

# 2018-19 ACADEMIC CATALOG



**St. Jude Children's  
Research Hospital**  
Graduate School of  
Biomedical Sciences





# St. Jude Children's Research Hospital

## Graduate School of Biomedical Sciences

The St. Jude Children's Research Hospital Graduate School of Biomedical Sciences is authorized by the Tennessee Higher Education Commission. This authorization must be renewed each year and is based on an evaluation of minimum standards concerning quality of education, ethical business practices, health and safety, and fiscal responsibility.

### ST. JUDE CHILDREN'S RESEARCH HOSPITAL GRADUATE SCHOOL OF BIOMEDICAL SCIENCES

262 Danny Thomas Place, Mailstop 1500

Memphis, TN 38105

Phone (901) 595-1500

Fax (901) 595-1525

Email: [sjgradschool@stjude.org](mailto:sjgradschool@stjude.org)

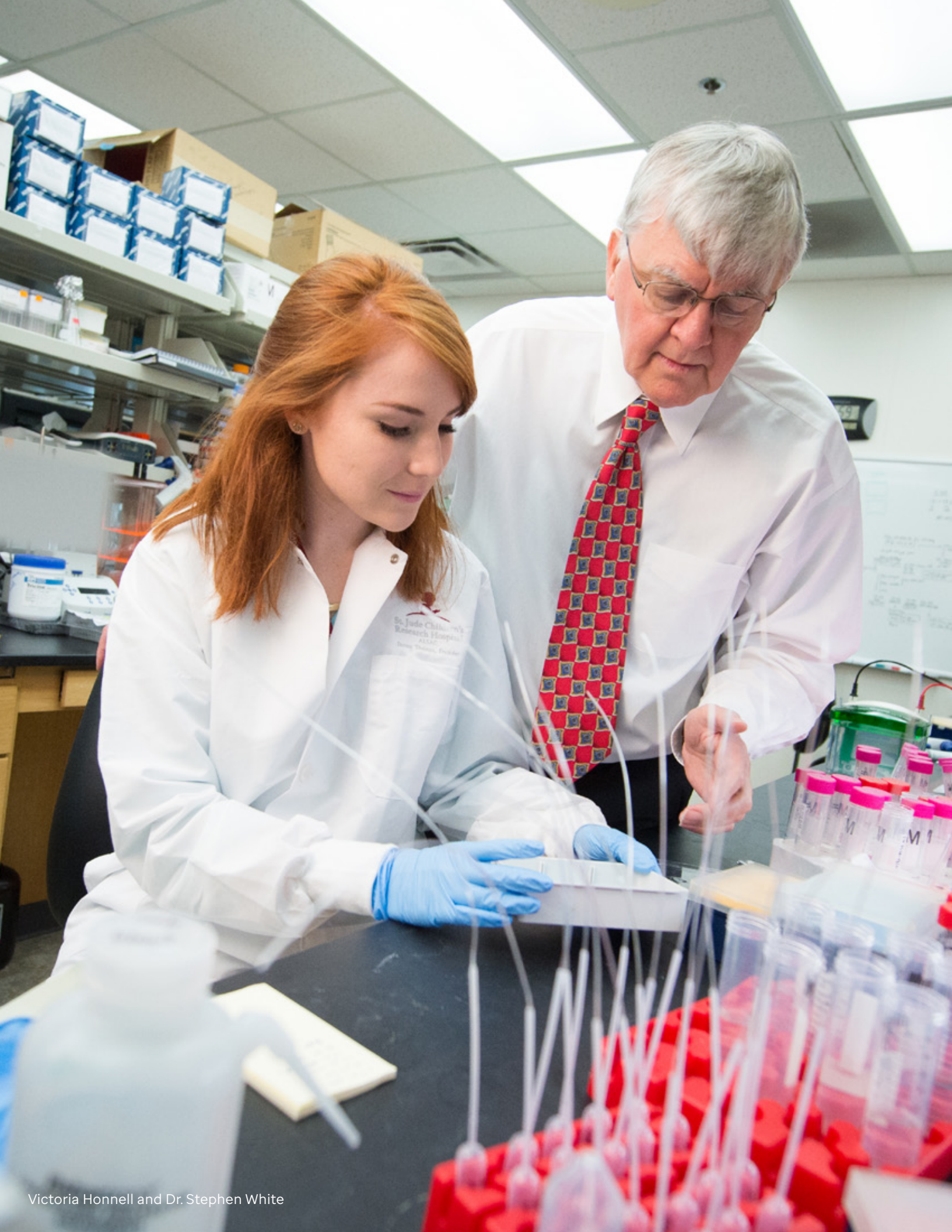
Web: [stjude.org/graduate-school](http://stjude.org/graduate-school)



First Day of School

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Victoria Honnell and Dr. Stephen White

# MESSAGE FROM THE DEAN

Welcome to the St. Jude Children's Research Hospital Graduate School of Biomedical Sciences!

Are you seeking an innovative biomedical graduate experience? If so, I strongly encourage you to explore the St. Jude PhD Program in Biomedical Sciences. The hospital was founded in 1962 to cure life-threatening childhood diseases through seamless interactions between clinicians and researchers. This uniquely integrated clinical and scientific environment provides unmatched opportunities for scientific graduate training. The first and only National Cancer Institute-designated Comprehensive Cancer Center devoted solely to children, St. Jude is also ranked the No. 1 pediatric cancer hospital by U.S. News & World Report. By advancing the research of the nation's top pediatric cancer hospital, your work here will make a real difference to our patients and to children around the world.

Our reputation for scientific and clinical excellence has been achieved by following a simple formula – hiring the best researchers and providing them with the best facilities. We used the same simple formula to create the Graduate School, which boasts a graduate faculty of internationally renowned investigators. As a graduate student, you will be taught and mentored by more than 100 scientific and clinical investigators working within 22 academic departments.

You will join a highly selective cohort of students, who will develop into elite biomedical scientists fully prepared to be leaders in research, academia, government and industry. Our resources are unparalleled, with access to state-of-the-art core facilities that will speed scientific discovery and expedite your progress to graduation. To foster collaboration and community, our students enjoy a custom-designed space in the Marlo Thomas Center for Global Education and Collaboration. The space encompasses the teaching facility, staff offices, a recreational and discussion area, and private study carrels for your first year in the program.

In our program, you will experience a curriculum that has been thoughtfully designed to meet the needs of modern biomedical research. St. Jude conducts research in many scientific disciplines including biology, chemistry, physics and computational biology, and our program is flexible for students with a wide variety of interests and backgrounds. Your rigorous scientific training has been designed to allow graduation in five years. You will also receive clinical mentoring to learn how basic science is best applied in patient care, and professional development training essential for a successful career. We are also able to accommodate clinical trainees who wish to obtain a PhD. Our challenging curriculum is ideally suited to independent, ambitious and fearless graduate students who enjoy working in teams and sharing creative ideas.

Memphis offers an outstanding quality of life for students and attractions that include a thriving music and arts scene, NBA basketball and AAA baseball, a rich cultural environment, parks and biking trails, world-class dining, and a fun and vibrant nightlife. St. Jude-sponsored housing for our graduate students is available along the beautiful Mississippi River or in the historic midtown area. Our outstanding social and intellectual environment is a major reason why St. Jude is consistently ranked on Fortune magazine's "100 Best Places to Work For."

I encourage you to learn more about the St. Jude Children's Research Hospital Graduate School of Biomedical Sciences and look forward to welcoming you to our remarkable institution.

Sincerely,



# GRADUATE SCHOOL ADMINISTRATION



Stephen W. White, DPhil  
President and Dean



Brian Walton, MBA  
Associate Dean



Dayna Baker  
Coordinator - Graduate  
School Operations



Tiffany Young-Polk, MS  
Registrar



Racquel Collins, MT (ASCP),  
MBA, PhD  
Assistant Dean



Shaloo Puri, MBBS, DTCD,  
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Spring Harbor, NY  
Former Dean, Watson School

# GRADUATE SCHOOL FACULTY

## RESEARCH

Baker, Suzanne  
Cao, Xinwei  
Chen, Taosheng  
Cheng, Yong  
Chi, Hongbo  
Clements, Wilson K  
Davidoff, Andrew  
d'Azzo, Sandra  
Demontis, Fabio  
Dyer, Michael A.  
Enemark, Eric  
Feng, Yongqiang  
Fischer, Marcus  
Fujii, Naoaki  
Geiger, Terrence L  
Gottschalk, Stephen  
Green, Douglas  
Grosveld, Gerard  
Haecker, Hans  
Han, Young-Goo  
Hatley, Mark  
Hendershot, Linda  
Herz, Hans-Martin  
Hurwitz, Julia  
Kalodimos, Charalampos  
Kanneganti, Thiru-Devi  
Klco, Jeffery  
Kriwacki, Richard  
Kundu, Mondira  
Labelle, Myriam  
Lee, Richard E  
Li, Chunliang  
McGargill, Maureen  
McKinney-Freeman, Shannon  
McKinnon, Peter  
Meagher, Michael  
Mittag, Tanja  
Moldoveanu, Tudor  
Mullighan, Charles  
Northcott, Paul  
Obeng, Esther

Ogden, Stacey  
Onar-Thomas, Arzu  
Opferman, Joseph  
Partridge, Janet  
Peng, Jamy  
Peng, Junmin  
Potts, Malia  
Potts, Ryan  
Pounds, Stanley  
Rampersaud, Evadnie  
Relling, Mary  
Rivas, Fatima  
Roberts, Charles  
Rosch, Jason  
Roussel, Martine  
Russell, Charles  
Savic, Daniel  
Schuetz, Erin  
Schuetz, John  
Schultz-Cherry, Stacey  
Schwarz, Lindsay  
Shelat, Anang  
Snyder, Scott  
Solecki, David  
Sorrentino, Brian  
Stewart, Clinton  
Stewart, Elizabeth  
Taylor, J Paul  
Thomas, Paul  
Tsai, Shengdar  
Tuomanen, Elaine  
Velasquez, Paulina  
Webby, Richard  
Weiss, Mitch  
White, Stephen  
Yang, Jun J  
Youngblood, Benjamin  
Zakharenko, Stanislav  
Zambetti, Gerard  
Zhang, Jinghui  
Zhu, Liqin

## CLINICAL

Anghelescu, Doralina  
Armstrong, Greg  
Bahrami, Armita  
Baker, Justin  
Bishop, Michael  
Brennan, Rachel  
Caniza, Miguela  
Chemaitilly, Wassim  
Choi, John  
Conklin, Heather  
Crabtree, Valerie  
Estepp, Jeremie  
Federico, Sara  
Gaur, Aditya  
Green, Daniel  
Hankins, Jane  
Harreld, Julie  
Inaba, Hiroto  
Mandrell, Belinda  
McCarville, Beth  
Merchant, Tom  
Metzger, Monika  
Morrison, Ray  
Mulrooney, Dan  
Nichols, Kim  
Pappo, Alberto  
Phipps, Sean  
Reiss, Ulrike  
Ribiero, Raul  
Robinson, Giles  
Sandlund, John  
Tinkle, Christopher  
Triplett, Brandon  
Wolf, Josh

# HISTORY OF ST. JUDE

More than 50 years ago, Danny Thomas, a struggling young entertainer with \$7 in his pocket, got down on his knees in a Detroit church, before a statue of St. Jude Thaddeus, the patron saint of hopeless causes. Danny Thomas asked the saint to “show me my way in life,” and pledged to someday build a shrine to the saint. His prayer was answered. Within a few years, Danny Thomas’ career prospered. Through films and television, he became a nationally known entertainer, and he remembered his pledge to St. Jude.

