Biochemistry Research

UNLV | COLLEGE OF SCIENCES

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

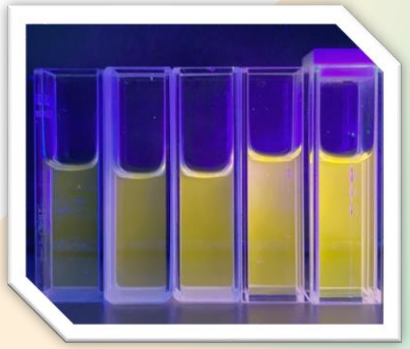
Liquid Crystalline Texture

Fluorescent Pyrylium Solution

Dr. Pradip K. Bhowmik Materials Chemistry Lab

Current Research Interests

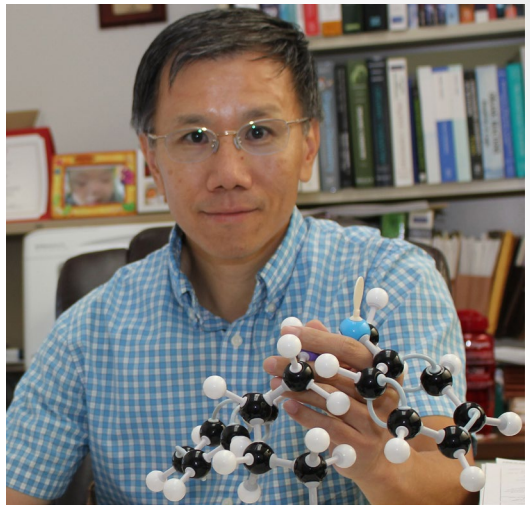
- Thermotropic and Lyotropic Liquid Crystalline Polymers
- Polyesters, Viologen Polymers, Poly(pyridinium salt)s
- Fire Retardant Polymers
- Light-Emitting Properties of Polymers
- Photo-responsive Polymers
- Proton and Anion Exchange Membranes
- Oxidation of Carbohydrates by Viologens
- Ionic Liquids, 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

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



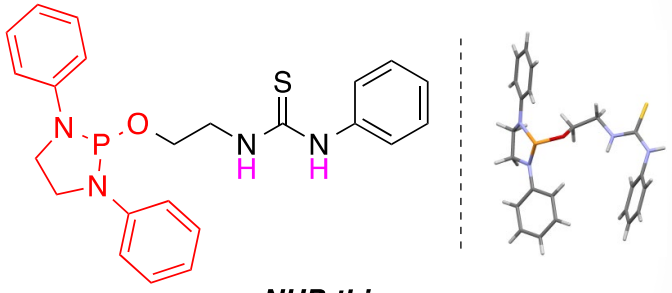
Areas of Expertise

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

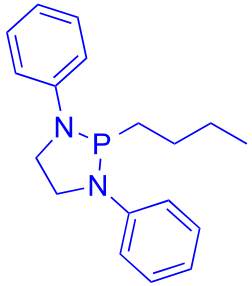
Research Summary:

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.

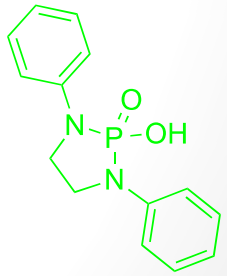
Kang's reagents-commercially available at Kerafast



NHP-thiourea
(phosphonylation reagent)



NHP-butane
(organocatalyst)

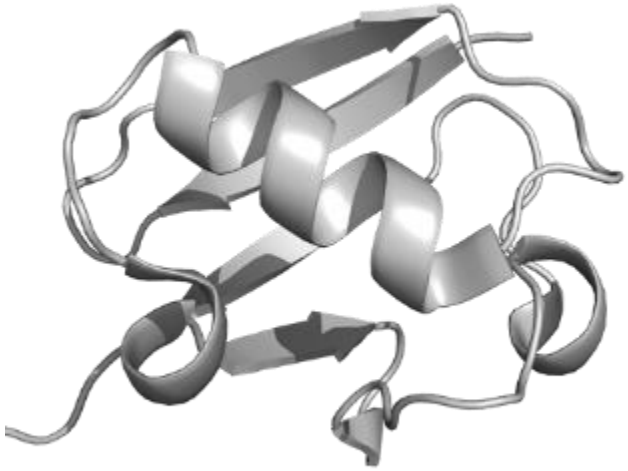


NHPA
(organocatalyst)

