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|  | |
| RESOURCES | |
| FACILITIES: Specify the facilities to be used for the conduct of the proposed research. Indicate the project/performance sites and describe capacities, pertinent capabilities, relative proximity, and extent of availability to the project. If research involving Select Agent(s) will occur at any performance site(s), the biocontainment resources available at each site should be described. Under “Other,” identify support services such as machine shop, electronics shop, and specify the extent to which they will be available to the project. Use continuation pages if necessary. | |
| Laboratory:  All of the faculty members included in this grant application are funded investigators, and each has his/her own independent laboratory with adequate resources and space to support the research activities of XXScholars. In addition to these individual research laboratories, a significant factor that has contributed to the successful expansion of the research programs of the School of Medicine at UNC has been the development of a wide variety of sophisticated and state-of-the art core facilities. All of these core facilities are readily available to the XX Scholars. The effort to develop and organize these shared-use core facilities has been led primarily by the UNC Centers and Programs dedicated to research. On the following pages we highlight the ***PhD-granting departments and curricula*** that are particularly relevant to our Scholars. We have also highlighted a number of the ***research-intensive centers*** that have a significant impact on the quality of the XXScholar experience here at UNC. We have provided descriptions of the many ***Core Facilities*** that are critical to the success of UNC’s various research programs. Finally, we have described the various ***laboratory construction and renovation programs*** that are currently underway here at UNC. | |
| Clinical:  UNC Health is a not-for-profit integrated health care system owned by the state of North Carolina and based in Chapel Hill. UNC Health Care currently comprises UNC Hospitals and its provider network, the clinical programs of the UNC School of Medicine, and eleven affiliate hospitals and hospital systems across the state. UNC Hospitals is a public academic medical center, which is comprised of NC Memorial Hospital, NC Children’s Hospital, NC Neurosciences Hospital, NC Women’s Hospital and the NC Cancer Hospital. UNC Hospitals’ relationship with the UNC School of Medicine creates a productive environment for translational and clinical research. Patients benefit from the most promising new developments in medical research while advancing health care through their participation in such studies. UNC is home to the NC Translational and Clinical Sciences (NC TraCS) Institute. The NC TraCS Institute is supported by a Clinical and Translational Science Award from NIH and offers programs to accelerate clinical and translational research from health science to discovery to dissemination to patients and communities. Their programs help researchers give their research the widest impact, through pilot grants, offering research training and early career mentoring programs, and using community outreach to create a presence in each of North Carolina’s 100 counties. | |
| Animal:  The animal facilities at UNC are fully accredited by the AAALAC and support a robust insfrastructure for animal models research. Additional information on the experimental animals program is contained in this section. | |
| Computer:  See attached below for description of the institutional, School of Medicine, and personal computing resources that are available to XX Scholars. | |
| Office: | |
| Other:  ***Didactic resources*** for the XX Program include the participating Schools, Departments, Centers, Curricula, and the library system of UNC. These resources are all described in the following sections. | |
| MAJOR EQUIPMENT: List the most important equipment items already available for this project, noting the location and pertinent capabilities of each.  The standard research equipment that is used by the XX Scholars is provided by their individual faculty advisors. In addition, the major pieces of equipment that are available to them in the various shared-use ***UNC Core Facilities*** (e.g., devices for DNA and peptide sequencing and synthesis, microscopes and imaging systems, flow cytometers, etc.) are described in this section.  In the following pages we outline the resources and facilities relevant to the XX Program including the Biological and Biomedical Sciences Program, UNC Departments and Curricula offering PhD degrees; the support provided by the Office of Postdoctoral Affairs; Research Centers; Core Facilities; and other research re facilities including clinical resources, computing resources, and libraries. | |

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# The University of North Carolina at Chapel Hill

Founded in 1792, the University of North Carolina represents the oldest public university in the United States. From these early beginnings, the University has grown to encompass a total of 16 institutions that together comprise the North Carolina consolidated university system. The University of North Carolina at Chapel Hill, referred to throughout this proposal as UNC, is consistently acknowledged as the flagship research institution within the state university system, and the leaders of the Chapel Hill campus have always set the very highest standards for excellence in education and research. The Chancellor at UNC is Dr. Kevin Guskiewicz. The campus encompasses 3,887 faculty members across 14 schools and the College of Arts and Sciences. This general atmosphere, with the available resources of the nationally recognized departments and centers makes UNC an exhilarating place to conduct science. The training environment at UNC is excellent with more than 400 Ph.D.s awarded each year through 65 doctorate degree programs.

The University of North Carolina at Chapel Hill leads southeastern public universities in the amount of extramural support for its research programs. UNC’s research enterprise has quadrupled in the last 15 years, and in the most recent NSF rankings (December 2017) UNC surpassed $1 billion in annual research expenditures. UNC is ranked 11th nationally among all research institutions in overall research and development expenditures, and 5th nationally in overall federal research and development.

UNC is one of only four public universities that houses all five schools of the health-related disciplines, Medicine, Dentistry, Pharmacy, Nursing, and Public Health. All of these are located on a single, contiguous campus at UNC-Chapel Hill. This arrangement encourages the formal and informal exchanges that enhance the concepts and resources of individual researchers, often resulting in new, cross-disciplinary collaborations. Unlike many institutions, in which the Medical Center is sited at a substantial distance from other campus components, UNC is truly one single university in that the Academic Affairs campus and the Health Affairs campus are immediately adjacent to one another. Such proximity fosters ongoing collaboration between faculty investigators from a wide variety of disciplines, a feature that should be apparent in this application.

UNC-Chapel Hill’s research funding directly supports the salaries of more than 10,000 North Carolinians across the state and has led to the start-up of more than 470 private businesses that employ an additional 8,090 workers across the state. Survey results show that industry funding for UNC research jumped 16% from 2015-2016, reflecting the University’s expertise and attractiveness to commercial partners.

**School of Medicine (SOM):** First established in 1879 and expanded to a four-year program in 1952, the [UNC School of Medicine](https://www.med.unc.edu/) has a long tradition as one of the nation’s leading medical schools. The school’s 1,814 full-time faculty members provide clinical services in the inpatient units at UNC Hospitals and the outpatient clinics on UNC campus while training the next generation of health care professionals. As Dean of the School of Medicine, Vice Chancellor for Medical Affairs, and CEO of UNC Hospitals, Wesley Burks’ has spearheaded a commitment to expanding and enriching resources available to researchers while emphasizing the collaborative links between basic scientists at the bench and treatments provided by clinicians in the hospital. UNC has spent over $250 million in recent years to enable high-throughput clinical and epidemiological studies. As a reflection of these efforts, in 2008 UNC was awarded a competitive *Clinical and Translational Science Award* (CTSA) which was renewed in 2013 and again in 2018. NC TraCS helps accelerate the translation of biomedical discovery into benefits for human health by improving research infrastructure and introducing best practices in biomedical informatics, education, and regulatory science. The work of the CTSA cores reaches across many projects on campus and have been particularly relevant in the area of clinical informatics, providing support for the development of a sophisticated data warehouse ([CDW-h- Carolina Data Warehouse for health](https://tracs.unc.edu/index.php/services/informatics-and-data-science/cdw-h)), and the tools and expertise for efficiently capturing and mining ever increasing amounts of clinical data.

The UNC SOM has built a remarkably diverse environment for biomedical research represented by 8 basic science and 20 clinical departments, as well as 36 centers, divisions, and programs. The SOM biomedical research program has grown steadily over the past decade and consistently ranks among the top in the country (1st in primary care, 23rd in research-2019 *US News and World Report* medical school rankings). The faculty also includes two Nobel Prize Winners: Oliver Smithies (2007, Physiology or Medicine) and Aziz Sancar (2015, Chemistry). The UNC School of Medicine received $511M total research funding in fiscal year 2019 and ranked 17th (Blue Ridge Institute) in NIH funding for fiscal year 2019 with $316M in funding. It is the only southeastern public university in the NIH top 20 and #6 overall for public medical schools. In 2019 18 SOM departments were ranked among the top 25 in NIH dollars awarded (rankings among public institutions are shown in parentheses): Anesthesiology – 14th (7th), Biochemistry and Biophysics – 5th (3rd), Biomedical Engineering – 3rd (1st), Cell Biology & Physiology – 4th (3rd ), Dermatology – 22nd (9th), Emergency Medicine – 8th (4th), Family Medicine – 6th (6th), Genetics – 6th (1st), Medicine – 12th (4th), Microbiology and Immunology – 3rd (2nd), Obstetrics & Gynecology – 3rd (2nd) Otolaryngology – 26th (11th), Pathology and Laboratory Medicine, 18th (9th), Pediatrics – 22nd (11th), Pharmacology – 5th (4th), Physical Medicine and Rehabilitation – 16th (7th), Psychiatry – 16th (7th), Radiology (includes radiation oncology) - 22nd (8th).

# The Biological and Biomedical Sciences Program (BBSP)

*[Note: The text below is just a suggestion and needs personalized information for your program. You will most likely want to rearrange, shorten, lengthen, etc to fit your individual needs.]*

*Email Anna O’Connell to request a spreadsheet outlining faculty service to BBSP (admissions committees and FYG service)*

**The Biological and Biomedical Sciences Program (BBSP).** In 2007 UNC consolidated its graduate recruitment and first year training in the biological and biomedical sciences into a unified BBSP admissions/first year program, led by **Dr. Jean Cook,** Associate Dean for Graduate Education**.**  BBSP provides the mechanism through which students interested in any of the 15 participating PhD programs apply for graduate study. The BBSP provides first-year PhD students with opportunities to explore different research areas (through research rotations and courses) before making a final selection of a dissertation advisor and graduate program. Yet, it in no way impedes direct tracking of students who enter with a defined interest in a research area or degree program. In short, students participating in the proposed **“XXXXXX”** program will be admitted to graduate school at UNC via the BBSP and, at the end of their first year, will choose one of our training faculty as research advisor and they will choose XXXXXX PhD program.

