

Biochemistry Research

Poop! There it is! Prophylaxis and Biological Variables Affecting Intestinal Bacterial Infections

- **Dr. Ernesto Abel-Santos**
- Professor
- Department of Chemistry & Biochemistry
- Email: ernesto.abelsantos@unlv.edu
- Website: <https://abelsantos.faculty.unlv.edu/>

Expertise

- Bioorganic chemistry
- Enzymology
- Bacterial Spore Germination
- Bioterrorism



Inhibition of *C. difficile* spore germination protects mice from infection

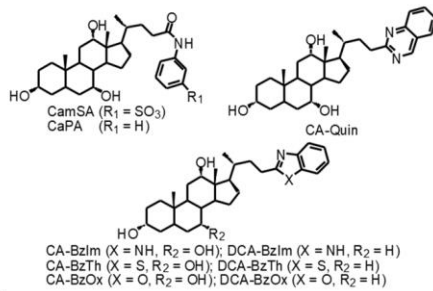
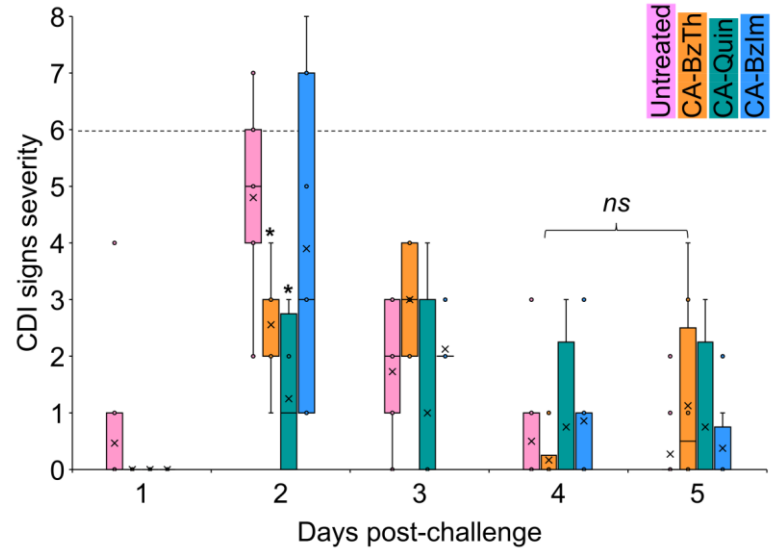
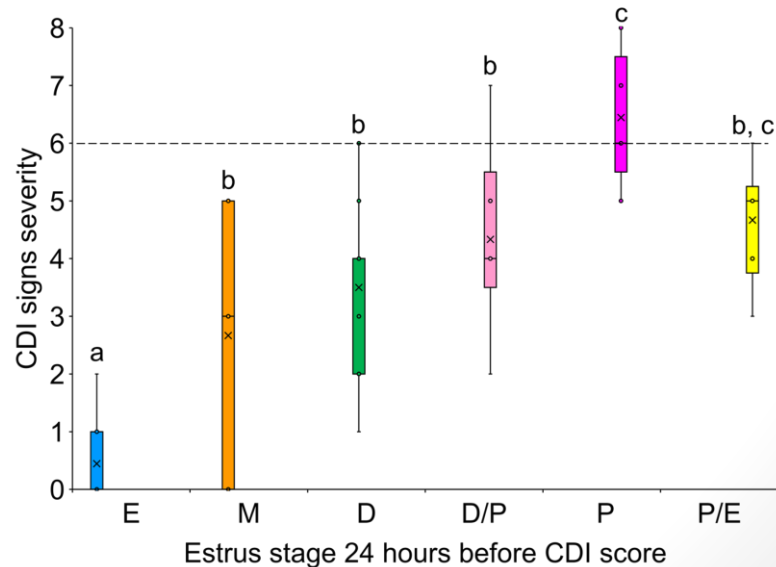
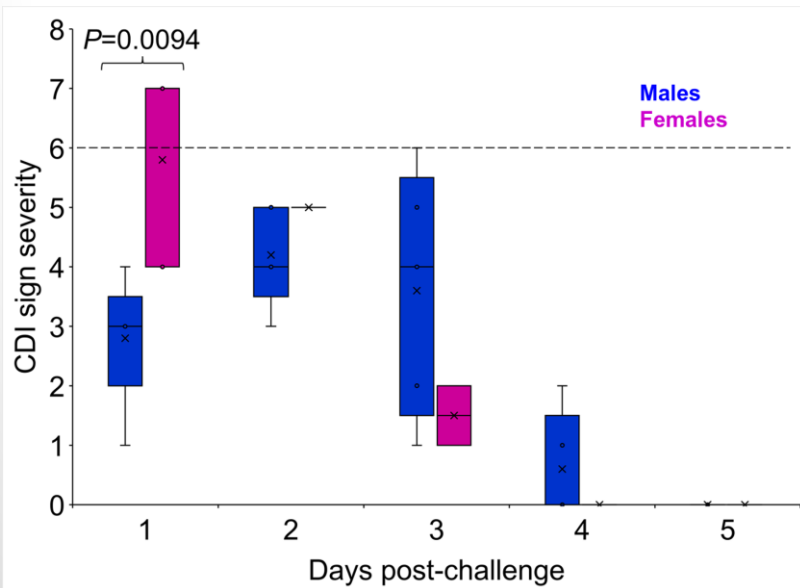


Table 1. NHBS-mediated germination inhibition of *C. difficile* strain R20291 spores

Name	IC ₅₀ (μM)
CA-Quin	21.6 ± 2.6
CA-BzIm	4.4 ± 0.3
DCA-BzIm	5.6 ± 1.2
CA-BzTh	5.9 ± 3.5
DCA-BzTh	Inactive
CA-BzOx	5.8 ± 2.8
DCA-BzOx	Inactive



C. difficile infection severity in mice is affected by their estrus cycle



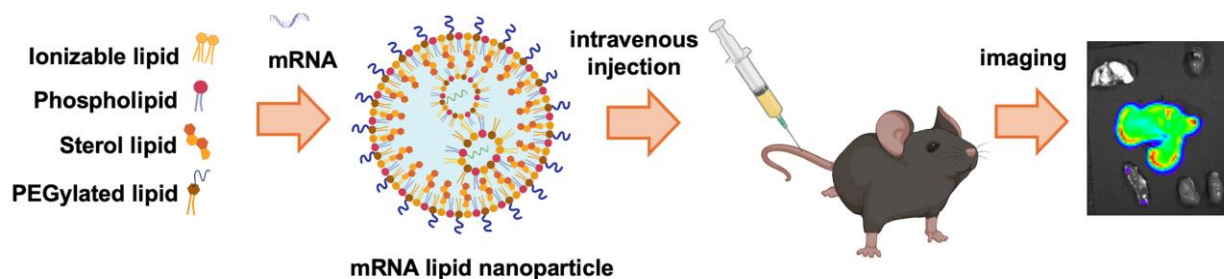
mRNA medicine

- **Dr. Chandrabali Bhattacharya**
- Assistant Professor
- Department of Chemistry and Biochemistry
- Email: chandra.bhattacharya@unlv.edu
- Website: <https://bhattacharya-lab.faculty.unlv.edu/>



