Murray State University’s biomedical science faculty team includes:

**Dr. David Canning (Developmental Biology)**

**Dr. Mark Mathay (Physical Chemistry/Biophysics)**

**Dr. James Stuart (Medical Microbiology)**

**Dr. Robert Voip (Toxicology, Biochemistry)**

**Dr. Sterling Wight (Neurophysiology)**

**Dr. Tim Johnston (Molecular Biology/Microbiology)**

**Dr. Edmund Zimmerer (Genetics/Molecular Genetics)**

**Dr. J. Ricky Cox (Biochemistry)**

**Dr. Terry Derting (Physiology)**

**Dr. Leon Dubbins-Gray (Parasitology)**

**Dr. Mark Masthay (Physical Chemistry/Biophysics)**

**Dr. Robert Volp (Toxicology, Biochemistry)**

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**Murray State University’s Undergraduate Research and Scholarly Activity (URSA) Office has been created to encourage undergraduate research, scholarly and creative activity across the campus and to promote undergraduate scholar- ship on all six of Kentucky’s regional university campuses. To this end, the URSA office coordinated the first multi-campus event, Posters-at-the-Capitol, held in Frankfort, Kentucky in January 2002.**
When Brian Greenwell was asked why he spends so much time working on his research project, he exclaimed, "I just enjoy working in the lab."

"In high school, the best class I had was my advanced placement biology class because we spent a lot of time doing experiments. I just learn more when I'm in the lab," explained Greenwell. The biology major from Owensboro, Kentucky, did not lose any time finding his way into a laboratory when he arrived at Murray State. By the middle of his first semester he was volunteering in the research laboratory of Dr. James Stuart, a medical microbiologist. By the beginning of the second semester, he was also helping Dr. William Spencer, an aquatic botanist, in an introductory botany, teaching laboratory. He was in his third semester at Murray State when he learned of the Howard Hughes program. Murray State when he learned of the Howard Hughes program. He was in his third semester at Murray State when he learned of the Howard Hughes program. Murray State when he learned of the Howard Hughes program.

"My first goal was to isolate 10 bacteriophages from human sewage using enrichment and plating techniques," Greenwell said. The phages were then cross-streaked against 14 different capsular strains of Enterococcus faecalis, with Greenwell recording the sensitivity levels of each strain. The DNA of each phage was isolated and cut with four restriction enzymes to prove its uniqueness on the molecular level. Greenwell compared the banding patterns and established the uniqueness of each phage. Work on the transduction assays is about to begin. Greenwell said the research is important because Enterococcus faecalis is a growing nosocomial, or hospital acquired, disease that can lead to urinary tract infections, septicemia and endocarditis. Understanding the transmission of antibiotic resistance among Enterococcus faecalis is an essential step in dealing with this problem. "Brian is one of the hardest working students I know," Stuart said. "His strong suit is his willingness to pitch in and just get the job done," Stuart continued. "I can always count on him to do what he says he is going to do."

Greenwell said he thinks his work on the Howard Hughes project will give him an edge over others in his field of molecular biology when he looks for a graduate school. "I feel that experience is everything. I have learned an enormous amount from this project."

"When asked about where he wanted to go to graduate school, Greenwell said, "I really haven't decided yet. After all, I've just finished my sophomore year.""
Helping Others

Ann Harper's life has always involved helping others. Growing up in Russellville, Kentucky, Harper cared for her grandmother, who suffered from Alzheimer's disease. She soon found herself doing volunteer work at a local nursing home. Today, Ann is an emergency medical technician and a rescue diver. It came as no surprise to Harper’s family when she said she wanted to go to Murray State University to pursue a career in medicine.

At Murray State, Harper, then a sophomore majoring in biology and minoring in chemistry, met Dr. David Canning, a developmental biologist involved in stem cell research. An interesting application of Canning’s work, and one that immediately attracted Harper, was the potential impact of this research on Alzheimer’s disease.

Harper’s Howard Hughes experience, “An Investigation of the Expression of Specific Genes Unique to β-Induced Reactive Astrocytes,” uses the brain cells of rats to identify genes unique to reactive astrocytes. Astrocytes are star-shaped brain cells that support the work of neurons by regulating their environment. Identification of genes unique to reactive astrocytes will provide powerful tools to further explore the creation of neuron growth inhibiting environments in brain trauma and Alzheimer’s disease.

“Harper’s HHMI project is being funded by the National Institutes of Health,” Canning explained. “Murray State’s primary role in this NIH project is to investigate cellular mechanisms responsible for creating scars at lesion sites in the central nervous system that inhibit the regeneration of neurons,” Canning said.