**BBSP Admissions*:*** Evaluation of applicants and recruitment occurs through one of four admissions committees composed of faculty from the 15 PhD programs. The admissions committees are subdivided along broad scientific areas and applications are distributed to the appropriate committee based on information provided by the applicant. This information includes five research interest areas (selected from a list of 33) and a list of faculty members whose specific research is of interest to the applicant. Of relevance to our training program, the interest areas include x, y and z.The admissions committees evaluate the applications in depth, with at least two faculty assigned per application. Interview and admission decisions are made by individual committees in coordination with the BBSP Director (**Dr. Cook)**, keeping in mind the desired target number of matriculating students (~ 90 students for all 15 programs). Important to our efforts of recruiting outstanding students to our training program, many of our training mentors regularly serve on the admissions committees (**xxxxxx**). UNC and BBSP is committed to increasing the presence of students from populations that are historically underrepresented in biomedical research, and participate in the NIH funded *Initiative for Maximizing Student Development* (IMSD). Students admitted to IMSD through the BBSP program receive professional development opportunities, community building experiences, coaching for classes and qualifying exams, mentoring and up training, and senior student cohort meetings. From the implementation of IMSD from 2008 – 2018, we have seen an increase in presence of underrepresented PhD students in the BBSP student cohort from 19% to 32%. Additionally, BBSP offers the Summer of Learning and Research (SOLAR) summer program and an NIH-funded Post-baccalaureate program (UNC PREP) to prepare diverse students for graduate research and careers in science.

**BBSP recruitment:** Students are invited to one of four recruitment weekends (January-March). During these visits, applicants interview with five faculty members, primarily of their own choosing, and they interact with current students and faculty in social settings. These weekends are organized around research areas (e.g. XXX), thus allowing faculty to focus their recruitment efforts. Nevertheless, a student can visit UNC during any weekend and be assured to meet individually with faculty representing their research interest. Students admitted through any admissions committee or recruitment weekend may ultimately join the **“XXXXX”**, but we anticipate that the majority of our students will come through during the “XXX” weekends. **The move to the BBSP admissions format has been extremely positive Application number increased (850 in 2007/pre-BBSP and average >1000 post-BBSP) and long-time admissions committee members agree that applicant quality is better: higher GPA scores, stronger research experiences and letters of recommendation.** The average GPA for the incoming BBSP class is 3.6.

**Applicant Statistics Summary**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total Applicants** | **Offers Made** | **Total # of students accepting our offer (# incoming)** | **Acceptance Rate** |
| **2019** |  | **293** | **117** | **40%** |
| **2018** | **1711** | **274** | **95** | **35%** |
| 2017 | 1368 | 232 | 78 | 34% |
| 2016 | 1493 | 252 | 79 | 31% |
| 2015 | 1162 | 221 | 80 (81) | 36% |
| 2014 | 1221 | 187 | 65 (65) | 34.7% |
| 2013 | 1217 | 230 | 91 (89) | 39.6% |
| 2012 | 1443 | 251 | 85 (86) | 33.8% |
| 2011 | 1149 | 250 | 84 (83) | 33.6% |
| 2010 | 1128 | 213 | 76 (74) | 35.6% |
| 2009 | 1086 | 202 | 86 (86) | 42.7% |
| 2008 | 1111 | 261 | 121 (122) | 46.3% |
| 2007 | 850 |  | 93 | 37% |

**BBSP First Year Activities.** The program for all first-year PhD students consists of the following.

First Year Groups (FYGs): During their first year, BBSP students are part of small (14-16 students), interest-based groups led by four faculty members. Four peer mentors (graduate students at different stages of their career) are also assigned to each FYG. In this manner, all students have a cohort of faculty and peers that provide a supportive community for navigating the first year of graduate school when they have yet to join a degree-granting program. Groups build community interactions through social events within the group. These mandatory FYGs meet once a week for 1.5 hours. Skill-building activities in the FYGs include scientific presentations by the students (four research seminars are presented by each student), logic/critical thinking/literature appreciation, quantitative skills, and scientific writing. Responsible conduct of research training, plus training in rigor and reproducibility, also occurs within the FYG setting. FYGs also provide the structure for advising (i.e. selection of research rotations and courses) and the initiation of scientific discourse (e.g. through oral and poster presentations). Each of the FYG faculty members are assigned four students for whom they serve as the primary academic advisor. To help with advising, these faculty members are provided with all the course requirement information for each PhD program. Some of our training faculty participate as mentors in these FYGs (**XXXX**). Thus, even before students commit to a research program, they will be advised of appropriate courses and aided in the selection of rotations by mentors knowledgeable in departmental and training grant requirements.

Laboratory Rotations:All BBSP students are required to complete three laboratory rotations: 11 weeks in the fall, 13 weeks in the winter (spans winter break), and 11 weeks in the spring. This is the mechanism by which students evaluate and decide upon a thesis laboratory and by which faculty evaluate and recruit students. At the end of each rotation, students present their rotation research to the UNC research community as a poster (rotation 1), written report (rotation 2) or short talk (rotation 3). Students select a thesis laboratory in April, after the third rotation. To support first-year students in their choice of laboratory rotations, information sessions are conducted by each PhD program before classes start in the fall.

Quantitative Skills Enrichment: BBSP students are required to take a biostatistics short course that is integrated within their FYG and presented in four sessions. This course is led by instructors from the Biostatistics Department (UNC School of Public Health) and covers statistical analysis skills for both continuous and discrete experimental outcomes found to be generally required in all dissertation research. The four sessions focus on: 1) biochemical data analysis, 2) morphological data analysis, 3) animal models, and 4) genomics and microarrays.

**BBSP Financial Support.** Funds for administration, recruitment and first year support (i.e. stipend, tuition, health insurance) come from intramural sources in the School of Medicine, the College of Arts and Sciences and from an annual “payback” mechanism in which each of the participating departments and centers contribute based on the number of students that matriculate in a particular unit. Once students join a lab in year two, they are supported by individual principal investigators or by training grants, such as the one we propose. The first year financial support of students by BBSP is advantageous to our process of selecting students for the training program. It enables a competitive selection process to identify the best students for T32 support by taking into account performance from the first year of graduate school. It also allows us to support those students that are most interested in xxxxx *per se*, because second year students have completed a year of graduate school and have decided on the area of research to pursue for their thesis work. With first year support, even with the best of intentions, it is not always possible to make the most appropriate selections with respect to these two issues.

Wellness Initiatives: In order to address the unique mental wellness needs of UNC PhD students, the SOM Office of Graduate Education now supports access to trained counselors for biomedical graduate students in addition to the services offered more broadly to students on the UNC campus.

# Departments and Curricula Offering Graduate School Programs/Degrees

UNC-Chapel Hill benefits from the availability of 14 PhD granting programs in the biological and biomedical sciences, each of which has a strong research portfolio. Together, these programs have enrolled on average more than 90 new graduate students annually, and maintained a steady-state level of approximately 500 students in their graduate-level training programs. These departments and curricula include: five participating departments from the School of Medicine; two departments from the College of Arts and Sciences; the School of Pharmacy; The School of Dentistry; The School of Public Health and four University-wide, PhD-granting curricula. These are described below – all representing research-intensive resources available to the UNC scholars. In fiscal year 2019 the School of Medicine received $511M in funded awards, which was 54% of the UNC sponsored research for that year. Three other health affairs schools are in the top 15 for NIH funding (Dentistry, Pharmacy and Public Health). Based on the most recently available aggregate award data from the Blue Ridge Institute for Medical Research, the School of Medicine ranked 17th nationally in NIH funding for FY2019. Only 5 public university Schools of Medicine ranked higher.

# Basic Science Departments in the School of Medicine

## Department of Biochemistry and Biophysics

Under the leadership of ***Dr. Leslie Parise*** (Department Chair), the Department of Biochemistry received $18.6M in NIH funding in fiscal year 2019, ranking 5th in NIH funding to Biochemistry departments. The Department's 45 full-time tenured and tenure-track faculty members include a unique blend of biophysical, biochemical, and molecular genetics specialists. Among the primary faculty are three members of the National Academy of Sciences: ***Dr. Richard Wolfenden*** elected in 2002, ***Dr. Aziz Sancar*** elected in 2005, and **Dr. Jack Griffith** elected in 2018. In recent years, department faculty members have been recipients of prestigious awards from the Keck, Beckman, Sloan, Pew, and Searle foundations; in 2007 Dr. Leslie Parise was elected as a Fellow of the American Association of the Academy of Sciences and Dr. Aziz Sancar was a recipient of the Koc Prize (Turkey’s highest scientific honor). In 2015 Dr. Sancar shared the **Nobel Prize in Chemistry**. In a collaborative effort with investigators from Yale and UC-San Francisco, ***Dr. Ronald Swanstrom***, Director of the UNC Center for AIDS Research (CFAR), has identified a timeline for HIV replication in the brain. Armed with potent tools, experience, and a wealth of new information, these scientists are positioned to solve fundamental issues of biology and disease.

The Department has close ties to other UNC programs and departments, including the Lineberger Comprehensive Cancer Center, the Neurosciences Center, the Integrative Program for Biological & Genome Sciences, the Cystic Fibrosis Center, the McAllister Heart Institute and the Center for AIDS Research. Areas of research excellence within the department include studies of genomic integrity, the dynamic biochemistry of chromatin, cell signaling and cell cycle control, epigenetics, proteomics, and enzymology. The Department co-sponsors the Macromolecular Interactions, Proteomics/Mass Spectrometry, StructuralBioinformatics, Structural X-Ray, and UNC Biomolecular NMR core facilities.

A vibrant, pan-campus Program in Molecular and Cellular Biophysics that unites faculty from multiple departments, including Physics, Chemistry and Computer Sciences, is also centered in this department. Faculty members teach modules in this program, and also teach courses in the Curriculum in Genetics. The Department currently has approximately 24 graduate students and 38 research scholars and postdoctoral fellows.

## Department of Biomedical Engineering

In 2003 UNC and NC State University formed a joint department of biomedical engineering in order to bring together the biomedical expertise from the UNC School of Medicine, physical science expertise from the UNC College of Arts & Sciences and the engineering expertise from the NCSU College of Engineering. Faculty and trainees have lab space at only one institution, but all programs for undergraduates and graduate students involve both campuses. The work and culture of the joint department are built on three core values: innovate, collaborate and translate. **Dr. Paul Dayton** has been the Interim Chair of the department since November 2019, and succeeds Dr. Nancy Allbritton who was the Chair of the Department since 2009. Dr. Dayton is an internationally recognized leader in biomedical ultrasound imaging and therapeutics***.*** BME ranks #3 nationally in NIH departmental funding for FY19 with awards totaling $9.4M. Areas of research focus for BME faculty include neural systems, microfluidics, bioinformatics, computational systems biology, biomaterials, medical devices, imaging metabolomics, single-cell assays and tissue engineering. Along with the traditional areas of bioengineering, there exist five focus areas of special merit for the MS and PhD academic programs. These areas encompass:

1. Regenerative Medicine, including tissue engineering, molecular biology, scaffolds, and mechanobiology;
2. Biomedical Microdevices, including biomedical microtechnologies, microfluidics and bioanalytical devises;
3. Pharmacoengineering, interfacing engineering and pharmaceutical sciences to develop safer and more effective medicine and medical technologies;
4. Imaging Engineering, including PET, CT, SPECT, MRI and photonics;
5. Rehabilitation Engineering, including biomechanics and assistive devices.