Expertise

- Biomaterials
- Drug and Gene Delivery
- Chemical Biology
- Medicinal Chemistry



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 Perylium Salts



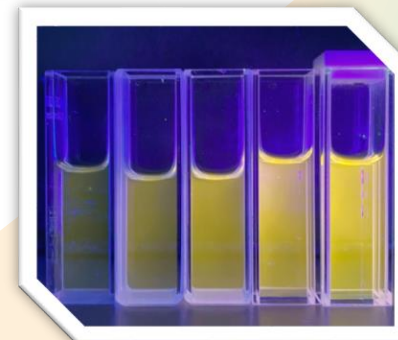
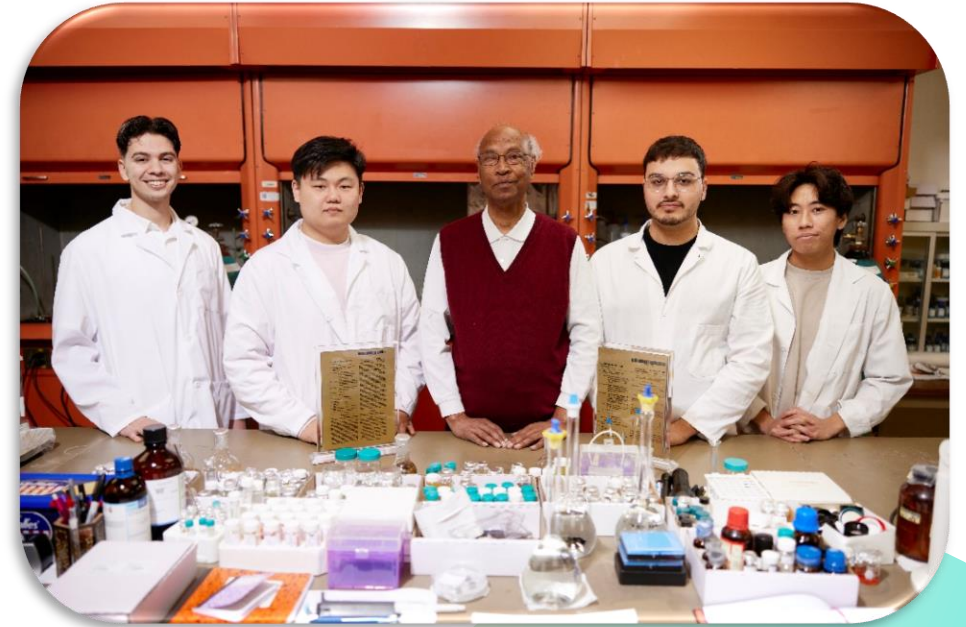
Liquid Crystalline Texture



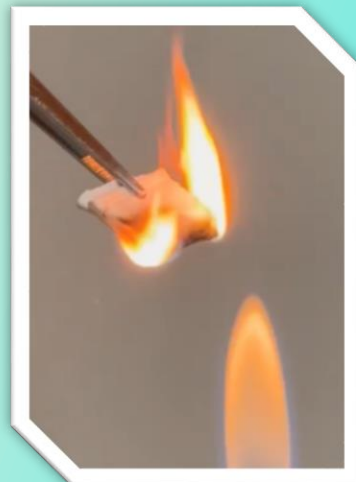
Fluorescent Perylium Solution

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



Guha Lab



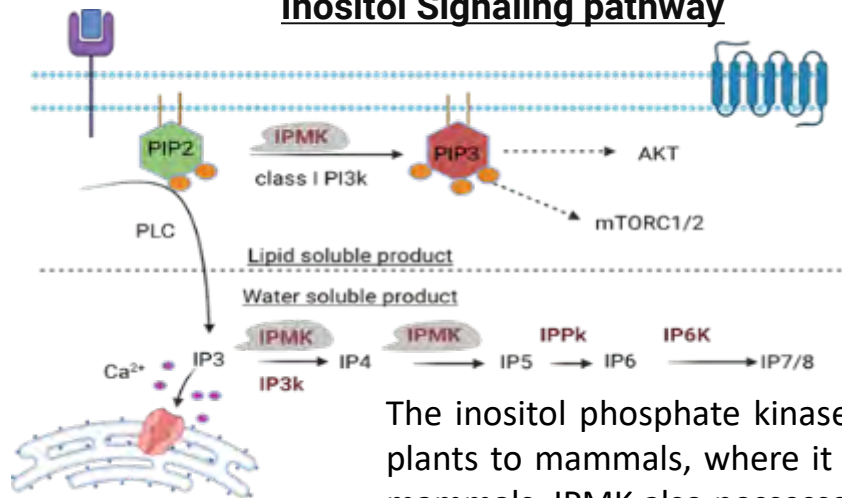
- **Dr. Prasun Guha, Ph.D.**
- Assistant Professor
- NIPM/School of Life Sciences
- Email: prasun.guha@unlv.edu
- Website: <https://guhalab.faculty.unlv.edu/>

Expertise: Guha lab has primarily two major focuses.

A] The lab aims to integrate cell signaling and epigenetic mechanisms of Crohn's disease, with special emphasis on the leaky gut.

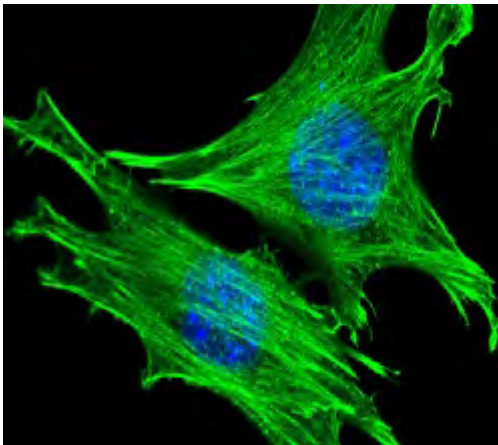
B] Our 2nd lab interest is to unravel the role of inositol signaling influencing nuclear functions.

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.

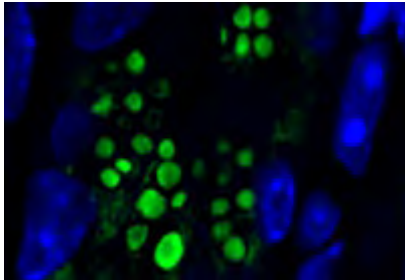
Confocal imaging of actin cytoskeleton staining (Green)



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.

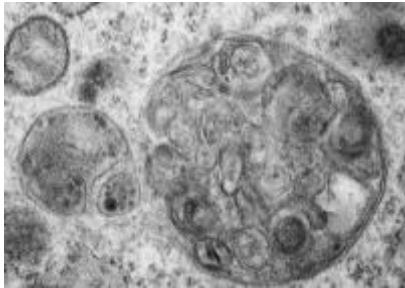
Confocal Imaging of Intestinal Paneth cell granules in green



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.