When the hospital opened its doors in 1962, a diagnosis of acute lymphoblastic leukemia (ALL) was a death sentence. ALL, the most common form of childhood cancer, had only a 4% survival rate. At that time, the Handbook of Pediatrics stated, “There is no cure for leukemia; treatment is directed at prolonging life and relieving symptoms.” Pioneering research at St. Jude resulted in patients with ALL having a 50% cure rate only 8 years after the hospital was established. Building on this early success, St. Jude developed protocols that have raised current survival rates for children with ALL to above 90%. The hospital’s research findings are shared with doctors and scientists around the world; thus, tens of thousands of children are alive today as a result of the research and clinical trials conducted at St. Jude.

Despite the greater than 90% cure rate, some forms of ALL continue to evade treatment. Today, researchers at St. Jude are using next-generation sequencing to explore the pathogenesis of leukemia and the effects of treatment, with the goal of identifying unique molecular targets for the development of more effective therapies. Several novel targets have been identified as a result of the St. Jude Children’s Research Hospital – Washington University Pediatric Cancer Genome Project, which sequenced the complete genomes of more than 600 matched samples of normal cells and cancer cells from patients with the most challenging and severe forms of childhood cancer. As a result of this work, personalized therapies are now being developed. Pharmacogenomic studies are also providing novel insights into inherited differences in drug response, which can further help to individualize treatment. To date, St. Jude has treated more than 30,000 children from across the United States and from more than 80 countries around the world. All patients are accepted by physician referral for newly diagnosed, untreated, or suspected cancer; HIV infections; or certain hematologic, immunologic, or genetic diseases. Patients are accepted based on their eligibility to enroll in an open St. Jude clinical research protocol. After an initial evaluation, assistance with transportation and local living expenses are also provided.

St. Jude patients and their families are never billed for treatment. ALSAC, the fundraising arm of St. Jude, covers all costs beyond those reimbursed by third-party insurers, and when no insurance coverage is available, ALSAC covers all of the patient’s costs. Most patients are seen on a continuing outpatient basis, but the hospital is licensed for 80 beds to accommodate patients who require hospitalization during treatment.

Danny Thomas’ “little hospital in Memphis”—which now has daily operating costs exceeding \$2.5 million dollars—has dramatically improved health care for children around the world and continues to work on improving treatments for pediatric cancer and other catastrophic childhood diseases. Danny Thomas passed away in 1991, but his children, Marlo, Terre, and Tony, carry on the mission and remain a driving force to ensure that their father’s dream endures.

# ABOUT ST. JUDE

St. Jude, located in Memphis, Tennessee, is a private nonprofit biomedical research institute where scientists strive to understand the molecular, genetic, and chemical basis of catastrophic childhood diseases. Research is focused on pediatric cancers, acquired and inherited immunodeficiencies, genetic disorders, and infectious diseases, as well as normal cellular processes. The goal of St. Jude is to develop cures for these diseases and promote their prevention.

The St. Jude campus is situated north of downtown Memphis, on the bluffs of the Mississippi River. The campus consists of hospital and research buildings; ALSAC fundraising headquarters; and a Good Manufacturing Practice (GMP) facility, which produces clinical-grade therapeutics. The research staff consists of basic science faculty, clinical faculty, postdoctoral fellows, clinical fellows, and graduate students from around the world.

St. Jude offers opportunities for postdoctoral and graduate training, which is available in a wide variety of research areas in the basic and clinical sciences. The proximity of laboratory and clinical activities provides an ideal setting for collaborative and translational research and facilitates interactions among investigators working in different disciplines.

## Current Research

The current basic and clinical research at St. Jude includes work in angiogenesis, apoptosis, cancer biology, cell cycle regulation, chemical biology and therapeutics, computational biology, developmental biology, epidemiology and cancer control, experimental hematology, gene therapy, genomics, immunology, infectious diseases, molecular genetics, molecular therapeutics, neurobiology, pathology, pharmaceutical sciences, proteomics, radiological sciences, signal transduction, stem cell transplantation, structural biology, virology, pediatric AIDS, and psychological effects of catastrophic illnesses. St. Jude also conducts long-term biomedical evaluations of its patients and is the only pediatric research hospital supported by a National Cancer Institute Comprehensive Cancer Center support grant. Research highlights from the previous year can be found in the annual Scientific Report, which is available online at [stjude.org/sci-rpt](http://stjude.org/sci-rpt).

## Nobel Prize

In 1996, Peter C. Doherty, PhD, who holds the Michael F. Tamer Endowed Chair in Immunology, was awarded the Nobel Prize for Medicine. This award recognized Dr. Doherty for key discoveries on how T cells identify and eliminate infected cells.

## Faculty in the National Academy of Sciences

Four members of the St. Jude faculty have been elected to the National Academy of Sciences: Charles J. Sherr, MD, PhD (1995); Peter C. Doherty, PhD (1998); Robert G. Webster, PhD (1998); and Brenda A. Schulman, PhD (2014).

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## Faculty in the National Academy of Sciences Institute of Medicine

Six members of the St. Jude faculty have been elected to the Institute of Medicine (IOM), a prestigious branch of the National Academy of Sciences. The hospital's IOM members include Peter C. Doherty, PhD, Immunology; President and CEO James R. Downing, MD; William E. Evans, PharmD, Pharmaceutical Sciences; Arthur W. Nienhuis, MD, Hematology; Mary V. Relling, PharmD, Chair of Pharmaceutical Sciences; and Charles J. Sherr, MD, PhD, Chair of Tumor Cell Biology.

## Howard Hughes Medical Institute

Four St. Jude faculty members are Howard Hughes Medical Institute (HHMI) investigators; Michael A. Dyer, PhD, Developmental Neurobiology; Brenda A. Schulman, PhD, Structural Biology and Tumor Cell Biology; Charles J. Sherr, MD, PhD, Chair of Tumor Cell Biology; and J. Paul Taylor, MD, PhD, Chair of Cell & Molecular Biology. An HHMI award offers not only generous funding but also freedom and flexibility. "The Hughes awards have provided me complete freedom and support to do what I want. The key is that Hughes is not project oriented but people oriented," says Dr. Sherr, whose HHMI grant has been renewed three times.

## Academic Programs Office

The vision of St. Jude emphasizes the importance of educating health care and research professionals. In keeping with this vision, the goal of the Academic Programs Office is to be a world leader in attracting the best basic and translational scientists and to provide superior educational and academic opportunities for them to become national and international leaders in advancing the research, prevention, and treatment of catastrophic diseases in children. To support this vision, Academic Programs assists in recruiting and onboarding postdoctoral fellows at St. Jude, provides a comprehensive Fellows Professional Development Program, and offers the opportunity for mentoring training. All students, including those enrolled in the Graduate School, are also encouraged to participate in the seminars, symposia, social functions, and professional development programs provided by Academic Programs. Many undergraduate and graduate students choose to study at St. Jude each year. Of these students, several are here to pursue their entire doctoral research project and thesis preparation under the affiliation agreements that St. Jude has with many universities – both domestic and international.

## Outreach

Close interactions with the neighboring University of Tennessee Health Science Center and Le Bonheur Children's Hospital provide a rich extended research environment in Memphis. The St. Jude mission is not restricted to Memphis and the Mid-South; St. Jude currently has eight affiliate hospitals in the U.S., where pediatric patients can be treated on St. Jude protocols. These affiliates are located in Peoria, Illinois; Shreveport, Louisiana; Baton Rouge, Louisiana; Johnson City, Tennessee; Huntsville, Alabama; Springfield, Missouri; Charlotte, North Carolina and Tulsa, Oklahoma. For the past 25 years, the hospital has also maintained a robust international presence establishing 24 partner sites in 17 countries. Led by the Department of Global Pediatric Medicine, a new initiative, St. Jude Global, will create a network of interactive programs and institutions so that every child has access to quality care for cancer and other life-threatening diseases.

# HISTORY OF THE ST. JUDE CHILDREN'S RESEARCH HOSPITAL GRADUATE SCHOOL OF BIOMEDICAL SCIENCES

November 2015 marked the official launch of the St. Jude Children's Research Hospital Graduate School of Biomedical Sciences (Graduate School). This new institution is designed to provide exemplary graduate education for the next generation of biomedical researchers. The school represents a major milestone in the history of St. Jude Children's Research Hospital (St. Jude).

The training of biomedical scientists has always been a key component of the hospital's mission, with hundreds of postdoctoral fellows, medical students, and clinical fellows annually contributing to ongoing patient care and research. Graduate student training has also been an educational priority, historically occurring through affiliations with other schools and colleges.

St. Jude leadership recognized that the world-class faculty, research, and facilities at St. Jude represent the perfect environment for elite graduate training, particularly in the area of translational medicine. This idea continued to evolve over the years, and in June 2015, the hospital's Board approved the school's establishment.

The subsequent development of the school has been rapid. The Tennessee Higher Education Commission officially approved the school in November 2015; the Hospital created a Board of Trustees and Advisory Board and recruited a highly experienced staff in 2016. With the infrastructure and curriculum update, the inaugural class arrived on campus in July 2017.

The mission of the Graduate School is to educate and train future generations of scientists who seek to understand the molecular basis of human disease and develop novel therapies based on that understanding. This goal aligns perfectly with the St. Jude mission of finding cures for pediatric catastrophic diseases. The establishment of the Graduate School and the addition of smart, motivated, and fearless young researchers to our research enterprise represents a major advance in the continuing development of this exceptional hospital.



Beth Stewart and classroom of students

# MISSION STATEMENT

The mission of the Graduate School is to educate and train future generations of scientists seeking to understand the molecular basis of human disease and develop novel therapies based on that understanding.

# VISION STATEMENT

The Graduate School is designed to maximize student potential through self-directed learning, with guidance by world-renowned researchers and clinicians. Instruction is given in a dynamic environment that annually provides education and training to hundreds of affiliated undergraduate and graduate students, postdoctoral fellows, medical students, and clinical fellows. Collaborative and translational research enables students to choose individualized paths to success and leadership in scientific discovery. These opportunities also raise awareness of the value and urgent need to develop young scientists who will discover cures and advance treatments for catastrophic childhood diseases.

# OBJECTIVES

- Support the St. Jude mission to advance cures, and means of prevention, for pediatric catastrophic diseases through research and treatment.
- Educate and train the next generations of researchers in pediatric catastrophic diseases.
- Afford students the opportunity to study in a unique environment of excellence in clinical and laboratory research that emphasizes collaborative translational research.
- Provide outstanding training through a learning paradigm that is based on self-directed study and mentorship from world-renowned scientists working in unparalleled facilities.
- Produce graduates of distinction who will conduct cutting-edge research.