The department now offers an undergraduate degree in Biomedical and Health Sciences Engineering. The department currently has 46 primary teaching and research faculty members, approximately 78 graduate students (MS and PhD seeking) and 22 postdoctoral fellows. BME faculty and students have started 31 companies and filed 138 patents and 366 invention disclosures.

## Department of Cell Biology and Physiology

In the summer of 2012, the departments of Cell & Developmental Biology and Cell & Molecular Physiology merged to form the Department of Cell Biology and Physiology. A nation-wide search led to the appointment of UNC’s own ***Dr. Kathleen Caron*** as the founding Chair of the new department. In fiscal year 2019 the department received $15.5M in NIH funding, ranking 4th among Physiology departments for NIH funding. This department has brought together over 49 tenured and tenure-track faculty, plus 16 postdoctoral fellows and 24 graduate students. **Faculty in the department previously developed a highly successful ‘Virtual Microscope’ for Histology instruction to medical students and graduate students, and are developing outstanding (and pioneering) instruments for delivery of Human Gross Anatomy educational content. The Department of Cell Biology and Physiology also houses two core facilities: the Hooker Imaging Core and the Histology Research Core Facility.**

Research interests of the combined faculty include cardiovascular biology, neurobiology, endocrinology, cell shape motility and adhesion, imaging technology, cytoskeleton, membrane trafficking, cell polarity, protein quality control, cancer biology, and GI, renal and respiratory physiology. **Faculty members are closely affiliated with a number of UNC Centers including: Lineberger Comprehensive Cancer Center, Bowles Center for Alcohol Studies, Center for Gastrointestinal Biology and Disease, Center for Thrombosis and Hemostasis, Comprehensive Center for Inflammatory Disorders, Cystic Fibrosis/Pulmonary Research and Treatment Center, the Neuroscience Center, and the Carolina Institute for Developmental Disabilities.** This breadth of research interests allows the department to offer students a unique exposure to physiology and modern experimental techniques at the molecular, cellular and systems levels.

**The new department includes a number of important recruitments. *Dr. Ben Philpot***, recruited from a faculty position at MIT, studies the basis for synaptic plasticity in the visual cortex of mice. ***Dr. Mark Zylka***, recruited from Caltech, uses genetic approaches to study peripheral-to-cord pain circuitry in mice. Dr. Zylka became the new Director of the Neuroscience Center in July 2016, with Dr. Philpot as his Associate Director. In 2017 Dr. Zylka was elected as an American Academy of Arts & Sciences fellow. ***Dr. Kathleen Caron*** came from Oliver Smithies’ group (our 2007 Nobel Laureate) and studies the role of adrenomedulin in lymphatic development and the placental vasculature. In 2010 Dr. Caron was appointed as an SOM Assistant Dean for Research, prior to her appointment as Department Chair. Two new recruits bring additional Neuroscience expertise to the department, ***Dr. Gregory Scherrer*,** joined the department in 2019 from Stanford University and investigates the neurobiology of pain perception and the mechanisms of opioid action. Dr. Adam Hantman, an HHMI Investigator from Janelia Farm whose lab studies how the nervous system controls voluntary movements.

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## Department of Genetics

***Dr. Terry Magnuson*** was recruited to UNC-Chapel Hill in July of 2000 to develop a foundation for research and training in the genome sciences to propel UNC- Chapel Hill to the forefront of the genomic revolution in the 21st century. Because this new knowledge will form the basis for novel, individualized treatment and prevention strategies for human disease (pharmacogenomics), and thus have a profound effect on how medicine will be practiced in the future, a critical part of the plan was the creation of the Department of Genetics in the School of Medicine (<http://genetics.unc.edu/>). The department acts as a springboard from which mammalian/human geneticists serve as the translational arm for genomic medicine, bringing practical applications from genomics into the clinical arena. The campus-wide effort in building genomic capabilities resulted in forty-five new faculty being recruited to multiple departments across the UNC-Chapel Hill campus, each of whom have established successful new research programs. Currently the Genetics Department has 56 tenured and tenure-track faculty.

Under the leadership of Dr. Magnuson, the Department of Genetics focused on mammalian and translational genomics. The faculty share interests in elucidating the genetic basis of human disease with each providing unique perspective and expertise in areas of human genetics, mouse models, epidemiology, and statistics. Maximizing the interplay among these highly complementary approaches is critical to success and will provide unprecedented opportunities to advance human health. The faculty study the role of genes implicated in human disease such as congenital heart disease and cystic fibrosis; inflammatory processes involved in allergic responses, asthma and arthritis; diabetes and breast cancer; psychiatric disorders such as depression and schizophrenia; colon cancer, lymphoma, brain carcinoma, and neurodegenerative disorders including dementia, motor neuron disease and parkinsonism; alcoholism and nicotine dependence; and birth defects. In fiscal year 2019, the department brought in $30.4M in NIH funding and ranked 6th in the nation.

***Dr. Fernando Pardo-Manuel de Villena*** directs the Collaborative Cross, the most genetically diverse mouse population in the world and is an international tool to probe the genetic basis of many diseases. In 2017, Dr. Pardo-Manuel became the second Chair of the UNC Genetics Department. ***Dr. Beverly Koller*** did her postdoctoral work with Dr. Oliver Smithies, Nobel Laureate, and through gene targeting developed the Cystic Fibrosis mouse model. She continues to be a leader in developing mouse models of human disease. ***Drs. James Evans and Jonathan Berg*** lead the UNC effort on whole exome sequencing and the use of such technology for clinical diagnosis. In addition, Dr. Evans has been highly active in the scientific education of the US judiciary at the State and Federal Supreme Court levels. ***Dr. Karen Mohlke*** was named a 2016 Smithies Investigator. ***Dr. Magnuson*** was elected into AAAS in 2007, was appointed as the UNC Vice Chancellor for Research in 2016 and was elected 2018 Vice President and 2019 President of the Genetics Society of America. ***Dr. Cynthia Powell***, Professor of Pediatrics and Genetics, was appointed to the US Health & Human Services Advisory Committee on Heritable Disorders in Newborns and Children. The Susan G. Komen Foundation recognized ***Dr. Charles Perou*** with the Brinker Award, its top scientific honor, for his work on understanding breast cancer as distinct molecular subtypes that have prognostic value using cutting-edge cancer genomics tools.

A significant educational component of the department includes three graduate programs: the **Curriculum in Genetics & Molecular Biology** (79 predoctoral trainees); the **Curriculum in Bioinformatics & Computational Biology** ( 49 predoctoral trainees); and a series of **Medical Genetics Training Programs** which includes the Medical Genetics Residency Program, Clinical Molecular Genetics Postdoctoral Program, Clinical Cytogenetics Postdoctoral Program, and the Genetic Counseling Master’s Degree. The Curricula are PhD degree-granting programs. The Curriculum in Genetics & Molecular Biology trains students to be creative, sophisticated research scientists prepared to pursue careers focused in genetics and genomics working in academic science, government, or commercial positions. Students conduct their dissertation research using diverse experimental approaches, from classical genetics to the most modern molecular methods, to address a broad range of contemporary problems in biomedical science. Our relatively new Curriculum in Bioinformatics and Computational Biology stands at the frontier of modern science by integrating mathematical approaches with experimental genetics. Additionally, there are 18 Genetics postdoctoral fellows housed in the Department.

The department also includes a clinical arm focused on medical genetics, which covers the broad spectrum of clinical genetic research from disease prevention to diagnosis and treatment. This specialty includes evaluation, mutation discovery, counseling and risk assessment through analysis and genetic testing. Locating the clinical group alongside basic scientists facilitates integration of cutting-edge genetic research with patient care.

## Department of Microbiology and Immunology

The Department of Microbiology and Immunology strives to conduct research that significantly advances the science of microbiology and immunology with emphasis on topics that could contribute to improved human health, and currently ranks 2nd in the nation among medical school microbiology departments ($24.4M in NIH grants – FY16. The faculty of the Department of Microbiology and Immunology focus on topics related to infectious diseases, studying both the pathogens that cause infection (bacteria, viruses, fungi) and host defenses against infection. Infectious diseases remain the largest cause of global mortality, providing compelling justification for studies aimed at understanding pathogen:host interactions and for developing knowledge that will lead to better ways of preventing and treating infectious diseases. The research being done in the laboratories in the department ranges from basic research on the molecular biology of bacteria and viruses to translational or clinical projects concerning different infectious diseases. Several investigators focus on the molecular basis of the immune system or on disorders of the human immune system (such as autoimmune disorders). The department Chair from 2008 – 2016, ***Dr. William E. Goldman***, moved to UNC from Washington University in September 2008. The department increased NIH funding by 60%f rom $8.5 million in 2007 to $23.4M in fiscal year 2017, ranking 3rd in the nation. ***Dr. Craig Cameron****,* was recruited as Chair of the Department in September 2019. Dr. Cameron is a leader in the study of RNA viruses, specifically RNA polymerases and RNA-binding proteins required for viral replication or mitochondrial function. The department has 26 faculty members involved in graduate student training and research. Most of the faculty members with joint appointments in the department have primary appointments in one of the clinical departments of the School of Medicine. In 2016 ***Drs. Dirk Dittmer*** and ***Victor Garcia*** were elected as Fellows of the American Academy of Microbiology and were joined by Drs. Miriam Braunstein and Robert Bourret in 2020. ***Dr. Peggy Cotter*** was elected as the 2017-18 President of the American Society for Microbiology. One of the newest members of the department, ***Dr. Helen Lazear***, is a member of a UNC team of investigators studying arboviruses, especially the flaviviruses such as Zika and developed the first mouse model for Zika infection. The research laboratories of the department are organized into four informal groups: Immunology, Microbial Genetics and Pathogenesis, Virology, and Molecular Biology. There is considerable overlap of research interests, and different labs frequently collaborate on specific research projects. The collegial and collaborative atmosphere in the department ensures that trainees have the opportunity to interact with numerous faculty members and to learn to use research techniques and approaches from different laboratories. The department currently has 59 graduate students and 34 postdoctoral fellows.

