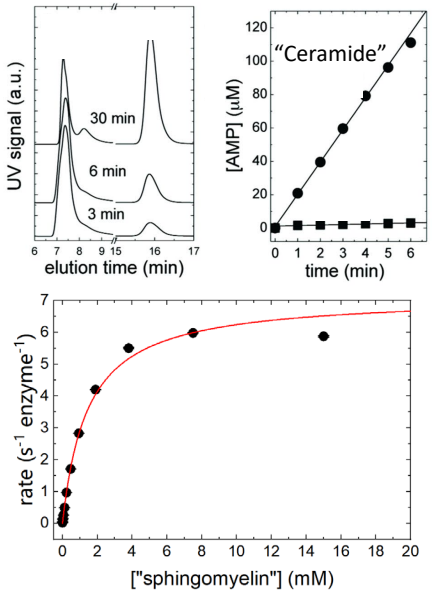

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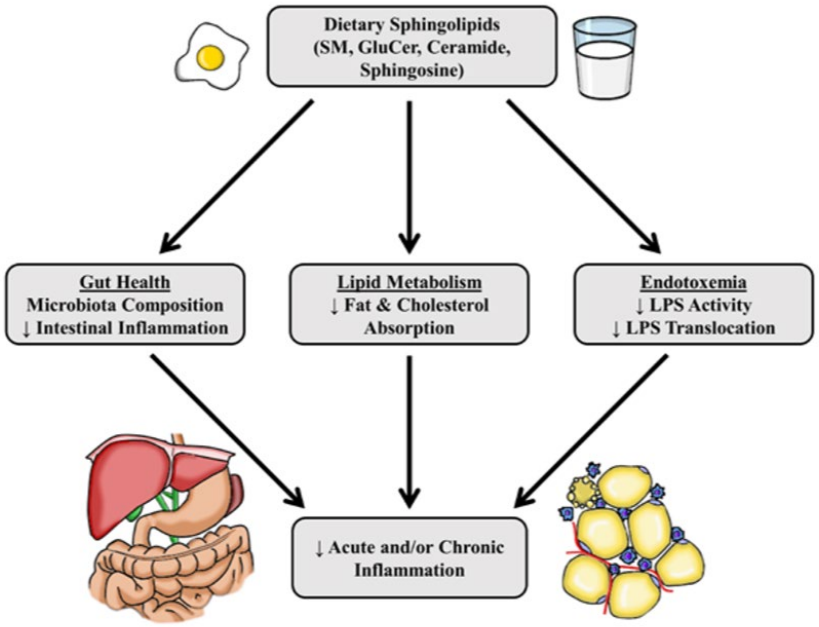
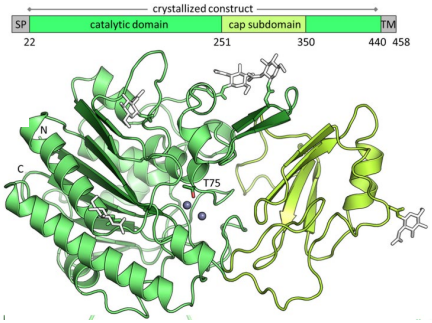
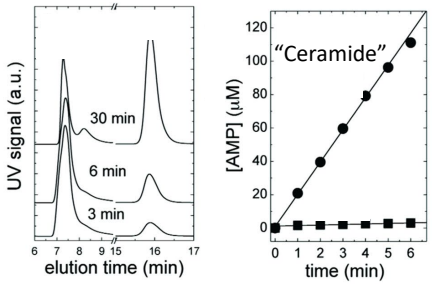
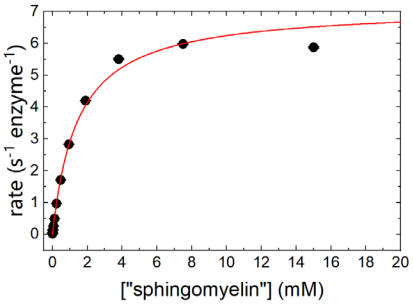






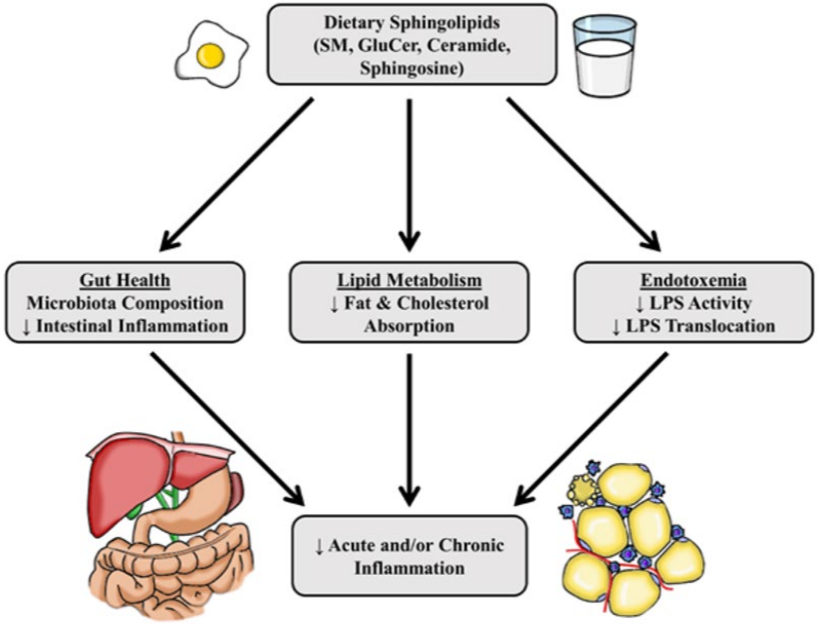


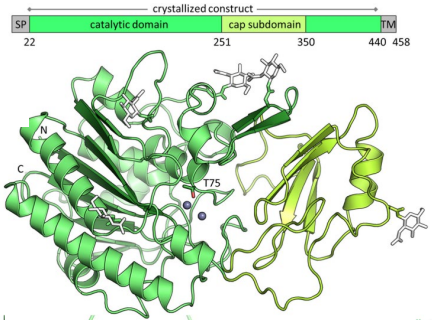
-Enzymology (Biochemistry!)

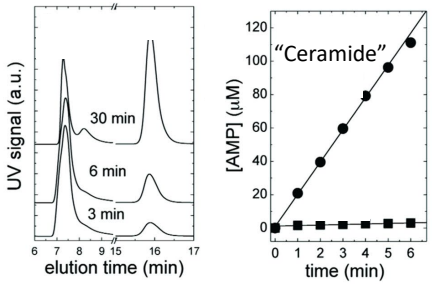
Marisa Michalchik

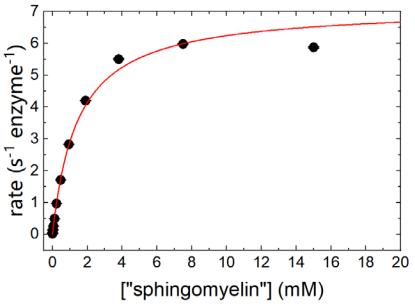
What could you do with us this summer?

ENPP7 – a lipid cleaving enzyme in your gut





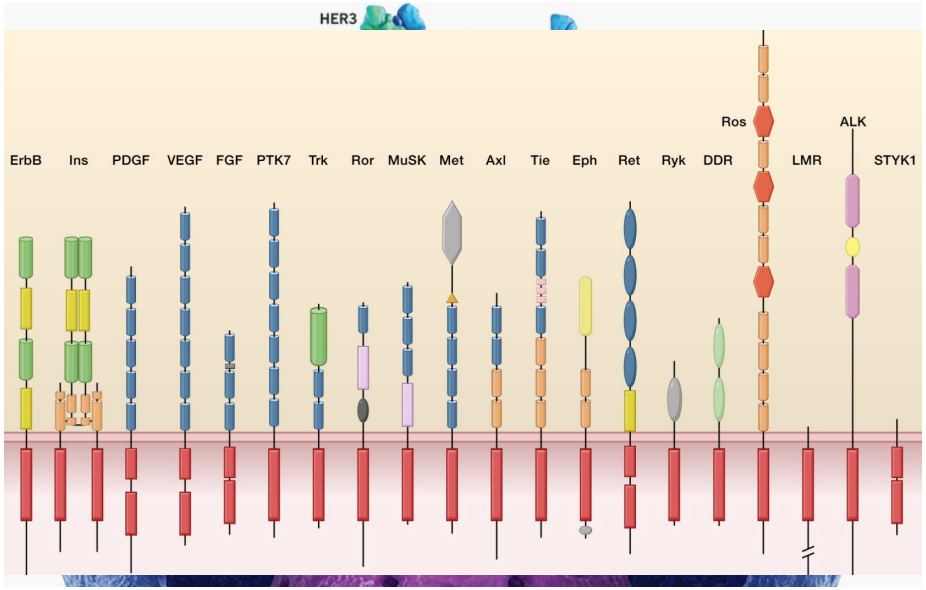




-Enzymology (Biochemistry!)
-Lab meetings
-Lunch discussions
-Coffee/Tea breaks
-Have fun and meet great people!

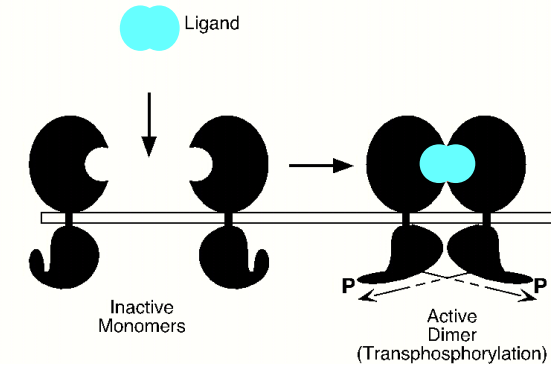
Yale *Cancer Biology Institute*

Regulation of Receptor Tyrosine Kinases (RTKs)



Regulate key cellular processes (proliferation, differentiation)
Disregulation can cause cancer and other diseases

"Textbook" view of receptor activation by
ligand induced receptor dimerization



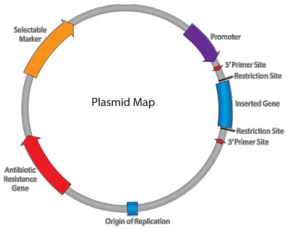
Elegant, but **it's more complex** for many of the 20 families of RTKs –
larger oligomers, lifetimes, co-receptors

Kate Ferguson

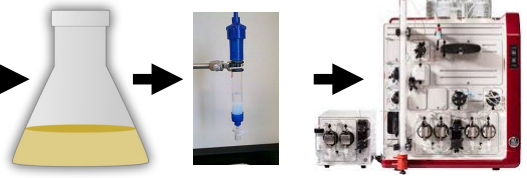
Yale Cancer Biology Institute & Department of Pharmacology,
Advanced Biosciences Building, Yale West Campus
kathryn.ferguson@yale.edu

Yale University
School of Medicine

Research Projects

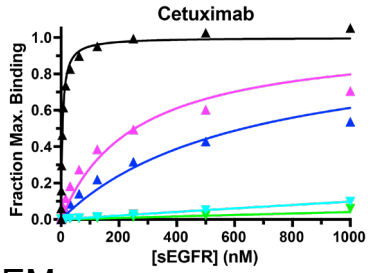


Generate/alter plasmids for protein expression



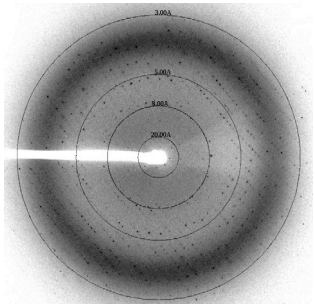
Recombinant protein purification

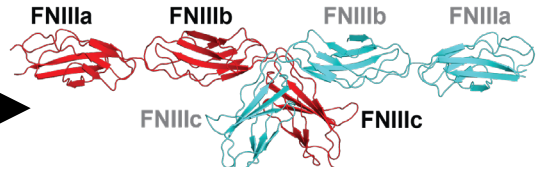
Quantitative Biophysical Experiments – oligomerization, ligand binding analysis



Low resolution shape information – SAXS, EM

Atomic resolution structure determination: X-ray crystallography, EM

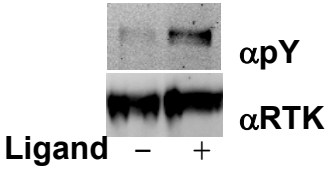




Predict mechanism and test hypothesis in cellular assays

Expression in mammalian cell

Functional assay



Yale *Cancer Biology Institute*

What to expect in the Ferguson Lab




- Small lab - two postdocs, and a rotation student
- Share space and collaborate with Lemmon Lab
- You would
  - work directly with one of my postdocs on daily basis
  - meet with me at least weekly to discuss progress and plans
  - Participate in our weekly group meetings (with Lemmon lab)
- Expect to start with simpler techniques and shadow to learn more advanced procedures
- Please email if you are interested!

THANKS!

Kate Ferguson

Yale Cancer Biology Institute & Department of Pharmacology,
Advanced Biosciences Building, Yale West Campus
kathryn.ferguson@yale.edu

Yale University
School of Medicine

Novel Approaches to evaluate and treat Gastrointestinal Diseases

John Geibel,MD,DSc,MSc,AGAF,FRSM
Vice Chairman Department of Surgery
Director of Surgical Research
Professor of Surgery and Cellular and Molecular Physiology
American Gastroenterological Association Fellow
Fellow of the Royal Society of Medicine

Yale SCHOOL OF MEDICINE

Projects Available for Summer 2019

- **Intestinal Repair**
  - Application of a nanoparticle based biological adhesive
    - Evaluate the tensile strength of the adhesive in *in vitro* and *in vivo* settings
  - Use of biological adhesive in 3D bioprinted intestine
    - Evaluate the use of "biopatches" for intestinal repair *in vivo*
- **Application of Novel Bioadhesives for Vascular Repair**
  - Use of unique bioadhesives for incorporation in vascular repair in animal models
- **Nanoparticle Therapy to treat Intestinal Diseases**
  - Using custom nanoparticles as a rapid therapeutic for intestinal diseases
    - IBD, Diarrhea, Crohns Disease

Mentoring Plan for Summer Students

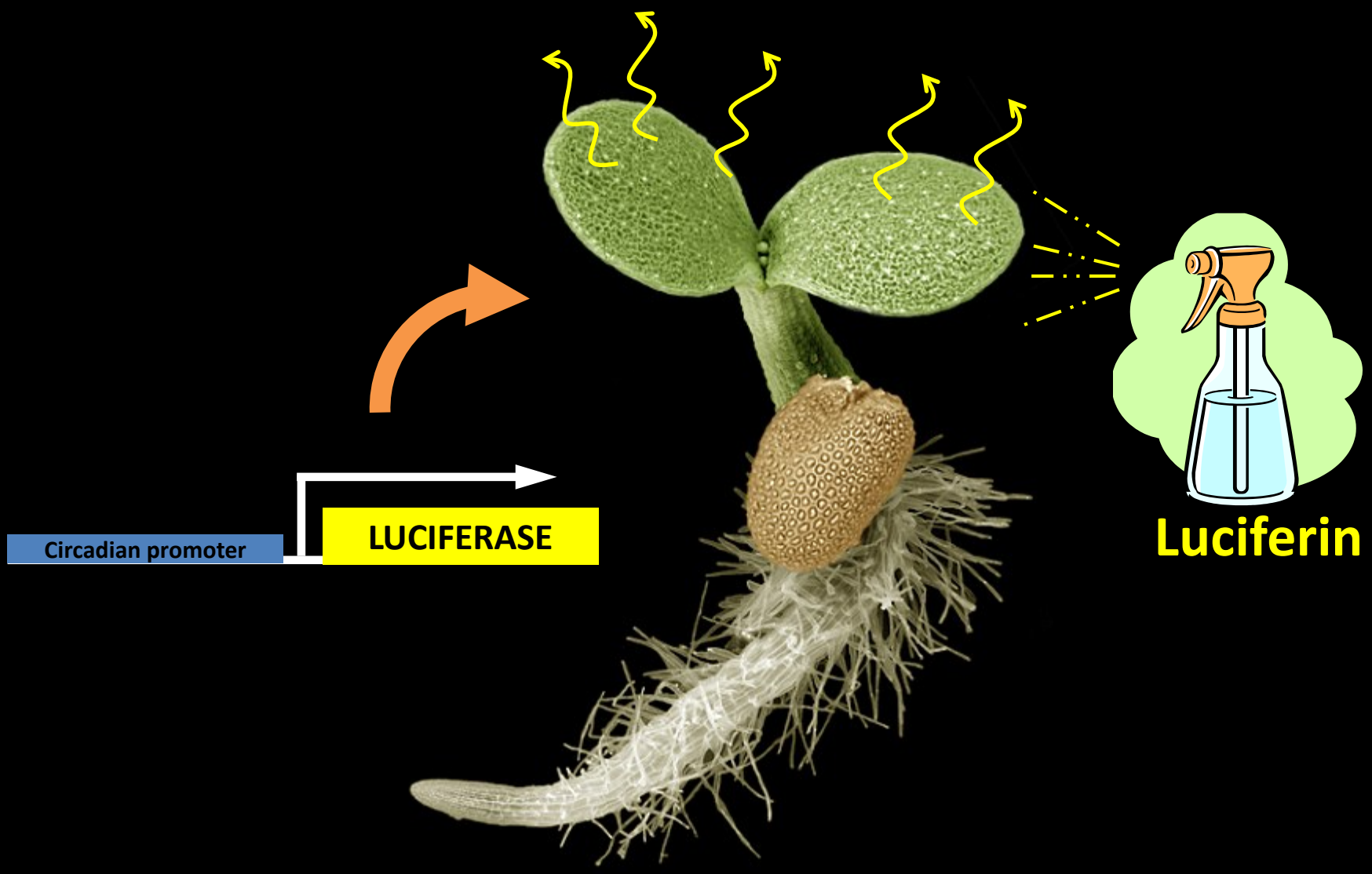
- Dr. Geibel will conduct weekly laboratory meetings to review goals for coming week
  - Lab Meeting will discuss all research projects in the lab and allow for discussions with all lab members
- Student will be Assigned to Senior lab personal who will monitor and help student with project
  - Student will both assist and conduct studies in the designated project
- Dr. Geibel will be available all summer to provide additional insight as needed in the lab.

Plants have circadian rhythms

Joshua Gendron
joshua.Gendron@yale.edu

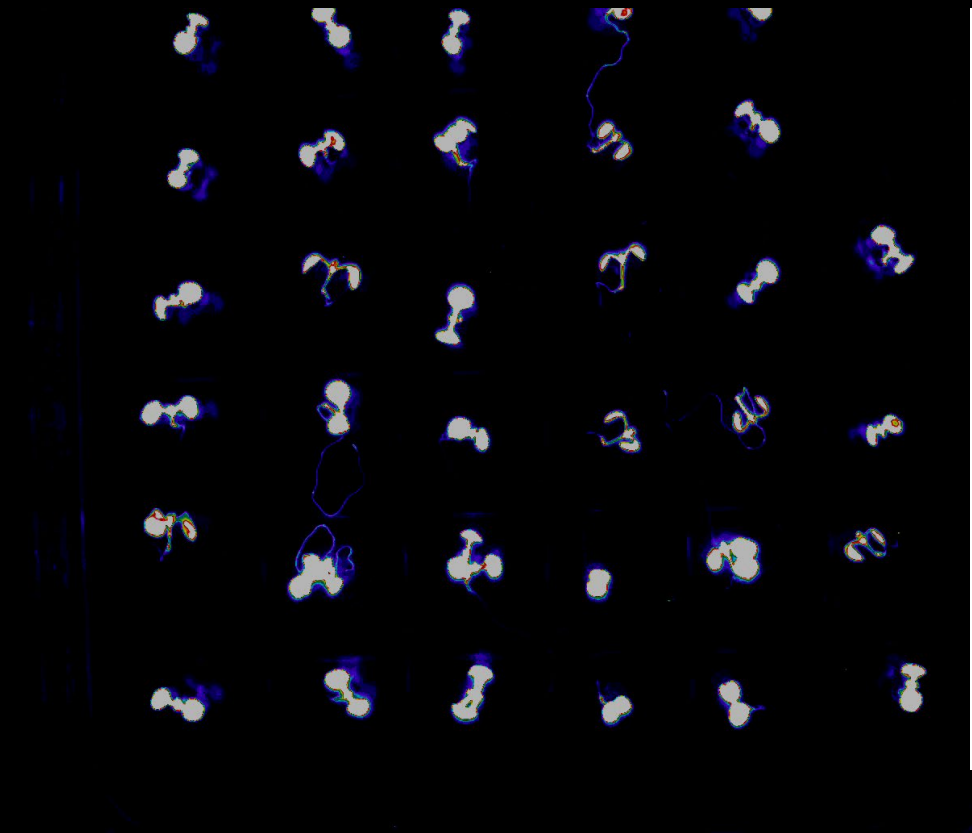
Lab focus:
Daily and seasonal rhythms in plants

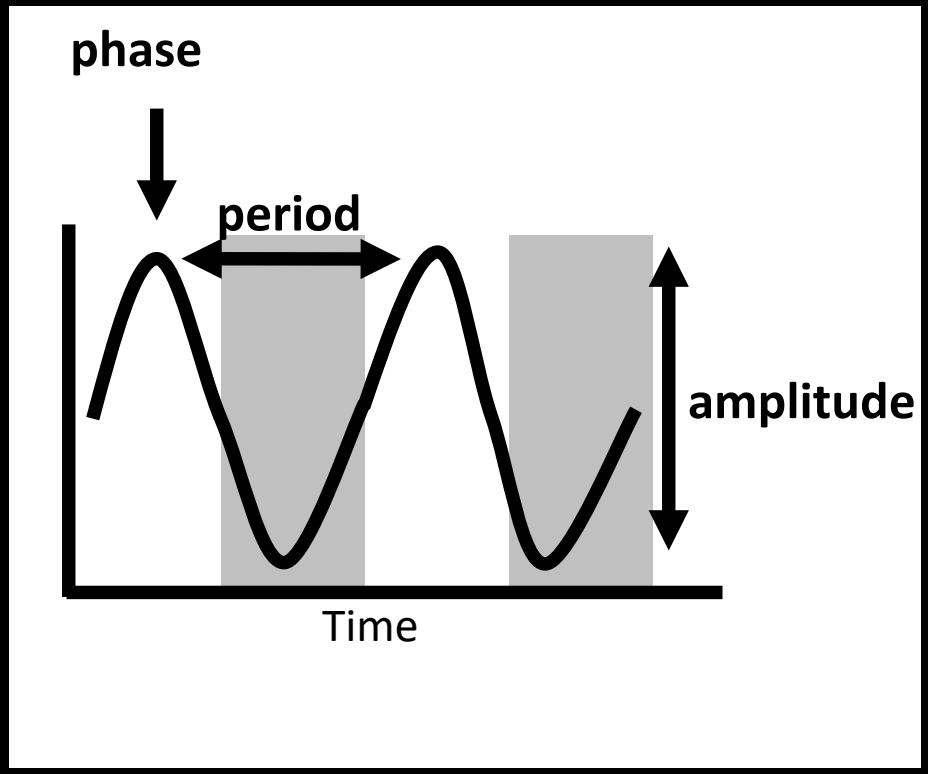
We can track circadian rhythms in real time



Millar *et al*. 1992

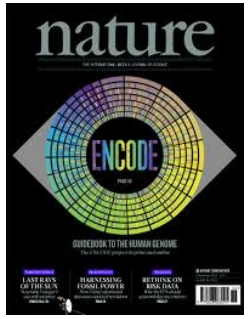
Students perform genetics, biochemistry, and molecular biology to understand daily or seasonal rhythms in plants





Students are actively performing experiments, mentored by me and a grad student or postdoc. Students are expected to participate similar to any lab member.

Gerstein Lab @ Yale (gersteinlab.org)



Program in Computational Biology & Bioinformatics (CBB)
Department of Biophysics & Biochemistry (MBB)

Lab focuses on biological data sciences

- Human Genomics
- Human Variation
- Functional Genomics

Participate in many big genomics consortia: **ENCODE, PsychENCODE, TCGA, exRNA** …

Contact: **joel.rozowsky@yale.edu** or **mark@gersteinlab.org**

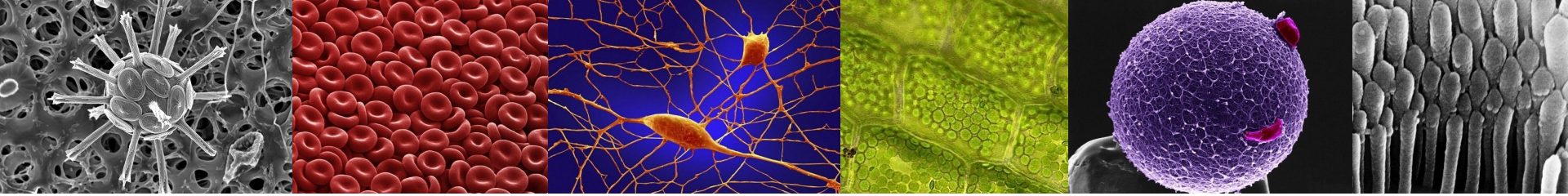
Projects in Gerstein Lab

- Human Genomics (ENCODE + exRNA)
- Cancer Genomics & Human Variation (TCGA + ENCODE)
- Brain Genomics (PsychENCODE)
- Specific Topics: Biological Networks, Machine Learning Approaches, Genome Annotation, Pseudogenes, Protein Structure, Structural Variation, Functional Genomics, Tool Development

Contact: **joel.rozowsky@yale.edu** or **mark@gersteinlab.org**

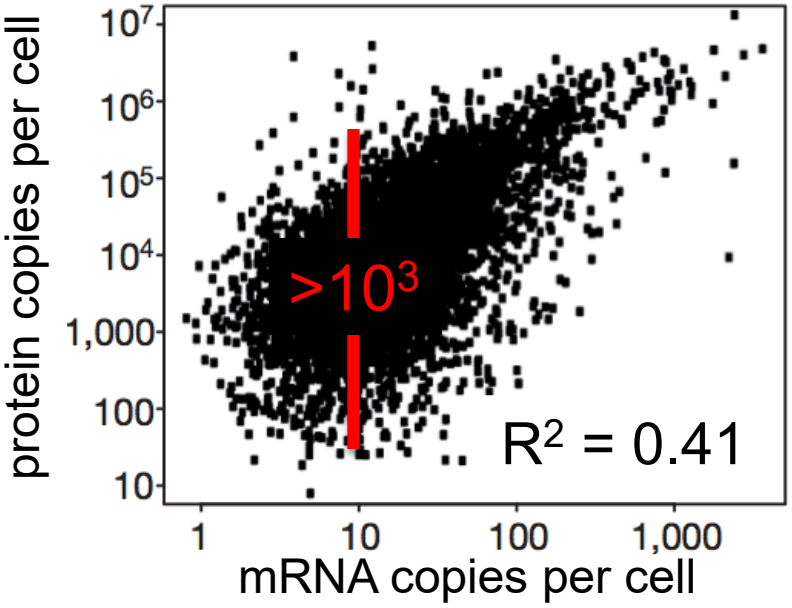
Gerstein Lab undergrad research experience

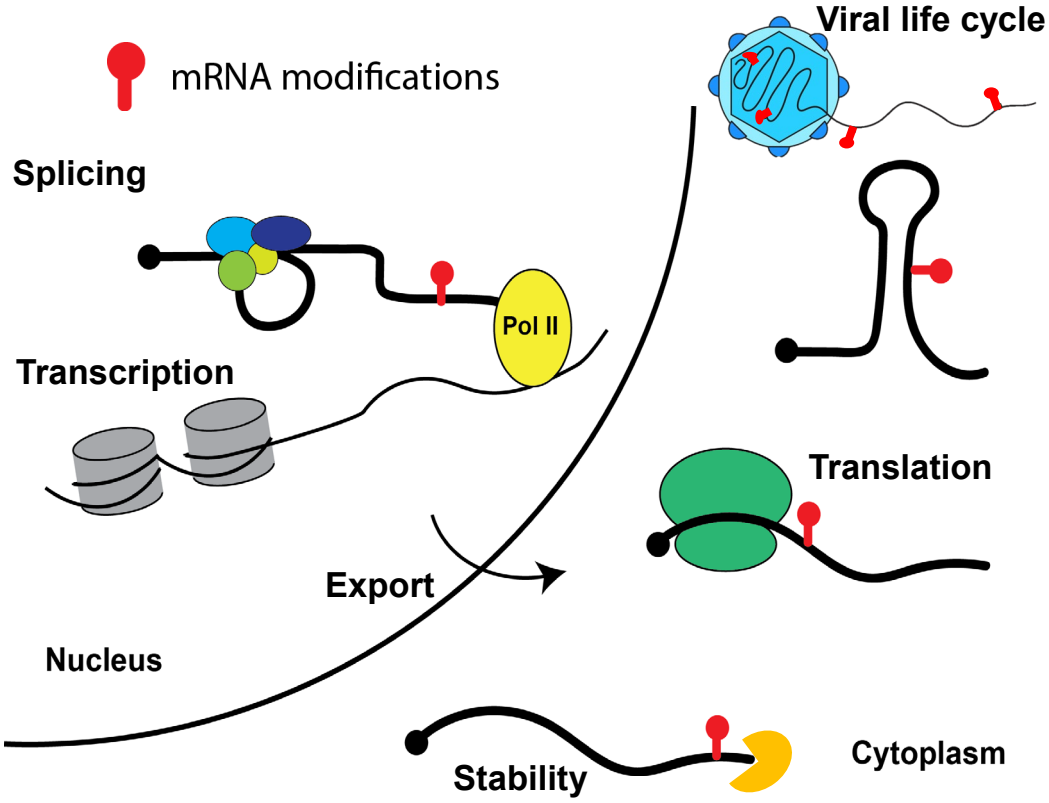
- Initially meet with MBG (will direct to potential mentors)
- Mentored by graduate students + postdocs + assoc. res. Scientists
  - big lab ~25 people + undergrads (5+ for summer)
- Weekly group meetings, journal clubs + subgroup meetings
- Lab Presentation (JC or GM) sometime during the summer presenting either a paper or summer work
- Many summer undergrad continue to work in the lab
- Many undergrads are included as authors on lab publications



DNA → m**RNA** → Protein

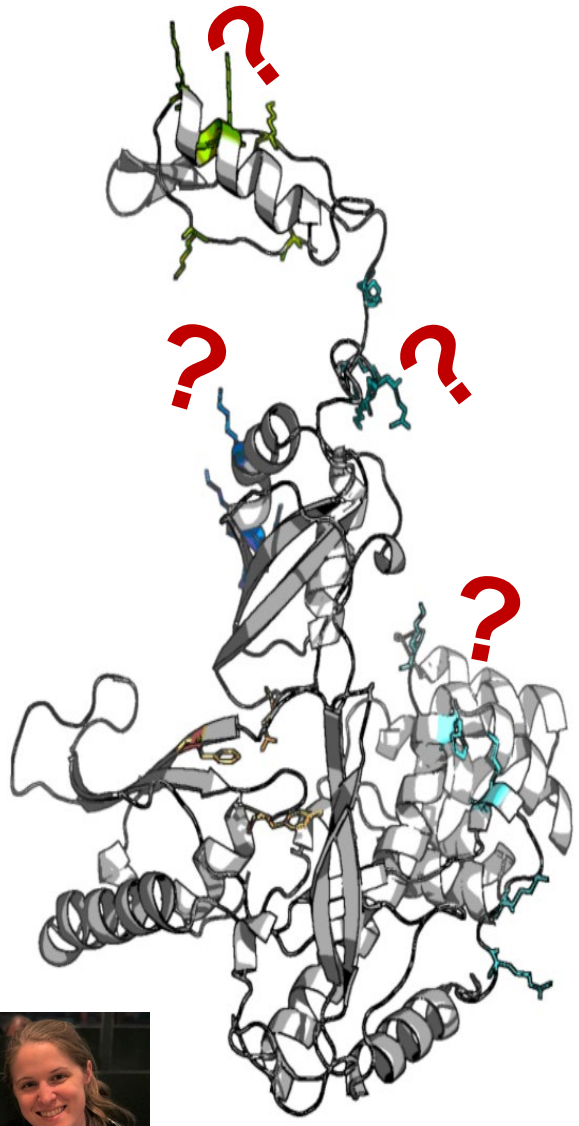
But did you know?