# ST. JUDE CHILDREN'S RESEARCH HOSPITAL GRADUATE SCHOOL OF BIOMEDICAL SCIENCES ACADEMIC CALENDAR 2018 – 2019

Fall Term	July 1 – December 31
Fall Registration	July 1 – July 15
Upper classmen report to labs	July 9
<b>First year students arrive</b>	<b>July 15</b>
<b>Orientation – first year students</b>	<b>July 23 – August 3</b>
Faculty research presentations	July 30 – August 3
Research Methods	July 24 – August 1
Topics in Clinical Translational Research	July 30 – December 16
<b>Convocation</b>	<b>August 2</b>
Course: Genes to Proteins	August 6 – September 5
Core Facilities	August 16 – December 11
Lab Rotation I	September 7 – October 18
Course: Cell Biology	October 22 – November 9
Mini-Course: Biostatistics	October 25 – December 13
Course: Developmental Biology	November 12 – December 14
<b>Thanksgiving Break</b>	<b>November 21 – November 25</b>
Classes Resume	November 26
Spring Registration	December 1 – December 15
<b>Winter Break</b>	<b>December 17</b>

Spring Term	January 1 – June 30
Classes Resume	January 2
Course: Cancer	January 2 – January 25
Topics in Clinical Translational Research	January 7 – June 13
Core Facilities	January 10 – June 13
Lab Rotation II	January 28 – March 8
<b>Spring Break</b>	<b>March 11 – March 15</b>
Course: Immunology	March 18 – March 29
Course: Infectious Diseases	April 1 – April 12
Course: Pharmacology & Chemical Biology	April 15 – April 29
Lab Rotation III	April 30 – June 10
<b>Commencement</b>	<b>June 23</b>
<b>Summer Break</b>	<b>June 24</b>

# THE MARLO THOMAS CENTER

The Graduate School is a custom-designed 4,600 sq ft space located in the Marlo Thomas Center. It contains private study carrels for first-year students, a state-of-the-art teaching facility, and administrative offices. There is also a student lounge equipped with a kitchenette, games, and TV. In addition to the Graduate School, the Marlo Thomas Center also contains an auditorium, a lecture hall, meeting rooms, a large atrium, and the Biomedical Library. The library is conveniently located adjacent to the Graduate School, maintains an extensive journal collection, and provides easy access to 4,800 electronic journals, 2,600 e-books, and several databases. In addition, the library maintains a collection of reference books and journals.

State-of-the-art videoconferencing capabilities enable faculty, staff, and students to share ideas, discoveries, and clinical information with experts and colleagues at other institutions. With more than 400 seats, the auditorium features folding desktops and outlets for electronic devices. The lecture hall seats 68 in a semicircle, giving it a stadium feel. The auditorium and lecture hall are powered by technologies that support the hosting of scientific conferences, academic lectures, institutional seminars, meetings, and symposia.

Seating areas are interspersed throughout the Marlo Thomas Center to foster idea-sharing. Inviting colors and comfortable couches encourage small, informal gatherings. Additionally, huddle rooms and meeting rooms, which are distributed throughout the Center, are custom designed to support informal and impromptu brainstorming sessions and discussions. These rooms contain high-definition monitors, cameras, and wall-mounted interface panels that allow users to control the technology settings and interact with remote participants.

The Marlo Thomas Center was opened in October 2014 and was designed to promote institutional interactions and to host national meetings. As St. Jude continues to chart new frontiers of discovery, the Center will support these efforts by encouraging and facilitating collaboration and innovation—two core principles central to the pursuit of contemporary research. With modern technology, attractive interior design, and emphasis on social interactions, students will find this space ideal for learning.





**MARLO THOMAS CENTER**

GLOBAL EDUCATION  
AND COLLABORATION



# ADMISSIONS

The application for the Graduate School is free. Application information can be found at [stjude.org/graduate-school](http://stjude.org/graduate-school). Applicants must complete the entire application and attach the seven required supporting documents (listed below) to be considered. Applicants must have at least an undergraduate degree (i.e., BA, BS, or equivalent). Those with an advanced clinical degree (i.e., MD, DO, PharmD, DVM, or DDS) will also be considered. Degrees should be awarded by a U.S.-accredited institution, but applicants (U.S. citizens or permanent residents) who received their degrees from institutions outside of the U.S. will also be considered. At the present time, the Graduate School cannot accept applications from international students.

There is no minimum grade-point average (GPA) or Graduate Record Examination (GRE) score requirement; however, it is expected that the application materials demonstrate that the applicant has broad training in core areas of life sciences and is equipped to succeed in graduate coursework and research.

## Undergraduate/Post-baccalaureate Applicants

Undergraduate and post-baccalaureate applicants should hold an undergraduate degree in biology, chemistry, physics, mathematics, or a similar science discipline. Additional advanced training in areas such as biochemistry, microbiology, immunology, organic chemistry, genetics, physiology, pharmacology, computational biology, and cell and developmental biology is strongly encouraged.

## Advanced Degree Applicants

The Admissions Committee will consider applicants with advanced degrees on an individual basis. Undergraduate degree(s), research experience, and career goals are important admissions criteria. Although applicants are required to complete the full number of course credits (90 hours, including the core course), other elements of training may be adjusted depending on the student's prior experience.

## Required Supporting Documents

1. A curriculum vitae that describes in full detail the applicant's academic background, including degrees, research experience, awards, publications, presentations, and other achievements.
2. Unofficial transcripts of academic records (final, official transcripts are due upon matriculation).
3. Letters of reference from three mentors, professors, or program directors. The letters must describe the student's academic successes, background in research, potential for achievement at the graduate level, and capacity for creative, self-directed study.
4. Previous exposure to laboratory research is required. Applicants are required to submit a one-page summary of their prior research experience.
5. A one-page summary that describes the applicant's most important contribution to research. Published work should not be sent. Instead, the applicant should explain in lay terms his/her best research experience, how that effort contributed to the overall project, and how the experience demonstrates the applicant's suitability for graduate studies.

6. A two-page personal statement that outlines the applicant's reasons for pursuing a graduate degree in biomedical sciences, the applicant's career goals, and how the applicant determined that the St. Jude Children's Research Hospital Graduate School of Biomedical Sciences is the best program through which to attain those goals.
7. Applicants are required to submit scores from the GRE General Test (ETS code 7888); however, we will accept the results of the Medical College Admission Test (MCAT) or equivalent examination scores. Scores should be sent directly to the St. Jude Children's Research Hospital Graduate School of Biomedical Sciences. Note: GRE General scores are valid for five years from test date, and the MCAT scores are valid for three years from test date.

## **Late Enrollment**

Late enrollment is only available at the Dean's sole discretion.

## **English Language Proficiency**

All students must be proficient in English because all instruction will be given in English.

## **Admissions Procedure**

Applications and supporting documents will be accepted through December 1 for admission to the following academic year. The application and seven required supporting documents must be received by 11:59 pm PST on December 1 for consideration. The Dean may waive this deadline only under exceptional circumstances and at his discretion. The Admissions Committee will review all applications, and the top applicants will be invited to visit the St. Jude campus. During this visit, the students will interview with the Dean and graduate faculty members, tour the campus and facilities, and experience greater Memphis and its attractions. The projected number of students accepted each year will be 12.

## **Environment of Diversity and Equal Opportunity**

St. Jude and the Graduate School encourage diversity on campus and do not discriminate on the basis of race, national origin, sex, genetic information, sexual orientation, age, religion, disability, veteran's status, disabled veteran's status, or any other status protected by federal or Tennessee law. The Graduate School is committed to creating an inclusive learning environment that provides cultural and ethnic diversity. Underrepresented minorities are encouraged to apply to the program.



Convocation 2017

# ACADEMIC PROGRAMS

The mission of St. Jude is to advance cures and means of prevention for pediatric catastrophic diseases through research and treatment. How does St. Jude find cures and means of prevention? Simple, through world-class research. The Graduate School aligns with the St. Jude institutional mission and focuses on learning basic scientific principles and connecting them to current scientific research. The Graduate School is designed to train and educate generations of researchers to respond to this mission. Both basic science and clinical graduate faculty teach the curriculum, which emphasizes translational research in cancer biology, infectious diseases, and genetic disorders.

## Program Objectives

- Apply fundamental concepts in the core areas of Biochemistry, Genetics, Molecular Cell Biology, Structural Biology, Cell Biology, Developmental Biology, Hematology, Cancer Biology, Immunology and Infectious Diseases, and Pharmacology and Chemical Biology.
- Understand and demonstrate the proper conduct of scientific research.
- Apply laboratory skills such as planning experiments, data acquisition, management, and analysis to a selected research problem.
- Plan and execute, with considerable independence, original and extensive laboratory research on a significant problem in the biomedical sciences.
- Critically evaluate the work of peers in biomedical sciences, including the choice of methods applied to problems and the interpretation of results obtained.
- Demonstrate advanced communication skills, both verbal and written, to disseminate the results of research.
- Apply the fundamental concepts in the biomedical sciences to public health issues, particularly in the detection, treatment and prevention of genetic, infectious, and other human diseases.



Christina Kackos and Dr. Jinghui Zhang

# CORE CURRICULUM

Term	Year	Course No.	Course	Credits
Fall	1	ORN8000	Orientation	0
Fall	1	RMD8000	Research Methods	0
Fall	1	BMS8001	Genes to Proteins	4
Fall	1	BMS8101	Cell Biology	3
Fall	1	BMS8201	Developmental Biology	3
Fall	1	BMS8302	Biostatistics	1
Fall	1	BMS8401	Core Facilities Program I	1
Fall	1	BMS8501	Topics in Clinical & Translational Research I	2
Fall	1	BMS8951	Lab Rotation I	3
			Fall	17
Spring	1	BMS8702	Cancer Biology	3
Spring	1	BMS8812	Immunology	2
Spring	1	BMS8822	Infectious Diseases	2
Spring	1	BMS8902	Pharmacology & Chemical Biology	2
Spring	1	BMS8402	Core Facilities Program II	1
Spring	1	BMS8502	Topics in Clinical & Translational Research II	2
Spring	1	BMS8952	Lab Rotation II	3
Spring	1	BMS8953	Lab Rotation III	3
			Spring	18
Credits Earned Year 1				35
Fall	2	BMS8961	Scientific Writing & Grantsmanship	3
Fall	2	BMS8991	Reading & Research	9
			Fall	12
Spring	2	BMS8992	Reading & Research	9
			Spring	9
Credits Earned Year 2				21
Candidacy Qualifying Examination				
Transitional Masters Granted				56
Fall	3	BMS9301	Reading & Research	9
			Fall	9
Spring	3	BMS9302	Reading & Research	9
			Spring	9
Credits Earned Year 3				18
Fall	4	BMS9401	Reading & Research	9
			Fall	9
Spring	4	BMS9402	Reading & Research	9
Spring	1	BMS8301	Computational Biology	1
			Spring	10
Credits Earned Year 4				19
Fall	5	BMS9501	Reading & Research	9
			Fall	9
Spring	5	BMS9502	Reading & Research	9
			Spring	9
Credits Earned Year 5				18
Doctoral Degree Awarded				111

## Program Overview

The first year of the program has been designed to provide students with the essential background knowledge for their subsequent research, introduce them to clinical research, and familiarize them with the research opportunities at St. Jude. During their first two weeks, students will receive an extensive orientation to the St. Jude campus and resources, be introduced to the faculty and their research, and complete the required training in human subjects' protection. Students will also participate in the Research Methods mini course which will expand their understanding of fundamental techniques, supporting concepts, and data analysis. For the remainder of the year, students will attend seven core courses, as well as a mini course in Biostatistics. Rather than a formal lecture series, these team-taught courses will emphasize current research, self-directed learning, and group discussions. In addition, a "Core Facilities Program" course will introduce students to the shared resources at St. Jude and the "Topics in Clinical and Translational Research Program" course will expose students to the institutional clinical and translational research. Clinical experience facilitates the student's understanding of the clinical applications of their basic science research. Finally, three six-week laboratory rotations are scheduled independently of course assignments. This will allow students to concentrate solely on coursework when in class and on research projects during the laboratory rotations. A Scholastic Oversight Team (SOT) will oversee the progress of students in their first year. At the end of the first year, students will select permanent laboratories and projects for their dissertation research. If an appropriate laboratory assignment cannot be made after three rotations, one additional rotation may be arranged with the Dean's approval.

