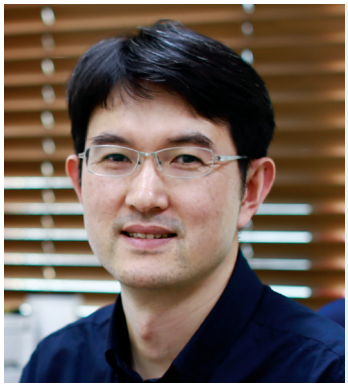
FACULTY RESEARCH PROFILE

POSTECH LIFE SCIENCES

POSTECH LIFE SCIENCES

Lab. of **Structural Biology of Macromolecular Interactions**



Prof. **Min-Sung Kim**

Contact

Phone: +82-54-279-2362
E-mail: ms.kim@postech.ac.kr
Homepage (lab): http://mskimlab.postech.ac.kr/

Education

B.S., POSTECH. Korea (1998)
M.S., POSTECH. Korea (2000)
Ph.D., POSTECH. Korea (2003)

Research Introduction

The growth and replication of living eukaryotic cells are regulated by lots of signals from outside and also from inside. Cell receives various signals from other cells by messengers, such as growth factor, which are recognized by cell surface receptors. On the other hands, inside of cell, intensive signals keep firing throughout the multiple networks to process/response the signal from outside and to check/maintain the right metabolism of cells (ex. DNA replication, DNA damage response) and to monitor physiological stress of cells (ex. nutrient depletion)

These inside-cell signaling networks are often composed of sensor, switch, adaptor, transducer and effector, like a sophisticated electric machine. Among these components, a few numbers of molecular switches control the lots of cellular process. Interestingly, these molecular switches can also integrated the information from sensor and determine the responses. Any unexpected disruption of these signaling pathway is responsible for human disease.

Dr. Kim is interesting in the biomolecular interactions between the components of signaling pathway molecules to improve our understanding of cellular process and to give a fundamental basis of rational approach to therapeutic intervention.

Career

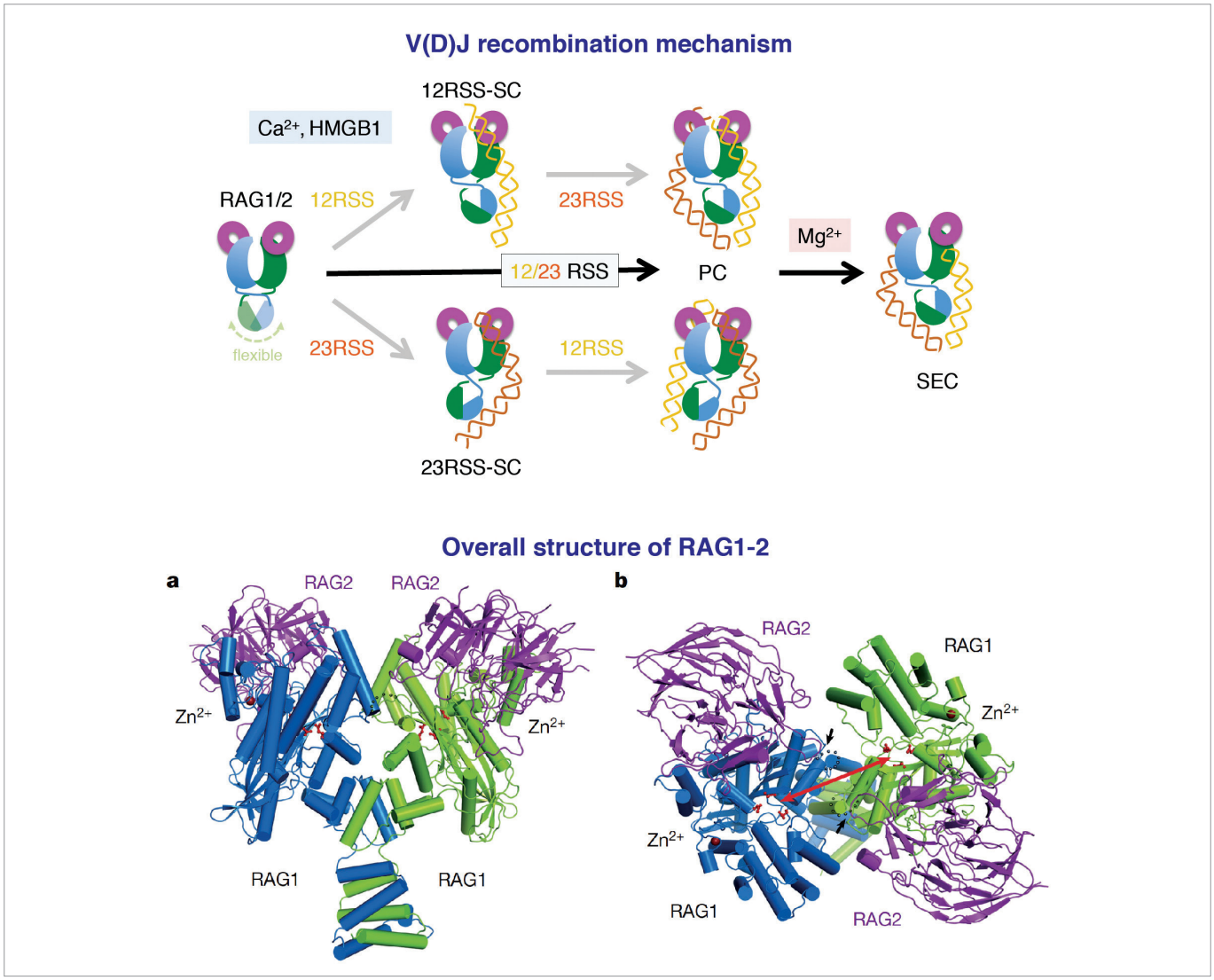
2003-2006: Postdoctoral Fellow, Dept. of Life Sciences, POSTECH
2006-2012: Postdoctoral Fellow, Dept. of Biophysics and Biophysical Chemistry, Johns Hopkins University
2012-2014: Research Fellow, NIDDK, National Institutes of Health
2014-2017: Staff Scientist, NIDDK, National Institutes of Health
2017-2023: Assistant Professor, Div. of Integrative Biosciences & Biotechnology (IBB), POSTECH
2023-Present: Associate Professor. Department of Life Sciences, POSTECH

Research Areas

- Protein engineering
- Protein/DNA/RNA interaction
- X-ray crystallography
- Electron Microscopy
- Membrane protein crystallography

Major publications

1. Chun Inseop, Kim MS, et al., (2023) Plant Communications 4. 100510
2. Kim Jieun, Kim MS, et al., (2021) OncoImmunology 10, 1899671
3. Lee CH, Kim MS, et al., (2020) Structure 28, 355-362
4. Kim MS, Wei Yang et al., (2018) Molecular Cell 70, 358-370
5. Tian Lan, Kim MS. et al., (2018) PNAS 115. 507-512
6. Notarangel L.D., Kim MS, et al., (2016) Nat Rev lmmunol 16, 234-246
7. Kim MS, Lapkouski M., et al., (2015) Nature 518, 507-511
8. Lee CH, Kim MS, et al., (2012) NSMB 19, 707-715
9. Kim MS, Saunders A.M., et al., PNAS 108, 13112-13117
10. Lim JH, Kim MS, et al., JBC 281, 8286-8295
11. Kim MS, Yi MJ, et al., (2005) Traffic 6, 1183-1195
12. Kim MS, Shin J, et al., (2003) JBC 278, 28173-28180
13. Kim MS, Byun M, et al.,(2003) Nat lmmunol 4, 787-793


V(D)J recombination mechanism
12RSS-SC
Ca2+, HMGB1
RAG1/2
12RSS
23RSS
12/23 RSS
PC
Mg2+
SEC
flexible
23RSS
12RSS
23RSS-SC
Overall structure of RAG1-2
a
RAG2
RAG2
Zn2+
Zn2+
RAG1
RAG1
b
RAG2
RAG1
Zn2+
Zn2+
RAG1
RAG2

Lab. of **Structural Bioinformatics**

Prof. **Sanguk Kim**

Contact

Phone: +82-54-279-2348 **Fax:** +82-54-279-2199
E-mail: sukim@postech.ac.kr **Homepage (lab):** http://sbi.postech.ac.kr/

Education

B.S., Genetic Engineering, Korea Univ., Seoul, Korea (1992)
M.S., Molecular Biology, Korea Univ., Seoul, Korea (1996)
Ph.D., Florida State University, Tallahassee, FL, USA (2002)

Research Introduction

We are developing computational biology methods and bioinformatics tools for network medicine and healthcare. Proteins are the major player of cellular function and they carry out their functional role through complex network of protein-protein interactions.

The protein repertoire varies depending on cellular states, tissue type, species, and disease state. However, little is known about how this repertoire changes under different cellular or disease states. To gain a better understanding of these dynamic changes, Kim's lab is developing essential applications for network biology and large-scale high-throughput data integration analysis. Systemic analysis of protein functional network will provide a framework for understanding how protein compositions respond to changes in human disease states.

Career

2002-2005: Post doctoral fellow, UCLA-DOE Center for Genomics and Proteomics, Los Angeles, CA POSTECH, Pohang, Kyungbuk, Korea
2005.9-2021.2: Director, Biological Research Information Center (BRIC), Korea
2009.1-2013.12: KIAS Associate Member, School of computational Science, Korea Institute for Advanced Study, Korea
2017.9-2019.8: Vice president for admissions and student affairs, POSTECH, Pohang, Kyungbuk, Korea
2017.9-2019.8: Dean of the School of Undergraduate Studies, POSTECH, Pohang, Kyungbuk, Korea
2019.9-2021.2: Vice president of Planning, POSTECH, Pohang, Kyungbuk, Korea
2014.3-Present: Professor, Department of Life Science, POSTECH, Pohang, Kyungbuk, Korea

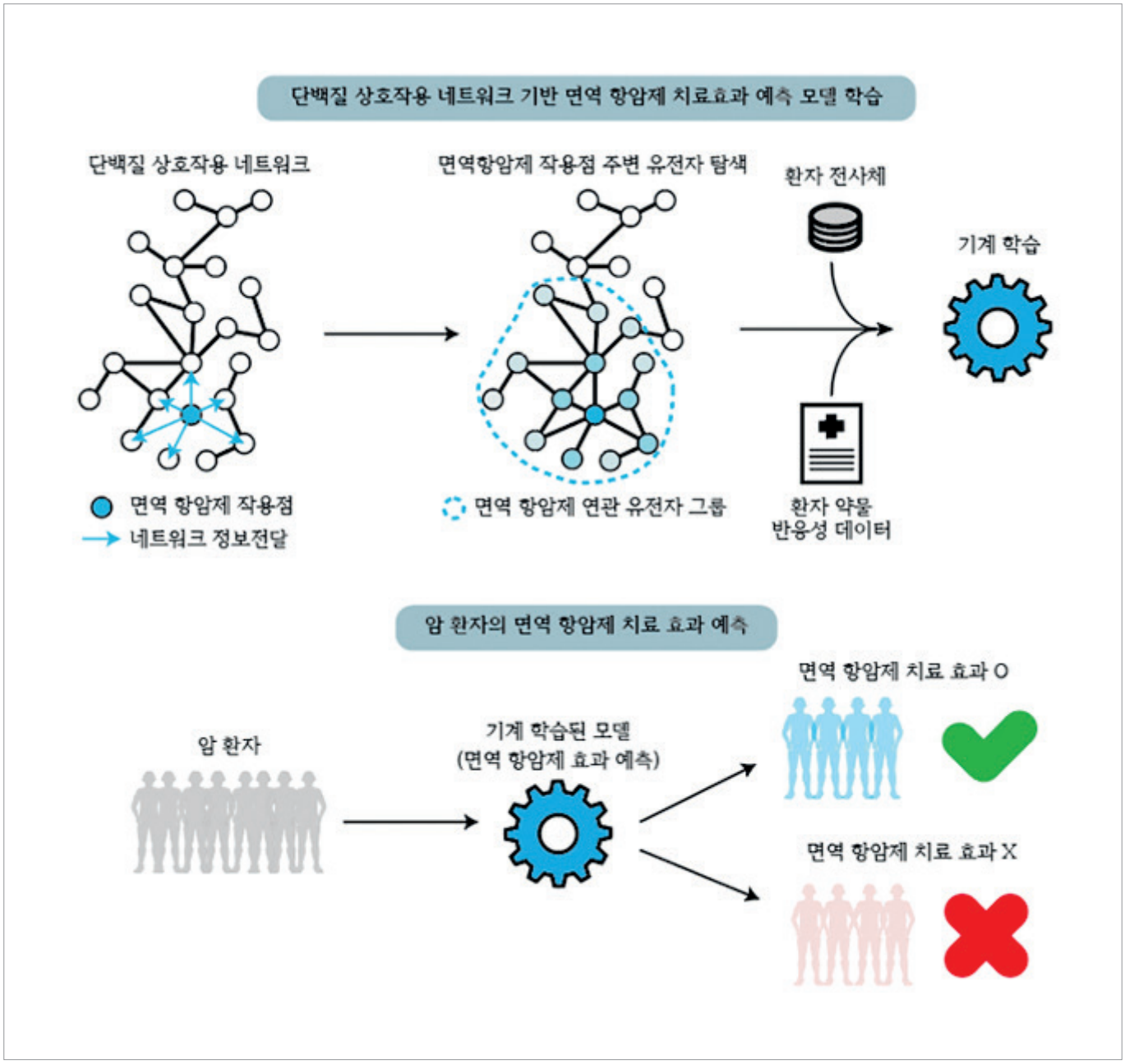
Research Areas

Computational Biology and Bioinformatics

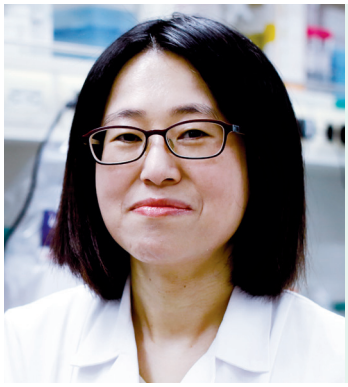
- Structural and functional characterization of membrane proteins
- Development of prediction methods for protein structure and proteinprotein interaction
- Systematic & quantitative analyses of molecular evolution and biodiversity
- Mathematical & statistical approaches to find bio-patterns from sequence and structural information

Major Publications

1. 2023.08. Drug approval prediction based on the discrepancy in gene perturbation effects between cells and humans. EBioMedicine. 94:104705
2. 2023.02. An evolution-based machine learning to identify cancer type-specific driver mutations. Briefings in Bioinformatics. 24(1):bbac593
3. 2022.06. Network-based machine learning approach to predict immunotherapy response in cancer patients. Nature Communications. 13(1):3703
4. 2022.02. Evolutionary rewiring of regulatory networks contributes to phenotypic differences between human and mouse orthologous genes. Nucleic Acids Res. 50(4):1849-1863
5. 2020.10. Network-based machine learning in colorectal and bladder organoid models predicts anti-cancer drug efficacy in patients. Nature Communications, 11(1):5485
6. 2020.08. Single-cell RNA sequencing identifies shared differentiation paths of mouse thymic innate T cells. Nature Communications, 11(1): 4367
7. 2019.08. Domain-mediated interactions for protein subfamily identification. Scientific Reports. 10(1):264
8. 2019.06. Evolutionary coupling analysis identifies the impact of disease -associated variants at less-conserved sites. Nucleic Acids Res. 47(16): e94
9. 2019.05. Epigenetic regulation of mammalian Hedgehog signaling to the stroma determines the molecular subtype of bladder cancer. Elife 8:e43024
10. 2018.05. Divergence of noncoding regulatory elements explains gene-phenotype differences between human and mouse orthologous genes. Molecular Biology and Evolution 35(7): 1653-1667


단백질 상호작용 네트워크 기반 면역 항암제 치료효과 예측 모델 학습
단백질 상호작용 네트워크
면역항암제 작용점 주변 유전자 탐색
환자 전사체
기계 학습
면역 항암제 작용점
네트워크 정보전달
면역 항암제 연관 유전자 그룹
환자 약물
반응성 데이터
암 환자의 면역 항암제 치료 효과 예측
면역 항암제 치료 효과 O
암 환자
기계 학습된 모델
(면역 항암제 효과 예측)
면역 항암제 치료 효과 X

Lab. of **Membrane transporters and structural biology**



Prof. **Young-Jin Kim**

Contact

Phone: +82-54-279-2324
E-mail: yjkim01@postech.ac.kr **Homepage(lab):** https://yjkim001011.wixsite.com/website

Education

B.S., Sungkyunkwan University, Suwon, Korea (2003)
M.S., KAIST,Daejeon, Korea (2005)
Ph.D., KAIST,Daejeon, Korea (2011)

Research Introduction

Molecules such as glucose, amino acids, nucleosides, and charged ions are essential for survival of cells but a large majority of them cannot penetrate the lipid bilayer. Transporters imbedded in the cellular membrane facilitate import or export of these molecules. Transporters have been studied for more than 60 years. However, the transport mechanism of most of these membrane proteins is still largely unknown due to many technical hurdles including expression, extraction, and crystallization.

To understand membrane transport processes, we use a large array of structural and biochemical approaches. The research tool we use is cryo-electron microscopy (cryo-EM). Using this technique we can determine atomic structures of transporters frozen in multiple conformational states. Several technical advances of electron microscopy in recent years revolutionized structural biology. First, the development of direct electron detection, second, the development of algorithms for data collection from imaging to classification and also for structural reconstruction, and third, the development of volta phase plate (VPP) for in-focus data collection. They solve a major challenge for structure determination of membrane proteins and have led to a rapid boom in the cryo-EM structure of various proteins ranging from 64 kDa to 150 MDa.

Our research focuses on the family of ATP-binding cassette (ABC) transporters that transport substrate across the cell membrane using ATP hydrolysis energy. The best known example of this is P-glycoprotein (P-gp).

P-gp is an ATP – dependent efflux pump that exports a structurally diverse array of hydrophobic drugs. Substrates bind to the inward-facing conformation in a cavity exposed to the cytoplasm and the membrane bilayer inner leaflet and are released in the outward-facing conformation in the presence of ATP binding. P-gp is an important target of anti-cancer drug discovery. Prolonged treatment of cancer often leads to resistance to multiple drugs. Overexpression of P-gp is commonly found multidrug resistant in cancer cells.

Therefore, the effectiveness of cancer chemotherapy treatment is often limited by overexpression of P-gp. Co-treatment of cancer chemotherapeutics with P-gp inhibitors has been shown to be effective in limiting drug resistance. P-gp has been extensively studied for several decades, but biological questions still remain, such as how P-gp recognizes both cancer drug and P-gp inhibitor and how we can stop their outward-facing conformation changes enabling substrate transport across membranes. Our lab would like to study the substrate transport mechanism by a combination of biochemical and structural analysis including cryo-EM. These structural and functional studies will help in not only better understanding disease from transporters but also will help achieve better drug design and development for humans.

Another focus is on the group of solute carrier (SLC) transporters. Some SLC transporters are targets of drugs and they are being actively studied. SLC transporters mediate influx or bidirectional movement of broad-ranged small substrates including inorganic ions, amino acids, lipids, sugars, neurotransmitters, and drugs. For example, neurotransmitter transporters are found in three distinct clusters: 1) The SLC1 family, 2) the SLC6 and SLC32 families, and 3) the SLC17 and SLC18 families. The other SLC transporters, belonging to the same family, transport a different substrate and use a different mechanism (e.g. symporter vs antiporter). For many SLC transporter families, several crucial questions remain unanswered: 1) how they interact with specific substrate; and 2) how they control the cellular influx of substrates involving their conformational change.

Our lab would like to explain the molecular mechanism of SLC using the structural and biochemical tool cryo-EM.

Career

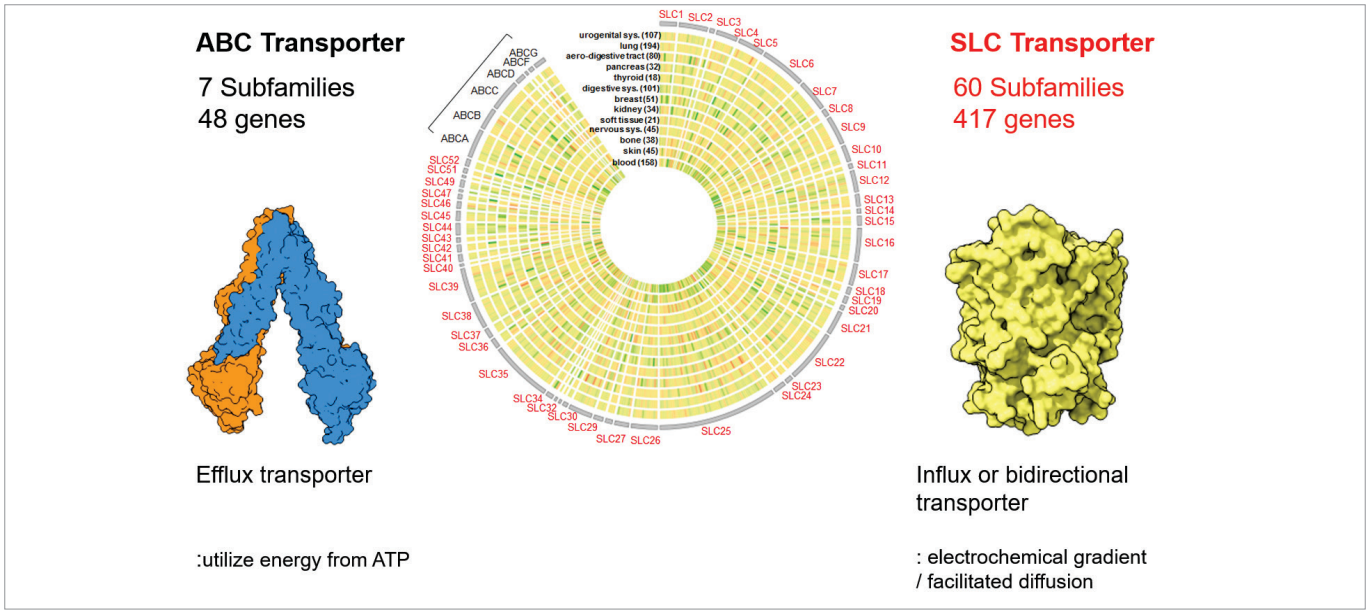
2011-2014 : Research associate, Dept. of Chemistry, KAIST
2014-2018 : Postdoctoral Fellow, The Rockefeller University, NY, USA
2018-2019 : Research associate, Dept. of Chemistry, KAIST
2019-Present : Assistant Professor, Dept. of Life Sciences, POSTECH

Research Areas

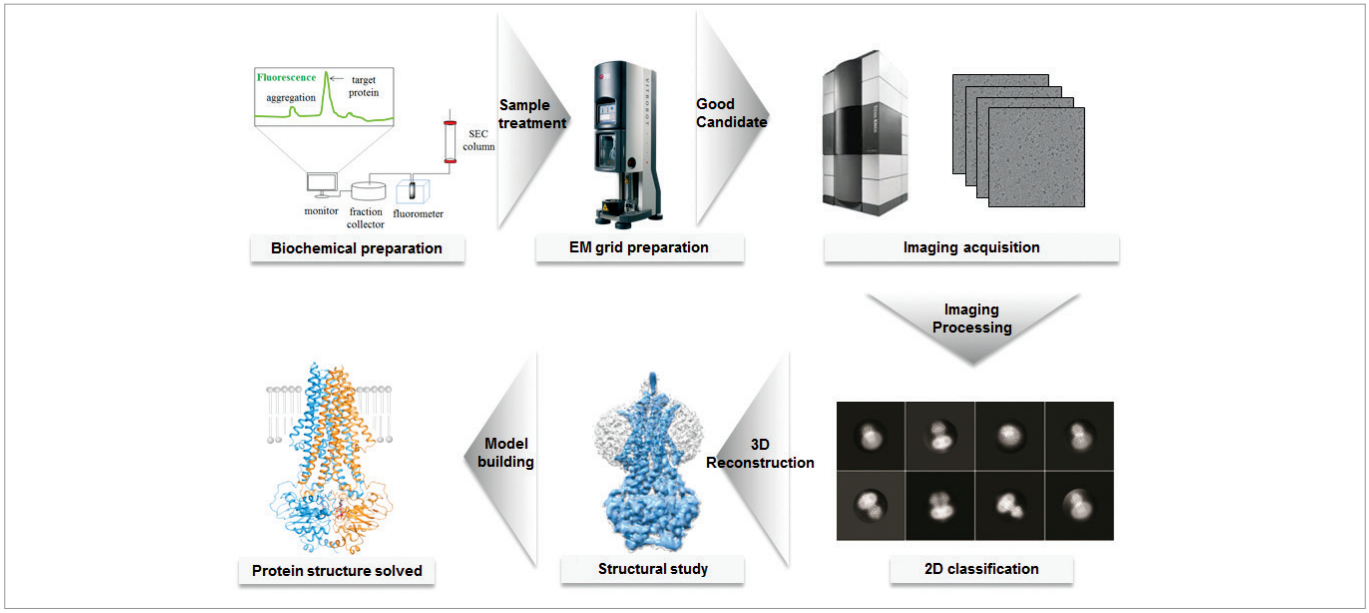
- The mechanism of membrane transporters
- Cryo-electron microscopy
- X-ray crystallography

Major Publications

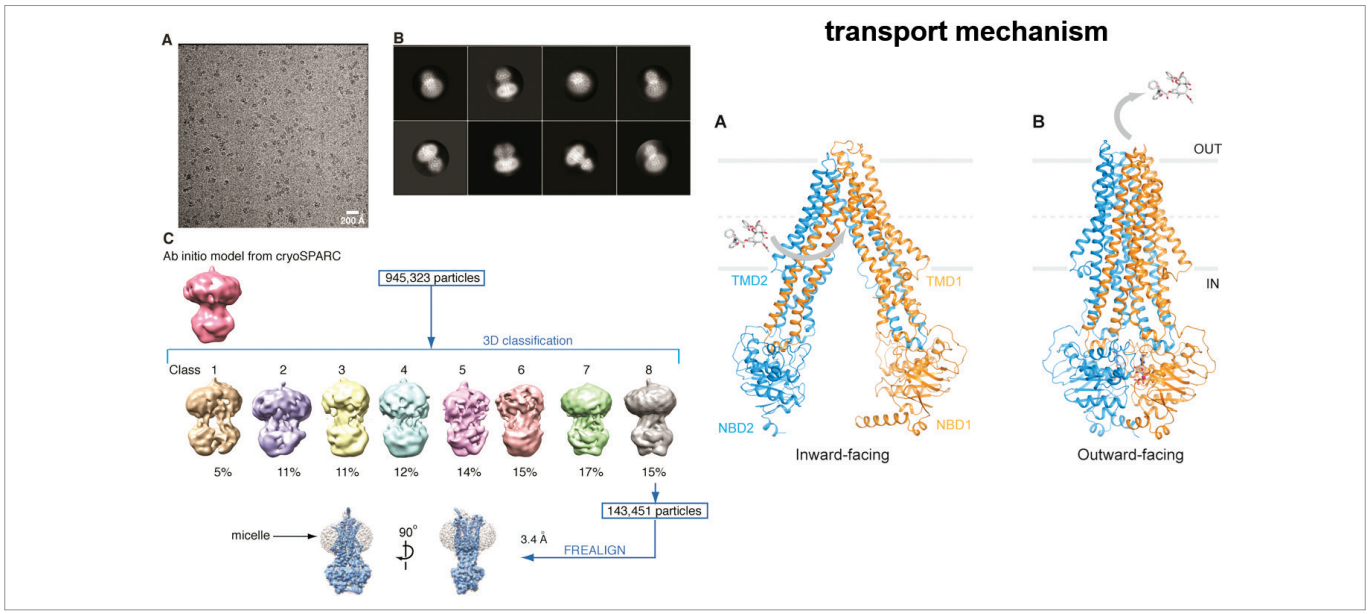
1. Kwon NY, Kim Y et al., (2018), Methods, 154,136-142
2. Kim Y et al., (2018), Science, 359(6378):915-919
3. Eckert JK, Kim YJ et al., (2013), Immunity, 39, 1-14
4. An HJ, Kim YJ, Song DH et al., (2011), J. Biol. Chem, 286(13): 11226-11235



Membrane transporters



Pipeline in Biological Cryo-EM



Human P-glycoprotein

Lab. of **Antibody Structure and Engineering**

Prof. **Jie-Oh Lee**

Contact

Phone: +82-54-279-2323
E-mail: jieoh@postech.ac.kr **Homepage (lab):** https://jieoh1.wixsite.com/jieoh

Education

B.S., Seoul National University, Korea (1987)
Ph.D., Harvard University (1995)

Research Introduction

TLRs play central roles in innate immune defense against viral and bacterial infection. They recognize common patterns in a large number ofmicrobial molecules and initiate potent immune responses against them. My research group has determined the first crystal structures of TLR-ligand complexes.