## Department of Pathology and Laboratory Medicine

Led by ***Dr. Russell Broaddus*** (Department Chair), the three coequal missions of the Department of Pathology and Laboratory Medicine are to: 1) provide exceptional, comprehensive, clinically effective and cost effective pathology and laboratory medicine services; 2) teach clinical and scientific concepts of pathology and laboratory medicine, and mechanisms of disease to a wide variety of learners; and 3) advance the practice of pathology and laboratory medicine, and the knowledge of diseases and disease mechanisms through innovative research spanning the spectrum from basic to translational to clinical. The department is both a basic science department with substantial extramurally funded research (average annual grant funding over the past 4 fiscal years of $7.5 million) and a strong clinical department with widely acclaimed excellence in providing cutting edge pathology and laboratory medicine services. It was home to ***Dr. Oliver Smithies***, Nobel Laureate (2007) in Medicine. The Department oversees important core research facilities including the Microscopy Services Laboratory, Anatomic Pathology Translational Core Laboratory, Experimental Animal Clinical Laboratory, and Gene Expression Laboratory.

The Department’s residency and clinical fellowship programs currently have ~30 trainees. The Clinical Training program includes a Residency Program in Pathology and Clinical Fellowships in Clinical Chemistry, Clinical Cytogenetics, Clinical Immunology, Clinical Microbiology, Clinical Molecular Genetics, Cytopathology, Forensic Pathology, Hematopathology, Molecular Genetic Pathology, Nephropathology, Surgical Pathology, and Transfusion Medicine. The Department’s Graduate Program in Molecular and Cellular Pathology currently has 15 outstanding students. Department faculty (41 tenured and tenure-track faculty), post-doctoral fellows (9), and graduate students are involved in a wide array of basic, translational, and clinical research. The current leading areas of research emphasis are cancer, vascular pathobiology, thrombosis and hemostasis, and translational molecular genetic pathology. Faculty, trainees and students are involved in most interdisciplinary centers in the School of Medicine, with major representation in the McAllister Heart Institute, Cystic Fibrosis/Pulmonary Research and Treatment Center, Kidney Center, Lineberger Comprehensive Cancer Center, and Integrative Program for Biological & Genome Sciences.

## Department of Pharmacology

The Department of Pharmacology grew under its former Chair, ***Dr. Gary L. Johnson***, and continues to grow under the leadership of its new Chair, ***Dr. Henrik Dohlman***, with approximately $19.5 million in fiscal year 2019, and the department currently ranks 5th in NIH funding amongst Pharmacology departments in the country. Furthermore, UNC has been ranked 2nd in the world for Pharmacology and Toxicology (U.S. News). There are 29 full-time tenured and tenure-track primary faculty, as well as 24 joint appointees representing the Departments of Medicine, Physiology, Psychology, Biomedical Engineering, Biochemistry & Biophysics, Chemistry and the Schools of Dentistry and Pharmacy. The Department of Pharmacology is unique among the biomedical sciences. Although it is firmly rooted in fundamental laboratory investigation, the long-term goal of pharmacological research is to provide new therapies for human disease. Thus, the discipline of Pharmacology occupies a key nexus between basic biological science and the clinical sciences. The Department of Pharmacology at UNC clearly provides one of the nation's most dynamic environments for pharmacological research and training. A major theme of the Department is to understand the receptors and signaling networks that are critically involved in the actions of drugs, neurotransmitters and cytokines. There is exceptional strength in neuropharmacology, structural biology, live cell imaging, proteomics and systems biology. ***Dr. Bryan Roth*** received the 2016 Louis S. Goodman & Alfred Gilman Award in Receptor Pharmacology from the American Society for Pharmacology and Experimental Therapeutics (ASPET). This award recognizes research with the potential to provide the basis for the discovery of drugs useful in the treatment of diseases. Faculty in Pharmacology play major leadership roles at UNC in emerging new disciplines including nanomedicine, bioinformatics, computational biology, gene therapy, and chemical biology and drug discovery. Pharmacology faculty are broadly involved in collaborative research in most of the institution’s Centers, particularly the Lineberger Comprehensive Cancer Center, McAllister Heart Institute, Alcohol Center, and the Gene Therapy Center. Currently the department has 40 graduate students, 40 postdoctoral fellows, and 22 research-track faculty.

## Department of Social Medicine

Run by ***Dr. Jonathan Oberlander****,* the Department of Social Medicine is committed to the promotion and provision of multidisciplinary education, leadership, service, research, and scholarship at the intersection of medicine and society. The faculty within the Department of Social Medicine have an extraordinary range of expertise and are from the fields of humanities, social sciences and clinical medicine. The faculty conduct research on issues such as health disparities and inequalities, reproductive health, health care reform, ethical implications of genomics research and clinical trials, health and human rights, prenatal screening, psychiatric care, production of medical knowledge, narrative medicine, and ethical issues surrounding HIV/AIDS prevention and treatment. This department also has three affiliated centers directed by departmental faculty: the Center for Bioethics (directed by ***Dr. Eric Juengst***), Center for Health Equity Research (directed by ***Dr. Giselle Corbie-Smith***), and the Center for Genomics and Society (directed by ***Dr. Gail Henderson****)*. The department currently has 21 Primary and Full Joint Faculty, 34 secondary faculty, and 2 postdoctoral fellows.

# Clinical Departments in the school of medicine

The UNC Hospitals has received a number of awards and recognitions: Becker’s Hospital Review named UNC Medical Center one of the ‘100 Great Hospitals in America in 2019’, the American Heart Association recognized UNC Hospitals’ commitment to quality stroke care, and 373 physicians from UNC Health Care were named to the ‘2017-2018 Best Doctors in America’ list (only 5% of doctors in America earn this prestigious honor).

## Department of Allied Health Sciences

The Chair of the department, ***Dr. Stephen Hooper*,** is a nationally recognized leader in allied health education, research, and clinical practice. The department houses 13 accredited degree programs in six different professional disciplines, with a current enrollment of over 400 students. The department includes seven divisions: Clinical Laboratory Science, Occupational Science and Occupational Therapy, Physical Therapy, Radiologic Science, Clinical Rehabilitation and Mental Health Counseling, Physician Assistant Studies, and Speech and Hearing Sciences. Additionally, The Department of Allied Health Sciences houses four centers, programs and units: Center for Literacy and Disability Science, Center for Human Movement Science, Program for Early Autism Research, Leadership & Service, and Neurodiagnostics and Sleep Sciences.

## Department of Anesthesiology

Under the leadership of ***Dr. David Zvara****,* the department provides clinical services for over 45,000 patients each year. In additional to outstanding clinical care in every discipline, including pain management and adult and pediatric critical care medicine, the department is a national leader in education and research. With $8.4M, in research funding in 2018 the department ranked 5th in the country for NIH funding.

## Department of Dermatology

Under the leadership of the former Chair, ***Dr. Luis Diaz***, the department committed to pursuing and maintaining excellence in routine and highly specialized dermatological care. Diagnosis and treatment of skin diseases are offered in the Dermatology and Skin Cancer Center, which is conveniently located just minutes away from the main campus and hospital. In addition to its clinical mission, new Chair, ***Dr. Nancy Thomas***, is enhancing the research programs in autoimmune skin diseases and melanoma, which enjoy a national and international reputation and are considered one of the world’s leaders in these areas of investigation. The Department of Dermatology also houses the UNC Dermatology Clinical Trials Unit which conducts research studies that evaluate and monitor the safety and efficacy of new treatments for dermatological conditions in children and adults such as acne, psoriasis, onychomycosis, epidermolysis bullosa, and pemphigus vulgaris, melanoma and basal cell carcinoma. The department is currently ranked 22nd nationally in NIH funding among dermatology departments. Teaching programs span the education of medical students, dermatology residents and post-doctoral fellows. The three-year residency program comprises 12 positions that are filled by the best applicants from around the country.

## Department of Emergency Medicine

Led by ***Dr. Jane Brice*,** the Department of Emergency Medicine consists of 40 clinical and research faculty, and multiple adjunct faculty participating in the teaching, administration, research and clinical care missions of the department. The department sees approximately 75,000 adults and 45,000 pediatric patients yearly. As one of the largest referral centers in North Carolina, it sees some of the highest acuity patients in the state. The faculty has diverse research interests including basic science, health informatics, EMS systems, health services, medical education, and patient-based clinical research. The department brings in over $10 million annually in external funding, is ranked #8 in NIH funding, and is one of the premier emergency departments in the world for studying emergency health informatics.

## Department of Family Medicine

The Department, led by Interim Chair ***Dr. Margaret Helto***n, who currently leads the department after ***Dr. Cristen Page*** assumed the role as the Executive Dean of the School of Medicine***,*** is top-ranked in the nation and provides patient-centered primary care, conducts groundbreaking research, and trains exemplary young doctors. The Department of Family Medicine is closely affiliated with North Carolina’s large Area Health Education Center network, with residency programs and training sites throughout the state. This department has a special interest in rural health. Currently, this department ranks 6th nationally in NIH funding among family medicine departments, and was ranked 4th in the 2019 rankings of “America’s Best Graduate School” by the U.S. News & World Report.

## Department of Medicine

***Dr. Ronald Falk*** became the new Chair of the Department of Medicine in 2015. In addition to his Chair responsibilities, he is also the Director of the UNC Kidney Center and the Center for Transplant Care. Along with Dr. J.C. Jennette, he established the Glomerular Disease Collaborative Network within the state of NC, 1,000 physicians from 400 clinics. Medicine is the largest of the clinical departments (133 tenured and tenure-track faculty, over 300 faculty total), but its faculty is also heavily engaged in research ranking 12th in NIH funding for fiscal year 2019 with $109M in award funding. Faculty research includes virtually all types of investigation, from clinical epidemiology and outcomes research to pure basic science and molecular biology, with considerable translational research between these poles. The department had 76 faculty members included in the *2017-18 Best Doctors in America* list. In 2016 ***Dr. Kim*** ***Isaacs*** was named the American Gastroenterological Associations Clinician of the Year, ***Dr. Victor Garcia*** was named a UNC Smithies Investigator; ***Dr. Myron Cohen’s*** HPTN 052 study proved that HIV treatment will prevent infection, ***Dr. David Margolis*** led a collaborative effort with GlaxoSmithKline to find a cure for HIV, the American Heart Association for the first time ever presented two major awards to one recipient—***Dr. Sidney Smith***. DOM Faculty are members of the McAllister Heart Institute, the UNC Kidney Center, the Lineberger Comprehensive Cancer Center, the Cystic Fibrosis/Pulmonary Research & Treatment Center, the Center for Gastrointestinal Biology & Diseases, the Institute for Global Health & Infectious Diseases, and the Thurston Arthritis Center. All of the Center Directors in this list are from the Department of Medicine. The Department actively cultivates physician scientists, hosting a Physician Scientist Training Program which provides career and training support in addition to salary support with protected research time, research funding, and ultimately a faculty appointment. This successful program is a pipeline for clinical and translational research leaders at UNC and was recently expanded to a school-wide program led by Dr. J. Alex Duncan, Associate Professor of Medicine.