Harper’s response was more personal. “In the past I helped treat symptoms of advanced cases,” Harper said. “I have directly seen how Alzheimer’s affects families, so helping to find a way to eliminate the disease would be such a personal and overwhelming achievement.” Harper went on to say, while her work in the laboratory and her classes consume much of her time, Harper indicated that her life at Murray State is not all work. Harper is the Vice President of Gamma Beta Phi, a national honor and service organization, and President of the Outback club, a campus outdoor and wildlife society.

While graduation is more than a year and a half away, Harper is looking to the future. Harper plans to attend the University of North Carolina at Charlotte, enter a graduate program in Molecular Cell Developmental Biology, and continue research. “Helping involved in the HHMI program showed her that becoming involved in research is another great way to help people.”

Victoria Petrie’s life had been defined by learning what she did not want to do – until the HHMI program helped her find something she really does want to do: become a genetic counselor and researcher to help those with genetically related illnesses.

“I grew up in Ruhlenberg County, Kentucky, in the Lake Malone area,” Petrie said. “My mother was a teacher at my school and I think everyone expected me to be a ballet dancer, but I knew that wasn’t what I wanted to do.” Petrie also took ballet classes as a child, but she said she knew she did not want to be a ballerina either. “I didn’t think I had the grace and stamina for that,” Petrie said.

Petrie does have grace and stamina in the laboratory, however, and she exhibits those qualities daily in her work on gene therapy at St. Jude Children’s Research Hospital in Memphis, Tennessee. Petrie is a member of a research team using globin gene therapy to find a way to facilitate healthy hemoglobin growth in children with sickle cell anemia. This genetic blood disorder can lead to frequent and severe infections, damage to major organs, and episodes of acute intense pain. “People associate St. Jude with cancer only,” Petrie said, “but we cure catastrophic illnesses in children using research and treatment.” That vision was one of the reasons Petrie became involved with the HHMI program.

“I really didn’t know what I wanted to do with my undergraduate degree in biology,” Petrie admitted. “Petrie’s Howard Hughes experience changed all that. “I have always wanted to make a difference in peoples’ lives,” Petrie said. “My work at St. Jude showed me how I could do that.”

Two weeks after her official notification of acceptance into the program, Petrie met her mentor, Dr. Derek Persons, Associate Member of Experimental Hematology at St. Jude.

Petrie said Persons has been instrumental in her success at St. Jude. “He is so good at going back and reviewing what we had done,” she said. “He really wanted to make certain I understood everything I did.” In her meetings with him, Petrie said Persons would ask her why she had done something a certain way. “Occasionally I would try to get away with saying ‘because they told me to,'” she said. “Dr. Persons never accepted that answer; Petrie said with a smile.

“Dr. Persons said that Vicky worked diligently during her summer at St. Jude mastering molecular cloning – an important part of gamma globin gene therapy. ‘Vicky has helped in our progress toward our ultimate goal of helping patients,’ Persons said. One of Petrie’s favorite sayings actually came from another physician on their research team, Dr. Abbot. Petrie said in teaching her to keep it simple, Abbot told her, ‘It’s molecular biology, not rocket science.’

Petrie said the HHMI project gave her a definite career path. “I know that I want to be involved in genetic counseling – in the research end of it,” Petrie said. Genetic counselors help people understand the consequences of being carriers of certain genes and the specific illnesses that result. Murray State’s Howard Hughes award opened doors for Petrie that she said she could not have opened on her own. “How would I have gotten my foot in the door?” Petrie asked. “Only real scientists work at St. Jude.”

Petrie is one of those real scientists now and wants to stay a part of the vision of St. Jude hospital. That vision is summed up in a statement by Danny Thomas, the founder of St. Jude – “No child should die in the dawn of life.” It may not be rocket science to some people, but finding a cure to a devastating childhood disease could lead to a Nobel Prize. Petrie thinks that winning one of those might be nice too.
We invite you to meet our Howard Hughes Medical Institute undergraduate research mentors.

Murray State University and the Howard Hughes Medical Institute are developing tomorrow’s leaders in the biomedical sciences while changing the face of science education.