These structures have revealed the extraordinary diversity of TLR-ligand interactions. From our structural observations, we have proposed a mechanism for receptor activation: ligand binding to the extracellular domains of receptors induces dimerization of the intracellular domains, which initiates signaling inside the cell by recruiting adaptor proteins to the receptor. In order to prove this hypothesis, we are trying to determine structures of complete TLR signaling complexes containing extracellular ligands and intracellular signaling proteins using cryo-EM.

The second research focus of my lab is developing therapeutic antibodies targeting membrane receptors. Monoclonal antibodies are the larges groups of biological therapeutics.The successful development of therapeutic antibodies often requires generation of a selective and potent molecule, humanization of sequences, affinity maturation, Fc engineering to modulate effector functions.

My lab is interested in determining large number of antibody structures in complex with their target proteins using a high speed cryo-EM method. Based on these structures, we design amino acid sequences that can improve performance of the antibodies. Affinity, specificity, stability and manufacturability of antibodies can be improved by this “structure based antibody optimization process”.

Career

2004: FEBS Letters Young Scientist Award (FEBS Letters)
2007: Scientist of the Year (Korea Science Reporters Association)
2008: KAIST Man of the Year (KAIST)
2008: Scientist of the Month (KOSEF)
2008: DuPont Science and Technology Award (DuPont, Korea)
2008: ShimK2008: 100 Outstanding Research Accomplishments, 2007 (KISTEP)
2010: 100 Future Leaders of Korea (Donga-Ilbo, daily newspaper)
2010: Nowotny Science Prize (International Endotoxin and Innate Immunity Society)
2018: Cheong-San Award (Korean Society of Biochemistry and Molecular Biology)

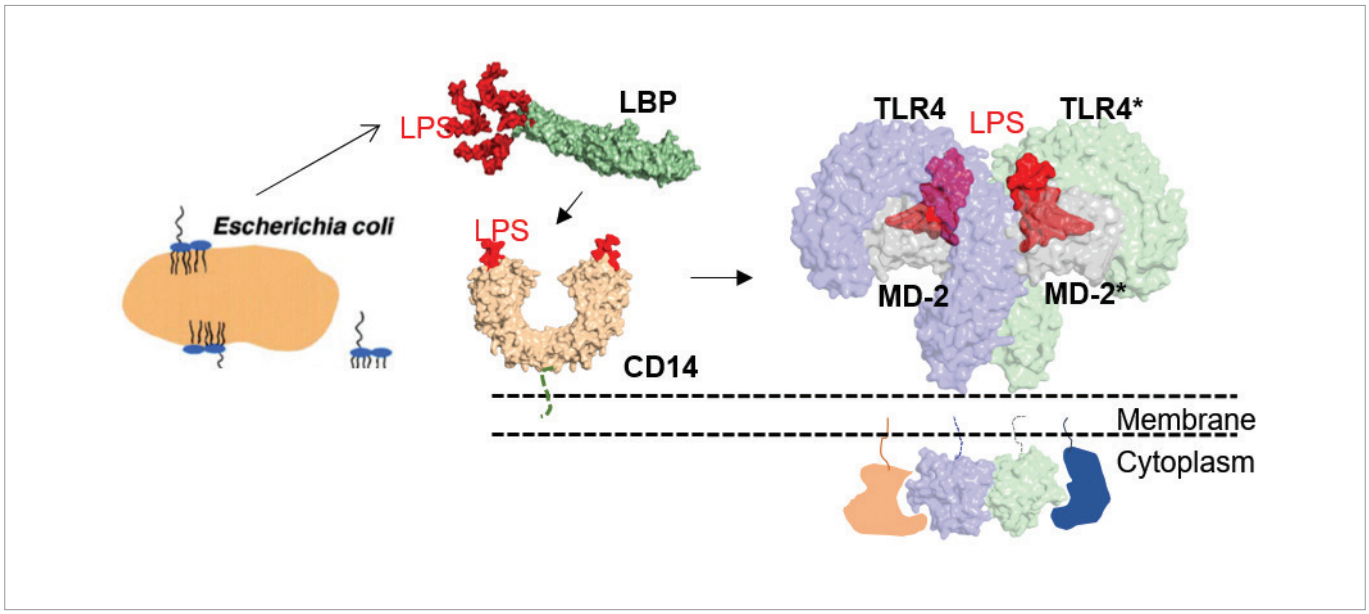
Research Areas

- Cryo-EM study of Toll-like Receptors
- Activation mechanism of cell surface receptors
- Structure based engineering of therapeutic antibodies

Major Publications

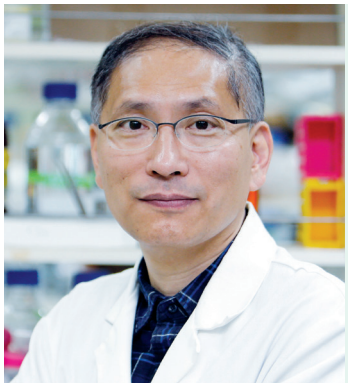
1. V.A. al., (2023) Cancer Research Comm., 3 (1): 80-96
2. Lim et al., (2022) Nat. Commun. 13: 6876
3. Jeong et al., (2016) Nat. Commun. 7: 11031
4. Eckert JK et al., (2013) Immunity, 39: 647
5. Kang JY et al., (2009) Immunity, 31: 873
6. Park BS et al., (2009) Nature 458: 1191.
7. Jin MS, Lee J-O, (2008) Immunity 29: 182
8. Jin MS et al., (2007) Cell, 130: 1071
9. Kim HM et al., (2007) Cell, 130: 906

Toll-like Receptor Structure and Activation mechanism



- Innate immune responses against bacterial, fungal and viral infection
- Activation mechanisms of membrane receptors
- Study of protein structures using antibodies and cryo-electron microscopy
- Development of therapeutic antibodies against membrane proteins

Lab. of **Structural Biology of Cancer**



Prof. **Yunje Cho**

Contact

Phone: +82-54-279-2288 **Fax:** +82-54-279-8111
E-mail: yunje@postech.ac.kr **Homepage (lab):** https://yunje8.wixsite.com/sbclab

Education

B.S., Seoul National Univ., Seoul, Korea (1986)
M.S., Iowa State Univ., Ames, U.S.A (1989)
Ph.D., Cornell Univ., Ithaca, U.S.A (1993)

Research Introduction

We are interested in understanding the molecular mechanisms of signal transduction by various GPCRs and tyrosine kinase receptors. These signaling pathways are related with various metabolisms including perception, neurotransmitter, sensing tastes, hearing and many other cellular and physiological functions. We are particularly interested in deorphanizing the orphan GPCRs. By doing so, we can find out novel agonists/antagonists/inverse agonists and make it possible to regulate the function of GPCRs and other receptors and provide important clues to cure the receptor-related diseases. Our studies also allow us to generate antibodies and aptamers that bind and control the functions of these receptors. We are currently working on GPCRs that are involved in tumorigenesis and neurodegenerative diseases.

Career

1989-1993: Ph. D., Protein Crystallography, Protein Engineering, Cornell Univ. (Ithaca, USA)
1993-1995: Post-doc, Protein Crystallography, Cancer Biology, Memorial Sloan-Kettering Cancer Center (N.Y. USA)
1995-2000: Senior Scientist, Korea Institute of Science and Technology (Seoul) Structural Biology Center
2000-2004: Associate Professor, Department of Life Sciences, POSTECH
2005-Present: Professor, Department of Life Sciences, POSTECH

Major Awards/Honors

- Queen Elizabeth II award, (British Government), Korea (1999)
- 2nd Young Scientist award (Presidential award), KAST, Korea (1999)
- Director, National Creative Research Center (DNA damage signaling center) (2001-2010)
- A Rising Star Fellow (POSTECH) (2011)
- Jongryeol Hong's Chair Professor (2013-2015)
- Science Prize 2016, POSCO TJ Park Foundation (2016)

Research Areas

- Structural Biology of membrane receptor biology – signal transduction
- Cellular Biochemistry and biophysics of Cancer; Tumor suppressors, DNA damage signaling
- Nucleic acid biochemistry
- Anti-cancer drug discovery

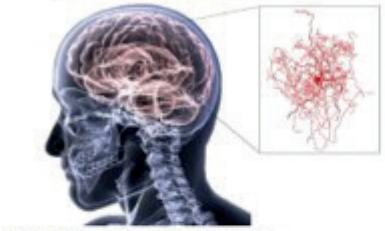
Activities

- Editorial Board, KSMCB (2014-Present)
- Vice President, KOSUA (2014-Present)
- Council Member, HFSP (Human Frontier Science Program) 2014-Present
- Member, Korean Academy of Science and Technology (2017-Present)
- President, KSSB (Korean Society of Structural Biology) 2017-Present

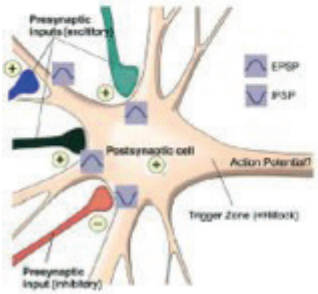
Major Publications

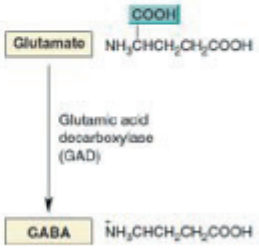
1. Shin JW, Park JH & Cho Y. (2024) Nature Structural & Molecular Biology
2. Kim JH et al & Cho Y. (2023) Acta Crystallographica Section D
3. Kim J et al & Cho Y. (2022) Nature Comm.
4. Jung C. S. et al & Cho Y (2022) Nature Comm.
5. Jeong E, Kim Y et al. & Cho Y. (2021) Nature Comm.
6. Kim Y et al. & Cho Y. (2020) J. Mol. Biol.

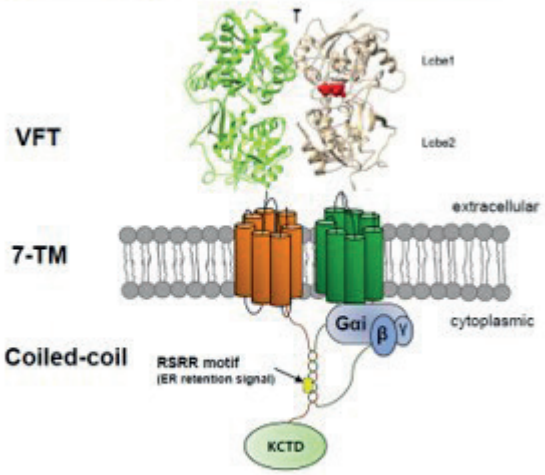
$GABA_B$ receptor: Structure and Function



Nervous system homeostasis







Lab. of **Intercellular Communication Network**

Prof. **Yong Song Gho**

Contact

Phone: +82-54-279-2345 **Fax:** +82-54-279-8609
E-mail: ysgho@postech.ac.kr **Homepage (lab):** https://catapy17.wixsite.com/lab-icn

Education

B.S., Seoul National University, Seoul, Korea (1987)
M.S., Seoul National University, Seoul, Korea (1989)
Ph.D., University of North Carolina at Chapel Hill, USA (1997)

Research Introduction

In multicellular organisms, including humans and bacteria, intercellular communication is an essential process. Cells release a variety of intercellular communication molecules into their surroundings that execute intracellular and intercellular communication via binding to their cognate receptors. To communicate with each other, cells secrete not only variable kinds of soluble intercellular communication molecules, such as growth factors and cytokines, but also extracellular vesicles (EVs), composed of various kinds of proteins, lipids, and genetic materials. EVs are extracellular organelles that modulate immune response as well as promote tumor invasion. These observations suggest that EVs could be regulators of intercellular communication, playing diverse roles compared with those of soluble intercellular communication molecules. However, the biological functions of EVs are generally unclear. We discovered that EVs from tumor cells promote angiogenesis via sphingomyelin and modulate VEGF action on endothelial cells. We will demonstrate that EVs act as multifunctional intercellular communicators through systemic research on the diversity and multiple roles of EVs as well as on the mechanisms of EV biogenesis. Furthermore, our researches will help us to develop novel cancer diagnostics and to identify novel targets that are involved in pathogenesis of diseases.

Aged humans experience higher rated of cancer, Alzheimer's disease and atherosclerosis. The pathogenesis of these diseases is not known at the molecular level. Because disregulation in the biogenesis of intercellular communication molecules and/or dysfunction in the intercellular/intracellular communication networks could lead to progression of several diseases, many groups have studied this field. However, worldwide studies have only focused on soluble intercellular communication molecules and intracellular communication. Therefore, the systemic studies on EVs are critical for understanding the intercellular communication network that is essential for decoding the secrets of life and elucidating the exact causes of many diseases.

Career

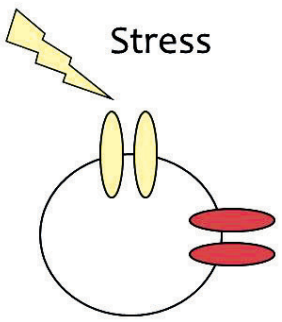
1998-2000: Visiting Fellow CDBRB, NIDCR, National Institutes of Health, USA
2000-2004: Assistant Professor, Kyunghee University, Korea
2004-Present: Assistant Professor, Associate Professor and Professor, Dept. of Life Sciences, POSTECH, Korea
2014-2016: Executive Chair of Education, International Society for Extracellular Vesicles
2012-2018: Editors-in-Chief, Journal of Extracellular Vesicles (2021 Impact factor=25.841)
2018-2019: President, Korean Society for Extracellular Vesicles
2019-2023: Founding President Asian Pacific Societies for Extracellular Vesicles

Research Areas

- Host-and bacteria-derived extracellular vesicles: Exosomes, microvesicles, and outer membrane vesicles
- Host-pathogen interaction
- Drug delivery system
- Vaccine

Major Publications

1. Won S, et al., (2023) Journal of Extracellular Vesicles, 12:e12357
2. Lee J, et al., (2021) Journal of Extracellular Vesicles, 10, e12133
3. Dinh NTH, et al., (2020) Journal of Extracellular Vesicles, 9(1):1766821
4. Choi D, et al., (2020) Journal of Extracellular Vesicles, 9(1): 1757209
5. Go G, et al., (2019) Advanced Healthcare Materials, 8, e1801082

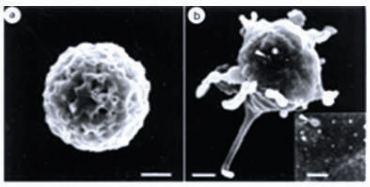


Soluble Intercellular Communicator

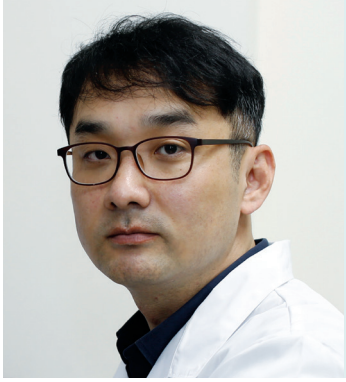
-Growth factor -Neurotransmitter
-Cytokine -Lipid …

Extracellular Vesicle = exosome

-Exosome
-Microvesicle
-Shed vesicle
-Matrix vesicle
. .



Lab. of **Immune Microbiota Interaction**



Prof. **Kwang Soon Kim**

Contact

Phone: +82-54-279-8727 **Fax:** Fax: +82-54-279-8379
E-mail: kskim27@postech.ac.kr **Homepage (lab):** https://sites.google.com/view/postech-imi-lab/home

Education

B.S., Yonsei University, Seoul, Korea (1996)
Ph.D., POSTECH, Pohang, Korea (2011)

Research Introduction

The current research in our lab. focuses on the immune-microbiota interaction in health and diseases. Gut microbiota is considered as a hidden organ that influences host physiology even in the extra-intestinal tissues.

Therefore, imbalance of gut microbiota is the key factor that contributes to the rise of chronic immune disorders in modern countries. Based on germ-free mouse facility we had established for the first time in Korea, we are studying intestinal immune system that can shape gut microbiota. We are also investigating the host-derived, microbial and dietary factors that affect the function of intestinal immune system. Better understanding of immune-microbiota interaction can pave the way for the development of microbiome targeted/based therapeutics against various chronic disorders such as, inflammatory bowel disease (IBD), autoimmune disease, metabolic syndromes and neurological disorders.

Career

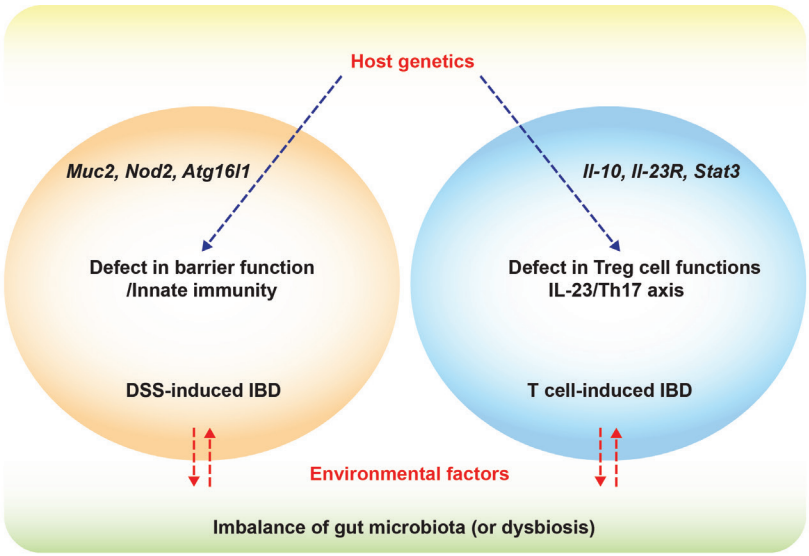
2011-2013: Postdoctoral Fellow, POSTECH, Pohang, Korea
2013-2017: Researcher, Institute for Basic Science, Pohang, Korea
2017-2019: Principal investigator (tenure track), Institute for Basic Science, Pohang, Korea

Research Areas

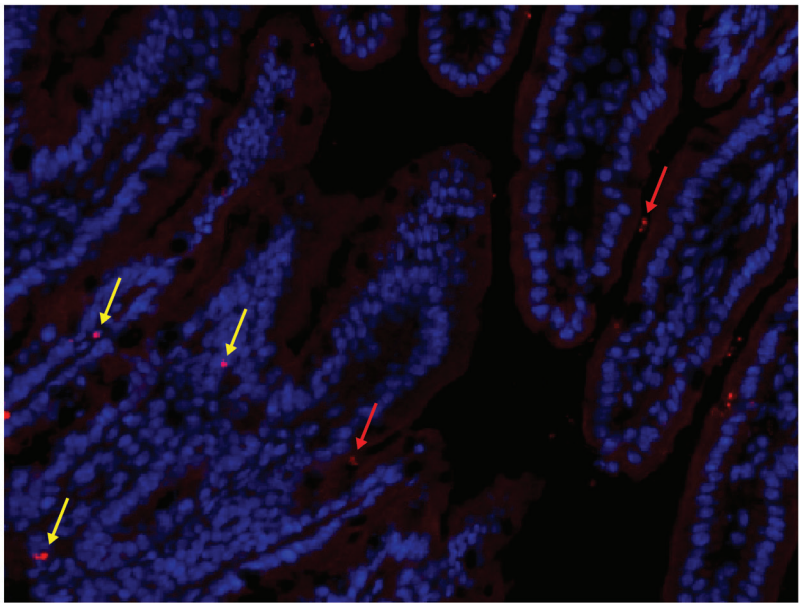
- Regulation of intestinal immunity by diet and gut microbiota.
- Gut fitness of pathogenic commensal microbes and intestinal pathogens
- Species-specific immune regulation by gut microbes.
- Pathogenesis of IBD & microbiome targeted/based drugs for IBD
- Regulation of autoimmunity by gut microbiota

Major Publications

1. Hong SW, O E, Lee JY, Lee M, Han D, Ko HJ, Sprent J, Surh CD and **Kim KS**. Food antigens drive spontaneous IgE elevation in the absence of commensal microbiota. Science Advances, 2019. (Recommended by Faculty of 1000)
2. Hong SW, O E, Lee JY, Yi J, Cho K, Kim J, Kim D, Surh CD and **Kim KS**. Interleukin-2/antibody complex expanding Foxp3+ regulatory T cells exacerbates Th2-mediated allergic airway inflammation. BMB reports, 2019
3. Yi J, Jung JS, Hong SW, Lee JY, Han DH, **Kim KS**, Sprent J and Surh CD. Unregulated APC activation by T cells breaks self-tolerance. PNAS, 2019.
4. Martin CE, Spasova DS, Frimpong-Boateng K, Kim H, Lee M, **Kim KS**, Surh CD. Interleukin-7 homeostasis is maintained by a potent hematopoietic cytokine sink comprised of innate lymphoid cells and T cells, Immunity, 2017.
5. **Kim KS**, Hong SW, Han D, Yi J, Jung J, Yang BG, Lee JY, Lee M, Surh CD. Dietary Antigens limit mucosal immunity by inducing regulatory T cells in the small intestine. Science, 2016. (Recommended by Faculty of 1000, Featured paper in 2016 by Society for Mucosal immunology, “2016 BRIC TOP5’s” in basic academic part from BRIC)



Inflammatory bowel disease (IBD) is a multifaceted disease mediated by overt immune responses against gut microbiota. Imbalance of gut microbiota (or dysbiosis) are associated with IBD.



Images of small intestinal vili (at 5 day post infection) from germ-free mice infected with Listeria (red), and nucleus (blue). Yellow arrows indicate Listeria in the lamina propria and red arrows on the epithelial cells or in the lumen.

Lab. of **Viral & Cellular Immunology**

Prof. **Young Chul Sung**

Contact

Phone: +82-54-279-2294 **Fax:** +82-54-279-5544
E-mail: ycsung@postech.ac.kr

Education

B.S., Yonsei University, Seoul, Korea (1981)
Ph.D., University of Minnesota, Minnesota, USA (1988)

Research Introduction

Since 1989, Prof. Sung has conducted extensive research in the field of vaccine and immunotherapy. His specialty has been developing therapeutic DNA vaccines for treating incurable diseases, including chronic hepatitis B, CIN/VIN, and tuberculosis, and he managed to expand his vaccine research from mouse model to non-primate, and ultimately to human patients (from bench to clinic). Many of these vaccines are currently being evaluated in clinical trials in collaboration with various pharmaceutical and biotech companies. Recently, he has been focusing on mesenchymal stem cell (MSC)-based gene therapies and antibody-fusion proteins. Based on the positive results obtained from preclinical studies, he plans to apply genetically engineered MSCs for cancer therapy and utilize hyFc-fusion technology for treating various types of infectious diseases as well as non-infectious diseases in clinic. Through many years of experiences in academia and industry, he has been establishing a global collaboration network among universities, institutions, hospitals, and companies to build a foundation for improving biotechnology in Korea and pioneering next generation therapeutics to save the lives of patients.

Career

1988-1989: Postdoctoral fellow, Harvard Medical School
1989-Present: Professor, Dept. of Life Sciences, POSTECH
2005-2011: Director, POSTECH-Catholic Biomedical Institute
2005-2021: CEO, Chairman Genexine, Ltd
2006-2008: President/vice-president, Korean Association of Immunologist
2009-2013: Director, POSTECH Biotech Center
2010-2012: Chairman, Dept. of Life Sciences, POSTECH
2023-Present: Chairman, SL MetaGen

Major Awards/Honors

- 7th Hantaan Prize from Hantaan Life Science Foundation (2003)
- The 2nd Mystery of life award (2008)
- Applied technology division of research achievements 2014 Tops from Biological Research Information Center (2014)
- Scientists of the Year 2014 from Korea Science Journalists Association (2014)
- 49th Science Day Presidential Citation for Science and Technology Promotion (2016)
- Winner of the 59th 2018 3.1 Culture Award (2018)

Research Areas

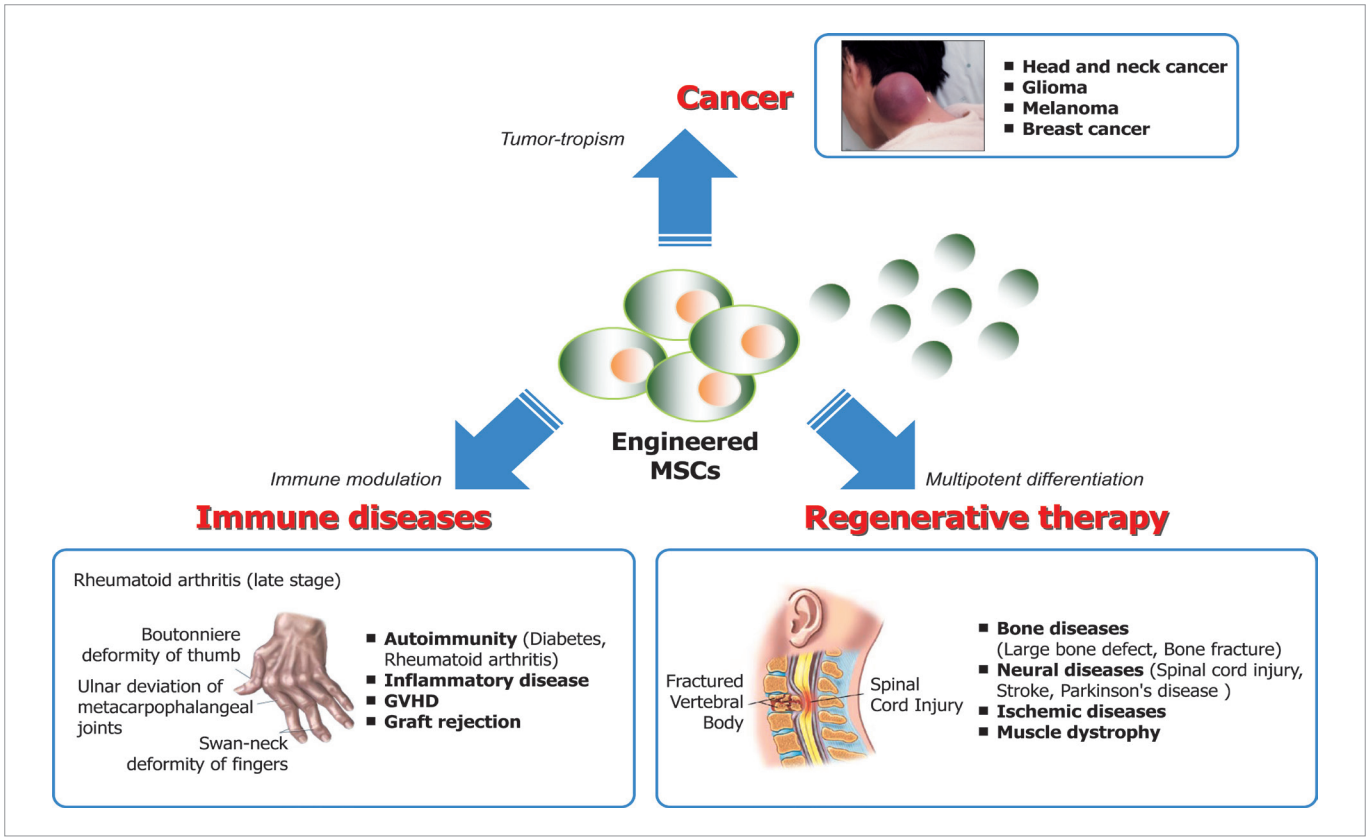
- Vaccine & Immunotherapy
- Stem cell-based cancer gene therapy

Activities

- Development of naked DNA immunetherpeutics for chronic hepatitis B & tuberculosis
- Evaluation of therapeutic efficacy of mesenchymal stem cell based cancer gene therapy
- Clinical trials and commercialization of various hyFc-fused longacting protein/peptide drugs

Major Publications

1. Combined IgE neutralization and Bifidobacterium longum supplementation reduces the allergic response in models of food allergy. SB An, et al., YC Sung, MH Jang. Nat Commun. 2022 Sep. 27;13(1):5669
2. Safety and immunogenicity of two recombinant DNA COVID-19 vaccines containing the coding regions of the spike or spike and nucleocapsid proteins: an interim analysis of two open-label, non-randomised, phase 1 trials in healthy adults. JY Ahn, et al., Sung YC, SH Park, JY Choi. Lancet Microbe. 2022 Mar. 3(3):e173-e183
3. Soluble Spike DNA Vaccine Provides Long-Term Protective Immunity against SARS-CoV-2 in Mice and Nonhuman Primates. Seo YB, et al., Sung YC. Vaccines(Basel). 2021 Mar. 24;9(4):307
4. Pembrolizumab combined with GX-188E therapeutic DNA vaccine in patients with HPV16-and/or 18- positive advanced cervical cancer. Youn JW, et al., Sung YC. Lancet Oncology. 2020 Dec. 21(12):1653-1660
5. A glycosylated Fc-fused glucagon-like peptide-1 receptor agonist exhibits equivalent glucose lowering to but fewer gastrointestinal side effects than dulaglutide. An IB, et al., Sung YC. Diabetes Obes Metab. 2020 Apr 20. 22(8):1455-1468
6. A Phase II, Prospective, Randomized, Multicenter, Open-Label Study of GX-188E, an HPV DNA Vaccine, in Patients with Cervical Intraepithelial Neoplasia 3. Choi YJ, et al., Sung YC, Suh YS, Park JS. Clin Cancer Res. 2020 Apr 1;26(7):1616-1623.