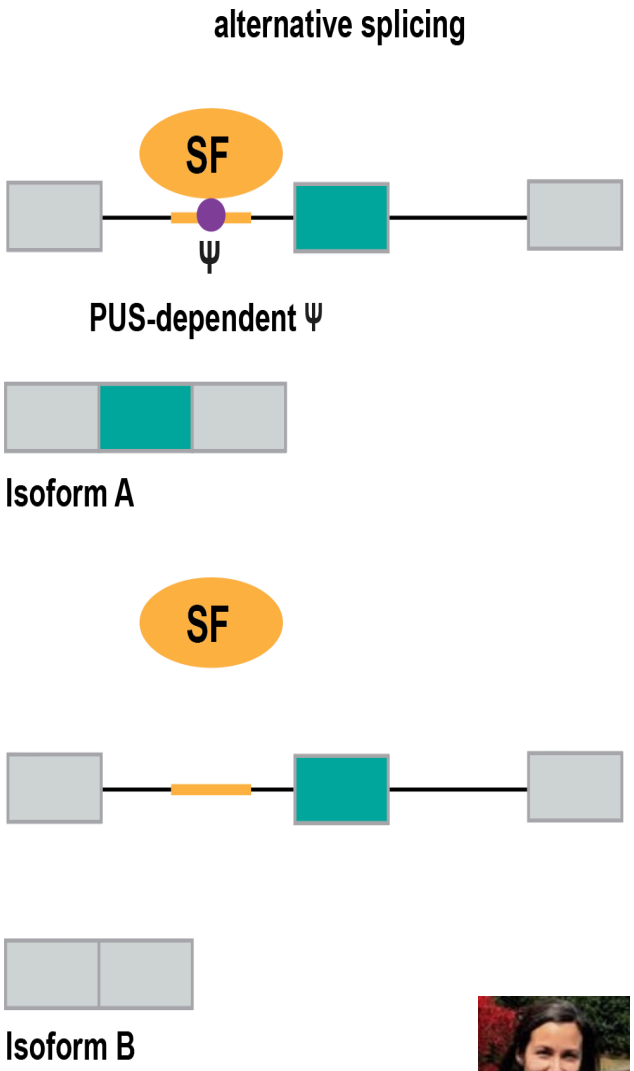
wendy.gilbert@yale.edu **come visit us in SHM C129!**

How does a PUS protein recognize it's RNA substrates?



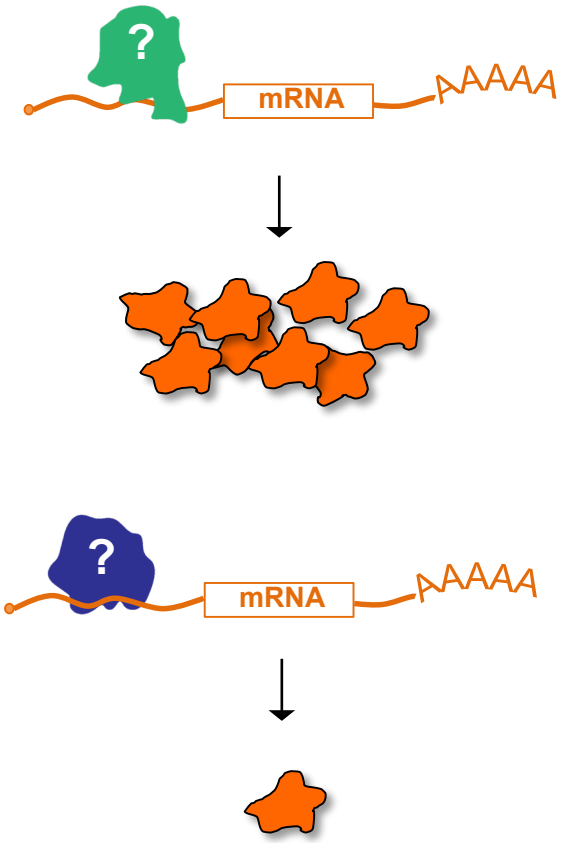
Erin Borchardt

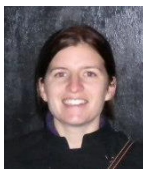
How ψ does regulate alternative splicing?



Nicole Martinez

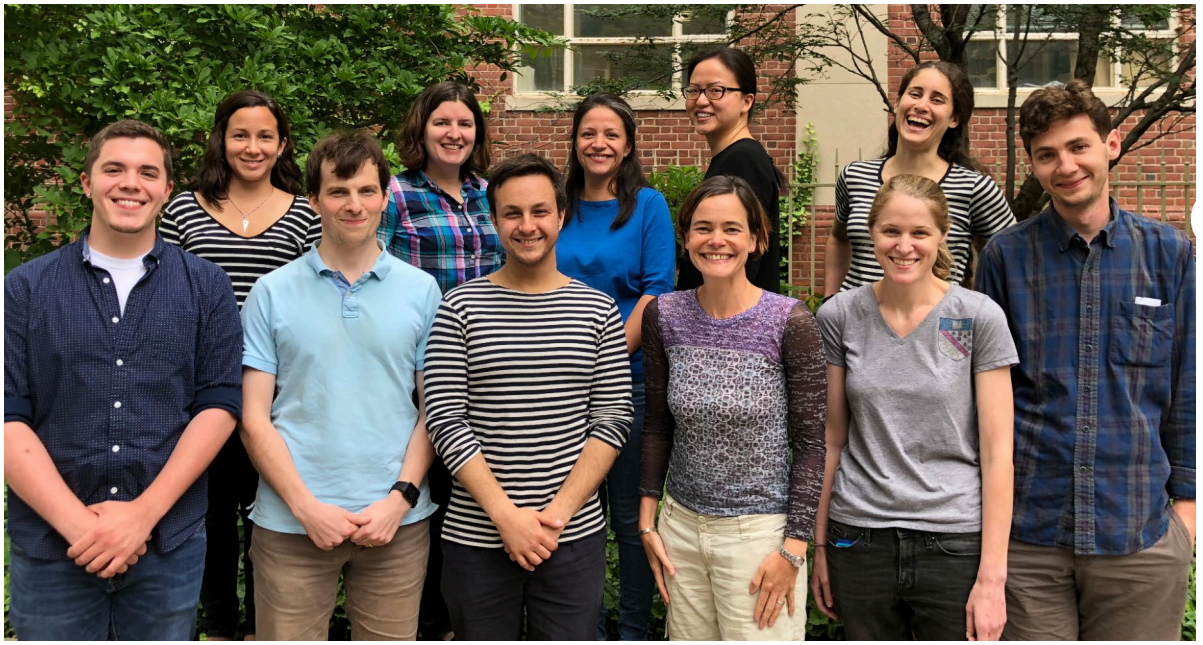
Which proteins regulate mRNA translation?





Rachel Niederer

Come work with us!

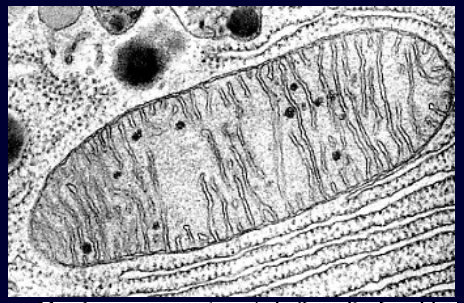


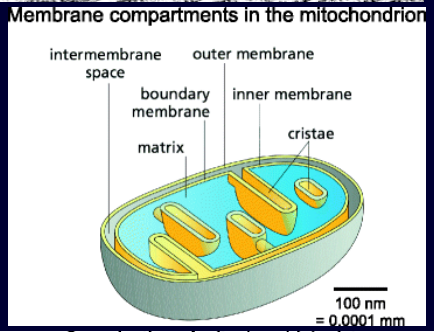
- we're looking for up to 3 students
- weekly lab meetings
- day to day mentoring by postdoc
- contact Dr. Gilbert if you are interested!

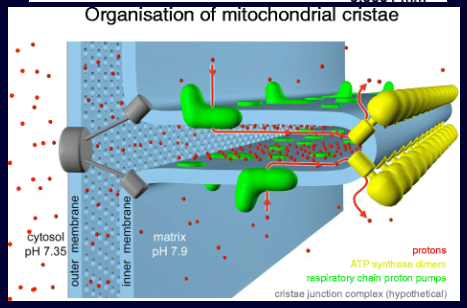
wendy.gilbert@yale.edu

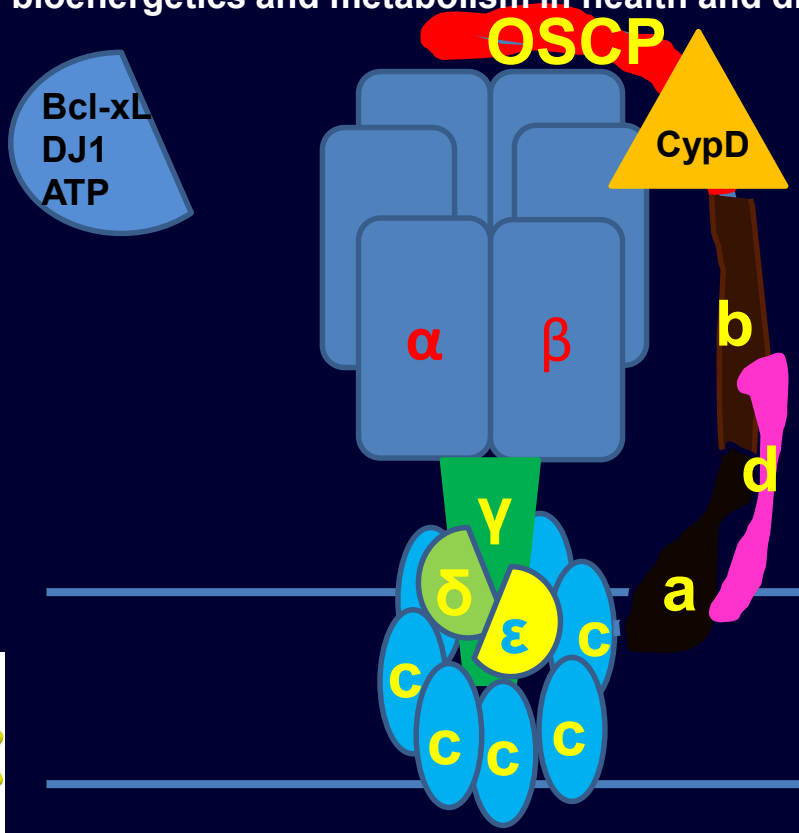
Elizabeth Jonas, elizabeth.jonas@yale.edu

ATP synthase contains a non-selective leak that regulates cellular bioenergetics and metabolism in health and disease







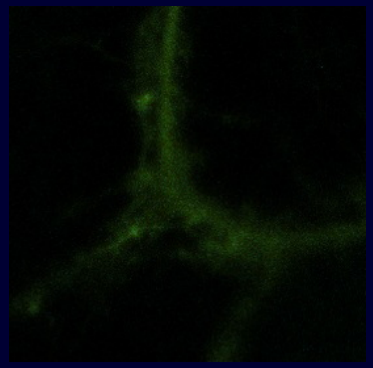


Projects for the summer:

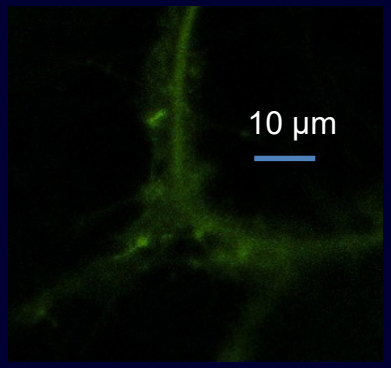
1. Mitochondria in LTP, the cellular basis of memory formation
2. Mitochondrial regulation of mRNA translation in the synapse and in translation of cell cycle proteins in Parkinson's disease.
3. Mitochondrial regulation of neuronal development: Changes in metabolism during normal development and in Fragile X Syndrome.
4. Regulation of synaptic vesicle positioning and acute changes in cytoskeleton during presynaptic plasticity.

Long term increases in ATP levels occur in synaptic spines after chemical NMDAr stimulation

Dendritic spines

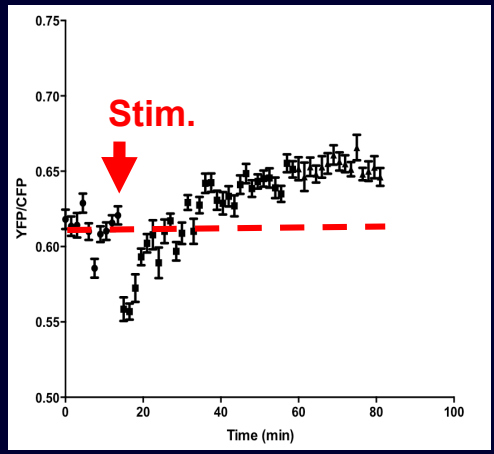


Before treatment



15 minutes after Stim.

27 minutes after Stim.



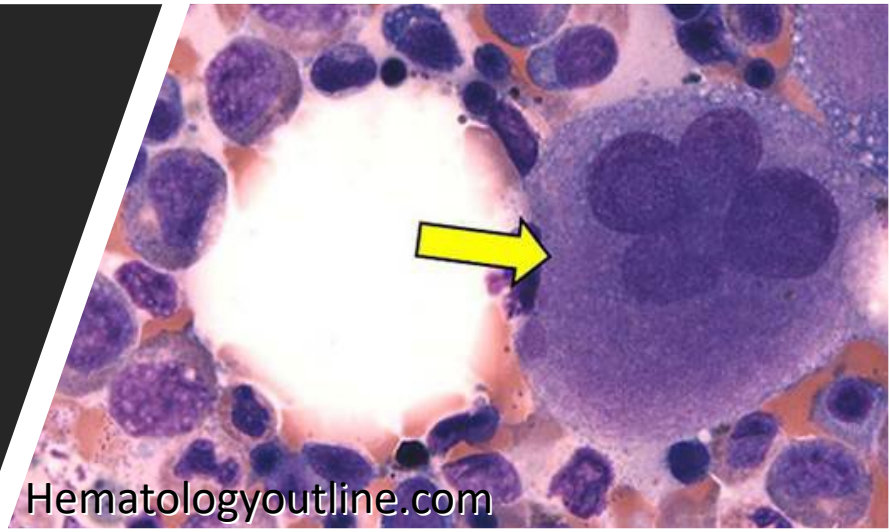
Details

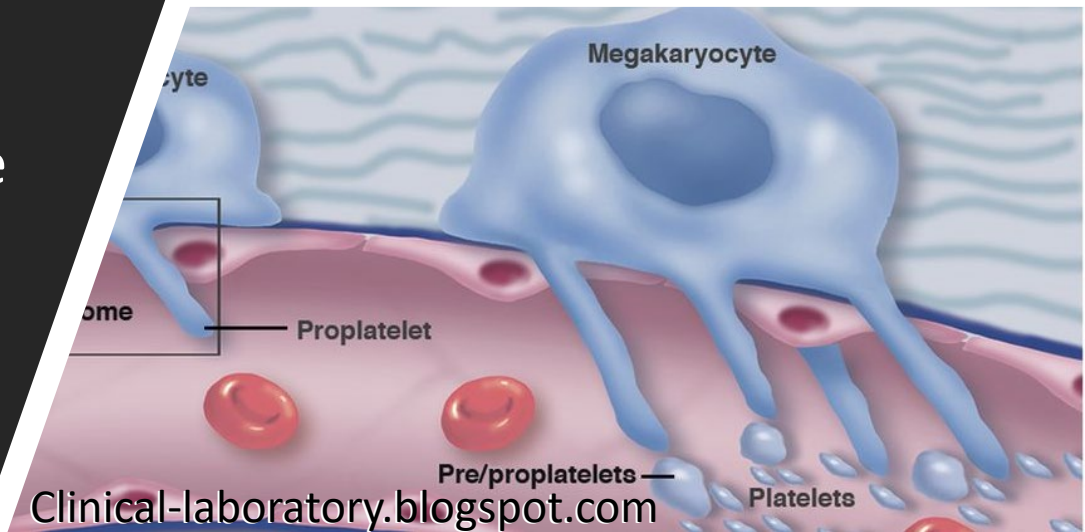
- Will meet with student weekly at least.
- Student will work closely either with me or with a post-doctoral fellow, depending on the project.
- Ideally, the student will participate in lab meetings and design a power point presentation on his/her work at the end of the summer.
- We would like to host 1-2 students.
- For more information, please email and meet with me to discuss. **elizabeth.jonas@yale.edu.**

Gene Regulation in Megakaryopoiesis

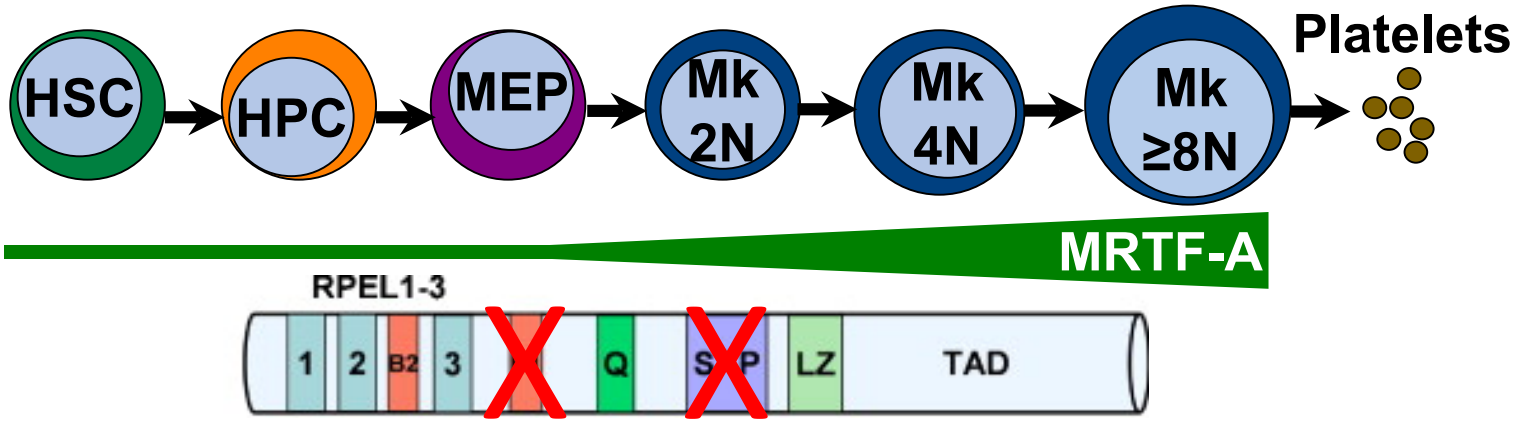
Vanessa Scanlon, PhD
Vanessa.Scanlon@yale.edu

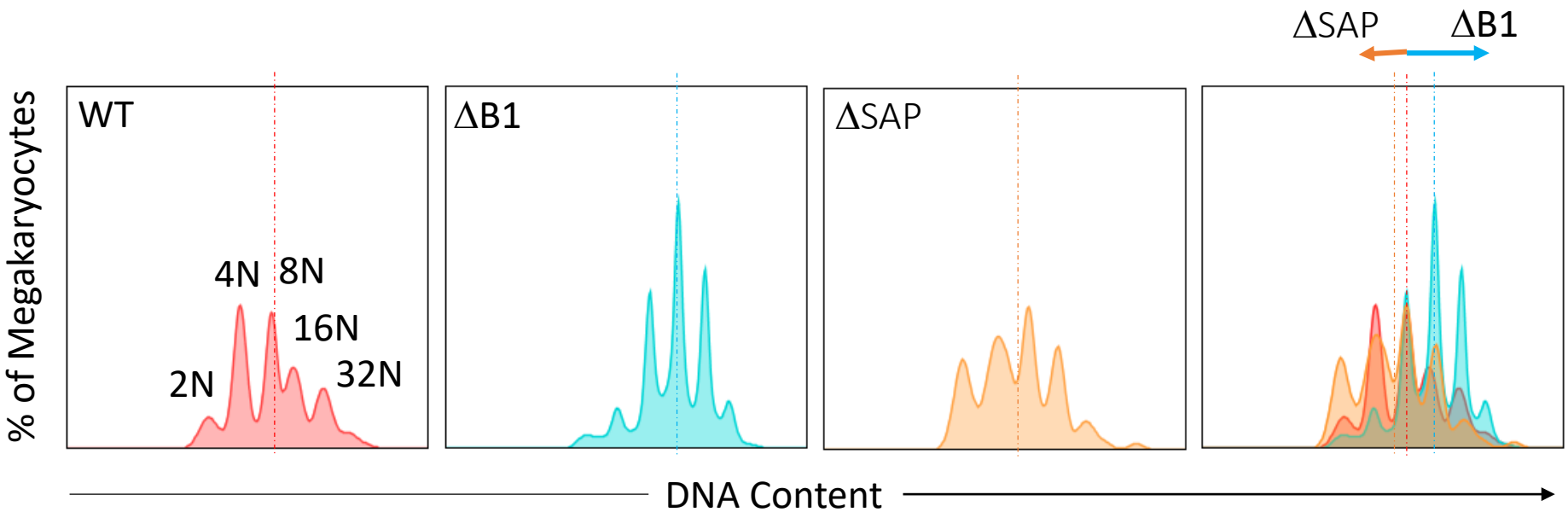
- Megakaryocytes (Mk)= Large polyploid bone marrow cells - generate platelets
- Critical for blood clotting
- Acute Megakaryoblastic Leukemia - increased megakaryoblasts (immature Mk cells) in the bone marrow





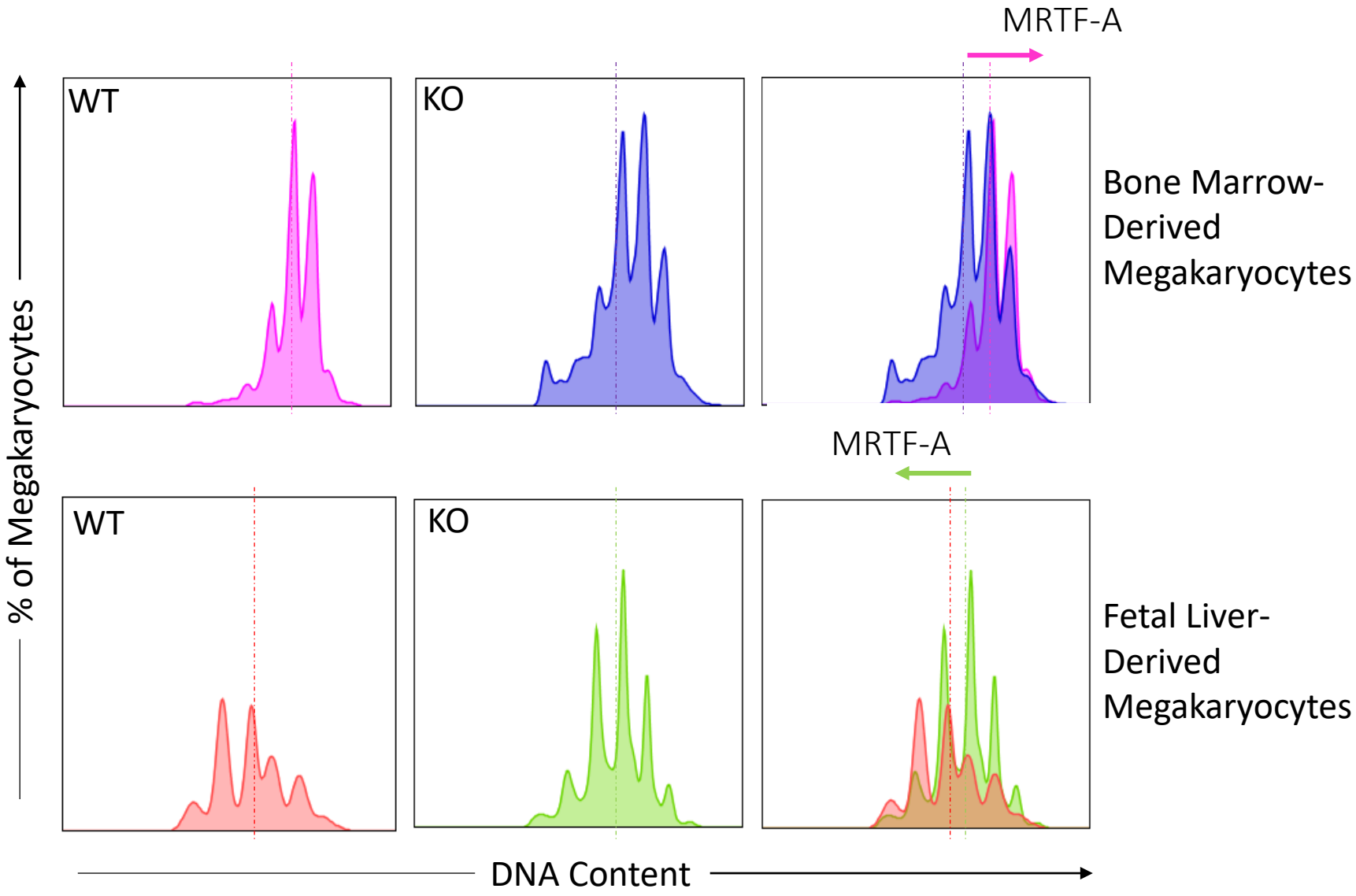
Which domains of MRTF-A are responsible for promoting megakaryopoiesis?