UNLV College of SCIENCES

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



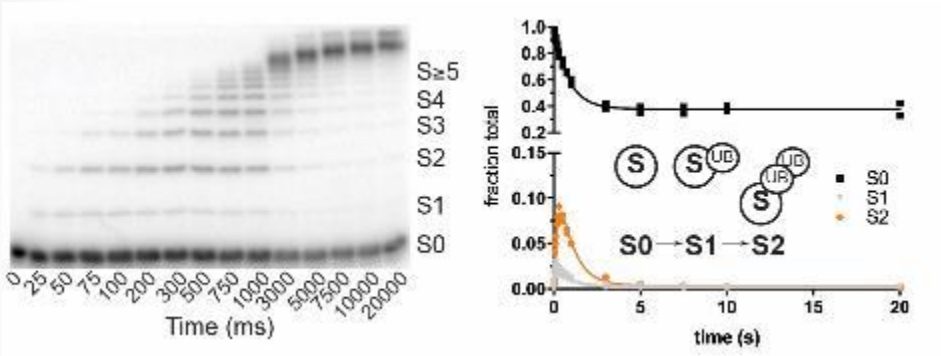
Expertise

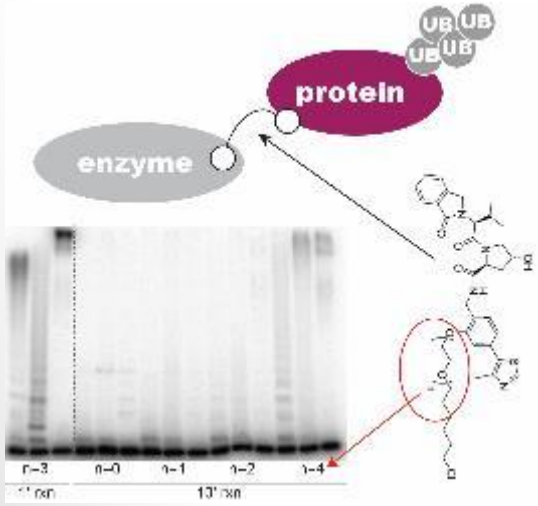
- Structural biology
- Proteomics
- Enzyme kinetics and biophysical assays
- Cell biology

UNLV | COLLEGE OF SCIENCES

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

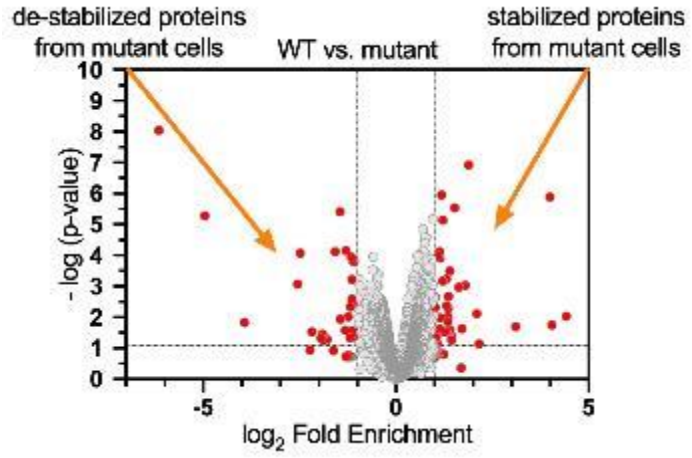
Kinetics help us understand how enzymes select protein targets for modification with ubiquitin.





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.