In the second year, the students will enroll in the Grantmanship course which will provide the requisite skills needed to write and submit a grant proposal. The grant proposal will be the basis of their dissertation research project. With the successful completion of their candidacy qualifying exam, students will be awarded a transitional Master of Science degree in Biomedical Sciences. A student who does not successfully defend their candidacy qualifying exam will be awarded a terminal Master of Science degree in Biomedical Sciences.

To complete the doctoral program, the student must (1) conduct original research in his/her assigned laboratory, (2) analyze and compile the research, (3) pass the candidacy qualifying exam, (4) complete an approved dissertation that reports the results and significance of the work, (5) ideally have at least two publications based on the student's original research, and (6) orally defend the dissertation. Throughout the dissertation phase of the program, students are provided opportunities to attend seminars, lectures, journal clubs, and scientific meetings.

A Dissertation Committee will guide each student through the dissertation process and in their choice of enhanced learning opportunities. The Committee is composed of five faculty members chosen by the student and approved by the Dean. The Committee is responsible for evaluating and monitoring the progress of their student by providing written feedback during each academic term and to approve the dissertation defense.



Dr. Maureen McGargill and Madeline Bush

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## Satisfactory Academic Progress

Students enrolled in a graduate degree program are required to demonstrate satisfactory academic progress (SAP) toward degree completion. Failure to meet SAP requirements in consecutive semesters is grounds for academic termination by the Dean of the Graduate School. Academic progress will be measured at the end of each academic term. In a meeting with the Deans at the end of the term, each student will receive a copy of their academic progress. A copy will also be placed in their student file.

The following milestones are required for compliance with SAP towards the completion of the doctoral degree:

- During the first year, the student will complete the mandatory courses. Grades will be based on (1) examinations of the presented material, (2) performance on assignments and problem sets, and (3) level of the student's participation in the class discussions.
- Overall performance will be continually assessed and discussed with the student throughout the course. An overall grade of A+ (98-100), A (93-97), A- (90-92), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), F (0-69) will be issued at the conclusion of each course.
- Cumulative GPA minimum is 3.0 on a 4.0 scale.
- Satisfactory participation and completion of assignments are required in the Core Facilities and Topics in Clinical & Translational Research courses. Clinical advisors and research advisors will jointly assess the student's participation and completion.
- During the first year, complete three six-week laboratory rotations. For each rotation, submit weekly progress reports and make a final presentation.
- By the beginning of the second year, select a research faculty advisor and laboratory to begin your dissertation research.
- During the early part of the second year, select a dissertation research topic and Dissertation Committee in consultation with your research faculty advisor and the Dean.
- By the end of the second year, pass the Candidacy Qualifying Examination. The examination involves the preparation and oral defense of a grant based on the proposed thesis research. The document will be prepared in conjunction with part I of a mandatory Scientific Writing course. In the event of a 'fail', the Dissertation Committee in consultation with the Dean can authorize one repeat of the examination.
- Write and submit a grant application to an outside funding agency to support the research in conjunction with part II of the Scientific Writing course. The grant will be submitted at the earliest opportunity after passing the Candidacy Qualifying Examination.
- Organize semi-annual meetings with the Dissertation Committee.
- While conducting independent research, publish or have accepted for publication at least two manuscripts.
- By the end of the fifth year, successfully prepare the dissertation, conduct the oral defense, and complete all degree requirements.

# RESEARCH ENVIRONMENT

St. Jude provides a unique environment for translational research. The campus is compact and highly integrated, with basic scientists and clinicians interacting on a daily basis. Studies are typically coordinated through multidisciplinary teams that strive to understand the causes of diseases at the cellular and molecular level and to translate this knowledge into novel therapeutics. Much of the research is conducted under the umbrella of the St. Jude Comprehensive Cancer Center and its partner organization, the Children's Infection Defense Center, which seeks to eliminate infectious diseases in children. This highly interactive approach defines translational research at St. Jude. The infrastructure drives cutting-edge basic science research, therapeutic drug development, disease modeling and preclinical testing, and the design and implementation of sophisticated pediatric clinical trials.

St. Jude is a world-renowned institution for pediatric cancer treatment. By remaining at the cutting-edge of research and being able to rapidly exploit emerging technologies and scientific advances, St. Jude is widely regarded as a dynamic and pioneering leader in translational cancer research. Pediatric patients with cancer who are immunocompromised are particularly vulnerable to infectious agents. Thus, in addition to being a leader in pediatric cancer research and treatment, St. Jude was driven to become a global leader in studies of infectious diseases. Nonmalignant pediatric blood diseases represent another prominent area of research at St. Jude. These disorders include sickle cell disease, hemophilia, and bone marrow-failure syndromes.

Faculty members are organized into departments according to their scientific and clinical expertise. Within their departments, faculty members have the necessary office space, administrative support, laboratories, and facilities that are required for their individual research and clinical activities. Each department is equipped with shared cold rooms, tissue culture rooms, conference rooms, and equipment. Individual laboratories are superbly equipped with standard instruments for biochemistry, molecular biology, protein purification, cell biology, microbiology, and chemistry, according to the needs of each researcher. St. Jude's superb Shared Resources (described in the following section) provide access to a multitude of key technologies that support the multidisciplinary research environment.

## Graduate Training and the St. Jude Research Environment

The world-class faculty and research environment at St. Jude provide unique opportunities for graduate education and training. Graduate students will have the opportunity to participate in all of the research programs and to become involved in the full spectrum of studies from basic science, through therapeutic development, and ultimately to clinical trials. Participation in multidisciplinary research teams also extends the mentoring that students receive, beyond that of their thesis advisors and laboratories, and exposes students to a wide array of basic science methods. These include, but are not limited to, in vivo imaging; cellular and subcellular imaging using multiphoton and super-resolution microscopy, as well as 3D electron microscopy; structural and dynamic analyses of macromolecules using light and electron microscopy, nuclear magnetic resonance, and X-ray diffraction; screening of small-molecule libraries using biochemical, biophysical, and cell biological approaches; medicinal and synthetic organic chemistry; drug interactions assessed by pharmacokinetics, pharmacodynamics, and pharmacogenetics; neurobiology; developmental biology; genomics and proteomics; computational biology and bioinformatics; genome engineering and editing; and the full spectrum of immunologic approaches. Thus, students graduating from the Graduate School will have acquired an enviable array of cutting-edge scientific and clinical skills and will be fully prepared to pursue an independent career in translational research.



Alex Hughes

# ACADEMIC REGULATIONS

## Academic Integrity

The Graduate School defines academic integrity as the pursuit of scholarly activity in an open, honest, and responsible manner. All students shall act with personal integrity; respect other students' dignity, rights, and property; and help create and maintain an environment in which all can succeed through the fruits of their efforts. Dishonesty of any kind will not be tolerated. Dishonesty includes, but is not limited to, cheating, plagiarism, and fabricating or falsifying information or citations; facilitating acts of academic dishonesty by others; having unauthorized possession of examinations; submitting work of another person or work previously used without informing the instructor; and tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the Graduate School Administration for possible further disciplinary sanctions, up to and including expulsion.

## Honor Code

In 2018, the Honor Code was established as an agreement between student and faculty to uphold a high standard of academic integrity at the Graduate School. The underlying spirit of the Honor Code is trust and commitment to original academic work which pervades the St. Jude community.

All examinations, quizzes, homework assignments, and research are subject to the Honor Code. After a thorough review of the Honor Code, students pledge their honor that they will abide by its terms. In exchange, faculty proctors need not be present in examination rooms. Additionally, students pledge a duty to report all suspected violations of the Honor Code to the Honor Committee or one of the deans of the Graduate School. The foundation of the Honor Code emphasizes the student-to-student accountability.

The Honor Committee is a group of five appointed members of the graduate student body and they are responsible for upholding the Honor Code. The members follow the constitutionally mandated procedures to ensure a fair and unbiased result of the investigation and adjudication of an alleged Honor Code violation.

The Honor Code is available in the office of the Graduate School.

## Code of Conduct

The St. Jude Graduate School Code of Conduct outlines the principles for how we conduct ourselves and perform our duties. This Code applies to all researchers, physicians, students, employees, volunteers, board members, and anyone who is conducting work on behalf of the Graduate School. Following this Code ensures that we pursue the Graduate School mission with the highest standards of integrity and that we continually earn and maintain the trust of those who look to us as a world leader in the academic community.

Ethical behavior is essential to the Graduate School mission. We are only as strong as our reputations as individuals and as an institution, which includes a commitment to respect ethnic, cultural, religious, and lifestyle differences of patients, their families, colleagues, students, and supporters. It also includes a commitment to ensure a culture of excellence, innovation, and creativity in research, scholarship, and everything we do.

- A drive and sense of urgency to succeed
- Honesty, integrity, and accountability in actions and decisions
- A culture of trust and teamwork

- Respect for employees and students under our supervision
- A commitment to the continuous development of our employees and students
- A commitment to diversity
- A commitment to local, state, national, and global social responsibility and institutional citizenship

This Code supplements policies and procedures that provide more detailed guidance and documents and fosters our commitment to ethical conduct and compliance throughout the institution.



## Responsible Conduct of Research Training

Students are required to attend St. Jude's Responsible Conduct of Research (RCR) Training Program. This training is based on a formal, comprehensive series of didactic lectures and discussion groups led by senior faculty and administrators. RCR training opportunities are currently provided monthly, with each session lasting one hour. Each student is required to obtain an annual minimum of eight hours of RCR training at face-to-face lectures and discussions.

The St. Jude RCR curriculum is complemented by the Collaborative Institutional Training Initiative (CITI) online courses on the protection of human participants and RCR; all students will complete this course as part of orientation. In addition, the CITI

RCR Training Program in Biomedical or Social & Behavioral Research provides a detailed overview of 10 core areas involved in RCR, which students are expected to complete within the first four months of the program.