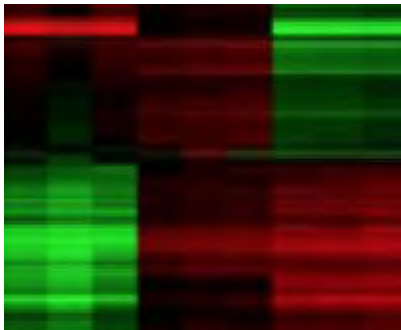
Trans mission electron microscopy of Autophagic vesicle



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

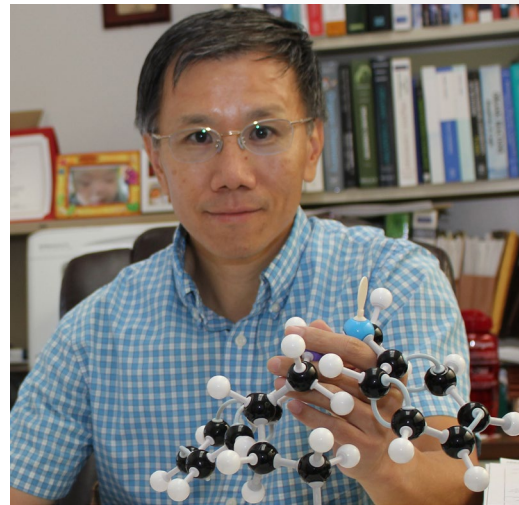


Genetics & Epigenetics

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.

Jun Yong Kang

- Assistant Professor, Department of Chemistry and Biochemistry
- Ph.D., Chemistry, Texas A&M University, College Station, TX
- CHE 217B, junyong.kang@unlv.edu
- http://jkang.faculty.unlv.edu/?page_id=110



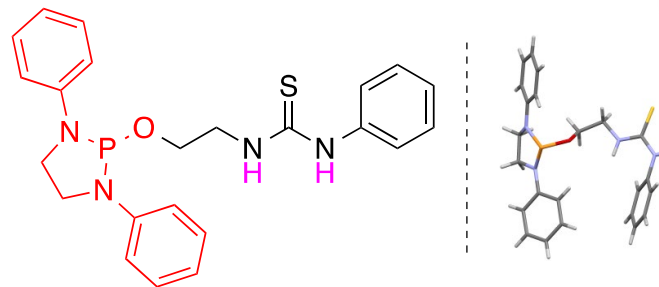
Areas of Expertise

- Synthetic organic chemistry
- Development of new synthetic methodology
- Asymmetric organocatalysis
- Organophosphorus chemistry
- Synthesis of bioactive small molecules

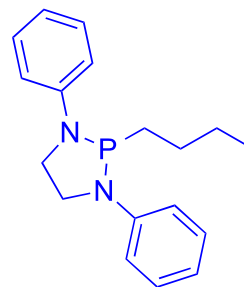
Research Summary:

The development of new synthetic methodologies plays a key role in medicinal chemistry, biochemistry, and materials chemistry. Professor Kang and his group have been developing novel synthetic transformation and new chemical reagents such as commercially available NHP-thiourea and NHP-butane to apply for pharmaceuticals and bioactive molecules.

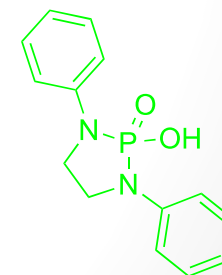
Kang's reagents-commercially available at Kerfast



NHP-thiourea
(phosphonylation reagent)



NHP-butane
(organocatalyst)



NHPA
(organocatalyst)

Ubiquitin-mediated protein degradation

Dr. Gary Kleiger

Professor and department Chair

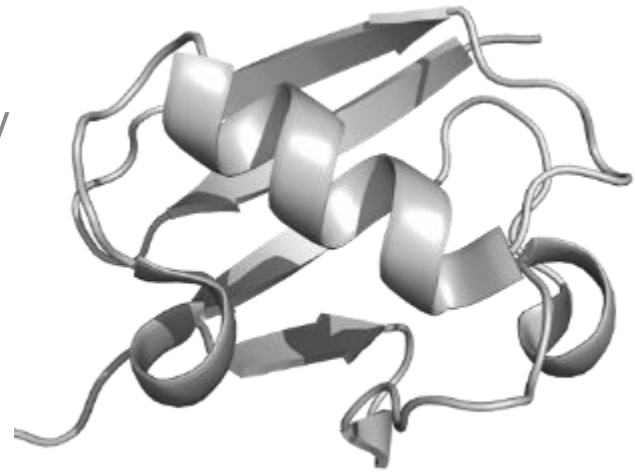
Department of Chemistry and Biochemistry