Cheng et al, Blood, 2009; Ma et al, MCB, 2007; Scharenberg et al, Int J Biochem Cell Biol, 2010; Eskow et al, unpublished

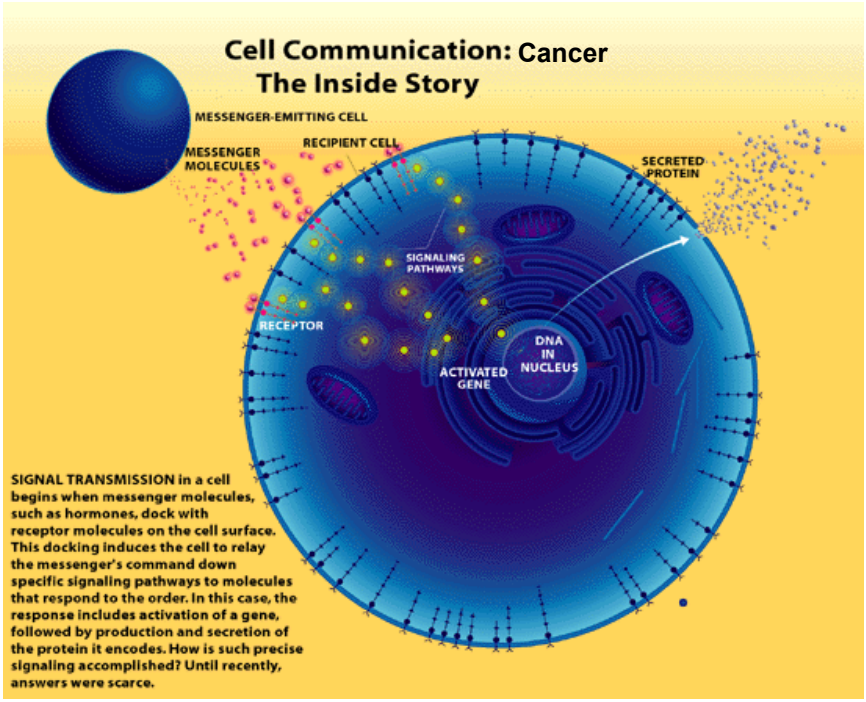
Does MRTF-A have opposite effects on megakaryopoiesis during development?



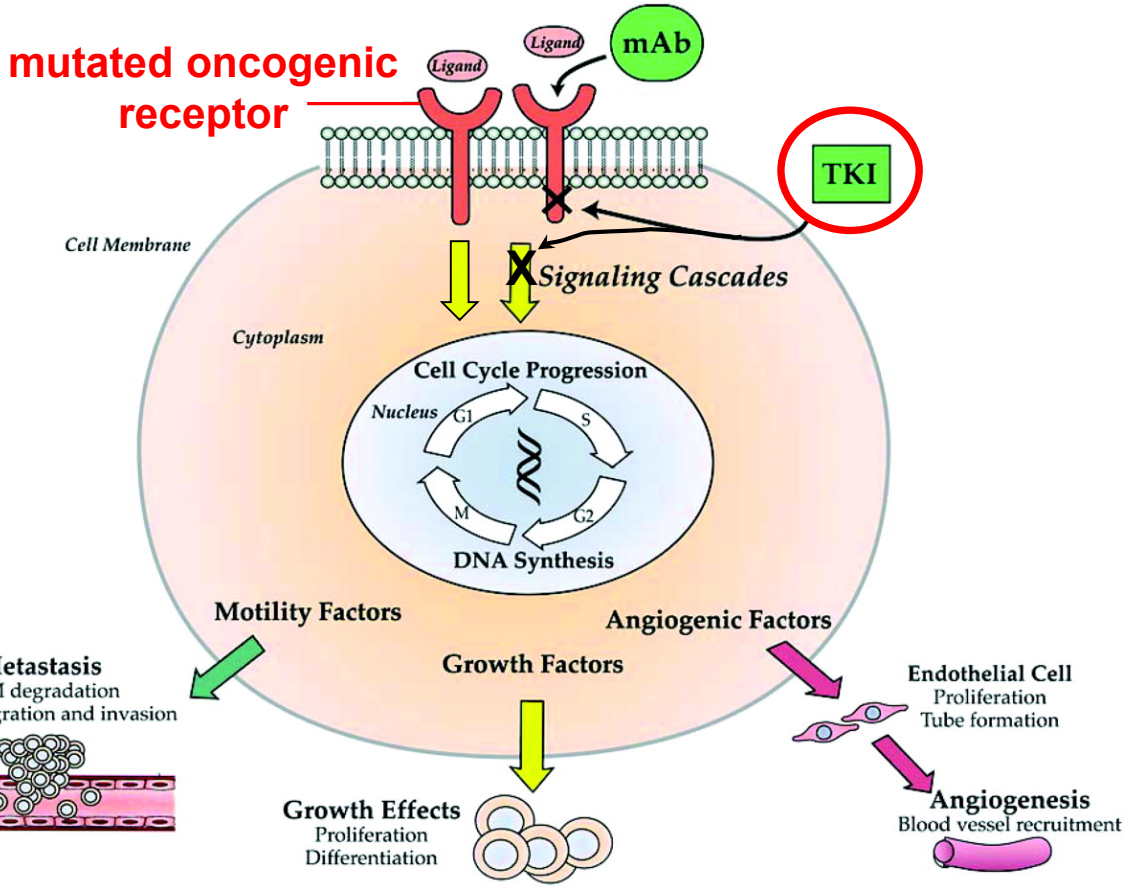
Eskow et al, *in preparation*

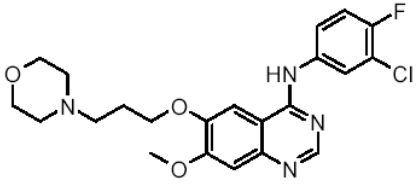
Yale *Cancer Biology Institute*

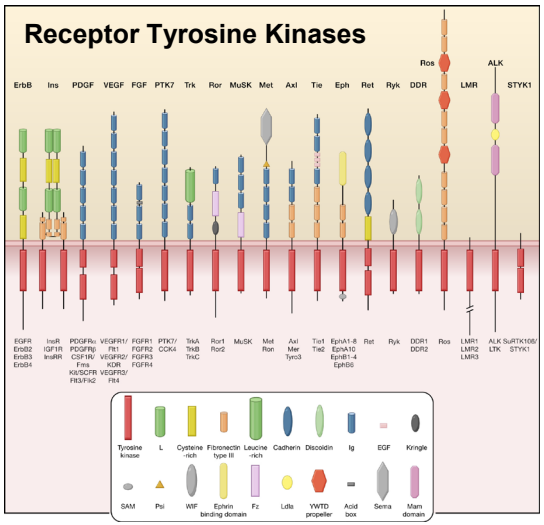
Signaling by cell-surface growth factor receptors: in biology and disease (cancer)

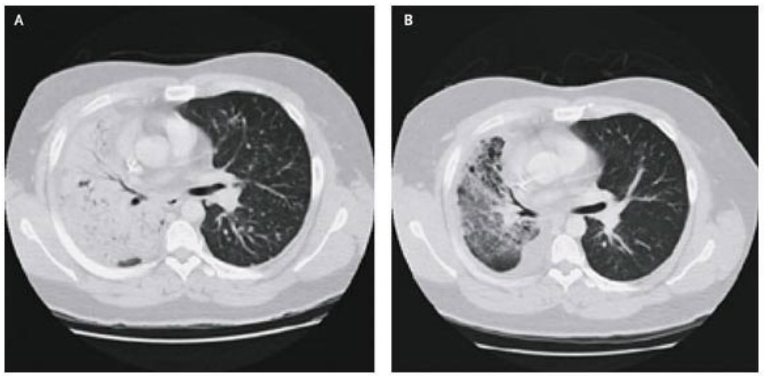


Mark A. Lemmon: Yale Cancer Biology Institute
Department of Pharmacology, YSM
mark.lemmon@yale.edu

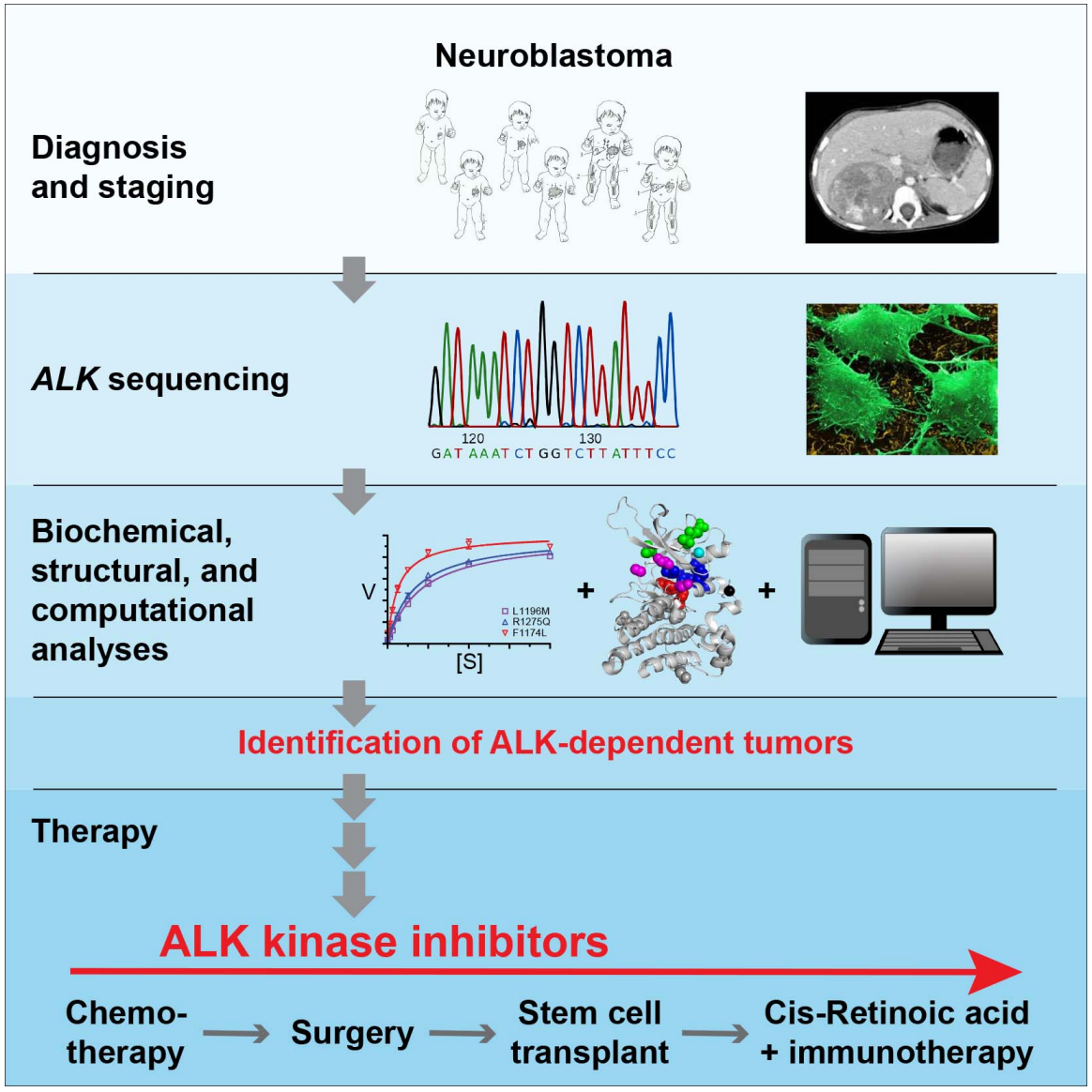






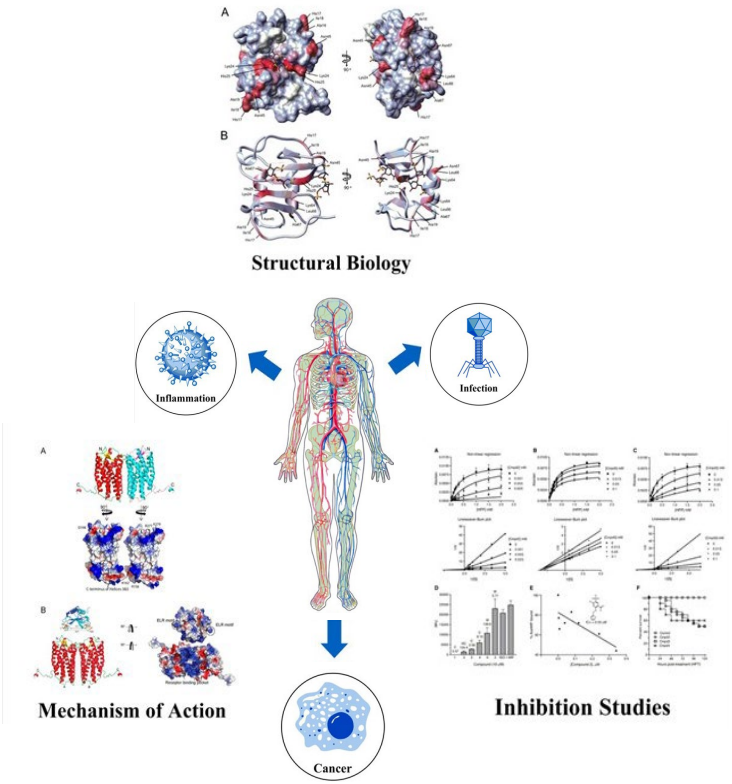


Lynch *et al., N.E.J.M.* **350,** 2129 (2004)



- Lab of 5 grad students, 5 post-docs, 3-4 undergrads, plus lab manager
- Direct Supervision by 1-2 grad students or postdoc
- Lab meetings Thurs afternoons
- Learn to make mutated recombinant protein and assess activity – for mutations found in lung cancer rebiopsy program at YNHH
- Help identify ‘rules’ for inhibitor application and choice

Elias Lolis (elias.lolis@yale.edu)



Lab background: Understand mechanism of macromolecules and small molecules in inflammation, cancer, and microbial infections.

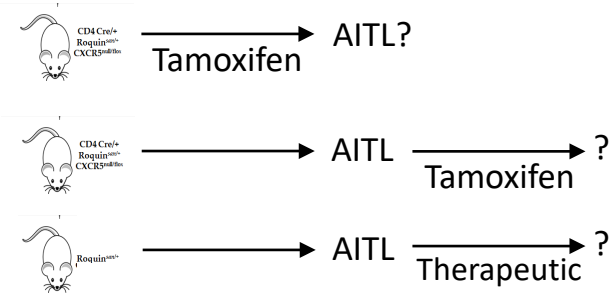
- Techniques:
  - Protein purification
  - Enzyme kinetics
  - X-ray crystallography
  - Yeast and mouse models

Elias Lolis (elias.lolis@yale.edu)

Macrophage migration inflammatory factor (MIF)

1. Molecular Dynamics defined an allosteric site at Y99
2. NIH researcher called about Y99C mutant in JSIA
3. **Characterize Y99A: enzyme kinetics, receptor binding, inhibitor binding.**

CXCR5 in angioimmunoblastic T-cell lymphoma (AITL)



1. AITL mouse model found in Australia
2. Inducible Cre/lox CXCR5 KO to determine if (a) **CXCR5 is involved in lymphoma development** and (b) **is a therapeutic target**.
3. **Develop therapeutics**

Mentoring

- My office it at the very end of the lab with an open door policy. I also have *ad hoc* meetings with individuals
- A senior member of the lab (two graduate students and two postdoctoral associates) will mentor the undergraduate
- Students present their work at lab meeting every other week
- Students present journal manuscript
- One undergraduate this summer
- Seven previous Yale undergrads: 2 of 3 MDs went to Yale Medical School, 2 worked at Science/Health companies, 1 Stanford Law, 1 Deceased

FIXING THE NUCLEUS

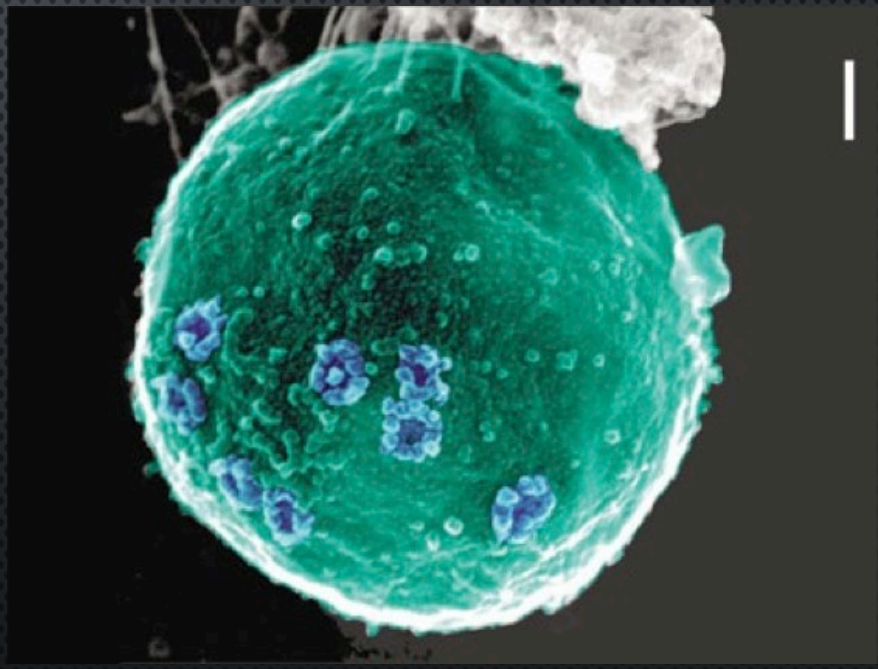
Patrick Lusk

Department of Cell Biology

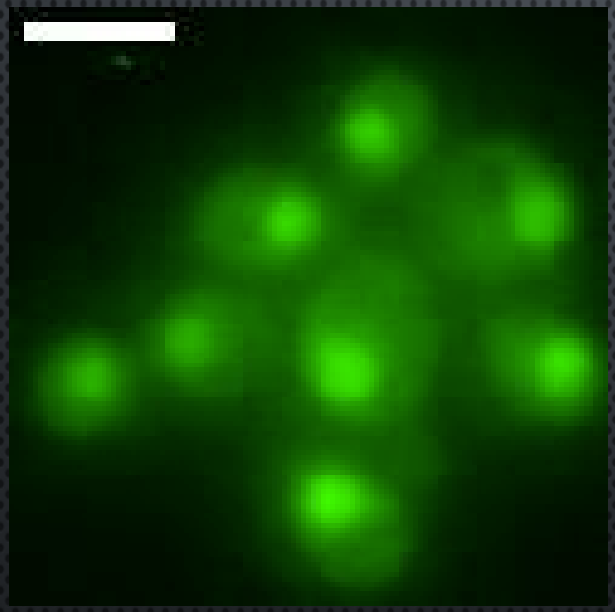
Patrick.lusk@yale.edu

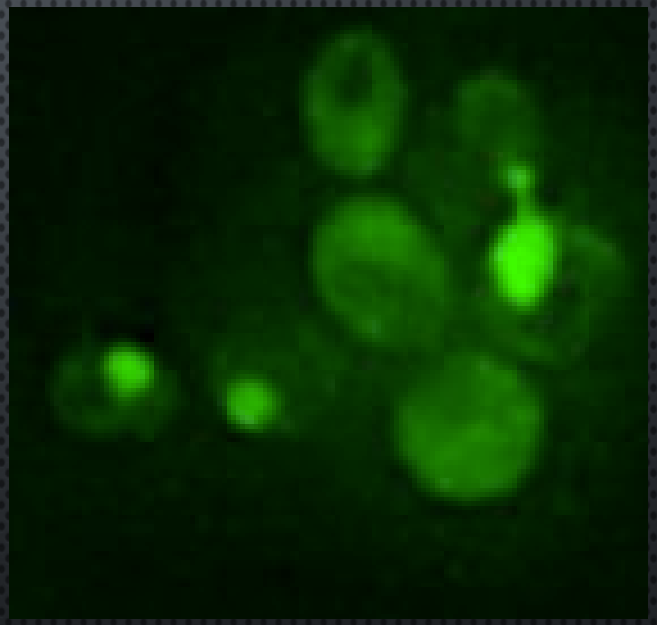
BCMM 254B

On twitter: @Plusk4u



WHAT ARE THE MECHANISMS OF NUCLEAR MEMBRANE REPAIR?





WHAT PEOPLE ARE SAYING ABOUT THE LUSK LAB

"5 stars…working with
Dr. Lusk's group was nothing short of a revelation!
-Bob Fluorophore, class of '19

"Two Thumbs Up! It was like living a dream, how can I work anywhere else?"
- Andrew Petri, class of '19

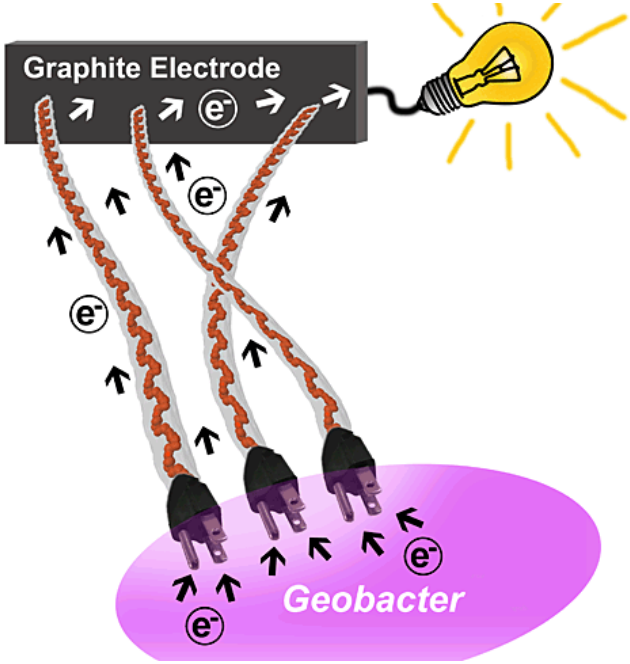
"Who knew yeast could be so beautiful?"
-Emma Pipette, class of '21

"Biology, mechanism, evolution….SCIENCE, so cool!".
-Doug Yestbudder

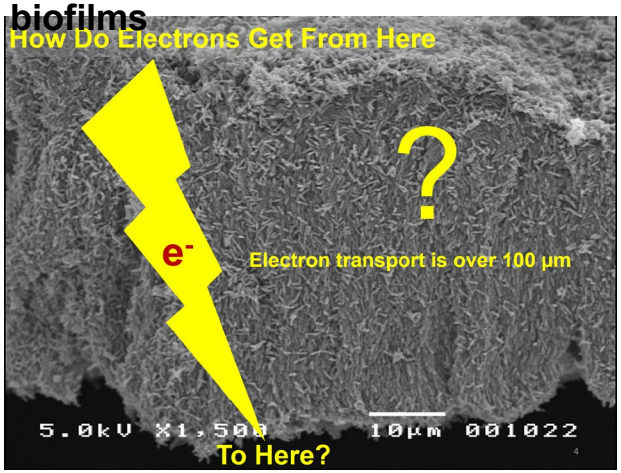
Nikhil Malvankar Lab

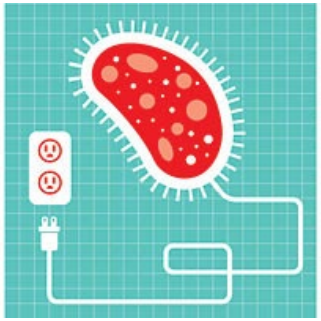
New imaging and measurement technologies to define the mechanisms by which microbes interact with and manipulate their environment. The ultimate goal is to engineer these interactions to control microbial pathophysiology and ecology.