UNLV | COLLEGE OF SCIENCES

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

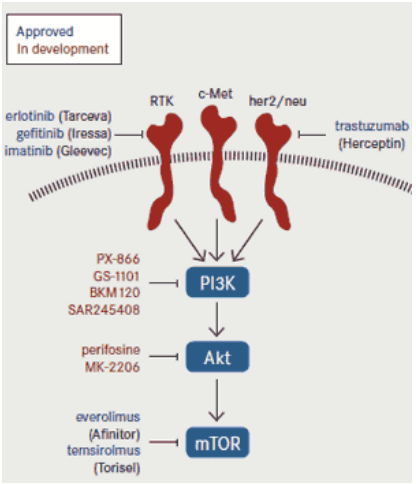
Expertise

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

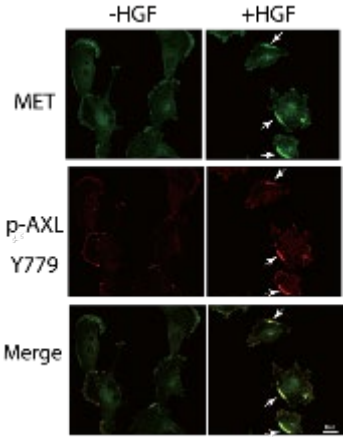
UNLV | COLLEGE OF SCIENCES

Regulation of cell surface receptor RTKs localization and activation

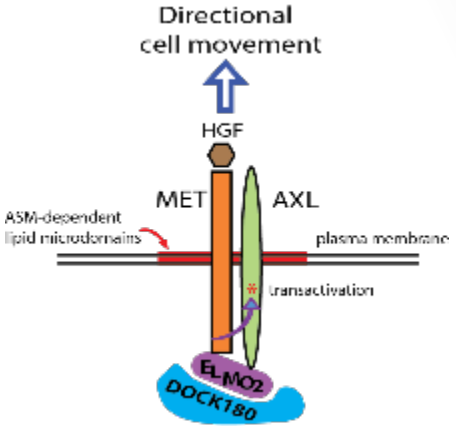
Problem: cancer cells often have multiple receptors (RTKs) activated on cell surface, making targeting inefficient



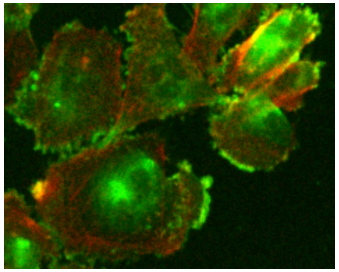
Co-activation of AXL-MET RTKs:
HGF (ligand for MET) also activates AXL, detected by antibodies for p-AXL-Y779



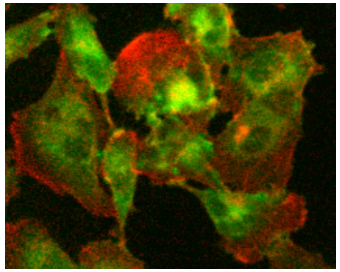
A novel mechanism discovered for RTK-Co-activation and signaling for cancer cell migration and invasion



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

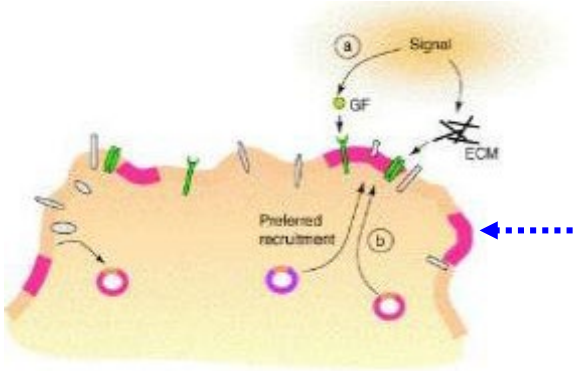


Vehicle



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.