Cancer
Tumor-tropism
Head and neck cancer
Glioma
Melanoma
Breast cancer
Engineered MSCs
Immune modulation
Multipotent differentiation
Immune diseases
Regenerative therapy
Rheumatoid arthritis (late stage)
Boutonniere deformity of thumb
Ulnar deviation of metacarpophalangeal joints
Swan-neck deformity of fingers
Autoimmunity (Diabetes, Rheumatoid arthritis)
Inflammatory disease
GVHD
Graft rejection
Fractured Vertebral Body
Spinal Cord Injury
Bone diseases (Large bone defect, Bone fracture)
Neural diseases (Spinal cord injury, Stroke, Parkinson's disease)
Ischemic diseases
Muscle dystrophy

Lab. of **Organelle Network**

Prof. **Joo-Yeon Yoo**

Contact

Phone: +82-54-279-2346 **Fax:** +82-54-279-2199
E-mail: jyoo@postech.ac.kr **Homepage (lab):** http://mgi.postech.ac.kr/

Education

B.A., Seoul National University, Seoul, Korea (1989)
M.S., Seoul National University, Seoul, Korea (1991)
Ph.D., University of Maryland, School of Medicine, Baltimore, USA (1997)

Research Introduction

1. Cellular mechanisms driven by Membrane-bound Biomolecular condensates

LLPS (liquid-liquid phase separation) is a phenomenon wherein macromolecules within a solution undergo de-mixing, resulting in the compartmentalization of cellular spaces in the absence of membranes. However, when LLPS occurs on or near membranes, it induces curvature deformation and interferes with the natural functions of the membrane. The protein or lipid components of membranes, as well as the membrane itself, play a crucial role in influencing the dynamics of molecular condensates. They can either facilitate the assembly reactions or lower the critical concentrations required for phase separation. In our laboratory, we are currently engaged in the exploration of cellular events and their regulation, specifically focusing on molecular condensates bound to intracellular membranes. We aims to unravel the intricate interplay between these condensates and membranes, understanding their impact on cellular processes and potentially for manipulating cellular behavior.

2. Organelle contact regulation via condensate assembly

The organelle contact, mediated by tethering complexes situated at the junctions between membranes of distinct organelles, plays a pivotal role in governing the biogenesis, dynamics, and homeostasis of organelles. Furthermore, it exerts control over signaling cascades and material transport within the cell. Given that a myriad of cellular activities are orchestrated at these organelle contact points, it is important to elucidate the mechanisms underlying their formation and regulation. In our laboratory, we are currently investigating membrane tethering mediated by molecular condensates and its implications under various physiological and pathological conditions. Our focus extends to exploring how these interactions are affected in scenarios such as virus infections, inflammation, and cancerous environments.

3. Bio-Membrane engineering toward Cell-Gene Therapy (CGT) Technology

One of the foremost challenges in advancing CGT technology lies in developing effective strategies for delivering genetic materials or cargoes into cells, overcoming the barriers presented by cell membranes. Leveraging expertise in organelle tethering and biomolecular condensates, our goal is to innovate methods that enhance the delivery efficiency and target specificity, offering valuable contributions to the field of CGT technology.

Research Areas

- Liquid-liquid phase separation, biomolecular condensates
- Endoplasmic reticulum-endosome, -autophagosome, -mitochondria network regulation
- ER stress responses, autophagy, ER-phagy, ER-Golgi vesicle trafficking, endosome trafficking
- Anti-viral innate host cellular responses

Career

1997-2004: Postdoctoral Fellow/Research Associate, Howard Hughes Medical Institute, The Johns Hopkins Univ., Baltimore, USA
2004-Present: Assistant, Associate, Full professor, Dept. of life sciences, POSTECH, Pohang, Korea.
2017-Present: Director, Organelle Network Research Center (ONRC-SRC)
2023-Present: Director, Innovation Research Center for Bio-Future Technology (B-IRC)

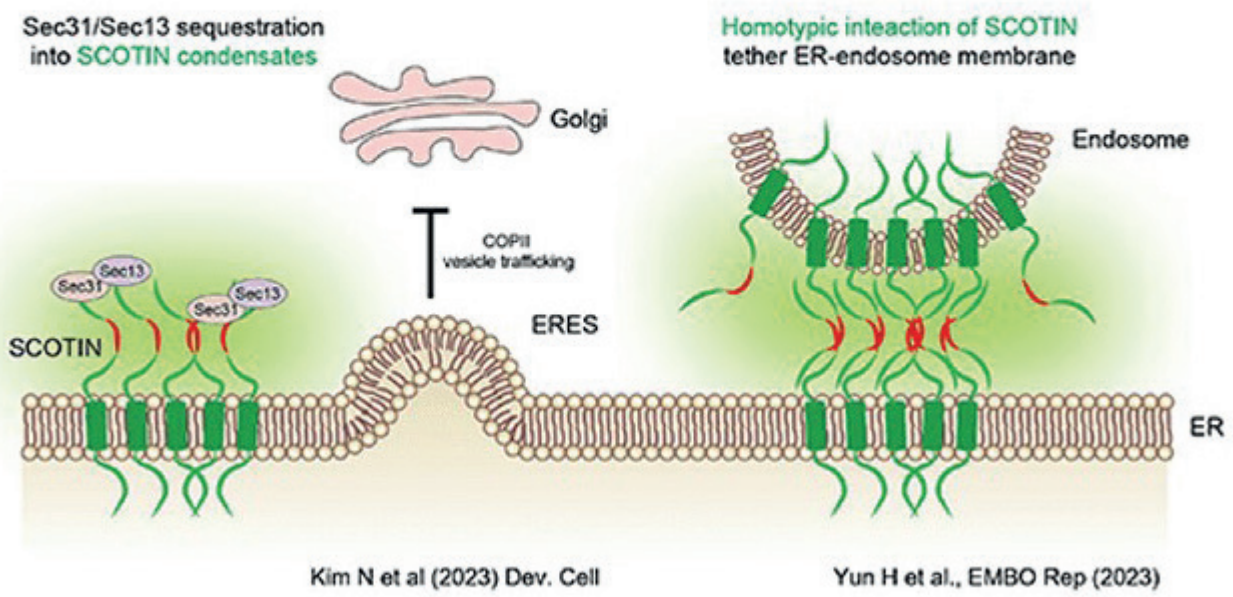
Activities

- Identify interferon- and DNA-damage inducible proteins of anti-viral (HCV, HIV) activity
- Investigation of the LLPS behavior of biomolecular condensate made of integral ER proteins in vitro and in cellulo.
- Investigation of the ER to Golgi vesicle trafficking and endosome dynamics regulation via biomolecular condensate on ER membranes
- Investigation of the p53 mRNA decay mechanism utilizing stress granule

Major Publications

1. Kim N. et al., (2023) Developmental Cell 58(19),1950-1966.
2. Yun HR et al., (2023) EMBO Reports 24(8) e56538.
3. Lee JE et al., (2021) Autophagy 18(7),1613-1628.
4. Seo JH et al., (2020) Scientific Reports 10(1):11183.
5. Ahn N et al., (2019) Journal of Virology 93(20):e00662.

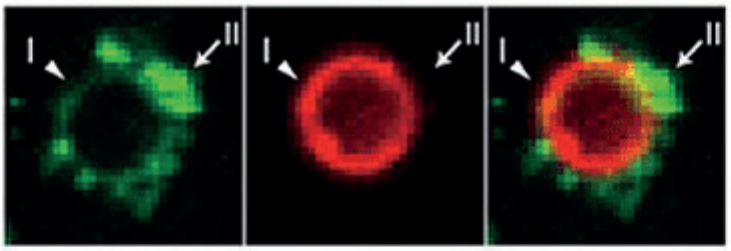
Organelle Network regulated by Membrane-bound Biomolecular condensates



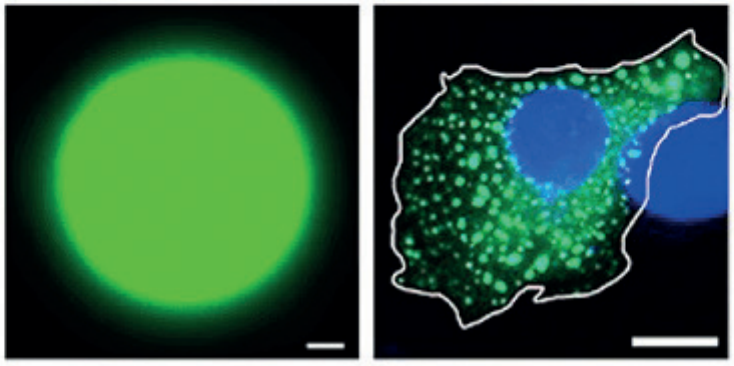
Kim N et al (2023) Dev. Cell

Yun H et al., EMBO Rep (2023)

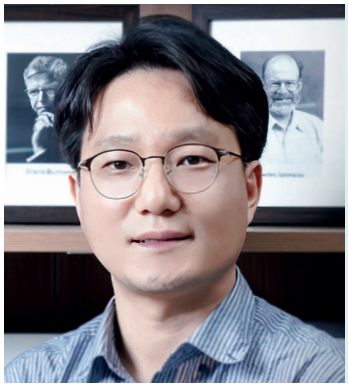
Membrane tethering via condensate



Biomolecular condensate
in vitro / in cellulo



Lab. of **Cellular Immunology**



Prof. **Seung-Woo Lee**

Contact

Phone: +82-54-279-2355
Fax: +82-54-279-5544
E-mail: sw_lee@postech.ac.kr
Homepage (lab): http://ci.postech.ac.kr/

Education

B.S., POSTECH, Korea (1994)
M.S., POSTECH, Korea (1996)
Ph.D., POSTECH, Korea (1999)

Research Introduction

The Postech Cellular Immunology Laboratory studies immune responses and related diseases based on animal physiology at the cellular level. Animal immune cells originate from the primary and secondary lymphoid organs, circulate through the organs of an individual, and are responsible for biological defense in the body. To better understand the principles and effects of the immune response, we first ask questions based on human physiology and then address them from an immunological perspective using mouse models and human samples. A good example of the direction of our research is illustrated by a recent publication from our lab (http://ci.postech.ac.kr/).

Career

Staff scientist, La Jolla Institutr of Allergy and Immunology, San Diego, USA

Post-doctoral fellow, La Jolla Institutr of Allergy and Immunology, San Diego, USA

Major Awards/Honors

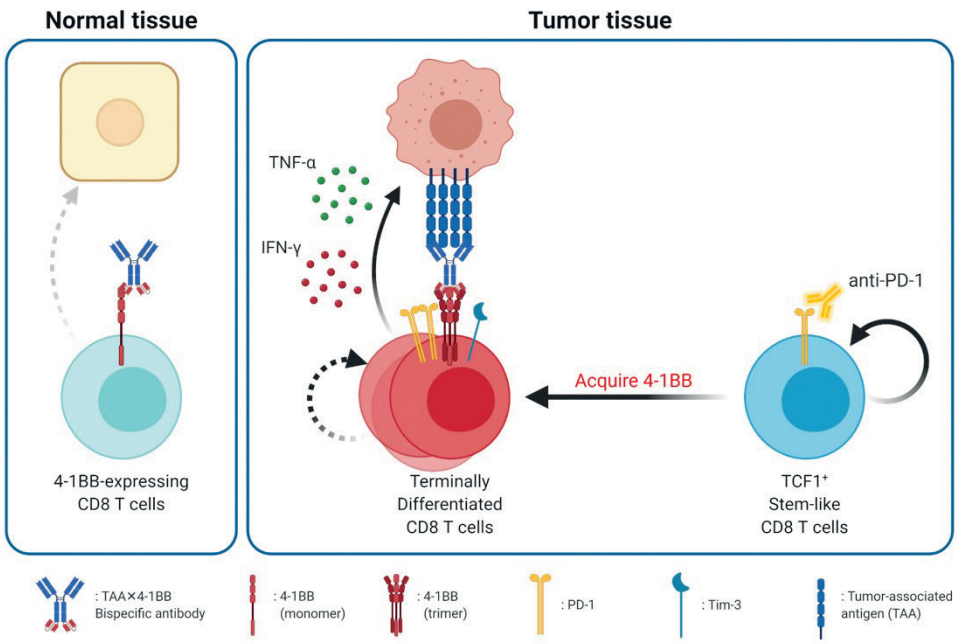
- Selected as one of the Top 5 Medical Researchers by BRIC in 2019
- Ministry of Education Commendation - Excellent Research by Research Foundation in 2020
- Postechian Education Award in 2020
- Ministry of Science and ICT Commendation - Contributions to Growth Industry in 2021
- Academic Achievement Award by the Korean Society for Immunology - Genexin in 2022
- Distinguished Professorship at POSTECH in 2023

Research Areas

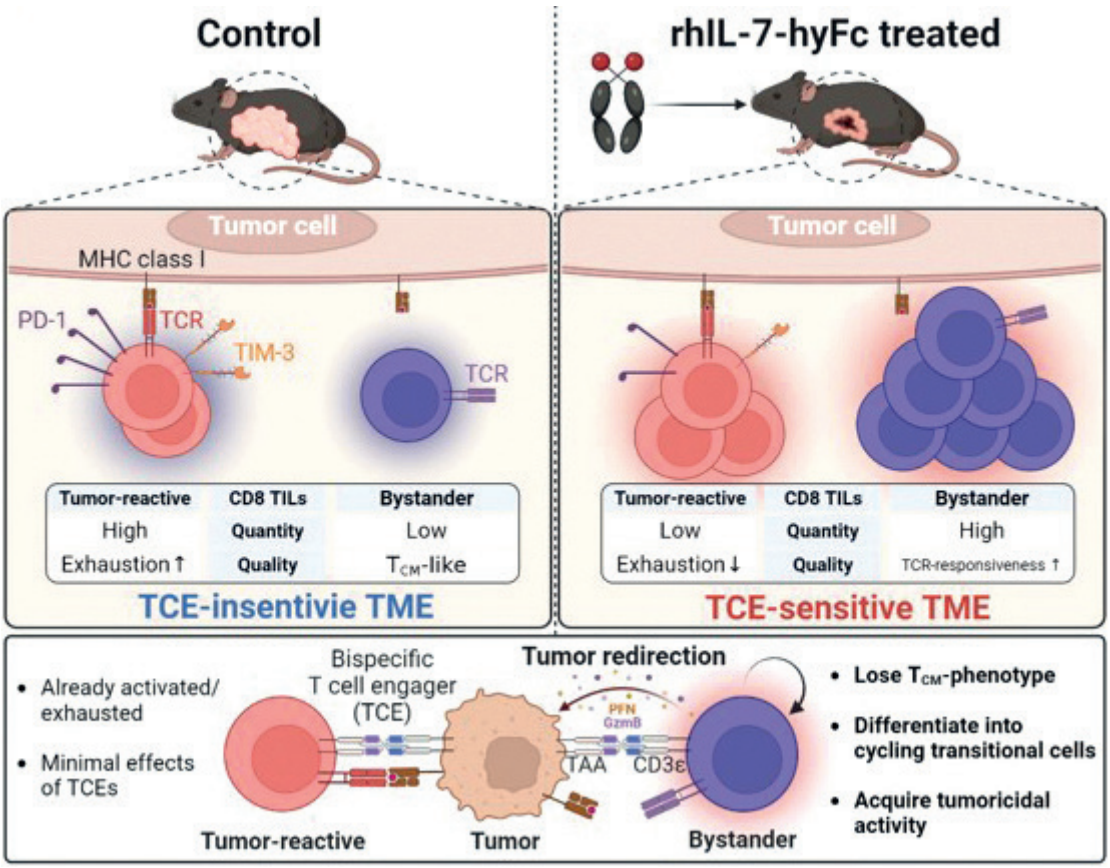
- Understanding roles of immune cells at the tumor microenvironment and development of cancer immunotherapy
- Epithelial-Immune cell interation in the mucosal tissues

Major Publications

1. Dong-il Kwon, et al., Seung-Woo Lee 2023. Fc-fused interleukin-7 provides broad antiviral effects against respiratory virus infections through IL-17A-producing pulmonary innate-like T cells. Cell Reports Medicine (in press)
2. Sora Kim, et al., Seung-Woo Lee. 2021. Fc-fused IL-7 mobilizes long-term HSCs in a pro-B cell-dependent manner and synergizes with G-CSF and AMD3 100. Leukemia. 35(10) 3030-3034.
3. Sookjin Moon, et al., Seung-Woo Lee. 2021. Niche-specific MHC II and PD-L1 regulate CD4 CD8aa intraepithelial lymphocyte differentiation. J Exp Med. 218(4): e20201665.
4. Gihoon You, et al., Seung-Woo Lee. 2021. B7-H3×4-1BB bispecific antibody augments antitumor immunity by enhancing terminally differentiated CD8 tumor-infiltrating lymphocytes. Sci. Adv. 7(3): eaax3160.
5. Young-Min Kim, et al., Seung-Woo Lee. 2020. Airway G-CSF identifies neutrophilic inflammation and contributes to asthma progression. Eur Respir J. 55(2): 1900827-1900912.
6. Seungwon Lee, et al., Seung-Woo Lee. 2019. Bone marrow CX3CR1+ mononuclear cells relay systemic microbiota signal to control hematopoietic progenitors in mice. Blood. 134(16): 1312-1322 (Cover article)

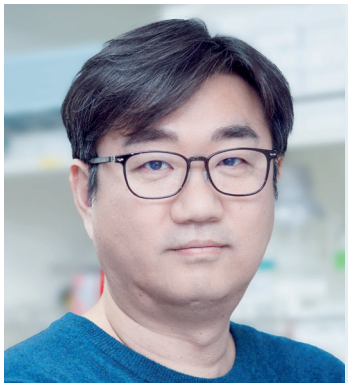


4-1BB targeting bispecific antibody augments antitumor immunity by enhancing terminally differentiated CD8+ tumor-infiltrating lymphocytes



The enhanced antitumor activity by combination with rhIL-7-hyFc and T cell engager antibody

Lab. of **Cancer and Immune Regulation**



Prof. **Yoontae Lee**

Contact

Phone: +82-54-279-2354

E-mail: yoontael@postech.ac.kr **Homepage (lab):** https://sites.google.com/view/postechleelab

Education

B.S., Seoul National Univ., Seoul, Korea (2001)

M.S., Seoul National Univ., Seoul, Korea (2003)

Ph.D., Seoul National Univ., Seoul, Korea (2006)

Research Introduction

Research areas that we are interested in include cancer and immunology. We have been identifying and investigating novel factors that regulate various immune disorders, including autoimmune diseases, sepsis, and cancers. We are also interested in castration-resistant prostate cancer development.

For our studies, we employ various experimental tools and skills, ranging from molecular and cellular biology to in vivo mouse physiology. The main goal of our study is to provide better insights on therapeutics for cancers and immune disorders.

Career

2007-2011: Postdoctoral Fellow, HHMI at Baylor College of Medicine, Houston, USA.

2011-2015: Assistant professor, Department of Life Sciences, POSTECH

2015-2022: Associate professor, Department of Life Sciences, POSTECH

2022-Present: Professor, Department of Life Sciences, POSTECH

Major Awards/Honors

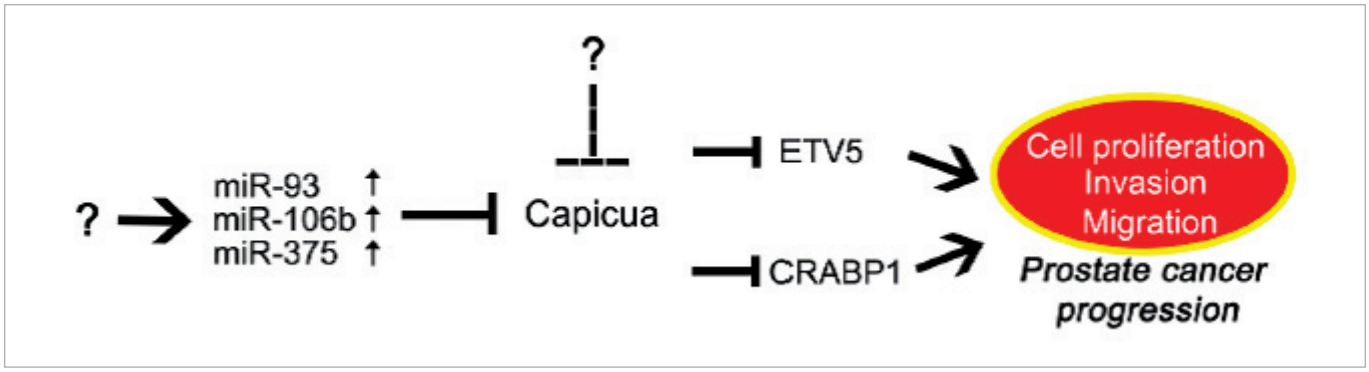
- Best thesis award (Korean Society for Molecular and Cellular Biology, 2006)
- Weintraub graduate student award (Fred Hutchinson Cancer Research Center at Seattle, 2006)
- BK21 distinguished studentship, President award (Korean Ministry of Science and Technology, 2006)
- Knowledge creation award (Korean Ministry of Science, ICT and Future Planning, 2013)
- Blue Ribbon Lecturer (Korean Society for Molecular and Cellular Biology, 2019)
- Macrogen scientist award (Korean Society for Molecular and Cellular Biology, 2022)
- Mueunjae chair professor (POSTECH, 2022)

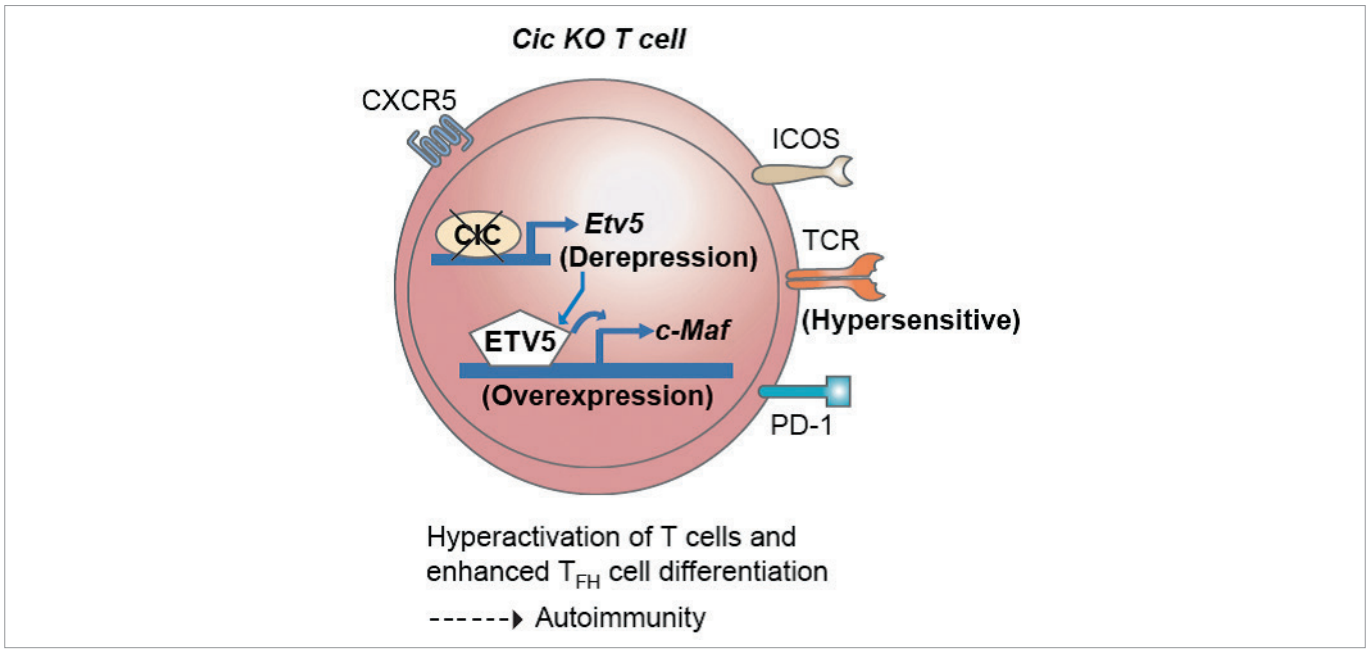
Research Areas

1. Mechanisms underlying tumorigenesis and cancer metastasis.
2. Regulation of immune cell development and immune homeostasis.
3. Regulation of Capicua transcriptional repressor activity.

Major Publications

1. Hong et al. (2022) Cell Reports 38(7):110386
2. Kim et al. (2021) eLife 10:e71769
3. Lee (2020) Experimental and Molecular Medicine 52:531-537
4. Yoe et al. (2020) Oncogene 39:3489-3506
5. Park et al. (2019) Hepatology 70(1):358-371
6. Kim et al. (2018) Hepatology 67(6):2287-2301
7. Park et al. (2017) Nature Communications 8,16037


?
?
miR-93
miR-106b
miR-375
Capicua
ETV5
CRABP1
Cell proliferation
Invasion
Migration
Prostate cancer progression


Cic KO T cell
CXCR5
ICOS
CIC
Etv5
(Derepression)
TCR
(Hypersensitive)
ETV5
c-Maf
(Overexpression)
PD-1
Hyperactivation of T cells and
enhanced T_{FH} cell differentiation
Autoimmunity

Lab. of **Immune Regulation and Tolerance (IRT)**

Prof. **Sin-Hyeog Im**

Contact

Phone: +82-54-279-2356 **Fax:** +82-54-279-0639
E-mail: iimsh@postech.ac.kr **Homepage (lab):** http://irt.postech.ac.kr/

Education

B.S., Korea Univ., Seoul, Korea (1987)
M.S., Korea Univ., Seoul, Korea (1989)
Ph.D., Weizmann Institute of Science, Israel (2001)

Research Introduction

Our body's immune system constantly faces the decision of whether to activate immune responses (immunity) or regulate (suppress) them (tolerance). When this finely tuned immune homeostasis is disrupted, various immune disorders arise. Particularly, immune hypersensitivity leads to allergic diseases such as atopic dermatitis and asthma, as well as autoimmune diseases like rheumatoid arthritis and juvenile diabetes. Therefore, in our laboratory, we investigate the mechanisms underlying the maintenance of immune homeostasis at the molecular and cellular immunological levels. Specifically, we conduct research to develop and elucidate the mechanisms of action of gut-targeted immunomodulatory agents that can control immune hypersensitivity reactions.

Career

1991-1996: Senior Research Scientist, Research Center of Chong Kun Dang Pharmaceutical Company, Seoul, Korea.
2001-2003: Postdoctoral Fellow, Department of Pathology, Harvard Medical School
2004-2008: Assistant Professor, School of Life Sciences, Gwangju Institute of Science and Technology (GIST)
2008-2012: Associate Professor, School of Life Sciences, Gwangju Institute of Science and Technology (GIST)
2012-2013: Professor, School of Life Sciences, Gwangju Institute of Science and Technology (GIST)
2014-Present: Professor, Division of Integrative Biosciences and Biotechnology, POSTECH
2014-2019: Group leader & Acting director, Academy of microbiology and Immunology, Institute of Basic Science,
2019-Present: CEO and founder, ImmunoBiome Inc.