Electric Bacterial Nanowires

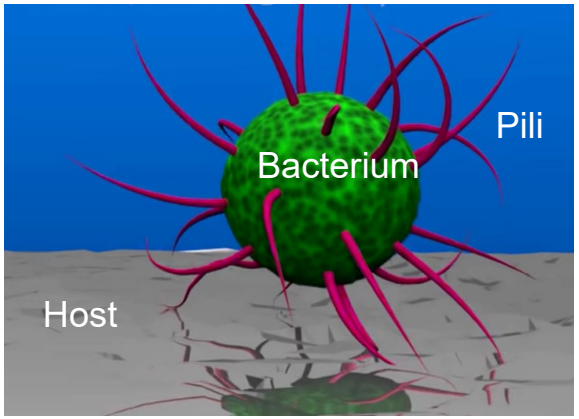


Bacterial communities in biofilms





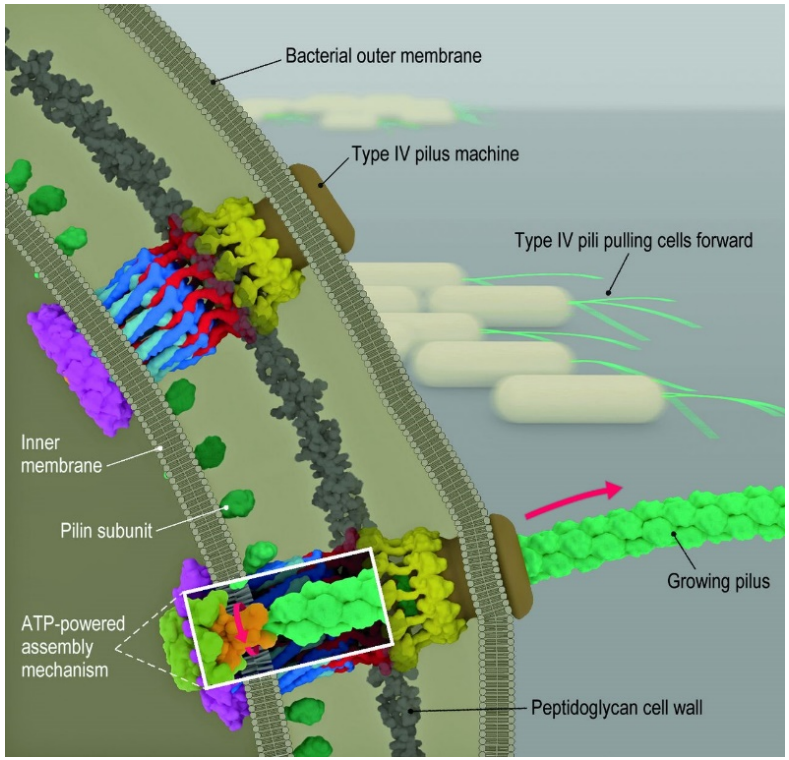
Host-pathogen Interactions in single cells and biofilms



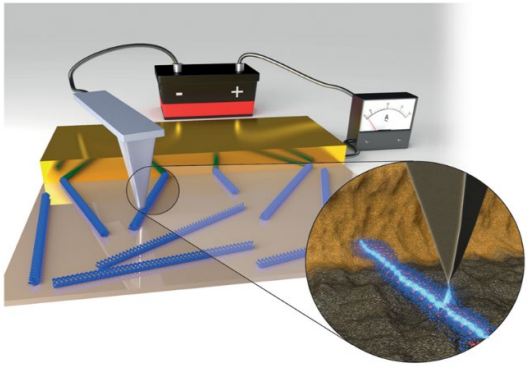
Nikhil Malvankar
Mol. Biophysics & Biochem.
Microbial Sciences Institute
nikhil.malvankar@yale.edu

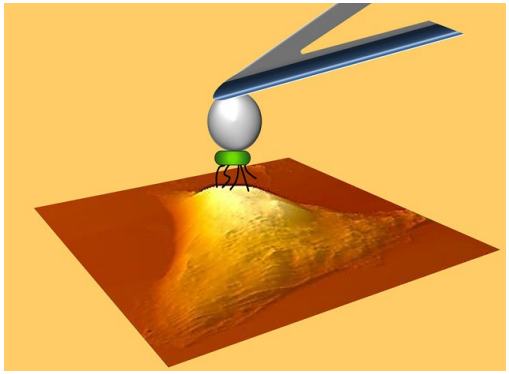
Rotation Projects – Physics, Chemistry, Biology & Engineering

Cryo Electron Microscopy & Tomography of bacterial nanowires and assembly

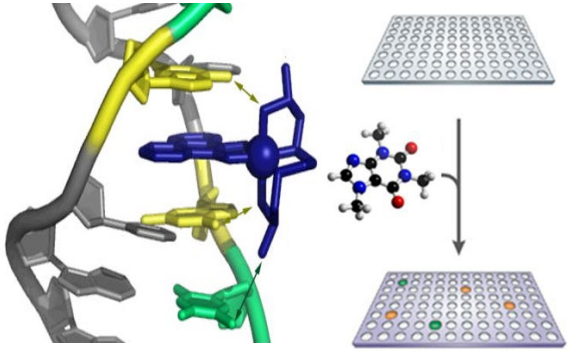


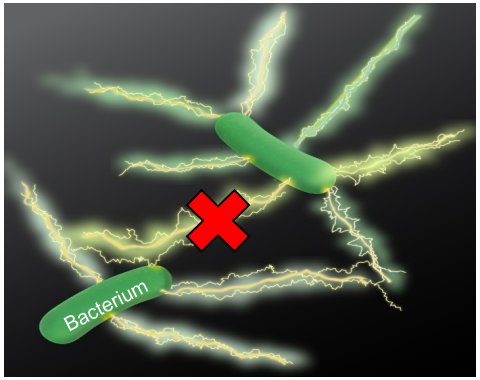
Targeting bacterial survival mechanisms





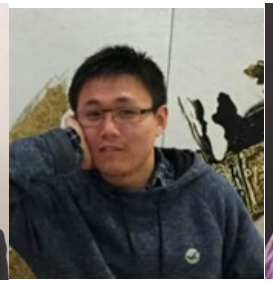
Novel drugs to neutralize host-pathogen interactions



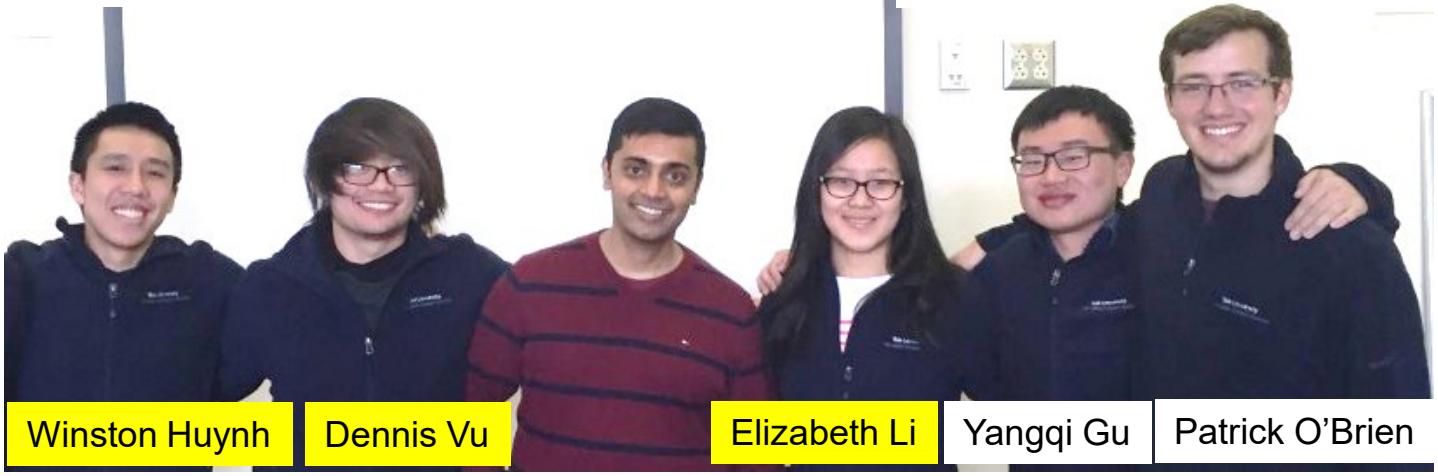




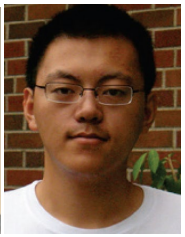


Sibel Yalcin Catharine Shipps Sophia Yi Peter Dahl Vishok Srikanth Cong Shen Ruchi Jain Dan Shapiro



Winston Huynh Dennis Vu Elizabeth Li Yangqi Gu Patrick O'Brien

Jen s Xinglong Ren

Claire Sheen

Undergraduate students

BURROUGHS WELLCOME FUND
Career Awards at the Scientific Interface

NIH DIRECTOR'S NEW INNOVATOR AWARD

DARPA DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

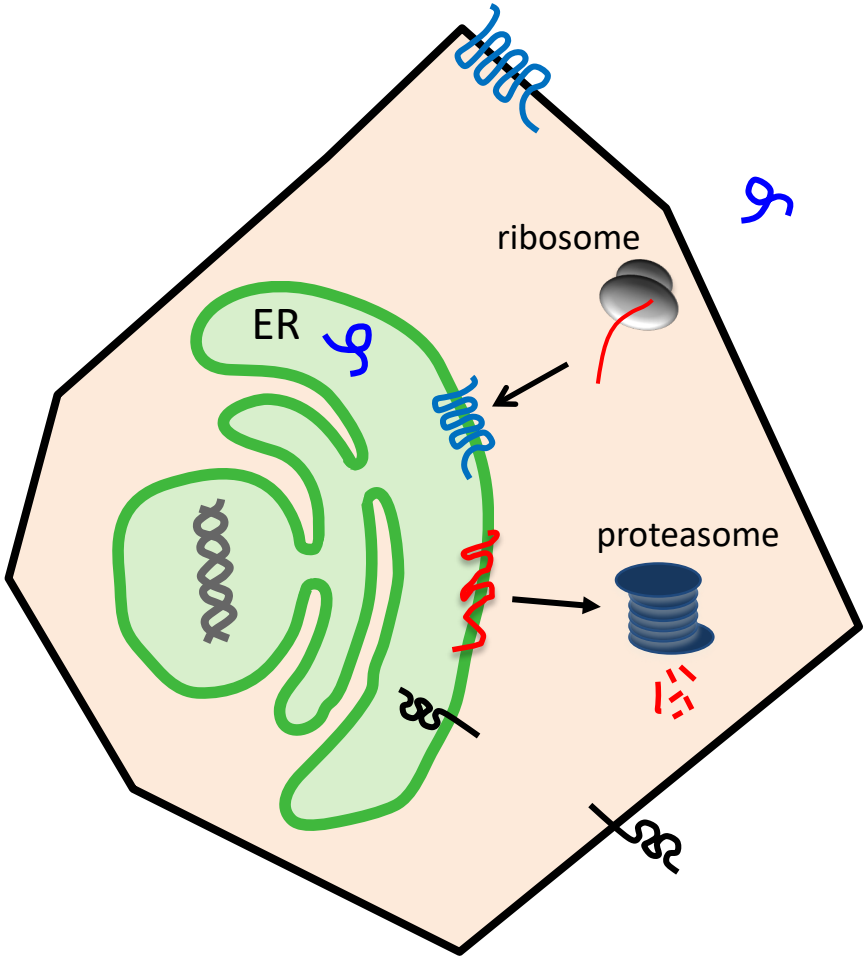
NSF CAREER Award

THE HARTWELL FOUNDATION

Charles H. Hood FOUNDATION

Protein biosynthesis and quality control at the ER

The Mariappan Lab (malaiyalam.mariappan@yale.edu)



The endoplasmic reticulum (ER)

- responsible for synthesizing ~ 30% of human proteome, which includes insulin, antibodies, channels and receptors.

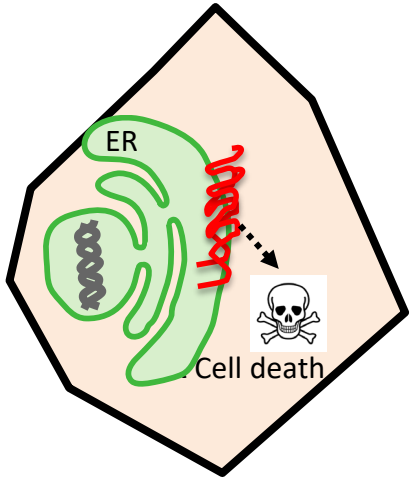
We are investigating:

- How are proteins targeted to the ER?
- How are misfolded proteins eliminated from the ER?
- How do the ER maintain its homeostasis ?

Why are we interested?

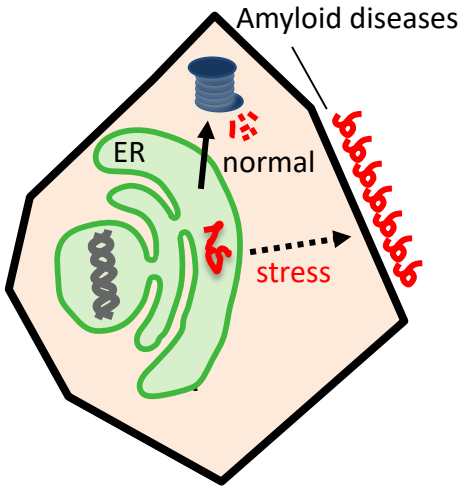
- Defects in protein biogenesis are associated numerous human diseases: Cystic Fibrosis, Diabetes, and Retinitis Pigmentosa.

Summer Projects for Undergraduate Students



1. How do Rhodopsin mutants cause blindness?

- Create mutations in the Rhodopsin gene by PCR and cloning
- Test the expression of mutants in HeLa cells by Western Blotting and Immunofluorescence
- Monitor the Unfolded Protein Response by luciferase assay
- Perform cell-based apoptosis assays



2. How are misfolded proteins secreted and cause amyloidosis?

- Test the secretion of misfolded proteins into the cell culture media by Western Blotting
- Test whether stress conditions stimulate the secretion of misfolded proteins
- Identify chaperones that retain misfolded proteins under normal conditions by mass spectrometry

The Marippan Lab (Two positions available)

malaiyalam.mariappan@yale.edu

Current Members

Jacob Culver (Graduate Student)
Sha Sun (Post-Doctoral Associate)
Xia Li (Post-Doctoral Associate)
Zhouping Hong (Rotation Student)

Previous undergraduate members

Sneha Mittal,
Keith Anderson
Nisha Rajamohan
Jessica Maddela

Previous high school student

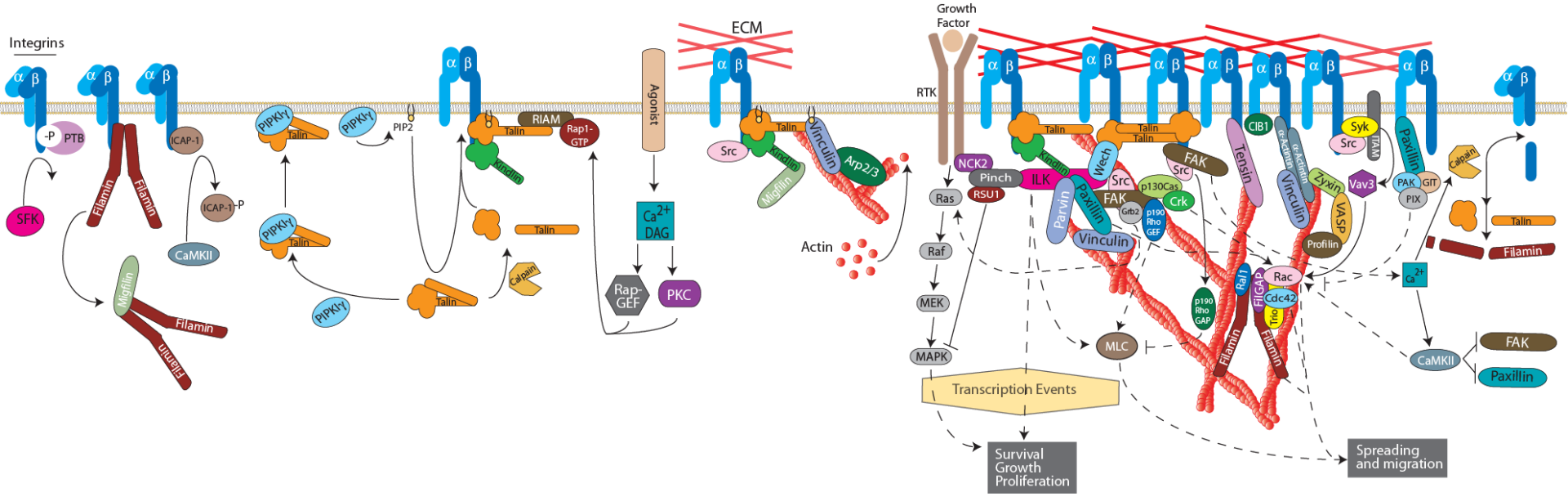
Nikhil Jaiswal
Poorna Balakumar

Mentoring of undergraduates

- Independent project
- Weekly one on one meeting with PI
- Working with post-docs or PI
- Presentation in lab meeting as well as in institute seminars

Adhesion Signaling and the Cytoskeleton

David A Calderwood
david.calderwood@yale.edu

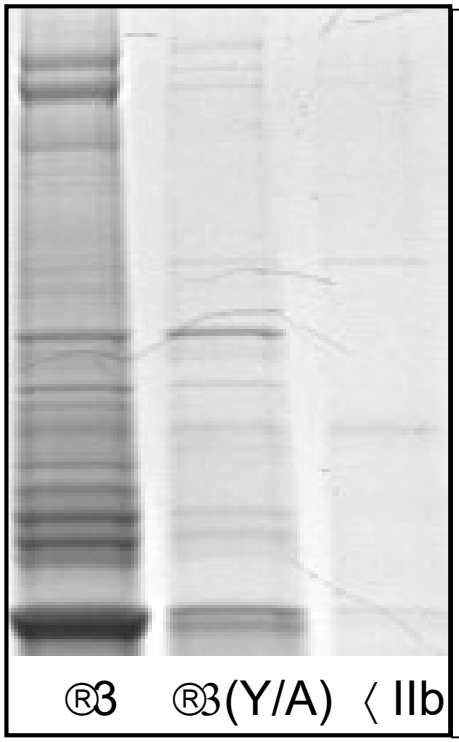


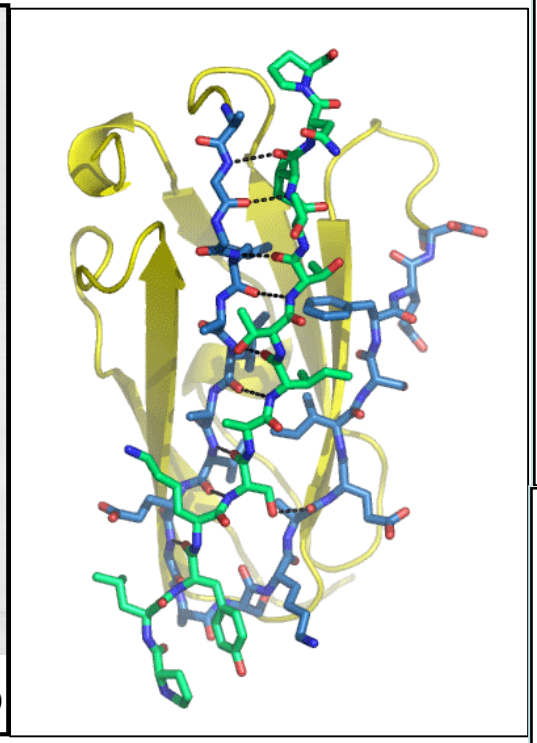
Functional significance of protein-protein interactions in controlling cell signaling, migration and morphogenesis

Structural Biology / Biochemistry / Cell biology

Adhesion Signaling and the Cytoskeleton

David A Calderwood





Structural Biology / Biochemistry / Cell biology

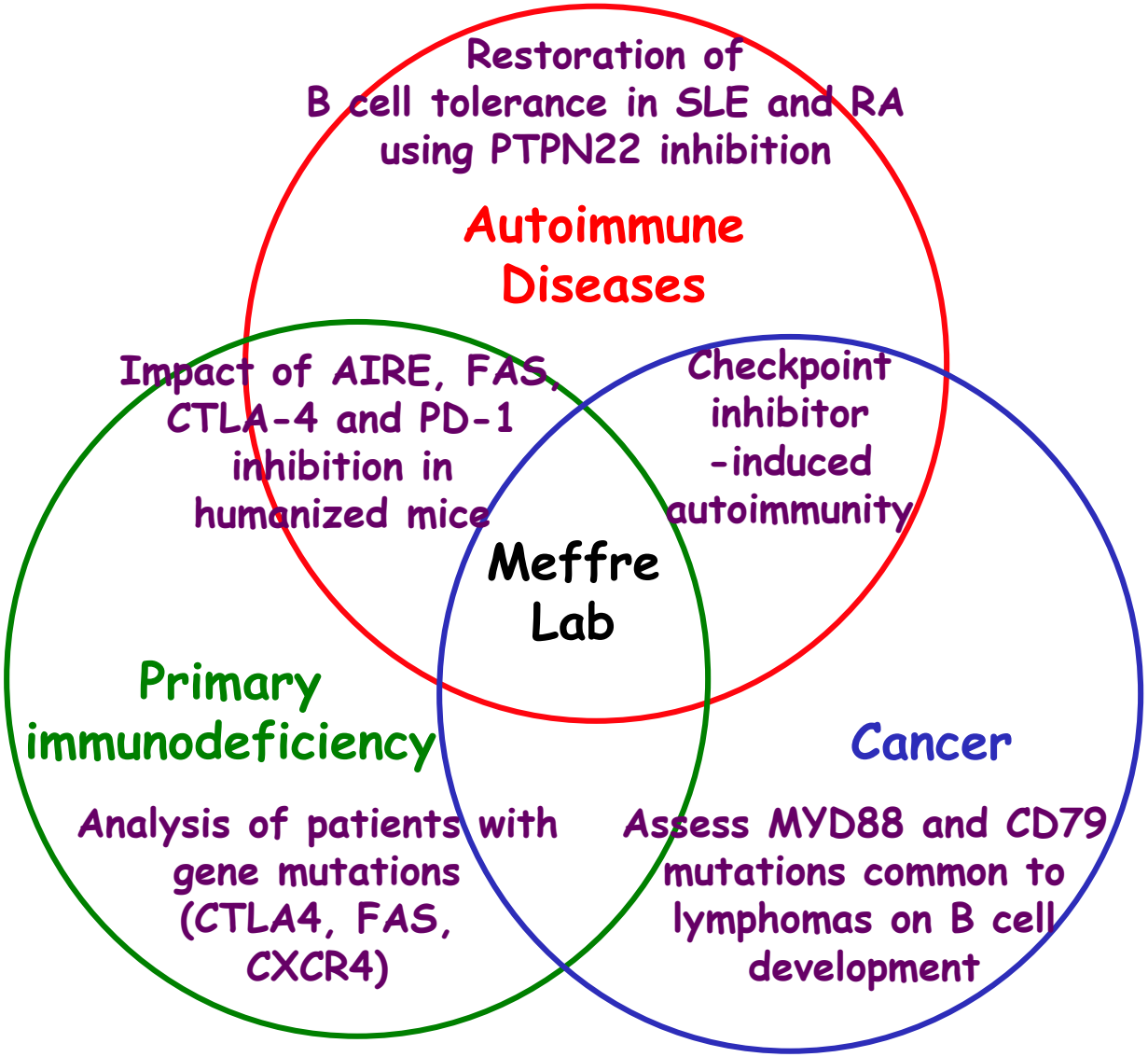
Adhesion Signaling and the Cytoskeleton

David A Calderwood
david.calderwood@yale.edu

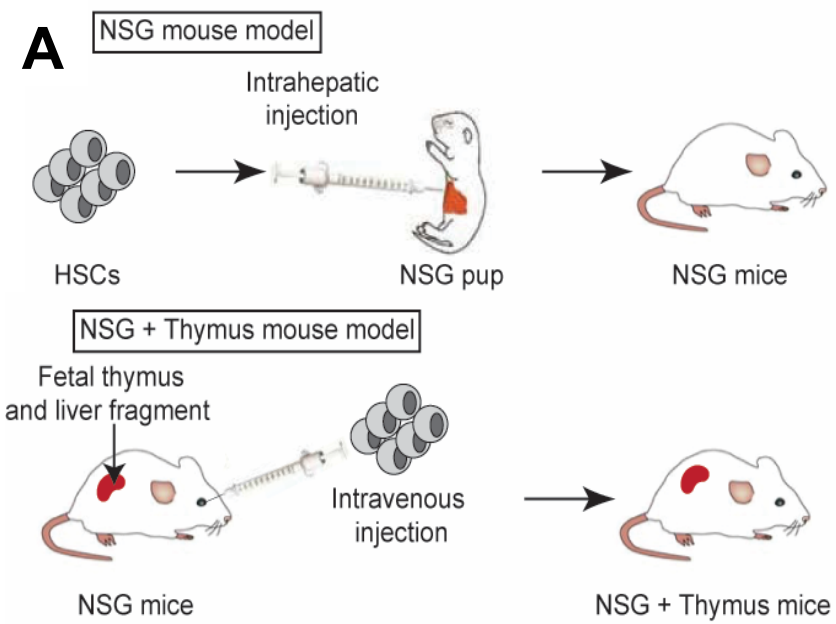
- Dept. Pharmacology, Medical School
- https://medicine.yale.edu/lab/calderwood/
- Lab meetings 9AM Wednesday SHMB395D
- Mentoring by postdoc or senior grad-student
- 1 position open

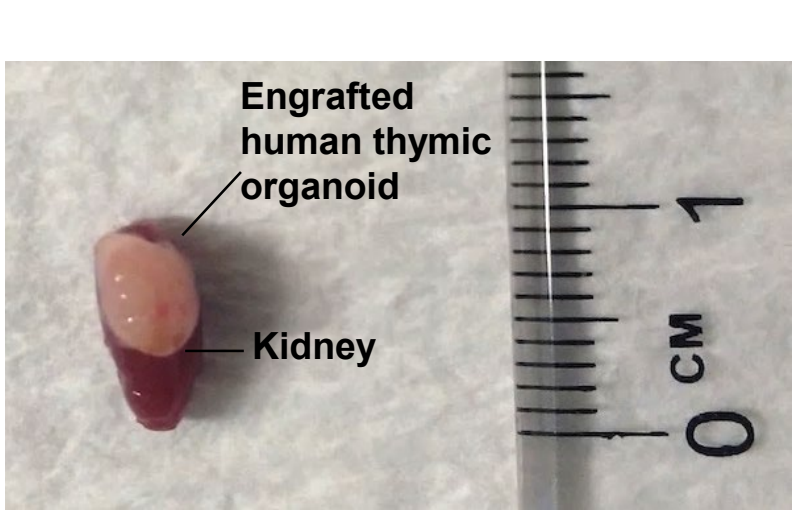
The regulation of human B cell tolerance

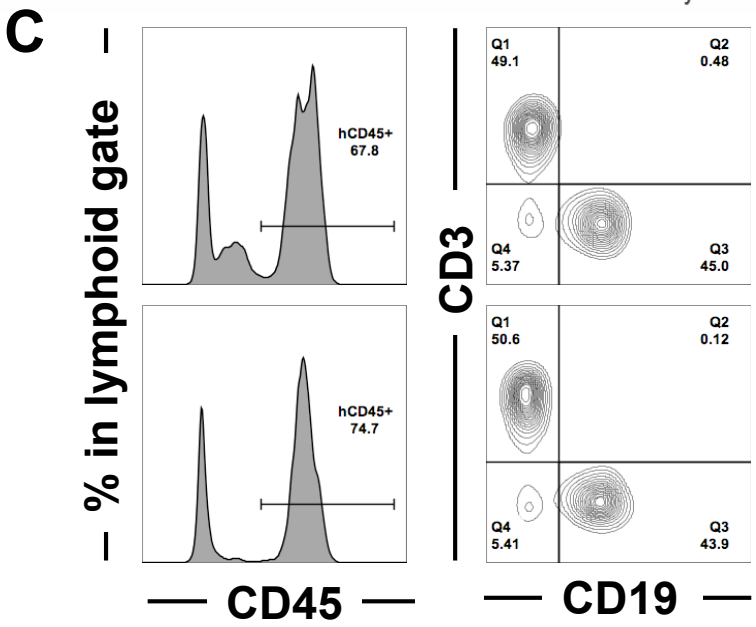
Eric Meffre, Department of Immunobiology
Eric.meffre@yale.edu

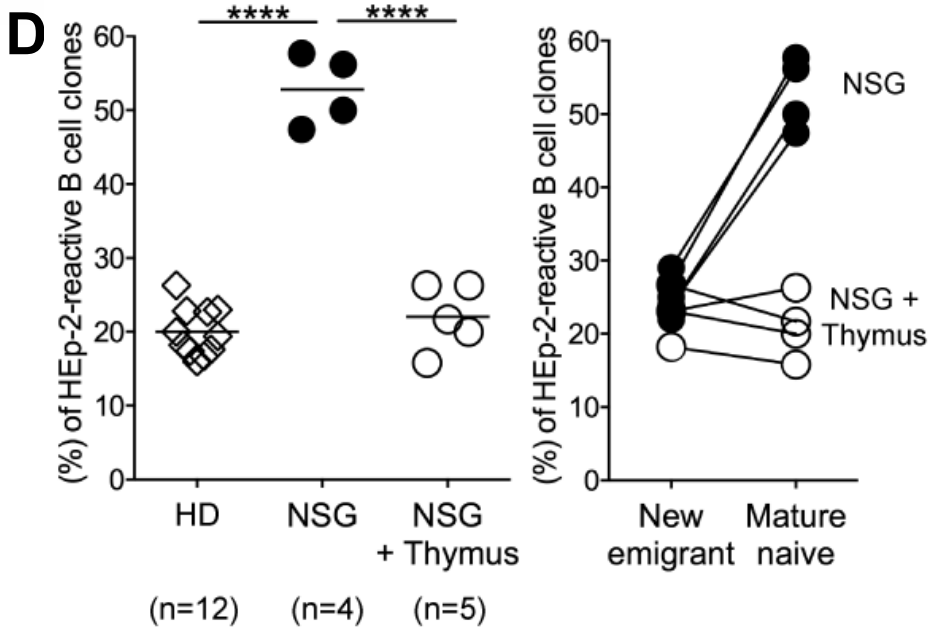


Humanized mouse models to study B cell tolerance

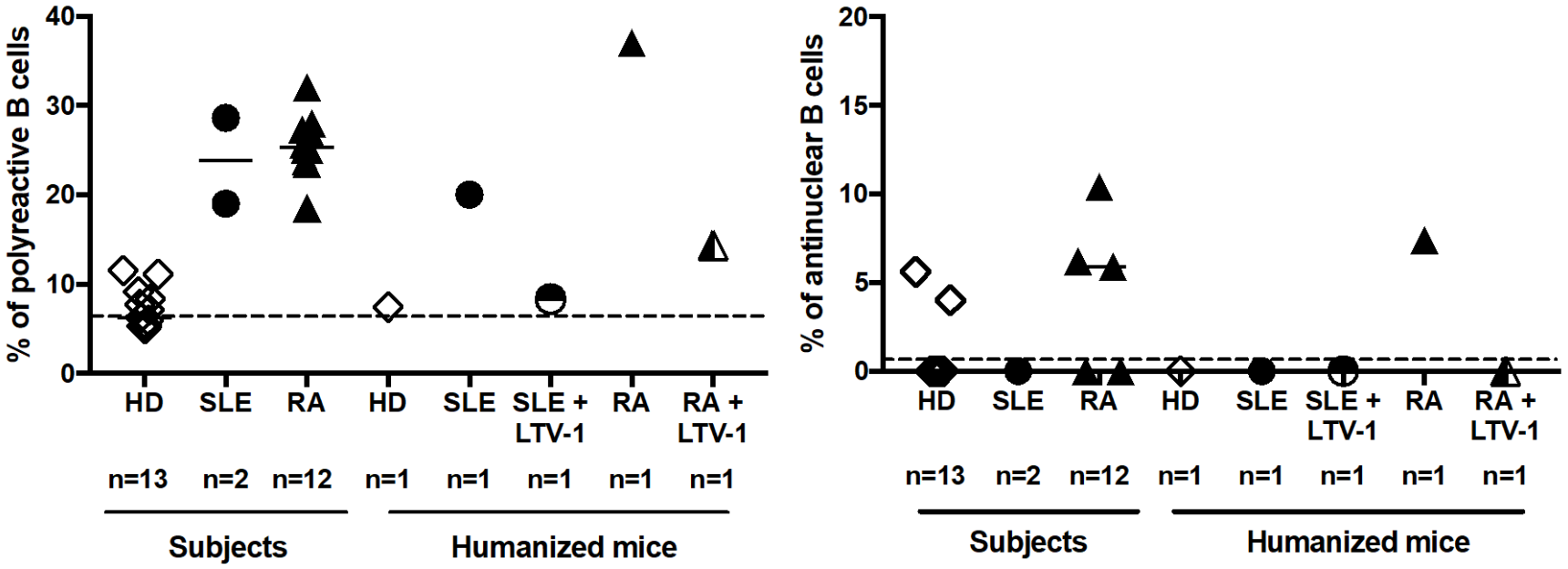








PTPN22 blockade prevents autoreactive B cell production in the bone marrow

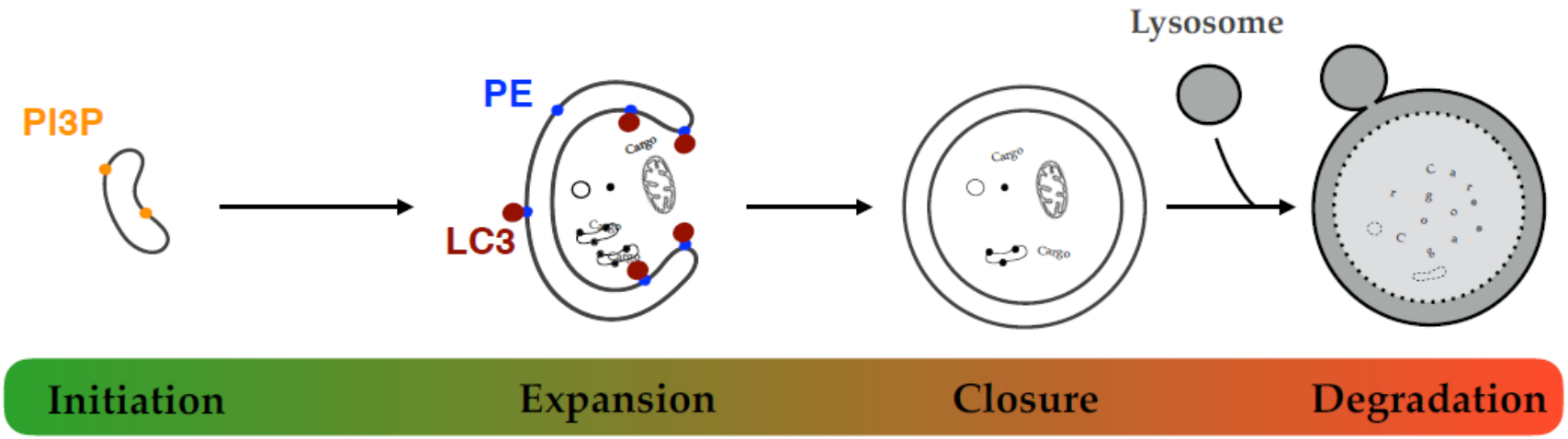


PTPN22 inhibition can correct defective central B cell tolerance in systemic lupus erythematosus and rheumatoid arthritis

Tom Melia,
Cell Biology Department
thomas.melia@yale.edu
203-785-2165

How cells fight intracellular challenges with the Macroautophagy pathway

The problem: things go catastrophically wrong in the cytoplasm all the time, how do cells get rid of dying organelles, invading pathogens or protein aggregates?