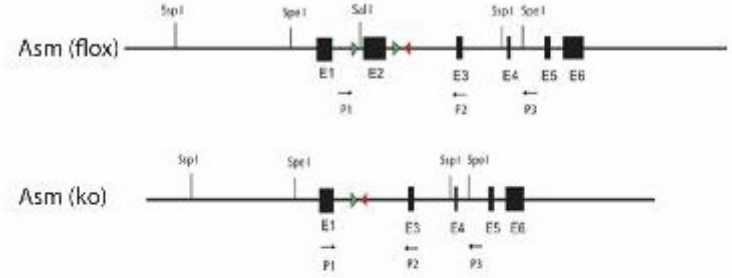


ASM-dependent
lipid microdomains

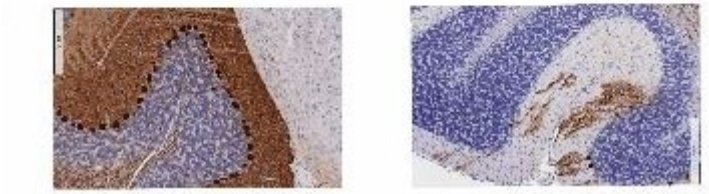
Mass-Spectrometry analyses revealed that the ASM-regulated local lipid microdomains were enriched with many signaling molecules.
Xiong et al. Biol. Open (2019) 8, bio040311.

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

A. Gene locus

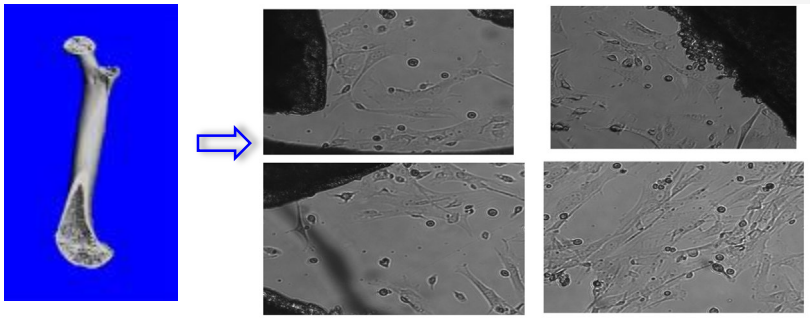


B. Loss of Purkinje neurons in cerebellum



Purkinje neurons immunostained with D28K antibody.

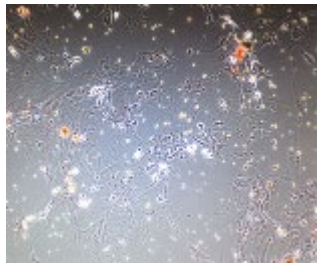
C. Mesenchymal stem cells (MSCs) cultured from bones