## Department of Neurology

Under the leadership of Dr***. Gwenn Garden****,* who became Chair in 2019, the department is committed to the mission of providing high quality neurological consultation and specialty neurological care to the people of North Carolina and to others who travel to our state; teaching medical students, residents, fellows, and practicing physicians the latest advances in evidence-based treatment of neurological disorders; and discovering better ways to prevent, improve and cure neurological disease through research in the laboratory and at the bedside. Research efforts include collaborative projects in the Neuroscience Center, the Biomedical Imaging Center, and the Carolina Center for Developmental Disabilities. The department hosts eight designated Centers of Excellence in the following areas: Stroke, Epilepsy, Movement Disorders Center, Muscular Dystrophy, Charcot-Marie-Tooth, Neurofibromatosis, Lewy Body Dementia, and PSP/CBS/MSA. The Department of Neurology also houses the NIH-funded Clinical Research Center which is available for faculty and resident clinical studies.

## Department of Neurosurgery

Currently led by interim chair ***Dr. Eldad Hadar*,** the department is committed to the principles of leading, teaching, and caring. Its patient-centered, customer-service-focused team stands ready to meet the needs of North Carolinians who require neurosurgical help. Departmental faculty collaborate with the power research engine that is UNC Medicine and the greater UNC campus, home to more than $700 million in NIH research funding. The department educates outstanding neurosurgery residents and UNC medical students with a forward thinking educational curriculum. The Department is committed to participation in team science. Our campus collaborators include the UNC Lineberger Comprehensive Cancer Center, the Biomedical Research Imaging Center, the Eshelman School of Pharmacy, Gillings School of Global Public Health and the Matthew Gfeller Sport-Related Traumatic Brain Injury Research Center. Cutting edge research includes work with a team in the School of Pharmacy to use stem cells derived from patient skin cells to hunt down and kill glioblastoma cancer cells.

## Department of Obstetrics and Gynecology

***Dr. Genevieve Neal-Perry*** is the Chair of the department and in 24 physicians were selected to the 2019-2020 Best Doctors in America List. 16 providers from the department were named in the 2015-16 U.S. News and World Report Top Doctors list, and was ranked 11th in the 2019 America’s Best Graduate Students rankings, also by U.S. News and World Report. In 2019 the department was ranked 3rd among Obstetrics & Gynecology departments in NIH funding, with $9.6M in awards. The department is ranked #1 in NC and #11 nationally in Gynecology by the 2016-17 *US News & World Report* rankings. Furthermore, the residency program within the department is ranked #2 in the nation in the 2017-18 Doximity Residency Navigator. Obstetrics & Gynecology is one of only a few departments in the nation with boarded fellowships in all 4 subspecialties (Maternal Fetal Medicine, Reproductive Endocrinology & Infertility, Gynecologic Oncology and Urogynecology & Reconstructive Pelvic Surgery). In addition, the department has fellowships in Family Planning, Global Women’s Health, Clinical Epidemiology and Advanced Laparoscopy & Pelvic Pain. The department has eight divisions including Advanced Laparoscopy & Pelvic Pain, Global Women’s Health, Gynecologic Oncology, Maternal Fetal Medicine, Midwifery, Reproductive Endocrinology & Infertility, Urogynecology & Reconstructive Pelvic Surgery and Women’s Primary Healthcare. The department houses the UNC Horizons Program, which is a substance use disorder treatment program for pregnant and/or parenting women and their children. In 2017 ***Dr. Kate Menard*** was named the new President of the NC Obstetrical & Gynecological Society.

## Department of Opthalmology

The department ,led by ***Dr. Donald Budenz***, provides premier eye care to North Carolinians and others, and has a strong tradition of reaching underserved populations. Excellence in education and research enhances the delivery of the highest quality eye care, which is delivered in an environment that is exceptionally welcoming, collegial and supportive both for those receiving and those providing the care.

The department is dedicated to providing a current and comprehensive educational program to its resident physicians, fellows, and medical students. Its goal is to produce leaders in ophthalmology who are medically, surgically and culturally competent. The department works to create an environment that fosters innovation and progress within the program through open lines of communication. It continually strives to incorporate the most innovative and medically relevant learning resources available, both within UNC and beyond, and to teach colleagues in ophthalmology and other medical fields how to provide better eye care to patients. Faculty are committed to the support of excellence in clinical, basic and translational eye research, and to developing nationally recognized, state-of-the-art research laboratories. UNC Eye also is committed to the study of new treatments in human disease through participation in large-scale multicenter, federally and privately sponsored trials (including gene therapy studies) and to the understanding of eye diseases through the close collaboration between its clinicians and basic research scientists. The research mission of UNC Eye is to pioneer new ideas and technologies that will set the stage for better and alternative treatments of eye diseases.

## Department of Orthopaedics

For over 50 years, the Department of Orthopaedics has provided superb musculoskeletal health care to patients, top rate education to students and residents, and innovative research and knowledge to the orthopedic profession. Their physicians are experts in the treatment of musculoskeletal injuries and conditions for both adults and children. The department is chaired by ***Dr. James Sanders*.**

## Department of Otolaryngology

The mission of the department, under the leadership of ***Dr. Wendell Yarbrough***, is to improve health care by enhancing the field of otolaryngology/head and neck surgery and by advancing its clinical application. To fulfill this mission, objectives are to provide excellent otolaryngologic/head and neck surgical patient care that can serve as a national mode; to provide outstanding medical and graduate student and postdoctoral and resident education that disseminates otolaryngology/head and neck surgery knowledge and facilitates more contributions to the knowledge base; and to carry out basic science, clinical, and health services research that advances the field of otolaryngology/head and neck surgery. In 2019 the department was ranked 26th among Otolaryngology departments ( 11th among public university departments) with $1.0M in NIH funding. By providing a team approach, the department is consistently highly ranked by *U.S. News & World Report* (#16 in 2019). The world-renowned Cochlear Implant Center consists of a diverse and dedicated group of scientists and physicians working on basic and clinical aspects of hearing health and disease. In 2016 ***Dr. Amelia Drake*** was appointed President of the American Cleft Palate-Craniofacial Association (ACPA). The department recently received full Accreditation for a Facial Plastic and Reconstructive Surgery Fellowship Program, which will supplement the other fellowship programs in Advanced Surgical Head and Neck Oncology and Microvascular Reconstruction, Neurotology, Pediatric Otolaryngology, and Rhinology, Allergy, and Endoscopic Skull Base Surgery.

## Department of Pediatrics

***Dr. Wesley Burks***, former Chair of the department, is currently Dean of the UNC School of Medicine, and heads a nationally renowned clinical research group dedicated to developing therapies for peanut allergies. ***Dr. Stephanie Davis*** leads the dedicated faculty in treating more than 70,000 children at North Carolina Children's Hospital and more than 25 satellite outreach clinics throughout the state. The Department has a faculty of nearly 150 physicians, every one of whom is dedicated to the care of children, from the tiniest premature infant to the critically injured adolescent. Many of the faculty are nationally and internationally renowned for their research in the fields of cystic fibrosis, oncology, hemophilia, sickle-cell disease, infectious diseases, genetics, neonatology, child abuse, adolescent medicine, obesity, behavioral pediatrics, endocrinology, bronchoscopy and congenital heart disease. ***Drs. Toni Darville*** and ***Suzanne Kennedy*** run the Children’s Research Institute which promotes collaboration by increasing the interactions of faculty within the Department of Pediatrics with those external to the department and advance the pediatric research goals at UNC. The Institute also translates research from basic science labs to clinical trials to Health Policy and Outcomes studies. These efforts help connect the basic and clinical research to the clinical care in the Children’s Hospital. The Department of Pediatrics now houses UNC’s Gene Therapy Center, and the Department hopes to increase the number of AAV clinical trials in children. ***Dr. David Peden*** was installed as the 2017 President of the American Academy of Allergy, Asthma & Immunology (AAAAI). The Department of Pediatrics ranks 22nd among Pediatrics departments with approximately $15.4M in NIH funding.

## Department of Physical Medicine and Rehabilitation

This department is comprised of doctors and psychologists who provide clinical care, teaching, research and advocacy primarily in North Carolina, but also through outreach to benefit rehabilitation patients worldwide. Its rehabilitation doctors, also called physiatrists, manage care through an interdisciplinary rehabilitation team of colleagues from UNC Health Care and other departments. For example, physiatrists regularly prescribe physical, occupational, speech and recreational therapy and monitor that therapy over time. They attend care conferences with nurses, social workers, care managers, therapists and other specialists to let the patient and family ask questions and make important decisions. Patients benefit tremendously from this wider interdisciplinary team and also from immediate access to the university’s full range of medical resources. This department currently ranks 16th in NIH funding among other physical medicine departments in the country.

The department is currently chaired by ***Dr. Joshua J. Alexander***. Faculty members and staff continue to improve rehabilitation care locally and globally through support groups, education, research and telecommunications, expanding UNC’s rehabilitation resources to individuals and families. Residents participate in the Global Partnership in Medical Rehabilitation, and the department continues to welcome participants from other countries, as delegations and in the international visiting scholars program. The Department is home to the [Program on Integrative Medicine](http://www.med.unc.edu/phyrehab/pim), which conducts research in complementary and alternative medicine, and which is the administrative home of the T-32 Research Fellowship in Complementary and Alternative Medicine.

## Department of Psychiatry

Since its establishment in 1952, the department has served the citizens of North Carolina, the nation, and where possible, the world community through its three interwoven missions: teaching/training, research, and clinical care. Recently, the Department of Psychiatry was ranked 20th in the annual rankings of “America’s Best Graduate Schools” by U.S. News & World Report. ACGME-accredited residency programs in adult, child and forensic psychiatry attract and retain outstanding candidates. They also offer the highest caliber continuing medical education for psychiatrists and other mental health practitioners. Through highly successful clinical and basic research programs, they aim to advance and deepen understanding of the causes of psychiatric illnesses and their concomitants. The department was under the previous leadership of ***Dr. David Rubinow***, who was inducted into the Institute of Medicine of the National Academics in 2012, but is now led by ***Dr. Samantha Meltzer-Brody****,* who was the principal investigator in the clinical trials that led to the approval of ZULRESSO – the first and only treatment specifically for postpartum depression. In fiscal year 2019, the department was ranked 16th among Psychiatry departments with $18.6M in NIH funding. The program and its graduates have played a major role in the development of more effective diagnostic, treatment, and prevention strategies for a wide array of psychiatric disorders. Its research encompasses basic molecular, cellular and genetic approaches, as well as biobehavioral and systems neurobiology, clinical investigations, and population-based outcomes research. The clinical mission integrates state-of-the-art biological, psychological and social approaches in the care of patients and their families and provides the foundation for the teaching and research missions. They also collaborate closely with other schools and units within the university, as well as with the North Carolina Division of Mental Health, Developmental Disabilities and Substance Abuse Services, the Area Health Education Centers (AHEC) system, and with private clinical practitioners throughout North Carolina. Faculty investigators are among the nation’s leaders in exploring the mechanisms that will ultimately explain human behavior and mental illness. The major areas of research include neurodevelopmental disorders (autism, fragile X syndrome, and Turner Syndrome), schizophrenia and related psychotic disorders, bipolar and depressive mood disorders, behavioral medicine, eating disorders and women’s mood disorders. The Department of Psychiatry houses number of centers and programs, such as the Center of Excellence for Eating Disorders, the Center for Women’s Mood Disorders, and the TEACCH Autism Program which provides core services meeting the clinical, training, and research needs of individuals with Autism Spectrum Disorder and their families. ***Dr. Joseph Piven*** most recently published a first-of-its-kind study that is developing the tool to predict autism in babies before behavioral symptoms emerge. In 2016 ***Dr. Susan Girdler*** was invited to participate in the first-ever US Women Summit that convened by the White House. ***Dr. Cynthia Bulik*** is Director of the UNC Center for Excellence for Eating Disorders and holds the first endowed professorship in this field.