Dr. James Stuart
Brian Greenwell

Dr. J. Ricky Cox
Adam Farley

Dr. Waleed Gaber
St. Jude

Dr. David Canning
Ann Harper

Dr. Edmund Zimmerer

Dr. Jin Liu
Adam Lowry

Dr. Leon Duobinis-Gray

Dr. Edward McFarland
Johns Hopkins University
Aaron Compton

Dr. Sterling Wright
Adrian Yeiser

Dr. Robert Volp

Dr. Derek Persons
St. Jude
Victoria Petrie

Dr. Timothy Johnston

Dr. Terry Derting
Stephen Compton
While Lee Webb sat on the steps of the old Pogue Library on a pleasant October evening, he reminisced about his opportuni-
ty with the Howard Hughes Medical Institute undergraduate
research program. For Webb, HHMI was an experience, rather
than just a research project.
Webb remarked that his “approach to science has changed”
due to “the new experience of using different methodologies,
coming up with unexpected results, and asking new questions
based on correlating my findings with others’ findings. It is a
very dynamic process.”
Webb’s project focused on the response of female mice to
odor signals released by males. He investigated whether the
attractiveness of male odors to females relates to the genetic
quality of males. First, he determined the preferences of
female mice for odors in the soiled bedding of male mice. Some
female mice were then paired with males whose odors they
preferred; others were paired with males whose odors the
females did not prefer. Webb then assessed several physiologi-
cal characteristics of the males and the sons produced by the
pairs of mice.
Webb’s research showed that females benefit from mating
with males with preferred odors, through increased numbers of
offspring conceived and increased sizes of reproductive and
digestive organs in the offspring.
Webb remarked that his hands-on experience was better than
work in a classroom because it allowed him to study science
directly. The research project “made me more self-reliant.”
Webb said his mentor, Dr. Terry Derting, a physiological ecolo-
gist at Murray State University, furthered the independent
aspect of the project. Derting encouraged him to decipher his
data for himself.
“Lee is hardworking, has a good sense of humor, and is willing
to help out in any way that he can,” said Derting as she leaned
back in her chair. “Lee’s research is only the third scientific
study that I know of to demonstrate that the genetic quality of
potential male mates can be communicated through odor cues,”
she said. “Recent research has demonstrated that even the
human brain responds to a pheromone or odor cue,” she added.
Thus, Lee’s research is an important step toward understanding
the potential consequences of preferences for certain odors.
Webb found his experience fun and challenging, and HHMI
“made it all possible,” he said. The research experience gave
him a whole new experience with biology. He is hoping that
his expertise will reach a new level, because he has the
chance to do more research through the HHMI program in the
upcoming summers.
After Webb completes his undergraduate studies he plans to
further his education by studying Physical Therapy in profession-
al school. “I would like to do physical therapy research,” he said.
In the meantime, Webb has presented his research to the
Biology Freshman Orientation class at Murray State University,
the Kentucky/Tennessee Academy of Science meeting and at
Posters-at-the-Capitol, a poster session at Kentucky’s state capi-
tol intended to help those who fund higher education understand
the importance of research to undergraduate education.
Webb’s HHMI experience will never be forgotten because it
gave him more insight into science and research. “I did not
know what it was like. Now, I have a real respect for the peo-
ple who do it.”

Laws of Medicine, Laws of Murphy

Adam Lowry, of Centralia, Illinois, is fast becoming a well-
educated man. Now in his first year at The Emory School of
Medicine in Atlanta, Lowry recently graduated with a biolo-
gy degree from Murray State University.
Lowry’s last days at Murray State were among his most
rewarding. During that time, he had the opportunity to
spend an entire summer studying genetic mutations on the
molecular level as an Undergraduate Research Scholar in the
Howard Hughes Medical Institute undergraduate
research program.
“I learned a great deal about the field of medical genetic-
is and the skills necessary to contribute to that field,” Lowry said. “I also learned a lot about Murphy’s Laws,” he went on to say. “I could definitely have lived without that.”
Lowry’s HHMI project, “Gene Mutations Responsible for
Metabolic VLCAD Deficiency,” studied the enzyme Very-Long
Chain Acyl CoA Dehydrogenase, or VLCAD. VLCAD is a meta-
abolic enzyme that helps break down fats for energy produc-
tion during periods of fasting, such as sleep or between
meals. A VLCAD deficiency may lead to dangerously low
blood sugar levels, which are a result of the body’s inability
to use efficiently the fat it has stored. VLCAD deficiency is
especially dangerous for infants and newborns.
Medical science currently has no standard test for VLCAD
deficiency. Lowry’s research, headed by his mentor, Dr. John
A. Phillips, Director of the Division of Medical Pediatric
Genetics at Vanderbilt University Medical Center, sought to
determine the exact nature of the VLCAD gene, laying the
groundwork for an applicable, Inexpensive test.
The summer began well for Lowry, as he and other mem-
bers of the research team performed various tests on DNA
samples from known VLCAD-deficient patients for compari-
sion to normal DNA.
Problems arose after a few weeks when tests started to
show results everyone knew to be incorrect. The last few
weeks of Lowry’s research were spent trying to discover the
culprit that was causing the problem. At Emory, he received
word from the Vanderbilt team that the culprit was a dete-
rminating product ordered from an outside lab.
Lowry believes the problem occurred as a result of a new
 technique being used on his project. But, according to
Lowry, he learned that solving such challenges are simply a
part of what research scientists do on a daily basis.
Lowry appreciated Phillips’ guidance. When not with his
patients, Phillips was always available to answer questions.
At weekly meetings, the research team would discuss proj-
ec-t goals and progress. After objectives were set, it was up
to Lowry and the rest of the team to implement them.
Lowry discovered much about medical research—including
that research very rarely goes as planned. He also says, “I
learned an equally important side-lesson: a genetics labora-
tory is a prime location to demonstrate Murphy’s Law.”
“As for the immediate future, I hope to receive my med-
ical degree from Emory and return to the St. Louis area to
practice,” Lowry said. “While medical research is not in my
future right now, my Howard Hughes experience will help
me as a doctor evaluate, understand and appreciate med-
ical research in a way I could not have in the past.”