Early-acting proteins form the PAS structure

Enzymes attach ubiquitin-like LC3 to the growing membrane

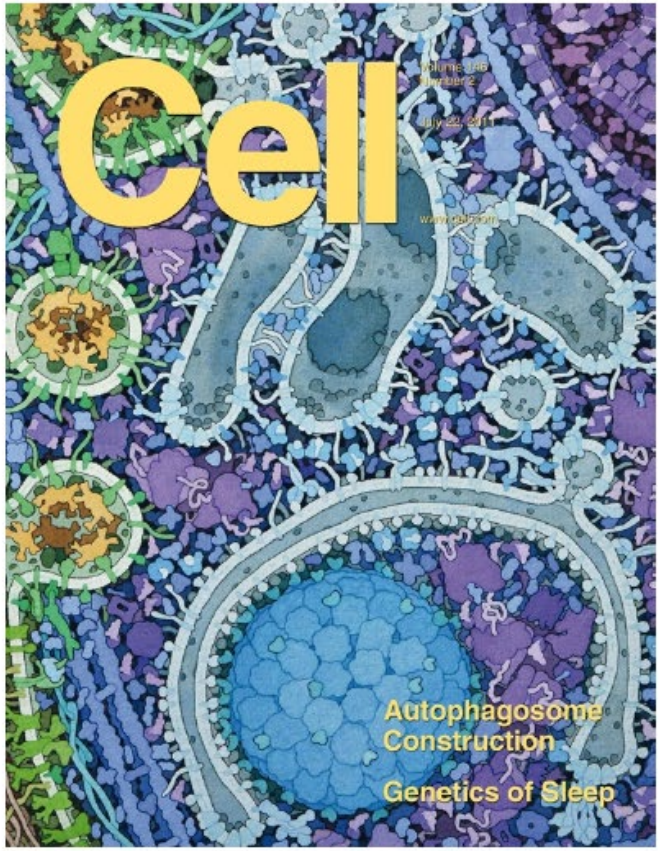
Release of many autophagy proteins other than LC3

Fusion with lysosomes to degrade cargo

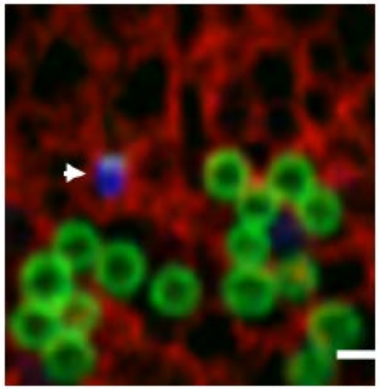
Tom Melia,
Cell Biology Department
thomas.melia@yale.edu
203-785-2165

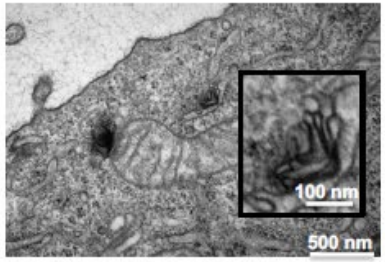
How cells fight intracellular challenges with the Macroautophagy pathway

Our approaches: **To figure out mechanism, we reconstitute protein activity on artificial membranes that mimic autophagosome structure. To establish biology, we test elements of these mechanisms in gene-edited cell lines.**

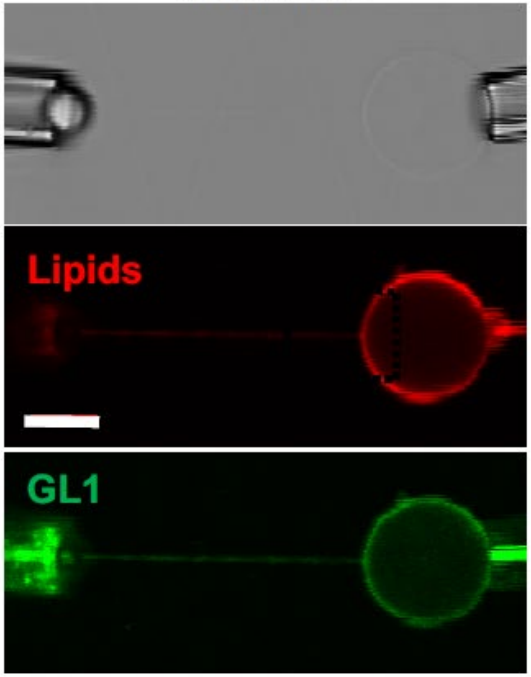


Follow membrane formation in cells





Mimic membrane formation on artificial membranes



Tom Melia,
Cell Biology Department
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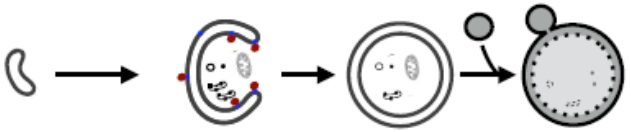
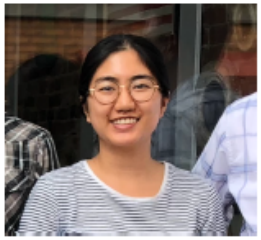
203-785-2165

How cells fight intracellular challenges with the Macroautophagy pathway

***What have undergraduates done*: Most summer students start off learning proteo-membrane reconstitution and explore fundamental activities of simple protein machines.**

	Yale	Other Institutes
Worked in my lab for a summer	11	6
Then decided to continue into school year	8	2*
Have appeared on at least 1 paper	4	4
Have data for papers not yet in submission	3	1





Laurie Wang
Class of 2019

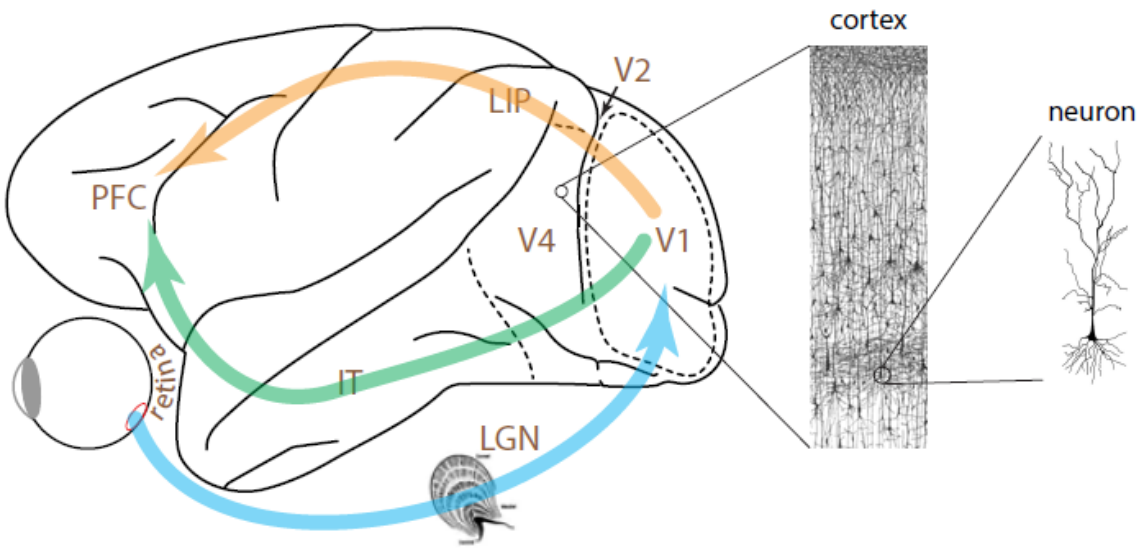
Summer project: used DNA-scaffolded liposomes to study enzyme activity on membranes with curvature similar to parts of autophagosome (collaboration with Lin lab)

Thesis project: Describing first ever disease phenotype of a patient discovered in Yale Genomics facility with mutations in Laurie's favorite autophagy enzyme.

PI: Anirvan Nandy (anirvan.nandy@yale.edu)
Graduate Student Mentor: Feng Xing (feng.xing@yale.edu)

Dept. of Neuroscience

Neural mechanisms of perception, attention & social cognition

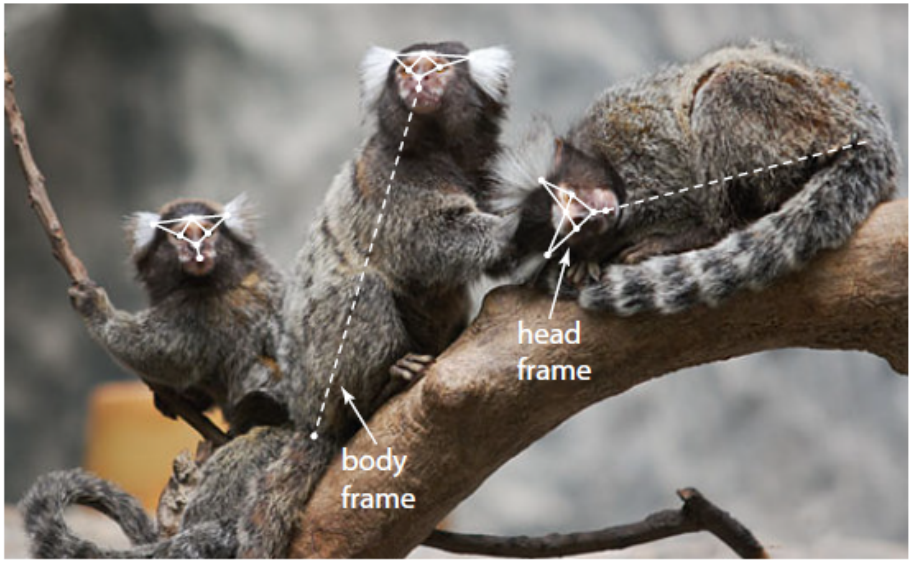


How do neurons in the visual cortex encode information about shapes of objects?

How is this encoded information changed by attention?

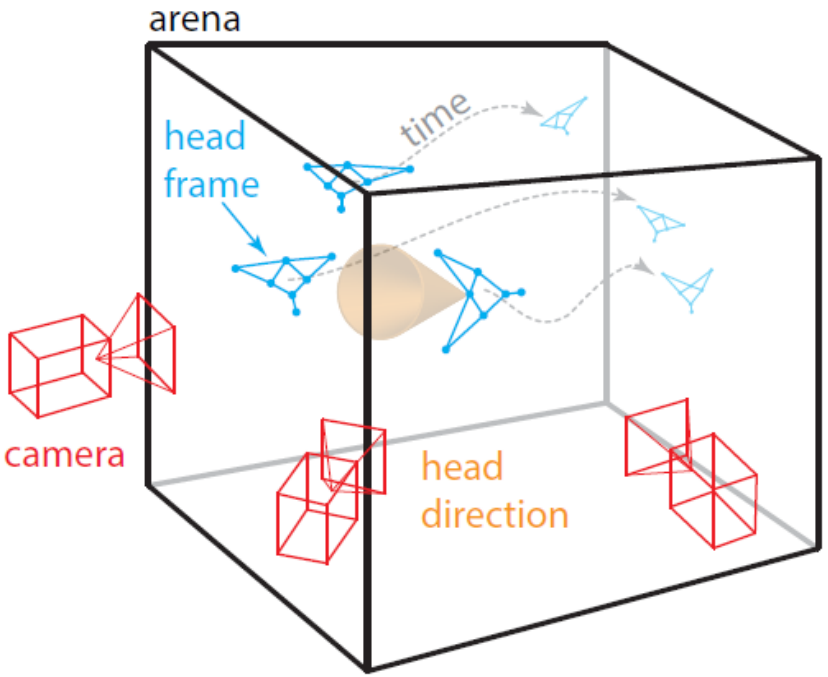
How do neurons in the pre-frontal cortex encode information about complex social interactions?

An important first step in understanding complex social cognition is an accurate quantification of behavior



We will use marmoset monkeys as a model system since they are highly pro-social animals

We will track interacting groups of marmosets using multiple cameras and use advanced computer vision and machine learning methods to accurately quantify their behavior



Roles & Expectations:

Student will be actively mentored daily by the graduate student mentor

Student will meet with PI weekly

Student will participate in weekly lab meetings

Position is available for one funded student

Thank You!

http://nandylab.org

Functional genomics of adaptive radiation in Antarctic fishes

thomas.near@yale.edu

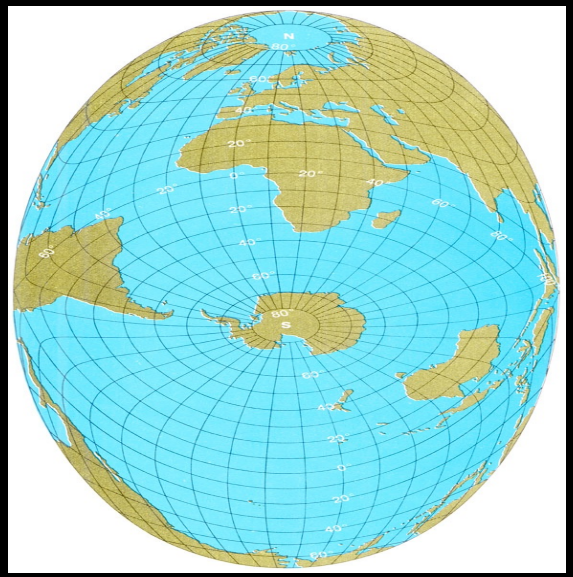
@tjnear

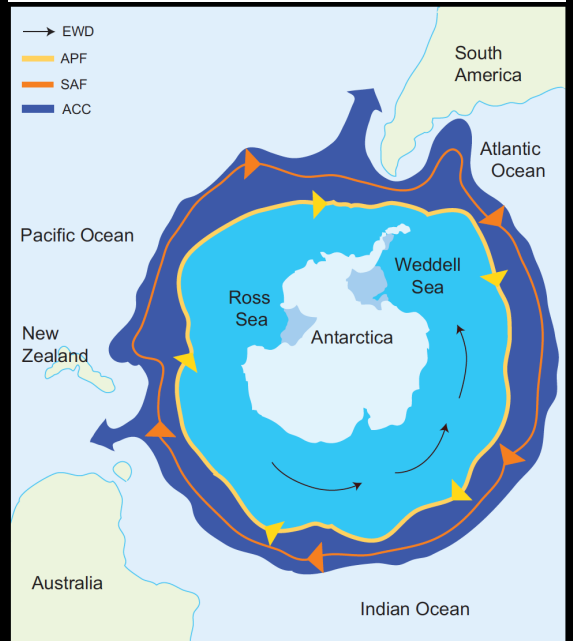
Thomas J. Near

Dept. Ecology and Evolutionary Biology and Peabody Museum of Natural History

Yale University

Southern Ocean Fish Fauna

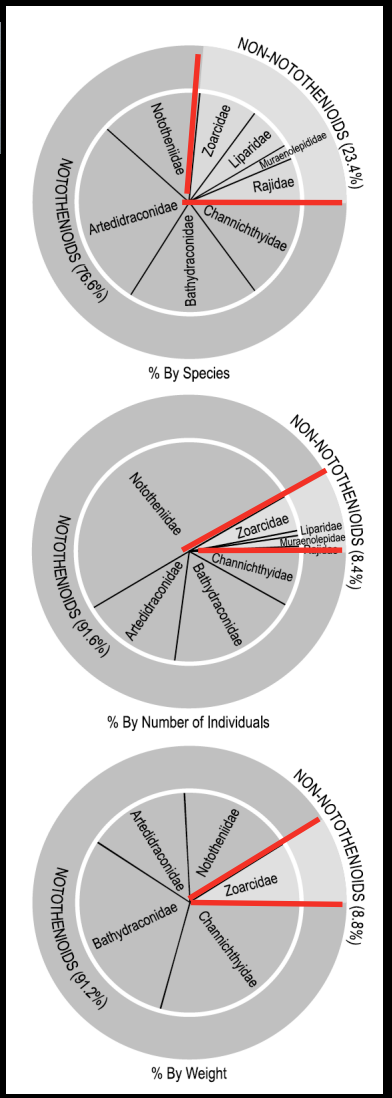




Pogonophryne marmorata

Chionodraco myersi

Trematomus borchgrevinki



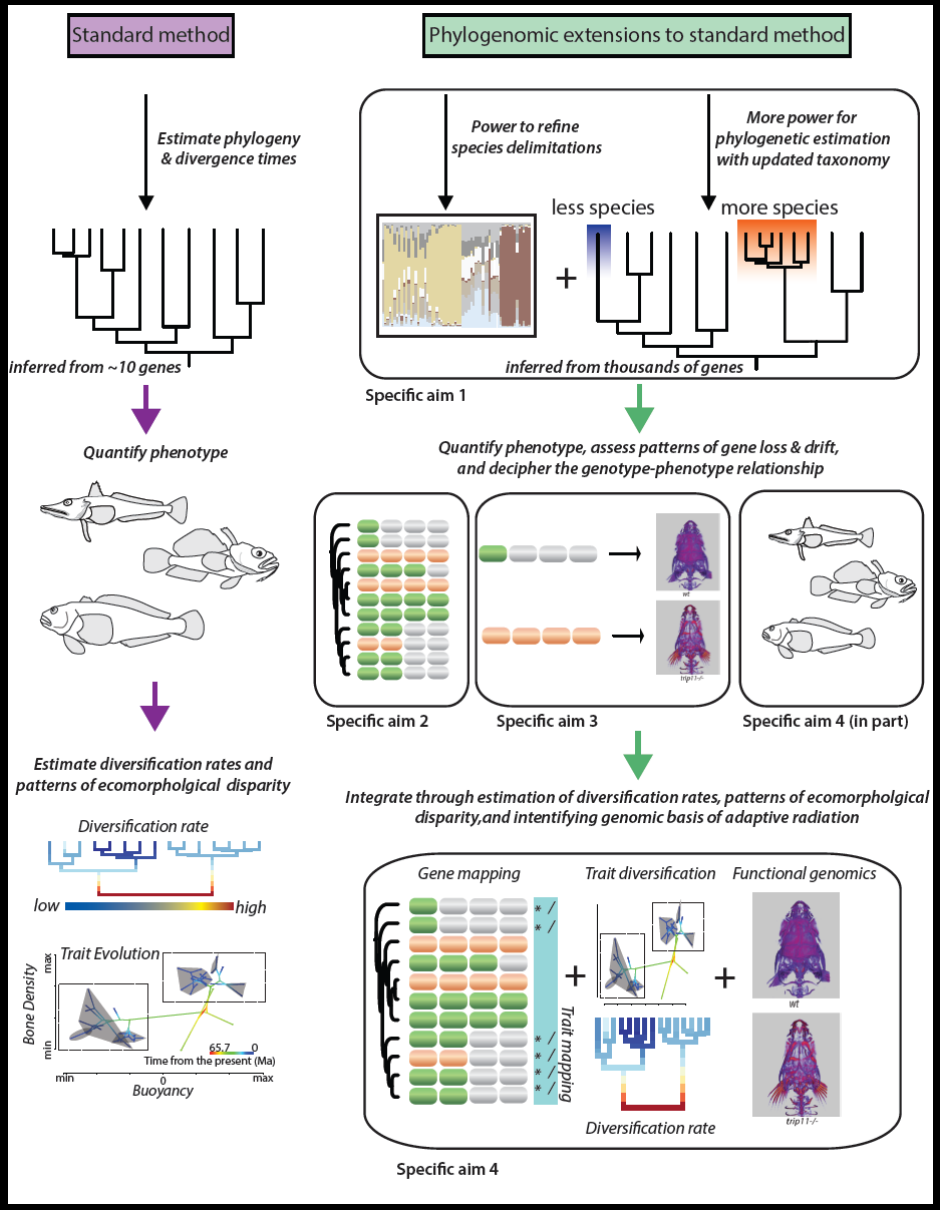
Diversity
76.6%

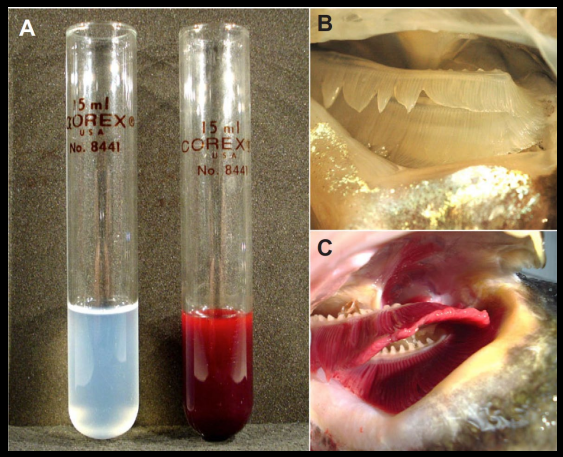
Abundance
91.6%

Biomass
91.2%

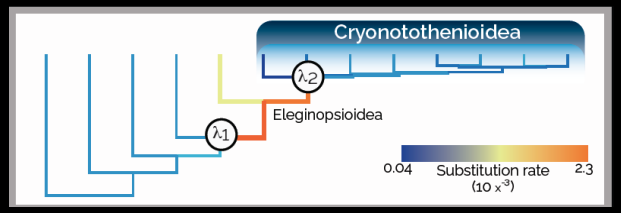
Eastman 2005

The study of adaptive radiation: the phylogenomic approach

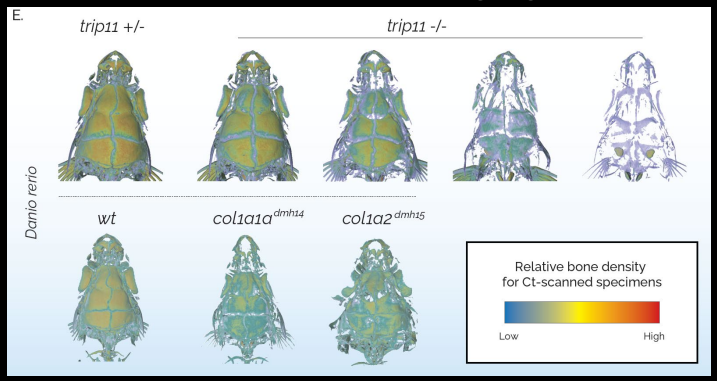




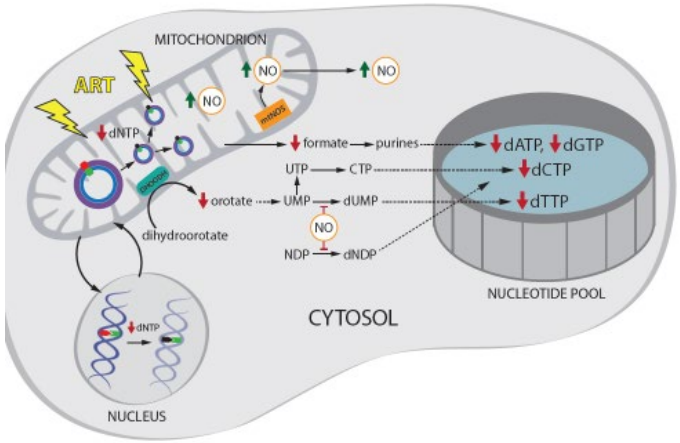
Phylogeny showing high rates of genomic evolution

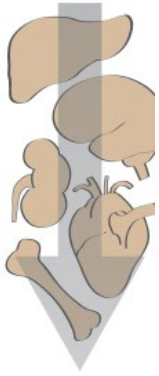


CRISPR-Cas9 induced mutations on target genes in Zebrafish

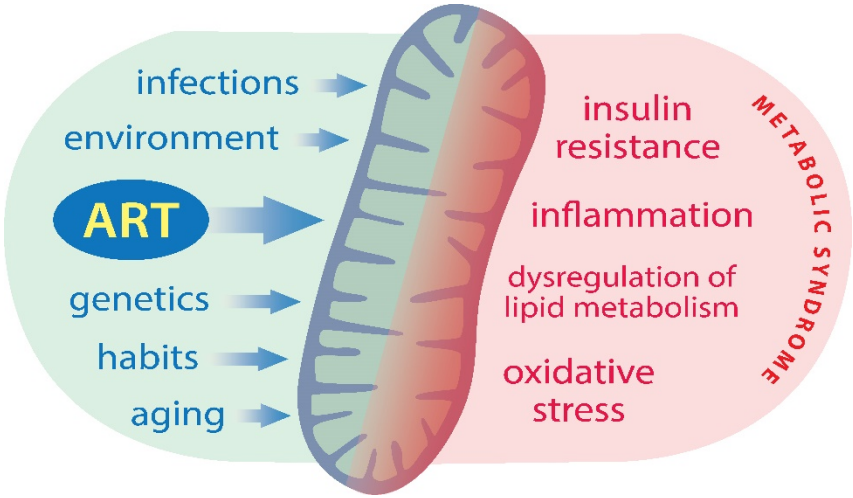


Paintsil Lab
Effects of Antiretroviral Therapy on Mitochondrial Function





Paintsil 2015 ©



"Our central hypothesis is that Antiretroviral Therapy (ART)-induced mitochondrial dysfunction is in the causal pathway of ART-associated toxicities:- metabolic syndrome, accelerated aging, and aging-related disorders such as cardiovascular diseases, cancer, and neurodegenerative diseases"

