那須雄介老師實驗室

Part 1 研究主題與核心科學 (Research Focus)

Q1-1 What are the core scientific questions addressed by this laboratory's research topics?

Our laboratory focuses on understanding cellular metabolism by developing new protein-based technologies. In particular, we engineer genetically encoded fluorescent biosensors that enable real-time visualization of metabolites inside living cells and organisms. The core scientific questions include:

- How can we engineer proteins to selectively detect specific metabolites?
- How do metabolites dynamically change in living cells during physiological processes such as neuronal activity or metabolic stress?
- How does cellular metabolism regulate biological functions at the subcellular, cellular, and organismal levels?

By developing new biosensors and imaging tools, our research aims to reveal previously inaccessible aspects of metabolism in living systems.

Q1-2 What is the current significance or potential application value of this research field?

Cellular metabolism plays central roles in many biological processes, including brain function, cancer metabolism, and immune responses. However, many metabolites cannot currently be measured with high spatial and temporal resolution in living cells.

Fluorescent protein-based genetically encoded biosensors provide powerful tools to visualize metabolites in real time, enabling researchers to directly observe metabolic dynamics. These technologies have important applications in:

- Neuroscience (e.g., brain energy metabolism)
- Cancer biology
- Metabolic disease research
- Biotechnology and synthetic biology

Ultimately, these tools can contribute to a deeper understanding of metabolic regulation and may support future biomedical innovations.

Q1-3 What types of research projects do summer students usually participate in? Do they work on independent small projects or assist with ongoing projects?

Summer students typically participate in small research projects related to ongoing work in the laboratory. Depending on the student's background and experience, they may:

- Assist with ongoing biosensor development projects
- Perform protein expression and purification experiments
- Conduct fluorescence measurements or imaging experiments
- Analyze experimental data

In some cases, students may also conduct a small independent project under close supervision.

Q1-4 What expertise or skills can summer students learn?

Students will gain experience in modern molecular biology, protein engineering, and fluorescence-based biochemical analysis. Skills may include:

- Molecular cloning and plasmid construction
- Recombinant protein expression and purification
- Fluorescence spectroscopy and plate reader assays
- Mammalian cell culture and transfection
- Fluorescence microscopy
- Experimental data analysis and interpretation

Students will also learn how scientific research is designed, conducted, and interpreted.

Part 2 實驗室運作與指導方式 (Mentorship)

Q2-1 Who directly supervises summer students?

Summer students are typically supervised by postdoctoral researchers, research assistants, or senior graduate students who are directly involved in the relevant research project. The PI also meets students periodically to discuss research progress and provide guidance.

Q2-2 What is the PI's approach to teaching research? How will the mentor guide summer students?

The PI emphasizes developing students' scientific thinking and curiosity. Students are encouraged to understand the rationale behind experiments rather than simply following protocols. Mentors provide hands-on training in laboratory techniques while also guiding students to think critically about experimental design, controls, and data interpretation.

Q2-3 Approximately how many summer students are accepted each year?

Typically, the laboratory accepts one summer student per year, depending on available mentoring capacity and research projects.

Q2-4 What expectations does the laboratory have for summer students (e.g., initiative, attention to detail)?

We expect students to demonstrate:

- Curiosity about scientific questions
- Initiative in learning new techniques
- Careful and responsible laboratory practice
- Attention to experimental details
- Willingness to ask questions and engage in discussions

Prior research experience is not required, but motivation and enthusiasm for learning are essential.

Q2-5 During the two-month period, what research concepts or experiences does the laboratory hope to provide to summer students?

During the internship, we hope students will gain:

- An understanding of how modern biological research is conducted
- Experience designing and performing experiments
- Exposure to interdisciplinary research combining chemistry and biology
- Training in data interpretation and scientific communication

Students will also learn how laboratory research contributes to broader scientific questions.

Part 3 能力需求與錄取評核 (Requirements & Selection)

Q3-1 What foundational courses or academic background are recommended for applying to this project?

Recommended background includes coursework in:

- Biochemistry
- Molecular biology
- Cell biology
- Chemistry (especially organic or physical chemistry)

Students with interests in biotechnology, bioengineering, or chemical biology are especially encouraged to apply.

Q3-2 Is prior research or laboratory experience required? If not, can students without experience still apply?

Prior research experience is not required. Motivated students without prior laboratory experience are welcome to apply. Necessary experimental techniques will be taught during the internship.

Q3-3 What criteria does the PI use to determine whether a student is a "good fit"?

A good fit student typically demonstrates:

- Strong curiosity about scientific research
- Motivation to learn new concepts and techniques
- Careful and responsible working style
- Good communication and teamwork skills

Interest in molecular biology, protein engineering, or metabolism research is also helpful.

Q3-4 What are the evaluation criteria for admission?

Admission decisions are based on a combination of factors including:

- Academic transcript and relevant coursework
- Statement of purpose describing research interests
- Motivation for participating in the internship
- Any prior research or laboratory experience

Motivation and intellectual curiosity are considered particularly important.

Q3-5 Is an interview required? If so, what qualities are emphasized during the interview?

Yes, shortlisted applicants may be invited to a brief interview. The interview focuses on understanding the student's research interests, motivation for joining the laboratory, and willingness to learn new experimental techniques.

Q3-6 Would first- or second-year students, or applicants from different academic backgrounds/majors, face any difficulties when applying?

First- and second-year students are welcome to apply. However, students with basic knowledge of molecular biology or biochemistry may find it easier to understand the research projects. Motivation and willingness to learn are more important than seniority.

Part 4 技術學習與能力發展 (Skills & Growth)

Q4-1 What specific experimental techniques can students learn during the internship?

Depending on the project, students may learn techniques such as:

- DNA cloning and plasmid construction
- PCR and molecular biology techniques
- Recombinant protein expression in *E. coli*
- Protein purification
- Fluorescence assays using plate readers
- Mammalian cell culture and transfection
- Basic fluorescence microscopy

Q4-2 Will students have the opportunity to work with or observe advanced instruments during the internship?

Yes. Students may have opportunities to use or observe advanced research instruments such as:

- Fluorescence plate readers
- Fluorescence microscopes
- Spectroscopic instruments used for biosensor characterization

These experiences provide exposure to modern experimental approaches in biological research.

Q4-3 After completing the internship, what soft skills will students develop?

Students will develop important research skills including:

- Critical thinking in experimental design
- Data analysis and interpretation
- Scientific discussion and communication
- Time management and laboratory organization
- Collaboration in a research team

These skills are valuable for future careers in science, biotechnology, or medicine.

- Qualities we value most in students:
  - Curiosity and enthusiasm for science
  - Carefulness and integrity in experiments
  - Initiative in learning new ideas
  - Willingness to collaborate and communicate