“My Howard Hughes experience will help me as a doctor evaluate, understand and appreciate medical research in a way I could not have in the past.”

Lee Webb

Adam Lowry
Finding a Career

As a high school student in Owensboro, Kentucky, Adrian Yeiser began to develop an interest in medicine. Three years of college, four medical internships, and a Howard Hughes project later, Yeiser is now certain that he wants a career in the medical field. Today, he will even tell you that he is seriously considering a career in medical research after becoming a doctor, a career path that was not in the picture before his Howard Hughes project.

In an animal physiology class, Yeiser met Dr. Sterling Wright, a neurophysiologist at Murray State, and liked how Wright's lab, he Howard Hughes internships were announced and Yeiser saw an opening in Wright's lab. From the start, Yeiser's drive and interest in medicine, as evidenced by his four medical internships, was clear. The projects in Wright's laboratory involve studying the pharmacology and biophysics of voltage-gated sodium channels cloned from muscle tissue. Sodium channels are responsible for the electrical activity in muscle cells that precedes muscular contraction. Yeiser's HHMI project, entitled "Using Aminoglycoside Antibiotics to Explore the Pore Forming Region of Voltage-Gated Sodium Channels," was an investigation that focuses on understanding the block of sodium channel currents by a common class of antibiotic drugs.

Yeiser has examined sodium channel sensitivity to a wide range of the aminoglycoside antibiotics to determine how drug size and net charge affect block of the channels. His research could ultimately provide clues about the architecture of the pore-forming region of the channel.

Yeiser presented his findings at the joint meeting of the Kentucky and Tennessee Academies of Science conference. He believes his HHMI research project gave him the opportunity to discover much about basic research—and about himself.

Yeiser's attention to detail and patience impressed Wright. "These are relatively tedious and difficult experiments to perform," Wright said. "Adrian did not give up and worked until he mastered the required techniques," Wright went on to say. "He was a dedicated and hard-working applicant." Having worked with Yeiser for almost a year now, Wright readily agrees.

Yeiser's work involved an in-depth analysis and review of a patient of Dr. Edward McFarland's. "When an athlete, in this case a jockey, sustains an injury to the rotator cuff," Compton said, "there is usually damage to the tendons insertion to the proximal humerus. In addition, an injury to the rotator cuff muscles can mimic the symptoms of an isolated strain injury to the supraspinatus and infraspinatus muscles without involvement of their respective tendons. An injury to the muscle and not to the tendon through such a mechanism is very unusual."

Compton's work involved an in-depth analysis and review of a patient of Dr. McFarland's. Compton's patient had just completed his rotator cuff repair at one of the most prestigious university hospitals in the nation, Johns Hopkins University. "Bright lights, big city." This is how Aaron Compton of Baltimore, Maryland, summarized the experience a physician experiences. By shadowing McFarland in the clinic and in the operating room, Compton learned how to interact with medical professionals and how patients present their symptoms.

In his Hughes application, Yeiser stated, "I assure you, you will not find a more dedicated and hard-working applicant." Having worked with Yeiser for almost a year now, Wright readily agrees. The educational experience Yeiser received as a research student greatly supplemented the course work in his degree program. "You learn more in a research lab than you learn in an ordinary classroom," he said. "The HHMI project allowed me to stay at Murray State over the summer, get to know my mentor, learn important lab techniques, and gain a perspective on the medical field I never really had," Yeiser said.

