Mechanisms of Health & Disease Research

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Statistical genetics and biostatistics

Dr. Amei Amei

Professor,

Department of Mathematical Sciences

Email: amei.amei@unlv.edu

Expertise

- Statistical methods to detect risk genes and gene-environment interactions underlying complex diseases
- Large-scale sequence-based genetic association studies
- Statistical inference of stochastic modeling
- Bayesian variable selection

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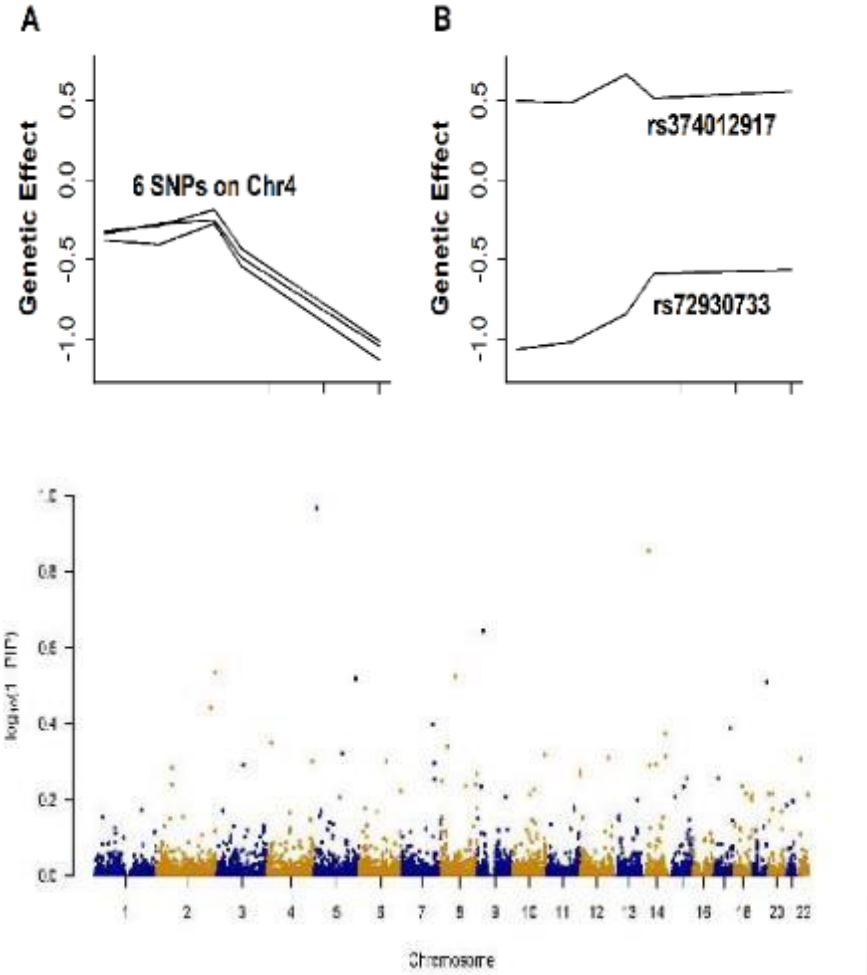
Genome-wide association studies in hypertension and schizophrenia

- In genome-wide association analysis of longitudinal traits, modeling time-varying genetic effect can increase power for the detection of genes underlying the development and progression of complex diseases.
- BVS methods can be used to reanalyze published datasets to discover new risk genetic variants for many diseases without new sample collection, ascertainment, and genotyping.



Dr. Pradip K. Bhowmik
Materials Chemistry Lab

Our interests focus on organic and polymer synthesis in general. More specifically, we are interested in developing novel light-emitting and liquid-crystalline polymers for their multitude applications in modern technology, including biosensors.

In another project, we are developing ionic liquids and ionic liquid crystals for their better ionic conductivities as electrolytes for next generation batteries. Significant efforts are concentrated on the development organic ionic plastic crystals for the solid state batteries.

Carbon nanotube-based composite materials based on ionic polymers are of significant interest in our group. In recent years, we are also actively pursuing the development of cisplatin analogs for cancer therapy.

Colorful Pyrylium Salts

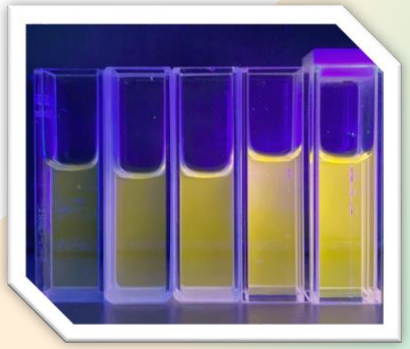
Liquid Crystalline Texture

Fluorescent Pyrylium Solution

Dr. Pradip K. Bhowmik Materials Chemistry Lab

Current Research Interests

- Thermotropic and Lyotropic Liquid Crystalline Polymers
- Polyesters, Viologen Polymers, Poly(pyridinium salt)s
- Fire Retardant Polymers
- Light-Emitting Properties of Polymers
- Photo-responsive Polymers
- Proton and Anion Exchange Membranes
- Oxidation of Carbohydrates by Viologens
- Ionic Liquids, Liquid Crystals, and Plastic Crystals
- Novel Light-Harvesters for Solar Energy Storage
- Fluorescent Molecules for Cell Imaging
- Pyrylium Salt Chemistry
- Lasing Properties in Organic Solvents and Water
- Two Photon Induced Absorption Fluorescent Properties
- Piezochromic Materials
- Magnetic Materials
- Cisplatin Analogues for Cancer Therapy



Polymer Flame Testing

Cellular Neurophysiology Lab

Dr. Darrin Brager

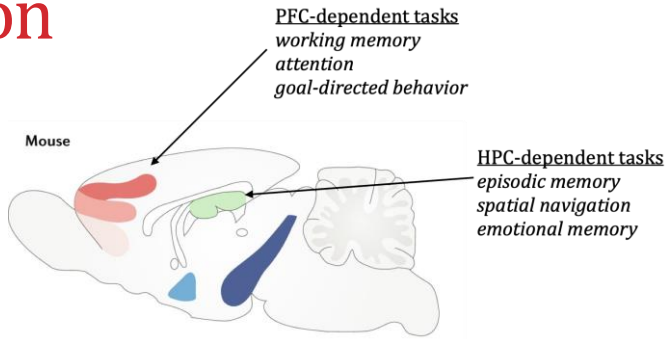
- Assistant Professor
- School of Life Sciences
- Email: darrin.brager@unlv.edu

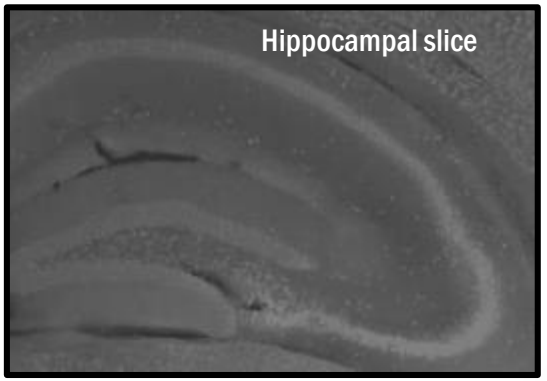
Expertise

- Whole-cell and patch clamp recording
- Synaptic transmission and plasticity
- Imaging and optogenetic investigation of neural circuits

Models of neurological dysfunction

- Our lab is interested in the cellular and molecular mechanisms of brain function. Our research seeks to establish a mechanistic link between pathological neuron function, with an emphasis on voltage-gated ion channels, and behavioral phenotypes.
- Our research includes the neuronal pathophysiology in rodent models of neurological disease – including Fragile X syndrome, temporal lobe epilepsy, depression, and tuberosclerosis.





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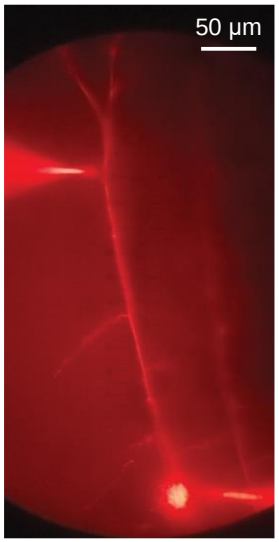
Studying the nervous system at the cellular level

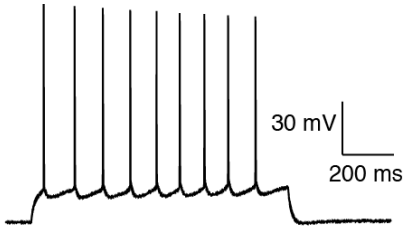
We employ a broad array of approaches including the preparation of acute brain slices, electrophysiological recording including direct dendritic and patch clamp recording, electrical and optogenetic stimulation, and Ca^{2+} imaging. We use biochemical and histological approaches to complement these techniques.



Dye-filled pyramidal neuron

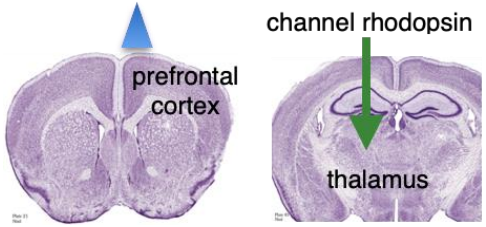
Electrophysiological recordings

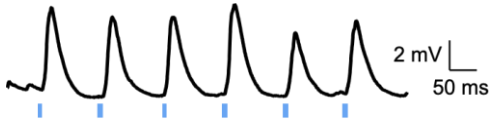
Patch clamp of single K^+ channels



Current clamp of action potentials

Optogenetic circuit mapping





Optogenetic activation of thalamic inputs to the prefrontal cortex

Link to publications

- https://www.ncbi.nlm.nih.gov/myncbi/darrin.brager.1/bibliography/public/

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Forest Inventory and Analysis

- **Dr. Brenda J Buck**
- Professor
- Department of Geoscience
- Email: Brenda.Buck@unlv.edu
- Website: https://unlv-fia.github.io/UNLV-FIA-Group/index.html

Expertise

- University partner to USDA-FIA. Area of emphasis is information management research and development to optimize the storage, delivery, and display of forest inventory data.
- The support we provide helps policy makers, land stewards and non-governmental groups base decisions and assessments related to the health, diversity, and productivity of U.S. forests and grasslands on scientifically credible information.

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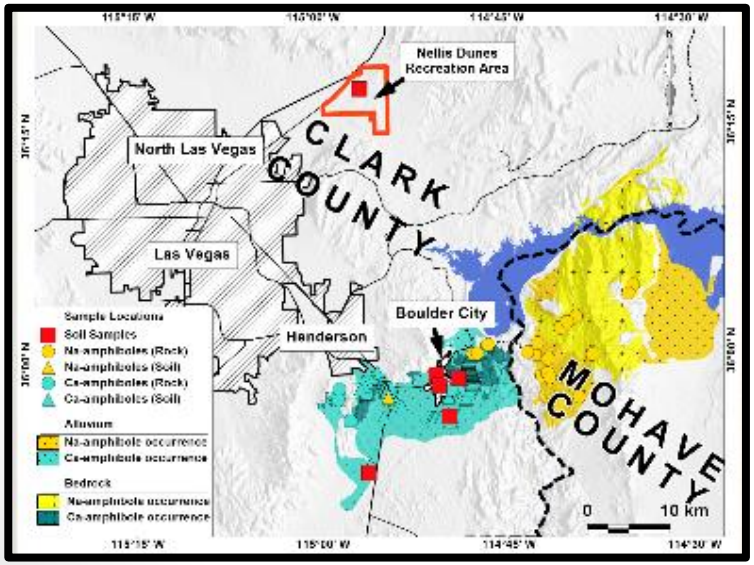
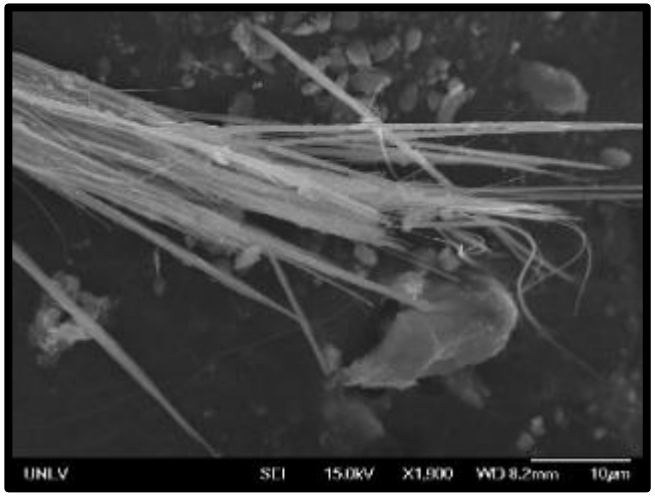
Medical Geology

- **Dr. Brenda J Buck**
- Professor
- Department of Geoscience
- Email: Brenda.Buck@unlv.edu

Expertise

- Expertise: Health effects of mineral dust; Asbestos; Heavy Metals; Soil Science/Geology





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Studies on Degenerative Diseases: Blindness and Alzheimer's Disease

Dr. Nora B. Caberoy
Associate Professor
School of Life Sciences
Phone: 702-774-1501
Email: nora.caberoy@unlv.edu

Expertise:

- Phagocytosis
- Retinal cell biology
- Retinal degenerative diseases (*Retinitis pigmentosa*, Age-related macular degeneration)
- Functional proteomics by phage display
- Alzheimer's disease therapy

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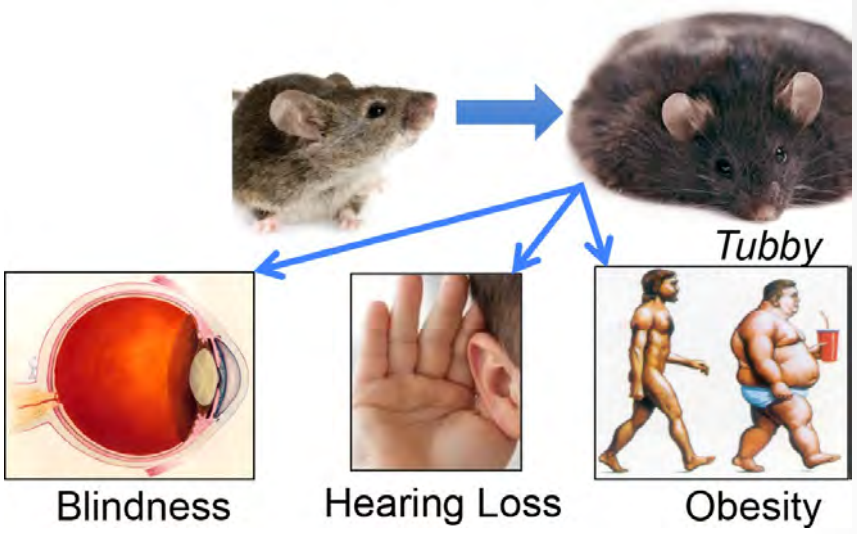
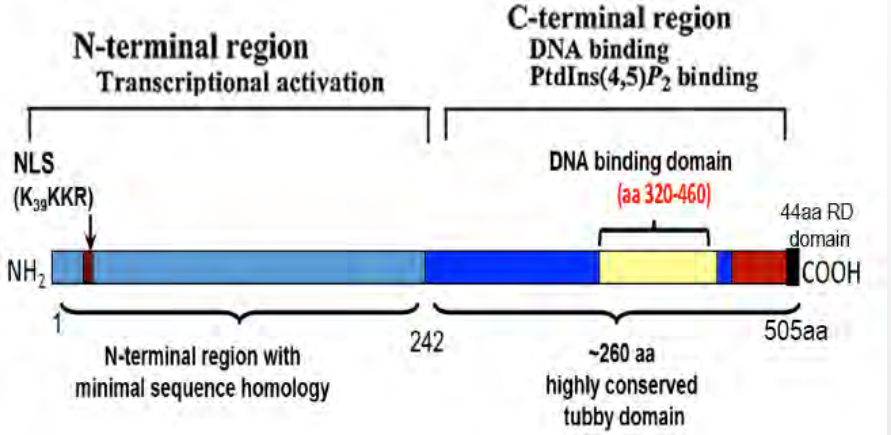
Delineating molecular mechanisms of blindness, hearing loss, and obesity