Elijah Paintsil, MD
Yale Child Health Research Center
464 Congress Avenue, New Haven
Email: Elijah.paintsil@yale.edu

Projects Available for Students

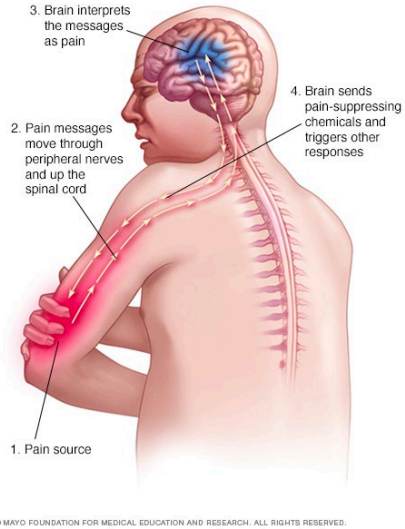
- Comparative effects of older and new generation nucleoside analogs on mitochondria DNA polymerase gamma expression
- Comparative effects of older and new generation nucleoside analogs on mitochondrial content in peripheral mononuclear cells and T-cell lines
- Identifying biomarkers of ART-induced mitochondrial toxicity
- Effects and underlying mechanism(s) of ART on metallothionein 1 gene expression
- Effects and underlying mechanism(s) of ART on cholesterol biosynthesis

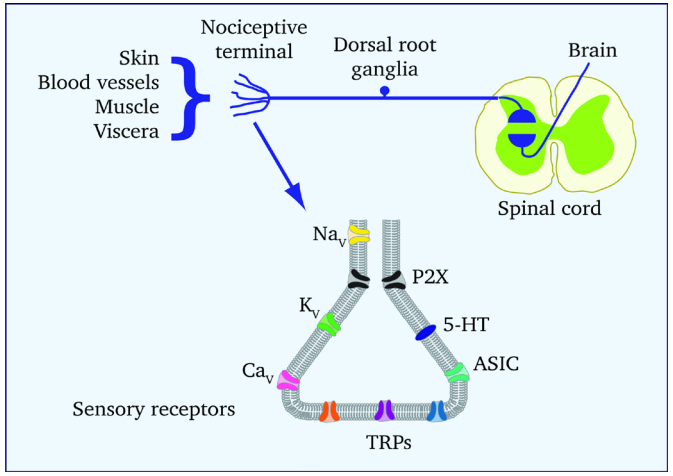
Mentoring Expectation

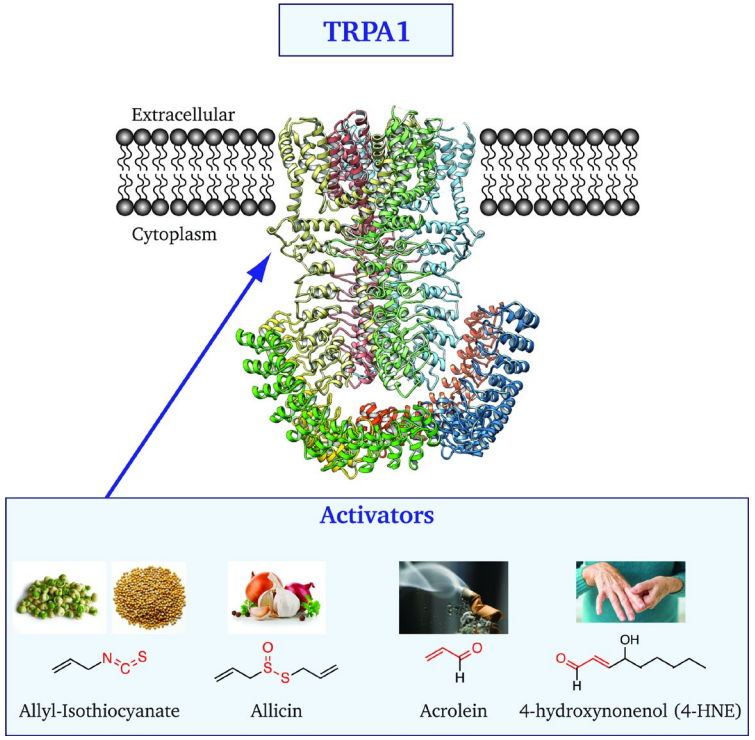
- I will meet with student daily to discuss progress
- Day to day mentoring of student by a Postdoc in the Lab
- The student is expected to participate in weekly Lab meetings
- We can take on 2 students
- The last 2 summers, we have hosted one Yale undergrad
- Their work resulted in manuscripts

The Paulsen Lab

Studying molecular mechanisms of pain at Yale University







Candie Paulsen

Candice.Paulsen@yale.edu

Ongoing projects in the Paulsen lab

1. Determine the structure of TRPA1 in its open, active conformation (Peter Niimi)
   (membrane protein biochemistry, negative stain EM, cryo-EM)

2. Identify TRPA1 interacting protein partners (Justin Sanders)
   (chemical biology, biochemistry, fluorescence microscopy, electrophysiology)

3. Express and purify the TRPA1 intracellular N-terminus for structural and biochemical analyses (Samantha Schaefer)
   (biochemistry; ultimately X-ray crystallography and pull down experiments)

4. Determine the structure of a human-rattlesnake TRPA1 chimera (Justin Sanders)
   (molecular biology, fluorescence microscopy, membrane protein biochemistry)

5. Characterize TRPA1's role in signal transduction cascades (TBD)
   (biochemistry)

Summer research structure

During the summer, the students (2) will…

- Meet with me daily to touch bases and establish an experimental plan
- Be mentored in the lab by Justin, Peter, and Samantha
- Attend all lab group meetings and journal clubs
- Give an end of summer presentation on their work to the lab

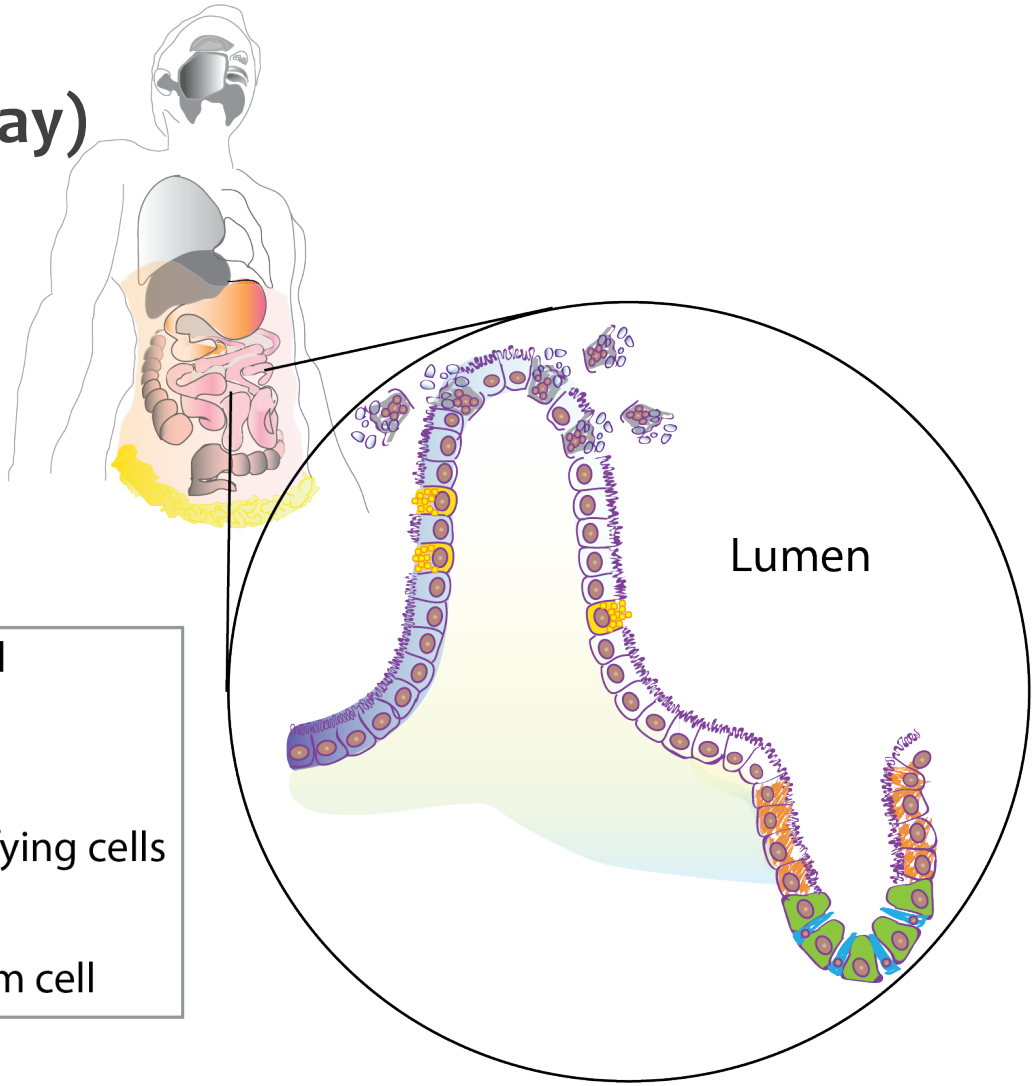
Death begets a new beginning

Carla V. Rothlin
HHMI Faculty Scholar
Associate Professor of Immunobiology and Pharmacology
Yale School of Medicine

What happens after ..... death?

What happens after cell death?

Adulthood
(>10^9 cells die per day)



Development

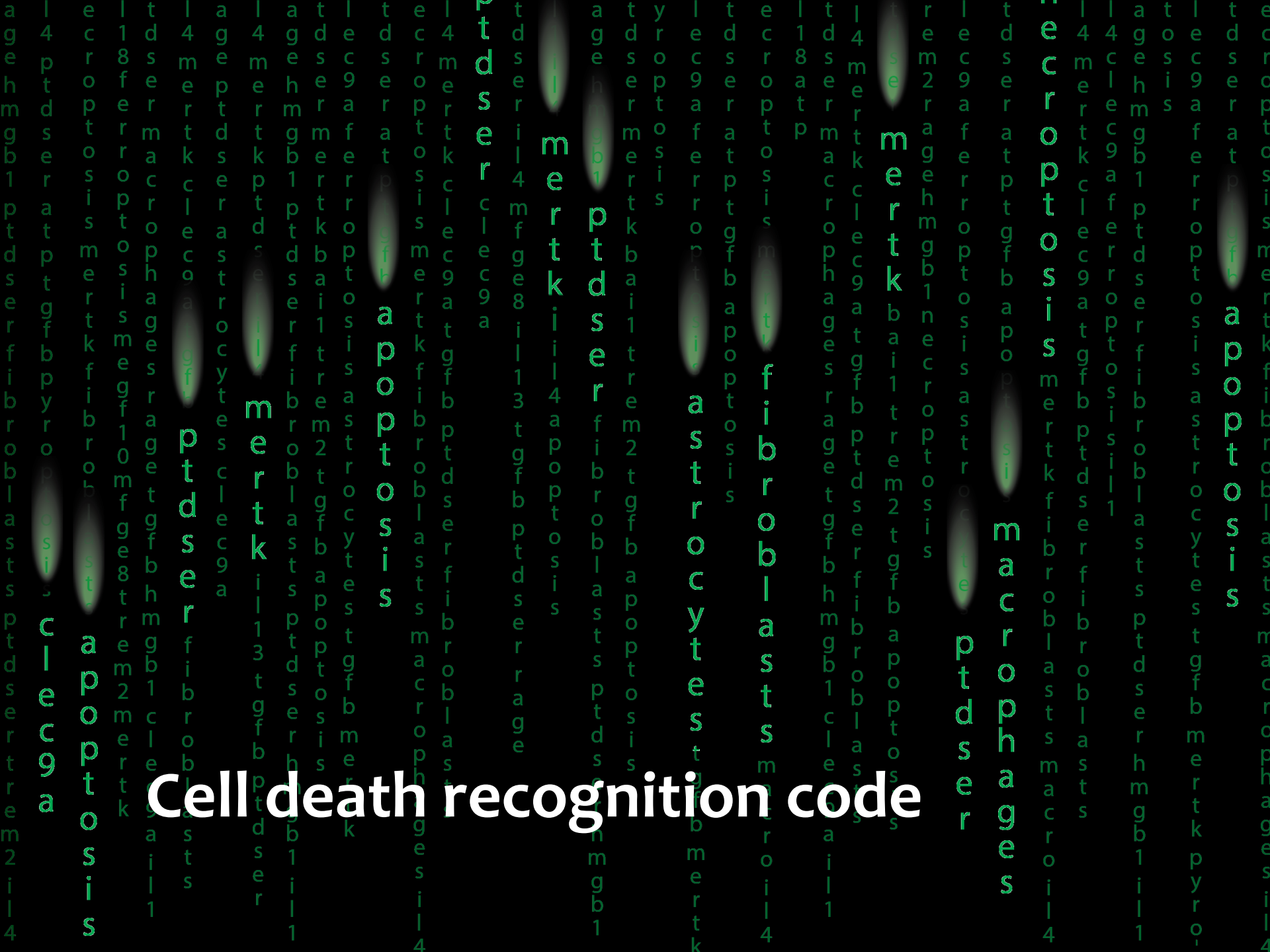
Injury

Homeostasis

Degeneration

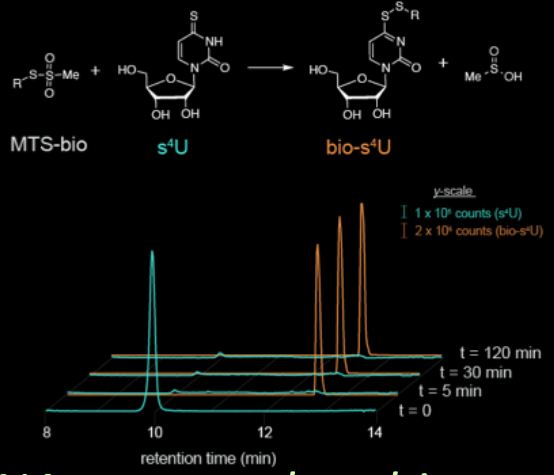
Infection


?
cell death
output1,2,3,4.....n

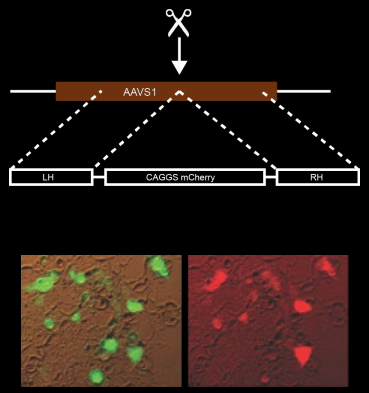

Cell death recognition code

Research in the Simon Lab: An integrated approach to studying RNA and chromatin biology

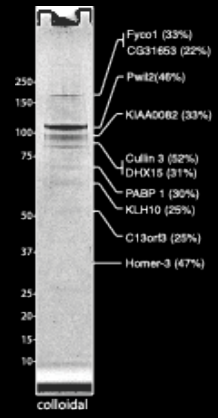
nucleoside chemistry



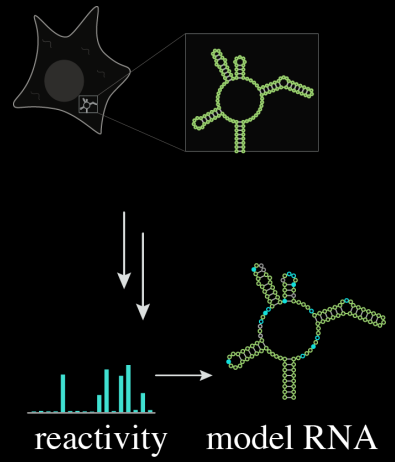
genome editing



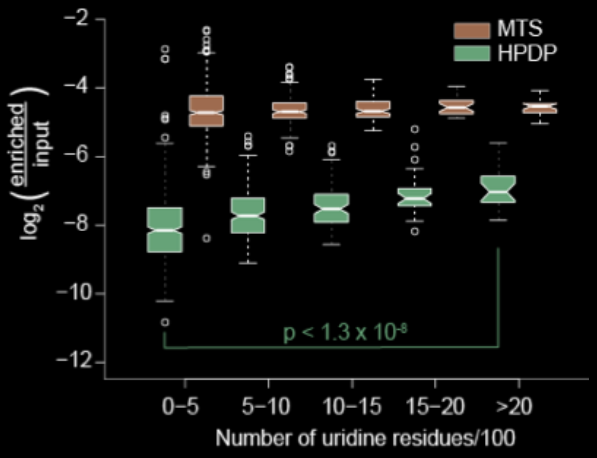
biochemical purifications



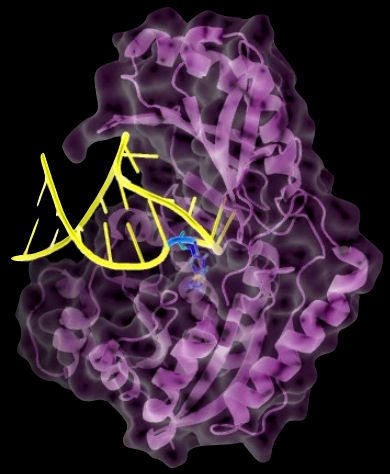
RNA structural probing



genomics

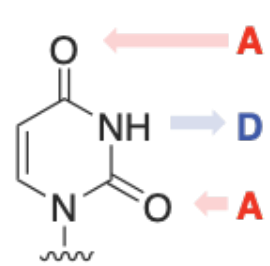


protein engineering

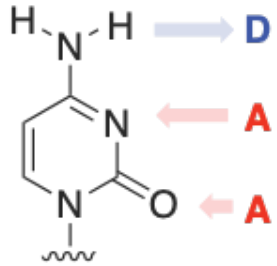


Matt Simon: matthew.simon@yale.edu

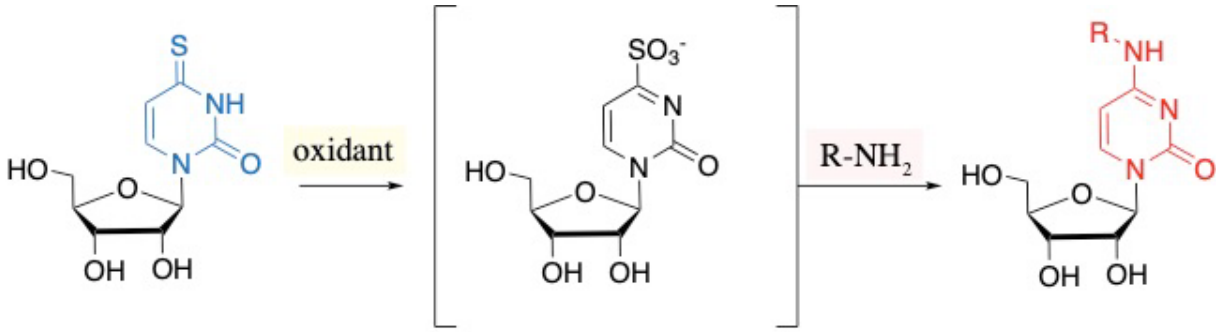
Project: Nucleotide recoding to reveal RNA population dynamics



uridine (**U**)



cytidine (**C**)



- Learn about the **chemical biology of nucleotides**.
- Learn **computational tools** to examine changes in global RNA populations.
- Use these tools to **understand the biology of how cells adapt** to changes in their environment.

Two undergraduate success stories: Catherine Stark and Peter Wang

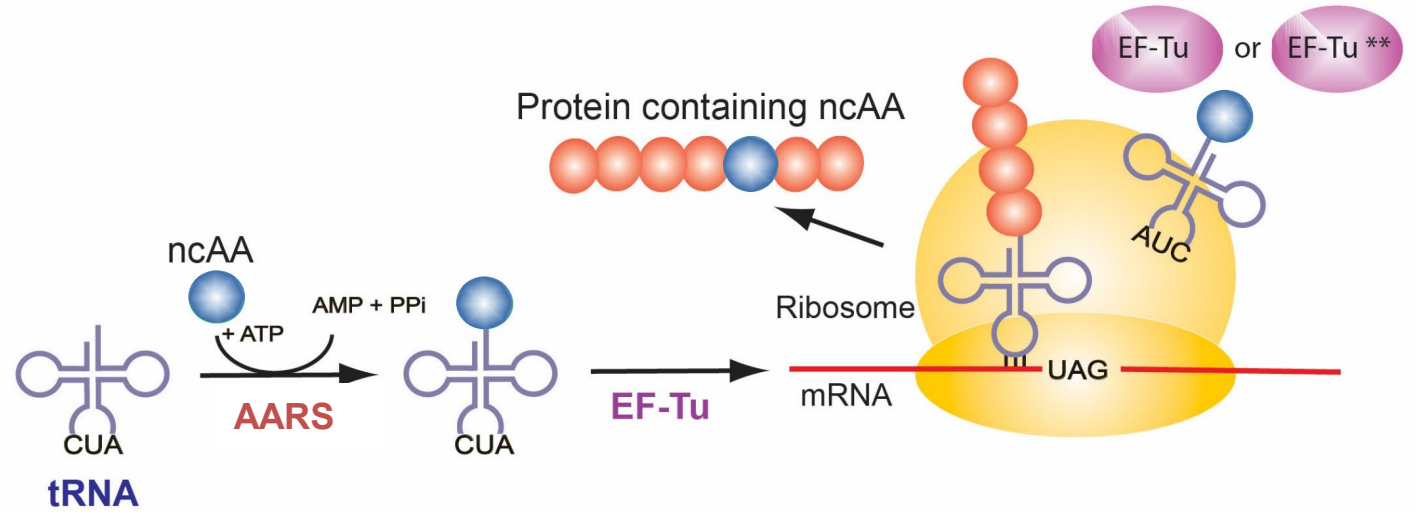
Duffy, E. E., Rutenberg-Schoenberg, M., **Stark, C. D.**, Kitchen, R. R., Gerstein, M. B., and Simon, M.D., (2015) Tracking distinct RNA populations using efficient and reversible covalent chemistry. *Mol Cell*, 59(5), 858-66.

Sexton, A.N., **Wang, P.Y.**, Rutenberg-Schoenberg, M. and Simon, M.D. (2017). Interpreting Reverse Transcriptase Termination and Mutation Events for Greater Insight into the Chemical Probing of RNA. *Biochemistry*, 56(35):4713-4721.

Wang, P. Y., Sexton, A. N., Culligan, W. J., & Simon, M. D. (2018). Carbodiimide reagents for the chemical probing of RNA structure in cells. *RNA*, rna.067561.118.

Dieter Söll / Kyle Hoffman
Department of Molecular Biophysics & Biochemistry
Yale University

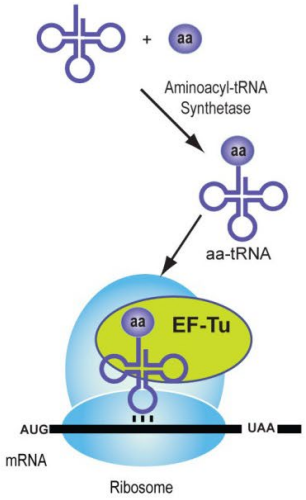
Adding amino acids to the genetic code



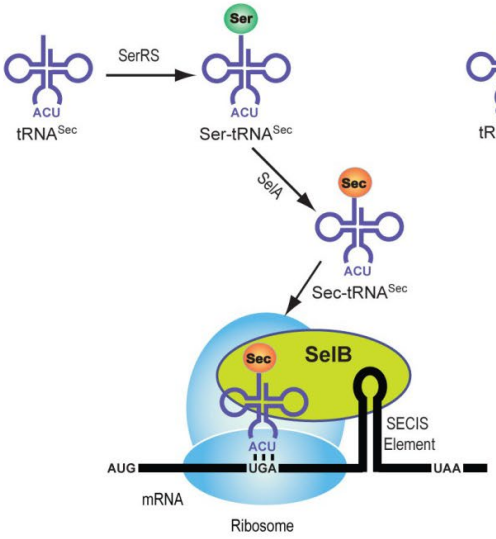
Develop variants of tRNA, aminoacyl-tRNA synthetases, elongation factors, and ribosomes

Re-wire translation for site-specific Sec insertion

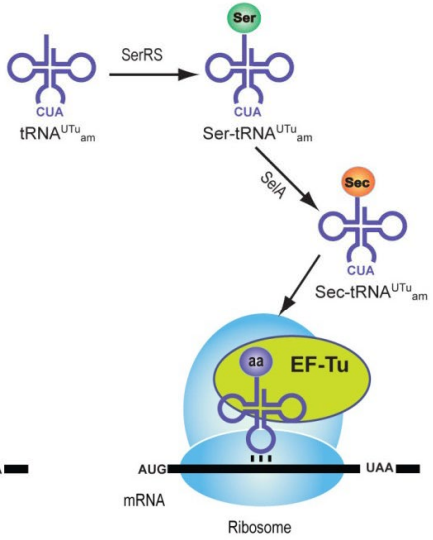
Normal AA insertion

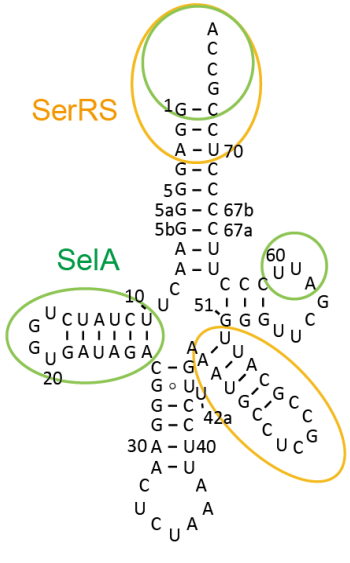


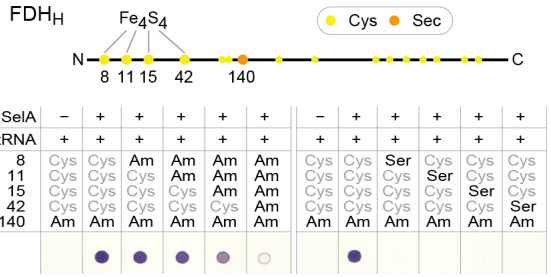
Normal Sec insertion



Re-wired Sec insertion





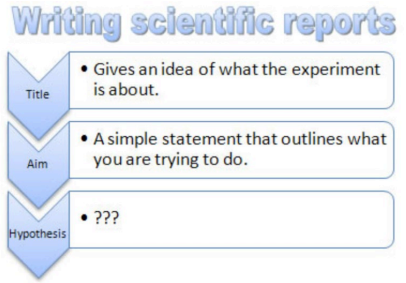


As SelA	–	+	+	+	+	+	–	+	+	+	+	+
allo-tRNA	+	+	+	+	+	+	+	+	+	+	+	+
FDH_H 8	Cys	Cys	Am	Am	Am	Am	Cys	Cys	Ser	Cys	Cys	Cys
FDH_H 11	Cys	Cys	Cys	Am	Am	Am	Cys	Cys	Cys	Ser	Cys	Cys
FDH_H 15	Cys	Cys	Cys	Cys	Am	Am	Cys	Cys	Cys	Cys	Ser	Cys
FDH_H 42	Cys	Cys	Cys	Cys	Cys	Am	Cys	Cys	Cys	Cys	Cys	Ser
FDH_H 140	Am	Am	Am	Am	Am	Am	Am	Am	Am	Am	Am	Am

Challenge: Design of synthetic tRNA^{UTu}

How you will be trained

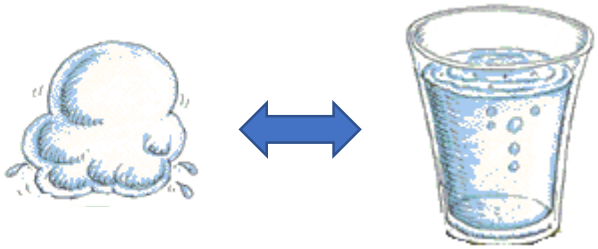
- Doing research: working side by side with a postdoc who will train you to become ’independent’
- Participate in weekly lab meetings
- Writing a short final report
- Giving a PowerPoint presentation to the group before departure
- Undergraduate seminar presentation
- GOAL: self confidence that allows you to tackle research in the future



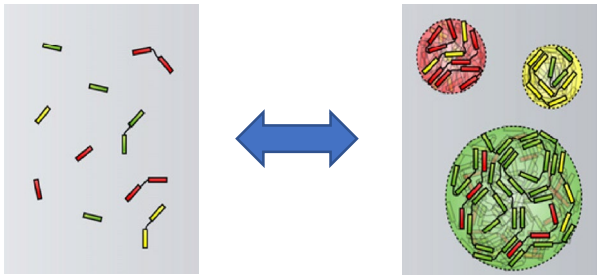
Phase Transition in Cell Signaling

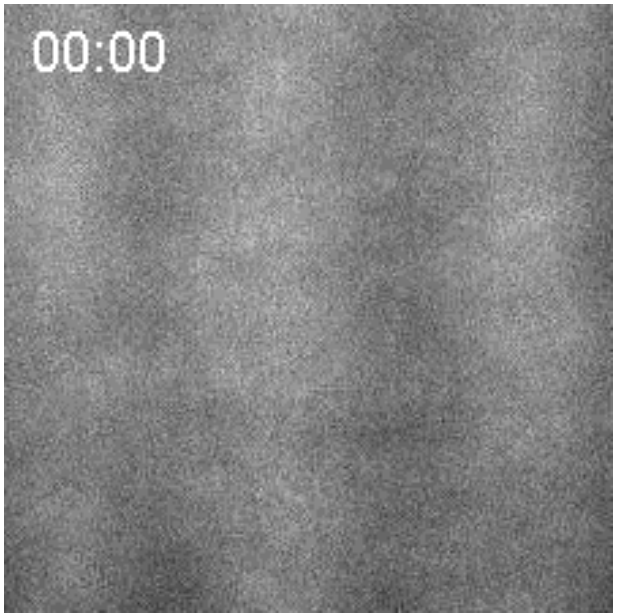
Gas Liquid

Water



Protein





Su*, Ditlev*, *Science* 2016

Xiaolei Su

xiaolei.su@yale.edu

www.sulab.net

Summer Projects

- How do lipids regulate phase transition during T cell activation?