gary.kleiger@unlv.edu

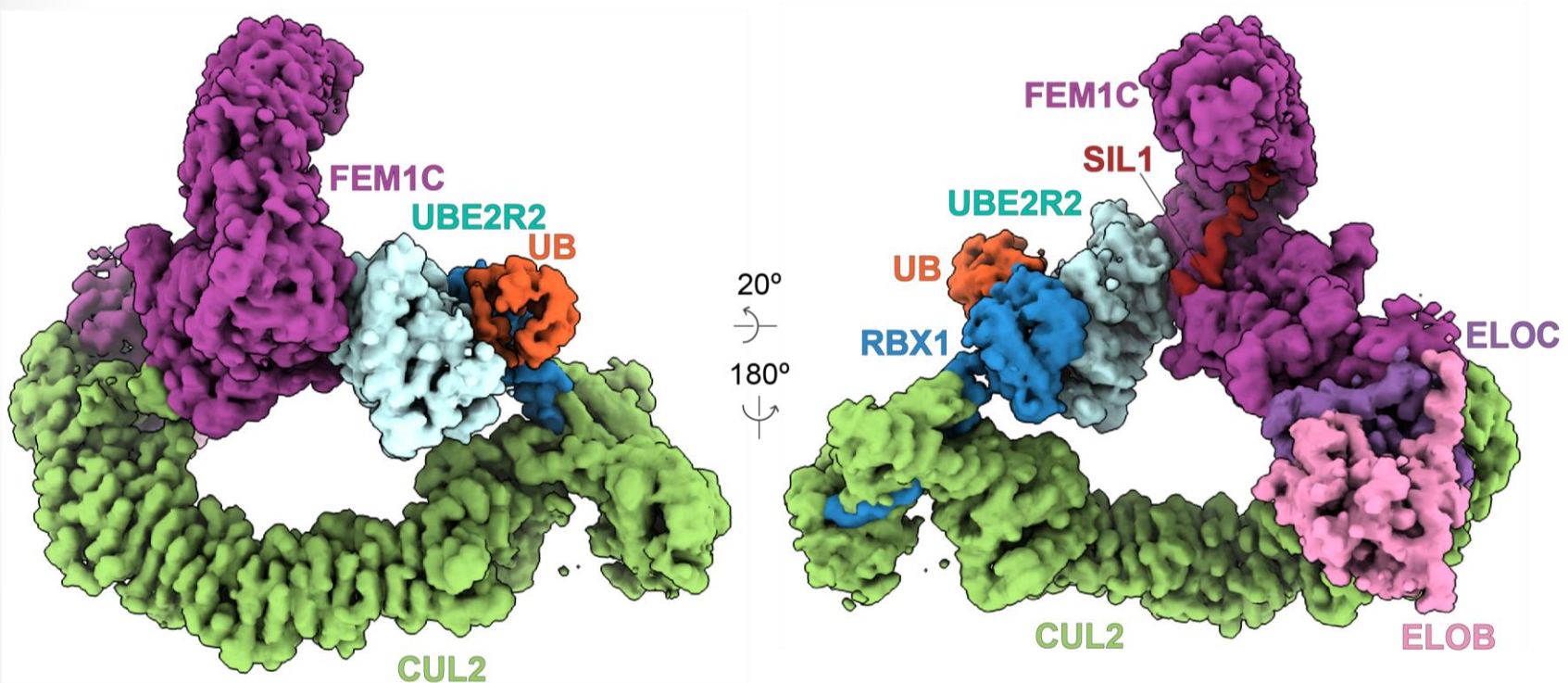
<https://kleiger.faculty.unlv.edu>

Expertise

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

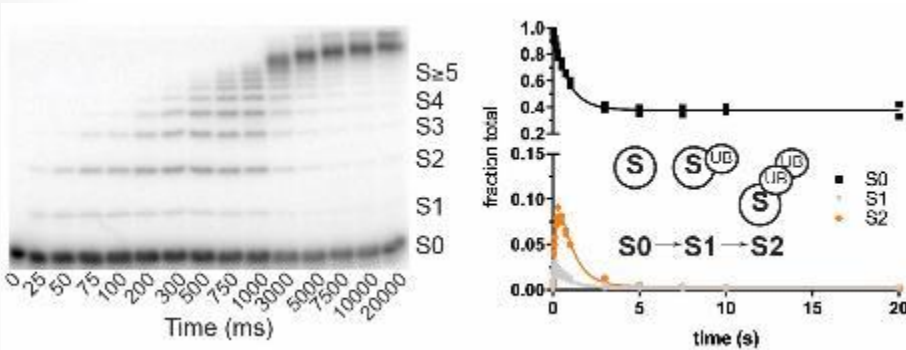


Determining the structures of enzymes that promote protein degradation by cryo-EM.

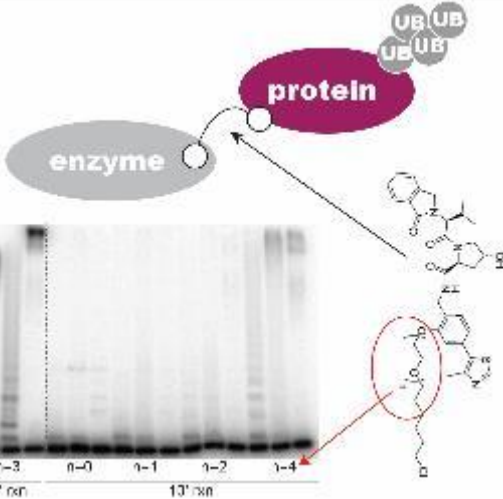
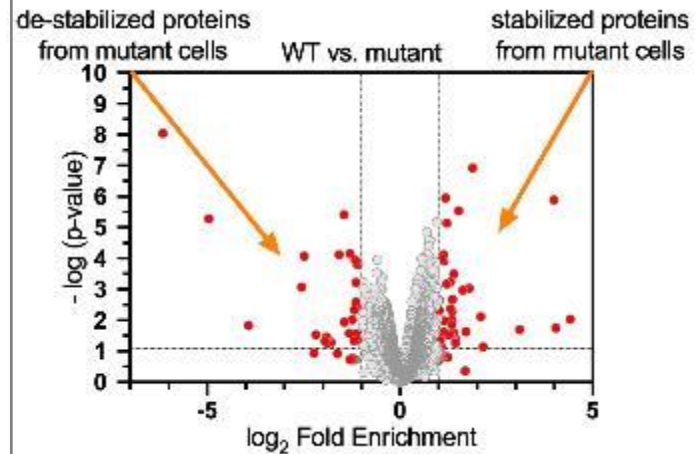


Uncovering how the enzymes that promote protein degradation function in human cells.