Mutation in Tubby gene resembles human syndromes:

- Hearing and/or vision - *Usher's, Retinitis pigmentosa*
- Obesity and sensory deficits - *Bardet Beidl, Alstrom's*
- Pathological mechanisms unknown



- Characterizing Tubby as a transcription factor
- Globally identifying genes regulated by Tubby
- Unraveling Tubby protein-protein interaction network



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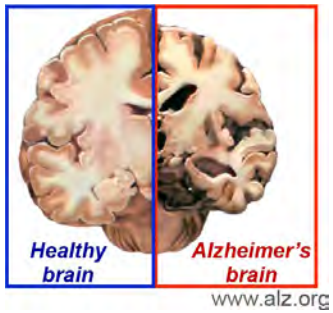
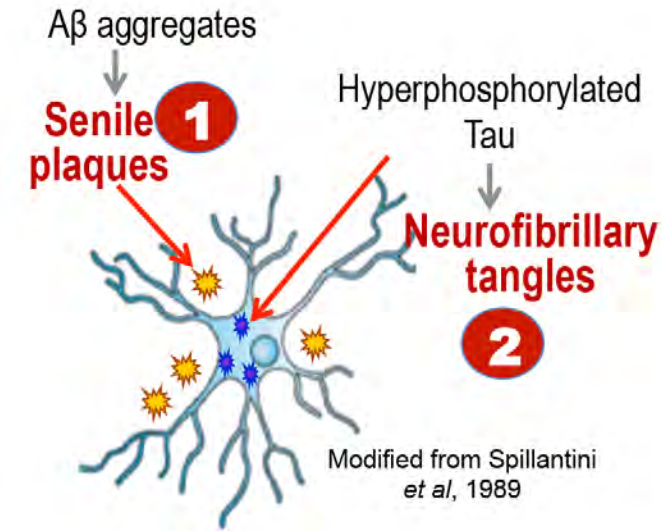
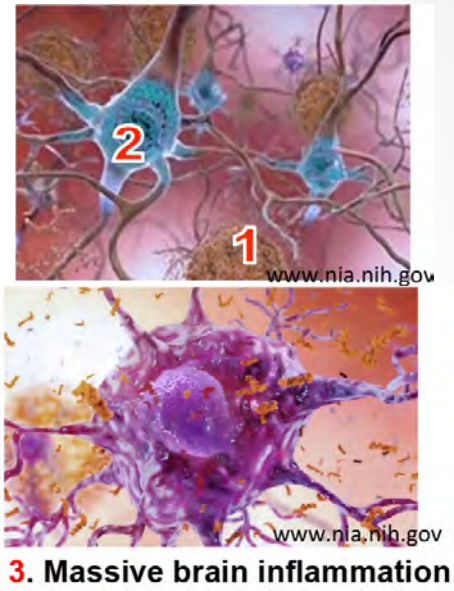
Redirecting phagocytosis of amyloid beta from inflammatory to non-inflammatory pathway

Alzheimer's Disease (AD): Pathological hallmarks

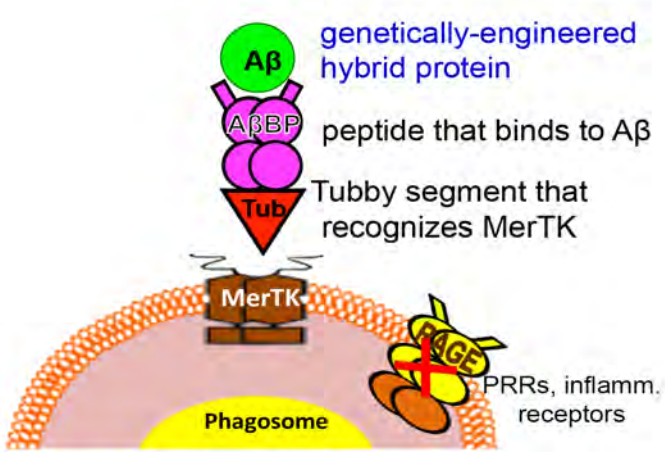






Strategy:

- engineer hybrid proteins
- binds oligomeric and fibrillar amyloid beta
- sequesters and directs phagocytic clearance of amyloid beta through non-inflammatory pathway



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Environmental Biology Research

Dr. Allen G. Gibbs
Professor
School of Life Sciences
Phone: 702-895-3203
Email: allen.gibbs@unlv.edu

Expertise

- Environmental physiology
- Insect physiology
- Experimental evolution

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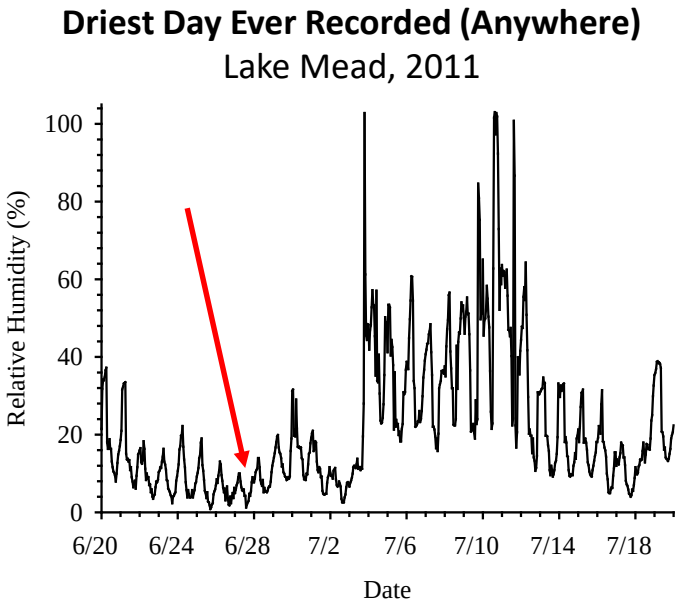
Environmental Physiology of Desert Invertebrates

Adaption to water stress:

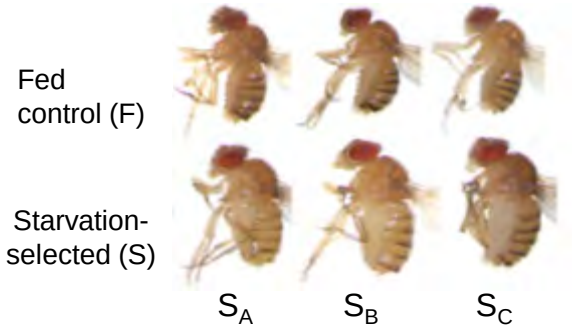


Adaptation to high temperatures:

Experimental Evolution Research Using Fruit Flies

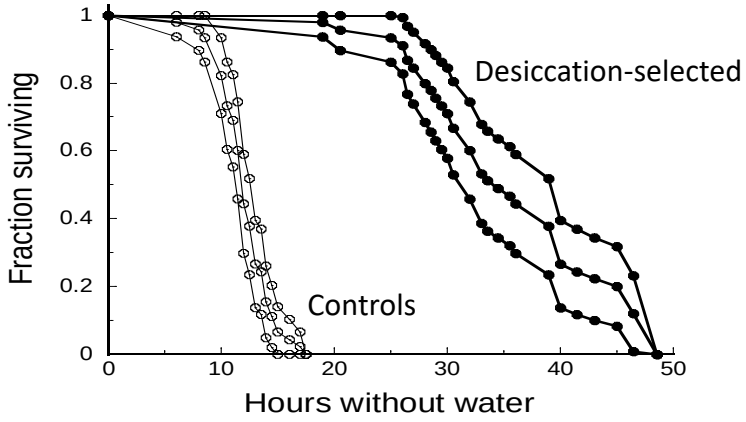
Starvation resistance:

- a fly model for obesity



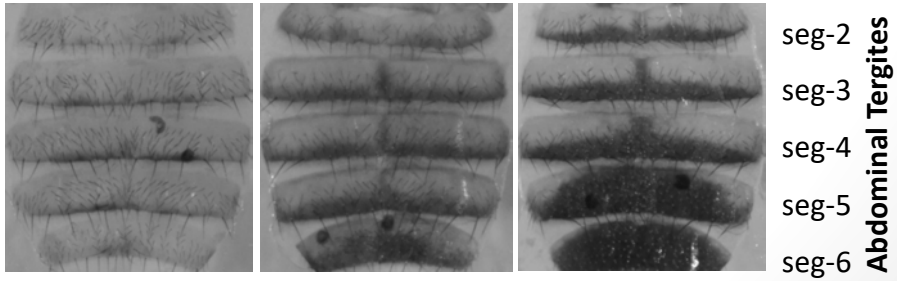
Desiccation resistance:

- understanding responses to desertification



Pigmentation:

- phenotypic correlations of melanization



Cell Signaling Lab

- **Dr. PRASUN GUHA**
- Assistant Professsor
- NIPM and School of Life Sciences
- Email: Prasun.guha@unlv.edu
- Website: https://guhalabs.faculty.unlv.edu/

Expertise

- Cancer Biology, Inflammatory biology, Neuroscience, and Cell and Molecular biology.
- Major focus is genomics and cell signaling
- Understanding the molecular mechanism of inositol signaling in controlling nuclear function

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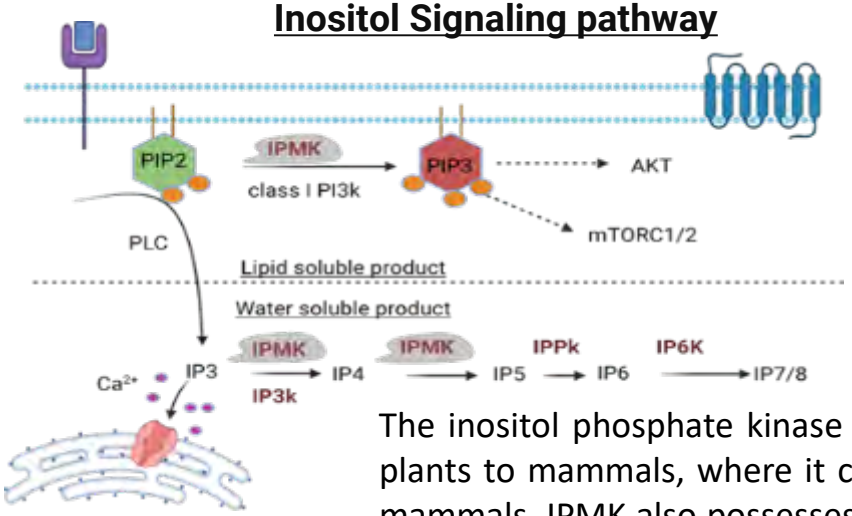
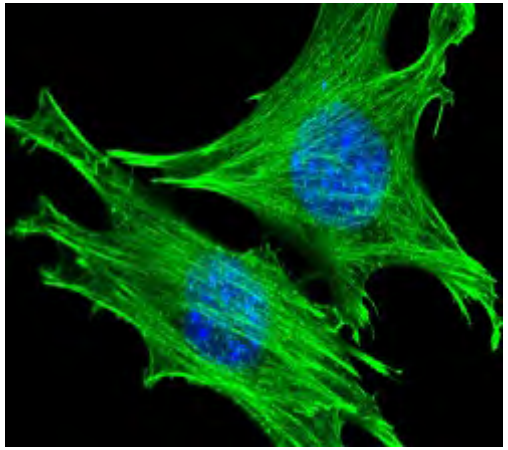
Inositol Signaling pathway



The inositol phosphate kinase function of **IPMK** is conserved from plants to mammals, where it converts IP3 to IP4 and IP4 to IP5. In mammals, IPMK also possesses phosphatidylinositol 3-kinase (PI3K) activity, generating phosphatidylinositol (3,4,5)-trisphosphate (PIP3), a second messenger that promotes cellular growth and cancer progression. We are interested in exploring the physiological importance of IPMK and inositol signaling in cell and animal models.

Confocal imaging of actin cytoskeleton staining (Green)



Cell Migration

The primary threat for cancer is the phenomenon called metastasis. Cell migration and invasion are critical for metastasis. We are interested in studying the mechanism of cell migration.

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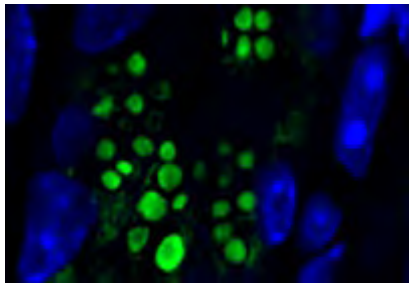
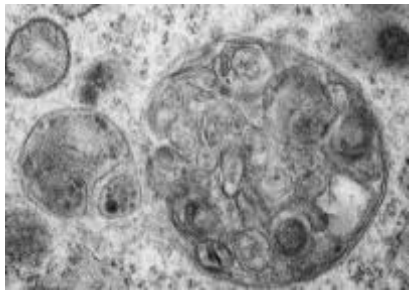
Confocal Imaging of Intestinal Paneth cell granules in green



Crohn's Disease

According to GWAS study and mutation analysis IPMK is linked to intestinal carcinoid and crohn's diseases. Our lab is currently investigating role of inositol signaling in intestinal function.

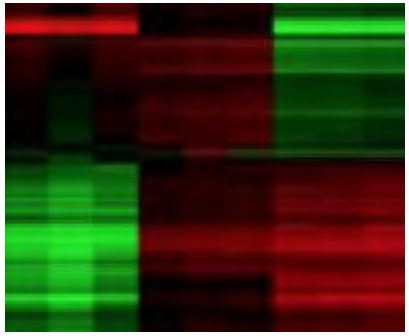
Trans mission electron microscopy of Autophagic vesicle



Autophagy

Autophagy is fundamental to maintaining cellular homeostasis and is linked to cancer and neurodegenerative disorders. However, the role of autophagy in controlling nuclear function is unknown. Our lab is currently investigating how autophagy impacts nuclear events.

Gene expression analysis



Genetics & Epigenetics

The nucleus is the brain of any cell. Our lab's major interest is to study how nuclear function influences disease progression, emphasizing cancer and neurodegenerative disorders.