Major Awards/Honors

- Cancer Research Institute Fellowship (USA, 2001-2004)
- Young Investigator Award by the Society of Biomedical Research (USA, 2003)
- Top 100 Achievements of National R&D (Korean government, 2011)
- Academic Research award (Korean Society for Molecular and Cellular Biology Academic Award, 2019)
- KAI-Genexine Grand Achivement Awards (Korean Association of Immunologists Academic Award, 2020)

Research Area

1. Immune regulation and tolerance at the cellular and molecular level:
   - Role of Etsl transcription factor in the biogenesis of Treg cells,
   - Molecular and cellular mechanism of TFH and TFR cells generation in health and disease
2. Molecular mechanism of IL-10 gene regulation in CD4 T cells and B cells:
   - Cross-talk between cis- and trans- acting factors
3. Role of gut microbiota in the development of diverse immune disorders and elucidation of underling mechanism of action.
4. Molecular mechanism of Treg cell or effector T cells generation induced by rationally selected bacteria: Identification of effector molecules and elucidation of underlying mechanism of action

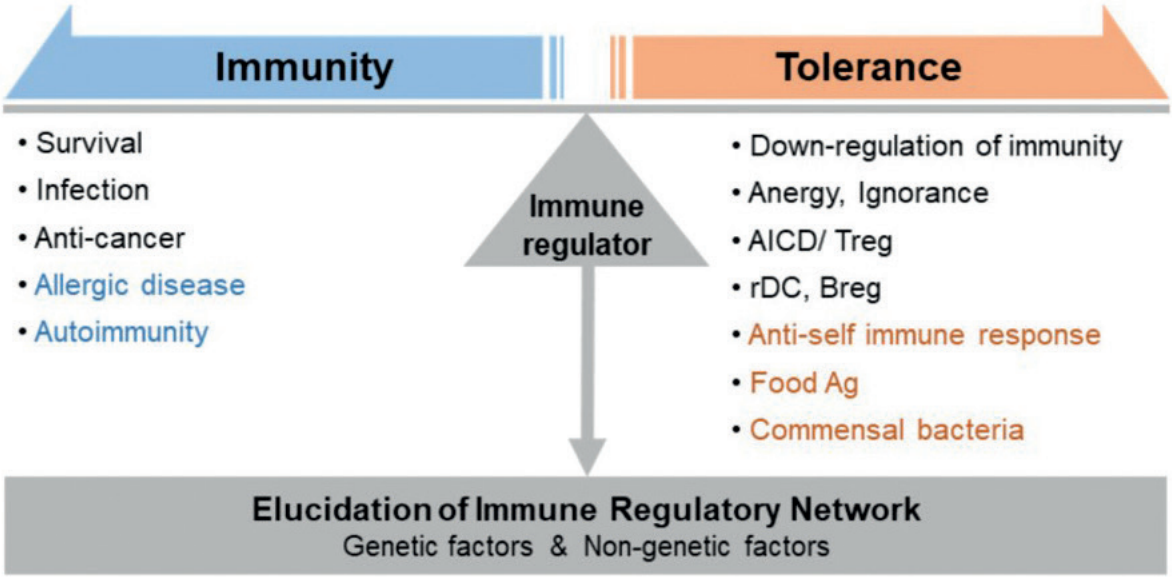
Major Research Achievements

- Defining the role of transcription factors (Etsl and NFATl) in immune regulation
- Discovery of the key cis- and trans-acting regulatory elements involved in IL-10 gene regulation
- Rationally selected probiotics as an immune modulator for hyperimmune disorders (autoimmunity and allergic disorders) and cancer

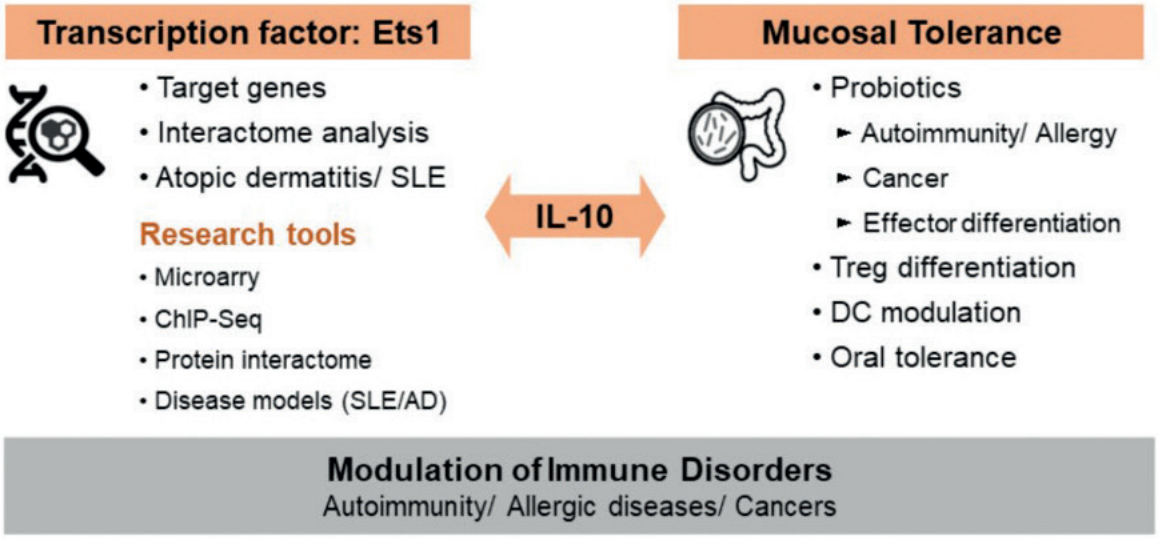
Major Publications

1. Exploring probiotic effector molecules and their mode of action in gut-immune interactions. FEMS Microbiology Reviews, 2023 Aug 4. fuad046, https://doi.org/10.1093/femsre/fuad046
2. Resolving the Mutually Exclusive Immune Responses of Chitosan with Nanomechanics and Immunological Assays. Adv Healthc Mater 2022 Apr 9;e2102667. doi: 10.1002/adhm.202102667.
3. Structural specificities of cell surface β-glucan polysaccharides determine commensal yeast-mediated immuno-modulatory activities. Nat Commun. 2021. June 14; 12(1):3611
4. Probiotics-derived metabolite ameliorates skin allergy by promoting differentiation of FOXP3+ regulatory T cells. J Allergy Clin Immunol 2021. 147 (4), 1517-1521
5. Harnessing the Bioresponsive Adhesion of Immuno-Bioglue for Enhanced Local Immune Checkpoint Blockade Therapy. Biomaterials. 2020: 263:120380
6. Of Men in Mice: The Development and Application of a Humanized Gnotobiotic Mouse Model for Microbiome Therapeutics. Exp Mol Med. 2020. Sep;52(9):1383-1396. doi.org/10.1038/s12276-020-0473-2. (Invited review).
7. Intestinal Microbiota Controls Acute Kidney Injury Severity by Immune Modulation. Kidney Int. 2020: S0085-2538(20)30553-6
8. Structural features and immunological perception of the cell surface glycans of Lactobacillus plantarum: a novel rhamnose-rich polysaccharide and teichoic acids. Carbohydr Polym. 2020; 233:115857.

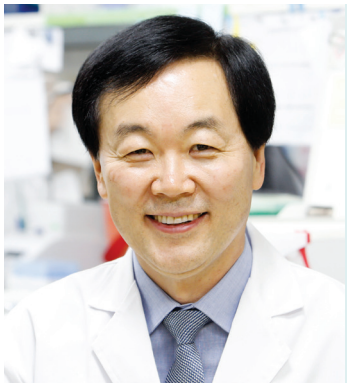
Immunological Homeostasis



Modulation of Immunological Homeostasis



Lab. of **Molecular Virology**



Prof. **Sung Key Jang**

Contact

Phone: +82-54-279-2298 **Fax:** +82-54-279-8009
E-mail: sungkey@postech.ac.kr **Homepage (lab):** http://mv.postech.ac.kr/

Education

B.S., Seoul National University, Seoul, Korea (1982)
M.S., Seoul National University, Seoul, Korea (1984)
Ph.D., University of New York, Stony Brook, USA (1989)

Research Introduction

Recently we reported that the initiation of eukaryotic mRNAs occurs by 'RNA looping' rather than by 'ribosome scanning'. According to the RNA looping hypothesis, translation begins with the association of a 40S ribosomal subunit with translation enhancing elements such as 5' cap, poly(A) tail and an IRES element. The association of a 40S ribosomal subunit to an mRNA, which is called 43S ribosomal preinitiation complex formation, is mediated by translational initiation factors such as eIF4E, eIF4G, PABP and eIF3. At this stage, various parts of the mRNA collide with the 43S ribosomal complex associated with the mRNA. The probability of collision between the 43S ribosome and a particular region on the mRNA depends on the length and the stiffness of the intervening segment between the target region and the 43S ribosome. And the effectiveness of the collision between the 43S ribosome and the initiation codon for the successful engagement of translation is affected by the single-strandedness and nucleotide sequence (Kozak's context) of around the initiation codon. We provided several lines of evidence proving the 'RNA looping hypothesis' using biochemical, molecular biological and mathematical approaches. We also investigate into the translational regulation mechanism under stress conditions. Particularly we are interested in how some of eukaryotic mRNAs are translationally active when translation of most mRNAs is repressed by various stresses. We found a new carrier of initiator tRNA (tRNAi) named eIF2A that facilitates loading of tRNAi onto the 40S ribosomal subunit under stress conditions. We found that c-Src mRNA, which is refractory to translational repression by stress, utilizes eIF2A for translation under stress conditions and that the eIF2A-mediated translation is essential for proliferation of cancer cells under stress conditions.

HCV is a pathogenic virus causing hepatitis, liver cirrhosis, and hepatocellular carcinoma. More than 170 million people are suffering from this virus infection worldwide. We are investigating the molecular basis of the pathogenic processes of HCV including the induction of inflammatory response and fibrogenesis. Moreover, we are trying to develop an anti-HCV drug based on the inhibition of NS5A activities required for viral RNA replication and virus assembly.

Career

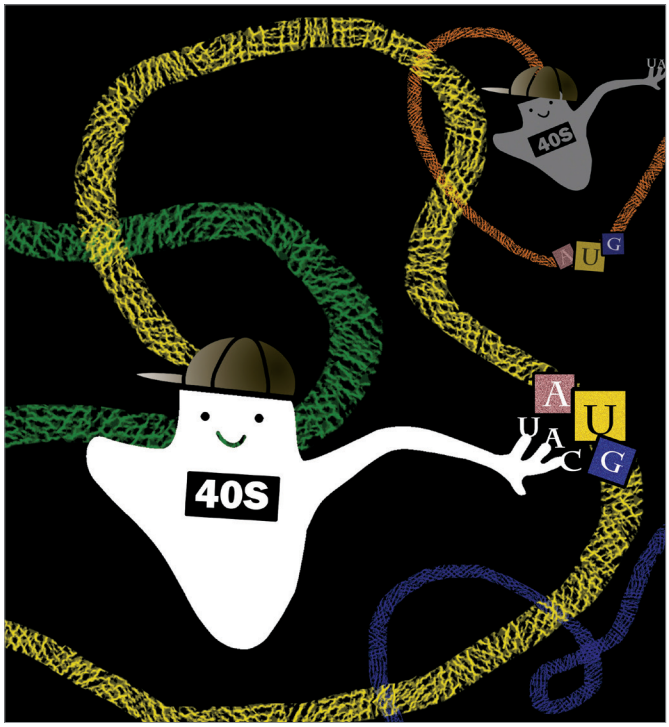
1989-1991: Postdoctoral associate, University of New York at Stony Brook
1991-2003: Assistant and associate professor, POSTECH
2001-2003: CEO, Panbionet Inc.
2003-Present: Professor, POSTECH
2009-Present: CSO, Aptamer Sciences Inc.
2013-2014: Head, Department of Life Sciences
2014-Present: Director, POSTECH Biotech Center
2018-Present: Fellow, Korean Academy of Science of Technology

Research Areas

- Hepatitis C Virus (HCV): Development of anti-HCV drugs
- Translation initiation mechanisms via cap and IRES elements
- Development of a subtype specific diagnostic tool for influenza virus using aptamers

Major Publications

1. Kwon OS, et al., (2017) Nucleic Acids Res. 45, 296-310
2. Paek KY, et al., (2015) Proc. Natl. Acad. Sci. USA 112, 1041-6
3. Lee SH, et al., (2014) Nucleic Acids Res. 42, 2697-707
4. Seo K, et al., (2013) Aging Cell 12, 1073-81.
5. Paek KY, et al., (2012) Nucleic Acids Res. 40, 7541-51.
6. Kim JH, et al., (2011) EMBO J. 30, 2454-64.



Translation initiation mediated by RNA looping: The cartoon depicts the 40S ribosomal subunit, which is associated with the 5’ cap structure, directly recognizes the initiation codon through an interaction between the initiation codon on mRNA and the tRNAi on the 43S ribosomal complex associated with 5’ cap structure. The 40S ribosome finds the initiation codon through a collision with the initiation codon mediated by looping out of the intervening segment. The frequency of effective collision is governed by position (probability of collision between the 40S ribosome and a specific site on the mRNA), context, and the accessibility of a specific AUG.

Lab. of **MIcrobial MEtabolite Signal Transduction** (MIME-ST lab)

Prof. **Ara Koh**

Contact

Phone: +82-54-279-2320
E-mail: graceara@postech.ac.kr **Homepage (lab):** https://arakoh.wixsite.com/arakoh

Education

B.S., Sogang University, Korea (2005)
Ph.D., POSTECH, Korea (2013)

Research Introduction

Dr. Ara Koh's research focuses on understanding how the gut microbiome influences human diseases (such as diabetes, cancer, and necrotizing enterocolitis) and responds to therapeutic interventions (including drugs, surgery, and diet). The goal is to develop microbiome-based therapeutics that can reduce inter-individual variations. Specifically, Dr. Koh's lab investigates the role of microbially produced metabolites and their interactions with host signaling pathways, which are important for host metabolism. The research employs various methods such as microbiome community cultures, human tissue-derived organoid systems, cell culture systems, and relevant disease models.

Career

2006-2007: Visiting Researcher, Stanford University School of Medicine
2014-2014: Postdoctoral Fellow, Department of Life Sciences, POSTECH
2014-2019: Postdoctoral Fellow, University of Gothenburg and Sahlgrenska Hospital
2020-2021: Assistant Professor, Sungkyunkwan University School of Medicine
2021-Present: Assistant Professor, Department of Life Sciences POSTECH
2021-Present: FEMS (The Federation of European Microbiological Societies) Deputy Ambassador
2023-Present: Associate Editor for npj Biofilms and Microbiomes (IF 9.2)

Research Areas

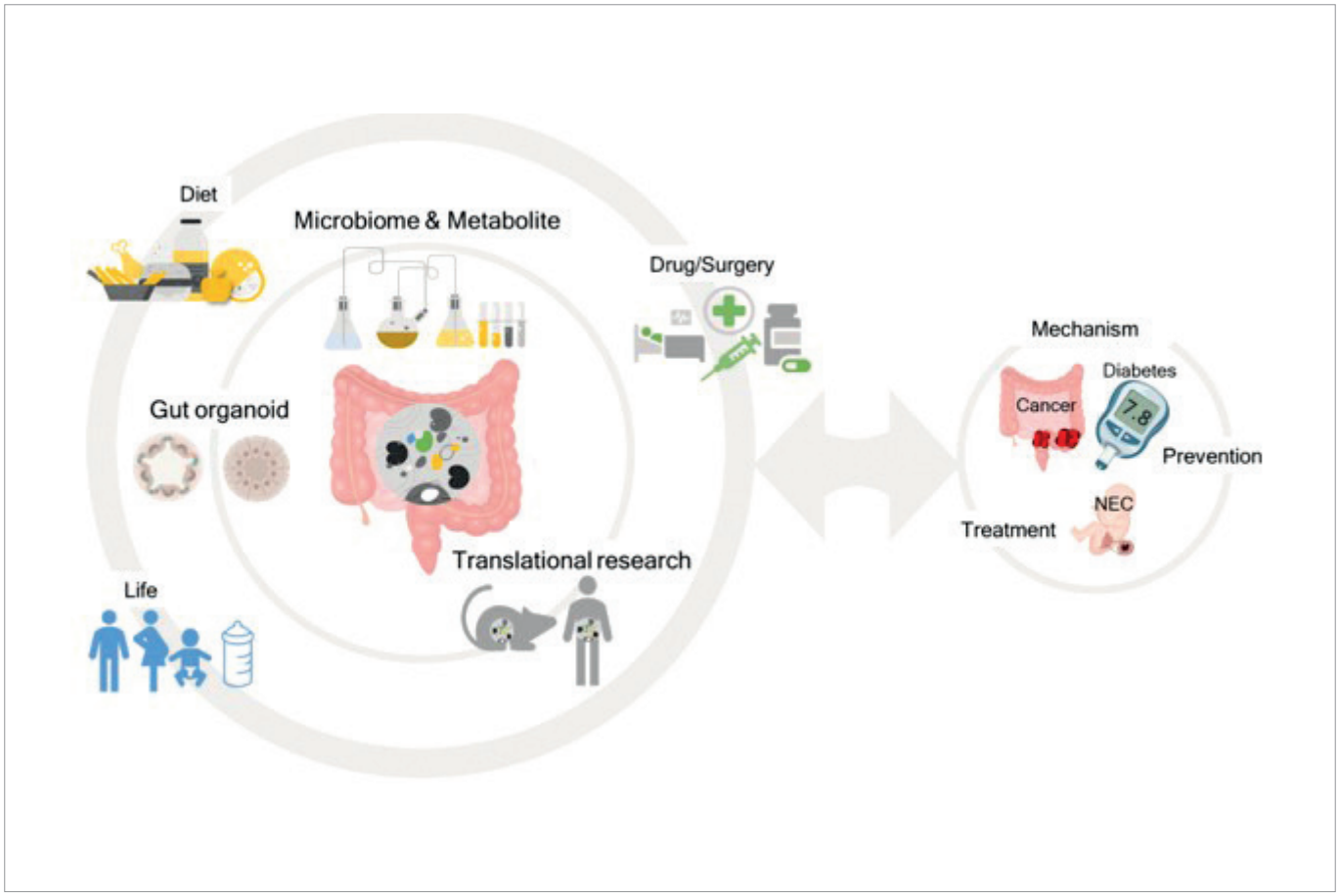
- Identification of bioactive microbial products associated with our health and disease
- Molecular mechanism of microbial products
- Long-term effects of the microbiome in the small intestine (organoid system)
- Microbiome-based therapeutics for maturation of the intestine from premature infants (Collaboration with Samsung Medical Hospital, use of biopsies from premature infants)

Major Awards/Honors

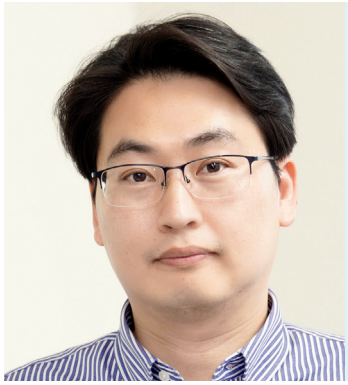
- Scholarship and Travel Award at Keystone Symposia by Keystone Symposia (2016)
- Scholarship and Travel Award at Keystone Symposia by Keystone Symposia (2018)
- POSCO Science Fellowship of POSCO TJ Park Foundation (2021)
- Samsung Research Funding & Incubation Center of Samsung Electronics (2023-2028)

Major Publications

1. Koh A* et al., (2020) Cell Metab., 32 (4): 643-653 *First and Co-corresponding author. (IF 21.567, JCR rank 1.748%)
2. Koh A* et al., (2020) Mol Cell., 78 (4):584-596. *First and Co-corresponding author. (IF 15.584, JCR rank 1.178%)
3. Molinaro A*, Koh A*, et al., (2020) Mol Metab., *Co-first authors. (IF 6.448, JCR rank 8.741%)
4. Koh A, et al., (2018) Cell., 175 (4): 947-961. (IF 38.637, JCR rank 0.618%)
5. Koh A, et al., (2016) Cell., 165 (2): 1332-1345. (IF 38.637, JCR rank 0.618%)


Diet
Microbiome & Metabolite
Drug/Surgery
Gut organoid
Mechanism
Cancer
Diabetes
7.8
Prevention
NEC
Treatment
Translational research
Life

Lab. of **Computational Biology**



Prof. **Jong Kyoung Kim**

Contact

Phone: +82-54-279-2353
Fax: +82-54-279-2199
E-mail: blkimjk@postech.ac.kr
Homepage (lab): https://cb.postech.ac.kr/

Education

B.S., POSTECH, Korea (2004)
M.S., POSTECH, Korea (2006)
Ph.D., POSTECH, Korea (2010)

Research Introduction

By integrating three innovative technologies of single-cell multi-omics, genome editing, and machine learning, we aim to address the following three research questions:

1. What are the genetic and molecular drivers of phenotypic heterogeneity across cells, organs, individuals, and species?
2. How does the collective behavior of a community of cells emerge from the behavior and cellular interactions of individual cells?
3. What are the roles of cellular heterogeneity in the collective behavior of organs or individuals across environments, diseases and species?

Career

2010 - 2011: Postdoctoral Fellow, Department of Computer Science, POSTECH
2011 - 2016: Research Scientist, EMBL-EBI, UK
2016 - 2020: Assistant Professor, Department of New Biology, DGIST
2020 - 2021: Associate Professor, Department of New Biology, DGIST
2022 - Present: Associate Professor, Department of Life Sciences, POSTECH

Major Awards/Honors

- Microsoft Research Asia Fellowship, Microsoft Research Asia (2006)
- TJ Park Bessemer Science Fellowship, POSCO TJ Park Foundation (2009)
- Best Dissertation Award, Department of Computer Science and Engineering, POSTECH (2010)
- Excellent Research Award, DGIST (2018)
- Excellent Academic Research Award, DGIST (2019)

Research Areas

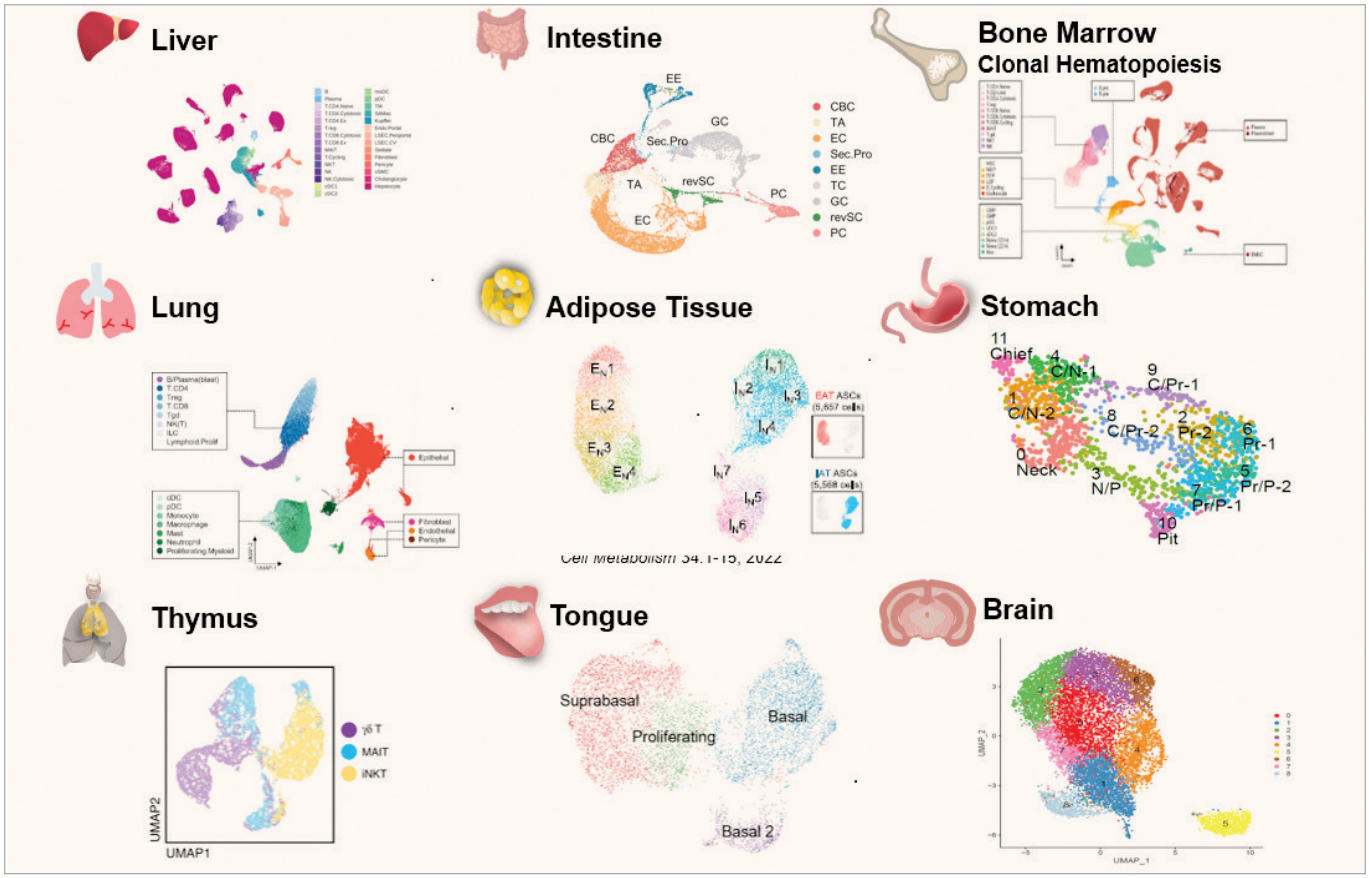
- Single-cell multi-omics
- Bioinformatics
- Machine learning
- Genome-wide genetic screening

Activities

- Editorial Board Member, Molecules and Cells (2021 - 2023)
- Promotion Committee Member, The National Project of Bio Big Data (2021 - Present)
- Academic Committee Member, The Korean Cancer Association (2020 - 2021)
- Steering Committee Member, Korean Society for Molecular and Cellular Biology (2021)

Major Publications

1. Han et al., (2023) Nature Aging 3:982-1000
2. Kim et al., (2023) Science Advances 9:eadi8454
3. Ha et al., (2022) Science Advances 8:eabk1239
4. Lee et al., (2022) Cell Stem Cell 29:826-839
5. Kwon et al., (2022) Nature Communications 13:1418
6. Nahmgoong et al., (2022) Cell Metabolism 34:458-472
7. Lee et al., (2020) Nature Communications 11:4367
8. Han et al., (2019) Cell Stem Cell 25:342-356



Cell Metabolism 34, 1–15, 2022

Lab. of **Synthetic Biology and Molecular Computing**

Prof. **Jongmin Kim**

Contact

Phone: +82-54-279-2322 **Fax:** +82-54-279-0666
E-mail: minijong@postech.ac.kr **Homepage(lab):** http://jkimlab.postech.ac.kr/

Education

B.S., POSTECH, Korea (2000)
Ph.D., California Institute of Technology, USA (2007)

Research Introduction

Synthetic biology aims to provide a principled approach towards building biological entities with complex and novel functionality using modular and programmable parts. Precise and programmable control of gene expression is becoming a basic requirement for many biological and biotechnological research applications.

To date, synthetic biology approaches yielded novel and sophisticated gene circuitry including molecular counters, synchronized oscillators, logic gates, memory devices, and analog signal processors.

Due to its simple base-pairing rules and well-characterized thermodynamic parameters, RNA molecules can form the basis of de–novo-designed synthetic regulators of gene expression. Recent advances in RNA nanotechnology, to which I have contributed with my postdoctoral work, will enable RNA components to sense and regulate gene expression with high sensitivity and fast dynamics and serve as a broadly enabling platform for many areas with biomedical applications. For instance, the ability to detect the dynamics of antibiotic resistance in bacterial populations and biofilms can serve as one of the first steps for developing anticipatory medical and cellular devices. Further, we expect that the technology developed for prokaryotic riboregulators can be adapted to eukaryotic systems in the future.