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



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



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-dimensional Data Analysis

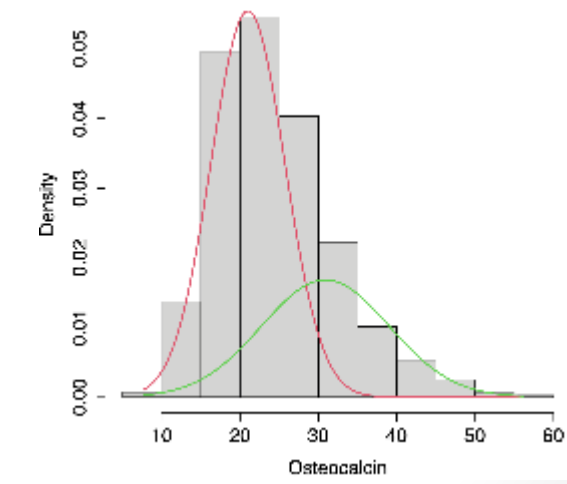
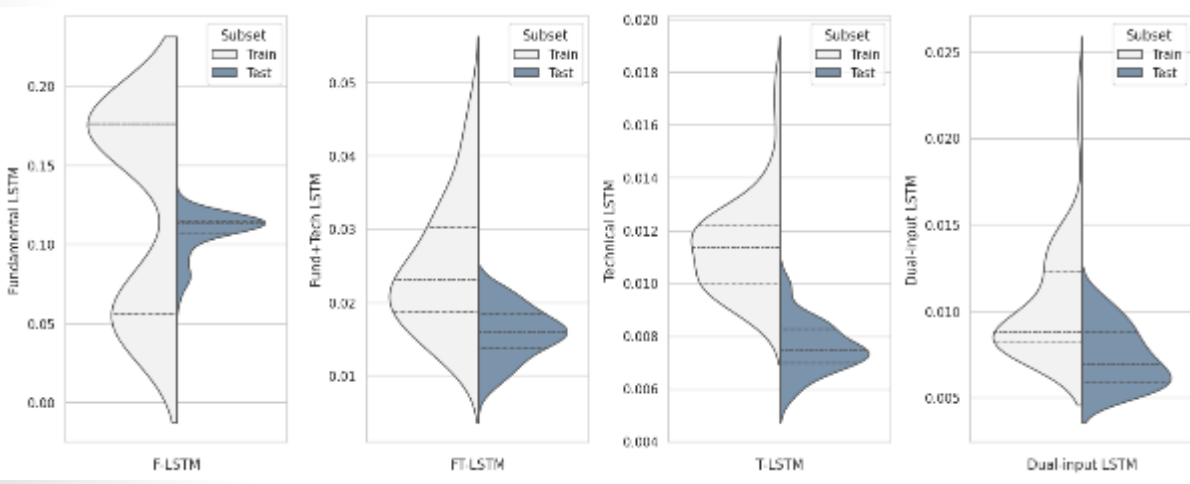
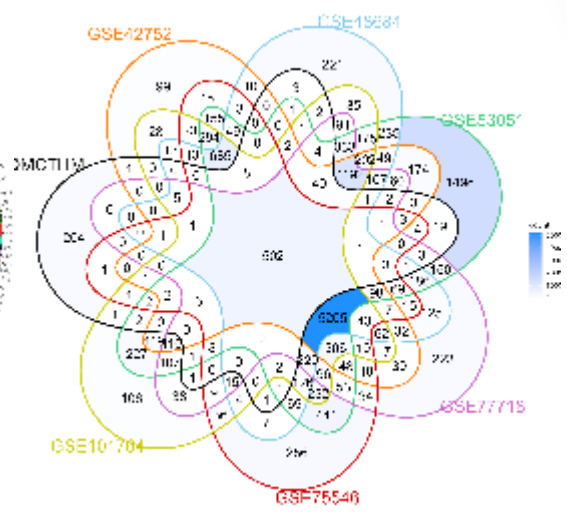
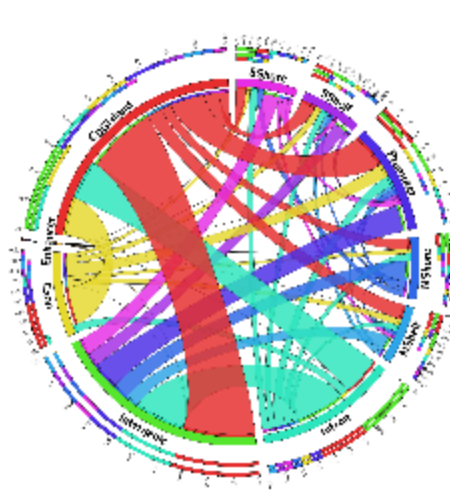
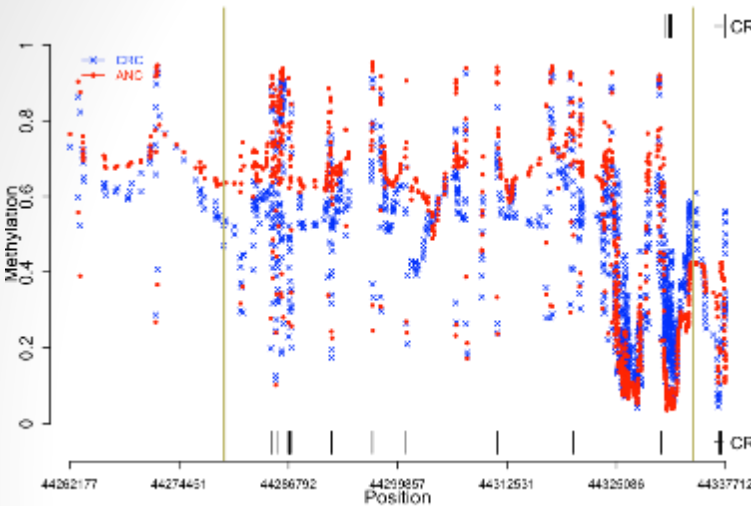
- **Dr. Farhad Shokoohi**
- Assistant Professor of Statistics
- Department of Mathematical Sciences
- Email: farhad.shokoohi@unlv.edu
- Website: <https://farhad.faculty.unlv.edu>



Expertise

- Bayesian and Frequentist Analysis
- Mixture Modelling
- Survival Analysis
- High-Dimensional Genomics and Epigenetic
- Sparse Estimation in Finite Mixture of Regressions
- Machine Learning in Medical and Financial Data
- Differential DNA Methylation Analysis in Cancer Epigenetics
- Hidden Markov Models
- Nonparametric and Semiparametric Regression
- Software Development

High-dimensional data analysis across a variety of sectors, including finance, healthcare, genomics, market, among others.



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

Dr. Hong Sun

Associate Professor

Department of Chemistry and Biochemistry

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Email: hong.sun@unlv.edu

Expertise

Cell signaling

Cancer cell biology

Stem cell biology

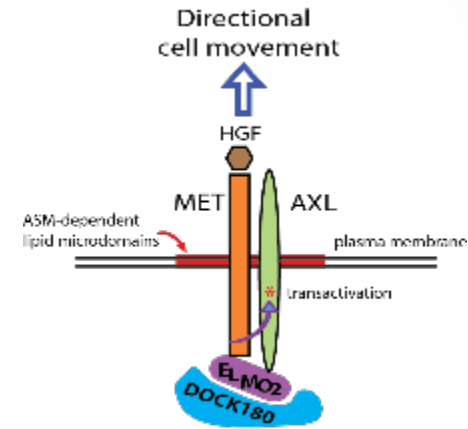
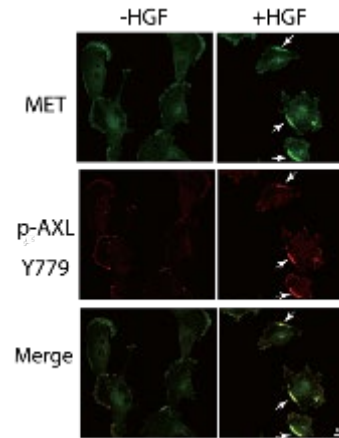
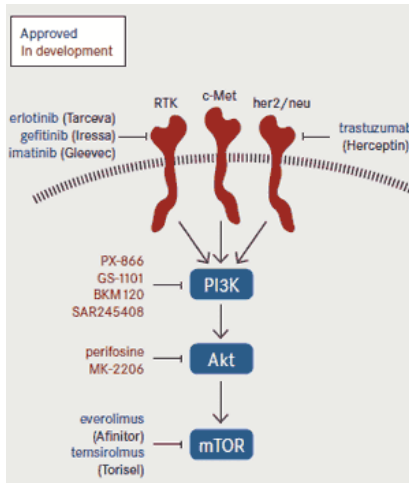
Mouse conditional knockout models

Regulation of cell surface receptor RTKs localization and activation

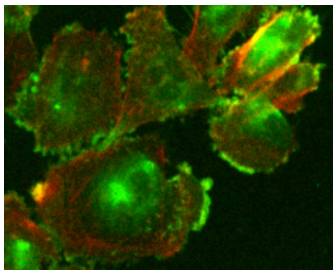
Problem: cancer cells often have multiple receptors (RTKs) activated on cell surface, making targeting inefficient

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

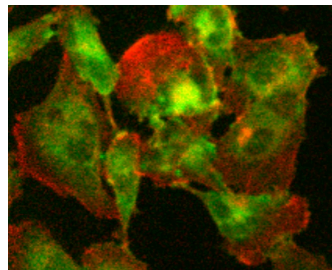
A novel mechanism discovered for RTK-Co-activation and signaling for cancer cell migration and invasion