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Han Lab

Dr. Mira Han

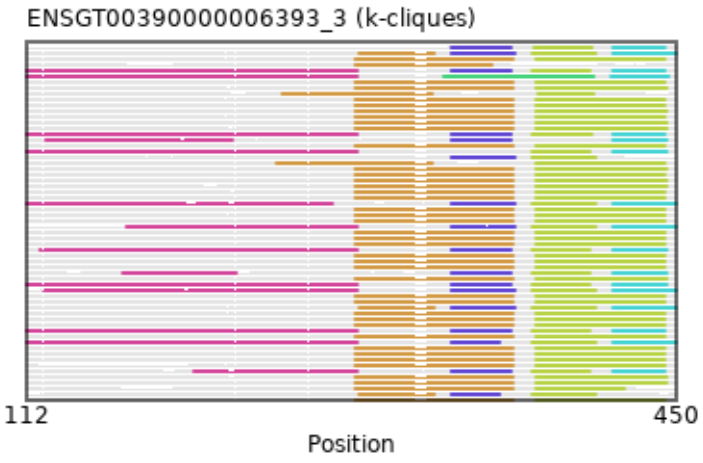
- Associate Professor,
- School of Life Sciences
- Phone: 702-774-1503
- Email: mira.han@unlv.edu

Expertise

- Molecular Evolution
- Genomics of transposons
- Next generation sequence analysis

Han Lab – molecular evolution

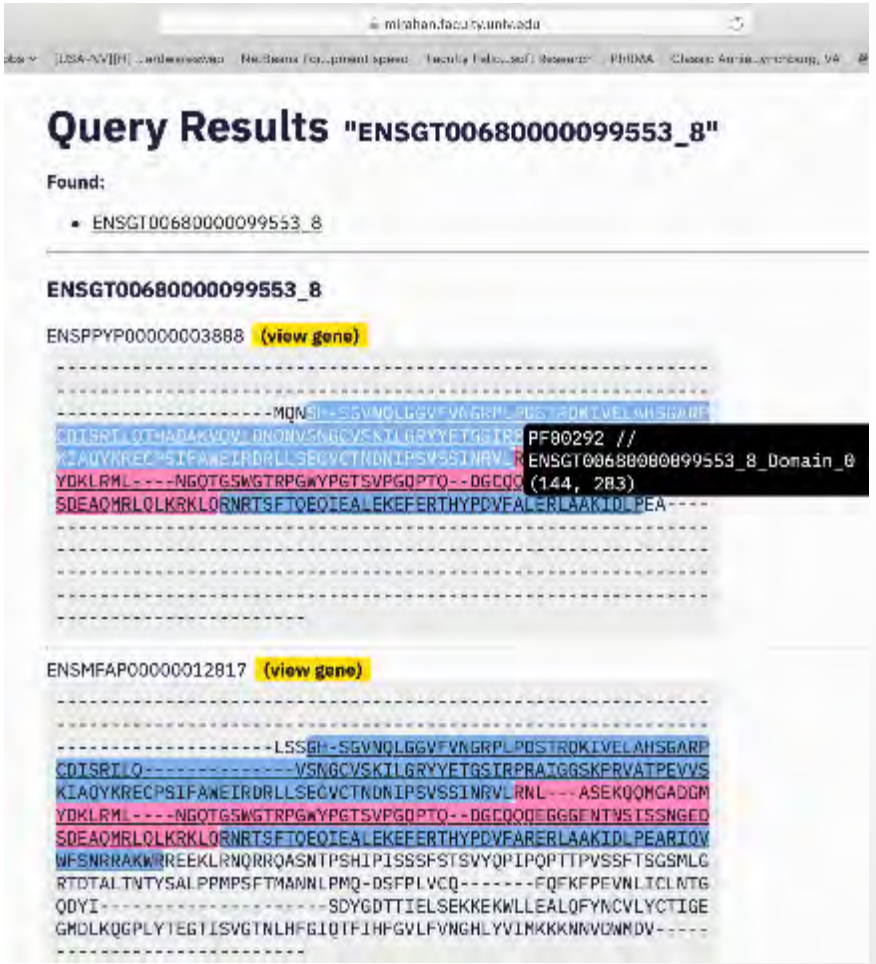
Evolution of domain architecture and interdomain linkers across 148 Amniote genomes



alignment

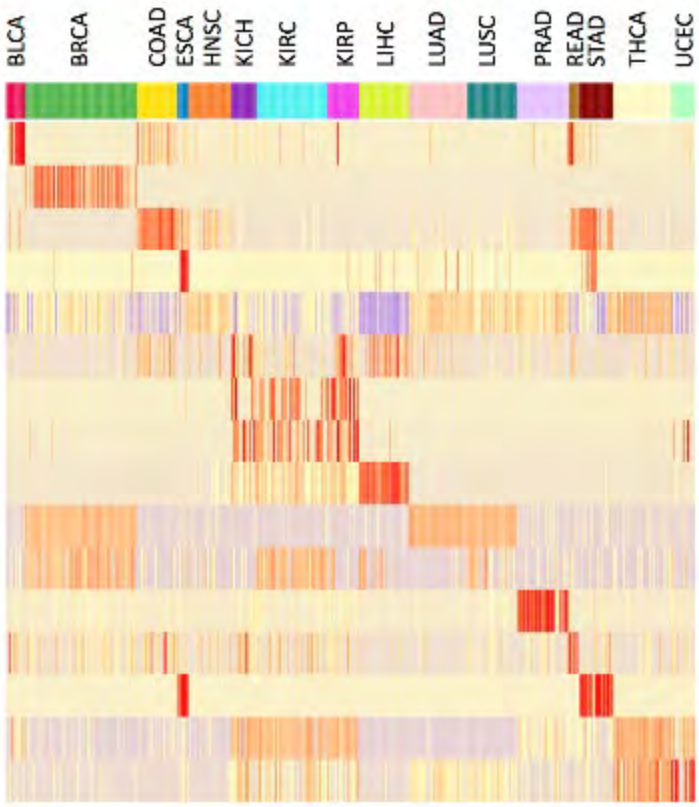
Domain homology across proteins

Database of homologous domains and linkers

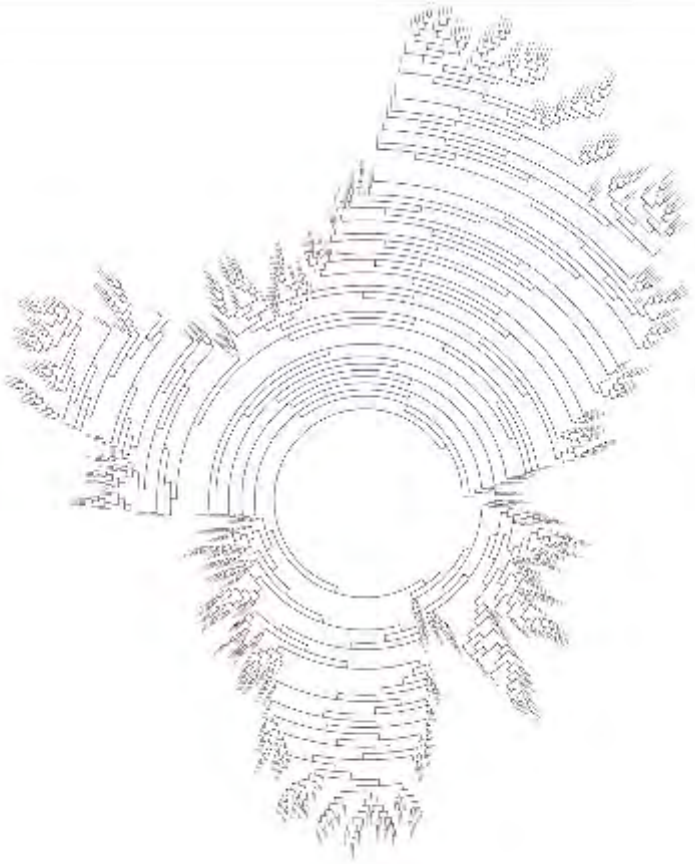


Han Lab – transposon genomics

Transposons in host regulation and disease



Tissue specific transposon expression



Predicted NANOG binding based on ancestral reconstruction of RLTR13D6 transposons

Integrative Physiology

Dr. Allyson Hindle

Assistant Professor

School of Life Sciences

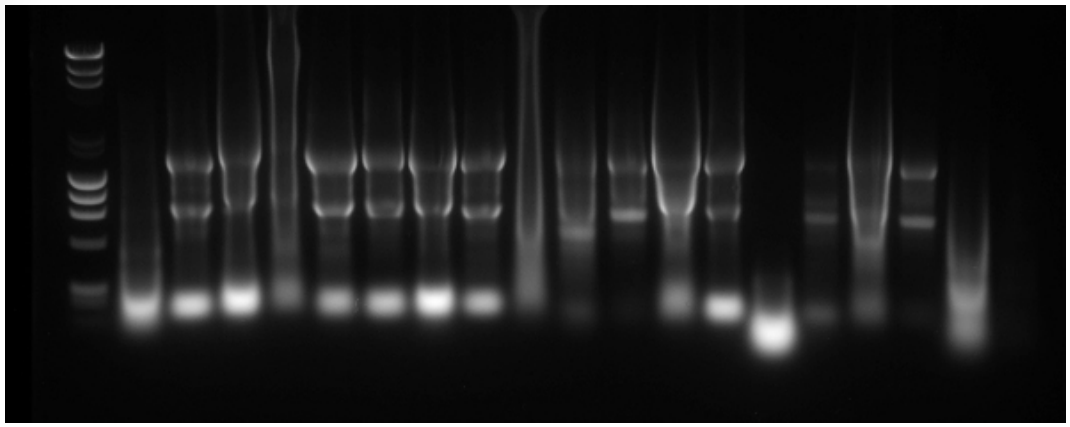
Phone: 702-895-4521

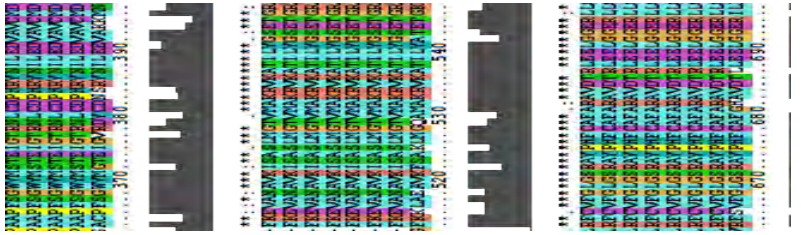
Email: allyson.hindle@unlv.edu

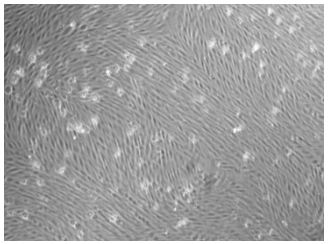
Expertise

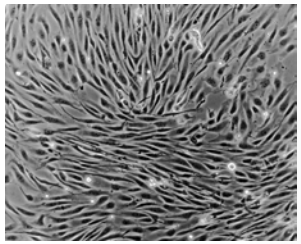
- molecular mechanisms of hypoxia tolerance in hibernating and diving mammals
- cardiovascular and blood pressure regulation
- comparative genomics, biomarker discovery and bioinformatics
- cell line resource development for non-model systems

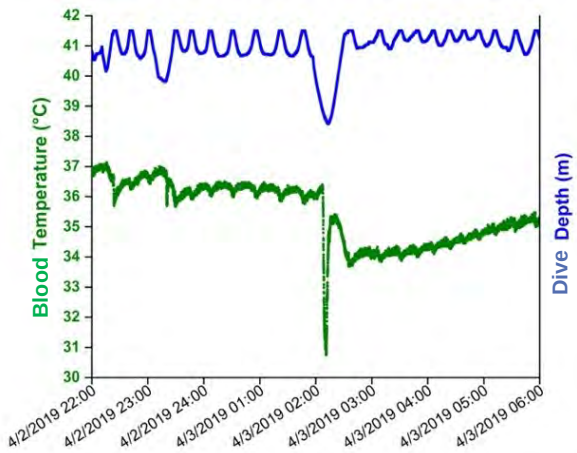
Cardiovascular protection of deep divers

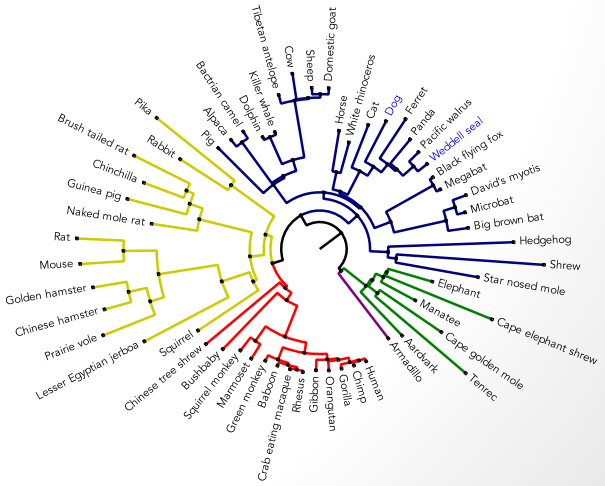




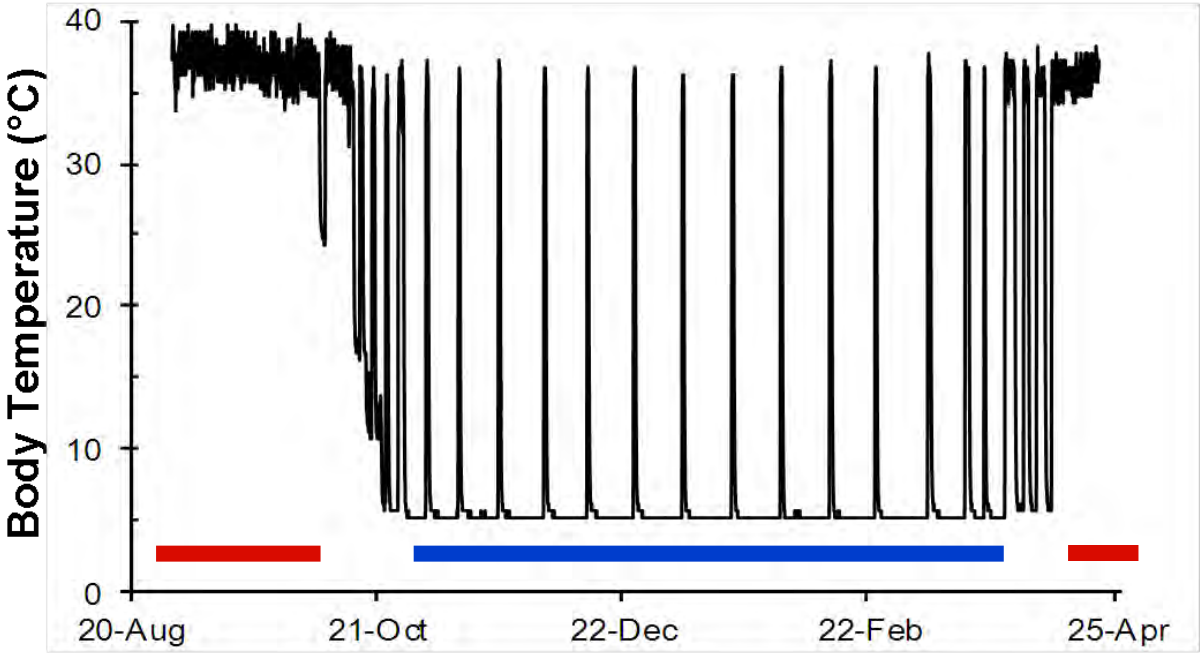






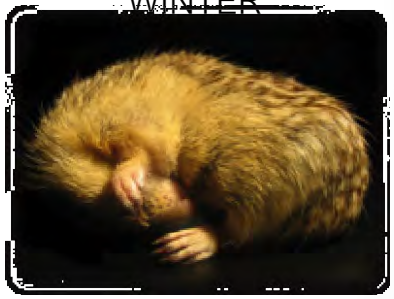


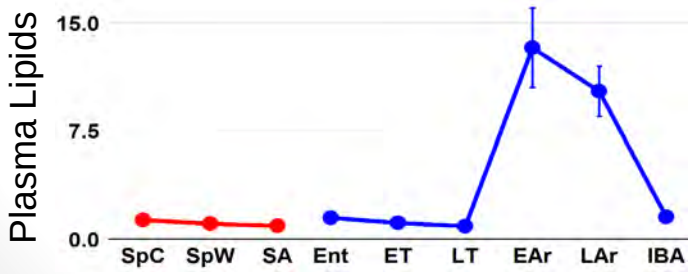
Metabolic control of small hibernators

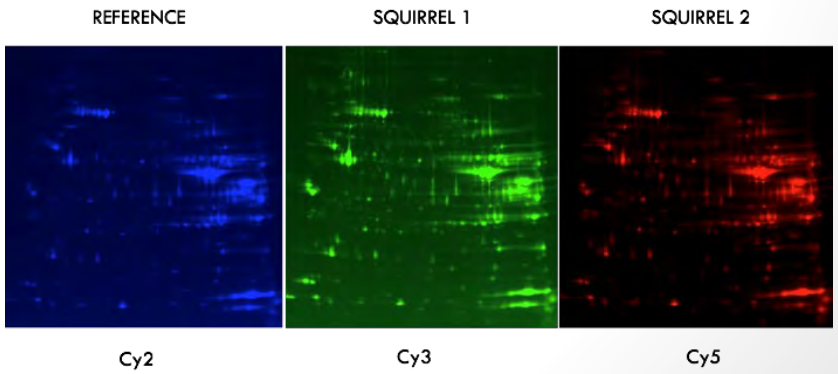


SUMMER

WINTER

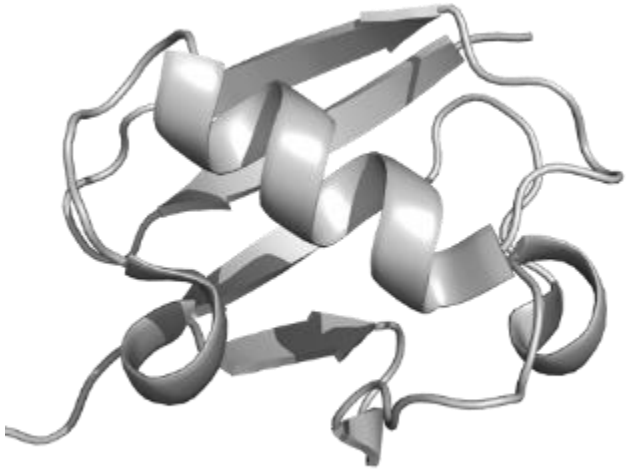






Ubiquitin-mediated protein degradation

Dr. Gary Kleiger
Professor and department Chair
Department of Chemistry and Biochemistry
gary.kleiger@unlv.edu
https://kleiger.faculty.unlv.edu