## Department of Radiation Oncology

Led by Interim Chair Keith Smith, faculty and staff in the department strive to exemplify UNC Health Care’s motto, “Leading, Teaching, Caring.” The department has a strong tradition of leadership and innovation. In particular, it has pioneered the use of computer-assisted image-guided therapy, which allows them to focus the radiation on the target tissues, while minimizing the risks to the surrounding normal organs. In 2018, ***Dr. Andrew Wang*** published a high profile publication in the journal of Clinical Cancer Research which described how circulating tumor cells can provide critical information about unique biological characteristics of the main tumor, how well a tumor’s treatment is progressing, or whether a previously-treated cancer is about to return and has developed IP to fuel two start up companies. Dr. Gaorav Gupta has recently developed an HPV blood test that shows promise for tailoring therapy for head and neck cancer patients and are working to commercialize the test. There is an active research focus in the department, and faculty strive to translate advances from the laboratory to the clinic to benefit patients. This translational research focus reflects a continuing commitment to state-of-the-art patient care and to the training of the next generation of radiation oncologists and other radiotherapy professionals.

## Department of Radiology

After ***Dr. Matthew Mauro*** stepped down (after 13 years of leadership) to focus on his role as President of UNC Faculty Physicians, ***Dr. Jeffrey Keith Smith*** assumed the role of Interim Chair of the Department of Radiology. The department offers a wide variety of diagnostic radiology examinations and interventional procedures, each providing state-of-the-art technology. Its team of internationally recognized radiologists and expert technologists provides the best service possible with the latest advances available within the field. The department provides a wide array of diagnostic imaging tests utilizing the most advanced imaging equipment available, ranging from conventional x-ray to dual source multi-detector CT, 3 Tesla MRIs and multi-slice PET/CT. A variety of sophisticated and advanced image-guided treatment procedures, such as radiofrequency, cryo and microwave ablation of tumors, uterine fibroid embolization, kyphoplasty, and occlusion of intracranial aneurysms are also available. The Department of Radiology also has an active research community in both the basic and clinical sciences, and ranks 22nd among Radiology Departments with approximately $7.3M NIH funding.

## Department of Surgery

The mission of the Department of Surgery is to provide the highest quality patient care to all people through innovation, world-class research, and training the next generation of surgical health care professionals and scientists. Directed by Distinguished Professor ***Dr. Melinda Kibbe****,* who was inducted into the National Academy of Medicine in 2016, the department has 74 attending and non-attending faculty members who are actively involved in research in numerous areas including abdominal transplant surgery, burn science, cardiothoracic surgery, gastrointestinal surgery, plastic and reconstructive surgery, surgical oncology, trauma and critical, and vascular surgery. The department has demonstrated a two-fold increase in the average number of publications per faculty member and total research grant dollars from 2016 to 2017. The Department of Surgery offers cutting edge clinical services and serves as a surgical referral center for patients and physicians world-wide. The Pancreatic Islet Cell Transplantation program within the department is ranked 10th in the nation, and the department now offers hyperthermic intraperitoneal chemotherapy treatment option for patients. ***Dr. Bruce Cairns***directs the Jaycee Burn Center that in 2016 was declared as one of the largest and best comprehensive burn centers in the world.

# Departments in the College of Arts & Sciences Campus

## Department of Biology

Under the leadership of ***Dr. Kerry Bloom***, the Department of Biology has over 50 faculty members with research interests that span the entire scope of modern biology from the disciplines of cell, molecular, and developmental biology through the areas of ecology, physiology and behavior. Total R&D expenditures for the department have increased over 40% in the last 10 years based on the NSF rankings website. The department received $12.8M in total extramural funding for FY 2019, $6.2M in NIH funding. Currently Biology occupies four buildings, with construction of the newest building, dedicated to genomic sciences, finished in the Spring of 2012. The Genome Sciences Building houses an interdisciplinary collection of scientists from biology, chemistry, physics and computer science.

Just over half of the Department of Biology faculty members work in the areas of molecular, cellular and developmental biology. Together, they form a very interactive group that fosters an environment emphasizing research collaboration and resource sharing. This has been instrumental in developing a state-of-the-art microscopy facility and a microarray facility. In addition, there are many formal and informal research ties among the diverse groups within the department. Notable among these are a group of investigators focused on understanding the dynamics of chromosome behavior ranging from the biochemistry and genetics of DNA repair/recombination to the movement of whole chromosomes during mitosis/meiosis as well as a group of investigators devoted to understanding the molecular aspects of developmental biology. Importantly, the department's investigators use a wide variety of approaches to attack important biological problems and often work on model biological systems -- single cell organisms such as *E. coli* or the budding yeast *S. cerevisiae*, model multicellular animals including the nematode *C. elegans*, the fruit fly *Drosophila* and the mouse, and model plants such as *Arabidopsis*. The genomics revolution has provided access to the complete DNA sequence of each of these organisms which, in turn, is offering access to all of the cell's biological machinery. The Department's faculty and students are taking advantage of this new information as they continue to focus on fundamental biological problems. The knowledge we gain in these model systems not only provides answers to these fundamental questions, but also, because all organisms share much of their cellular machinery, provides direct insight into the cellular defects that underlie human disease. ***Dr. Corbin Jones*** is the Faculty Advisor to the UNC High-Throughput Sequencing Core facility, which has developed into a major facility used by faculty across campus.

The Department of Biology provides a bridge between the biology-oriented research ongoing in other basic science departments such as chemistry, physics, and computer science and the biomedical research community located in the Medical school. Dr. Bob Duronio is Director of the Integrative Program for Biological and Genome Sciences which bridges the College and the Medical School. The department has a very active undergraduate research program that trains a significant fraction of our undergraduate majors for future careers in research and medicine. The formal ties between Biology and the Medical School include joint participation in two interdepartmental graduate training programs. Most of the Department of Biology faculty members who are involved in molecular, cellular and developmental biology research participate in both of these interdepartmental graduate training programs. The Department is home to about 48 graduate students in molecular and cellular and approximately 35 postdoctoral fellows.

## Department of Chemistry

The Department of Chemistry is under the leadership of ***Dr. Jeffrey Johnson,*** and has a distinguished faculty of 50 that includes five members of the National Academy of Sciences, six members of the American Academy of Arts and Sciences, a past president of the American Chemical Society, a Priestly Medal recipient, and numerous recent recipients of other national and international awards. The research program is one of the strongest in the country with more than 300 publications published annually and over 100 patents filed within the last 10 years. Current faculty bring in over $24 million in external funding to the department annually. The Department supports six areas of research including analytical chemistry, chemical biology, inorganic and organometallic chemistry, organic chemistry, materials/polymers/nanoscience, and physical and theoretical chemistry. ***Drs. Leif Huang and Joel Tepper*** lead the Carolina Center of Cancer Nanotechnology Excellence, which includes members from the College of Arts & Sciences and Schools of Medicine and of Pharmacy. The department also houses the Mass Spectrometry Core Laboratory that provides training opportunities for undergraduate, graduate and post-doctoral scholars and offers mass spectrometric services to the department, UNC, and the greater Research Triangle area. Research discoveries by faculty in the department include ultramicroelectrodes in neuroscience for *in vivo* electrochemical measurements and sensors for in vivo healthcare monitoring. Faculty members collaborate with both the Lineberger Comprehensive Cancer Center and the McAllister Heart Institute. The graduate Chemistry program has a long-standing tradition and is one of the largest and oldest in the country with the first Ph.D. degree in Chemistry awarded in 1883. The department currently has 108 graduate students and ~40 postdoctoral fellows.

## School of Pharmacy

The Eshelman School of Pharmacy (ESOP) at The University of North Carolina at Chapel Hill offers both a professional pharmacy program leading to the Pharm.D. degree and a graduate program in Pharmaceutical Sciences (PHRS) leading to the Ph.D. degree in a research-intensive environment. The ESOP ranks 1st in the U.S. News’ List of Best Pharmacy School, ranked 2nd among Schools of Pharmacy based on the research funding awarded by the National Institutes of Health ($19.3 in FY2019) and in Total Research Funding ($30.4M). Over the last seven years, the graduate program has grown both in scope and in size. The number of students enrolled in PHRS has increased from 55 to 112 students. Over the same period, the number of tenure-track faculty in the ESOP has grown more than 30% to 128. The School’s proximity to the Research Triangle Park and other research campuses spurs collaboration and partnerships in academia and with industry. Research in ESOP has spawned a number of spin-off companies with 231 active issued patents and 48 startups. The PHRS Ph.D. program is an umbrella program as the ESOP is organized into five Divisions based on research and/or practice emphasis: Medicinal Chemistry and Natural Products (MCNP), Molecular Pharmaceutics (MOPH), Pharmacotherapy and Experimental Therapeutics, and Pharmaceutical Outcomes and Policy, and Pharmacy Practice and Experiential Education. Each Division offers a track within the PHRS Ph.D. program, and MCNP and MOPH faculty participate in the BBSP. The respective tracks are designed to train students in a specialty area of drug discovery and experimental biology (MCNP) or drug delivery, formulation, and metabolism (MOPH).

