ZIRUI FU

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EDUCATION

Yale University School of Medicine *Sep. 2025 - Present*
Ph.D. in Translational Molecular Medicine
Affiliated with Yale Medical Research Scholar Certificate Program

University of Wisconsin, Madison *Sep. 2022 - Dec. 2024*
B.S. in Genetics and Genomics
Distinctive Scholastic Graduation Achievement, College of Agricultural and Life Sciences

INTEREST STATEMENT

Supported by the NSF Graduate Research Fellowship (GRFP), I am pursuing a Ph.D. and a long-term research career focused on Artificial Intelligence and Cell Biology. My goal is to investigate the fundamental mechanisms of cancer progression through the integrated application of computational and experimental biology approaches.

PUBLICATIONS & PRESENTATIONS

- Rizvi, S. A. †, Levine, D. †, Patel, A. †, Zhang, S. †, Wang, E. †, Perry, C. J.†, Vrkic, I., Constante, N. M., **Zirui F**., et.al (2026). Scaling large language models for next-generation single-cell analysis. ***Nature***. In revision.
- **Zirui F**., et.al (2026). Face/Off: Phase-Specific Modeling of Lineage Plasticity Using Near-Patient Models in Genitourinary Cancers. ***Gene***. In revision
- **Zirui F**, Kim, I. Y., Mu, P. (2026). Lineage Plasticity in Prostate Cancer: Molecular Mechanisms, Clinical Consequences, and Therapeutic Opportunities. Textbook Chapter in ***Prostate Cancer (2nd ed.)***. In press.
- K. Jiang, **Zirui F**, et.al (2025). Single-cell resolution uncovers neighboring cell subtypes that share steroidogenic capacity during fetal testis development, Proc. Natl. Acad. Sci ***PNAS***, 122 (23) e2501392122.
- Choushi, W., Xiaoling, L., Quanhui, X., **Zirui, F.**, et al. (2025). Prostate Cancer Exploits Neurolysin to Modulate the Tumor Microenvironment and Therapy Resistance via KIF Mediated WNT Secretion. ***Nature***. In revision.
- Duo, H., Jin, M., Yang, Y., Baheti, R., Feng, Y., **Zirui, F.**, et al. (2024). Effect of Antiplatelet Therapy after COVID-19 Diagnosis: A Systematic Review with Meta-Analysis and Trial Sequential Analysis. ***PloS One***, 19(2), e0297628.
- **Zirui, F.**, Keer, J., Anbarasi, K., Tyler, K., Joan, J. (2023). Dynamics of Spatiotemporal Maturation of Fetal Leydig Cells. Poster presentation in **Upper Midwest Summit for Reproductive Science,** Northwestern University, USA
- **Zirui, F.**, Zi, W. (2021). The Wing Development and Sexual Differentiation of Bean Aphid under the Selective Pressure of Sublethal Pesticide. Presented at **Yau Award International Conference**, Tsinghua University, CN

RESEARCH EXPERIENCE

Generate World's Largest Bladder Cancer Patient-Derived Organoid Bank, and Build Up the First Bladder Cancer Multi-Omics Public Database, *Graduate Student*
Mentor: Associate Prof. Ping Mu, Yale University *Jul. 2025 - Present*

Aim: Establish a large-scale, strong clinically relevant *ex vivo* model for high resolution sequencing. Organize all the preexist sequencing data to a user-friendly database for systematic translational research.

- Generated and curated bladder cancer patient-derived organoid bank, preserving histopathological features and clinically relevant tumor states for downstream molecular profiling.
- Optimized culture and processing workflows to support high-resolution sequencing, including single-cell RNA sequencing and transcriptomic analyses.
- Designing and implementing a user-friendly bladder cancer multi-omics database, enabling efficient data retrieval, cross-sample comparison, and hypothesis-driven exploration.
- Linked organoid-based molecular profiles with clinical annotations to facilitate studies of tumor heterogeneity and therapy response.

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The Role of Kinesis Family Protein in WNT ligand Trafficking in Prostate Cancer Drug Resistance
Supported by Summer Undergraduate Research Fellowship (SURF)
Mentor: Associate Prof. Ping Mu, Yale University *Jun. 2024 - Aug. 2024*

Aim: Investigate the molecular mechanisms driving drug resistance in castration-resistant prostate cancer patients.