Expertise

- Structural biology
- Proteomics
- Enzyme kinetics and biophysical assays
- Cell biology

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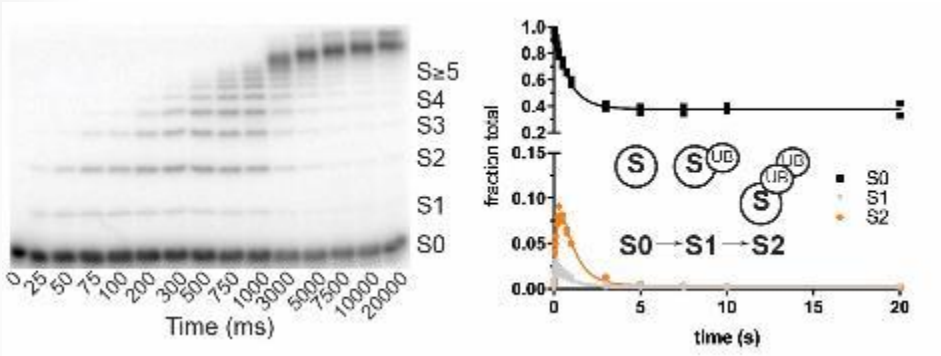
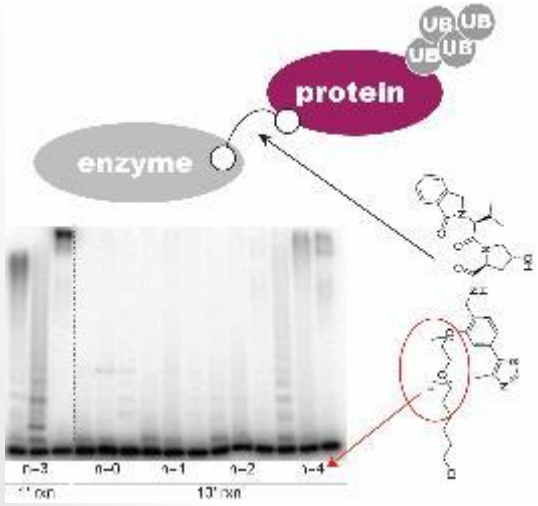
Uncovering how the enzymes that promote protein degradation function in human cells.

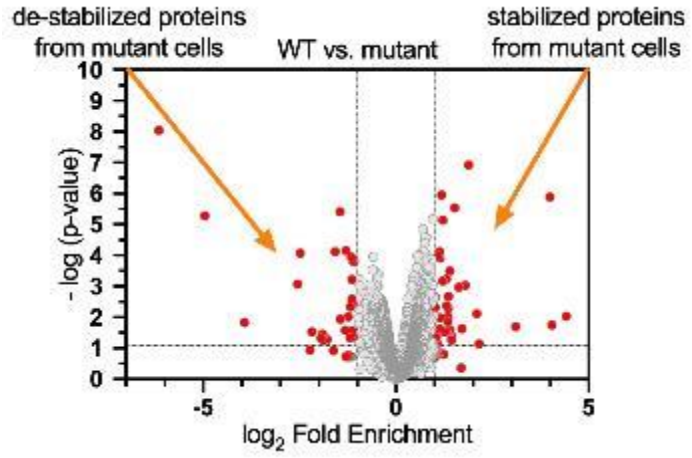
Kinetics help us understand how enzymes select protein targets for modification with ubiquitin.





Small molecule inducers of protein degradation can be used to treat human disease. We study the mechanism of how they function both in test tubes and cells.

High-resolution mass-spectrometry tells us how mutations in enzymes that lead to human disease affect the stabilities of key human cellular proteins.



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Organic Materials Chemistry

Dong-Chan Lee, Ph.D.

Associate Professor

Department of Chemistry & Biochemistry

Phone: 702-895-1486

Email: dong-chan.lee@unlv.edu

Expertise

- Organic semiconductors with tunable electronic properties
- Self-assembly (nanomaterials, organogels, etc.)
- All organic room-temperature phosphors
- Materials development for solid-state emission with high quantum yield

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Electronic-Property Tuning with Smart Molecular Design

E_{LUMO}

-3.16 eV

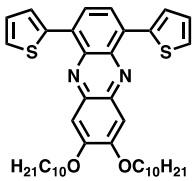
-3.26 eV

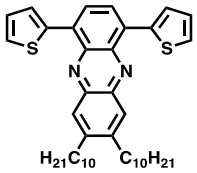
-3.22 eV

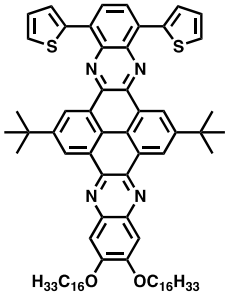
-3.89 eV

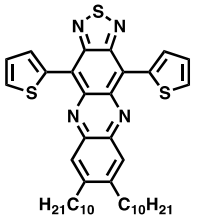
-3.80 eV

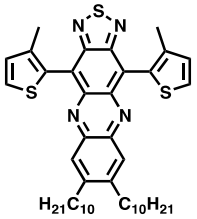
-3.84 eV

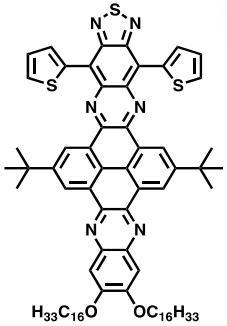












E_{HOMO}

-5.43 eV

-5.45 eV

-5.49 eV

-5.32 eV

-5.51 eV

-5.40 eV

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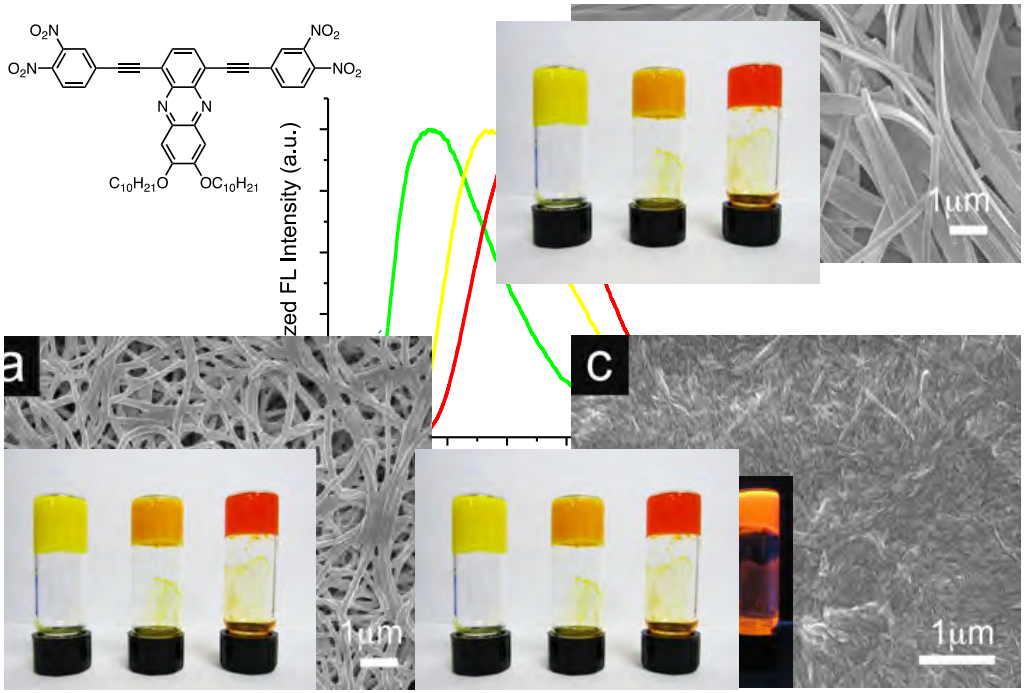
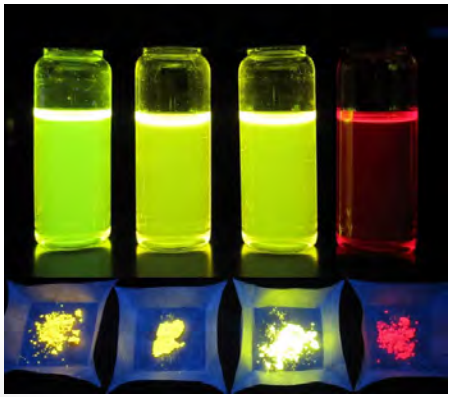
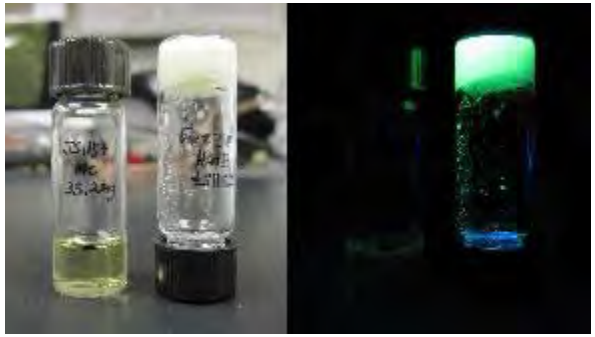
Solvent-Dependent Morphology Control through Organogelation





Solid-State Emission with High Quantum Yield



Gel-Induced Room Temperature Phospho-rescence

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Meiselman Lab: Vectors and Dormancy

- **Dr. Matthew R. Meiselman**
- Assistant Professor of Neurophysiology
- School of Life Sciences
- Email: matthew.Meiselman@unlv.edu
- Website: meiselmanlab.com

Expertise

- Dr. Meiselman completed his PhD. In Cell, Molecular, and Developmental Biology at University of California-Riverside before studying neurobiology during his Postdoctoral work at Cornell University
- Dr. Meiselman focuses on the molecular and neural components which comprise dormancy (an extended depression of metabolism and behavior).
- Mosquitoes, ticks, and other medically-relevant arthropods depend on this state change for survival during winter or dry seasons
- We use the genetically tractable fruit fly as an “engine for discovery” to learn about this state, with the goal of applying this knowledge to other species to curtail the contraction of vector-borne disease

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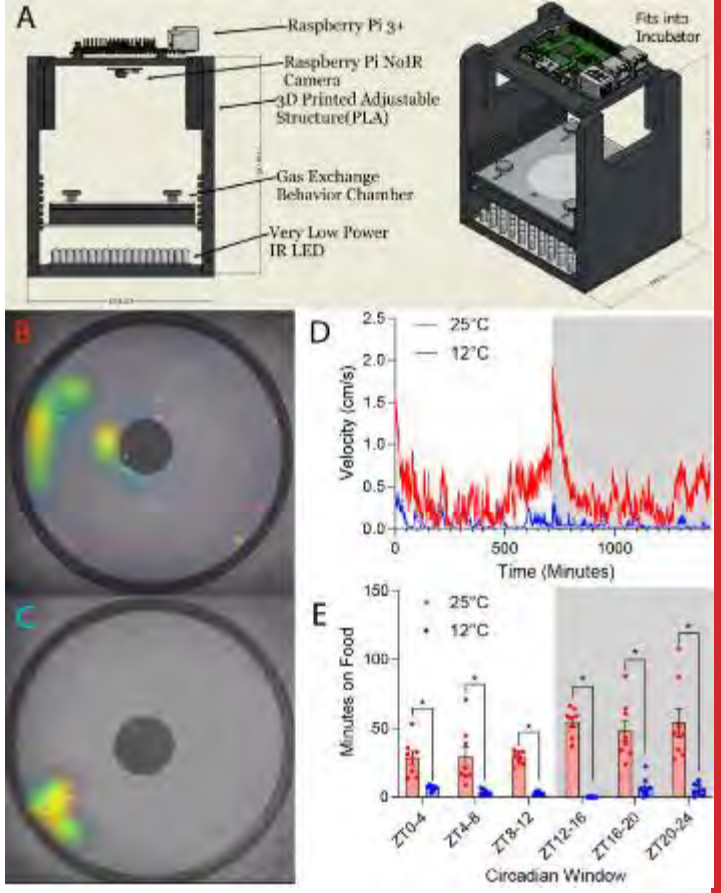
Our lab currently has two main projects:

1. We are searching for neurons that control dormancy in *Drosophila melanogaster*. By using transgenic activators and inhibitors of neural activity, we are attempting to induce dormancy (normally a response to cold) in warm conditions, and to prevent induction of dormancy in cold conditions. We are also searching for **ethological signatures of dormancy,** such as changes in circadian rhythmicity, sleep or photopreference, which can complement our metabolism-oriented definition.



2. We are attempting to understand the drivers of tick questing (hunting) behavior. We are using custom-built apparati and high-resolution video analysis to determine how tick circadian rhythm or activity levels respond to ambient temperature, humidity and lighting conditions. This may lead to better information linking climatic conditions to tick bite risk.