## Attendance Policy

Any degree program within the Graduate School is a full-time program. Students are expected to attend all lectures and other scheduled academic seminars. Any student who will not be in attendance for a lecture or academic seminar must contact the Registrar to request an approved absence prior to the start of the class. The Registrar will send out notification of an approved absence to the appropriate staff and faculty. In general, lectures and seminar will be recorded. Unapproved absences will be reviewed by the Dean of the Graduate School and the student may be subject to disciplinary action. Attendance will be monitored and excessive absences or late arrivals, as determined by the Dean based on accepted academic standards, may be grounds for dismissal from the program.

Personal leave time beyond the published holiday and break schedules requires approval from the student's research and clinical advisors and the Dean.

## Experiential Credit

The Experiential Credit policy for the Graduate School will address the following:

- Formal request by the student
- Evaluation of the student's request
- Application of the experiential credit to the student's academic record/transcript
- Appeal of the evaluation decision

### **Formal Request by the Student:**

A graduate student enrolled in the doctoral program in the Graduate School may submit a request for experiential credit detailing the nature of the prior learning, substantiating the quality of the learning as it relates to the required curriculum, and demonstrating the mastery of the related material. It is strongly recommended that the graduate student include how the learned material has furthered their understanding and knowledge base.

### **Evaluation of the Student's Request:**

The formal request will be reviewed and evaluated by the Senior-Vice President/Associate Dean. The result of the evaluation is to determine what credit, if any, may be awarded to the graduate student in lieu of enrolling in the course itself. The evaluation is required to confirm that the student has demonstrated knowledge and mastery of the subject matter. The graduate student may be required to provide additional evidence in support of their request including the ability to thoroughly explain the concept and what can be done with the knowledge.

### **Application of the Experiential Credit to the Student's Academic Record/Transcript:**

The Senior-Vice President/Associate Dean will provide a written evaluation (email or typewritten letter) of the graduate student's request to the graduate student, the student's SOT, and the Registrar. If experiential credit is awarded, the Registrar will update the student's academic record and transcript to reflect the experiential credit approved and will add the written evaluation to the student's academic file. If no experiential credit is awarded, the Registrar will simply add the written evaluation to the student's academic file.

### **Appeal of the Evaluation Decision:**

The graduate student may appeal the evaluation of the experiential credit to the Dean of the Graduate School within five (5) business days from the date of the initial decision. The Dean may meet with the student, and/or review the case file, and/or discuss the initial decision with the Senior-Vice President/Associate Dean. The Dean will render a written decision on the appeal within ten (10) business days from the date of the receipt of the appeal. The Dean's written decision will be communicated and filed in the same manner as the initial evaluation decision. The Dean's decision will be the final decision on the matter.

## **Transfer Credits**

The curriculum at the Graduate School has been developed from the publications of historical significance and current literature relating to each course. It is required that coursework and research will be completed at or under the supervision of a faculty member of the Graduate School. Transfer credit may be granted for a student transferring into the Graduate School from another program. The Graduate School in conjunction with relevant faculty will assess the prior graduate training and evaluate the appropriate credits to be transferred. Unless there are exceptional circumstances, as determined by the Dean, transfer students will be required to receive additional credits from necessary segments of the first year coursework and pass the Candidacy Qualifying Examination.



Dr. Michael Dyer and Matthew Bell

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## Transferability of Credit to Other Institutions

The Graduate School is licensed by the Tennessee Higher Education Commission to confer Masters and Doctorate degrees, and will apply for accreditation by the Southern Association of Colleges and Schools Commission on Colleges, an accrediting agency recognized by the United States Department of Education. However, another school does not automatically accept academic credits earned from a school that is licensed and accredited. In the U.S. higher education system, the receiving institution, taking into account such factors as course content, grades, accreditation, and licensing, determines transferability of credit.

The mission of the Graduate School is to help the student prepare for entry-level employment in the student's chosen field of study. The value of this degree program is its deliberate focus on marketable skills. The credits earned are not intended as a stepping-stone for transfer to another institution. For this reason, it is unlikely that the academic credits you earn at the Graduate School will transfer to another school. You should contact any educational institutions that you may want to transfer credits earned at the Graduate School to determine if the institutions will accept the credits you have earned.

**The Graduate School does not imply, promise, or guarantee that credits earned will transfer to other institutions, since those determinations are made according to the policies of the receiving institution.**

## Dismissal from the Program

A student may be dismissed from the Graduate School for a number of reasons, including but not limited to, failure to pass the Candidacy Qualifying Examination; consistently poor performance as evidenced by grades, work-in-progress reports, and failure to attend required core courses, journal clubs, and laboratory meetings; inappropriate and unprofessional behavior; ethical research violations, as well as professional misconduct, as defined in the Code of Conduct. Dismissal from the program requires approval by the Dean.

## Readmission

A student who has been dismissed from the Graduate School will not be readmitted under any conditions.

## Student Grievances

The Graduate School administration and faculty intend to provide the best-possible learning environment for students. In that spirit, students are encouraged to seek assistance about a grievance from the students SOT (first year), research advisor, teaching faculty, and/or Dissertation Committee at the earliest opportunity. Every effort will be made to reach a resolution at this level. If after a thorough review and discussion, the student still feels the complaint has not been adequately addressed, the student should submit the complaint in writing, with a summary of discussion to date, to the Dean. The Dean will then review the complaint, obtain other information needed to complete a resolution. In most circumstances, this process will take less than 30 days to complete. Under exceptional circumstances, a committee of senior faculty will be convened to review the matter.

Complaints that allege discrimination, sexual harassment, or any other form of harassment should be reported immediately to the Associate Dean of the Graduate School. The Associate Dean will guide the student through the appropriate process, as outlined in the Graduate School Policies and Procedures. Should the complaint involve the Associate Dean, the student should contact the Dean for assistance.

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The decision/resolution of the subcommittee is final. However, students in the state of Tennessee may appeal a decision to the Tennessee Higher Education Commission licensure staff at 404 James Robertson Parkway, Suite 1900, Nashville, TN 37243; phone: (615) 741-5293, if the student does not feel that the issue has been adequately addressed.

Appeals for final course grades follow the process above and must be submitted before the end of the following semester. Any grade standing beyond that period is not available for review and will remain on the transcript. Students are advised to discuss concerns about grades and academic progress with their advisors at the earliest possible time.

### **Incomplete Grades**

With the Dean's approval incomplete grades may be issued when the semester ends and a student's work is academically acceptable, but for a valid reason the student has been unable to complete all required work. To remove an incomplete grade, the student is expected to complete all uncompleted work by the time agreed upon with his/her advisor, or by the end of the next semester at the latest.

Incomplete grades are indicated on a student's transcript as an "I," which will be replaced with the appropriate grade and credit awarded when the student completes the work, as approved by the course faculty or research faculty advisor, as appropriate. If the grade has not been changed by the end of the following semester, the "I" will be replaced with an "F," which will be calculated into the student's GPA. Reversal of the "F" grade may be possible, if the work is subsequently completed and reversal is recommended by the student's advisor. This option would be granted only in extraordinary circumstances and with the Dean's approval.

### **Leaves of Absence**

A student may request a leave of absence at any time after matriculation. In the first year, the student may submit a leave of absence request in writing to the Dean and meet with his/her SOT. During subsequent years, the student may request a leave of absence in writing to the faculty research advisor. The advisor will forward the request to the Dean for discussion and for a decision. If the request is approved, the Dean will sign off on the request and instruct the Registrar to record the leave and file the request in the student's file. Normally, leaves of absence are for one semester only, but a leave for a longer duration may be approved on a case-by-case basis. If the student does not return at the end of the approved leave, he/she will be withdrawn from the program and must reapply through the entering students' application process. Exceptions to this policy require the written request of the student's advisor and the approval of the Dean.

A first-year student who requests a leave of absence will receive a grade of "I" for incomplete coursework. The student must complete the coursework within one semester of returning to the program, or the "I" will become an "F," and the student may be dismissed from the program for unsatisfactory academic performance. Time taken on an approved leave of absence will not be included in the time-to-degree calculation for degree completion.

### **Class Cancellation**

A class may be cancelled up to two weeks before the start date. If an entire session of classes is cancelled prior to the beginning of the semester, students will be given the opportunity to take the classes to complete the degree.

Should an unavoidable event such as epidemic, natural disaster, civil unrest, or threat of terrorist activity result in partial or complete cancellation, an appropriate evaluation of the academic credit you attained will follow.



## **Student Withdrawal**

A student may withdraw from the Graduate School at any time. If a student is not certain about withdrawing from the entire program or even a semester, alternatives are available with the Dean's approval.

A student in the Graduate School who wishes to withdraw from the program for any reason should first meet with their research advisor to discuss the withdrawal request, and then meet with the Dean to finalize the written and signed withdrawal notice. First-year students will also meet with their SOT. The student's research data must be stored on the network drive; laboratory notebooks must be complete; and the Graduate School property, including the assigned laptop computer, must be returned before the Dean approves withdrawal. The student's transcript will indicate a "W" for the student's currently enrolled courses. "Withdrawal from the Program" and the date of the withdrawal will be noted on the transcript in the current academic term. The effective date of withdrawal is the date the Registrar receives the written withdrawal notice.

A student who formally withdraws in good standing from the program and later wishes to be reinstated must reapply through the same application process as all entering applicants, unless prior arrangements have been made and approved by the Dean.

## **Placement Assistance**

The "next step" for students who successfully complete a PhD in Biomedical Sciences is intended to be a postdoctoral fellowship, industry position, or teaching. Although there is no formal placement office in the St. Jude Graduate School, the best-possible placement assistance for postdoctoral fellowships is through faculty advisors and other mentors in the program. Their support in placing graduates into premier fellowships is invaluable. An extensive network of former St. Jude postdoctoral fellows are another resource to find placements in academia and industry.

## **Refund Policy**

Each student will receive a Graduate School or departmental tuition scholarship or waiver that covers the entire cost of the program and, therefore, is not eligible for a tuition refund.

# DEGREES AWARDED

## Master's Degree - Transitional

All students who successfully defend their Master's thesis will be awarded a transitional Master of Science degree in Biomedical Sciences and will advance to candidacy.

## Master's Degree - Terminal

If a student fails to complete his/her PhD studies, he/she may apply to the Dean for a terminal Master of Science degree in Biomedical Sciences. To be considered for terminal Master's degree, the student must:

- Complete the first-year core curriculum, and
- Pass all core curriculum exams, and
- Complete at least one year of full-time research, and
- Accumulate sufficient research data to support a Master's thesis.

Once the Dean, in his/her sole discretion, approves the request for a terminal Master's degree, the student will write and submit a Master's thesis and defend it during an oral exam administered by his/her committee. The student's Dissertation Committee and the Dean will make final judgment on the amount and quality of the student's work, whether or not it rises to a Master's level of research and academic accomplishment, and a terminal Master's degree is awarded.