Career

2007-2010: Senior Researcher, CbsBioscience Inc.
2010-2014: Postdoctoral Scholar, California Institute of Technology
2014-2018: Postdoctoral Research Fellow, Wyss Institute, Harvard University
2018: Senior Scientist, NuProbe USA Inc.
2018-Present: Assistant Professor, Dept. of Life Sciences, POSTECH

Research Area

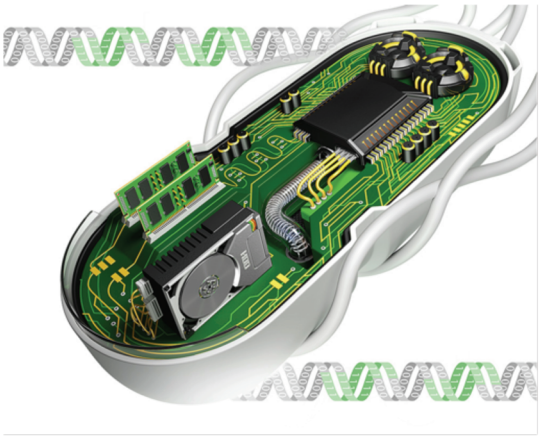
- Synthetic biological circuits
- Smart probiotics
- Nucleic acid engineering
- Molecular computation

Major Publications

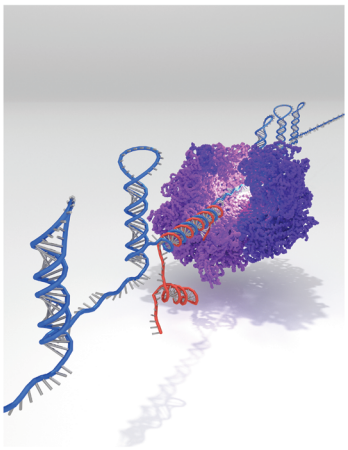
1. Kim J, Simmel FC, (2022) Nature Chemistry 14, 1210-1211
2. Kim J, et al., (2019) Nature Chemical Biology 15, 1173-1182
3. Green AA*, Kim J*, et al., (2017) Nature 548, 117-121
4. Kim J, et al., (2014) Nucleic Acids Research 42, 6078-6089
5. Weitz M, Kim J, et al., (2014) Nature Chemistry 6, 295-302
6. Kim J, et al., (2011) Molecular Systems Biology 7, 465
7. Kwon JH*, Kim J*, et al., (2010) Clinical Cancer Research 16, 5511-5521
8. Kim J, et al., (2010) Cancer Science 101, 1521-1528
9. Kim J, et al., (2006) Molecular Systems Biology 2, 68

Synthetic Biology and Molecular Computing Lab

jkimlab.postech.ac.kr

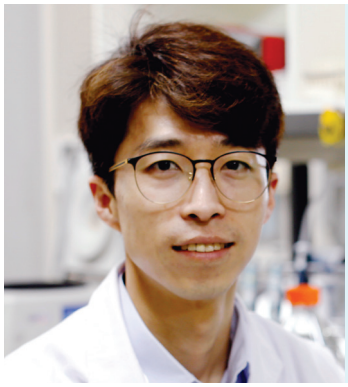


MIT News 2013



Synthetic biology aims to build increasingly complex biological systems and engineer organisms to perform novel functions. As shown in the figure, the ultimate goal of synthetic biology is to be able to create complex and versatile biological systems much as computers. We are broadly interested in developing synthetic biological devices with applications in biosensing, imaging, and potentially in diagnostics and therapeutics. We have demonstrated programmable biomolecular oscillator in test tubes and ribocomputing systems in the cell.

Lab. of **Membrane and organelle biology**



Prof. **Seung-Yeol Park**

Contact

Phone: +82-54-279-2325
E-mail: seungpark@postech.ac.kr **Homepage (lab):** http://mbl.postech.ac.kr/

Education

B.S., Ajou University (2006)
Ph.D., KAIST (2011)

Research Introduction

The Golgi complex plays a pivotal role in the secretory pathway. After synthesis in the endoplasmic reticulum (ER), cargoes traverse to the Golgi complex, enabling their transport to final destinations with the appropriate glycosylation. Extensive research has uncovered that organelles in the secretory pathway exert regulatory control over diverse cellular processes, including signal transduction, metabolism, autophagy, and polarity.
The distinct structure of the Golgi complex undergoes changes in patients with specific cancers, immunodeficiency, and neurodegenerative diseases. Consequently, our enduring challenge extends beyond comprehending the mechanisms underlying cargo transport in the secretory pathway to unraveling the molecular dynamics of the membrane under varying conditions.

Career

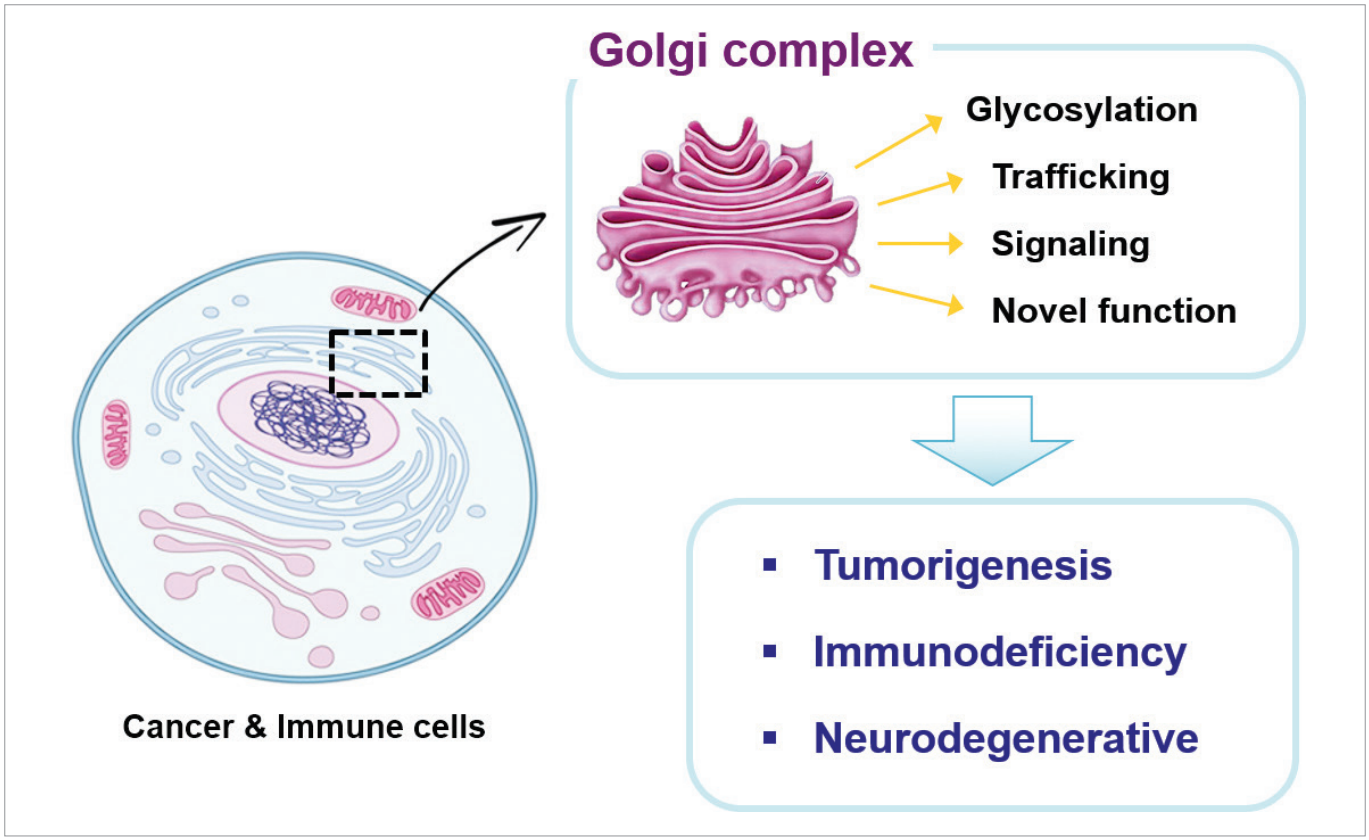
2008-2009: Visiting scientist, University of Washington & PNRI
2011-2017: Postdoctoral fellow, Brigham and Women's Hospital & Harvard Medical School
2017-2019: Instructor, Brigham and Women's Hospital & Harvard Medical School
2019-Present: Assistant Professor, POSTECH

Research Areas

- Membrane dyanmics and trafficking
- Golgi complex and organelle network
- Glycosylation in cancer & immunology
- Golgi signal related to aging process

Major Publications

1. Terminal fucosylation of haptoglobin in cancer-derived exosomes during cholangiocarcinoma progression. Front Oncol. 2023
2. Schizophrenia-associated Mitotic Arrest Deficient-1 (MAD1) regulates the polarity of migrating neurons in the developing neocortex. Mol Psychiatry. 2023
3. MON-2, a Golgi protein, mediates autophagy-dependent longevity in Caenorhabditis elegans. Sci Adv. 2021
4. Combined immunodeficiency due to a mutation in the γ1 subunit of the coat protein I complex. J Clin Invest. 2021
5. The late stage of COPI vesicle fission requires shorter forms of phosphatidic acid and diacylglycerol. Nat Commun. 2019
6. GAPDH inhibits intracellular pathways during starvation for cellular energy homeostasis. Nature. 2018
7. Coordinated regulation of bidirectional COPI transport at the Golgi by CDC42. Nature. 2015


Golgi complex
Glycosylation
Trafficking
Signaling
Novel function
Cancer & Immune cells
Tumorigenesis
Immunodeficiency
Neurodegenerative

Lab. of **Microbiome and Human Diseases**

Prof. **Woongjae Yoo**

Contact

Phone: +82 54-279-2358
E-mail: : wjyoo@postech.ac.kr **Homepage (lab):** https://sites.google.com/view/woongjae-yoo-website

Education

B.S., Chung-Ang University, Korea (2011)
Ph.D., Seoul National University, Korea (2017)

Research Introduction

In high-income countries, the leading causes of death are non-communicable diseases, such as Inflammatory Bowel Disease (IBD), cancer, and cardiovascular disease. An important feature of most non-communicable diseases is inflammation-induced gut dysbiosis characterized by a shift in the microbial community structure from obligate to facultative anaerobes such as Proteobacteria. This microbial imbalance can contribute to disease pathogenesis due to either a microbiota-derived metabolite being depleted or produced at a harmful concentration. However, little is known about the mechanism by which inflammation mediates changes in the host physiology to induce disruption of the microbial ecosystem in our large intestine leading to disease.

Our group uses a multidisciplinary approach combining microbiology, molecular biology, cell biology, immunology, and pathology to understand how inflammation-dependent changes in host metabolism can result in gut dysbiosis and increased risk of non-communicable disease. Specifically, we used various mouse models, including diet-induced-obesity, chemical-induced colitis, and germ-free animals, to identify metabolic pathways in the gut bacteria and in the host response to microbiota-induced metabolites that will aid in the prevention of human disease. Our group also tries to figure out the mechanisms by which gut microbes adapt and overcome this harsh intestinal inflammatory condition by regulating their metabolism and gene expression.

Another arm of our research program focuses on how intestinal inflammation caused by the bacterial pathogen *Salmonella enterica* serovar Typhimurium induces changes in host physiology and how these changes can cause disruption of the microbial ecosystem (microbiota) in our large intestine and promote pathogen colonization and disease.

Career

2017.3-2017.8: Postdoctoral Researcher (Seoul National University, Korea)
2017.9-2018.8: Postdoctoral Researcher (University of California at Davis, USA)
2018.9-2022.8: Postdoctoral Researcher (Vanderbilt University Medical Center, USA)
2022.9-2023.2: Research Instructor (Vanderbilt University Medical Center, USA)
2023.2-Present: Assistant Professor (POSTECH, Korea)
2023.9-Present: Adjunct Professor (Yonsei University, Korea)

Key Questions

- How do the host and the microbiota work together to promote health?
- What are the mechanisms leading to gut dysbiosis during inflammation?
- Can we identify the metabolic pathways in gut bacteria and the host response to microbiota-produced metabolites that will aid in the prevention of human diseases?
- Can we prevent non-communicable diseases by targeting host epithelial metabolism?
- Which mechanisms are used by enteric pathogens (e.g., *Salmonella* Typhimurium) to overcome microbiota-mediated colonization resistance?

Research Areas

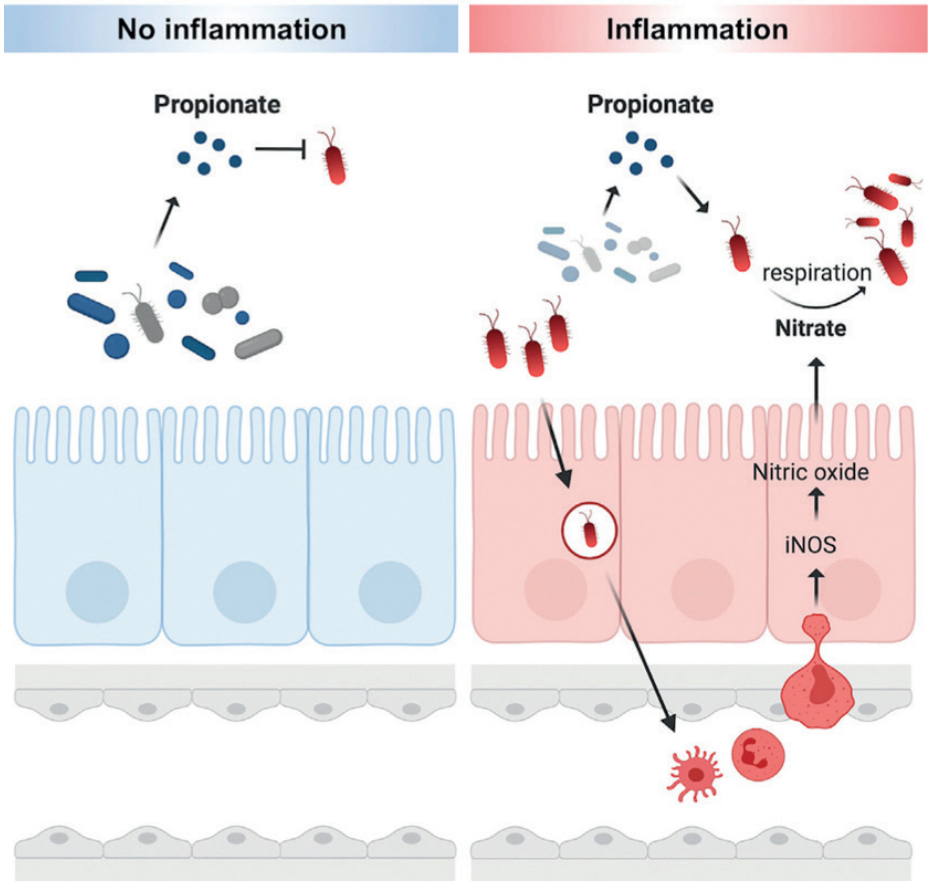
- Host-Microbe Interaction
- Bacterial Physiology and Metabolism
- Bacterial Pathogenesis
- Molecular Genetics of Bacteria
- Role of gut microbiota in high-fat diet-induced obesity and non-communicable diseases

Major Awards/Honors

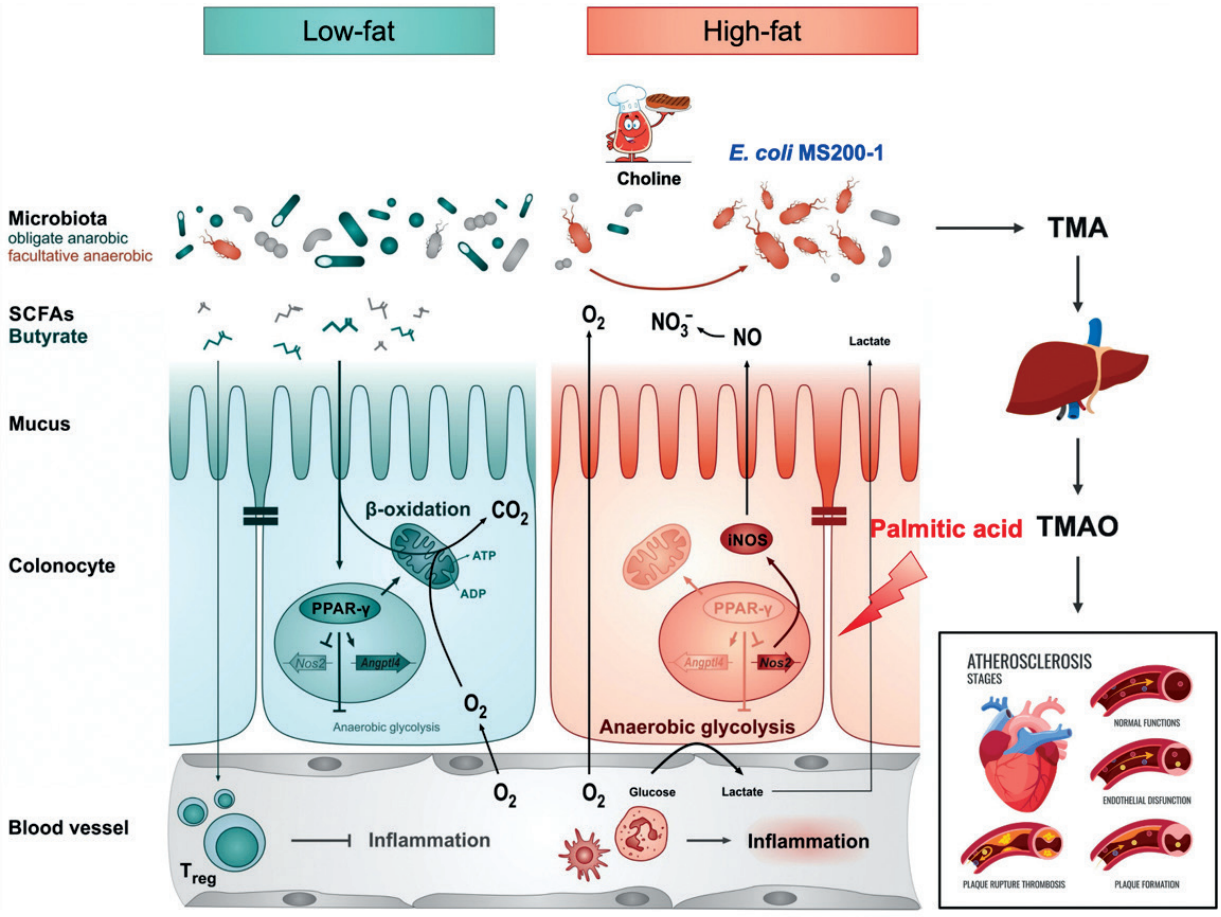
- Postdoctoral Fellowship Program (Nurturing Next-generation Researchers) in 2020 granted by National Research Foundation of Korea (NRF) (2020)
- Sidney P. Colowick Outstanding Postdoc Award in the Division of Molecular Pathogenesis, Vanderbilt University Medical Center, USA (2021)
- Singsong Award for Young Scientist, The Korean Society for Microbiology and Biotechnology (2022)

Major Publications

1. Shelton CD and Yoo W et al. (2023) An early-life microbiota-metabolite protects against obesity by regulating intestinal lipid metabolism. Cell Host & Microbe 31(10):1604-1619.e10.
2. Shelton CD & Yoo W et al. (2022) *Salmonella enterica* serovar Typhimurium uses anaerobic respiration to overcome propionate-mediated colonization resistance. *Cell Reports* 38(1): 110180
3. Yoo W et al. (2021) High-fat diet-induced colonocyte dysfunction escalates microbiota-derived trimethylamine *N*-oxide. *Science* 373(6556): 813-818



Shelton & Yoo et al. (2022) *Cell Reports* 38(1): 110180



Yoo et al. (2021) *Science* 373(6556): 813-818

Lab. of **Tumor Microenvironment and Metabolism**

Prof. **Min-Sik Lee**

Contact

Phone: +82 54-279-2351
E-mail: : minsiklee@postech.ac.kr **Homepage (lab):** https://cancermetabolism.postech.ac.kr/

Education

B.S., Sungkyunkwan University. Korea (2009)
M.S., Sungkyunkwan University. Korea (2011)
Ph.D., Yonsei University. Korea (2016)

Research Introduction

How cancer cells alter their metabolism and shape their distinctive metabolic milieu?, how cancer cells and other types of cell harness nutrients in their local environments (or Tumor MicroEnvironements, TMEs) for their benefits?, how systemic metabolism of the host affects TMEs and in turn influences the metabolism of cancer cells are major areas of focus in our lab.

The Lee lab conducts research that contributes to the treatment of cancer by understanding the altered metabolic behaviors of cancer cells and identifying vital metabolic mechanisms for cancer growth and survival. The understanding of tumor metabolism has gained significant attention and has become the hallmark of cancer in recent decades. However, previous metabolic studies focused on cancer cells have had limitations due to the insufficient consideration of the tumor's growing environment.

1. Our research team aims to analyze and elucidate the metabolic characteristics of the tumor microenvironment (TME) using cutting-edge technologies and ideas. 2. We observe how various types of cancer adapt to their unique metabolic environments through multi-omics approach and 3. further investigate key metabolic mechanisms required for tumor growth and survival in the context of in vivo using state-of-the-art genetically engineered mouse and surgical mouse models, and fresh tissue samples from cancer patients. Our research encompasses the development of therapies, starting from fundamental research to assess whether these key metabolic mechanisms can be utilized as treatment targets. The Lee lab eagerly awaits the support of motivated and curious students and researchers to work together in overcoming the unsolved challenges in the development of cancer treatments targeting metabolism.

Career

2016-2017: Postdoctoral Fellow, Dept. of Biochemistry, Yonsei University, Korea
2017-2023: Postdoctoral Fellow, Div. of Endocrinology, Boston Children's Hospital/Harvard Medical School, USA
2023-Present: Assistant Professor, Dept. of Life Sciences, POSTECH, Korea

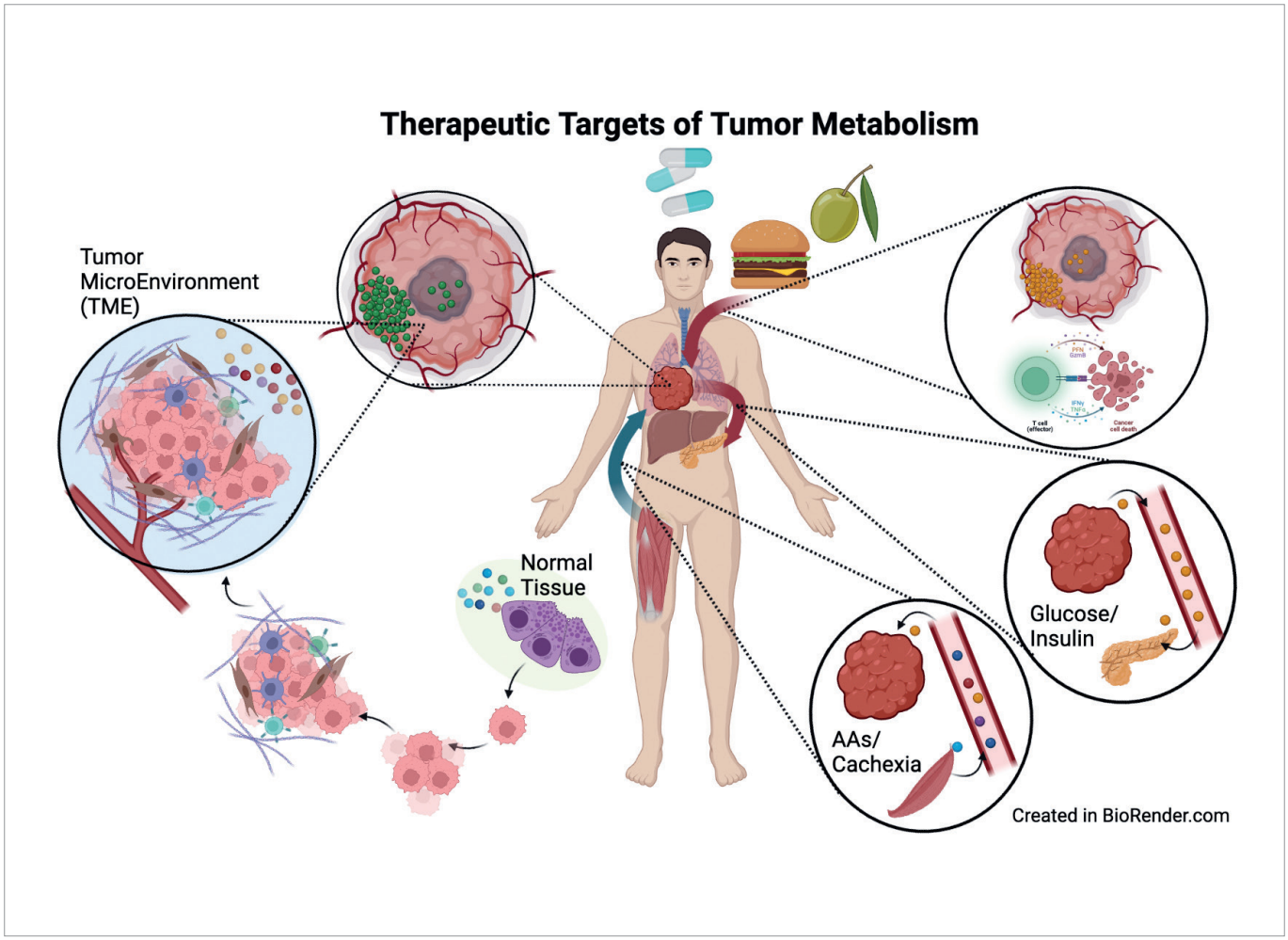
Research Areas

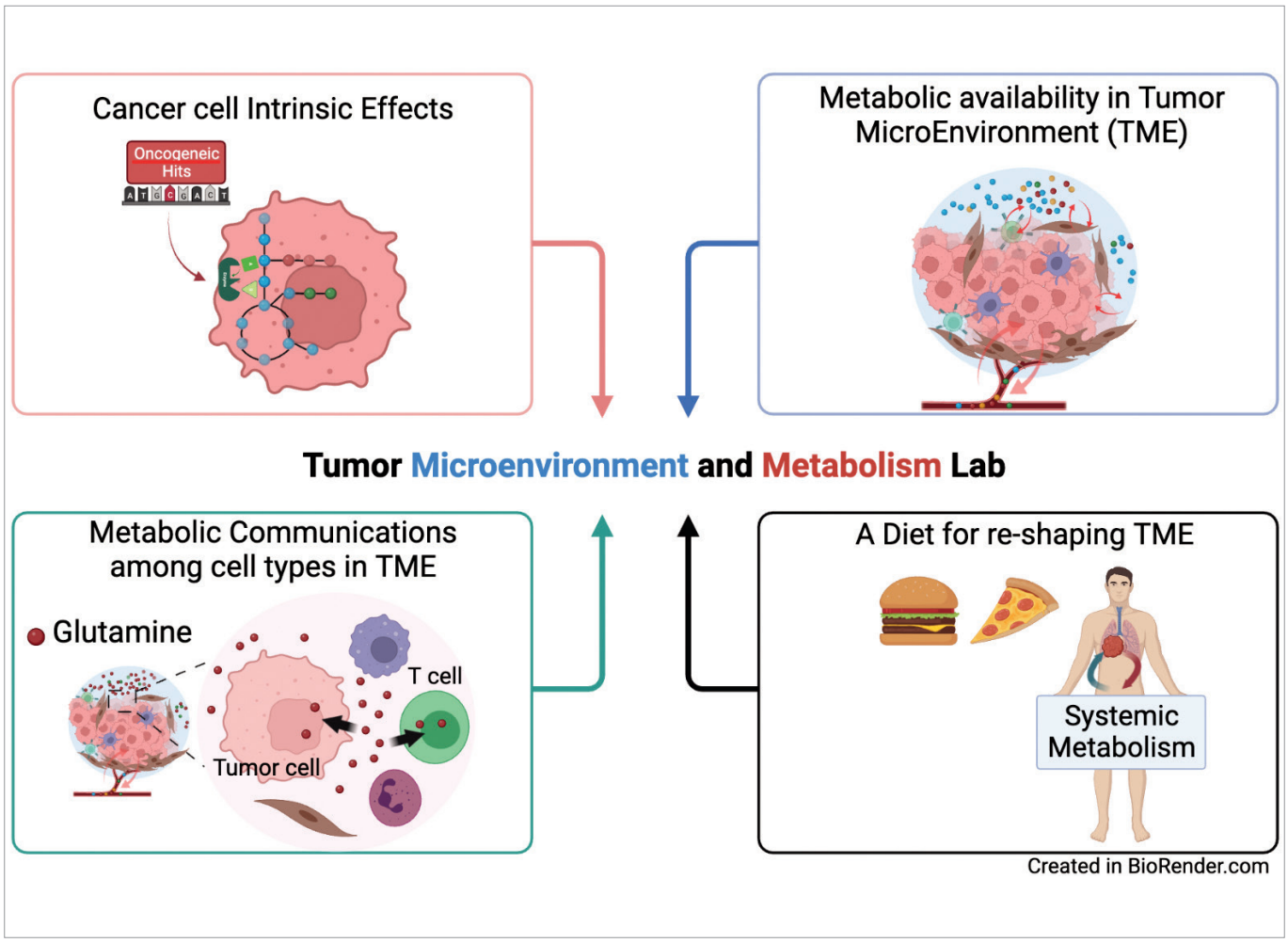
Cancer Metabolism and Tumor Microenvironment

- Deciphering metabolic composition in Tumor MicroEnvironment (TME)
- Cancer metabolism and behavior
- Metabolic competition/cooperation between Cancer cells and Other cell types
- Systemic metabolism and Cancer behavior
- Metabolic Tracing in Cell, Live animal, and Patient tissue

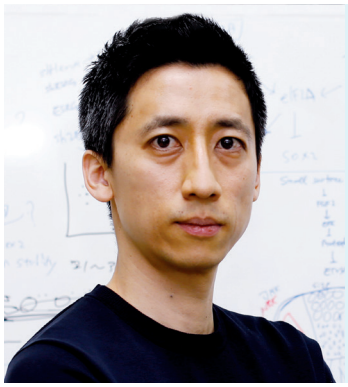
Major Publications

1. M-S Lee, et al., (2023) Nature 616(7956), 339-347
2. P-Y Tsai and M-S Lee, et al., (2021) PNAS 118(10), e2003014118
3. M-S Lee and H-J Han, et al., (2018) Nature Communications 9(1), 3404
4. H Xu and M-S Lee, et al., (2018) PNAS 115 (16) 4228-4233
5. M-S Lee, et al., (2015) Nature Communications 6:7769
6. M-S Lee, et al., (2013) Cell death and differentiation 20, 620–629


Therapeutic Targets of Tumor Metabolism
Tumor MicroEnvironment (TME)
Normal Tissue
Glucose/ Insulin
AAs/ Cachexia
Created in BioRender.com


Cancer cell Intrinsic Effects
Oncogeneic Hits
Metabolic availability in Tumor MicroEnvironment (TME)
Tumor Microenvironment and Metabolism Lab
Metabolic Communications among cell types in TME
Glutamine
T cell
Tumor cell
A Diet for re-shaping TME
Systemic Metabolism
Created in BioRender.com

Lab. of **Pluripotent Stem Cell Biology**



Prof. **Jiwon Jang**

Contact

Phone: +82-54-279-2321
E-mail: jiwonjang@postech.ac.kr **Homepage (lab):** http://esc.postech.ac.kr/

Education

B.S., Seoul National University, Korea (2006)
Ph.D., Seoul National University, Korea (2011)

Research Introduction

Pluripotent stem cells (PSCs) lie at the top of the stem cell hierarchy with the unique features, immortality and pluripotency. PSCs maintain their identity through indefinite proliferation while having an ability to produce all cell types in our body. Due to these interesting features, PSCs have provided an unprecedented experimental system for cellular and developmental biology and translational medicine. However, fundamental mechanisms governing immortality and pluripotency of PSCs have not been fully understood. Our lab is interested in discovering novel molecular and cellular mechanisms for PSC proliferation and differentiation. Furthermore, fundamental principles we discovered in stem cells will be exploited to develop therapeutics for anti-aging.