MCNP and MOPH comprise dynamic, multifaceted scientific disciplines dedicated to the improvement of human health through hypothesis-driven biological research as well as pharmaceutical discovery and development. The MCNP and MOPH divisions are chaired by ***David Lawrence*** and ***Leaf Huang***, respectively. A major faculty recruitment effort has brought several high-profile individuals to the ESOP, including ***David Lawrence****,* ***Stephen Frye*** and ***Bill Janzen*** in MCNP, and ***Xiao Xiao****,* ***Russell Mumper****,* ***Michael Jay***and ***Rudy Juliano*** in MOPH. Faculty in MCNP and MOPH play major leadership roles at UNC-Chapel Hill in emerging new disciplines including nanomedicine, bioinformatics, computational biology, chemical biology and drug discovery. As part of the emerging focus of the ESOP on translational research the School has recently established the **Center for Integrative Biology and Drug Discovery**, which is directed by Stephen Frye, a former global head of Medicinal Chemistry at GlaxoSmithKline, and the **Center for Nanotechnology in Drug Delivery**, which is directed by Dr. Alexander Kabanov. PHRS faculty are broadly involved in collaborative research in many of the university’s other Centers, including the Lineberger Comprehensive Cancer Center, Carolina Center of Cancer Nanotechnology Excellence, Gene Therapy Center, Program in Molecular Therapeutics, and the Gates Foundation Program on Infectious Diseases. PHRS faculty also participate in other curricula and hold joint appointments with many other departments, including Chemistry, Biochemistry and Biophysics, Pharmacology, Biomedical Engineering, the Cell and Molecular Biophysics Program, the Curriculum in Toxicology, and the training program in Material Science and Engineering.

# University-wide Curricula

There are also four University-wide, PhD-granting curricula, each of which is available and highly relevant to our XX Scholars.

## Curriculum in Bioinformatics and Computational Biology

The Predoctoral Training Program in Bioinformatics and Computational Biology (BCB) was established at UNC-Chapel Hill in Fall 2002 to address the need for expertise in two related disciplines, bioinformatics and computational biology. These are the disciplines that can analyze and interpret the large, complex datasets which have emerged in the last decade as genomics, proteomics, systems biology, and other high-throughput approaches have become more feasible. Bioinformatics and computational biology utilize techniques from applied mathematics, informatics, statistics, and computer science to solve biological problems. In 2007, the training program transitioned to the Ph.D. Curriculum in Bioinformatics and Computational Biology which is now led by Dr. Will Valdar, The goal of the Ph.D. Curriculum is to train the next generation of scientists who can develop and apply quantitative/analytical tools to driving biological problems. The Ph.D. curriculum provides the necessary latitude to prepare students with the right balance of quantitative skills (e.g., mathematics, statistics, and computer science) and experimental approaches (e.g., genetics, cell biology, molecular biology) for making important contributions to modern biological research. There are currently 26 full professors, 11 associate professors, and 29 assistant professors mentoring BCB students. The Ph.D. curriculum consists of four key components: formal coursework, research rotations, Ph.D. research and a colloquium. The coursework includes three tiers of training: foundational courses, core modules, and advanced courses. Eight specialized core modules have been developed that cover major areas of bioinformatics and computational biology, such as information theory, machine learning, sequence comparison, phylogeny, data management, ontology, data mining, biostatistics, biomolecular structure/function prediction, and modeling of complex systems. In addition to the PhD candidates, the program also offers graduate students getting their PhD in another department or curriculum the opportunity for certificate level training, which would concentrate in a specific area. There are currently 48 predoctoral students in the curriculum.

## Curriculum in Genetics and Molecular Biology

The Curriculum in Genetics and Molecular Biology is an interdepartmental PhD program directed by ***Dr. Jeff Sekelsky*** that was established in 1963 and has had continuous NIH T32 support since 1975. The goal of the program is to train students to be creative, sophisticated research scientists in the disciplines of genetics and molecular biology. The training emphasizes the acquisition of basic knowledge in genetics and molecular biology, the accumulation of laboratory skills, and the development of the ability to formulate experimental approaches to solving contemporary problems in the biological and biomedical sciences. The Curriculum in Genetics and Molecular Biology is the only UNC-Chapel Hill program that specifically emphasizes genetics, and has enabled many faculty with superb research programs to train predoctoral students in this discipline. The 79 training faculty have appointments in all of the basic science departments in the School of Medicine as well as the Department of Biology in the College of Arts and Sciences. These faculty members participate in student training by acting as dissertation sponsors, serving on dissertation committees, teaching in Curriculum sponsored courses, inviting speakers for the Curriculum's seminar series, and serving on administrative committees such as the Written Qualifying Exam Committee. There are currently 83 students enrolled in the Curriculum and they are training in over 50 different laboratories on the UNC-CH campus. Students enrolled in the Curriculum have been first or co-first authors on over 150 publications from 2012-2017. Student research in the Curriculum is quite broad, with particular strengths including the generation and characterization of mouse models of human diseases, the characterization of molecular mechanisms of replication, recombination and repair, gene therapy, the control of gene expression, and the genetic basis of cancer.

## Curriculum in Neuroscience Curriculum

The Neuroscience Curriculum stresses a multi-disciplinary approach to the study of neurons, the brain, behavior, and neuropsychiatric disorders. The Curriculum is directed by ***Dr. Mark Zylka,***and includes more than 64 faculty members in 13 departments and 5 specialized research centers. The faculty is highly competitive in receiving extramural grant support, with over $42 million in funding to UNC neuroscientists (as of April, 2007). These funds help to support individual research laboratories as well as impressive core facilities available to faculty and students. The curriculum facilitates communication between neuroscientists across departmental barriers and promotes better understanding among students and researchers of the conceptual and technical approaches in different disciplines. In 2019, Neuroscience Curriculum moved into the Neuroscience Research Building, which also houses the UNC Neuroscience Center. A central conference room, computing, administrative, and student office space is located near the labs of many of the primary faculty in the training program, creating a real neuroscience community. Fifty students are currently enrolled in the Neuroscience Curriculum.

## Curriculum in Toxicology & Environmental Medicine

The Curriculum in Toxicology & Environmental Medicine is an interdisciplinary graduate program that brings together UNC-Chapel Hill faculty members with research and teaching interests in toxicology. The Curriculum administers the graduate training program leading to the PhD degree in toxicology. Faculty members in the Curriculum are drawn from the UNC-Chapel Hill Schools of Medicine, Pharmacy, and Public Health, and from organizations within the nearby Research Triangle Park, such as the Chemical Industry Institute of Toxicology, the Environmental Protection Agency, and the National Institute of Environmental Health Sciences. The Curriculum is currently led by ***Dr. Ilona Jaspers.***

The goal of the program is to develop trainees that are knowledgeable in the basic principles of toxicology with in-depth experience in the development, execution and publication of research relevant to toxicology. Students are exposed to general techniques that cut across disciplines, such as molecular biology, genomics, animal models and biomarkers of exposure. The six general areas of emphasis are mechanisms/susceptibility to environmental disease, computational toxicology, developmental toxicology, ethanol toxicity, immunotoxicology, mechanistic toxicology, molecular carcinogenesis, neurotoxicology, and senobiotic metabolism and hepatic toxicology. Currently there are 17 predoctoral trainees in the curriculum.

# Office of Postdoctoral Affairs (OPA)

This nationally-recognized postdoctoral initiative, founded in a collaborative effort between Academic Affairs and Health Affairs at UNC-Chapel Hill, has been under the direction of ***Dr. Sibby Anderson-Thompkins***, who joined this program in January 2007 and brought ten years of experience in higher education research, policy, and administration. In conjunction with the UNC Postdoctoral Association (PDA), the Office of Postdoctoral Affairs has a campus-wide mandate that engenders a strong sense of community among all young researchers at UNC and promotes their professional development. The OPA works with the Office of the Provost, the School of Medicine, the College of Arts and Sciences, the Office of Graduate Education and individual Centers and Departments to provide a series of career and professional development programs for postdoctoral fellows at UNC and at neighboring institutions. Because postdoctoral fellows and graduate students share many career and professional development needs, all of the OPA programs are also open to graduate students.

Examples of career services and professional development programs coordinated by the OPA include career seminars, interviewing skills, negotiating skills, resumes and CVs, public speaking skills, and nontraditional careers in science. The evolution of this unique UNC postdoctoral initiative and its development of a comprehensive training program have gained national recognition and was described in an article published by the educational committee of the American Society for Cell Biology.

As part of a continuing commitment to building a culturally diverse intellectual community and advancing scholars from underrepresented groups in higher education, UNC initiated the Carolina Postdoctoral Program for Faculty Diversity. The purpose of the Program is to develop scholars from underrepresented groups for possible tenure track appointments at the University of North Carolina and other research universities. The program supports 10 postdoctoral scholars, engaged full-time in research and writing for a two-year term, providing salary, research funding and professional development support.

# UNC Research Centers

While all faculty members have a primary appointment in a Department, most also are members of the large number of centers and programs dedicated to research at UNC. These Centers help provide space, staff affiliated with core facilities and specialized services for faculty members and their trainees. A selected group of centers that are particularly relevant to the X Scholars are listed below and then briefly described in the text that follows.