## Doctorate Degree

The Graduate School will award the doctoral degree upon the successful completion of the following requirements:

- First-year courses and accompanying exams (two semesters)
- Laboratory rotations and clinical assignments
- Satisfactory attendance and participation in the required journal clubs, seminars, and laboratory meetings
- Candidacy Qualifying Exam (end of the second year)
- Grant application
- Two research publications
- Dissertation research
- Dissertation thesis
- Oral defense of thesis

Students are expected to complete all coursework, three laboratory rotations, and clinical assignments during the first year. The second year is devoted to research and enhanced preparation for the Candidacy Qualifying Exam. At the end of the second year, students must have passed all requirements to take the Candidacy Qualifying Exam to attain doctoral degree candidacy status. Each student will be assigned a SOT at the beginning of the first year to assist with the coursework. Each student will then, in consultation with the Dean, select a five-member Dissertation Committee at the beginning of the second year. The Dissertation Committee will include the primary thesis advisor and will meet with the student at least twice a year,



Rahul Kumar and Dr. Paul Northcott

evaluate the Candidacy Qualifying Exam, and generally work with and guide the student toward timely completion of the required research. This Committee will also oversee the preparation and oral defense of the dissertation and recommend pass/fail. Students who fail the Candidacy Qualifying Exam and/or the oral defense of their thesis will be able to repeat them once. During both exams, a member of the Dissertation Committee, who is not the candidate's primary mentor, will be appointed as Chair.

### **Intent to Graduate**

An Intent to Graduate form must be submitted to the Graduate School at the beginning of the semester in which the student expects to complete a degree.

### **Degree Completion Time Limit**

Students are expected to complete the doctoral degree in five years, with six years as the maximum time allowed. If a student has officially been approved to withdraw from the program and then re-enters, the period of withdrawal will not be included as part of the time to degree. Any exceptions to this policy require the approval of the Dean.

## **The COMMITMENT-LEADERSHIP Student-Mentor Compact**

### **As a student, I will:**

- Collaborate with my mentor to develop a research project that will address a key scientific question.
- Organize and plan my pathway towards timely completion of my degree.
- Maximize my progress and continually seek guidance from my mentor and colleagues.
- Manage time constraints to work efficiently, and maintain consistent and optimum performance.
- Increase my skillsets, knowledge and independence by seeking the best training opportunities.
- Thoroughly embrace my role as a student and be respectful of my mentor, advisors and peers.
- Maintain accurate and detailed scientific records in compliance with St. Jude policy.
- Endeavor to publish my research and data in a timely manner in consultation with my mentor.
- Note and comply with ethical standards and regulations, and the Code of Conduct.
- Thrive under the tutelage of my mentor as I embark on a career in science.

### **As a mentor, I will:**

- Listen to my student and develop an intellectually stimulating research project.
- Establish challenging but achievable and clearly defined research goals.
- Assess my student's performance regularly and counsel them on realistic career opportunities.
- Develop a training plan that enhances my student's scientific knowledge, skills and independence.
- Engage with my student: I will listen to them, be approachable and share my knowledge.
- Reinforce ethical research standards and report alleged violations without bias.
- Sustain a stimulating research environment that promotes curiosity, excitement and creativity.
- Help my student to be both an independent thinker and a collaborative researcher.
- Inspire my student to complete their studies quickly and to pursue the next stage of their career.
- Publish my student's research and appropriately acknowledge their contributions.

# STUDENT SUPPORT

The Graduate School offers an array of student support programs, services, and activities that are consistent with its mission and vision – “To educate and train future generations of scientists”. These support systems promote a higher level of academic learning and development, and foster personal growth beyond the classroom.

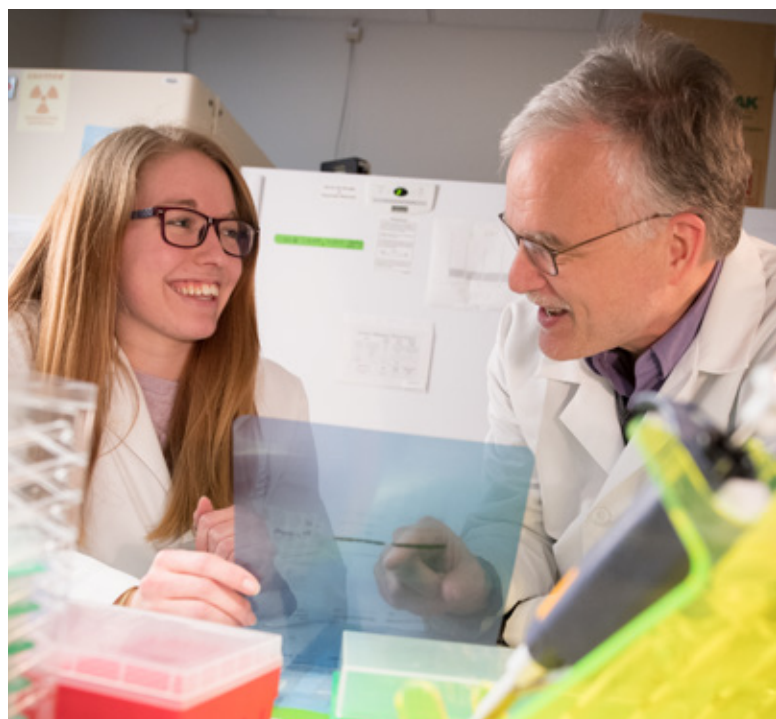
The Graduate School offers the following comprehensive personal and training support packages to all students accepted into the program:

## Personal Support Package:

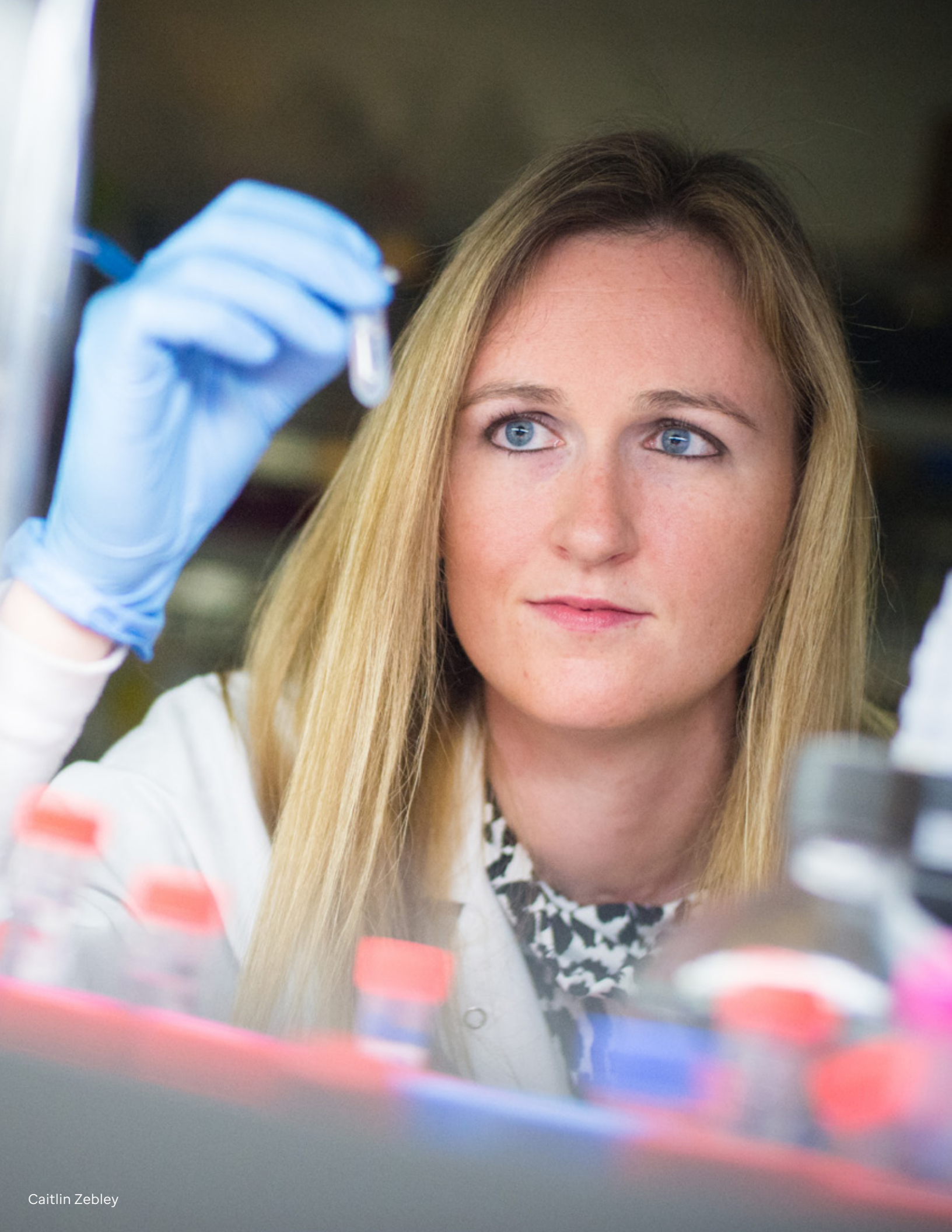
- Competitive stipend - currently \$36,000 annually
- Medical benefits for students and dependents
- Medical and personal leave with required approvals
- Special services accommodations
- Free health services
- On-campus Fitness and Wellness Center
- Holidays and approved breaks
- Kay Café Dining
- Free on-campus parking
- Opportunities to volunteer in programs supporting St. Jude patients

## Training Support Package:

- Full tuition waiver
- Allowance to support laboratory research
- Laptop computer for the duration of studies at St. Jude
- Electronic access to St. Jude research resources
- Electronic access to St. Jude learning and educational resources
- Access to the Biomedical Library and electronic services including online access to scientific journals
- Professional development and skills training
- Allowance to fund training related travel - scientific meetings, etc.
- Academic success support and services
- Mentoring and tutoring support program
- Internationally recognized guest speaker program
- Career development support



Rebecca Florke and Dr. John Schuetz



Caitlin Zebley

# RESOURCES

## ON-CAMPUS

Contact Person	Department	Title	Telephone
Dr. Stephen White	Graduate School	Dean	(901) 595-1503
Dayna Baker	Graduate School	Coordinator – Graduate School Operations	(901) 595-1500
Dr. Racquel Collins	Graduate School	Assistant Dean	(901) 595-1504
Brian Walton	Graduate School	SVP and Associate Dean	(901) 595-1502
Tiffany Young-Polk	Graduate School	Registrar	(901) 595-1501
Josh Burnwatt	Information Services	Sr. Applications Analyst I	(901) 595-7893
Kimyata Pruitt	Information Services	Sr. Technical Support Specialist	(901) 595-4468
IT Help Desk	Information Services	Help Desk	(901) 595-2000
Jan Orick	Biomedical Library	Director	(901) 595-3388
Brent Powell	Spiritual Care Services	Director	(901) 595-3672
Security	Security	Main Operator	(901) 595-4444
Transportation	Security	Main Operator	(901) 595-4444