Yeiser's summer at Johns Hopkins gave him the opportunity to interact with medical students and residents. "The HHMI project allowed me to stay at Murray State over the summer, get to know my mentor, learn important lab techniques, and gain a perspective on the medical field I never really had."
Stephen Compton, a Murray State University sophomore from Murray, Kentucky, cannot recall a time when he was not interested in science. He is fascinated with science because it “explains why things are the way they are.” Compton met Dr. Terry Derting, an ecophysiologist on the biology faculty at MSU, at a meeting with graduates from his alma mater, Murray High School. He soon accepted her invitation to help with on-going research in her laboratory. Before long, he was learning to obtain blood samples through heart puncture and isolating DNA for PCR analyses.

When the opportunity to participate in further research through the HHM research program arose, Compton jumped at the opportunity. His research, “Determining the Immune System’s Role in a Mammalian Energy Budget,” involved using house mice to determine “how much energy it takes to maintain the immune system and to mount an immune response.”

Whether the immune system is a costly component of an animal’s energy budget is a controversial question. Compton wondered about questions like “If a person has a virus, does the immune system take away energy normally used by other systems of the body?”

If Compton’s research showed that maintaining immunocompetence is a high-priority process, then equipping traditionally used to describe energy budgets of animals can be modified to include the cost of immunocompetence.

To address his questions, Compton determined the energy cost of maintaining immunocompetence by comparing control mice with mice whose immune system had been suppressed. In a second experiment, he injected mice with sheep red blood cells and phytohemagglutinin to stimulate immune responses, then measured the energetic consequences of those responses.

Derting provided the idea for Compton’s experiment, but Compton developed his own methods for testing his hypotheses. He learned how to perform a variety of techniques and measurements, including using an open-system respirometer, collecting blood samples, conducting white blood cell counts, giving various types of injections, and performing dissections.

Derting remarked that “Stephen recognizes that all activities can be valuable learning experiences, whether in his direct area of interest or not. He enjoys research in the laboratory as well as helping with long hours of field work—even when up to his knees in mud!” Compton enjoyed working with Derting and appreciated the confidence she showed in him. He gained self-esteem during the project by learning that he was capable of a lot more than he had thought. “Stephen’s awareness of himself and his abilities has grown tremendously as a result of his research activities,” Derting said.

Compton believes that being involved in research has put him in a better position than students who have relied solely on classroom instruction. “Using the summer for research will benefit me as I attempt to get into the medical field,” Compton said.

Compton has presented his research at the Kentucky/Tennessee Academy of Science meeting, and is already working on writing an article for submission to a professional scientific journal.

Compton is particularly excited about the upcoming summer. His second assignment with the Howard Hughes program will be at Johns Hopkins University. “Who could have imagined that someone from Murray, Kentucky, would be spending a summer at one of the world’s most highly regarded medical research universities,” Compton said.

A WHOLE NEW WORLD

“It was a whole new world,” explained Thalya Burden as she spoke of her summer experience at St. Jude Children’s Hospital.

The summer after her junior year, Burden, an applied math major and Regents Scholar from Paducah, Kentucky, worked on the kind of research project few undergraduates ever see. Under the guidance of Dr. Waleed Gaber, a nuclear physicist and primary research investigator in the Department of Radiation Oncology at St. Jude, she investigated the side effects of radiation therapy on lab rats. After a glass plate was surgically implanted in the cranium of rats, Burden directly observed leukocyte activity and permeability of the blood brain barrier.

This was not Burden’s first research experience. Through her sophomore and junior years, Burden worked with Dr. Renee Fister, a Murray State University mathematics professor, on an optimal control problem applied to immunotherapy.

While I certainly enjoyed the MSU project,” Burden explained, “it was a very different kind of problem.” The St. Jude project required that Burden integrate computers and advanced technology.

At St. Jude, Burden was introduced to state-of-the-art medical imaging technology. This experience gave Burden the opportunity to see research applied to a real life situation. “If we can determine what causes the side effects of radiation, then we can find ways to prevent those effects,” Burden said.

Burden especially appreciated working with her mentor. “Dr. Gaber treated me like a colleague, not like a student. We spent many hours a week discussing the problems we encountered during our research,” said Burden. She explained that Gaber listened to her ideas and gave her the freedom and encouragement to pursue them.

“At St. Jude, we were not always in the lab,” Burden explained; “We also attended three to four seminars every week on a variety of medical topics.” In several instances, Burden found the seminars directly applicable to her own research project.

Prior to her St. Jude experience, Burden had considered a future only in mathematics. Today, Burden is seriously considering pursuing a doctorate in biomedical engineering, a career choice she had not considered before her HHMI appointment.

Benjamin Franklin once said, “Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it.” Thalya Burden sought out new information and discovered a whole new world.