- Hypothesized and demonstrated the critical role of Kinesin family (KIF) motor proteins in the intracellular transport of WNT ligands, affecting tumor microenvironment signaling pathways.
- Performed CRISPR/CAS9 knockout experiments and tumor progression analyses, utilizing immunofluorescence and live cell imaging to confirm co-localization of KIF proteins with WNT ligands, validating their molecular interactions.
- Developed a customized Python and OpenCV pipeline to detect intracellular secretion anomalies, revealing the specific role of KIF proteins in altered cellular trafficking dynamics.
- Manuscript in revision with *Nature*.

Subcellular Transcript Level Patterns in Androgen-Producing Fetal Leydig Cells (FLCs) within the Developing Testis, *Research Assistant*
Mentor: Prof. Joan Jorgensen, UW- Madison Department of CBS *Dec. 2022 - Dec. 2024*

Aim: Understand the regulation of FLC differentiation and maturation, as their androgen production is critical for the masculinization of the developing male phenotype in mammalian systems.

- Investigated the spatial-temporal patterns of androgen synthesis pathway gene transcripts within FLCs of developing mouse testes based on subcellular mRNA localization.
- Developed technical proficiency in frozen sectioning, high-throughput imaging microscopy, mouse embryo dissection, and routine animal husbandry, ensuring high-quality sample preparation for subsequent analysis.
- Optimized data analysis workflow by incorporating automated image quantification techniques, successfully improved the precision and efficiency of transcript localization studies.
- Manuscript in preparation.

The Effect of Antiplatelet Therapy after COVID-19 Diagnosis, *Research Intern* *May. 2022 - Aug. 2022*
Affiliation: Peking Union Medical College

Aim: Evaluate the risk factors of cardiovascular and cerebrovascular diseases in COVID-19 patients treated with antiplatelet drugs by comprehensive meta-analysis, resulting in a published manuscript: *PloS One,* 19(2), e0297628.

- Assisted in data collection from sources like PubMed and EMBASE; Contributed to the paper writing process.

The Genetic Mechanism of Aphid Drug Resistance Utilizing Bioinformatic Sequencing, *Research Assistant*
Mentor: Prof. Su Wang, BJ Academy of Agriculture and Forestry Sciences *Dec. 2020 - Dec. 2021*

Aim: Investigate transcription factors driving drug resistance in Bean Aphids under traditional pesticides and provide potential genetic targets for innovative biological pesticide design.

- Hypothesized and demonstrated that Bean Aphids tend to perform gender switching and wing development under the selective pressure of sublethal pesticide exposure, leading to the formation of drug resistance.
- Self-taught bioinformatic techniques and conducted GO & KEGG database analysis to compare upregulated enrichment pathways among 32,006 targeted genetic candidates from mRNA sequencing results; Identified specific genetic SNP locations.
- Won the S.-T. Yau High School Science Award national gold metal and global honorable mention with a 36-page manuscript; Presented at Tsinghua Medical School.

LEADERSHIP & ACTIVITIES

Vines Art for Autistic Children Support *Jun. 2023 – 2025*
Chef Editor

- Initiated and curated exhibitions featuring artworks created by children with autism under the theme of supporting marginalized groups; Led a team of 6 artists and editors to execute the exhibitions.
- Negotiated and collaborated with different social organizations, including China Charities Aid Foundation for Children, to host art exhibitions on National Ecology Day, attracting over 50,000 participants and receiving media coverage from *Guangming Daily*, the second-largest CN official media outlet.
- Launched online campaigns and public service advertisements, generating 40 million views and over half a million likes; successfully raised public attention to the challenges faced by marginalized families.

Mentorship and Career Guidance Initiative Group *Sep. 2022 – Present*
Co-founder

- Provided one-on-one career mentoring for students with limited resources or disabilities, focused on pairing them with mentors who share similar backgrounds or challenges to foster meaningful connections.
- Promoted confidence-building by guiding students to seek opportunities aligned with their strengths and interests, while offering them practical strategies for overcoming self-doubt and obstacles.
- Charged an affordable fee of $10 per hour, with all personal proceeds donated to rural school-building projects, creating a lasting social impact, and enhancing educational access for underserved communities.

SKILLS

Analysis Skills: GO, KEGG, AlphaFold, R, LaTex, Python, NIS-Elements, GraphPad Prism, Fiji, Adobe Illustrator, BioRender, Photoshop, Procreate

Bench Proficiency: Cell culture, Embryonic dissection, Frozen sectioning, Western blot, Plasmid cloning, Gene knockdown/knockout techniques, Microscopy (fluorescence, confocal), Immunohistochemistry, RT-qPCR