- How does phase transition promote chimeric antigen receptor (CAR) activation?

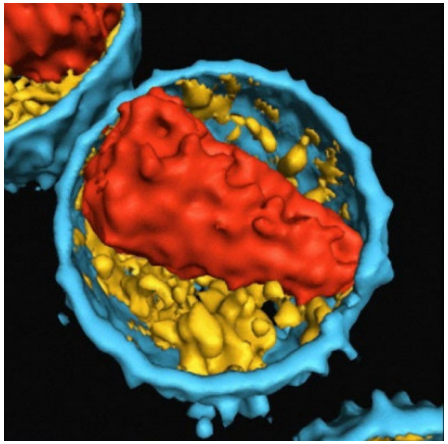
Mentoring

Summer students last year:

Kendra Libby (class ‘21, kendra.libby@yale.edu)
Hannah Triscott (class ‘19, hannah.triscott@yale.edu)

- Independent project
- I (PI) am the mentor
- Daily interactions
- Bi-weekly presentation
- Working together on proposal and progress report

Host Genetic Control of HIV/HIV Cure

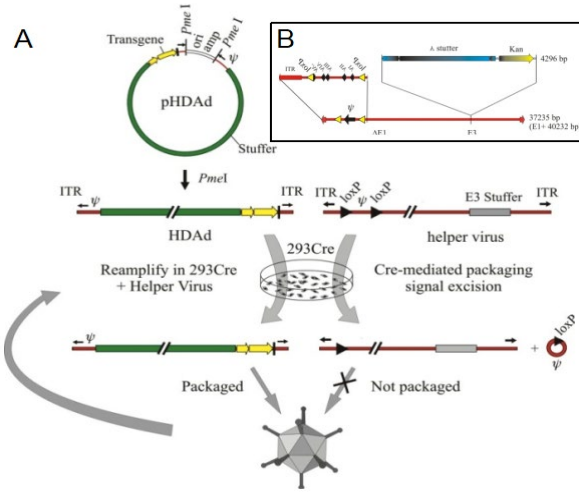


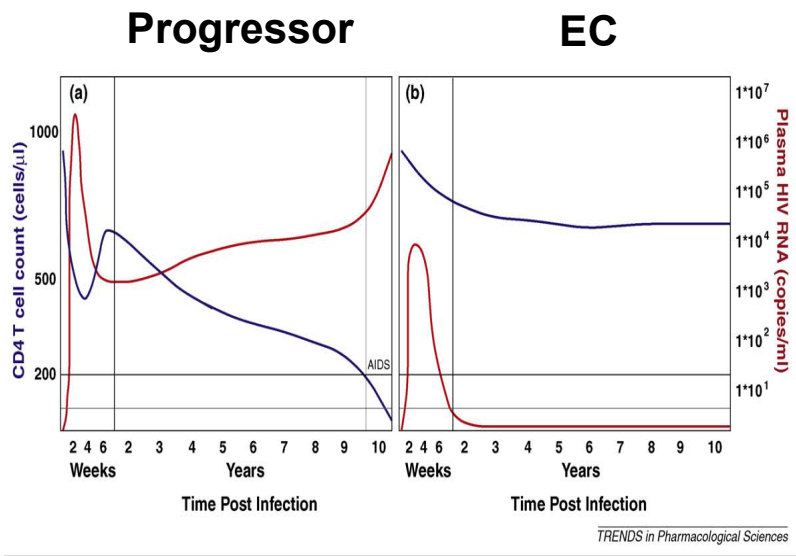
My office

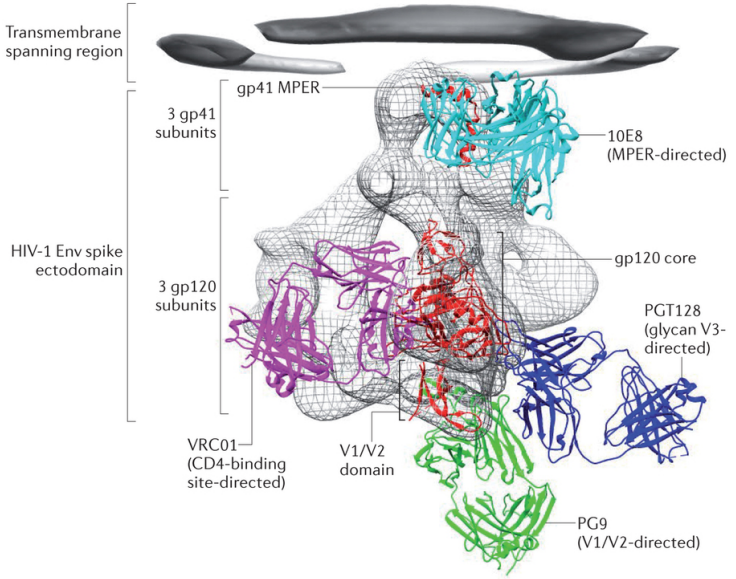
Richard Sutton, MD-PhD
Section of Infectious Diseases
& Department of Microbial Pathogenesis
Yale University School of Medicine
Richard.Sutton@yale.edu

Possible Projects:

- Post-transcriptional regulation of *ccr5*
- Vectored delivery of anti-HIV bnAbs
- Study of cnpy4 in HIV elite control
- KO of *ccr5* in hematopoietic cells







The student experience:

- Will work directly with post-doc or me (I am usu around)
- Typically we have 2-3 undergrads in the lab
- BSL1 or BSL2, focus is molecular biology
- Get to give lab meeting!
- Recent former undergrads: med school, applying to med school, working in translational or clinical research (NYU & Pitt), grad school in chemistry (here)

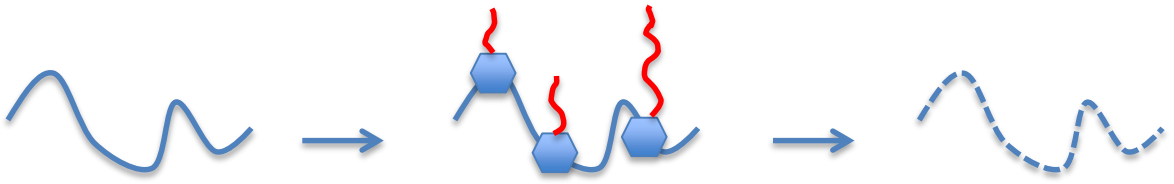
Carson Thoreen, PhD

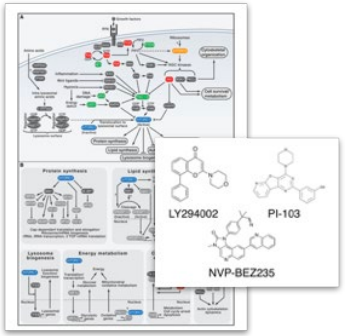
Cellular and Molecular Physiology

carson.thoreen@yale.edu

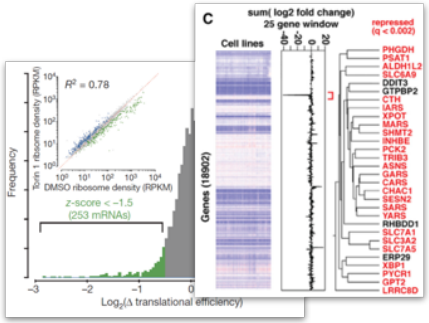
campuspress.yale.edu/thoreenlab

Post-transcriptional regulation of complex programs of gene expression

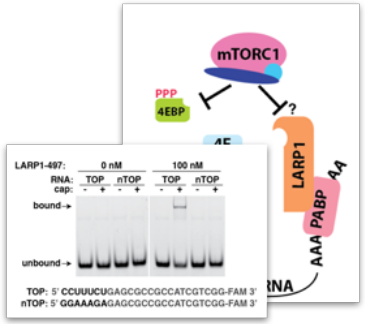




Signaling



Bioinformatics



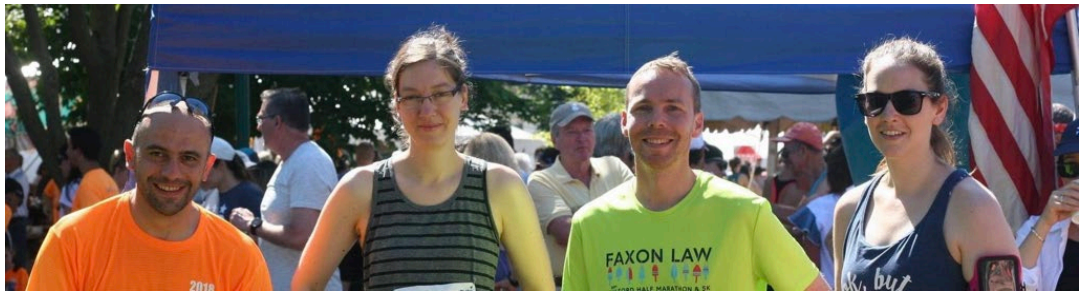
Biochemistry

Potential summer projects

1. Identify mRNA sequences that control translation using a reporter system.
2. Bioinformatic discovery of sequences that destabilize mRNAs.
3. Biochemical study of interactions between a regulatory protein and its RNA targets.

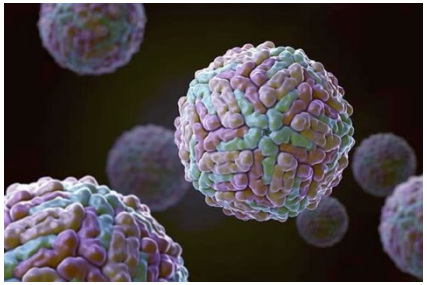
How the lab works

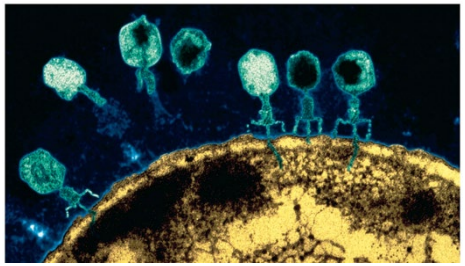
- Paired with post-doc.
- Participate in bi-monthly meetings that alternate between data and journal club.
- Meet with me on a weekly basis.



Turner Lab for Virus Evolution and Virotherapy

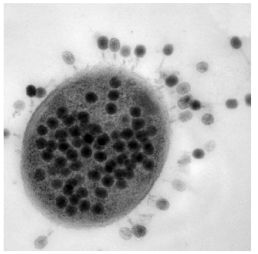
- How do viruses evolutionarily adapt to new environments, such as novel hosts?
- Which virus traits are useful for biotechnology, such as developing novel therapies?



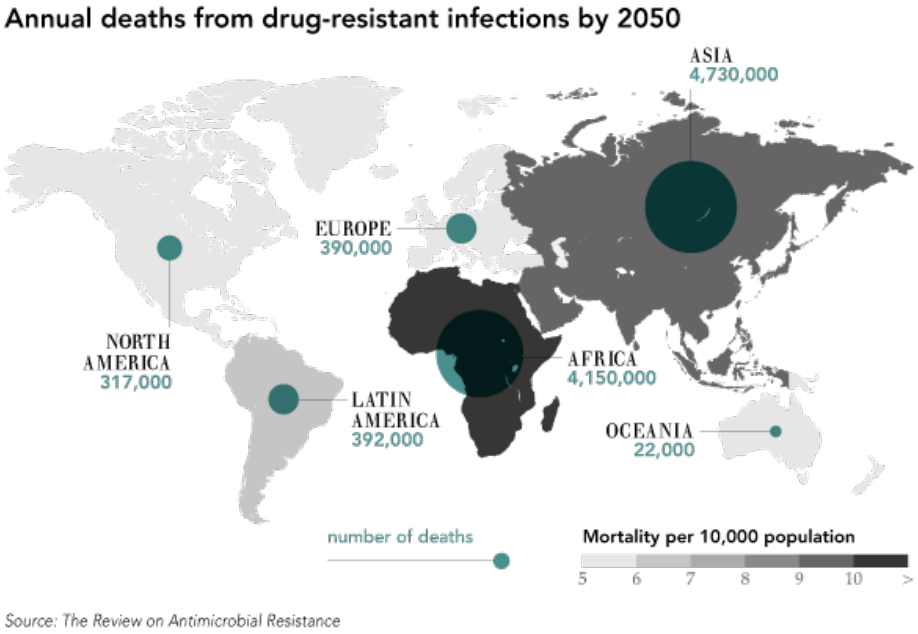


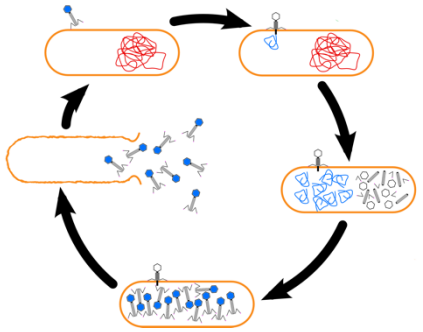
Paul E. Turner
Professor of Ecology & Evolutionary Biology, Yale U.
Microbiology Faculty, Yale School of Medicine.
paul.turner@yale.edu

Summer Project



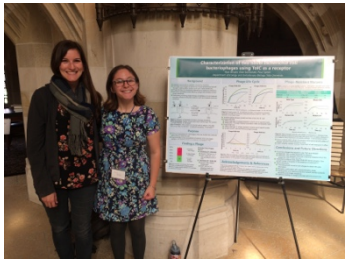
- Discover and characterize novel viruses (bacteriophages).
- Test how the phages select for evolution of reduced virulence in bacteria.
- Determine best phage candidates to develop as novel therapies targeting drug-resistant bacterial pathogens.

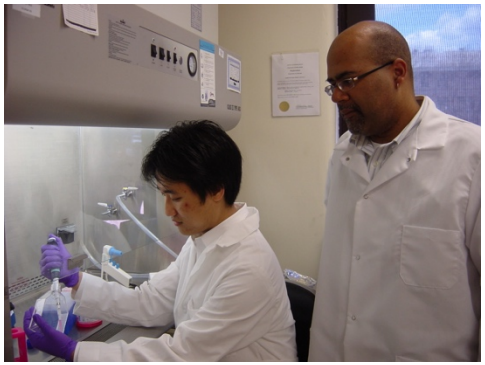




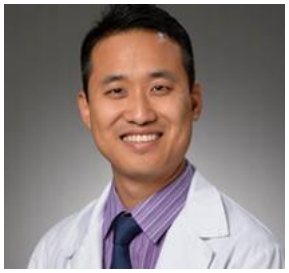
Mentoring Plan

- Daily interaction with direct research mentor (graduate student, or postdoc)
- Weekly meetings with Professor Turner
- Weekly group lab meetings
- Goal: Train you to become a creative and independent scientist!





Dr. Yul Yang, MD
Yale Class ’07



Roughly 75 undergrads trained in our lab, since 2001

Dr. James Pease, PhD
Assistant Prof, Wake Forest U
Yale Class ’07

Mary Ann Santucci
Yale Class ’18

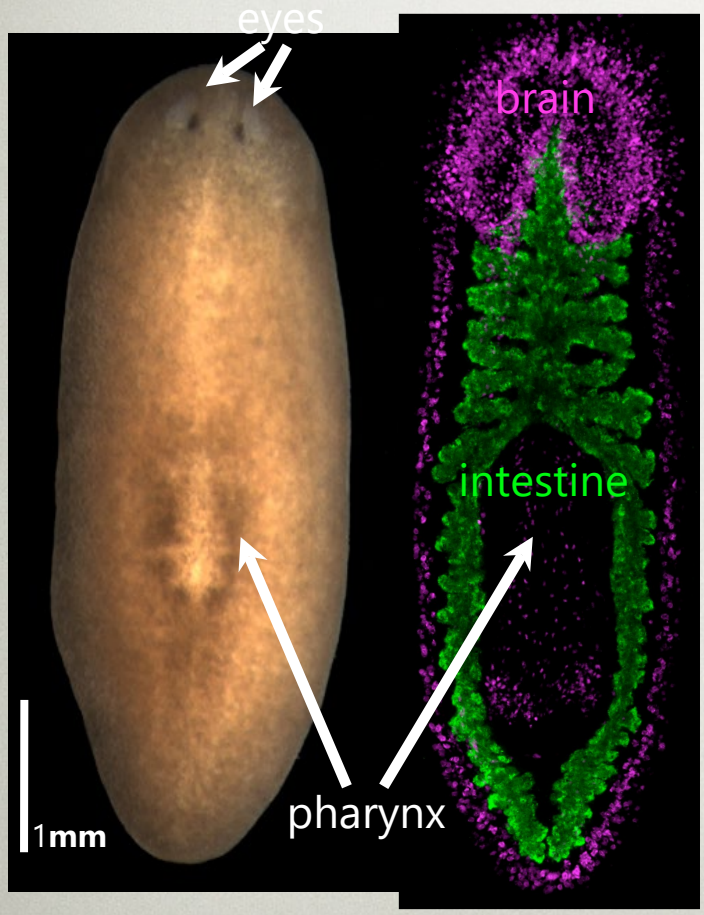
Cecilia Sanchez, Derek Park,
Kelly Diaz, Kristen Brao
Yale Class ’13

Earl Chism
Yale Class ’18

Josien van Wolfswinkel
josien.van.wolfswinkel@yale.edu
vanwolfswinkellab.org

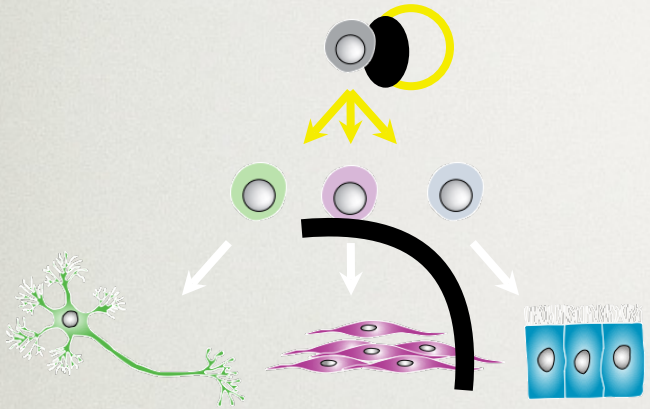
Planarian regeneration and stem cell biology

Schmidtea mediterranea



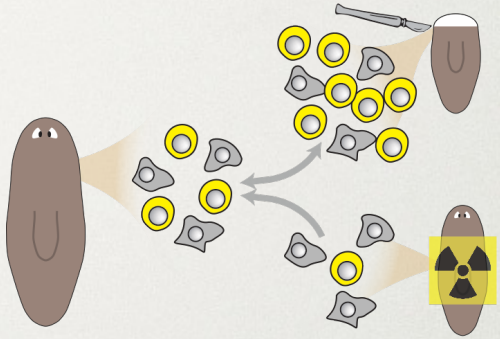
Lab projects

Regulation of pluripotency and cell specification



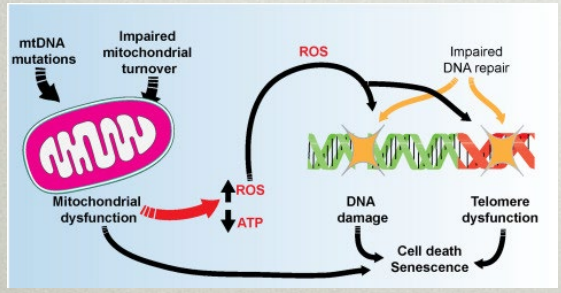
How do stem cells make decisions?

Stem cell control



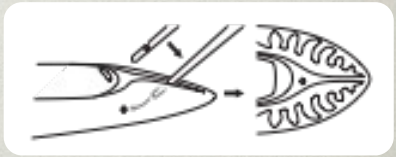
How do planarians avoid cancer and aging?

Metabolism and regeneration

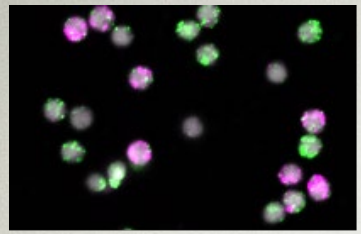


?

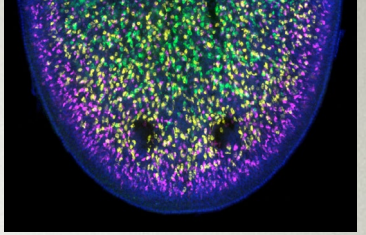
Making transgenics!



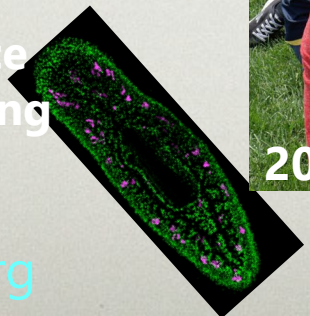
www.vanwolfswinkellab.org



Visit us on the 10th floor of KBT!