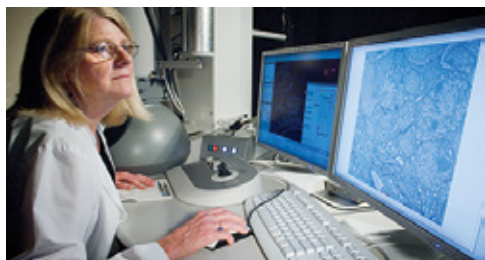
## OFF-CAMPUS

Resource	Service	Address	Telephone
Emergency	Police/Fire		911
Memphis Police	Police	170 N. Main Street Memphis, TN 38103	(901) 636-3700
Baptist Memorial Hospital	Hospital	6019 Walnut Grove Road Memphis, TN 38120	(901) 226-5000
Methodist University Hospital	Hospital	1265 Union Avenue Memphis, TN 38104	(901) 516-7000
Regional One Health Medical Center	Hospital	877 Jefferson Avenue Memphis, TN 38103	(901) 545-7100
St. Francis Hospital	Hospital	5959 Park Avenue Memphis, TN 38119	(901) 765-1000
Baptist Minor Medical Center	Walk-in Clinic	3295 Poplar Avenue, Suite 105 Memphis, TN 38111	(901) 327-8188
Methodist Minor Medical Center (Midtown location)	Walk-in Clinic	1803 Union Avenue, #2 Memphis, TN 38104	(901) 722-3152
Lakeside Behavioral Health System	Mental Health – inpatient	2911 Brunswick Road Memphis, TN 38133	(901) 377-4700

# SHARED RESOURCES

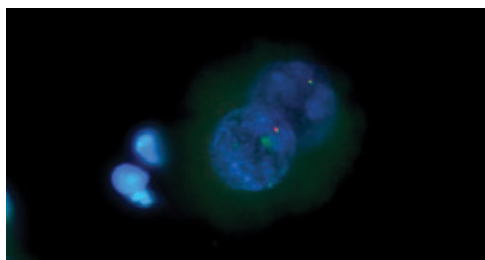
St. Jude and its Cancer Center Support Grant provide an impressive array of shared resources and core facilities to support all research programs on campus. More than 40 facilities provide St. Jude investigators with access to cutting-edge technologies. Expert technologists staff these facilities that provide access to sophisticated instrumentation not readily available in each laboratory.

## SCIENCE

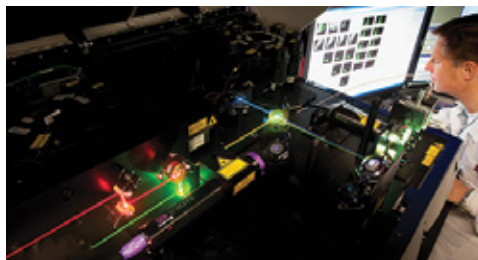


**Cell and Tissue Imaging Center - Electron Microscopy** is a highly-specialized resource utilizing advanced techniques in electron microscopy imaging.

**Cell and Tissue Imaging Center - Light Microscopy** assists scientists on design and execution of the imaging experiment; assists with image acquisition, analysis, quantification, presentation, and publication; and educates on the theory and practice of the resident technologies.



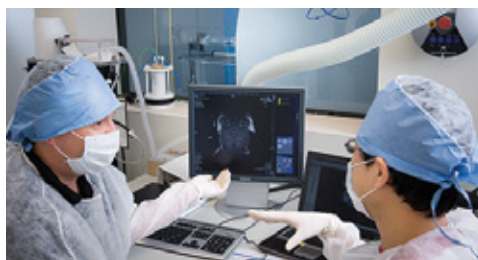
**Cytogenetics** provides a large diversity of cytogenetic services, including standard G-band karyotyping, spectral karyotyping, FISH analysis, and FISH probe design and development.



**Flow Cytometry and Cell Sorting** provides investigators with access to expertise in all aspects of flow cytometry and cell sorting.



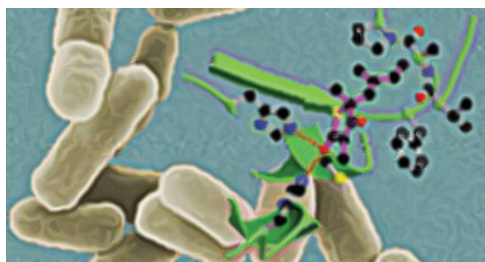
**Molecular Interaction Analysis** provides research investigators with state-of-the-art technologies for the quantitative characterization of proteins and protein interactions on surfaces and in solution.



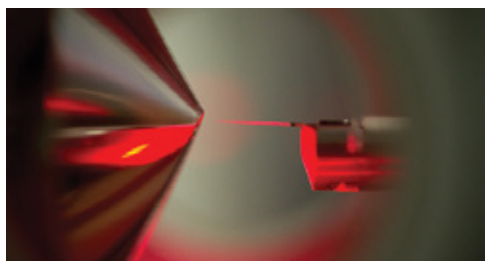
**Preclinical Imaging Core** facilitates the use of cutting-edge imaging technology to complement investigators' research efforts, including magnetic resonance imaging (MRI), bioluminescence imaging, and high-resolution ultrasound.



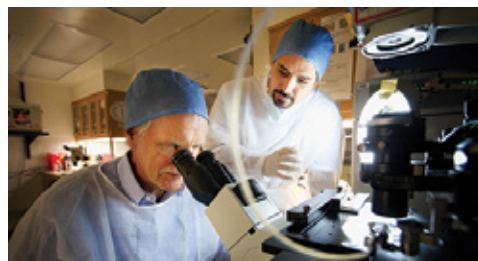
**Preclinical Pathology Core** supports and advances translational research by providing the highest quality laboratory services utilizing state-of-the-art equipment, accurate laboratory methods, and personnel with expertise in comparative pathology.



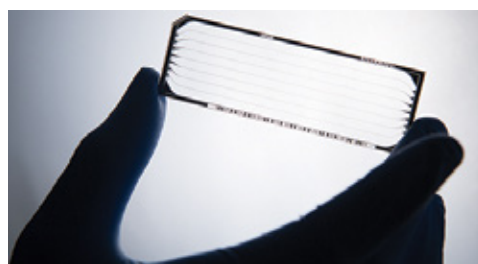
**The Protein Production Facility** provides a large-scale protein expression and purification service to support the translation of discoveries in molecular and cellular biology to chemical and structural biology.



**Proteomics and Mass Spectrometry Facility** provides mass spectrometry-based protein analysis services to investigators, including simple protein characterization, posttranslational modification analysis, and comprehensive profiling of the proteome and phosphoproteome.



**Transgenic Core Unit** incorporates the latest in genome-editing technologies to rapidly produce genetically modified models and provides gene-targeting services, stem cell lines for gene-targeting experiments, selectable marker plasmids for construction of gene-targeting vectors, and training in stem cell culture.



**Hartwell Center for Bioinformatics and Biotechnology** provides expertise and research support in several high-throughput biotechnologies, including Functional Genomics, Genome Sequencing, Genotyping Analysis, High-Throughput DNA Sequencing, and Macromolecular Synthesis.

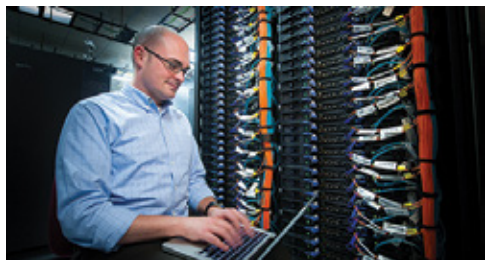
## INFORMATICS



**Bioinformatics & Research Computing** provides investigators with access to sophisticated bioinformatics resources that exist in their own departments and also within a shared resource closely aligned with the Comprehensive Cancer Center and the Pediatric Cancer Genome project.

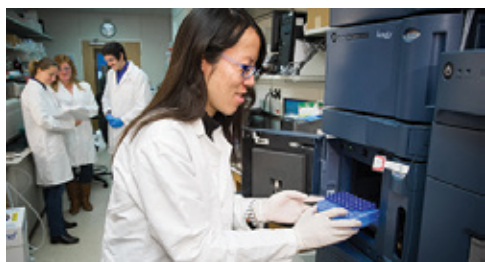


**Biostatistics** promotes clinical, translational, and laboratory investigations through the further development and creative application of statistical science, including interfaces with biology, medicine, and information technology.



**High-Performance Computing Facility** is part of St. Jude Information Sciences and provides principal investigators and their research groups with access to on-campus scientific computing facilities through a variety of computing platforms.

## CLINICAL AND TRANSLATIONAL



**Clinical Pharmacokinetics** facilitates and centralizes high-quality, competitively funded, peer-reviewed pharmacokinetic/ pharmacodynamic research in clinical models.



**Good Manufacturing Practice Facility/ Therapeutics Production and Quality** provides investigators the ability to develop and produce innovative therapeutics that may not find an initial investment by a major pharmaceutical company. The facility also supports the manufacture of products for use in preclinical studies.



**Human Applications Laboratory** provides expertise in hematopoietic stem cell processing, gene transduction, flow cytometric analysis and sorting, primary human tissue culture, and cellular vaccine preparation.



**Preclinical Pharmacokinetics** supports pharmacokinetic and pharmacodynamic investigations executed in the preclinical setting by way of bioanalytical methods development and validation, preclinical study design, and pharmacometric analyses.

## OTHER SHARED RESOURCES



**Biomedical Communications** supports the internal and external initiatives of the medical, scientific, and administrative communities by providing comprehensive visual communications solutions, including photography, digital imaging, broadcast video, illustration, graphic design, and print production.



**Biomedical Engineering** blends traditional engineering and medicine to advance health care through the creation of innovative devices and service procedures.



**Biomedical Library** provides resources 24 hours a day, seven days a week and can be accessed during normal business hours, after hours, or through the Biomedical Library intranet site.



**Office of Technology Licensing** assists with patenting and licensing inventions and exchanging research materials, facilitates interaction with investigators from other academic institutions and companies, and reviews consulting agreements.



**Scientific Editing** provides editing, copyediting, and proofreading of scientific documents and also presents workshops on writing, publication strategy, and good grantsmanship.

The **Biomedical Library** staff manages access to approximately 7,600 electronic journals, nearly 19,000 electronic books, and multiple databases that include PubMed, Web of Science, SciFinder, Journal Citation Reports, UpToDate, and CINAHL. All of the library materials are accessible to St. Jude employees and students from their desktop or laptop – including via remote access. The Biomedical Library is located in the MTC and open 24 hours a day, 7 days a week, and fully staffed (3 professional staff and 1 support staff) during regular business hours Monday-Friday. Computer workstations in the library provide additional access to full-text electronic journals, the Internet, and databases. Other services provided by the Biomedical Library staff include interlibrary loans, assistance with NIH Public Access Policy compliance, and literature search consultations.