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

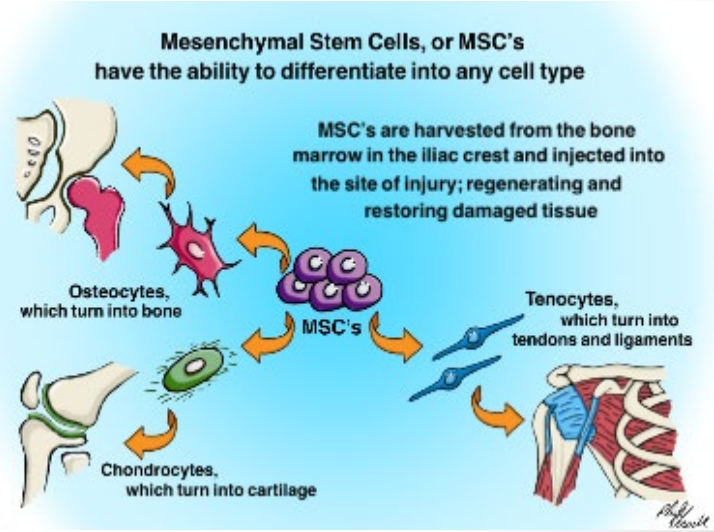
Wild-type MSCs

ASM mutant MSCs



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

E. Potentials of MSCs for tissue repair



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

UNLV | COLLEGE OF SCIENCES

Genetic switches & molecular mechanisms controlling virulence

Central themes of this project

Transcriptional control of bacterial genes

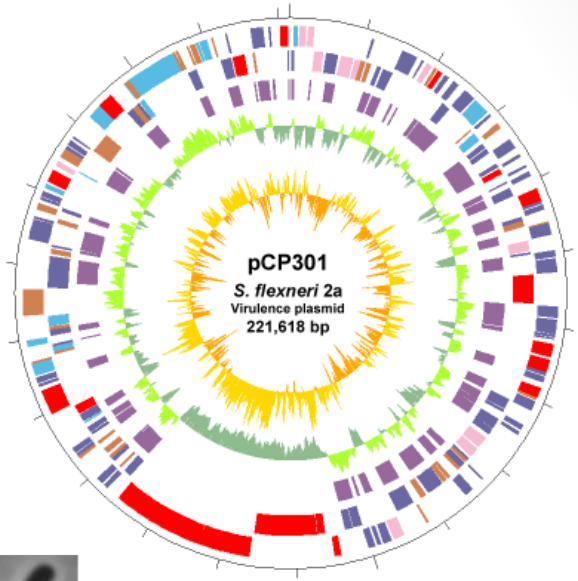
Dynamic nucleoid remodeling

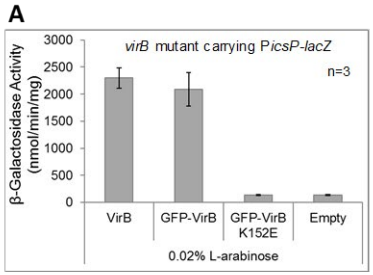
DNA-protein and ligand-protein interactions

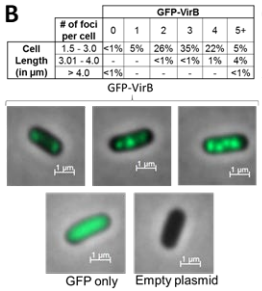
Evolutionary relationship of bacterial proteins

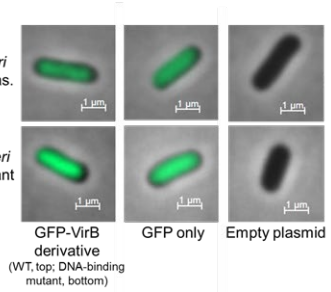
Bacterial management of large plasmids

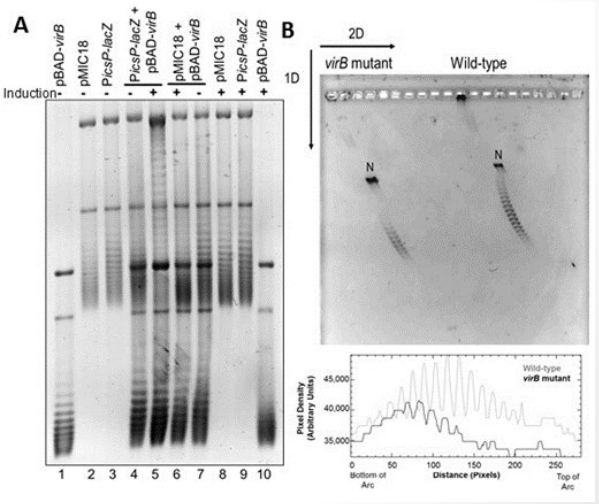
Novel targets for antibiotics and therapeutics