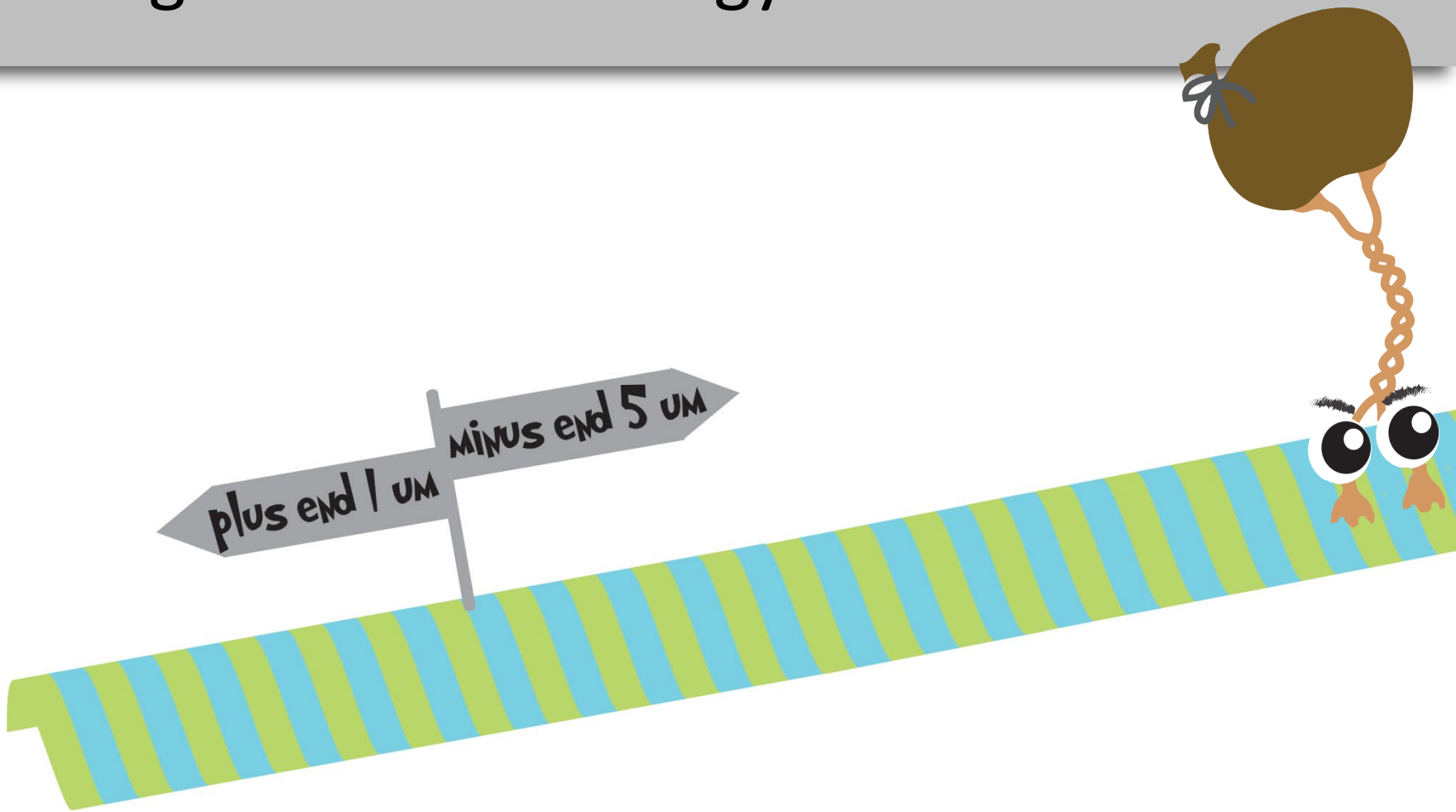


Yale stem cell center
Yale center for RNA Science
Yale Pepper center for Aging



www.vanwolfswinkellab.org

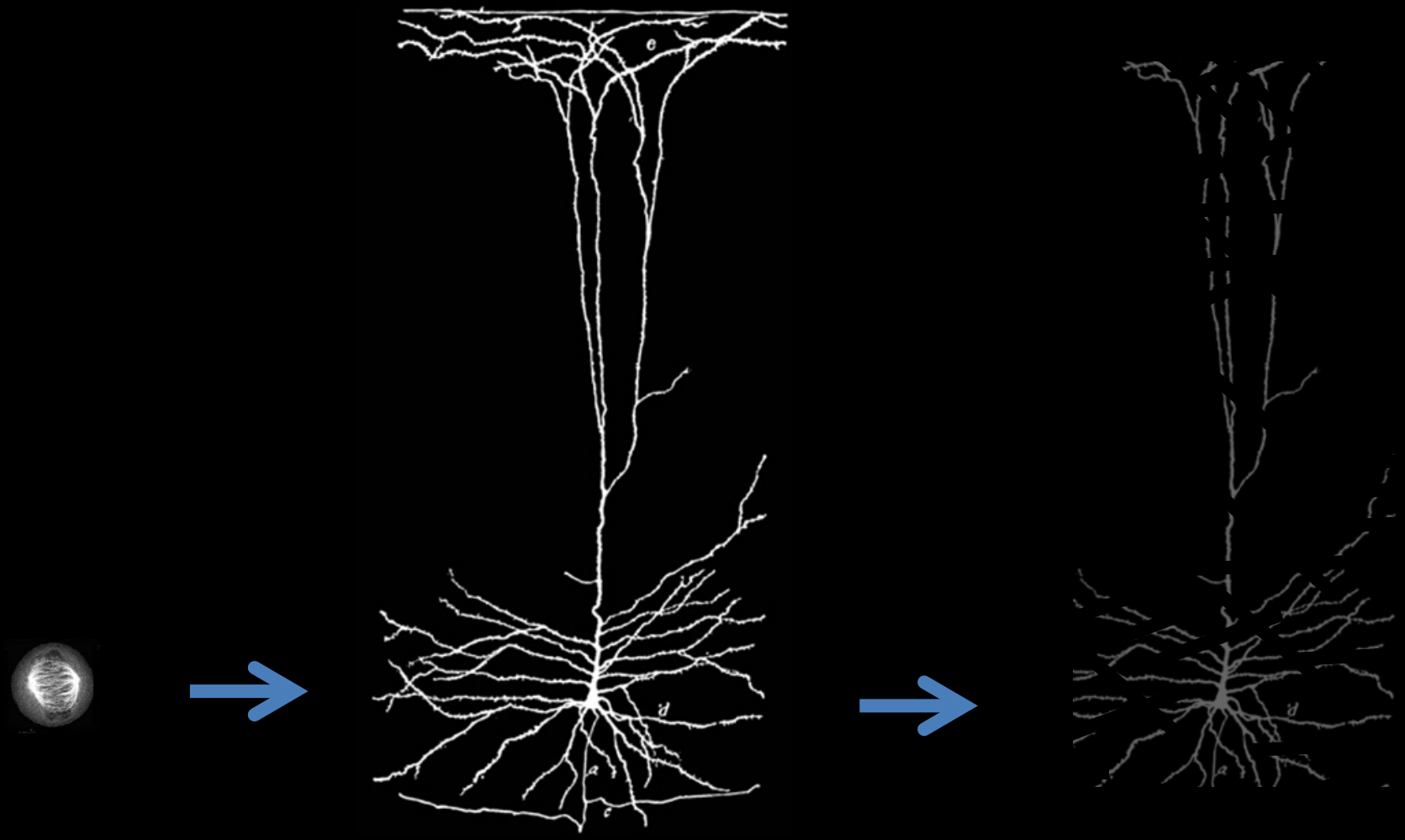
Yogev lab: Cell biology of the neuron



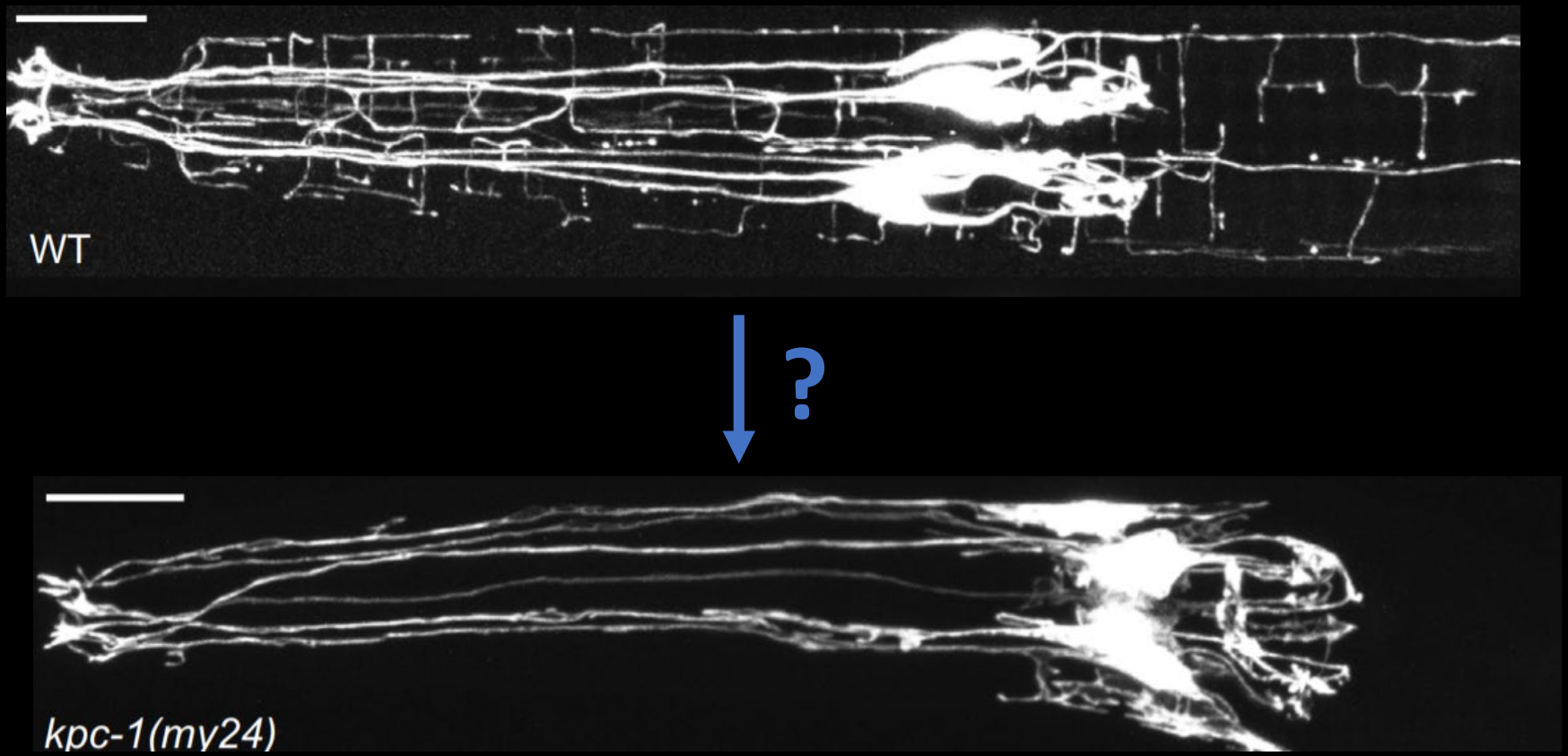
shaul.yogev@yale.edu
Depts of Neuroscience & Cell Biology

www.yogevlab.org

We are interested in neuronal cell biology – how neurons polarize, grow and remodel



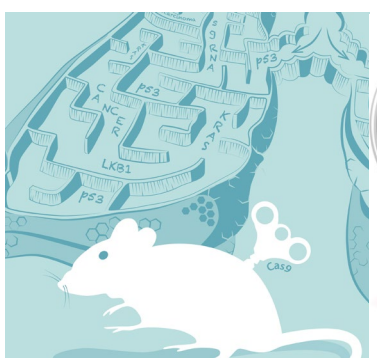
Summer project: study the mechanisms of neuronal remodeling in *C. elegans*

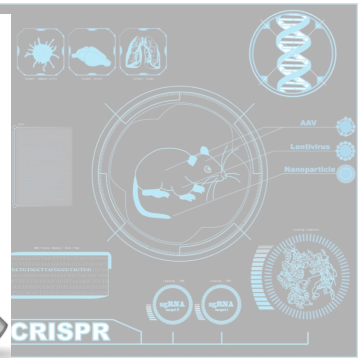


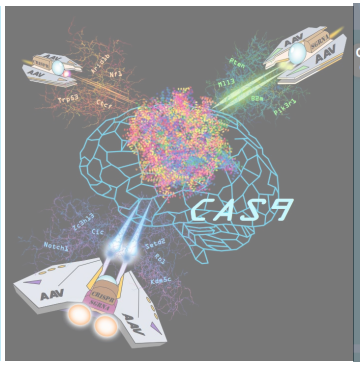
Methods: genetics and imaging
Mentoring by PhD student (daily) and PI (weekly)

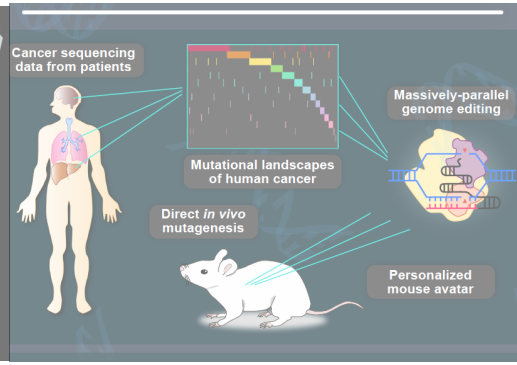
Faculty – Student / Yale 2019-01-04

Lab Focus: Genome editing and Cancer Immunology





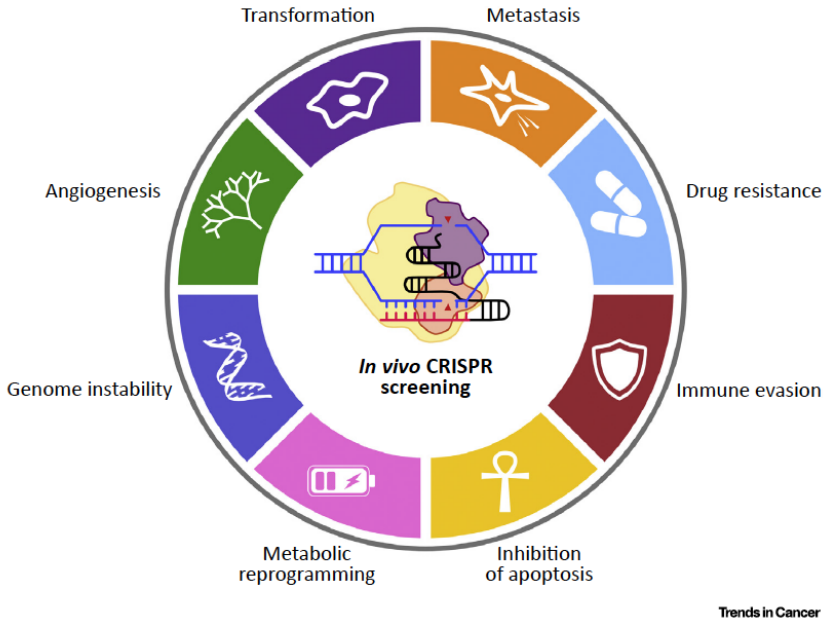


Sidi Chen, PhD
Group Leader, Assistant Professor
NIH Director's New Innovator (2018)
Department of Genetics & Systems Biology Institute
Yale Cancer Center & Stem Cell Center
Yale University School of Medicine
sidi.chen@yale.edu

Yale University

Student projects

- High-throughput mapping of functional drivers
- In vivo screens for novel drug targets
- Immune engineering
- Genetic interaction mapping
- Tumor immunity
- Development of novel biotechnologies
- Single cell sequencing



Yale University

Student mentoring

Each UROP paired with a PhD, MD/PhD or postdoc level mentor

Meeting with PI weekly

Presentation of research at the end

2-4 UROP students in 2019 summer

Can attend all lab activities. Other opportunities

Funding

Sidi Chen Lab:

Matt Dong
Ryan Chow
John Park
Paul Renauer
Adan Codina
Chris Guzman
Guangchuan Wang
Lupeng Ye
Krista Chen
Johanna Shen
Zhigang Bai
QJ Yang
Li Zhang
Xiaoyun Dai
Youssef Errami
Hyunu Ray Kim
Xiaoya Zhang
Yaying Du
Jianjian Guo
Lyuyun Zhu, **+ Alumni**

Yale University

The Evolutionary Systems Biology Lab @West Campus

Günter P. Wagner
Ecology and Evolutionary Biology
Obstetrics, Gynecology and Reproductive Sciences
Systems Biology Institute

Our Philosophy

- Nothing **Biology** makes sense except in the light of **Evolution**
  - T. Dobzhansky
- Nothing in **Evolution** makes sense except in the light of the rest of **Biology**.
  - James Griesemer
- Projects:
  - Evolutionary cell biology
  - Evolutionary biology of female reproduction
  - Evolutionary biology of cancer

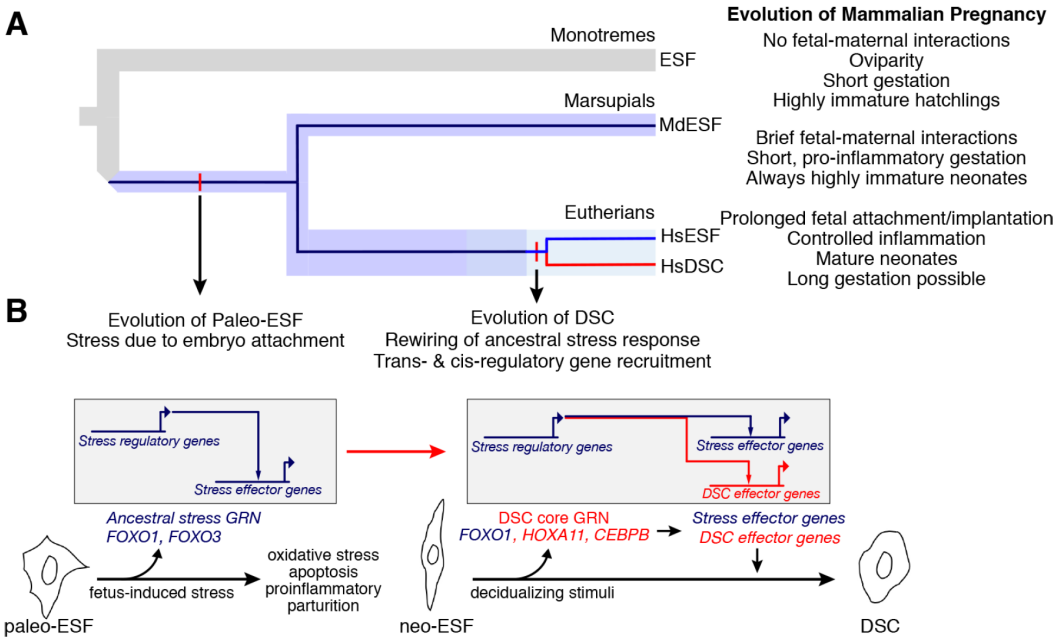
Evolutionary Cell Biology

PLOS BIOLOGY 2018

RESEARCH ARTICLE

The mammalian decidual cell evolved from a cellular stress response

Eric M. Erkenbrack[1,2], Jamie D. Maziarz[1,2], Oliver W. Griffith[1,2,3], Cong Liang[2,4], Arun R. Chavan[1,2], Mauris C. Nnamani[1,2], Günter P. Wagner[1,2,5,6]*



Eric Erkenbrack

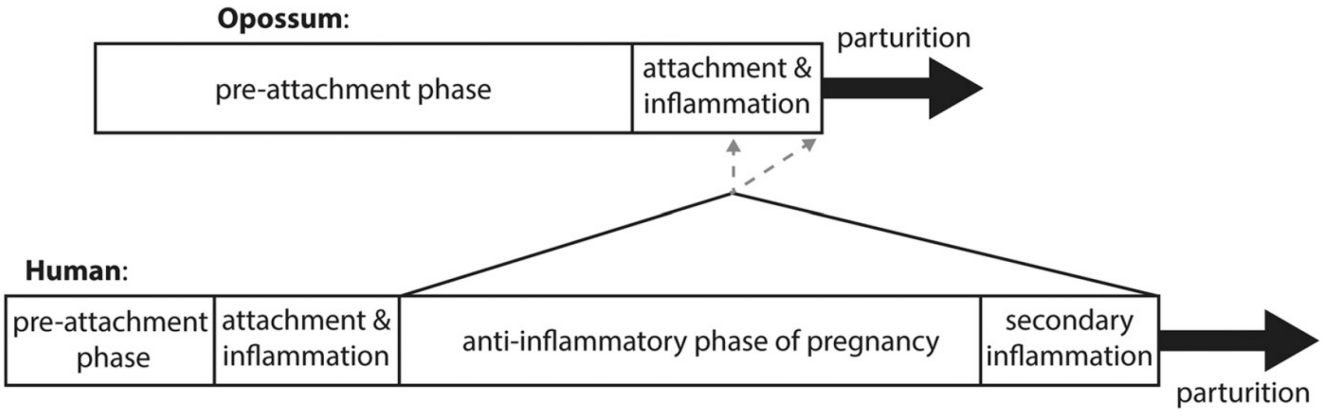
Evolutionary biology of female reproduction

PNAS

Embryo implantation evolved from an ancestral inflammatory attachment reaction

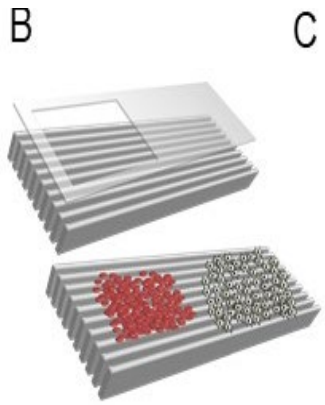
Oliver W. Griffith[a,b,1], Arun R. Chavan[a,b], Stella Protopapas[a,b], Jamie Maziarz[a,b], Roberto Romero[c,d,e,f], and Gunter P. Wagner[a,b,g,h]

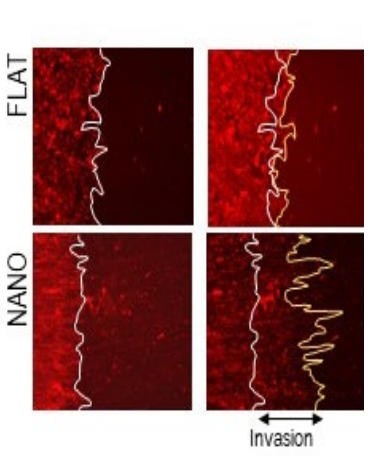
[a]Department of Ecology and Evolutionary Biology, Yale University, New Haven, CT 06520; [b]Yale Systems Biology Institute, Yale University, West Haven, CT 06516; [c]Perinatology Research Branch, Division of Obstetrics and Maternal-Fetal Medicine, Division of Intramural Research, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Detroit, MI 48201; [d]Department of Obstetrics and Gynecology, University of Michigan, Ann Arbor, MI 48109; [e]Department of Epidemiology and Biostatistics, Michigan State University, East Lansing, MI 48824; [f]Center for Molecular Medicine and Genetics, Wayne State University, Detroit, MI 48202; [g]Department of Obstetrics, Gynecology and Reproductive Sciences, Yale Medical School, New Haven, CT 06510; and [h]Department of Obstetrics and Gynecology, Wayne State University, Detroit, MI 48202

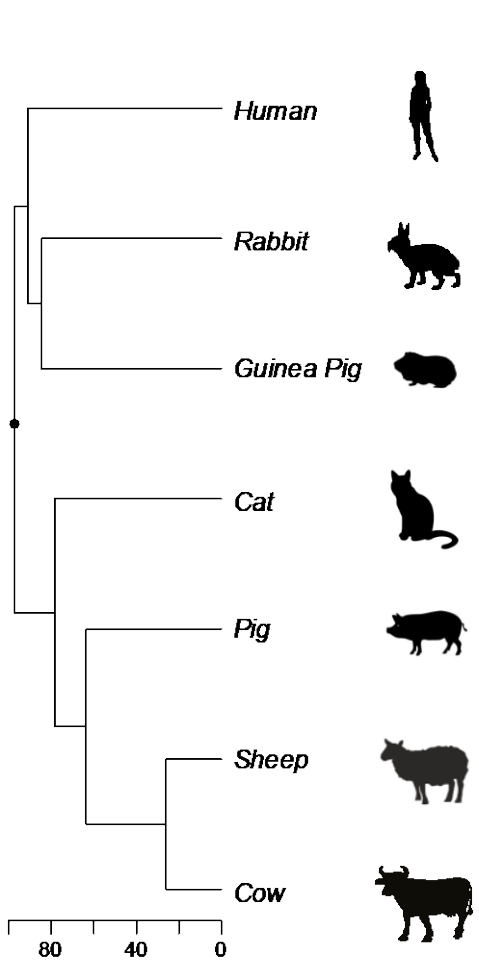


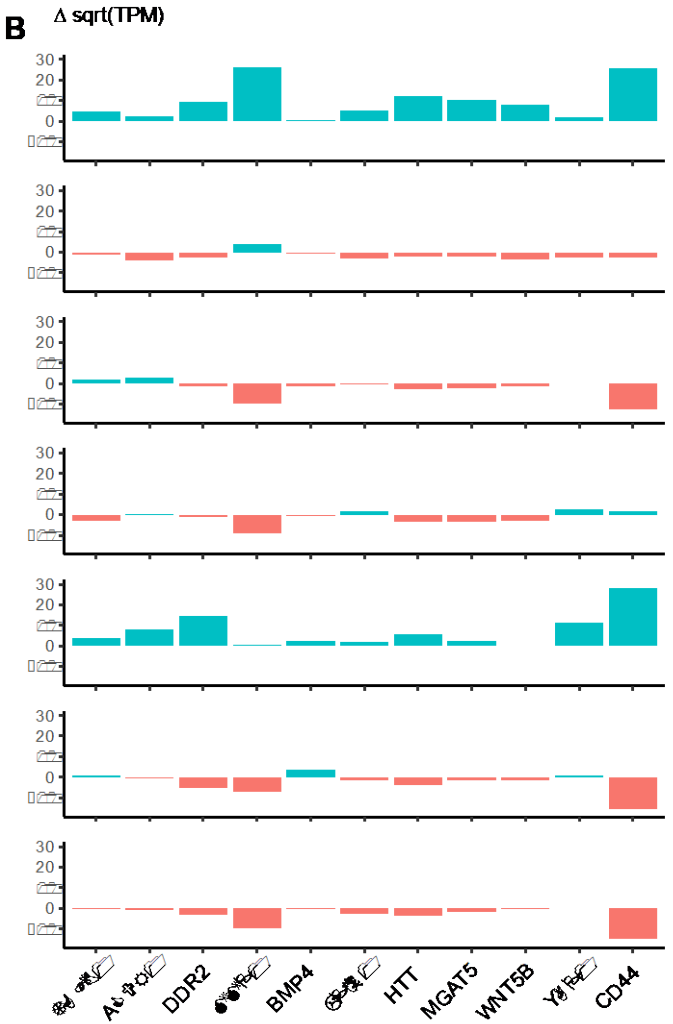
Oliver Griffith

Evolutionary biology of cancer





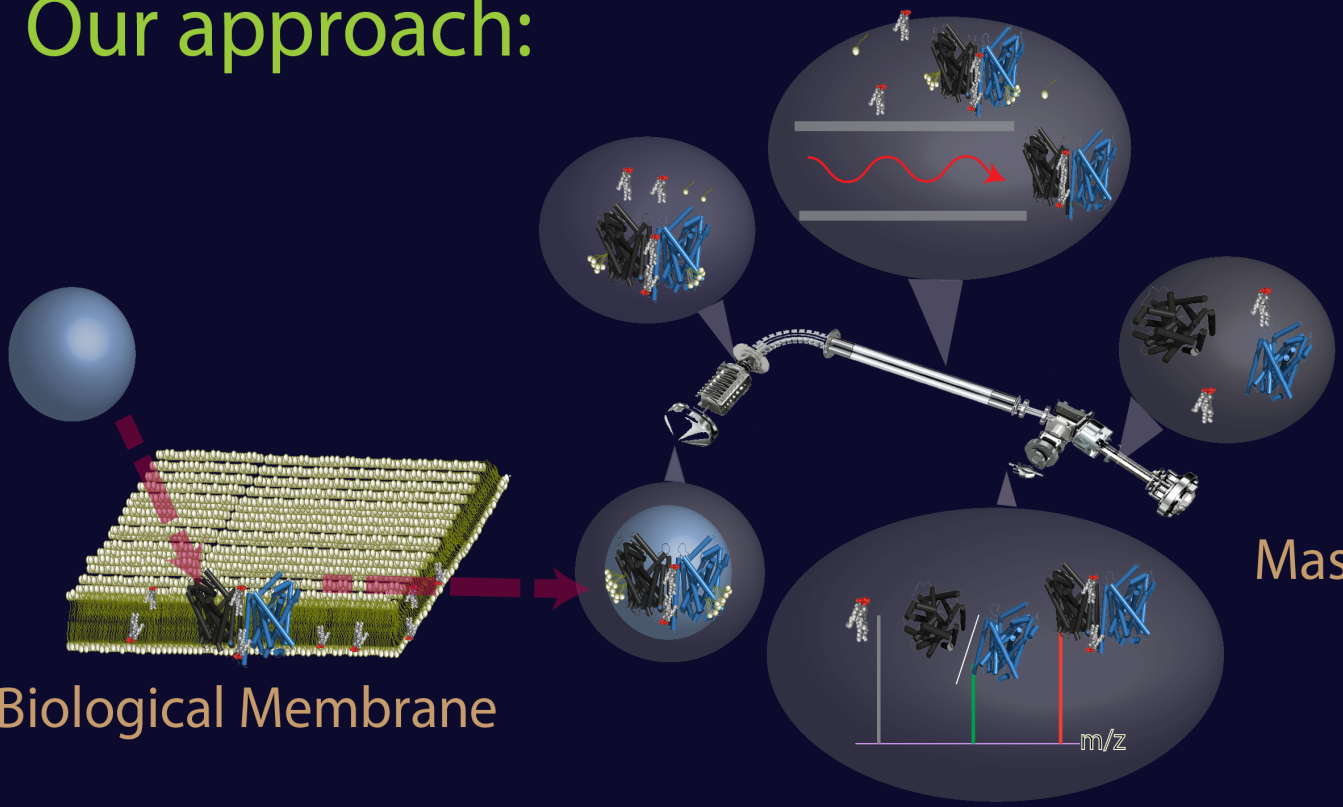




Discovering membrane protein interactome through native mass spectrometry

Kallol Gupta (kallol.gupta@yale.edu)

Our approach:



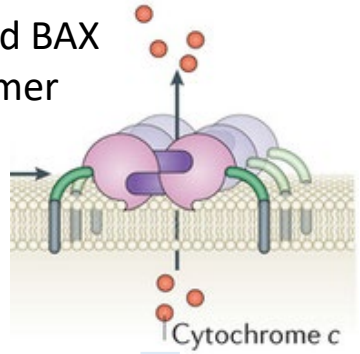
(i) Direct identofication of novel membrane complexes
(ii) Spatio-temporal evolution of protein complexes through cell cycle
(iii) Deconvoluting cellular signalling pathways - cellular pathogenesis
(iv) Drug screening against native complexes

Why we care about membrane protein oligomerisation

- A quarter of expressed genome codes for membrane proteins
- 60% marketed drugs target membrane proteins

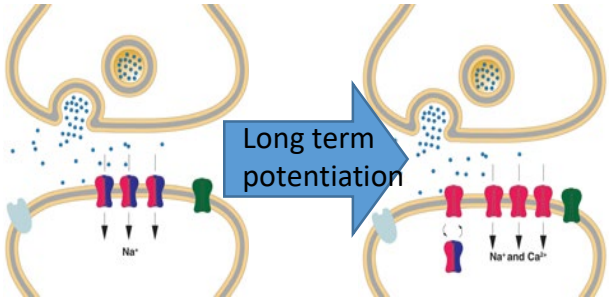
- BAK/BAX: Cell death
  Apoptotic signaling

Activated BAX
Oligomer



- Activators – Cancer
- Suppressors- Neurodegeneration

- Synaptic signaling

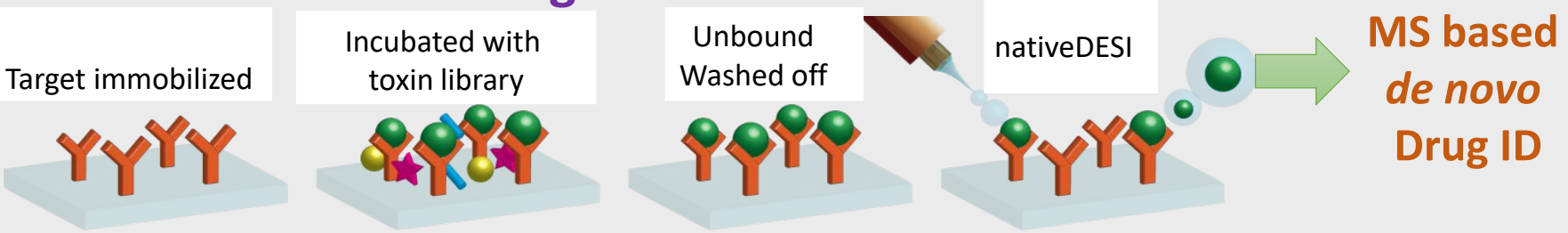


Heteromeric
AMPA

Homomeric
AMPA

- Progression of memory
- Neurocognitive disorders

- **nativeMS based drug screen**



Acknowledgements

Anushka Halder
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Joe Donlan
Stephen Ambrose

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Kevin Giles (Waters Corp.)

Phill Stansfeld, Oxford
Gary Rudnik, Yale University
Moitrayee Bhattacharyya, UC Berkeley