# STUDENT LIFE

## LIFE IN MEMPHIS

Situated on a bluff overlooking the Mississippi River, Memphis is the metropolitan hub of a six-state area known as the Mid-South. Residents of Memphis enjoy a relatively low cost of living, the purest water supply in the country, more trees per square mile than any other city, a temperate climate, four distinct seasons, and the hospitable atmosphere and pace of the “City of Good Abode.” Memphis provides all the charm and hospitality of a Southern city and the cultural diversity and entertainment opportunities of a large metropolis. A wealth of recreational activities is available for casual and competitive athletes, from scenic trails and river routes to organized races, clubs, and events. With a metropolitan population of more than a million people, Memphis retains much of the allure of a small town, yet features world-class museums, parks, music, dining, and entertainment. Notable destinations include the following:

- Professional sporting events, including the Memphis Grizzlies NBA basketball team; the Memphis Redbirds Triple-A minor league baseball team, which is an affiliate of the St. Louis Cardinals organization; and the Mississippi RiverKings minor league ice hockey team
- Beale Street, one of the most famous music districts in the world
- Memphis Botanic Garden and Dixon Gallery and Gardens
- Broadway shows at the Orpheum Theatre and multiple local performing arts groups
- Concerts at the FedEx Forum, Cannon Center for the Performing Arts, and Levitt Shell
- Shelby Farms, one of the nation’s largest urban parks
- Kayaking on the Wolf River



# HOUSING

A wide variety of affordable housing exists to suit almost any lifestyle. Choices range from high-rise apartments and renovated downtown lofts overlooking the river to a seemingly endless array of single-family homes in the area's numerous metropolitan, suburban, and rural neighborhoods. One of the most popular places to live in Memphis is Mud Island. Located on the Mississippi River and only 1.5 miles from the St. Jude campus, Mud Island provides a central location with a true community feel. A lighted walking/jogging path borders a park along the riverfront. With six apartment complexes and hundreds of single-family homes, a small retail district, and striking views of the river, it is no wonder that many St. Jude postdoctoral fellows, faculty, and staff have chosen to call Mud Island their home. Other popular housing areas include multiple historic neighborhoods in Midtown, the South Main arts district, and South Bluffs. Whether you prefer an older, established family neighborhood or an arts area with proximity to trendy restaurants and nightlife, these diverse neighborhoods have much to offer and are only a short distance from the St. Jude campus.

The Graduate School offers discounted housing for first-year graduate students: Harbor Island Apartments on Mud Island and Parcels at Crosstown Concourse in Midtown. Graduate student housing in either location offers roommate-style living with two queen bedrooms and two separate bathrooms, fully outfitted kitchens, private laundry room, and community amenities. The apartments are fully furnished, and all extra charges for utilities (electric, heat, water, cable, and internet) are included as part of your housing contract. For students relocating to Memphis with significant others, there are a limited number of one-bedroom apartments. The housing contract is \$28 per day (~\$850 per month). Free shuttles are available 24/7 at either location, offering a safe and convenient way for students to transfer between the St. Jude campus and student housing throughout the week.

**Whatever your interests,  
the greater Memphis area  
offers something for  
everyone!**



# COURSE DESCRIPTIONS

## **New Student Orientation | ORN 8000**

**0 credits**

The new student orientation course is designed to assist new students in their academic and social preparation for success in the graduate program. This course will assist in the completion of all materials, the student's adjustment to the St. Jude campus and resources, and the faculty members and their research.

## **Research Methods | RMD8000**

**0 credits**

This introductory course covers fundamental techniques, supporting concepts, and data analysis. This course aims to provide students with practical knowledge and experience with some of the most common experiential methods used.

## **Genes to Proteins | BMS 8101**

**4 credits**

This course will cover fundamental topics in biology at the molecular level and provide a molecular foundation for the subsequent core courses. We will build upon the central “genes to proteins” dogma of molecular biology by discussing how genes are organized and packaged in the cell, how genes are regulated, and the determinants of gene transcription, gene silencing, and epigenetics. We will continue by discussing how proteins are generated, modified, and function in the cell. During this section, the Core Facilities Program will showcase the state-of-the-art methods in gene sequencing and protein analysis and will illustrate the power of these approaches to differentiate disease states.

## **Cell Biology | BMS 8101**

**3 credits**

This course will cover fundamental topics in biology at the cell and organelle level and provide a molecular foundation for the subsequent core courses. We will build upon the foundation of Genes to Proteins and focus on how cellular organelles contribute to normal and disease biology in Part 1. Part 2 will focus on how organelle systems collaborate to regulate cellular biological process including energy production, receive and transmit signals with the outside environment, regulate homeostasis, and regulate movement. During this section, the Core Facilities Program will showcase the state-of-the-art methods in cellular imaging from both electron microscopy and light microscopy and illustrate the power of these techniques to assess normal and disease biology.

## **Developmental Biology | BMS 8201**

**3 credits**

This course will cover fundamental topics in developmental biology and will consist of three parts. Part 1 will include a basic introduction to model organisms, including major invertebrate and vertebrate models; major stages of vertebrate embryonic development and their molecular regulation; and an introduction to modern evolutionary concepts and the construction of phylogenies. Part 2 will cover the basic definition of a stem cell, describe biologically important and clinically relevant examples of stem cells, and explain the transcriptional mechanism by which stem cells are maintained and differentiate. Part 3 will discuss fundamental topics in developmental neurobiology and cover the structure, function, development, and dysfunction of the central and peripheral nervous systems. These three parts will be highly complementary; for example, Part 3 will complement Parts 1 and 2, with a focus on neural induction, genesis, migration, and neural crest cells. The Core Facilities Program will highlight state-of-the-art methods in transgenesis, stem cells, gene editing, and veterinary pathology and will illustrate the power of these methods to model diseases, establish platforms for drug studies and genetic analysis, and achieve the long-term goal of directed differentiation of therapeutically useful cell types.

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**Cancer | BMS 8702****3 credits**

This course will cover essential concepts in cancer pathogenesis, highlighting fundamental cellular regulatory processes that are subverted in cancer. We will build upon previous discussions of genome organization and apply these to understand the genomic abnormalities that drive cancer development, how they are identified, and new insights into disease classification driven by identification of molecular signatures. We will include historical examples of how oncogenes and tumor-suppressor genes were identified, integrated with discussion and analysis of current literature highlighting different model systems for cutting-edge analysis of the mechanistic consequences of cancer-associated mutations and signaling pathways of central importance in cancer. During this section, the Core Facilities Program will showcase state-of-the-art methods in monitoring tumor development in the Preclinical Imaging Core. Students will also engage in clinical shadowing during this section.

**Immunology | BMS8812****2 credits**

This course will cover fundamental topics in immunology. The course will begin by examining the cellular components of the innate and adaptive arms of the immune system, which will include a discussion of how these cellular subsets develop, become activated, and differentiate. It will continue by discussing how the immune response is carefully orchestrated to eliminate foreign pathogens without destroying healthy cells. It will also examine how the immune response can be manipulated to enhance protection against pathogens, prevent autoimmunity, and eliminate tumors.

**Infectious Diseases | BMS8822****2 credits**

This course will cover the basic methods for infectious diseases and case studies of important disease syndromes and entities. Methods will include stating the signs and symptoms of infectious diseases to which first responders may be exposed; Identifying preventive measures such as standard precautions, immunizations and infectious disease screenings; stating post-exposure procedures; and describing recordkeeping roles and responsibilities. The course will cover topics associated with microbes in health and disease and therapeutic strategies. It will build upon the preceding sections by discussing how microbes affect basic cellular/immunologic processes, how these lead to particular syndromes/diseases, including cancer, how the host can affect microbes, and the concept of “good” microbes. It will also delve into cutting-edge therapies through the use of systems biology, while moving the students toward a “big picture” understanding of the molecular mechanisms of disease, with a focus on the immunocompromised host.

**Pharmacology & Chemical Biology | BMS 8902****2 credits**

This course will introduce fundamental concepts important to the science of drug action and target identification. The course will build upon our understanding of the initial rationale for and ultimately the successful implementation of novel drug therapies at St. Jude. The course will describe and discuss features of the host, the target cell, and the biochemical targets that affect drug action. The course will also discuss modern approaches to screening for new drugs and the identification of drug targets. This course will be complemented by core facility visits.

**Topics in Clinical & Translational Research Program | BMS 8501 | BMS 8502****2 credits each**

The Topics in Clinical & Translational Research Program is led by a multidisciplinary team comprising a basic scientist, a translational researcher, and a clinical researcher. To participate in this program, students will need to complete mandatory human subjects’ protection training by using the online Collaborative Institutional Training Initiative (CITI) platform provided through St. Jude Children’s Research Hospital. There will be six modules (one week each) during the first year, and each module will be taught concurrently with the basic science curriculum and other topics. Each module will have an experiential component and a conceptual component. In addition to the six modules, each student will be assigned a patient at the beginning of their first year of graduate school. The clinical and basic research faculty will identify suitable patients to be followed throughout the year.

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**Computational Biology | BMS 8301****1 credit**

This course covers the algorithmic and machine learning foundations of computational biology, combining theory with practice. We cover both fundamental topics in computational biology and current research frontiers. We study fundamental techniques, recent advances in the field, and work directly with current large-scale biological datasets.

**Biostatistics | BMS 8302****1 credit**

Biomedical research is becoming increasingly data-intensive and data-driven, and St. Jude has an outstanding interdisciplinary program with innovative biostatistics tools for accessing, managing, analyzing, and integrating such complex data. This course is designed to provide students with a rigorous statistical education, coupled with exposure to a broad range of biomedical research applications. This course will also prepare students to be part of an interdisciplinary team for conducting biomedical research.

**Core Facilities Program | BMS 8401 | BMS 8402****1 credit each**

The Core Facilities Program is designed and will be scheduled to complement the basic science topics under discussion during the core courses. Students will participate in structured visits to the institutional and departmental research core facilities to observe how the available technologies work and learn about our onsite capabilities.

**Laboratory Rotations | BMS 8951 | BMS 8952 | BMS 8953****3 credits each**

An important component of the students' first year training will be three lab rotations in the laboratories of selected graduate faculty. Each rotation will be six weeks, and no other course work will occur during that time. This approach will also ensure that students become fully immersed in the research of their chosen laboratories. Each student will be assigned a small research project during the rotation, and will formally present results the graduate faculty and other researchers.

**Scientific Writing & Grantsmanship | BMS 8961****3 credits**

The Scientific Writing & Grantsmanship course is intended to teach students the basic writing skills needed to successfully publish manuscripts and obtain grant funding. However, other peer-to-peer professional communications will also be included (e.g., professional correspondence, peer review, meeting abstracts).

**Reading & Research | BMS 8991 | BMS 8992 | BMS 9301 | BMS 9302 |  
BMS 9401 | BMS 9402 | BMS 9501 | BMS 9502****9 credits each**

Research is a requisite part of the curriculum and will be undertaken as three distinct laboratory rotations during the first year or, with previous academic credit earned, as an enrollment in Reading & Research in year one and continuous enrollment in subsequent Reading & Research courses until the student's dissertation defense. This course enables the student to function as a member of a research team in a laboratory setting while also furthering their independent dissertation research. The student's primary advisor will continuously evaluate their progress in accordance with the student's qualifying exam proposal. The student and primary advisor will meet at least once per term with the student's dissertation committee and to submit an evaluation by the end of each term to the Dean. It is expected that the student will author a minimum of two papers related to their independent research for submission to a journal(s) for publication.





262 Danny Thomas Place  
Mail Stop 1500  
Memphis, TN 38105-3678  
Phone (901) 595-1500 | Fax (901) 595-1525  
[sjgradschool@stjude.org](mailto:sjgradschool@stjude.org)

**[www.stjude.org/graduate-school](http://www.stjude.org/graduate-school)**