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Dr. Jeffery Shen
Professor,
School of Life Sciences
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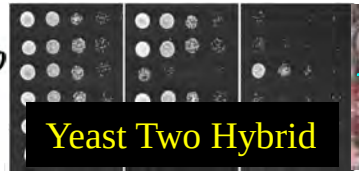
Email: jeffery.shen@unlv.edu

Expertise

- Big Data Analysis to Study Biology, Agriculture and Medicine
- Molecular Mechanisms Controlling Plant Responses to Drought Heat, and Salinity
- Seed Germination, Tissue Culture and Plant Transformation
- Molecular Basis of Leukemia (in collaboration with Dr. J. Cheng at the University of Chicago Medical School)
- Nutrition of Cereal Crops (in collaboration with Dr. Christine Bergman, Ph.D. and R.D. at UNLV)

Molecular Basis of Drought Stress Responses and Seed Germination



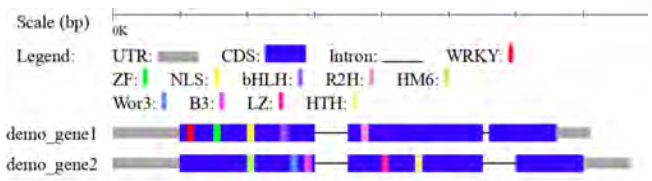
BMC Genomics, 2016, 17:102
Plant Science, 2015, 236:214-222
Front. Plant Science,2015; 6: 1145
Trends in Plant Sci, 2010, 15: 247

Short Read Assembly Algorithm

for Genome and Transcriptome Analysis

http://shenlab.sols.unlv.edu/shenlab/software/Tiling_Assembly/tiling_assembly.html

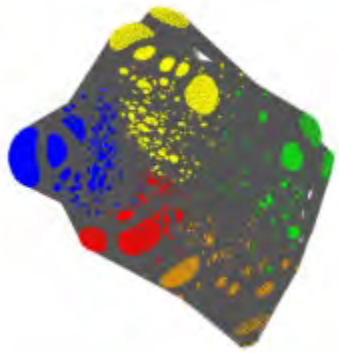
DNA Research, 2015, 22: 319-329
Genomics, 2014, 103:122-134



Promoter and Coding Region Structures

http://shenlab.sols.unlv.edu/shenlab/software/TSD/transcript_display.html

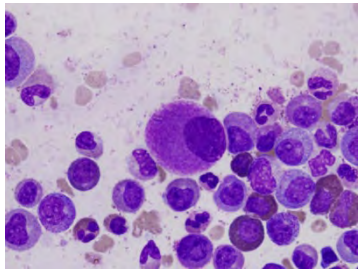
Bioinformatics, 2016, 32:2024-2025
Plant Cell Environ. 2017, 40:2004-2016



Signaling network Analysis

Molecular Basis of Leukemia

(in collaboration with Medical School, University of Chicago)



Cytogenetically normal refractory cytopenia with multilineage dysplasia (CN-RCMD)

Nature Communications, 2018, 9:1163
Leukemia, 2013, 27: 1291-1300

Biochemistry – Interrogate Cell Signaling Pathways by Molecular, Genetic and Proteomic Approaches

Dr. Hong Sun
Associate Professor
Department of Chemistry and Biochemistry
Telephone: (702) 774-1485
Email: hong.sun@unlv.edu

Expertise

Cell signaling
Cancer cell biology
Stem cell biology
Mouse conditional knockout models

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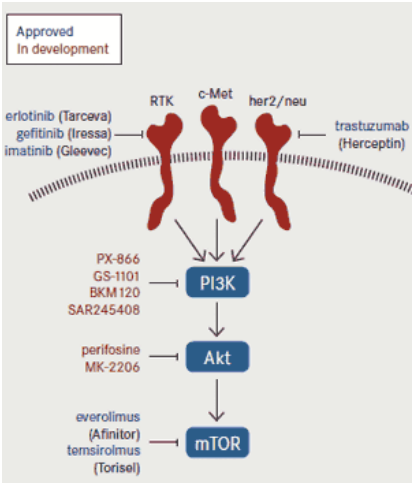
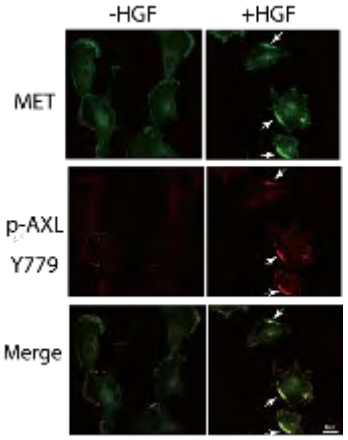
Regulation of cell surface receptor RTKs localization and activation

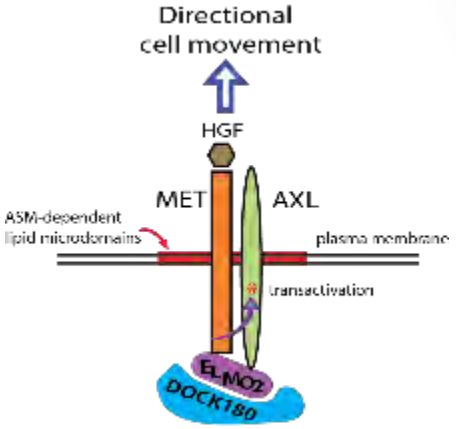
Problem: cancer cells often have multiple receptors (RTKs) activated on cell surface, making targeting inefficient



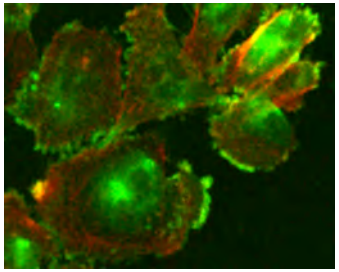
Co-activation of AXL-MET RTKs:
HGF (ligand for MET) also activates AXL, detected by antibodies for p-AXL-Y779



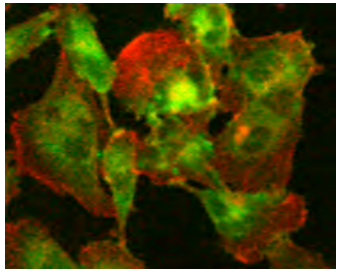
A novel mechanism discovered for RTK-Co-activation and signaling for cancer cell migration and invasion



Li et al., J. Biol. Chem. (2018) 293:15397-15418.

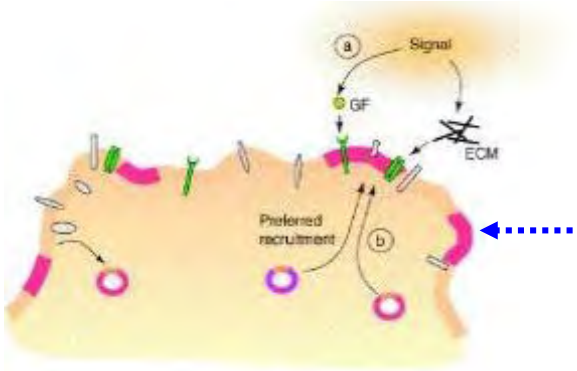


Vehicle



ASM Inhibitor

ASM inhibition prevents the MET RTK to be transported to the cell surface, as revealed by immunostaining (MET, green label; and a control cell surface protein, red label).
Zhu et al, J. Cell Science (2016) 129, 4238-4251.

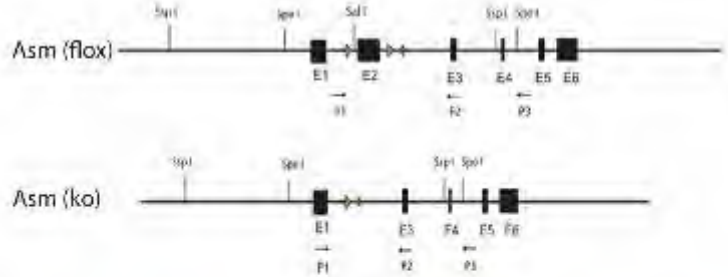


ASM-dependent
lipid microdomains

Mass-Spectrometry analyses revealed that the ASM-regulated local lipid microdomains were enriched with many signaling molecules.
Xiong et al. Biol. Open (2019) 8, bio040311.

Regulation of stem cell maintenance: insights from the genetic studies in novel mouse knockout models

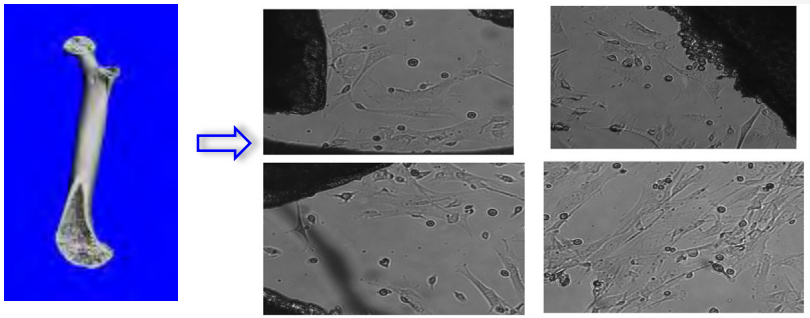
A. Gene locus



B. Loss of Purkinje neurons in cerebellum

Purkinje neurons immunostained with D28K antibody.

C. Mesenchymal stem cells (MSCs) cultured from bones



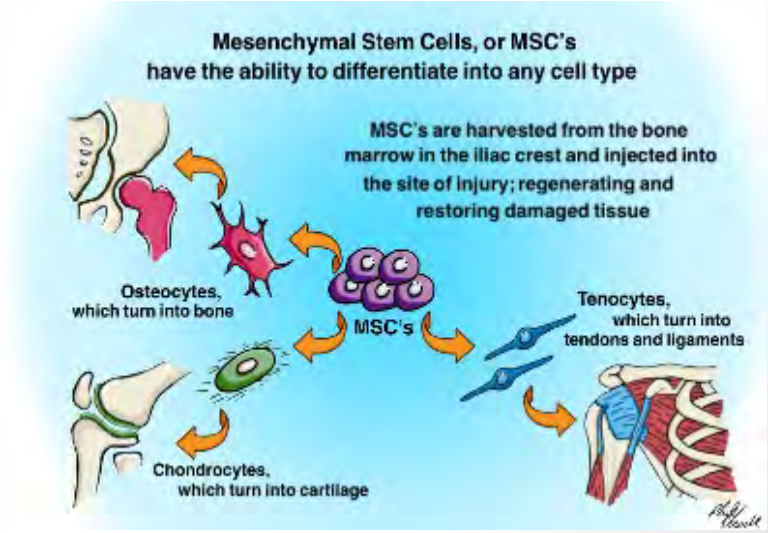
D. ASM mutant MSCs failed to become bone-forming cells

Wild-type MSCs

ASM mutant MSCs

(*in vitro* differentiation assay, then stained with alizarin red)

E. Potentials of MSCs for tissue repair



Aridland Population Biology and Evolution

Dr. Daniel Thompson
Associate Professor
School of Life Sciences
Phone: 702-895-3269
Email: daniel.thompson@unlv.edu

Expertise

- Evolutionary genetics
- Population and evolutionary ecology
- Insect – plant interactions
- Conservation ecology - endemic insects
- Quantitative genetics, Phenotypic plasticity, and Developmental Reaction Norms
- Multivariate Statistical Analysis
- Animal movement, Habitat Selection, and Spatial ecology

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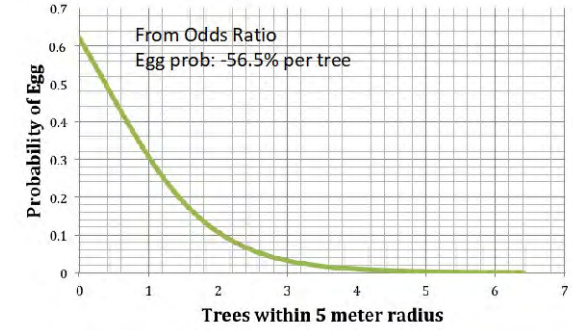
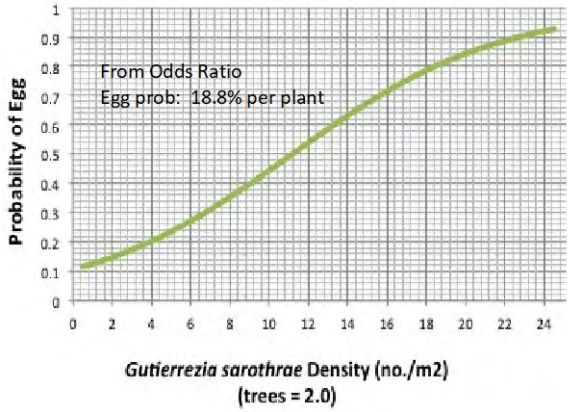
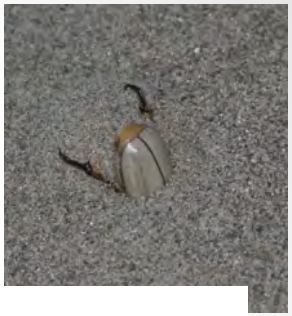
Research on Larval Host Plant Selection of the Endangered Endemic Mt Charleston Blue Butterfly (*Icaricia shasta charlestonensis*) Informs Habitat Conservation and Restoration in Spring Mountains National Recreation Area

- Tree Density has a strong negative effect on female butterfly host plant selection and egg-laying (Logistic regression of egg occurrence versus density of bristlecone .pines).
- Tree encroachment on open slopes and ridges constricts butterfly reproduction– particularly on ridgelines with high quality butterfly habitat.
- Nectar plants such as *Gutierrezia sarothrae* have a positive effect on the likelihood of a female's selection of a larval host plant for egg deposition.
- Avoidance of trees and attraction to nectar determine a female butterfly's placement of eggs on larval host plants.
- Ongoing fieldwork investigates caterpillar (larva) growth, foodplant requirements, and interactions with mutualistic ants to further understand the essential characteristics of butterfly habitat. This new information is being used by the US Forest Service and the US Fish and Wildlife Service to guide conservation and management decisions in the Spring Mountains, Clark County, Nevada.



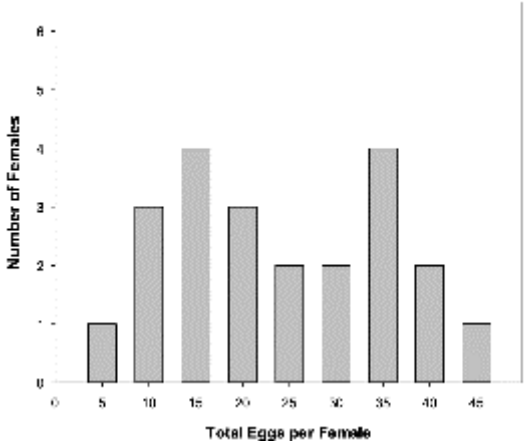


Ecological research on Giuliani's Dune Scarab Beetle (*Pseudocotalpa giulianii),* Big Dune, Nevada, --guiding management decisions of the B.L.M.

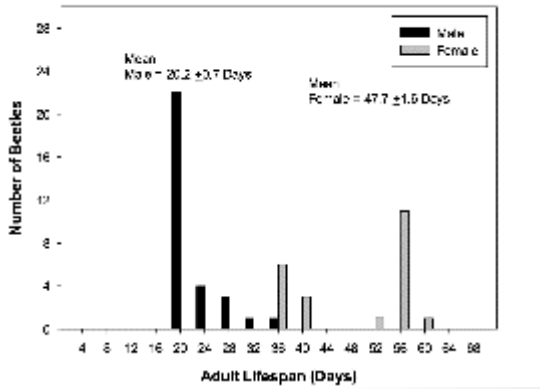


Giuliani's Dune Scarab Beetle (*Pseudocotalpa giulianii*) is a rare beetle endemic (known to occur only at) Big Dune and Lava Dune, Nye County, Nevada. Little is known about the beetle's life history, egg to adult stage development, larval food, and habitat requirements. Research conducted with Dr. Leslie DeFalco (USGS) in 2019 and 2020 has established:

- Adults do not feed, dwell in the sand, and emerge at sundown each evening for 3 weeks, late April – May
- Male beetles emerge from sand and fly every night for an average of 52.2 min to mate, while female beetles remain buried in sand after initial emergence and mating.
- Female beetles, on average, deposit one egg per day after mating.
- Female beetles have an average lifespan of 47.7 + 1.6 days.
- Male beetles have an average lifespan of only 20.2 + .7 days.
- The longer female lifespan, their apparent cessation of emergence following mating, and their deposition of single eggs scattered through sand has important implications for the conservation of this rare species.
- Laboratory experiments have revealed that beetle larvae hatch within 2 – 3 weeks from eggs and develop at a slow rate with an estimated 2 to 3 years of growth prior to pupation and adult emergence. To date, feeding experiments indicate that dry plant debris scattered in the sand is an essential food source. Further experiments are being conducted to determine whether larvae feed on roots of desert plants and to measure energy storage in fat tissue that apparently fuels adult activity and mating.
- Research findings are informing Bureau of Land Management (BLM) decisions about managing recreational activity at Big Dune and restoring beetle habitat following disturbance by recreational off-road vehicles..