Career

2011-2012: Postdoctoral Fellow, Department of Biological Sciences, Seoul National University, Korea
2012-2016: Postdoctoral Fellow, Neuroscience Research Institute, University of California Santa Barbara
2016-2018: Assistant Project Scientist, Neuroscience Research Institute, University of California Santa Barbara
2018-Present: Assistant Professor, Department of Life Sciences, POSTECH

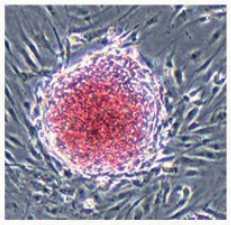
Research Areas

- Molecular and cellular mechanisms of pluripotency
- Molecular dissection of early brain development
- Role of intrapopulation diversity in human embryonic stem cells
- Development of new techniques for therapeutic applications of stem cells
- Reversing aging-related phenotypes by stem cell factors

Major publications

1. Han D, Liu G, Oh Y, et al., (2023) Nature Communications, 14(1):632.
2. Jang J, Han D, et al., (2019) PLoS Biology, 17(9):e3000453.
3. Jang J, Wang Y, et al., (2016) Cell, 165: 410-420.
4. Lalli MA, Jang J, et al., (2016) Human Molecular Genetics, 25 (7): 1294-1306.
5. Jang J, Wang Y, et al., (2014) Stem Cells, 32(10): 2616-2625.

Molecular Mechanisms for Pluripotency



Human Pluripotent Stem Cells
(hPSC: hESC & iPSC)

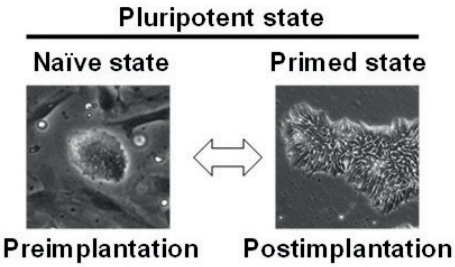
Ectoderm → Skin cells, Neurons, Pigment cells

Mesoderm → Muscle cells, Blood cells, Kidney cells

Endoderm → Lung cells, Thyroid cells, Gut cells

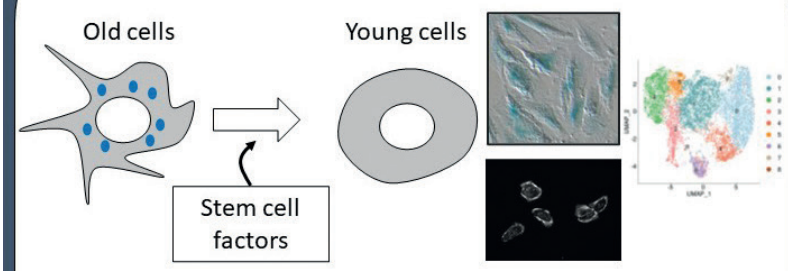
- How do pluripotent stem cells produce all cell types in our body?
- What are key genes governing pluripotent differentiation?
- How do somatic cells re-acquire pluripotency during cellular reprogramming?

Dynamic Transition between Pluripotent States



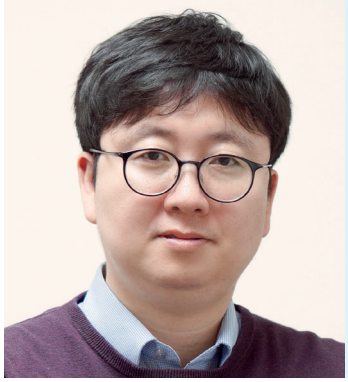
- What cellular events happen during the naïve to primed transition?
- Why is it important for stem cells to transit between two different states?
- What are molecular mechanisms controlling the dynamic transition of stem cell states?

Reversing Aging by Stem Cell Factors



- What stem cell factors can reverse aging processes?
- What are the underlying mechanisms for aging?
- How can we develop stem cell factors as therapeutics for anti-aging?

Lab. of **Stem Cell Biology and Regenerative Medicine**



Prof. **Sekyu Choi**

Contact

Phone: +82-54-279-2359
E-mail: sekyuchoi@postech.ac.kr **Homepage (lab):** https://choilab.postech.ac.kr

Education

B.S., Sogang University, Korea (2007)
Ph.D., KAIST, Korea (2014)

Research Introduction

Mammalian skin serves as a physical barrier protecting organisms from damage, injury, and dehydration (Lim C, Lim J and Choi, Mol Cells, 2023). In addition, the skin controls body temperature and receives complex sensory signals. These diverse functions are made possible by different types of cell types. The epidermis, the hair follicle, the melanocyte lineage, and the sebaceous gland contain adult stem cells and are among the most highly regenerative tissues (Lee and Choi, Experimental & Molecular Medicine, 2024). These stem cells regenerate in an environment filled with adipocytes, muscle, fibroblasts, immune cells, blood vessels, and neurons. The cell-cell interactions which occur in this organ are complex. We are also examining the process of regeneration for other tissues (by the regeneration team (Lee J, Lee K, and Kim B) in SCBRM lab). Therefore, it is possible to investigate how cells from different lineages coordinate their behavior to maintain functional organs by exploring the mammalian skin and other tissues.

Stem cells need to respond not just to the niche but to systemic changes such as immune change, stress, metabolic alteration, or aging) (Jang H, Jo Y et al., BMB Reports, 2023; Choi et al., Nature, 2021). In addition, we have established approaches to determine if and how changes in stem cell fates influence cell-cell interactions and stem cell behaviors (Jo Y, Choi H, Kwak M, and Kim B).

Career

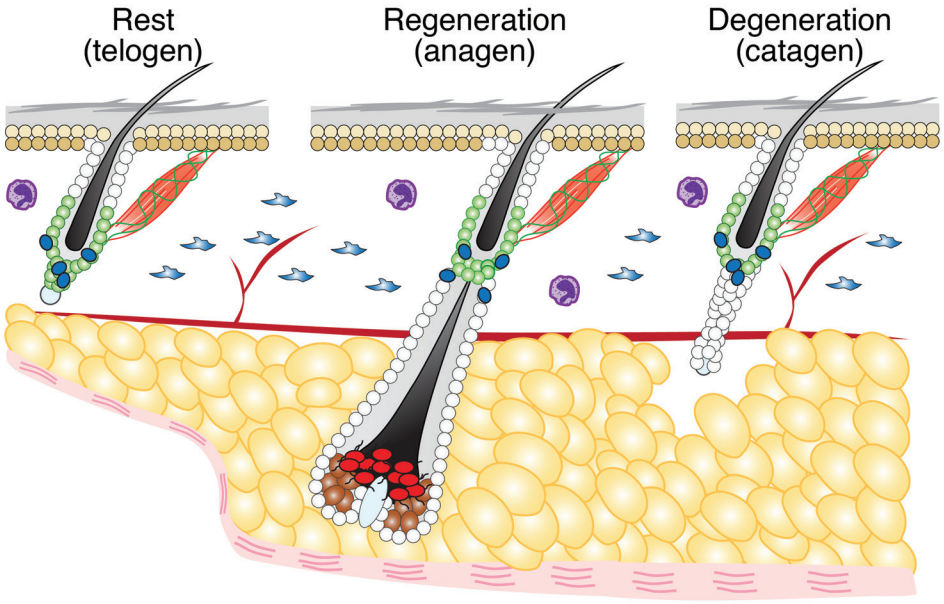
2014 - 2016: Postdoctoral fellow, Institute of Molecular Biology and Genetics, Seoul National University
2016 - 2021: Postdoctoral fellow, Department of Stem Cell and Regenerative Biology, Harvard University
2021 - 2021: Research Associate, Department of Stem Cell and Regenerative Biology, Harvard University
2021 - Present: Assistant Professor, Department of Life Sciences, POSTECH

Research Areas

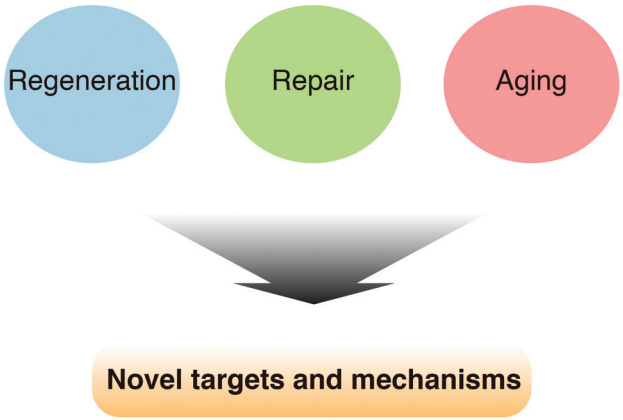
- Stem cell biology
- Hair follicle stem cells, Melanocyte stem cells, Epithelial stem cells
- Hormonal regulation and aging
- Epithelial biology and skin regeneration

Major Publications

1. Lee JH, Choi S (2024) Exp Mol Med. 56(1):110-117
2. Lee D et al. (2024) Nature Comm. 15(1):468
3. Lim C, Lim J, Choi S (2023) Mol Cells. 46(10):573-578
4. Jang H, Jo Y, Lee JH, Choi S (2023) BMB Rep. 56(1):2-9
5. Choi S et al. (2021) Nature 592(7854):428-432
6. Zhang B, Ma S, Rachmin I, He M, Baral P, Choi S et al. (2020) Nature 577(7792):676-681
7. Choi S, et al. (2017) J Biol Chem. 292(35):14473-14485
8. Choi S, Lim D. Chung J (2015) PloS Genetics 11(5), e1005263
9. Choi S, Kim W, Chung J. (2011) J Biol Chem. 286, 2658-2664



Regulation of Stem Cells during Regeneration, Repair, and Aging



Lab. of **Tissue regeneration and development**

Prof. **Yun Ha Hur**

Contact

Phone: +82-54-279-2295 **Homepage (lab):** http://hurlab.postech.ac.kr
E-mail: hur9111@postech.ac.kr

Education

D.V.M., Seoul National University (2016)
Ph.D., Cornell University (2021)

Research Introduction

In the Laboratory of Tissue Regeneration and Development, we are dedicated to unraveling the intricate dynamics of tissue repair and development, employing mouse skin and embryos as our model systems. Our research initiatives delve into the complexities of wound healing process and the sophisticated landscape of tissue development, including embryonic growth.

At the core of our investigations lies a comprehensive exploration of the roles played by stem cells, emphasizing their intercellular communication within the tissue microenvironment, occurring in diverse forms, including extracellular vesicles. Navigating the elaborate system of cellular communication, differentiation, and regeneration, our objective is to elucidate the underlying mechanisms governing these processes. Ultimately, our goal is to provide innovative therapeutic strategies that advance regenerative medicine and effectively address tissue-related disorders.

Career

2021-2024: Postdoctoral Fellow (AACR Immuno-oncology fellow), Laboratory of Mammalian Cell Biology and Development, The Rockefeller University
2024-Present: Assistant Professor, Department of Life Sciences, POSTECH

Research Field

- **Tissue repair and regeneration**
  - Stem cell biology
  - Intercellular communication & Extracellular vesicles
  - Aging
- **Tissue development**
  - Embryonic development
  - Cellular senescence

Research Topics

- Investigating the interaction between tissue-resident stem cells and their microenvironment during the process of skin wound healing.
- Exploring the roles played by intercellular communication via extracellular vesicles (i.e. microvesicles and exosomes) in the wound healing process.
- Studying the effects of aging-induced changes in stem cells on delayed wound healing.
- Unraveling the mechanisms and significance of intercellular communication during mammalian embryonic development.
- Understanding the contributions of cellular senescence to wound healing and embryonic development.

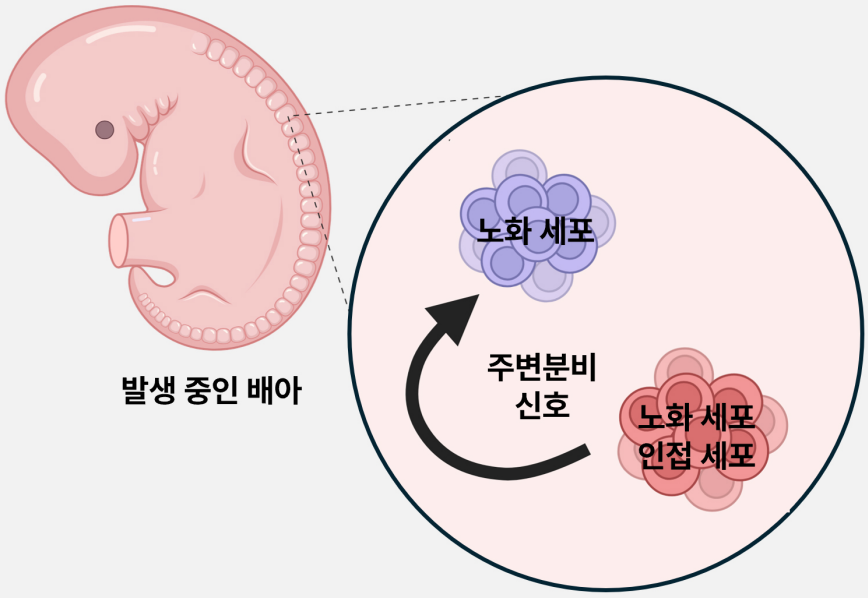
Major Publications

1. Liu S and **Hur YH** et al. (2023), A tissue injury sensing and repair pathway distinct from host pathogen defense. **Cell** *186*, 1-17.
2. **Hur YH** et al. (2021), Embryonic stem cell-derived extracellular vesicles maintain ESC stemness by activating FAK. **Developmental Cell** *56*, 277–291.
3. **Hur YH** et al. (2020), Extracellular vesicles and their roles in stem cell biology. **Stem Cells** *38*, 469–476.

Major Awards/Honors

1. 2023 KASBP-Dong-A-ST Fall Fellowship (2023)
2. 2022 Stem Cell Research Annual Meeting, Global young scientist award; runner-up (2022)
3. SUNY Chancellor's Distinguished Dissertation Award finalist (2022)
4. AACR-Incyte Immuno-oncology Postdoctoral Research Fellowship (2022-2024)
5. Cornell Biomedical & Biological Sciences Three Minute Thesis (3MT) Presentation Award (2020)
6. 2018 Cornell Biomedical & Biological Sciences Symposium Poster Presentation Award (2018)
7. 2017 Cornell Biomedical & Biological Sciences Symposium Runner-up Poster Presentation Award (2017)

조직 발달



- 배아 발생 중 세포간 상호작용 기전과 역할 연구
- 세포 노화의 발생과 조절 기전 연구

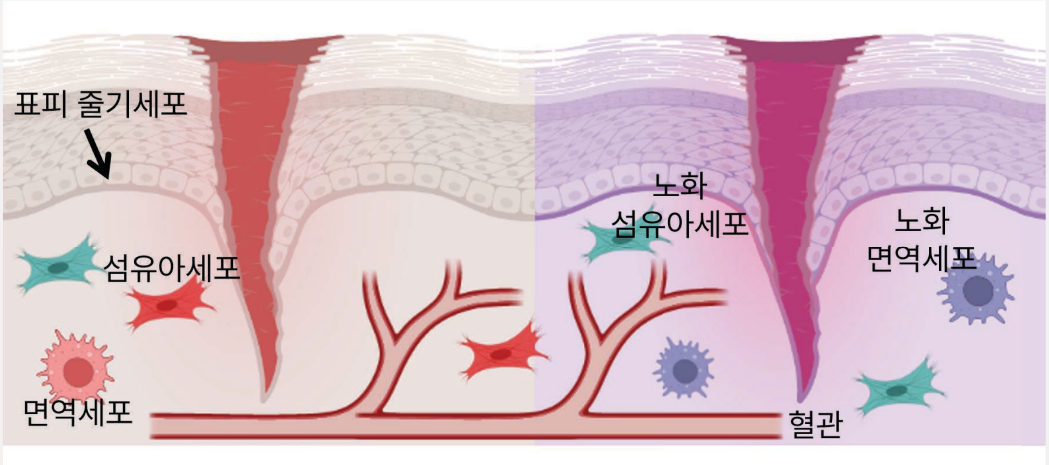
조직 재생

어린 개체

✓ 일시적인 세포 노화 (senescence)
: 창상 치유 촉진

노화 개체

✓ 영구적인 세포 노화 (senescence)
: 창상 치유 저해



- 상처 치유 과정에서 표피 줄기세포와 주변 미세환경의 상호작용 연구
- 노화에 따른 창상 치유 지연 기전 연구
- 조직 미세환경 변화에 따른 세포 노화의 역할 변화 연구

조직 재생과 발달 과정 중 세포간 상호작용 기전으로서 세포외소포체(엑소좀)의 역할 연구

Lab. of **Molecular Neuroscience**

Prof. **Joung-Hun Kim**

Contact

Phone: +82-54-279-2347 **Fax:** +82-54-279-2199
E-mail: joungkim@postech.ac.kr **Homepage (lab):** https://www.joungkim-lab.com/

Education

B.S., Microbiology, Seoul National University (1992)
M.S., Medicine, Seoul National University (1996)
Ph.D., Neurobiology, Imperial College, University of London (2000)

Research Introduction

We are interested in elucidating how neurons are interconnected and affect each other, and how synapses are modified at the cellular and molecular level. Synapses can vary in their size, strength, and the number. These differences contribute to learning and memory, beyond the plasticity of neural networks and synapses.

First, we study synaptic plasticity by means of changes in the level of gene expression or circuit specific modulation using viral vectors and transgenic animals. Using genetically modified materials, we can reveal mechanism of spike time dependent plasticity (STDP), dopamine and it's receptors role in synaptic plasticity or involvement of cell adhesion molecules such as Neuroligin-1. Whole-cell recording is a critical method for observing neural activity in living neurons, and this technique to observe changes of synaptic plasticity. Moreover, we apply behavior experiment using rodents, to find the physiological meaning of alteration in synaptic plasticity.

Second, neurodegenerative diseases or neuropsychiatric disorders appear apparent with failures in synaptic functions and plasticity. Therefore, we pursue the pathophysiology and specific molecular mechanisms of neuronal diseases such as Alzheimer's disease (AD), autism, or bipolar disorder. Toward this end, we employ variety methodologies, inducing varied behavioral tests, electrophysiological studies in vivo or acute slice, time-lapse imaging of synaptic structures, and optical determination of bimolecular interaction as well as standard biochemical assays.

Third, chronic exposure to drugs of abuse (e.g. cocaine) makes longlasting addictive memory. We investigate electrophysiological, structural and behavioral changes to study long-term changes of reward circuit. Because dopamine D1 and D2 receptor show opposite direction of response in the nucleus accumbens, and they are separately expressed in specific cell type, we are eager to distinguish the functional properties of each type of neurons. BAC transgenic mice (Drd1a-EGFP, Drd2-EGFP) enable us to study drug addiction in a celltype specific manner.

Finally, we also conduct systemic approach to study neuronal circuits for functional understanding of various brain areas. For this, we employ a cutting-edge method, opto-or chemo-genetics, which enables us to control the activity of distinct type or group of neurons by optical-or chemical-stimuli and Engram labeling tool, which can label the activated neuronal groups by distinct stimuli. Thus, we can accurately see the role of only optically stimulated neural population or stimuli specific responsible neuronal population in vivo. Currently we are applying these techniques on drug addiction and fear memory research.

Career

2000-2005: Postdoctoral Fellow, Columbia Univ., NY, USA.
2001-2004: Research associate, HHMI, NY, USA.
2005-2009: Assistant Professor, POSTECH
2010-2016: Associate professor, POSTECH
2016-Present: Professor, POSTECH

Research Areas

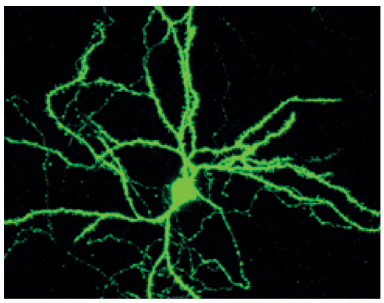
- Molecular mechanisms of synaptic plasticity
- Mechanistic study of cell adhesion molecules
- Pathophysiology of neurodegenerative and psychiatric diseases
- Cell-type specific alteration of neuronal circuitry occurred by drug addiction

Activities

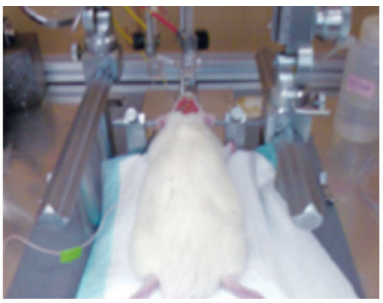
- Functional roles of Neuroligin-1 in mature neural circuits
- Elucidation of small GTPase mechanism to long-term memory
- Structural changes of individual synapses in synaptic plasticity
- Identification of pathway-specific alteration of synaptic plasticity
- Drug addiction mechanism in the basal ganglia circuit
- Amygdala circuits for fear memory

Major Publications

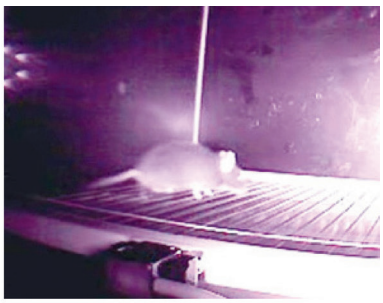
1. Ko Bum, et al., (2023) Cell Reports 42(7):112678
2. Kwon J, et al., (2023) Biological Psychiatry 94(5):378
3. Yang YR, et al., (2017) Mol Psychiatry 22(10):1473
4. Kwon OB, et al., (2015) Neuron 88(2):378
5. Budreck EC, et al., (2013) Proc Natl Acad Sci USA. 110(2):725
6. Choi YB, et al., (2011) Neuron 70(3):468
7. Kim J, et al., (2011) Biol Psychiatry. 69(11):1026
8. Jung SY, et al., (2010) Proc Natl Acad Sci USA. 107(10):4710
9. Kim J, et al., (2008) Proc Natl Acad Sci USA. 105(26):9087



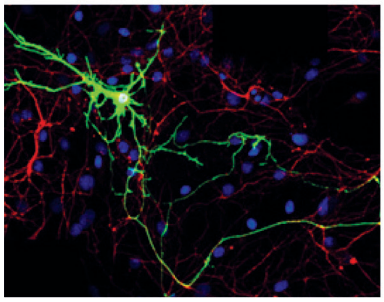
Rabies virus-induced Retrograde tracing



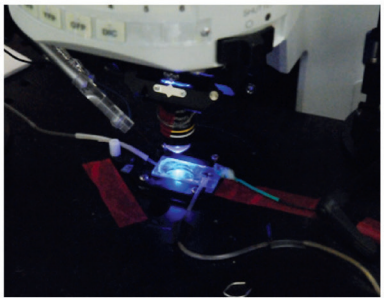
In vivo recording



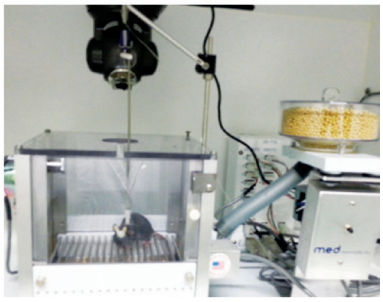
Fear conditioning



Immunocytocemstry



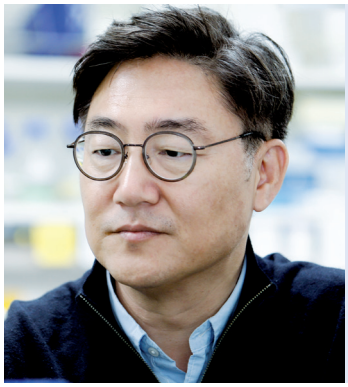
Patch recording Setup & Optogenetic stimulation



Self-administration Setup

Molecular biology + **Electrophysiology** + **Behavioral analysis**

Lab. of **Neuroepigenetics**



Prof. **Tae-Kyung Kim**

Contact

Phone: +82-54-279-2293
E-mail: tkkim@postech.ac.kr **Homepage(lab):** http://www.nepilab.com/

Education

B.S., Korea University, Seoul, Korea (1993)
Ph.D., Rutgers University – Robert Wood Johnson Medical School (2000)

Research Introduction

My lab is interested in understanding how sensory experience can be accurately translated into neuronal and behavioral plasticity through genetic and epigenetic regulation. Sensory experience-evoked neural activity plays essential roles in brain development and cognition, not only by instructing structural and functional changes in individual synapses, but also by triggering various calcium-dependent signaling cascades which ultimately lead to the activation of specific gene expression programs in the nucleus. This activity-induced nuclear gene expression is the cell-wide adaptation mechanism that permits the synaptic and behavioral plasticity to be long lasting. The function of activity-dependent gene regulation is especially well established for learning and memory.

Many key players in these programs have been implicated in several human neurological disorders such as Autism Spectrum Disorder (ASD), Epilepsy, and Schizophrenia. Our overarching goal is to advance our understanding of the pathophysiology of various neurological disorders by defining new regulatory mechanisms and molecular players in genetic and epigenetic regulatory networks in the brain.