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



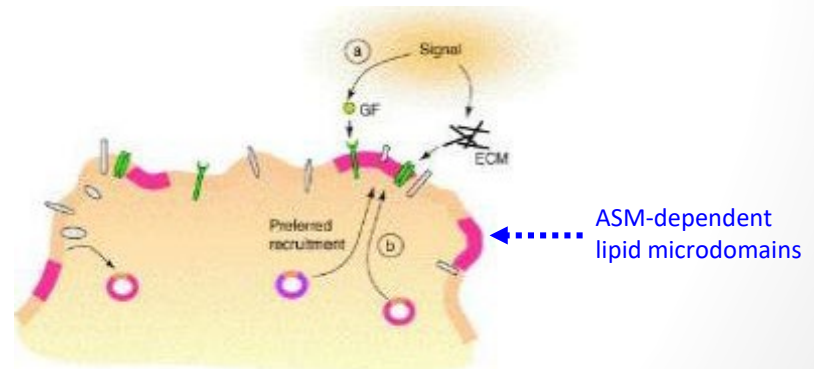
Vehicle



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.

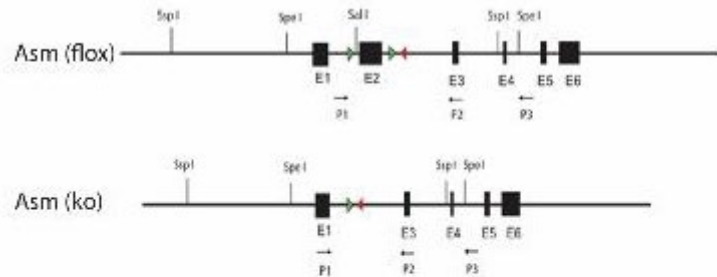


Mass-Spectrometry analyses revealed that the ASM-regulated local lipid microdomains were enriched with many signaling molecules.

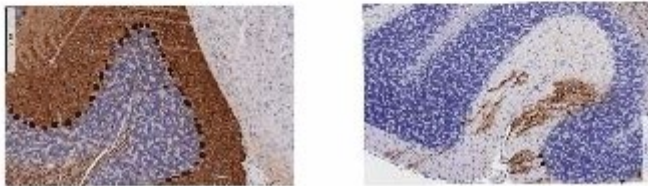
Xiong et al. Biol. Open (2019) 8, bio040311.

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

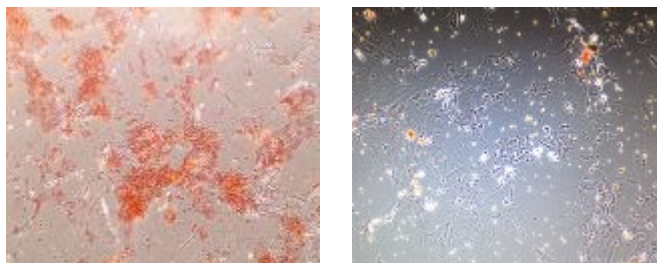


Purkinje neurons immunostained with D28K antibody.

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

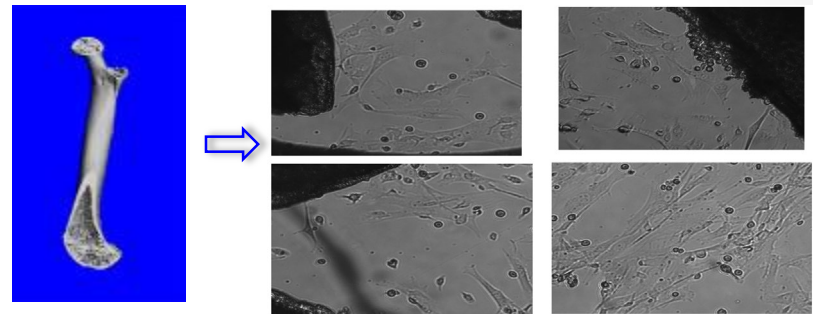
Wild-type MSCs

ASM mutant MSCs

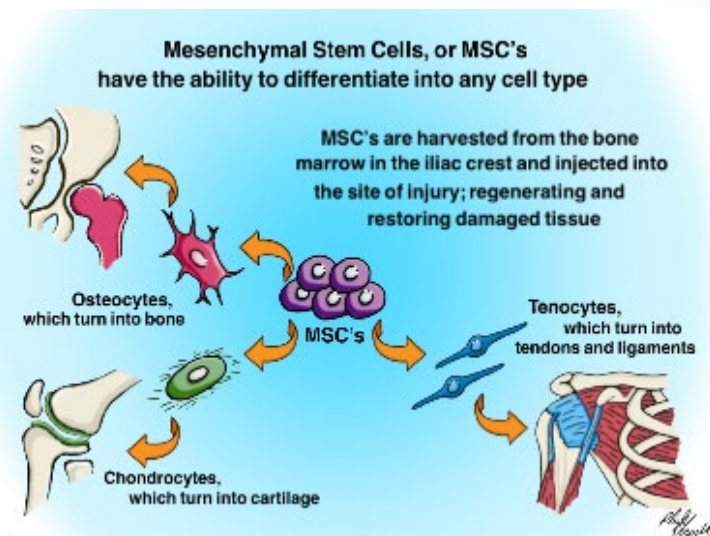


(*in vitro* differentiation assay, then stained with alizarin red)

C. Mesenchymal stem cells (MSCs) cultured from bones



E. Potentials of MSCs for tissue repair



Microbiology

Dr. Helen J. Wing

Professor,

School of Life Sciences

Phone: 702-895-5382

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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

Genetic switches & molecular mechanisms controlling virulence

Central themes of this project

Transcriptional control of bacterial genes

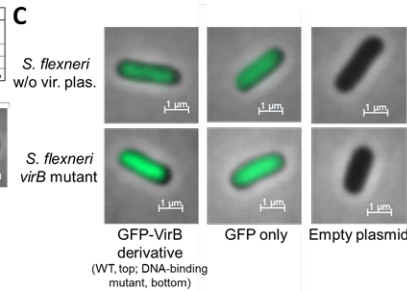
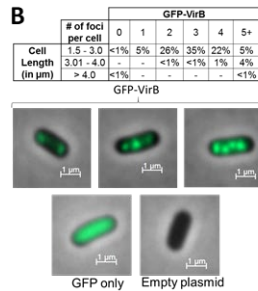
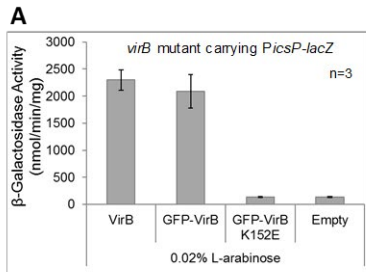
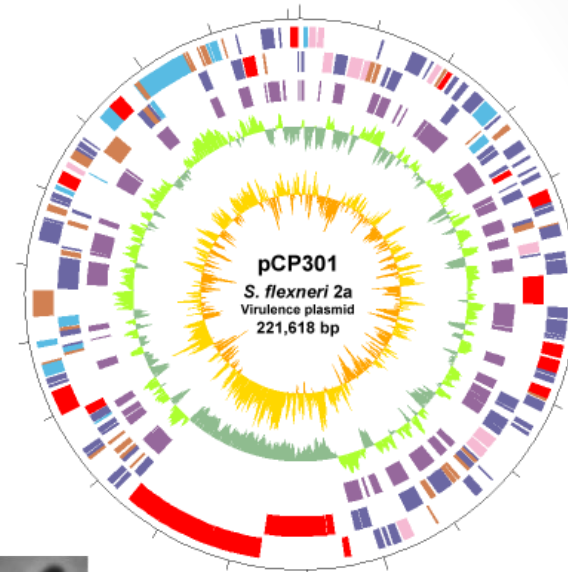
Dynamic nucleoid remodeling