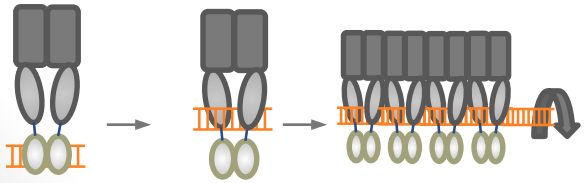


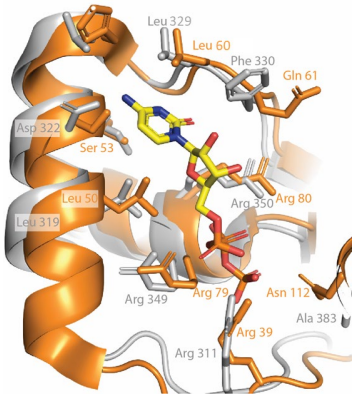
A: Current model

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

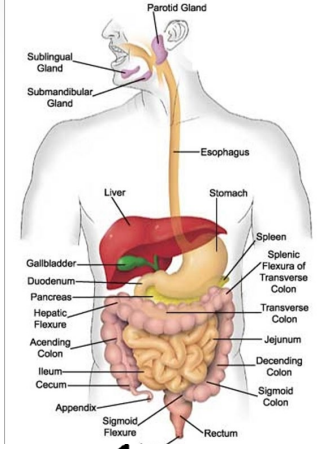
Step 2: Binding to its recognition site is a prereq. for Δlk, focus formation & anti-silencing

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



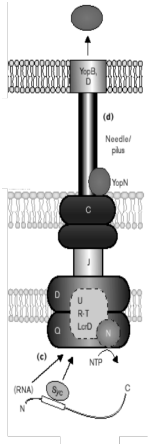
Fast Facts

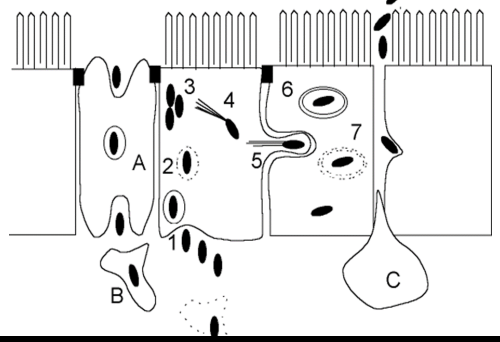
Shigella species - causal agents of bacillary dysentery

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





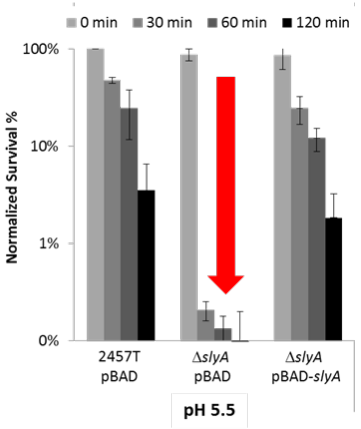
Central themes of this project

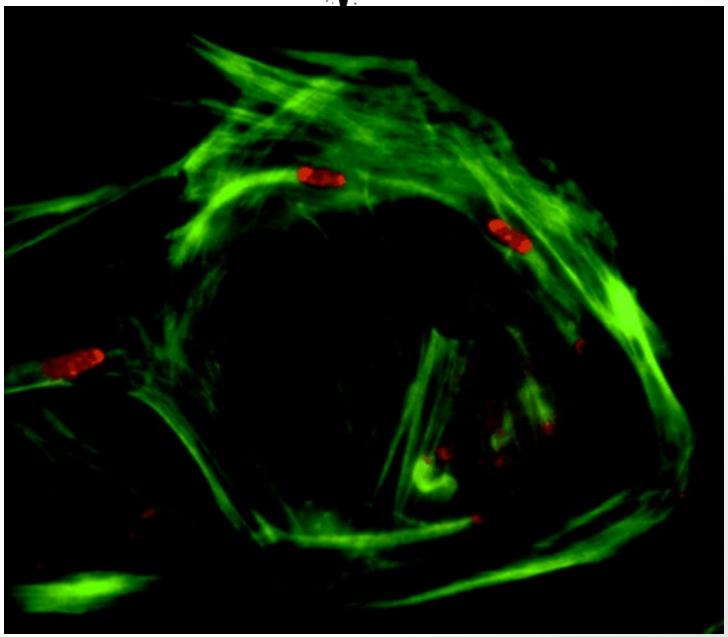
Why are these pathogens so infectious?
- we explore their acid resistance (stomach acid)

