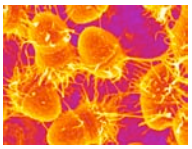
National Science Foundation
WHERE DISCOVERIES BEGIN

UNIVERSITY OF MINNESOTA

NSF Summer Research Experiences for Undergraduates (REU) Program
Microbiology: From Atoms to Ecosystems at the University of Minnesota

Microbiology has never been more important or exciting than it is today. Microorganisms live everywhere life is possible and are more numerous than any other kind of organism. It has been estimated that 5 x 10^{31} microbial cells exist on earth, weighing more that 50 quadrillion metric tons. The earth's oceans teem with over 100 million viruses per teaspoon. Microbes are indispensable components of our ecosystem: no other life forms are as important for the maintenance of life on earth. Microbes carry out more photosynthesis than green plants, and are responsible for recycling critical elements for life, including carbon, nitrogen, hydrogen and oxygen. Despite their obvious benefits, microbes also are the major cause of morbidity and mortality worldwide and new microbial diseases are identified each year.

THE PROGRAM:



This National Science Foundation supported program provides intensive, mentored research experiences in microbiology and is intended for students who wish to pursue a Ph.D. after graduation. The program will engage students in a variety of interactive, cooperative learning, research-related, professional development and social activities including:

- an orientation weekend retreat at the Lake Itasca Biological Station
- a 5-day mini-course to continue to build student confidence, critical thinking skills and community
- independent research under the direction of an experienced faculty mentor
- weekly seminars, interactive workshops, and field trips to foster effective scientific communication, and explore career options in academia, government and industry
- mentored preparation of a research summary website and a scientific poster to be presented at a University-wide research symposium
- social activities to maintain community and facilitate informal interactions between students and members of the University community

GOALS OF THE PROGRAM:

- To enhance research participation and access to research-oriented careers in microbiology by undergraduate students, especially those from underrepresented groups
- To provide students with a solid foundation of critical thinking skills and ongoing support that will instill confidence and promote success in research
- To engage students in meaningful, cutting-edge independent research experiences in microbiology, and expose them to the excitement and creativity of the enterprise in a world-class research environment
- To raise participant awareness of research options and career opportunities available within the broad area of microbiology, and facilitate their pursuit of careers in science

SPECIFIC PROGRAM BENEFITS:

The field of Microbiology lies at the foundation of many other biological sciences and it takes advantage of many levels and modes of inquiry. The experimental methodologies you will learn in our program are completely transportable and can serve to underpin future research in other natural sciences including ecology, biochemistry, cell biology, genetics, and molecular biology. Our program will prepare students

for research careers by linking explicit training in scientific communication with career planning and laboratory opportunities in some of the most exciting areas of contemporary Microbiology.

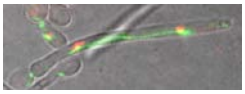
Additional benefits include:

- Opportunities for travel awards to national scientific meetings for students with outstanding research performance.
- Trips and social events provided throughout the summer to take advantage of the rich environment of cultural and recreational opportunities offered by the Twin Cities and surrounding areas.
- Professional development seminars and workshops on clarifying career goals, selecting a professional program and applying to graduate school.

THE SCHEDULE:
The program will host participating students for a period of ten weeks, beginning May 28, 2009 and ending on August 9, 2009. On-line applications will be available in November and participant selection will begin in January, with a final deadline for application materials February 1. Selection of participants will be completed in March. Up to 10 students will be selected based on their academic record, statement of interest and letters of recommendation.

THE AWARD:
Participants will receive a stipend, a meal allowance, university dormitory housing, and reimbursement for travel costs.

ELIGIBILITY/SELECTION CRITERIA:



Participants must be U.S. citizens or permanent residents, must be enrolled at a 4-year accredited college or university, and must be in their sophomore or junior year at the time of application. All applicants must have successfully completed (or be currently enrolled in) at least one biological sciences course. We welcome all applications and particularly encourage students from schools that do not have extensive research programs and students from groups underrepresented in the sciences. Application materials can be found at the University of Minnesota Life Sciences Summer Undergraduate Research Program website: http://www.cbs.umn.edu/main/summer_research/application.html

AREAS OF RESEARCH:

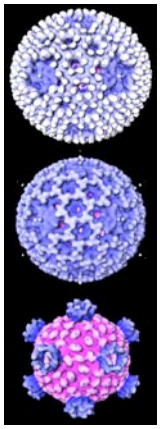
Approximately 25 laboratories will provide an outstanding array of possible research areas. Students will have the opportunity to work with faculty who study fundamental microbiological problems, ranging from the subatomic analysis of virus structure to the influence of microbial communities on entire ecosystems.

Environmental Microbiology: What types of microorganisms comprise our planet's ecosystems and what are the processes mediated by microbes in nature?

Ongoing projects in this area include: Mechanisms of electron transfer in iron-reducing *Geobacter*, toxic metal respiration and growth at low temperatures by the aquatic bacterium *Shewanella,* mechanisms of resistance to ionizing radiation in the bacterium *Deinococcus,* bacterial pathways involved in nitrogen fixation and degradation of herbicides.

Faculty: Daniel Bond, Jeff Gralnick, Larry Wackett, Mike Sadowsky

Microbial Gene Expression: How is gene expression controlled at the molecular level? How do microbes sense and respond to changes in the environment?



Ongoing projects in this area include: Signal transduction pathways controlling adaptation to extracellular pH in the yeast *Candida,* whole-genome microarray analysis of signal transduction systems controlling pilus gene expression in *Burkholderia*, transcriptional regulation of iron utilization genes in *Bordetella,* regulatory control of herpes virus gene expression, mechanisms controlling cell-cell signaling by mating pheromones in the bacterium *Enterococcus*.

Faculty: Dana Davis, Christian Mohr, Sandra Armstrong, Stephen Rice, Gary Dunny

Host-Microbe Interactions: How do microbes establish and maintain complex interactions with hosts? What defines the host-microbe interaction?

Ongoing projects in this area include: Secretion systems controlling plant-microbe interactions, genetic and biochemical analysis of cytomegalovirus-host cell interactions, role of host proteases in the capacity of reoviruses to penetrate host cell membranes, mechanisms of host cell toxicity mediated by the bacterium *Staphylococcus.*

Faculty: Leslie Schiff, Wade Bresnahan, Patrick Schlievert, Anath Das

Microbial Structure: How are microbial structures assembled? What are the mechanisms controlling morphogenesis?

Ongoing projects in this area include: Bacteriophage assembly and DNA packaging at the atomic level, live-cell imaging techniques to define retrovirus assembly, the role of cytoskeletal proteins, motor proteins, and cell cycle checkpoints in the ability of *Candida* to undergo morphogenetic switching.

Faculty: Dwight Anderson, Louis Mansky, Judy Berman

Contacts:

Dr. Leslie Schiff
schif002@umn.edu
Dr. Christian Mohr
mohrx005@umn.edu
Life Sciences Summer Undergraduate Research Programs
http://www.cbs.umn.edu/main/summer_research/
University of Minnesota Department of Microbiology
http://www.microbiology.med.umn.edu/http://www.microbiology.med.umn.edu/