Career

2001-2002: Postdoctoral Fellow, Rutgers University - Robert Wood Johnson Medical School
2002-2009: Postdoctoral Fellow, Department of Neurobiology, Harvard Medical School
2010-2017: Assistant Professor, Department of Neurosciences, UT Southwestern Medical Center (endowed title: Distinguished Scholar in Neuroscience)
2017-2018: Associated Professor with Tenure, Department of Neurosciences, UT Southwestern Medical Center
2018-2021: Associate Professor with Tenure, Department of Life Sciences, POSTECH
2022-Present: Professor, Department of Life Sciences, POSTECH

Awards/honors

2002: Lefler postdoctoral fellowship, Harvard Medical School
2003: Jane Coffin Childs Memorial Fund for Medical Research
2010: Reagent Scholar, UT Southwestern Medical Center
2012: The Welch Foundation
2012: The Klingenstein Fellowship Award
2012: Association of Korean Neuroscientists (AKN) junior faculty award
2014: BRAIN EAGER Award (co-PI), National Science Foundation
2018: SFARI Pilot award (co-PI), Simons Foundation
2023: The Korean Society for Integrative Biology Excellence in Science Award

Research Areas

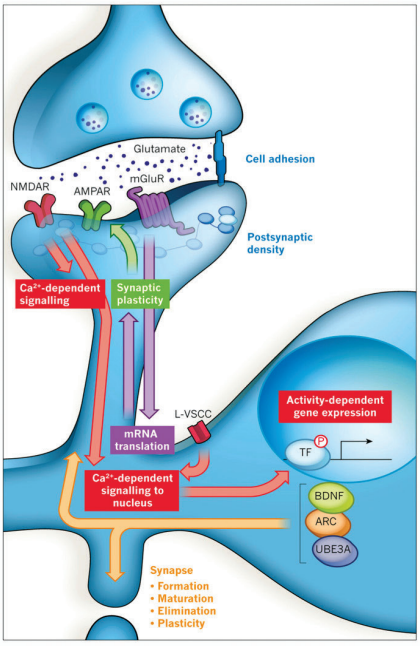
- Functional characterization of long non-coding RNAs
- Epigenetic regulation in the brain and cognitive diseases
- Functional characterization of cis-regulatory DNA elements
- Role of nuclear gene expression in synaptic and behavioral plasticity
- Functional genomics and single cell approaches to understand gene regulatory network in the brain

Major Publications

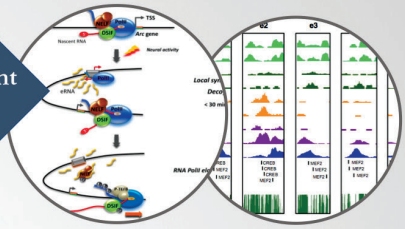
1. Kim S-K, et al., Tae-Kyung Kim. Functional coordination of BET family proteins underlies altered transcription associated with memory impairment in Fragile X syndrome. Sci Adv. 2021 May;7(21)
2. Gorbovytska V., et al., Tae-Kyung Kim*, and Claus-D. Kuhn* (co-corresponding). Enhancer RNAs stimulate Pol II pause release by harnessing multivalent interactions to NELF. Nat. Comm. 2022 May 4;13(1):2429
3. Schaukowitch K, et al., Kim TK. An Intrinsic Transcriptional Program Underlying Synaptic Scaling during Activity Suppression. Cell Rep 2017
4. Joo JY, et al., Kim TK. Stimulus-specific combinatorial functionality of neuronal c-fos enhancers. Nat. Neurosci. 2016
5. Kim TK, Shiekhattar R. Architectural and Functional Commonalities between Enhancers and Promoters. Cell 2015
6. Schaukowitch K, et al., Kim TK. Enhancer RNA Facilitates NELF Release from Immediate Early Genes. Mol. Cell 2014
7. Koike N, et al., Kim TK, Takahashi JS. Transcriptional Architecture and Chromatin Landscape of the Core Circadian Clock in Mammals. Science (Article) 2012
8. Kim TK, et al., Greenberg ME. Widespread transcription at neuronal activity-regulated enhancers. Nature (Article) 2010

LABORATORY OF NEUROEPIGENETICS

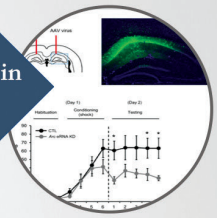
Research Areas



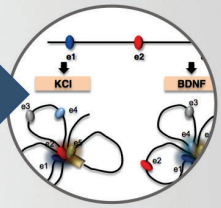
Mechanism of activity-dependent gene expression



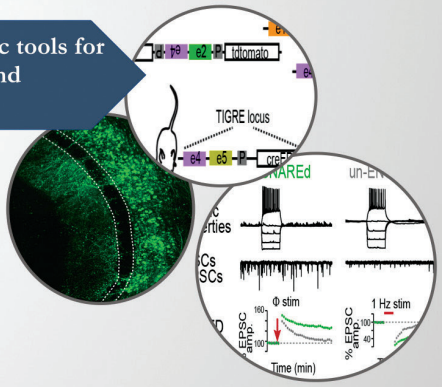
Functions of lncRNAs (eRNA) in brain plasticity



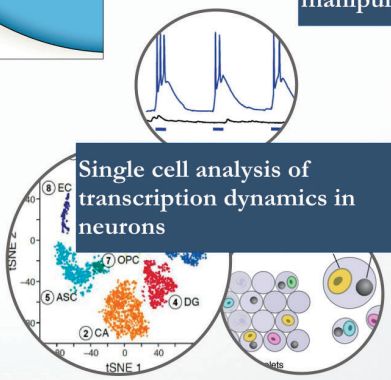
Hierarchical organization of enhancer network



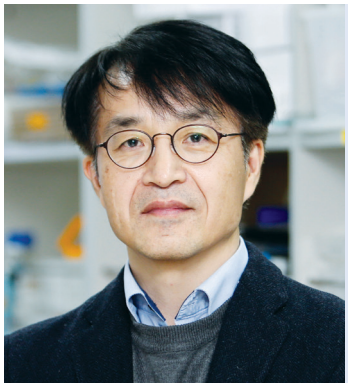
Development of genetic tools for labeling, monitoring, and manipulating neurons



Single cell analysis of transcription dynamics in neurons



Lab. of **Molecular NeuroPsychiatry**



Prof. **Sang Ki Park**

Contact

Phone: +82-54-279-2349 **Fax:** +82-54-279-2199
E-mail: skpark@postech.ac.kr **Homepage (lab):** http://mnpsy.postech.ac.kr/

Education

B.S., Seoul National University, Korea (1991)
M.S., Seoul National University, Korea (1993)
Ph.D., University of Virginia, USA (2001)

Research Introduction

Mental disorders, including mood disorders and schizophrenia, represent some of the most pressing health challenges in today's society. Despite their prevalence, the intricate molecular mechanisms driving these disorders remain largely unexplored. At the forefront of this challenge is Molecular Psychiatry, an innovative field that merges molecular neurobiology with psychiatric disorder research. This exciting area of neuroscience offers fresh perspectives in understanding the complex pathogenesis of various psychiatric conditions.

Our lab is dedicated to deepening our understanding of the molecular foundations of major psychiatric disorders. We employ a range of cutting-edge techniques, from biochemistry and molecular biology to cell biology, pharmacology, genetics, and behavioral science. Our research aims to uncover new molecular targets for treatment and broaden our comprehension of higher brain functions. Through our work, we aspire to make significant contributions to mental health treatment and understanding.

Career

2001-2006: Postdoctoral Research Fellow, Harvard Medical School/Howard Hughes Medical Institute
2006-2006: Postdoctoral Associate, MIT/Picower Institute of Learning and Memory
2004-2008: NARSAD Young Investigator
2014-2014: Research Scientist, Jonhs Hopkins University School of Medicine
2006-Present: Assistant, Associate, and Full professor, Dept. of Life Sciences, POSTECH

Major Awards/Honors

2004 & 2006: National Alliance for Research on Schizophrenia and Depression (NARSAD, USA Young Investigator Awards
2011: MEST Excellent Research Achievements 50
2011: National R&D Achievements 100
2019: Proud POSTECHIAN Award

Activities

- Elucidation of modulatory pathways for dopamine receptor signaling
- Understanding of the cellular function of schizophrenia susceptibility factors
- Analysis of functional relationships among the risk components ofpsychiatric diseases

Research Areas

1. Molecular modeling of schizophrenia

Schizophrenia is a complex psychiatric disorder that is thought to have both neurochemical and neurodevelopmental causes in its pathogenesis. The complexity of the pathogenesis has been interfering establishment of the genuine molecular model. Recent advances in human genetics provided reliable candidategenes causative in thee pression of schizophrenia. We attempt to understand their physiological function to elucidate the molecular basis of schizophrenia.

2. Neurodevelopment and diseases

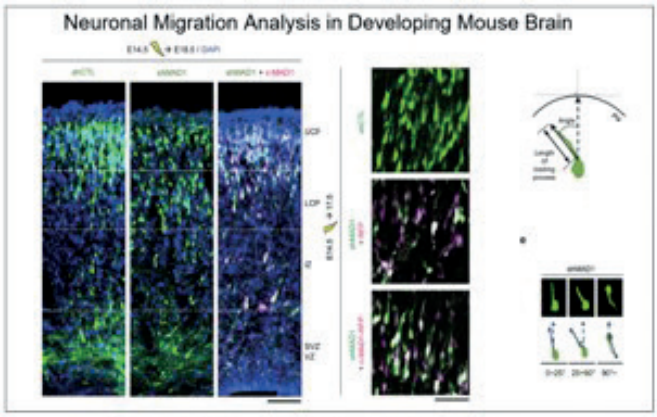
We are exploring the multifaceted aspects of neurodevelopment and its regulatory mechanisms, with a special focus on how these processes contribute to neurodevelopmental disorders. Our research spans several crucial stages of brain development, including neurogenesis (the formation of new neurons), neuronal migration (the movement of neurons to their destined locations in the brain), neuronal maturation (the process of neurons reaching functional maturity), and synaptic formation (the establishment of connections between neurons).

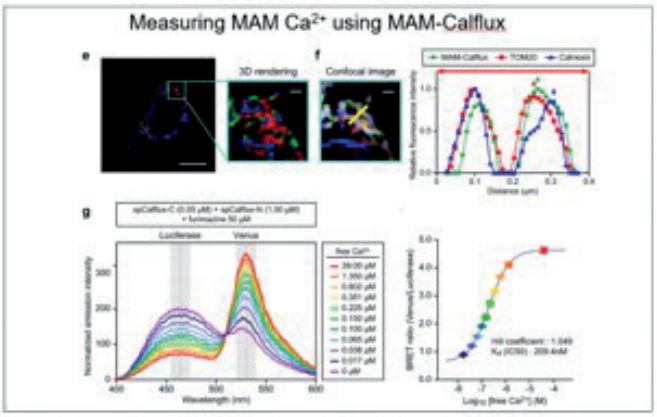
3. Interorganellar communications and psychiatric conditions

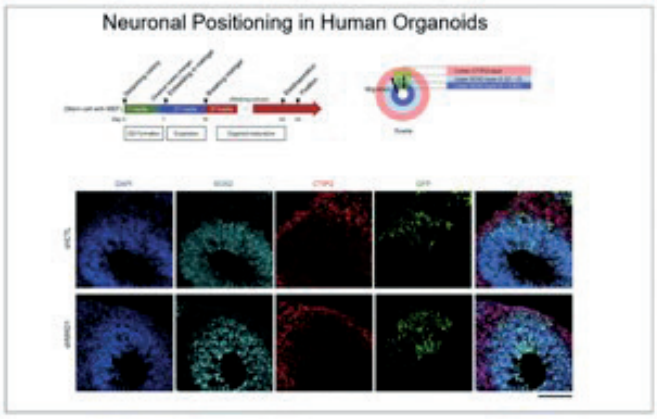
Our lab investigates the complex networks formed by intracellular organelles with primary interest in the Mitochondria-Associated ER Membrane (MAM), a crucial contact site between mitochondria and the endoplasmic reticulum. In neurons, MAM is pivotal in modulating signal transduction, neural activity, neuronal metabolism, neuronal apoptosis, and stress responses, primarily through the regulation of intracellular calcium. Our research explores the link between the functionality of these organelle networks and major neuropsychiatric disorders, aiming to uncover new insights into their pathophysiology.

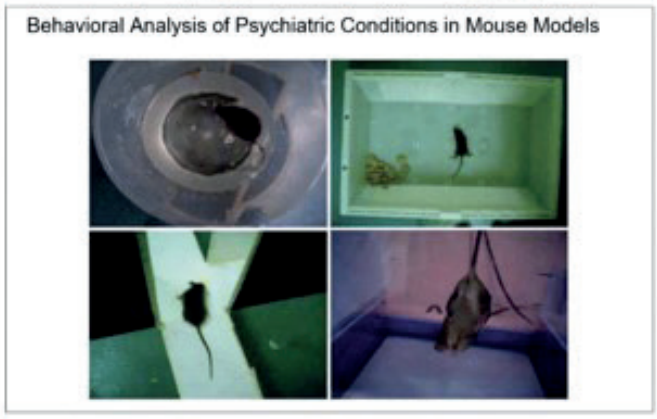
Major Publications

1. Nhung TTM et al. (2023) PNAS 120 (32) e2303402120
2. Cho EB and Woo YS et al. (2023) Nat Communications 13:3586
3. Mun DJ et al. (2023) PNAS 120 (8) e2214507120
4. Goo BS et al. (2022) Molecular Psychiatry 28:856~870
5. Park SJ et al. (2017) Cell Reports 21:2748-2759
6. Park YU et al. (2010) PNAS 107:17785-90
7. Park SK et al. (2005) Cell 122:275-287


Neuronal Migration Analysis in Developing Mouse Brain


Measuring MAM Ca2+ using MAM-Calflux


Neuronal Positioning in Human Organoids


Behavioral Analysis of Psychiatric Conditions in Mouse Models

Lab. of **Neurogenetics**

Prof. **Seung Tae Baek**

Contact

Phone: +82-54-279-2360

E-mail: sbaek@postech.ac.kr **Homepage (lab):** https://sites.google.com/site/baeklabpostech/

Education

B.S., Chungnam National University, Daejeon, Korea (1999)

M.S., Chungnam National University, Daejeon, Korea (2007)

Ph.D., University of Texas Southwestern Medical Center, TX, USA (2012)

Research Introduction

Our lab is interested in understanding the mechanisms involved in human brain diseases. We have developed new research directions utilizing in vitro and in vivo approaches to model neurodevelopmental diseases associated with seizure such as focal malformation of cortical development and linear nevus sebaceous syndrome.

We are exploring the stem cell-based model to further highlights pathogenic mechanisms and pharmacoresistant seizure to identify new avenues for targeted therapeutic intervention. Potential future therapies may include pharmacologically targeting defective gene regulatory networks and will require extensive understanding of the genetic, cellular, and molecular mechanisms controlling neurological development and function.

We will take advantage of the unique animal and stem cell models to investigate the molecular mechanisms of neurodevelopmental diseases associated seizures and uncover fundamental processes governing normal brain development and function.

Career

2012-2014: Postdoctoral Fellow, Univ. of California San Diego, CA, USA

2014-2017: Postdoctoral Fellow, The Rockefeller University, NY, USA

2017-Present: Associate Assistant Professor, Dept. of Life Sciences, POSTECH

Major Awards/Honors

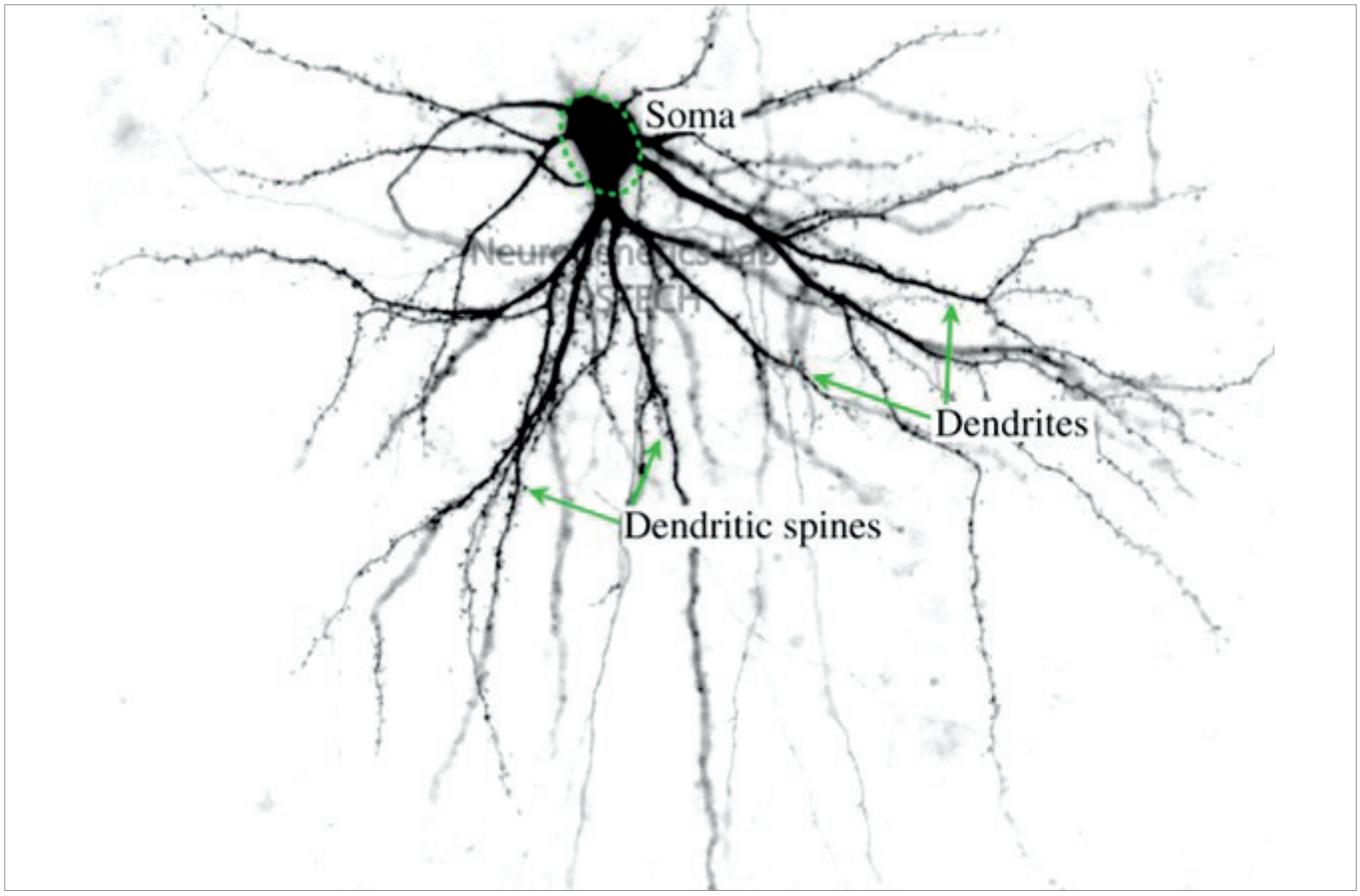
- American Heart Association, Predoctoral Fellowship (2010)
- Weinstein Cardiovascular Development Conference, Travel Award (2011)
- Brain and Behavior Research Foundation, NARSAD Young Investigator Award (2015)

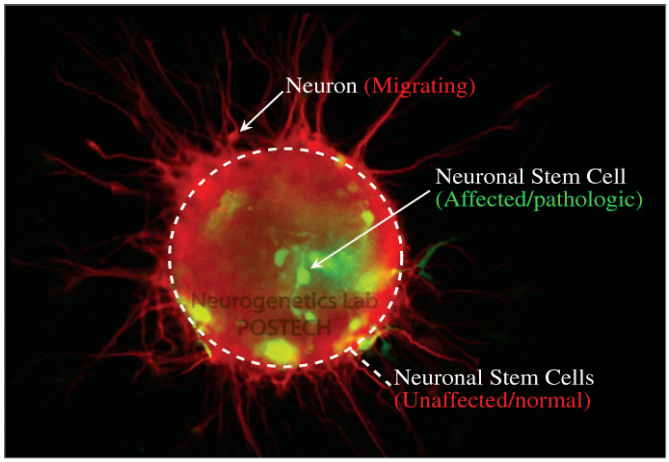
Research Areas

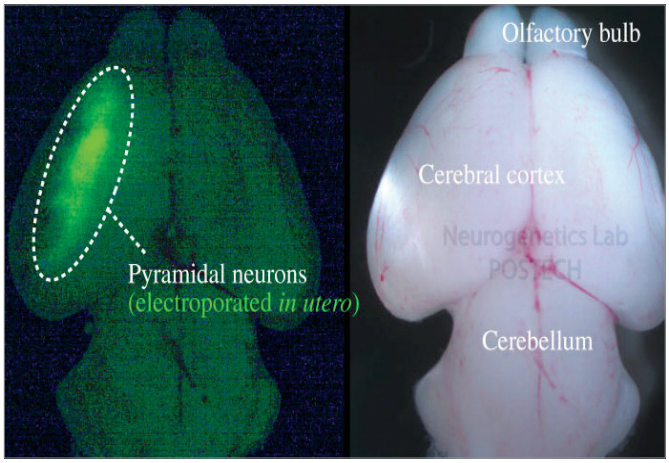
- Cellular and molecular genetics of neurodevelopmental diseases
- Development of novel treatment strategy of epilepsy using stem cell/animal models
- Neurodevelopmental function of oncogenic mutations found in brain tumor

Major Publications

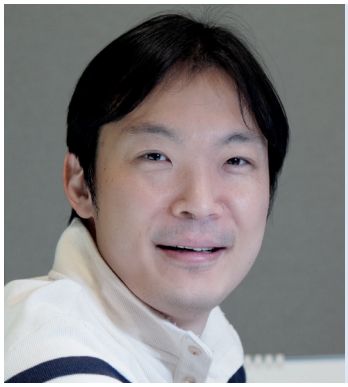
1. Yun EJ, Kim D, et al., (2023) Cell Death&Disease, 14(7):423.
2. Kim YE, Kim YS, et al., (2023) Cell Reprots, 42(1):112003.
3. Yun EJ, Kim D, et al., (2022) Cell Death Discovery, 8(1):308.
4. Wenderski W, Wang L, et al., (2020) PNAS, 117(18):10055-10066.
5. Yun EJ, Kim S, et al., (2020) Cell Death&Disease, 11(9):771.
6. Yun EJ, Lin CJ, et al., (2019) Clinial Cancer Research, 25(14):4542-4551.
7. Schaffer AE, Breuss MW, et al., (2018) Nature Genetics, 50(8):1093-1101.
8. Baek ST, Copeland B, et al., (2015) Nature Medicine 21, 1445-54.
9. Yun EJ, Baek ST, et al., (2015) Oncogene 34, 2741-52.
10. Baek ST, Kerjan G, et al., (2014) Neuron 82, 1255-62.


Soma
Dendrites
Dendritic spines


Neuron (Migrating)
Neuronal Stem Cell
(Affected/pathologic)
Neuronal Stem Cells
(Unaffected/normal)


Olfactory bulb
Cerebral cortex
Pyramidal neurons
(electroporated *in utero*)
Cerebellum

Lab. of **Neuroimmunology and CNS Barriers**



Prof. **Jongshin Kim**

Contact

Phone: +82-54-279-8421 **Fax:** +82-54-279-8289
E-mail: jskim81@postech.ac.kr **Homepage (lab):** http://neuroimm.postech.ac.kr

Education

M.D., Seoul National University (2006)
Ph.D., KAIST (2015)

Research Introduction

We aim to define the cellular and molecular mechanisms of immune regulation and neuro-immuno-vascular interactions in the CNS and its barriers during homeostasis and pathologies, and to translate the findings to find new therapies for CNS autoimmunity, inflammation, and infections.

1. CNS immune tolerance and privilege
- Decode the mechanisms governing CNS (brain and retina) immune tolerance and privilege in the thymus, lymphoid organs, and the CNS

2. CNS autoimmunity, inflammation, and infections
- Unravel the roles of microglia, border-associated macrophages, dendritic cells, T cells, and endothelial cells and their interactions in CNS autoimmunity (multiple sclerosis, uveitis), inflammation (Alzheimer's disease), and infections (meningitis, encephalitis, and retinitis)

3. CNS barriers and fluids
- Characterize the immunological niches in CNS barriers (meninges, choroidal plexus, RPE/choroid, ciliary body, BBB/BRB) and fluids (CSF, aqueous humor) and identify their roles in immune homeostasis and inflammation in the CNS

Cancer Metabolism and Tumor Microenvironment

2006-2007: Intern, Seoul National University Hospital
2007-2011: Resident, Department of Ophthalmology, Seoul National University Hospital
2015-2017: Research Fellow, Center for Vascular Biology, Institute for Basic Science (IBS)
2017-2019: Clinical Fellow, Vitreoretinal Surgery, Department of Ophthalmology, Seoul National University Bundang Hospital
2019-2022: Postdoctoral Associate, Department of Ophthalmology & Visual Sciences, Washington University School of Medicine in St. Louis
2022-Present: Assistant Professor, Department of Life Sciences (JA), Medical Science and Engineering Program (JA), Department of IT Engineering, POSTECH

Major Awards/Honors

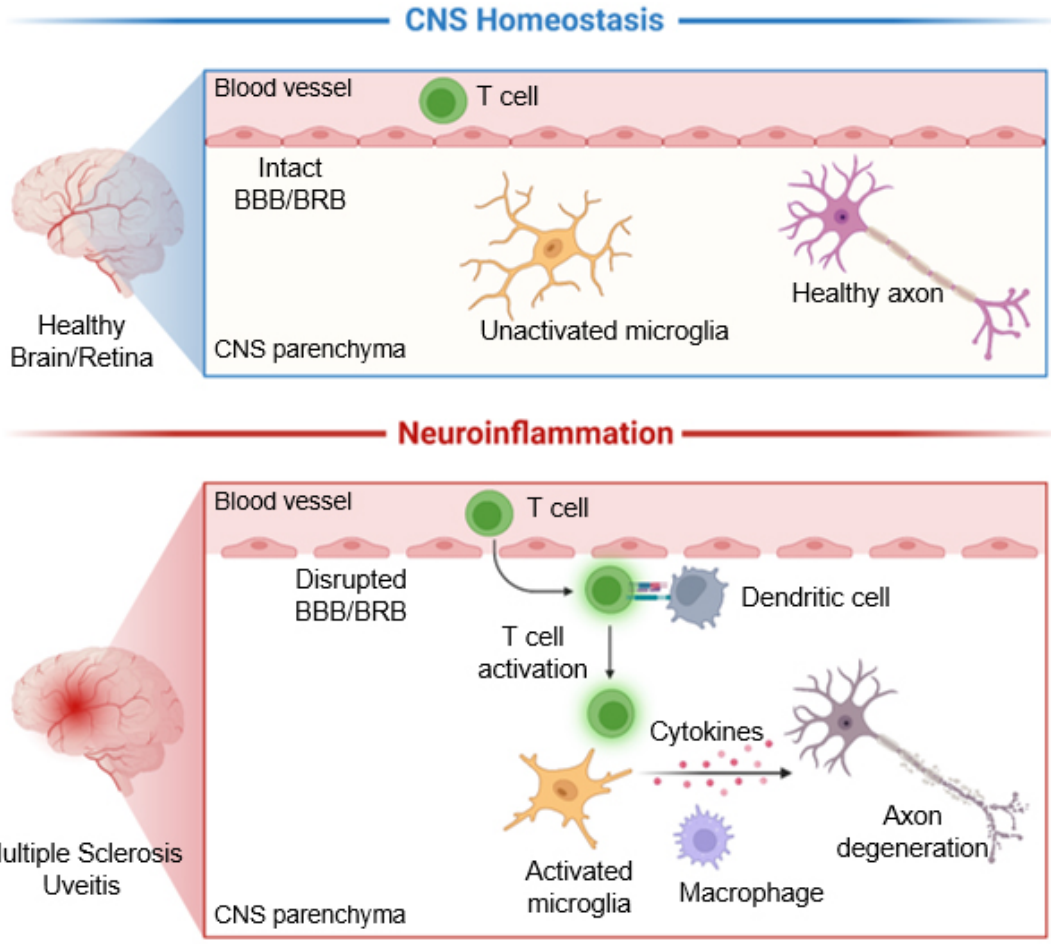
- Global Ph.D. Fellowship (2011)
- ARVO International Travel Grant (2014)
- BRIC Top 5 Research in Medical Science (2017)
- VitreoRetinal Surgery Foundation (VRSF) Research Fellowship (2019)

Research Areas

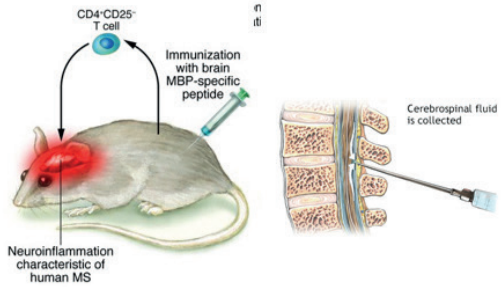
- Neuroimmunology
- Vascular biology
- Tolerance and Autoimmunity
- Neuro-Immune interactions
- Ophthalmology

Major Publications

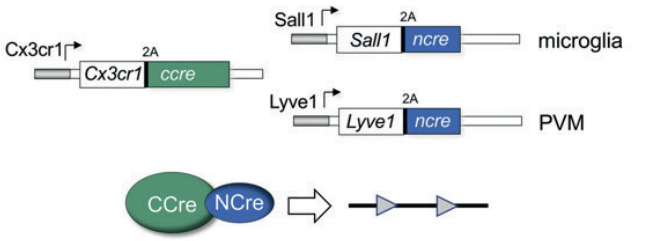
1. Cook ME*, .. , Kim J, et al. (2022) Sci Immunol. 7(76):eabo0981.
2. Kim J*, Park KH. (2021) Retina. 41(9);1839-1850.
3. Kim J*, Kim YH*, et al. (2017) J Clin Invest. 127(9):3441-3461.
4. Kim MH*, Kim J, et al. (2016) EMBO J. 35(5):462-78.
5. Kim J*, et al. (2015) Nat Commun. 6:6781.