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

UNLV | COLLEGE OF SCIENCES

Current research areas in Zhang Laboratory:

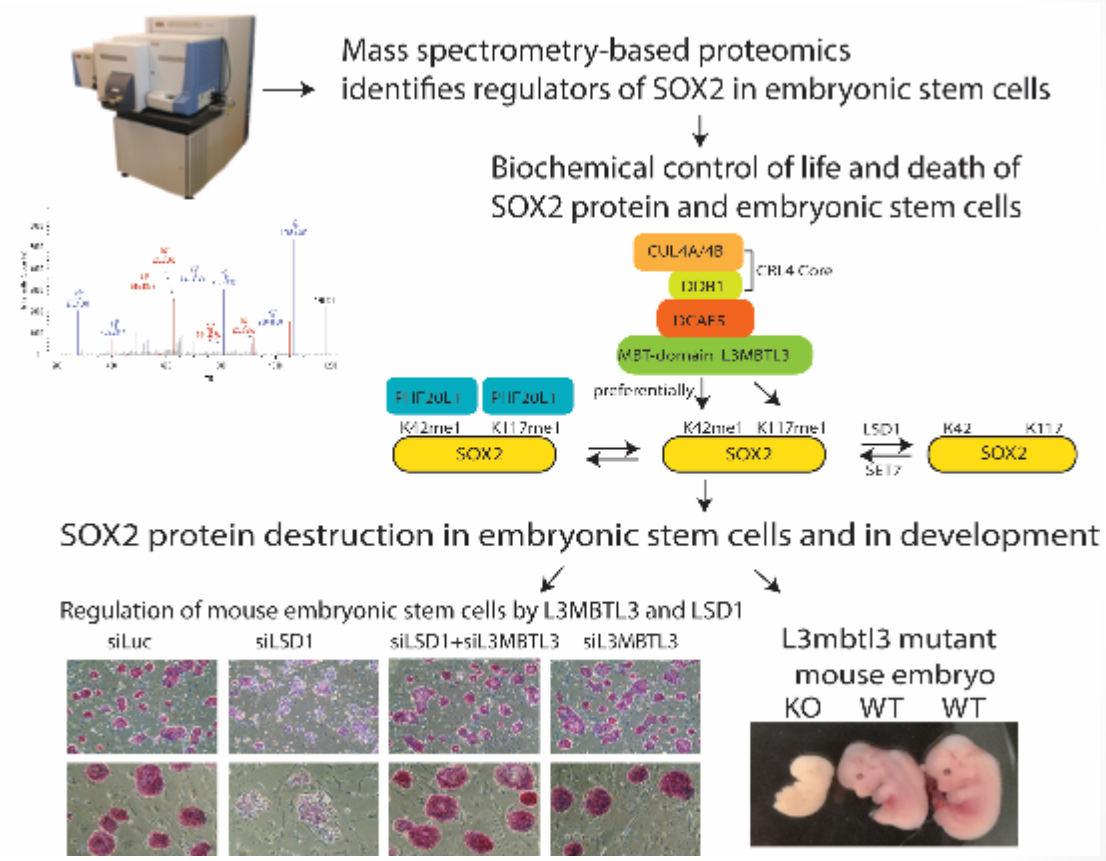
• Discover novel proteins essential for stem cell regulation, examples:

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.

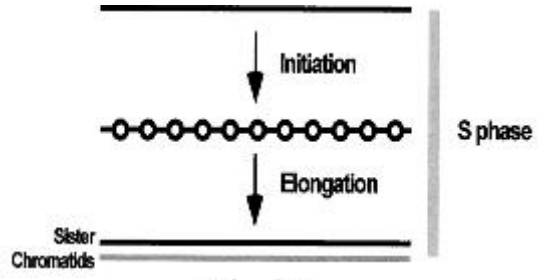
- SOX2 is also a master regulator of many adult stem cells including the stem/progenitor cells for brain, lung, colon, breast, liver, cochlea/ear, skin, retina, ovary, bladder, esophagus, and testes for tissue repair/regeneration.