DNA-protein and ligand-protein interactions

Evolutionary relationship of bacterial proteins

Bacterial management of large plasmids

Novel targets for antibiotics and therapeutics

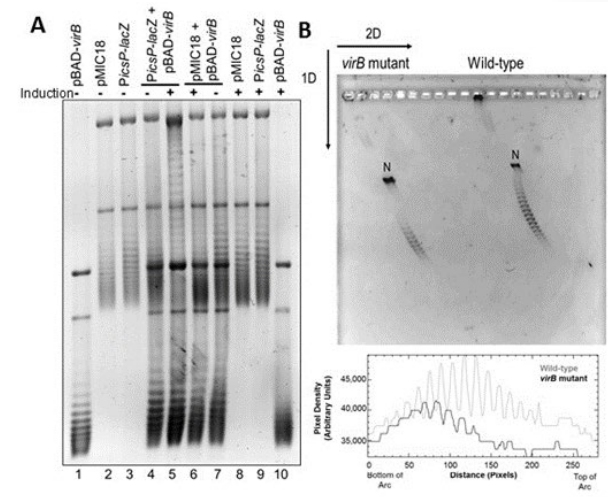
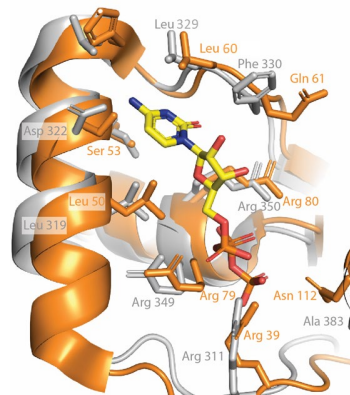
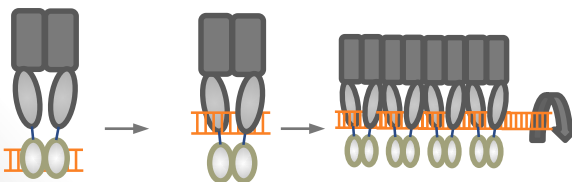


A: Current model

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

Step 2: Binding to its recognition site is a prereq. for ΔIk, 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)

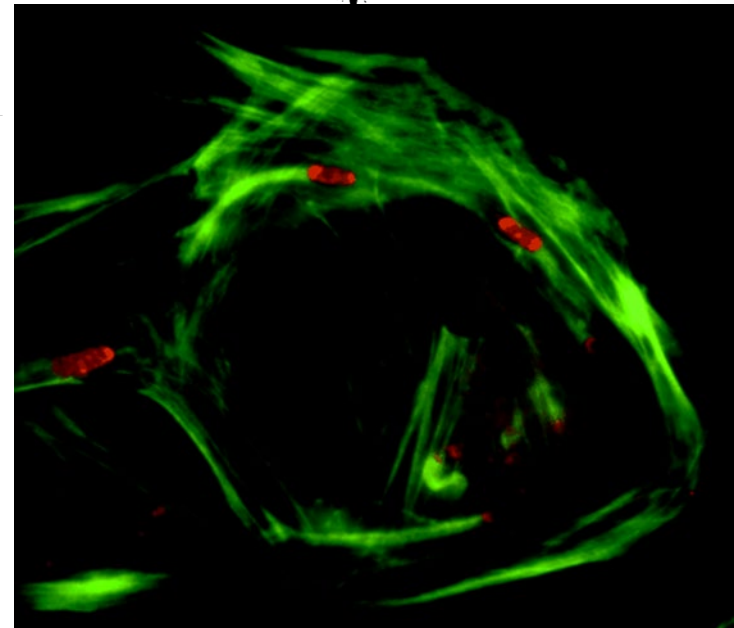
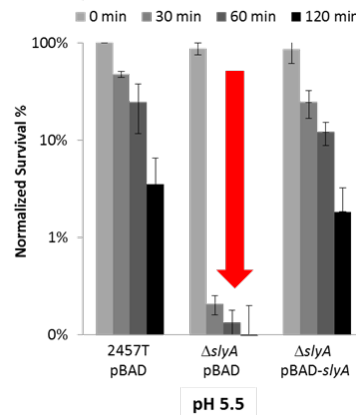
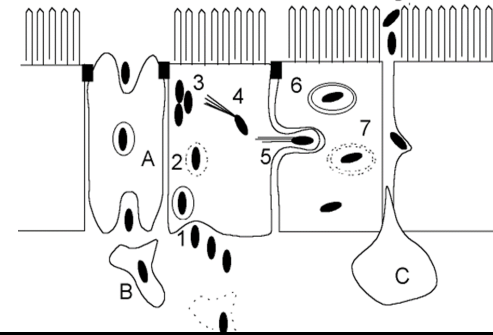
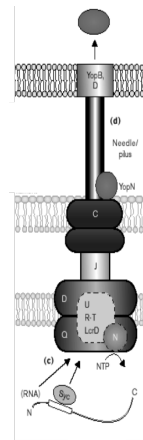
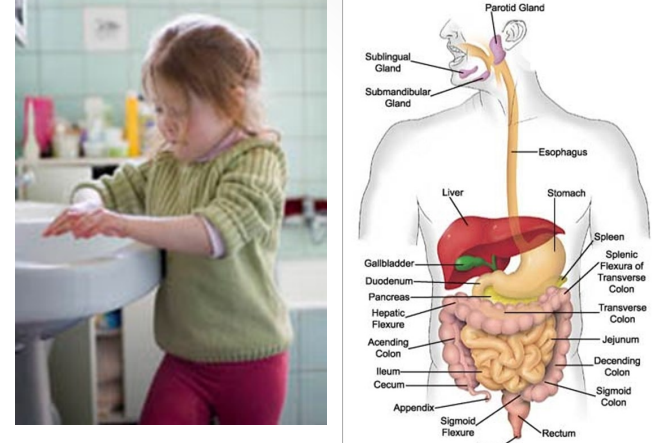
How do they enter host cells?