Total eggs per female beetle obtained in the laboratory, April 29 to June 12



Average lifespan for 30 male beetles and 22 female beetles, observed from April 19 to June 12 in the laboratory

Regeneration and Stem Cell Biology

Ai-Sun (Kelly) Tseng, Ph.D.

Associate Professor, School of Life Sciences

Adjunct Associate Professor, School of Medicine

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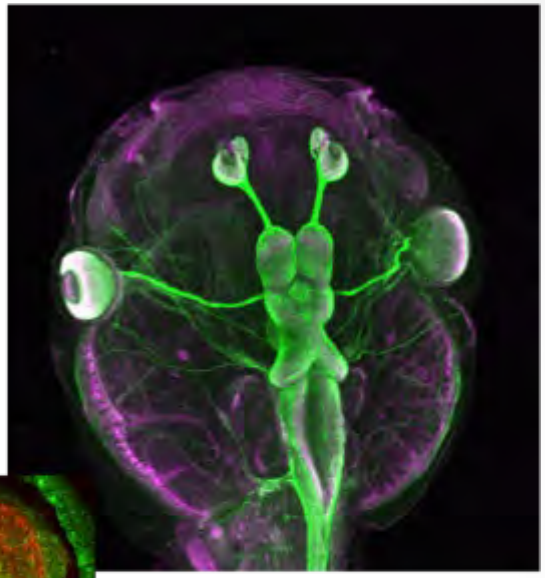
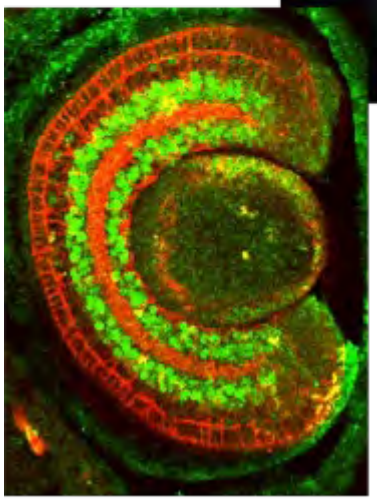
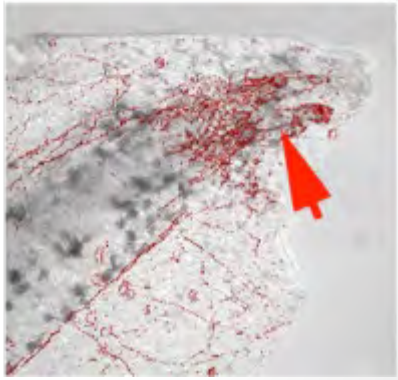
Email: kelly.tseng@unlv.edu

Website: http://tseng.faculty.unlv.edu







Expertise

- Eye regeneration
- Limb regeneration
- Stem cell biology
- Bioelectrical signaling
- Cell proliferation and growth

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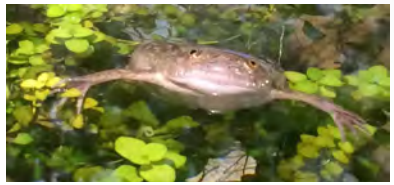
Understanding Vertebrate Organ Regeneration

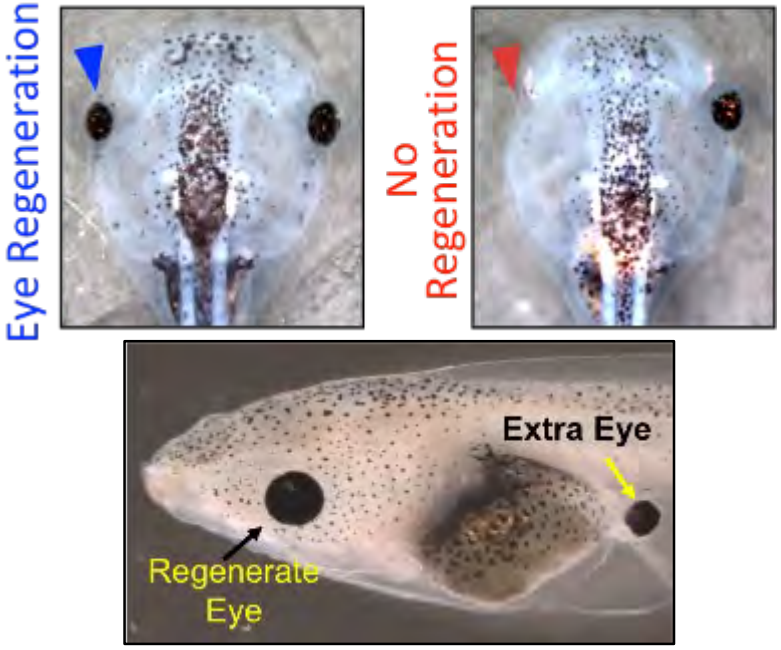
Kelly Tseng

Why Can Some Animals Regenerate Body Parts but Others Cannot?

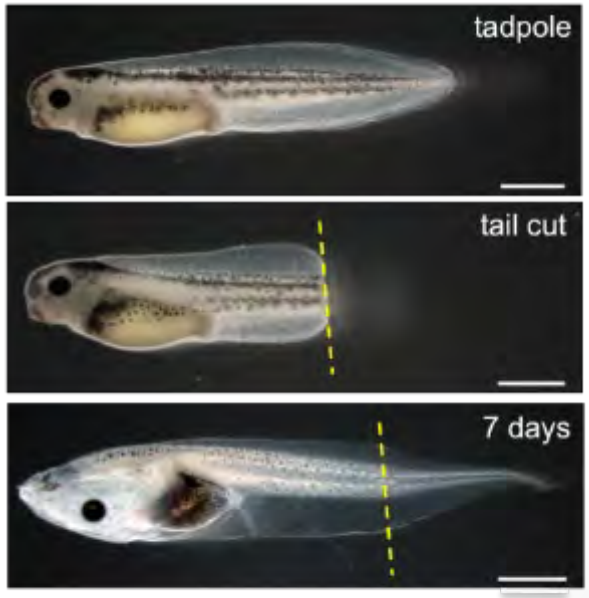
Goal: understand natural regeneration using a model system with high regenerative ability (clawed frog)



Eye Regeneration



Spinal Cord Regeneration



Projects:

1) Identify and define mechanisms that drive tissue regeneration
2) Develop successful strategies to regenerate lost tissues and organs

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Understanding Vertebrate Organ Regeneration

Kelly Tseng

Recent Publications:

- Kha, C. X., Guerin, D.J., and Tseng, K. A.-S. (2020) Studying *in vivo* Retinal Progenitor Cell Proliferation in *Xenopus laevis*. In: Mao CA. (ed) *Retinal Development. Methods in Molecular Biology*, *2092:19-33*. Humana, New York, NY.
- Kha, C. X, Guerin, D.J., and Tseng, K. A.-S. (2019) Using the *Xenopus* Developmental Eye Regrowth System to Distinguish the Role of Developmental Versus Regenerative Mechanisms. *Frontiers in Physiology*, May 8;10:502. doi: 10.3389/fphys.2019.00502.
- Kha, C. X., and Tseng, K. A.-S. (2018) Developmental Dependence for Functional Eye Regrowth in *Xenopus laevis. Neural Regeneration Research, 13*:1735-38.
- Kha, C. X., Son, P. H. , Lauper, J., and Tseng, K. A.-S. (2018) A Model to Investigate Developmental Eye Repair in *Xenopus laevis. Experimental Eye Research, 169*:38-47.
- Tseng, A.-S. (2017). Seeing the future: using *Xenopus* to understand eye regeneration. *genesis: The Journal of Genetics and Development, 55*(1-2), e23003. http://dx.doi.org/10.1002/dvg.23003

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Bacterial Physiology Research

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Assistant Professor
School of Life Sciences
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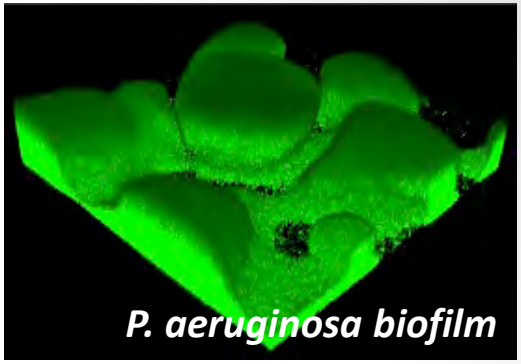
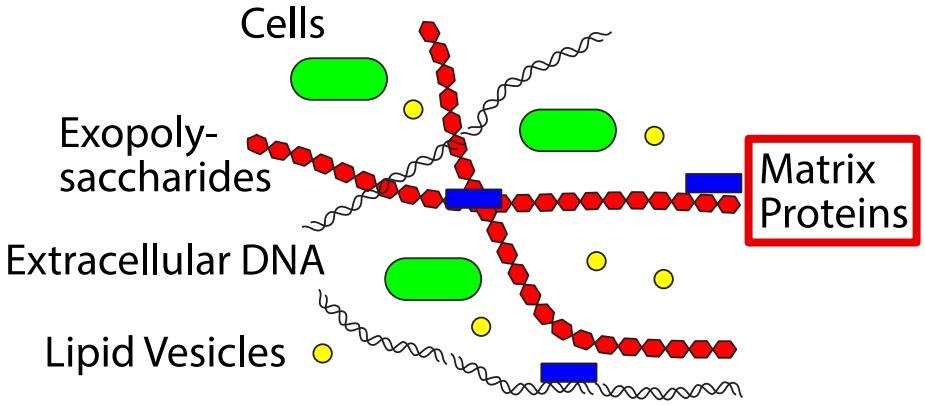
Email: boo.tseng@unlv.edu

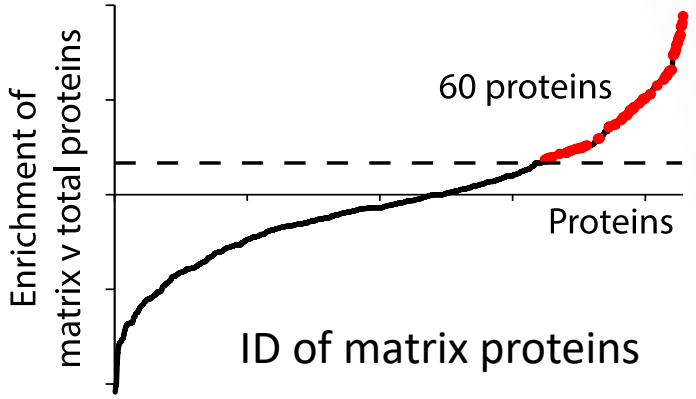
Expertise:

- *Pseudomonas aeruginosa*
- Biofilms
- Bacterial stress response
- Antimicrobial susceptibility
- Cystic fibrosis lung infections

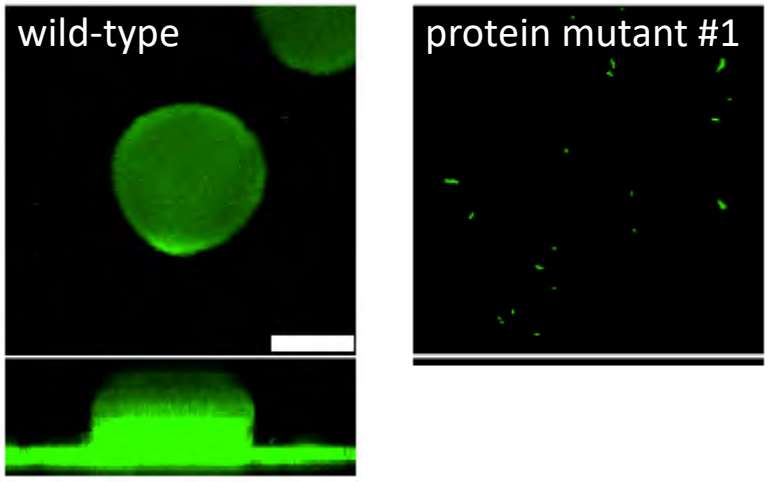
Identifying the roles of biofilm matrix components



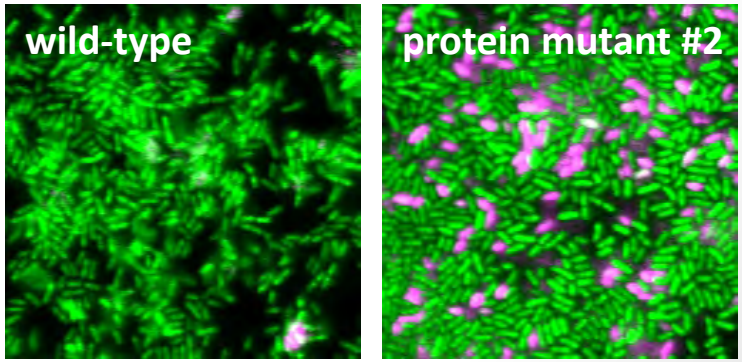




Functions in biofilm formation

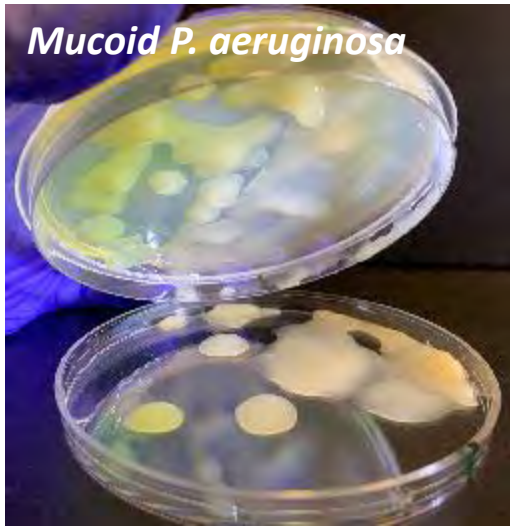


Functions in antimicrobial susceptibility

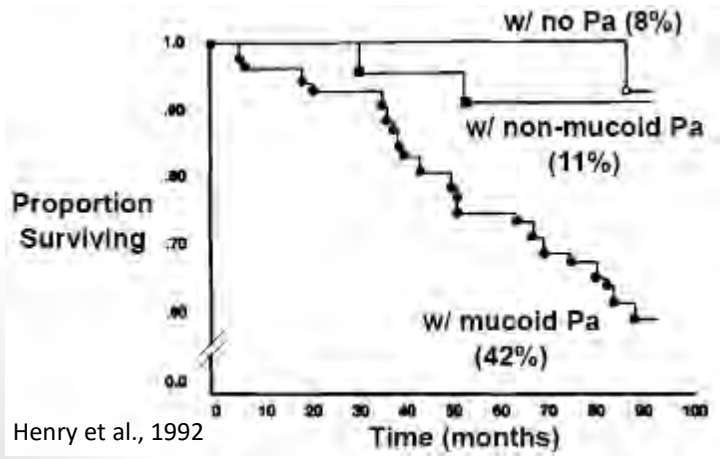


Treated with elastase (green: alive; purple: dead)

Mechanism behind the essentiality of bacterial envelope stress inhibitor

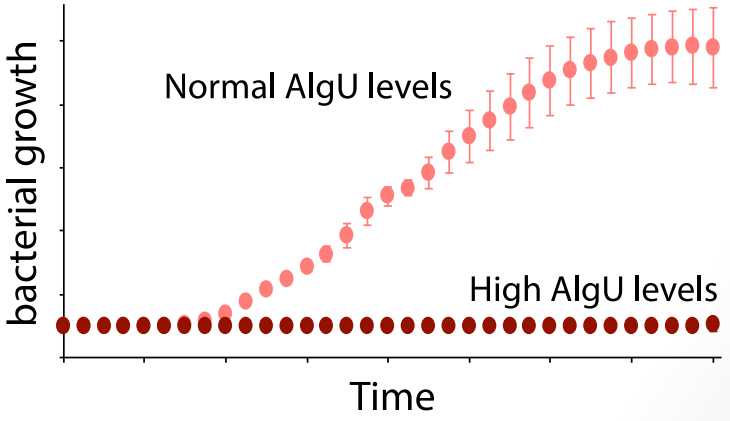


- Exopolysaccharide overproducing (e.g. mucoid) bacteria arise during chronic lung infection
- Associated with poor disease outcomes
- Due to mutation in *mucA* gene, which encodes for inhibitor of envelope stress response via AlgU
- BUT *mucA* required for bacterial viability and overproduction of AlgU inhibits growth



Henry et al., 1992

In children with cystic fibrosis



Question: why is a gene commonly mutated in clinical isolates required for bacterial viability?