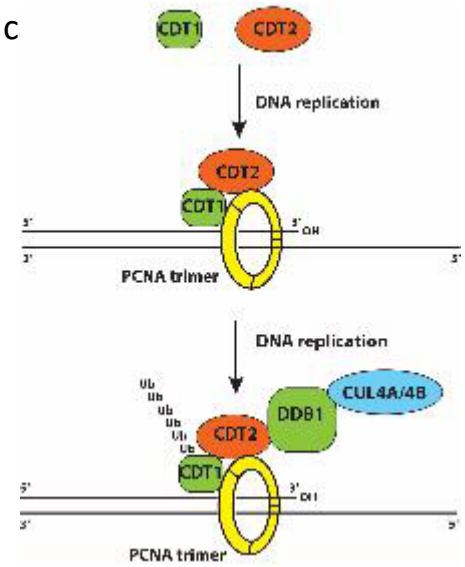
- Artificial Sox2 expression (together with Oct4 and accessary Klf4, and Myc) can virtually convert any differentiated cells, such as skin or blood cells, into induced pluripotent stem cells (iPSCs), the embryonic stem cell-like cells.

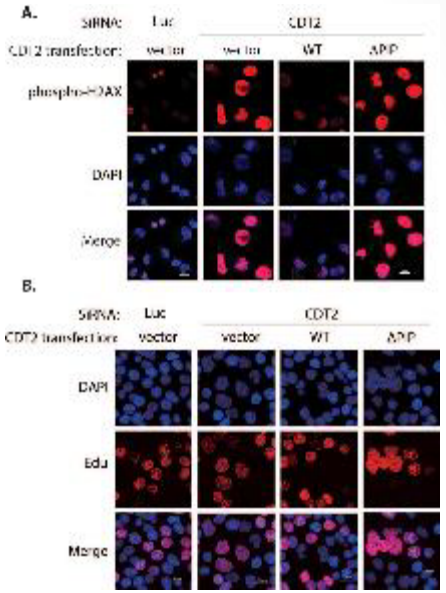


- Discover novel proteins important for epigenetic and cell cycle regulation, examples:
- **Regulation of DNA replication and DNA methylation in normal and cancer cells**

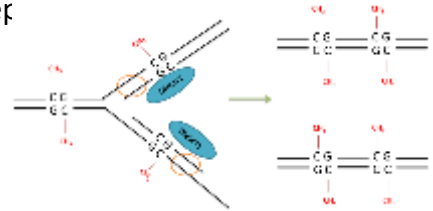
  - How DNA replicates only once in one cell cycle in animal cells? How re-replication is prevented that causes genome instability and c





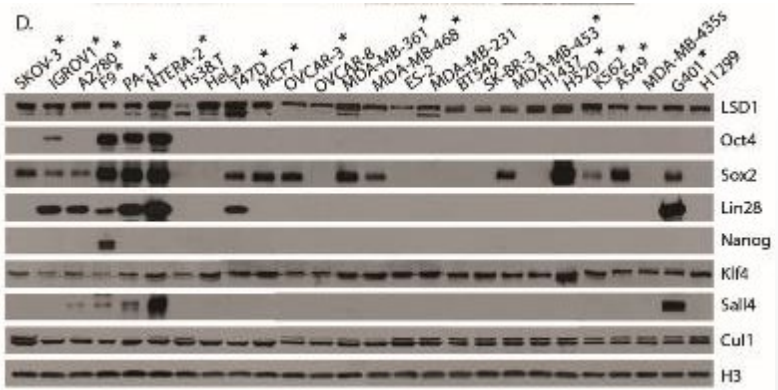


  - How the fidelity of epigenetic DNA methylation is maintained during DNA rep



- **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

UNLV | COLLEGE OF SCIENCES