CNS Autoimmunity models (EAE, EAU) / Human CSF & Blood

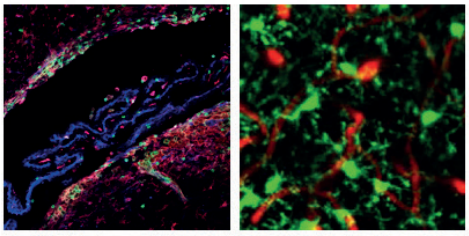


Genetically engineered Mouse models (GEMMs)

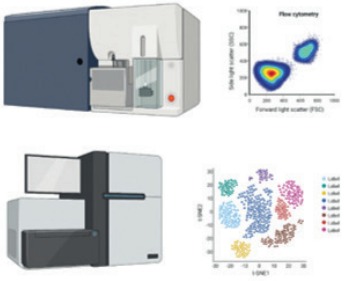


Steffen Jung group (Weizmann)

Confocal imaging / Intravital 2p imaging



Multicolor flow cytometry Single-cell RNA-seq



Lab. of **Plant Genomic Recombination**

Prof. **Kyuha Choi**

Contact

Phone: +82-54-279-2361 **Fax:** +82-54-279-2199
E-mail: kyuha@postech.ac.kr **Homepage (lab):** https://www.pgr.postech.ac.kr/

Education

B.S., Seoul National University, Seoul, Korea (2000)
M.S., Seoul National University, Seoul, Korea (2002)
Ph.D., Seoul National University, Seoul, Korea (2007)

Research Introduction

Meiotic crossover recombination produces recombined chromosomes to ensure genome integrity and increase genetic diversity in progeny. Meiotic recombination initiates with the formation of numerous DNA double-strand breaks (DBSs), but only a small number of these DSBs are repaired as chromosomal exchanges of crossovers, resulting in 1~2 crossovers per chromosome pair. The distribution and frequency of DSBs and crossovers are non-uniform along chromosomes, mainly occurring at recombination hotspots found at gene promoters and terminators in euchromatin, while heterochromatin is recombination suppressed. The narrow range of crossover numbers and skewed distribution of crossovers are major obstacles to be addressed in modern plant breeding. Hence, manipulation of crossovers is of great interest in plant breeding to maximize genetic gain. We aim to understand mechanisms controlling the number and position of crossovers in plants. To achieve this, we use advanced methods of recombination measurements, including genome-wide crossover mapping and fluorescent crossover reporter-based genetic screening of high crossover rate mutants. Our studies on meiotic recombination in the model plant Arabidopsis will help accelerate plant breeding for food security by recombining or mapping useful genetic and epigenetic variations in crop varieties.

Career

2007-2010: Postdoctoral research fellow, Seoul National University, Korea
2010-2012: Postdoctoral research EMBO fellow, University of Cambridge, UK
2012-2016: Postdoctoral research associate, University of Cambridge, UK
2016-2017: Research Professor, Gyeongsang National University, Korea
2017. 2-: Faculty, Department of Life Sciences, POSTECH

Major Awards/Honors

- EMBO Long-Term Fellowship (2009-2010)
- Suh Kyungbae Foundation Young Investigator Fellowship (2017-2022)
- POSTECH Mueunjae Distinguished Professor (2023-2025)

Research Areas

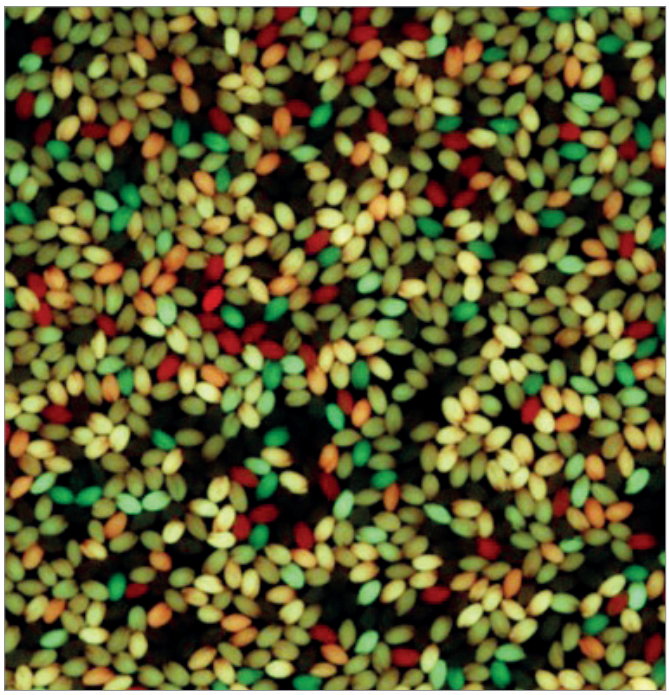
- Mechanism of meiotic crossover pattering in plants
- Epigenetic control of meiotic recombination in plants
- Control of plant meiotic crossover number and position in plants

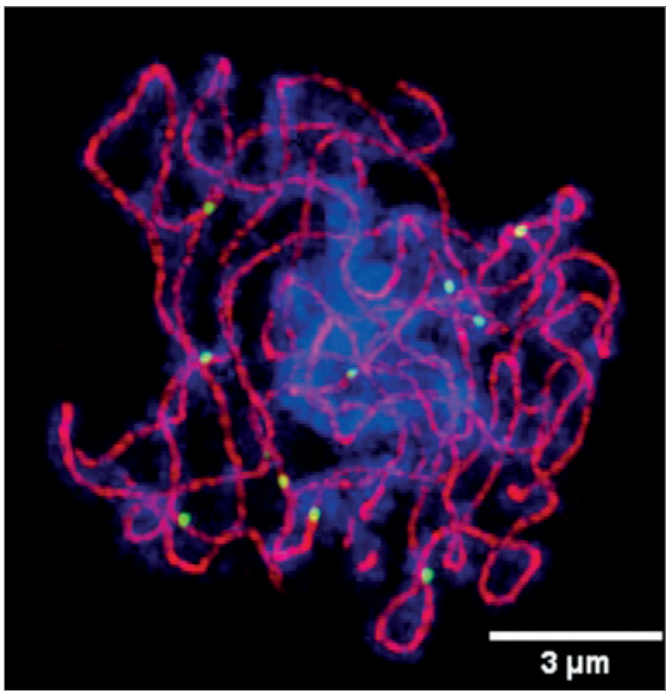
Activities

- Genetic identification of anti-crossover factors in plants
- Genome-wide mapping of meiotic DSBs and crossovers in Arabidopsis
- Genome-wide mapping of historical recombination hotspots in Arabidopsis
- Elucidation of a role for histone variant H2A.Z in promoting crossovers in Arabidopsis

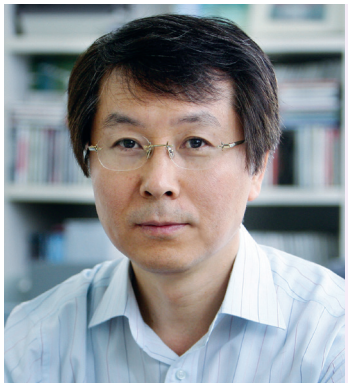
Major Publications

1. Kim J, et al., (2022) EMBO Journal 41, e109958
2. Dageswaran D, et al., (2021) Nature Plants 7, 452-467
3. Lim E, et al., (2020) Plant Journal 101, 473-483
4. Choi K, et al., (2018) Genome Research 28, 532-546
5. Choi K, et al., (2016) PLoS genetics 14, e1006179
6. Choi K, et al., (2016) Plant Physiology 171, 1128-43
7. Choi K, et al., (2013) Nature genetics 45, 1327-1336
8. Choi K, et al., (2011) Plant Cell 23, 289-303
9. Choi K, et al., (2007) Development 134, 1931-1941
10. Choi K, et al., (2005) Plant Cell 17, 2647-2660




3 µm

Lab. of **Cellular Systems Biology**



Prof. **Inhwan Hwang**

Contact

Phone: +82-54-279-2128 **Fax:** +82-54-279-8159
E-mail: ihhwang@postech.ac.kr

Education

B.S., Seoul National University, Seoul, Korea (1981)
M.S., Seoul National University, Seoul, Korea (1983)
Ph.D., University of North Carolina-Chapel Hill (1988)

Research Introduction

The plant cell is composed of various subcellular compartments. To coordinate and regulate all these subcellular compartments to function as a single unit, a large number of molecules must be involved in these complex processes. Therefore, we are trying to isolate and characterize important molecular players of these processes by molecular, biochemical, and cellular approaches.

We have discovered and characterized many important proteins in various steps of intracellular trafficking pathways and elucidated the molecular mechanisms of protein trafficking. Endocytosis is another important area of our research. Now, we are trying to understand how abiotic and biotic stress responses are regulated by protein trafficking and endocytosis. In addition, we are also actively studying molecular mechanisms of protein targeting to chloroplasts and mitochondria. We started to elucidate the cytosolic events involved in protein targeting to chloroplasts and mitochondria. Furthermore, by deciphering the protein targeting mechanisms to these endosymbiotic organelles, we are trying to understand the evolution of these organelles. Another important research topic is to develop molecular and cellular tools to develop the plant cells as a protein production system for valuable proteins.

Career

1988-1993: Harvard Medical School, Postdoctoral fellow
1993-1999: Professor at Gyeongsang National University
1998-2007: Head of the center for protein intracellular trafficking
1999-Present: Professor at POSTECH
2008-2010: Chairman of Life Science
2008-2013: Chairman of Integrative Biosciences and Biotechnology
2019.8-Present: Chief Scientist, Beijing Forestry University, China

Major Awards/Honors

2005: Eilmak Cultural Foundation, Eilmak Cultural Award (Science and Technology Category)
2007: Proud POSTECHIAN Award (School of Science and Technology) from Pohang University of Science and Technology
2008: Inchon Memorial Foundation, 23rd Incheon Award (Science Category)
2011: Fellow of Pohang University of Science and Technology
2015: Best Academic Award from the Korean Society of Plant Biologists
2017: Presidential Commendation from the Ministry of Science and ICT and the Federation of Korean Science and Technology Societies
2017: Presidential Lecture Award from the Korean Society for Molecular and Cellular Biology
2018: Selected as one of the Top 100 Outstanding Achievements in National Research and Development Projects in 2018
2019: Commendation from the Deputy Prime Minister and Minister of Education for Contributions to Industry-Academia Cooperation

Research Areas

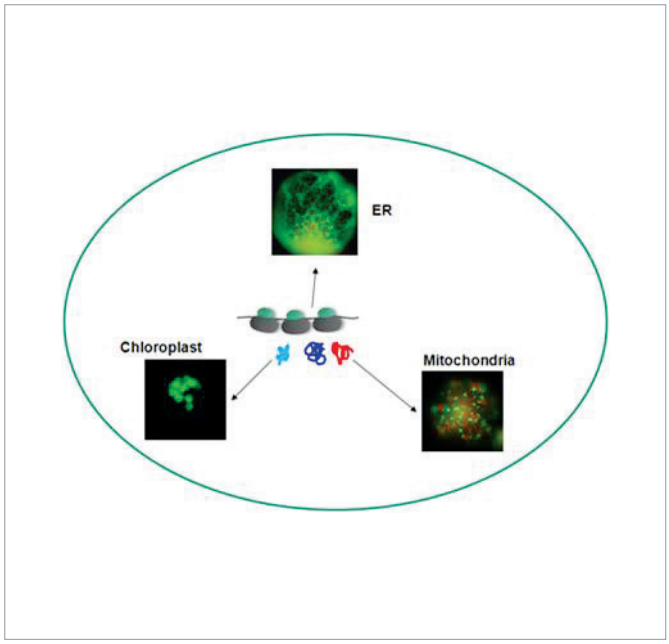
- Protein translation mechanism and protein biogenesis
- Protein targeting and trafficking mechanisms
- Organelle biogenesis and evolution
- Abiotic stress responses and its application in biomass production
- Reprogramming of plant cells as a protein production system

Activities

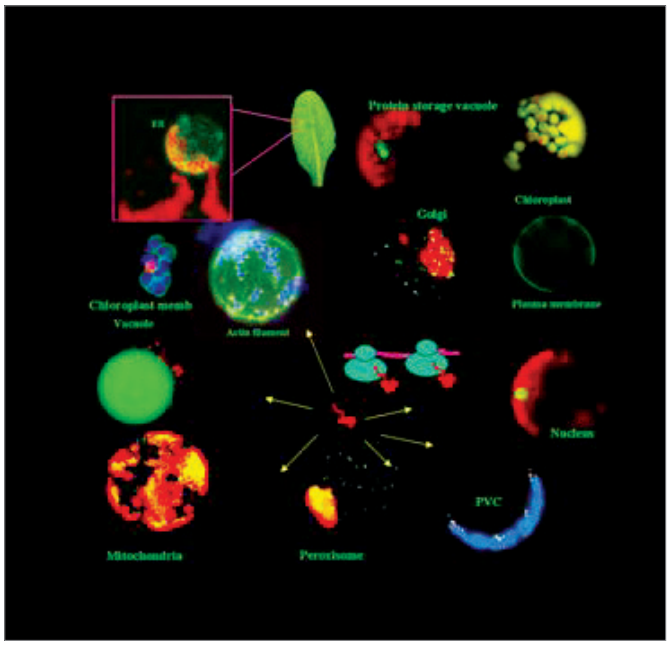
- Editorial board members: Plant Cell, Plant & Cell Physiology, J. Plant Biology, Frontiers in Plant Cell Biology, Frontiers in Plant Traffic and Transport
- Organizer of ICAR-2016 (Korea)
- Plenary lecture at ICAR in Japan (2010)
- Keynote speaker at ENPER in Germany (2010)

Major Publications

1. Junho Lee, et al. (2023), Journal of Integrative Plant Biology, 65,6,1505-1520
2. Sang-Yun Han, et al. (2023), Frontiers in Plant Science, 2023(14)
3. Thangarasu Muthamilselvan, et al. (2023), Journal of Plant Biology, 1-10
4. Junho Lee, et al. (2023), 65(6):1505-1520
5. Areum Yun, et al. (2023), FRONTIERS IN PLANT SCIENCE, 2023(14): 1138089
6. Dabeen Kim, et al. (2022), Journal of Integrative Plant Biology, 65(2):408-416
7. Shammi Akter, et al. (2022) Frontiers in Plant Science, 2022
8. Md Rezaul Islam Khan, et al. (2022), scientific reports, 2022(12):16377
9. Seungjin Woo, et al. (2022), Journal of Integrative Plant Biology, 64(8):1596-1613
10. Jinseung Jeong, et al. (2022), Plant Physiology, 190(1):238-249


ER
Chloroplast
Mitochondria


80S
TOC 75
Translocon


ER
Protein storage vacuole
Golgi
Chloroplast
Chloroplast membr
Vacuole
Actin filament
Plasma membrane
Nucleus
PVC
Mitochondria
Peroxisome

Lab. of **Developmental Signaling Network**

Prof. **Ildoo Hwang**

Contact

Phone: +82-54-279-2291 **Fax:** +82-54-279-0629
E-mail: ihwang@postech.ac.kr **Homepage (lab):** http://dsn.postech.ac.kr/

Education

B.S., Seoul National University, Seoul, Korea (1989)
M.S., Seoul National University, Seoul, Korea (1991)
Ph.D., University of Maryland, College Park, USA (1999)

Research Introduction

Our research delves into the intricate communication systems governing the form and function of plants, emphasizing efficient interactions among cells, tissues, organs, and responses to environmental stimuli. We focus on unraveling the signaling networks of key phytohormones such as cytokinin, auxin, brassinosteroid, abscisic acid, and salicylic acid, utilizing our proprietary 'interactome' database and molecular networks. Our investigations extend to understanding epigenetic regulations involved in induced resistance against pathogen attacks, particularly priming at the genome level. Recently, our research scope has expanded to address fundamental questions about how plants regulate cambial activities, vasculature development, and biomass production. Employing 'systems biology' approaches and interdisciplinary research, we aim to provide a comprehensive tool for deciphering these complex interactions, crucial for gaining insights into the essence of plant life.

Career

1999-2002: Postdoctoral Fellow, Harvard Medical Institute, Massachusetts General Hospital
2002-Present: Faculty, Pohang University of Science and Technology
2019-2022: Seok-Cheon Chair Professor, Pohang University of Science and Technology
2023-Present: Seok-Cheon Honor Professor, Pohang University of Science and Technology

Major Awards/Honors

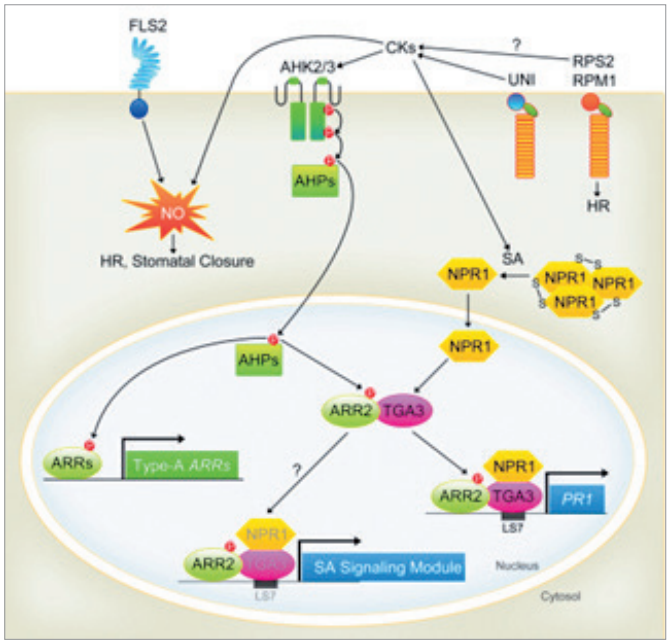
- 2012, Minister's award, Ministry of Agriculture, Food and Rural Affairs
- 2012, Selected as Top 100 national R&D performances, KISTEP
- 2013, Macrogen Scientist Award, KSMCB
- 2014, Best Research Award, KSPB
- 2014, Postechian Award (Research), POSTECH
- 2019, Rose Lecture Award, KSMCB
- 2021, Cargill Life Science Award, KAST
- 2021, Life Science Award, KSMCB
- 2023, Academy Award, the National Academy of Sciences, Republic of Korea
- 2023, Selected as Top 100 national R&D performances, KISTEP

Activities

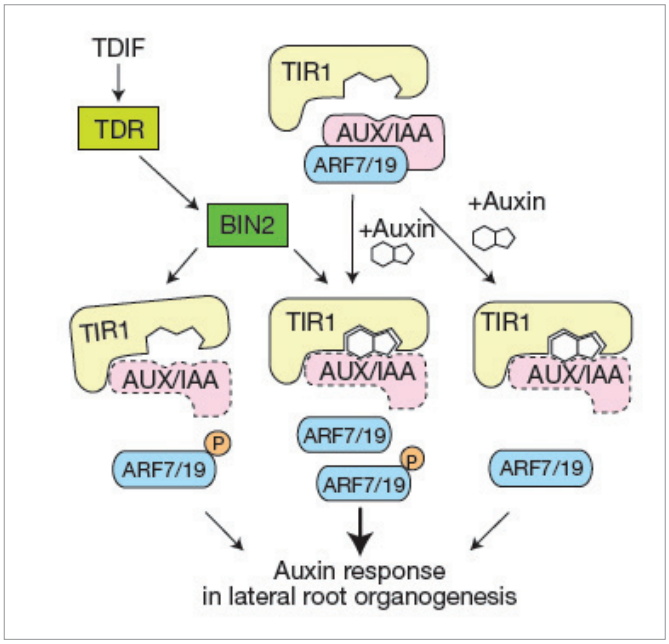
- Elucidate developmental signaling cross-talks in plants
- Understand the role of plant hormones in defense against pathogens
- Understand molecular mechanisms of RNA structure-mediated phloem differentiation

Major Publications

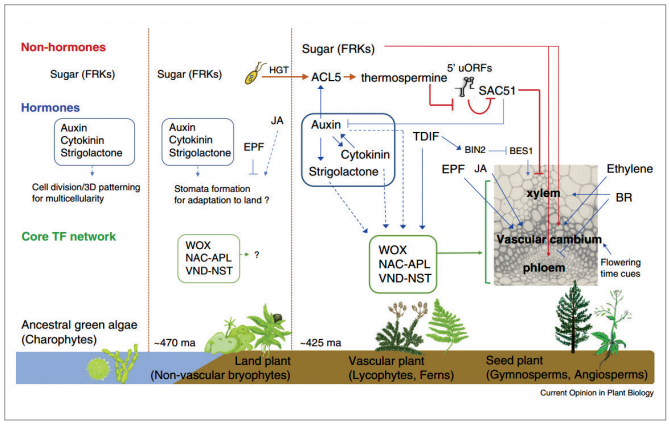
1. Dang et al., 2023, Molecular Plant 16:1131-1145
2. Lee et al., 2023, Genome Biology 24:106
3. Nam et al., 2023, PNAS 120:1-11
4. Nam et al., 2022, Plant Biotechnology Journal 20:1533-1545
5. Park et al., 2021, Plant Physiology 186:1734-1746
6. Lim et al., 2019, Plant Journal 101:473-483
7. Cho, Cho, Hwang, 2019, Current Opinion in Plant Biology 51:51-57
8. Cho et al., 2018, Nature Plants 4:376-390
9. Han et al., 2018, Nature Plants 4:605-614
10. Dominique et al., 2017, The Plant Cell 29:543-559
11. Cho et al., 2017, Current Opinion Plant Biology 35:91-97
12. Ryu et al., 2014, Nature Communications 5, 4138
13. Cho and Ryu et al., 2014, Nature Cell Biology 16:66-76
14. Choi et al., 2014, Molecular Plant 7:792-813
15. Kim and Cho et al., 2013, The Plant Journal 75:755-766
16. Choi et al., 2013, The Plant Journal 73:380-391
17. Hwang, Sheen, Muller, 2012, Ann. Rev. Plant Biol. 63:353-380



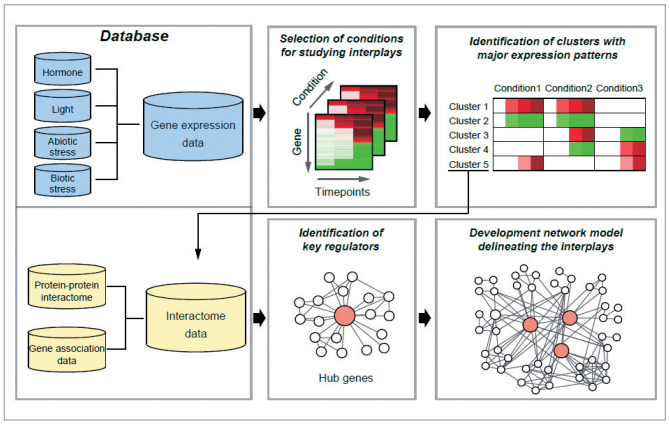
Cytokinin-induced immune response



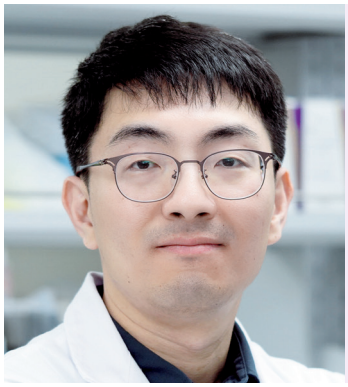
TDIF-TDR-BIN2-mediated regulatory module of auxin siganl transduction



Plant vascular development and evolution.



Lab. of **plant-microbe-environment interactions**



Prof. **Jong Hum Kim**

Contact

Phone: +82-54-279-2352
E-mail: jonghumkim@postech.ac.kr
Twitter: @JonghumKim7
Homepage (Lab): https://sites.google.com/view/jonghum-kim-website

Education

B.S., Yonsei University, Korea (2010)
Ph.D., Yonsei University, Korea (2017)

Research Introduction

A long-standing dogma in plant disease susceptibility states that disease development requires not only the presence of a virulent pathogen and a susceptible host but also a set of disease-favoring environmental conditions. How environmental conditions influence the plant and the pathogen during an active interaction is poorly understood, leaving a big gap in our understanding of how disease outbreaks occur in nature. To gain insight into the molecular basis of the "disease triangle" dogma, our lab is interested in research projects to elucidate how suboptimal environmental factors intercept the molecular network associated with disease development under global climate change, becoming a serious concern for humankind.

Career

2017-2018: Postdoc. Associate, Department of Systems Biology, College of Life Science and Biotechnology, Yonsei University, Seoul, South Korea (Advisor: Dr. Woo Taek Kim)

2018-2019: KRF Postdoc. Fellow (Korea Research Foundation Postdoc. Fellowship), DOE Plant Research Laboratory, Michigan State University, East Lansing, United States (Advisor: Dr. Sheng Yang He)

2019-2020: Research Specialist, Howard Hughes Medical Institute, DOE Plant Research Laboratory, Michigan State University, United States (Advisor: Dr. Sheng Yang He)

2020-2023: Research Specialist, Howard Hughes Medical Institute, Duke University, United States (Advisor: Dr. Sheng Yang He)

2023-Present: Assistant professor, POSTECH, Pohang, South Korea

Research Areas

- Understanding the effect of suboptimal environmental conditions on plant-microbe interactions from the view of plant physiology to the molecular level
- Designing climate-resilient crop plants through genome-editing methods

Major Awards/Honors

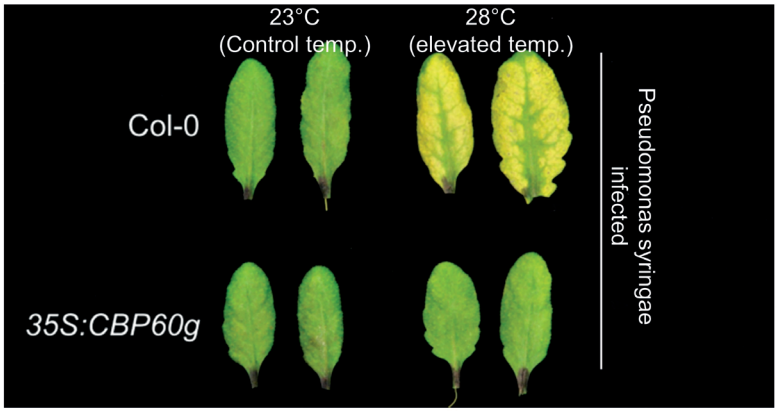
Postdoctoral Fellowship Program in 2018 granted by National Research Foundation of Korea (NRF) (2018)

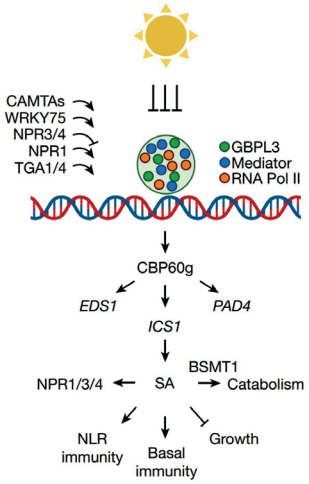
Major Publications

1. Chen J, Li L, Kim JH, Neuhäuser B et al., (2023) Small proteins modulate the activity of the Arabidopsis thaliana ion channel-like immune regulator ACD6. *BioRxiv*
2. Kim JH, Castroverde CDM et al., (2022) Increasing the resilience of plant immunity to a warming climate. *Nature* 607:339-344
3. Kim JH, Oh TR et al., (2019) Inverse correlation between MSPR1 and AtHSP90.1 balances the cytoplasmic PQC process in Arabidopsis. *Plant Physiol* 180(2):1230-1240
4. Kim JH, Cho SK et al., (2017) MPSR1 is a novel cytoplasmic PQC E3 ligase for eliminating emergent misfolded proteins in Arabidopsis thaliana. Proc Natl *Acad Sci* U S A 114(46): 10009–E10017
5. Oh TR, Kim JH et al., (2017) AtAIRP2, an Arabidopsis RING E3 Ubiquitin Ligase, Positively Regulates ABA-mediated Seed Germination and Salt Stress Response in Early Seedlings by Stimulating ATP1/SDIRIP1 Turnover. *Plant Physiol* 174: 2515-2531
6. Kim JH and Kim WT, The Arabidopsis RING E3 Ubiquitin Ligase AtAIRP3/LOG2 Participates in Positive Regulation of High-Salt and Drought Stress Responses. (2013) *Plant Physiol* 3: 1733-1749

Toward design of “dream” plants for climate resilience

Plants have amazing genetic potential to build temperature-resilient immunity





Remaining questions

- **How do plants sense heat waves that influence disease?**
- **What is the signal transduction pathway(s)?**
- **Can we build climate-resilient immunity in crop plants?**

POSTECH LIFE SCIENCES

FACULTY
RESEARCH PROFILE