School of Life Sciences

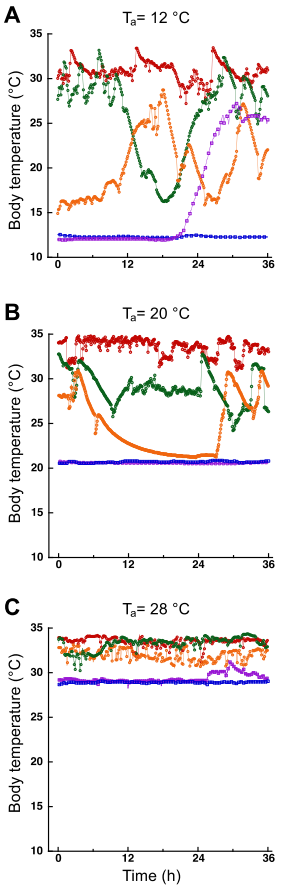
Dr. Frank van Breukelen
Professor and Director
School of Life Sciences
Phone: 702-895-3944
Email: frank.vanbreukelen@unlv.edu

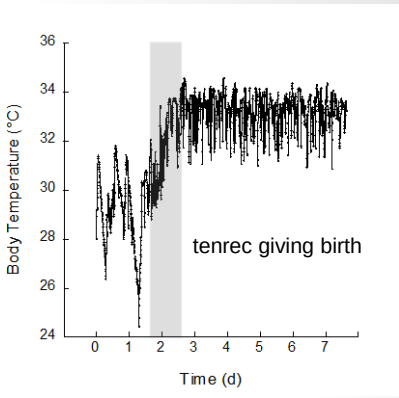
Expertise

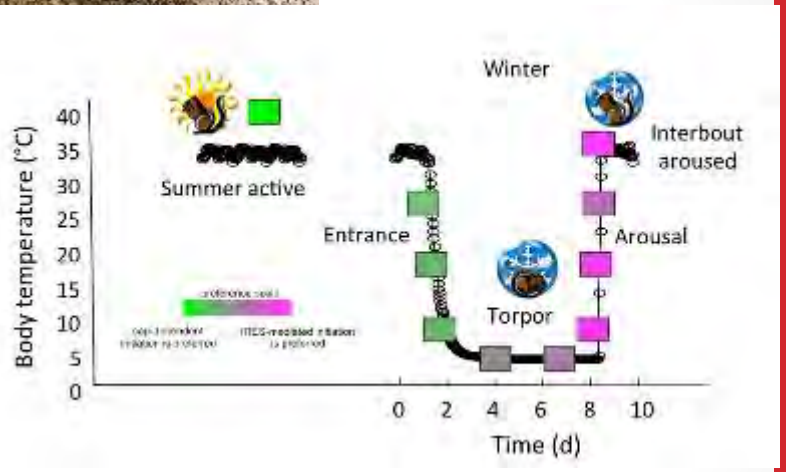
- Metabolic depressions like mammalian hibernation
- Life in extreme environments

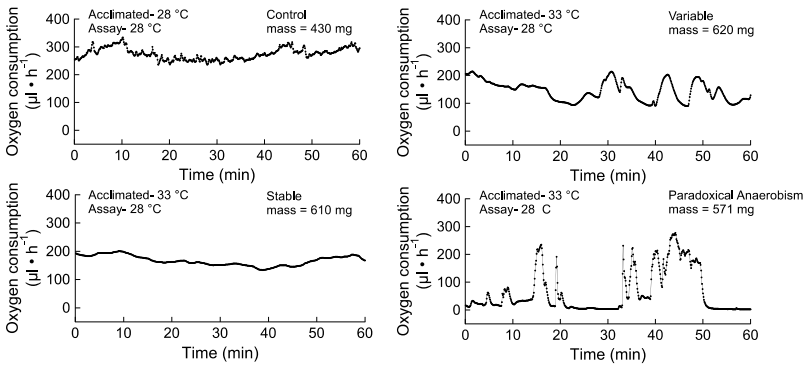
Areas of research

- Hibernation in tenrecs and ground squirrels
- Paradoxical anaerobism in pupfish
- We use a variety of approaches from whole animal physiology to biochemistry to understand how animals live in extreme environments









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Understand cancer from an embryonic prospective

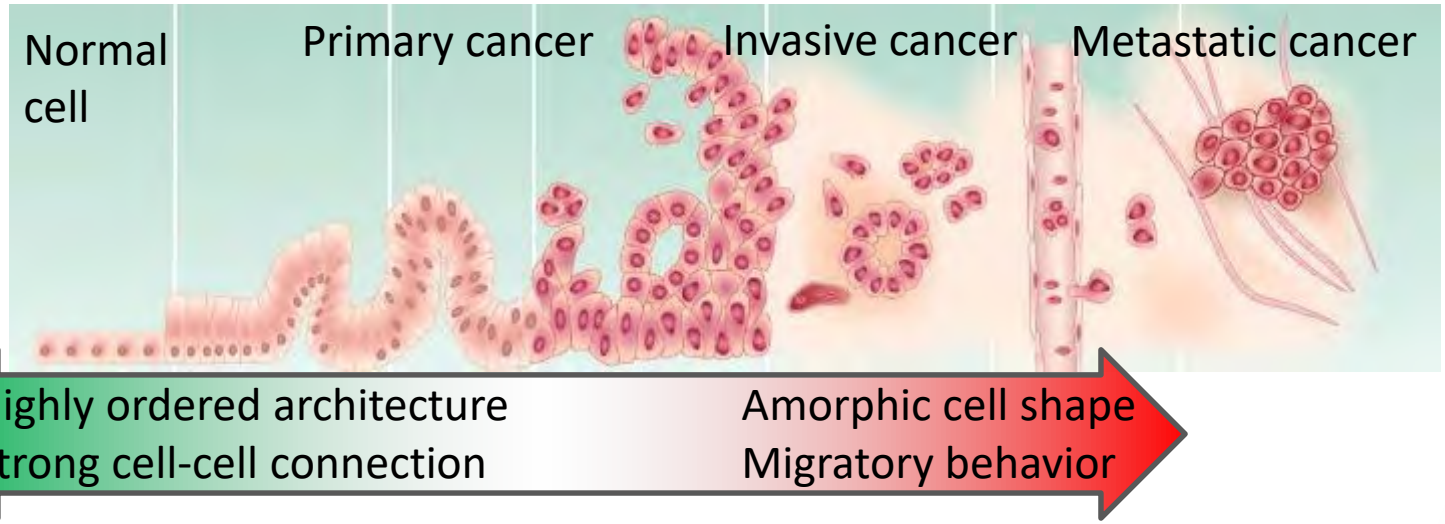
Dr. Mo Weng
Assistant Professor
School of Life Sciences
Phone: 702-895-5704
Email: mo.weng@unlv.edu

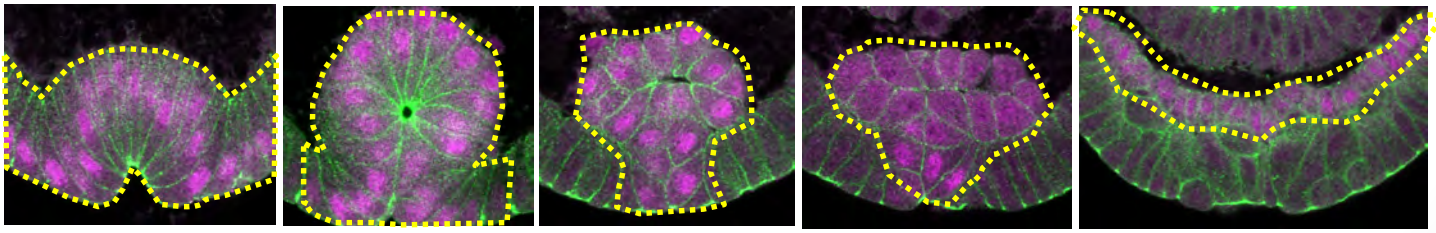
Expertise

- Epithelial-mesenchymal transition
- Developmental genetics
- mechanobiology
- Cancer biology

Understand cancer from an embryonic prospective

- Metastasis, the cause of death for 90% cancer patients, is not a cancer invention but a hijacked natural program essential for generating diverse structures in embryos, called epithelial-mesenchymal transition (EMT).



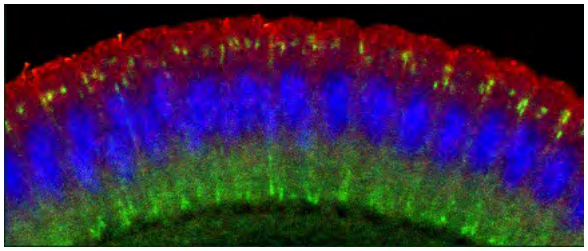


Embryo EMT

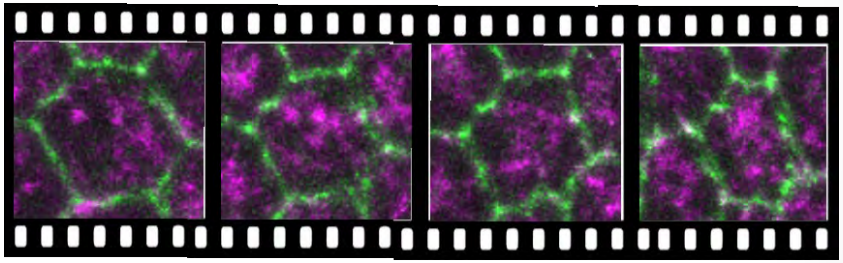
Understand cancer from an embryonic prospective

We use multidisciplinary approaches to study both biochemical and mechanobiological pathways controlling cell polarity and cell fate.

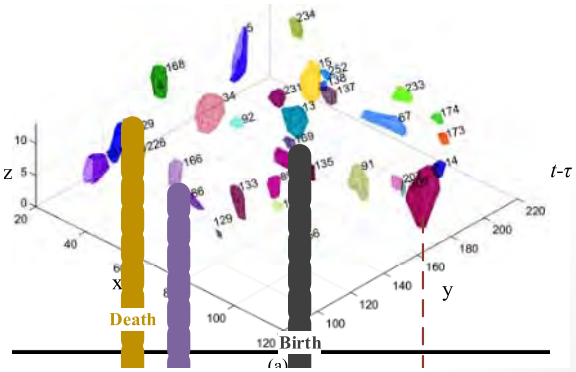
- Seeing is believing: Laser scanning confocal imaging probes micrometer cellular structures in 3D at high resolution and sensitivity



- Live cell imaging records the dynamics of cells and proteins as the living embryo taking on increasingly complex structures.



- Machine-learning approaches extract invisible principles from information-rich images and make predictions



- Genetic approaches such as gene editing test the roles of individual genes and their interaction.

Microbiology

Dr. Helen J. Wing
Professor,

School of Life Sciences
Phone: 702-895-5382
Email: helen.wing@unlv.edu

Expertise

- Microbiology focusing on agents of Infectious Disease
- Bacterial Gene Regulation
- Bacterial Physiology
- Molecular Biology controlling virulence
- Identification of novel drug targets
- Antibiotics use & Antibiotic resistance

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Genetic switches & molecular mechanisms controlling virulence

Central themes of this project

Transcriptional control of bacterial genes

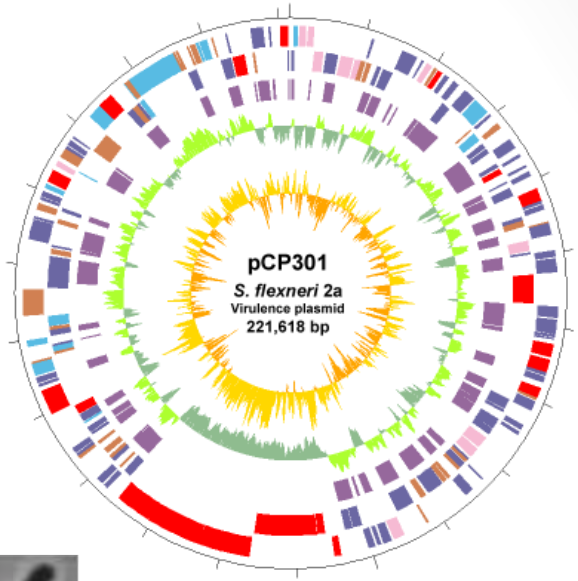
Dynamic nucleoid remodeling

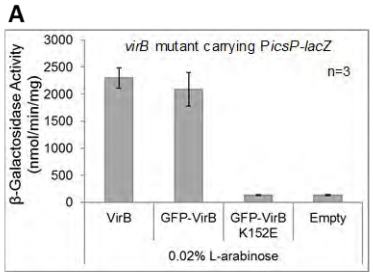
DNA-protein and ligand-protein interactions

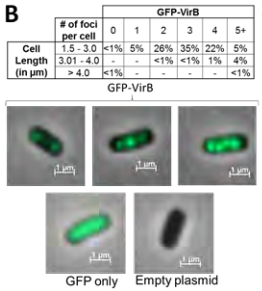
Evolutionary relationship of bacterial proteins

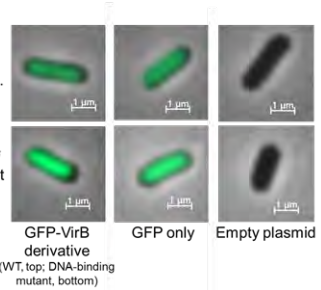
Bacterial management of large plasmids

Novel targets for antibiotics and therapeutics







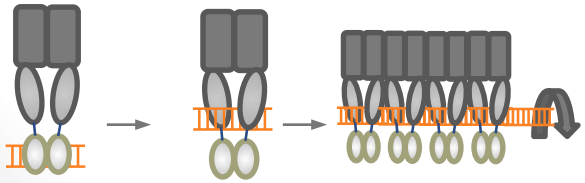


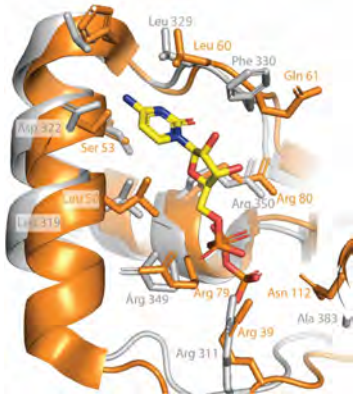
A: Current model

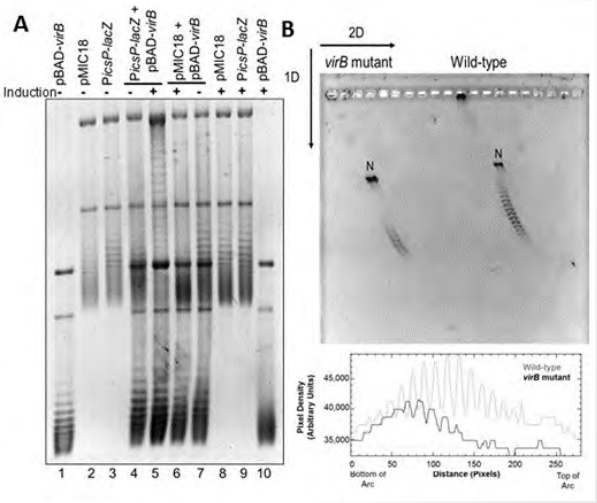
Step 1: Non-specific interactions with DNA (in vitro only)

Step 2: Binding to its recognition site is a prereq. for Δlk, focus formation & anti-silencing

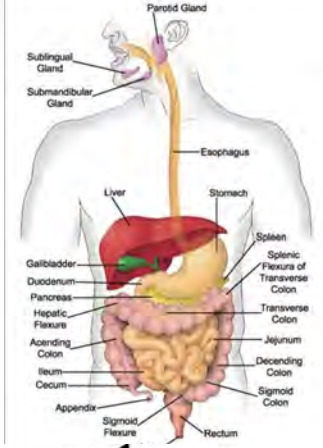
Step 3: Spreading along DNA causing torsion in the DNA helix. The triggered change in DNA supercoiling is sufficient to relieve gene silencing.