- 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

Current research areas in Zhang Laboratory:

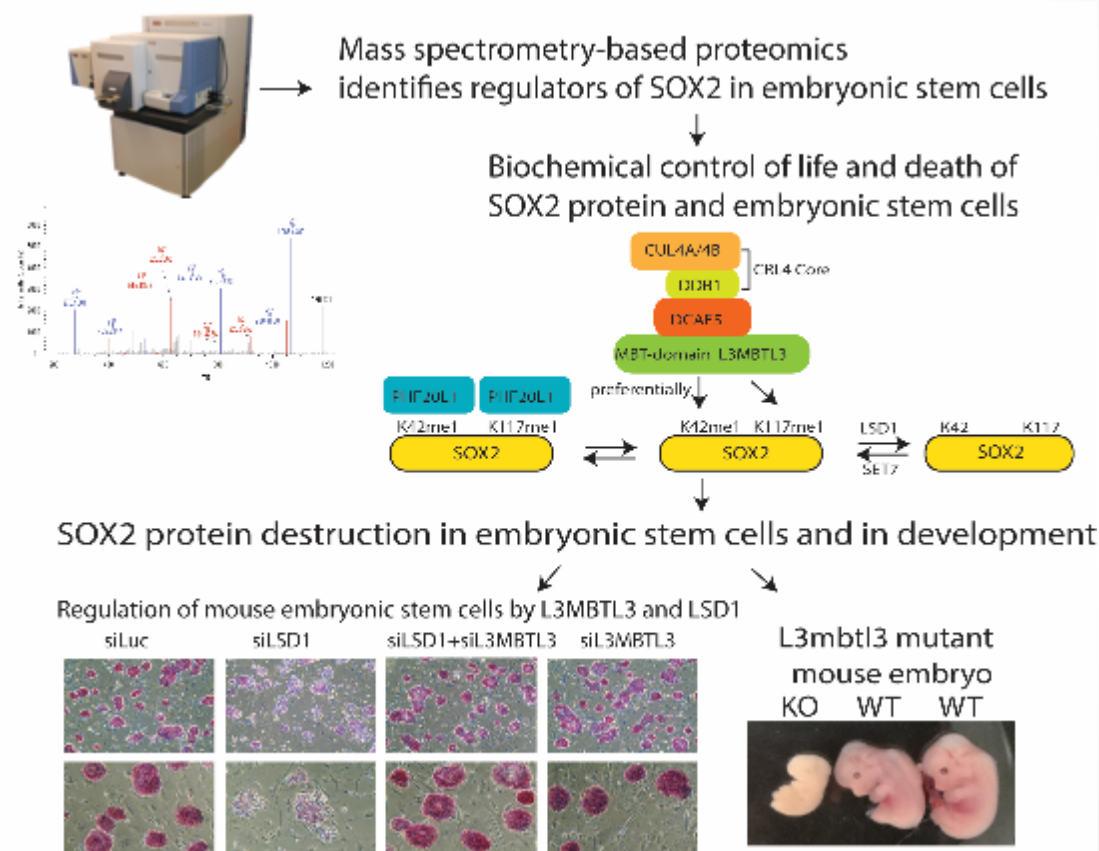
- Discover novel proteins essential for stem cell regulation, examples:

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.

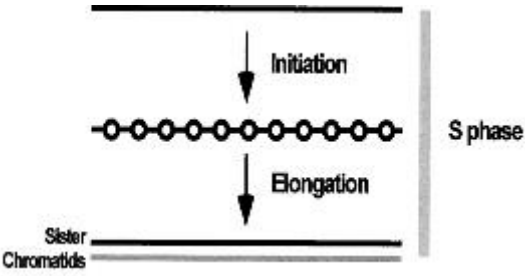
- SOX2 is also a master regulator of many adult stem cells including the stem/progenitor cells for brain, lung, colon, breast, liver, cochlea/ear, skin, retina, ovary, bladder, esophagus, and testes for tissue repair/regeneration.

- Artificial Sox2 expression (together with Oct4 and accessory 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.

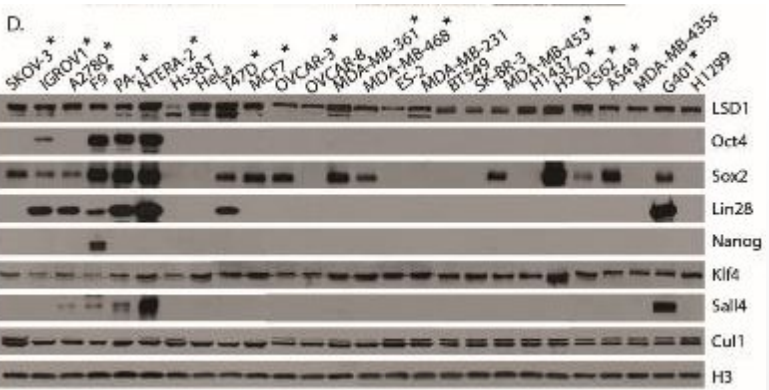
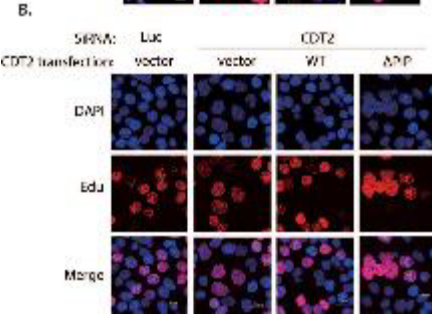
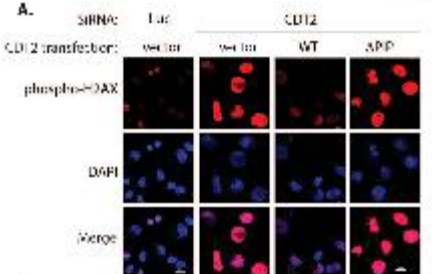
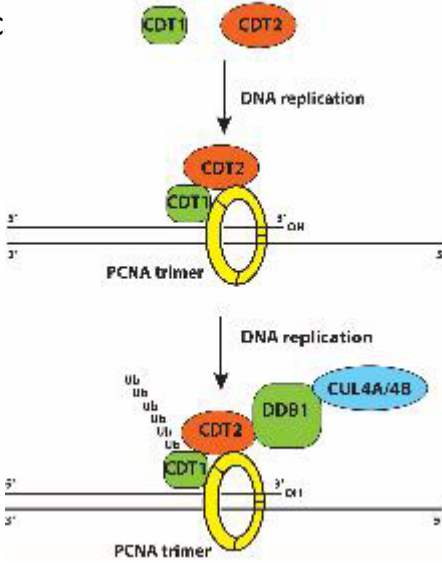
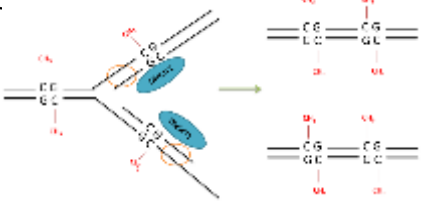


- Discover novel proteins important for epigenetic and cell cycle regulation, examples:
- Regulation of DNA replication and DNA methylation in normal and cancer cells

• 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 replication



• **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