Shigella pathogenesis



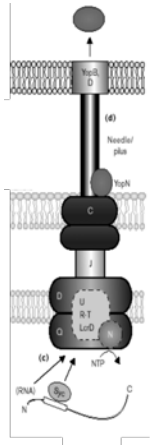
Fast Facts

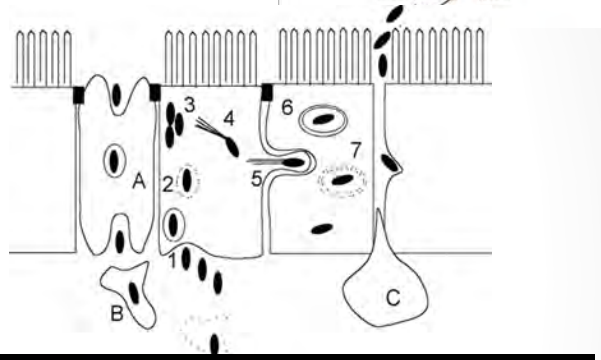
Shigella species - causal agents of bacillary dysentery

Cause an estimated 80-165 million cases per year and 600,000 deaths, mostly in children under 5 years.

Highly infectious (low infectious dose)

Increasingly resistant to commonly used antibiotics





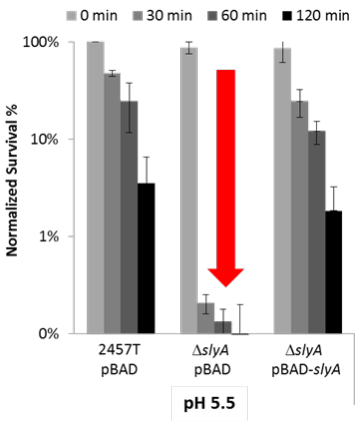
Central themes of this project

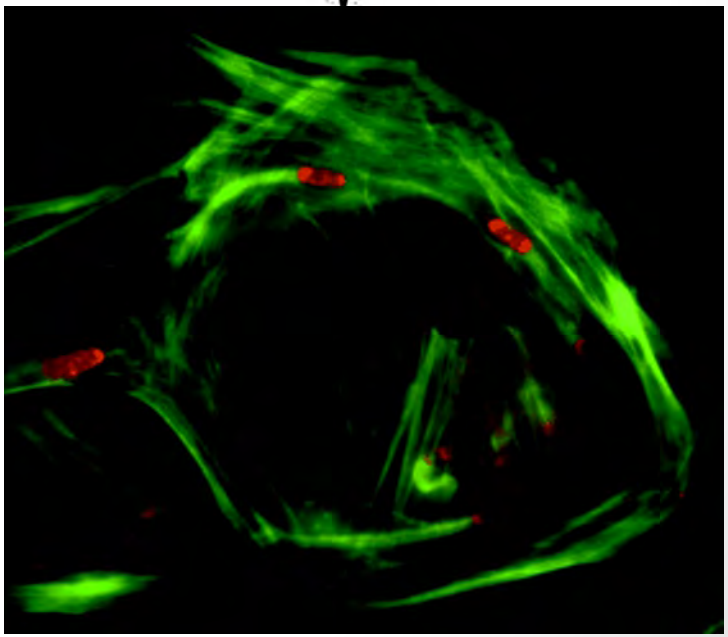
Why are these pathogens so infectious?
- we explore their acid resistance (stomach acid)

How do they enter host cells?
- we study regulation of the Type III secretion system (a bacterial conduit that delivers proteins into host cells).

How do these bacteria cause disease in humans?

-one way is to hijack the host's actin cytoskeleton. The bacteria use the actin to move through the host cell cytoplasm!





Through these studies we hope to identify new ways to treat & prevent Shigellosis

Management & Leadership of UNLV VTM production for SNPHL

Through April 2020 and into the Fall, Dr. Wing led a team of volunteers in making VTM(S) media for Southern Nevada Public Health Labs.

Volunteers came from the School of Life Sciences, Department of Chemistry and the UNLV School of Medicine (listed below).

By the end of the project 50,000 vial of medium had been made, which were used by SNPHL Strike teams to test for SARS-Cov-2 (the agent of COVID-19 disease)

UNLV Volunteers:

UNLV SoLS: Monika Karney (Wing Lab Manager and co-lead), Holly Martin (Grad), Tatiana Ermi (Grad), Shrikant Bhute (Post-doc), Isis Roman (Undergrad), Boo Shan Tseng (Asst Prof.) & Cody Cris (Undergrad/Grad).

UNLV Chemistry: Ernesto Abel-Santos (Prof and co-lead), Naomi Okada (Grad), Jacqueline Phan (Grad), Chandler Hassan (Grad), Lara Turello (Grad) & McKensie Washington (Undergrad),

UNLV SoM: James Clark, Michael Briones, Liz Groesbeck & Anita Albanese (all Med students)

Stem Cells, Genetic and Epigenetic Inheritance, Cancer

Dr. Hui Zhang
Associate Professor
Department of Chemistry and Biochemistry
Phone: (702)774-1489
Email: hui.zhang@unlv.edu

Expertise:

- Biochemistry and developmental regulation of pluripotent embryonic stem cells, adult stem cells, and related diseases

- Regulation of chromatin structure, epigenetics, and transcription by protein methylation and ubiquitin enzymes

- DNA replication, DNA repair, cell cycle, genome instability, and cancer

- Targeting the vulnerability of human cancers

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Current research areas in Zhang Laboratory:

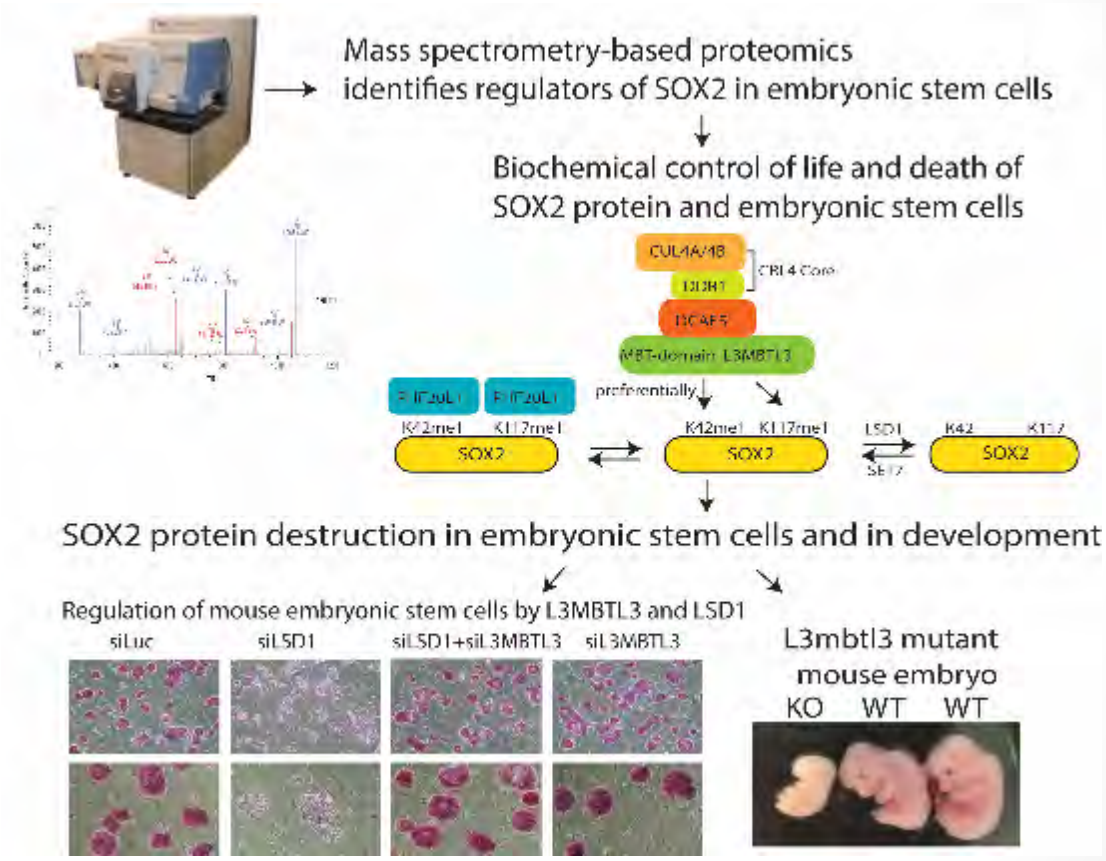
• Discover novel proteins essential for stem cell regulation, examples:

How SOX2 is regulated in embryonic stem cells and many other stem cells in development?

- Sox2 is a master stem cell protein that controls the self-renewal and pluripotency of embryonic stem cells that can develop into any tissue types of cells in development.

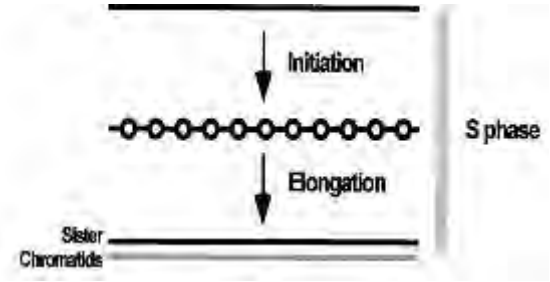
- SOX2 is also a master regulator of many adult stem cells including the stem/progenitor cells for brain, lung, colon, breast, liver, cochlea/ear, skin, retina, ovary, bladder, esophagus, and testes for tissue repair/regeneration.

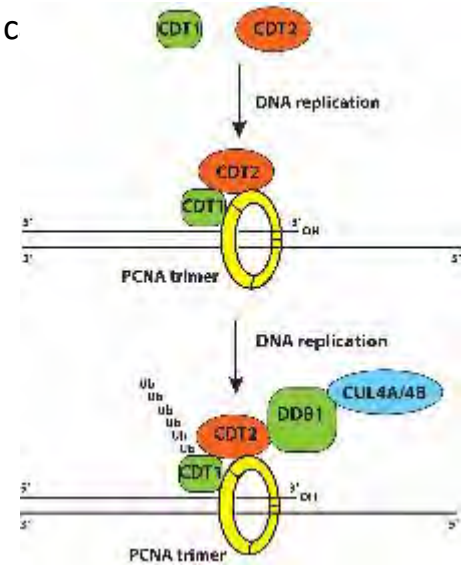
- Artificial Sox2 expression (together with Oct4 and accessary Klf4, and Myc) can virtually convert any differentiated cells, such as skin or blood cells, into induced pluripotent stem cells (iPSCs), the embryonic stem cell-like cells.

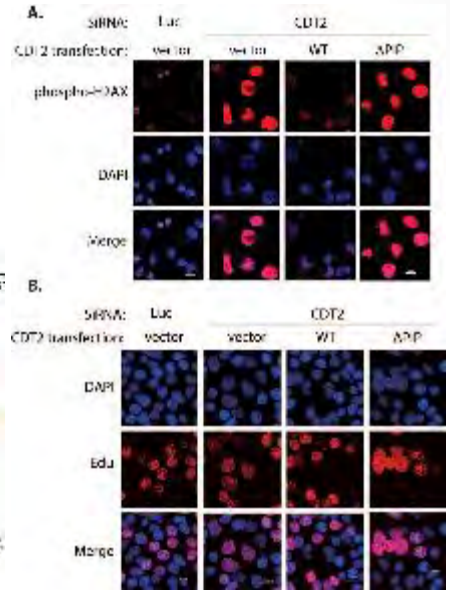


- Discover novel proteins important for epigenetic and cell cycle regulation, examples:
- **Regulation of DNA replication and DNA methylation in normal and cancer cells**

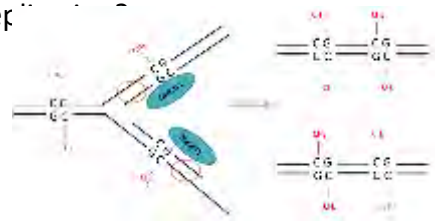
  - How DNA replicates only once in one cell cycle in animal cells? How re-replication is prevented that causes genome instability and c





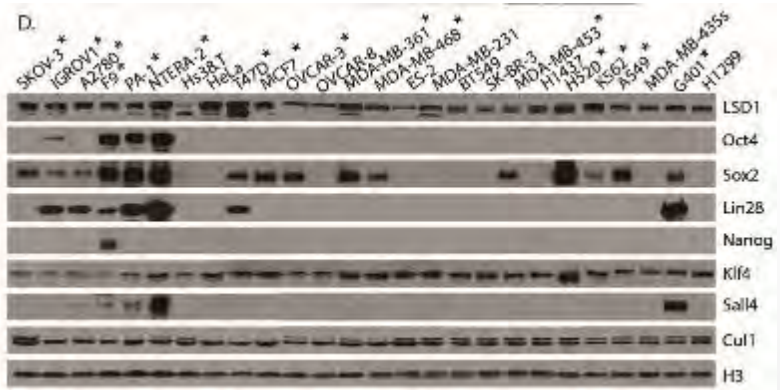


  - How the fidelity of epigenetic DNA methylation is maintained during DNA rep



- **Cancer Biology and therapy development**

Elevated SOX2 levels cause many cancers including cancers of lung, brain, breast, and ovary. These cancers are hard to treat because they behave like stem cells due to SOX2 expression. We are developing novel LSD1 chemical inhibitors that target the epigenetic vulnerability of these cancer cells.



The presence of SOX2 in different types of cancer cells is responsible for sensitivity towards our LSD1 inhibitors. *: Sensitive to LSD1 Inhibitors

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