**Table of Selected Research Centers and Institutes at UNC-CH**

| *Name* | *Admin Unit* | *Director* | *Primary Funding*  *Source* | *Number of Members [including non-UNC members]* |
| --- | --- | --- | --- | --- |
| Blood Research Center | SOM | Nigel Key, MD | NIH/NHLBI | 20 |
| Biomedical Research Imaging Center (BRIC) | SOM | Weili Lin, PhD | NIH | 9 |
| Bowles Center for Alcohol Studies | SOM | Fulton T. Crews, MD | NIH/NIAAA | 22 |
| Carolina Center of Cancer Nanotechnology Excellence | SOP | Leaf Huang, PhD | NIH/NCI | 8 |
| Carolina Institute for Developmental Disabilities | SOM | Joe Piven, MD | NIH/NICHD | 62 Research faculty |
| Carolina Population Center | UNC | Elizabeth Frankenberg, Ph.D. | NIH/NICHD | 68 |
| Cecil G. Sheps Center for Health Services Research | UNC | Mark Holmes, PhD | NIH, Other Federal | 214 |
| Center for Aging and Health | SOM | Jan Busby-Whitehead, MD | NIH, HRSA | 26 |
| Center for AIDS Research (CFAR) | SOM | Ronald Swanstrom, MD | NIH/NICHD;NIAID;  NCI; CIDA; NIMH;NHLBI | 200 |
| Center for Environmental Medicine & Lung Biology | SOM | David Peden, MD | US EPA Cooperative Agreement; NIH | 23 |
| Center for Gastrointestinal Biology and Disease | SOM | Robert Sandler, MD | NIH/NIDDK | 33 members  38 associates |
| Cystic Fibrosis/Pulmonary Research and Treatment Center/ Marsico Lung Institute/ | SOM | Richard Boucher, MD | NIH/NHLBI | 40 |
| Gene Therapy Center | SOM | Stephanie Davis, MD | NIH | 5 |
| Global HIV Prevention and Treatment Clinical Trials Unit (ACTU) | SOM | Joseph Eron, MD | NIH, HRSA, SPNS, SAMSHA, FRAM | 11 |
| Institute for Global Health and Infectious Diseases | UNC | Myron S. Cohen, MD | NIH/NIAID | 75 |
| Integrative Program for Biological and Genome Sciences | SOM/CAS | Bob Duronio, PhD | NIH and NSF | 24 |
| Lineberger Comprehensive Cancer Center | SOM | Shelley Earp, MD | NIH/NCI | 320 |
| McAllister Heart Institute | SOM | Victoria Bautch, PhD and Rick Stouffer, MD | NIH/NHLBI | 125 |
| Neuroscience Center | SOM | Mark Zylka, PhD | NIH/NIMH, NINDS | 37 |
| Nutrition Obesity Research Center | SPH | Elizabeth Mayer-Davis, PhD  Steven Zeisel, MD/PhD | NIH/NIDDK | 60 + over 40 affiliates |
| Program in Computational Medicine | SOM | Tim Elston, PhD  Charles Perou, PhD | NIH | 48 |
| Program in Precision Medicine and Health | SOM | Jonathan Berg, MD, PhD | NIH | Pan-SOM |
| Thurston Arthritis Research Center | SOM | Richard Loeser, MD | NIH/NIAMS | 49 |
| UNC Kidney Center | SOM | Ron Falk, MD | NIH/NIDDK | 42 |

Abbreviations: SOD = School of Dentistry; SOM = School of Medicine; SPH = School of Public Health; UNC = UNC-CH and/or the consolidated university

***Blood Research Center-*** The mission of the Blood Research Center is topromote interdisciplinary research in non-malignant blood disorders across UNC. The center is led by Dr. Nigel Key and includes 20 primary faculty members. The objectives of the center are to promote research that has a primary focus in the (patho)physiology of red or white blood cells, platelets, or circulating proteins, especially those that impact blood coagulation; leverage the outstanding international reputation of UNC in this field to recruit and retain world-class scientists in blood research; and develop new programs in blood research that complement existing strengths and reflect evolving broader needs for hematologic expertise.

***Center for AIDS Research (CFAR) -*** The purpose of the UNC Center for AIDS Research (CFAR) is to provide the multidisciplinary environment and infrastructure to support investigation of the HIV/AIDS epidemic using clinical and behavioral research, HIV biology and pathogenesis at the molecular level, and educational outreach. The UNC CFAR is a consortium of three complementary institutions: UNC-Chapel Hill, Research Triangle Institute, and FHI 360. Eight core facilities/laboratories support researchers. The current membership from the three institutions is over 200 investigators, but over 3x that many researchers receive news of CFAR events, programs and HIV/AIDS-related funding opportunities. Our multidisciplinary structure integrates and spans traditional basic science, translational and behavioral research, through substantial work in population-based research. CFAR inspires new science with investigators making drug and vaccine discoveries, developing new methods for detection of acute HIV infection, helping to define new methods of treatment and care, and making important observations about social forces affecting the spread of HIV.

***Global HIV Prevention and Treatment Clinical Trials Unit-*** The Global HIV Prevention and Treatment Clinical Trials Unit (ACTU) is dedicated to carrying out and developing research on HIV infection and its associated opportunistic infections and providing access to promising clinical protocols to persons living with HIV. This Center, established and continuously funded since 1987, is one of the most productive ACTUs in the nation. Among its areas of focus are antiretroviral therapies, immunomodulators, opportunistic infections, HIV-related malignancies, the wasting syndrome, neurologic complications of HIV, and HIV-related GI illnesses. There five sub-units within the ACTU: The AIDS Clinical Trials Group, The Acute HIV Program, The HIV Prevention Trials Network, The HIV Vaccine Trials Network, and the HIV CURE Center. Patients are enrolled in clinical trials in cooperation with 36 other centers. The Retroviral Research Laboratory is housed in the Department of Laboratory Medicine and Microbiology and Immunology.

***Integrative Program for Biological and Genome Sciences*** - The central research mission of IBGS is the support of research into the mechanisms by which molecules and cells coordinate organism development and function using model systems and genomics approaches. This is accomplished through a unique structure and 24 core faculty which bridge the School of Medicine and the College of Arts and Sciences. IBGS emphasizes the use of experimental systems that combine the power of genetic, biochemical/chemical, and cell biological approaches, including non-mammalian model organisms such as yeasts, flies, worms, frogs, zebrafish, and plants. Discoveries made using model systems have and will continue to provide numerous paradigms of cellular function and tissue and organ development that are important to the etiology and treatment of human disease.

***Institute for Global Health and Infectious Diseases –*** The IGHID seeks to advance the goal of promoting global health research, teaching and service activities. It recognizes that the most pressing health challenges and emerging diseases know no boundaries. As citizens of a globally interconnected world, health problems around the world affect us here at home. The IGHID was established in 2007, an expansion of the UNC Center for Infectious & Sexually Transmitted Diseases. At that time, health affairs faculty were already working successfully in well over 50 countries. The IGHID is a pan-university organization that works to bolster existing global health efforts and complement the globalization of the main campus. With major ongoing efforts in Malawi, China, Nicaragua, and Guatemala, plus the addition of a strong team of obstetrician-gynecologists in Zambia starting in 2012, UNC now boasts the largest global women’s health division. The backbone of the IGHID’s efforts has always been in the area of NIH/AIDS as UNC is home to a top-10 ranked AIDS program. A number of faculty within IGHID have expertise in vector-borne diseases such as Zika infection and Malaria. In December 2011 the research led by IGHID Director, ***Dr. Myron Cohen***, was named scientific “Breakthrough of the Year” by the journal *Science*. The faculty investigators in the IGHID bring in more than $60 million in research revenue.

***Lineberger Comprehensive Cancer Center -*** Established in 1975, this is one of only 49 National Cancer Institute (NCI)-designated Comprehensive Cancer Centers. Under the direction of ***Dr. H. Shelton Earp***, awardee of The University of North Carolina Distinguished Service Award in 2015, LCCC is one of the leading cancer centers in the nation. ***Dr. Angela Smith,*** along with a colleague from University of Washington, received an $8.5M contract to launch a study comparing two different treatments for patience with non-muscle invasive bladder cancer. As a result of the recent recruitment of ***Drs. Gianpietro Dotti and Barbara Savoldo*** and under the direction of ***Dr. Jonathan Serody***, UNC Lineberger’s Clinical Immunotherapy Program currently has eight open clinical trials that are investigating the use of CAR-T immunotherapies. The center brings together some of the most exceptional physicians and scientists in the country to focus on advancing the prevention, early detection and treatment of cancer. Researchers from more than 40 academic departments across campus participate in the center and the center administered $100 million in federal grants in FY19. The center sponsors 10 research programs:

* The five Basic Laboratory Science programs in Cancer Cell Biology, Immunology, Molecular Carcinogenesis, Molecular Therapeutics, and Virology investigate the molecular and genetic basis of carcinogenesis and progression.
* The Clinical Science programs in Clinical Research, Breast Cancer, and Radiobiology and Imaging encompass multidisciplinary translational research, clinical trials, and innovative clinical applications of computer science in radiation oncology.
* The two Public Health Science programs are Cancer Prevention and Control, and Cancer Epidemiology (including Biostatistics).

In addition to these 10 programs, the Center hosts one of the nation's eight Specialized Programs of Research Excellence (SPORE) in breast cancer funded by the National Cancer Institute. With research that spans the spectrum from the laboratory to the bedside to the community, LCCC faculty work to understand the causes of cancer at the genetic and environmental levels, to conduct groundbreaking laboratory research and to translate findings into pioneering and innovative clinical trials. This effort is fueled by collaboration across the population, basic and clinical sciences.

The ***McAllister Heart Institute***’s mission is to solve fundamental questions regarding cardiovascular disease through basic, preclinical and applied research including new tools for diagnosis and treatment. Founded in 2000 and now co-directed by ***Drs. Victoria Bautch and Rick Stouffer***, the Center houses 40 members and administers $16M in funding. Active programs include angiogenesis, atherosclerosis, cardiovascular development, integrative physiology, vascular wall biology, cardiac function, and clinical/translational research. Discoveries made by MHI investigators may provide new diagnostic tools and therapies that can be used to advance the care of patients with diseases of the heart, blood and circulation.

***UNC Gene Therapy Center*** – The School of Medicine created this Center in 1996 with the goal of merging molecular genetics research with healthcare delivery. The Center provides important resources to investigators through its Vector Core, which was created to support basic and preclinical gene therapy studies. Critical expertise was established to develop and produce first generation vectors for pre-clinical studies. The Vector Core is a premier academic center for production of AAV research vectors, many of which were developed by the former Director, ***Dr. R. Jude Samulski***. The core participates in ongoing research of AAV in order to exploit the unique features of this virus to develop an efficient viral vector system for use in human gene therapy. Continued efforts in understanding the mechanism of viral replication and integration for both wild-type and recombinant AAV are being pursued in order to create more efficient gene transfer vectors.

***Marsico Lung Institute*** - This center began as the Cystic Fibrosis/Pulmonary Research Center, which is why it houses one of the largest clinical programs in cystic fibrosis in the country. It still has a strong focus on Cystic Fibrosis (CF) and carries out basic research with a multidisciplinary team focusing on the pathogenesis of and therapy for this genetic disease. With expertise in CF, The Institute houses the CF Clinical Translational Core, The CFTR Functional Analysis Core, the CF Center Tissue Procurement and Cell Culture Core, the Pre-Clinical Core that is designed to provide services to analyze the efficacy of treatments that target different stages of CF, and the Mucus/Mucin Biochemistry and Biophysics Core. The Marsico Lung Institute also contains the Adult Cystic Fibrosis Center, one of the first and largest adult centers in the country. Investigative teams within the Marsico Lung Institute have research emphases including: gene therapy, airway epithelial cell biology, transgenic animals, airway epithelial mucin secretion biology, mediators of inflammation in airway epithelial ion transport, mucociliary clearance, and extracellular nucleotide receptors. The most recent multidisciplinary effort involves clinicians, biomedical investigators, physicists and applied mathematicians working to understand the physical basis of lung clearance. Through mathematical modeling and experimental projects relating to the physics and chemistry of mucus, the group is working to understand the interactions between cilia and mucus, and the role of the airways epithelium in maintaining an environment appropriate for effective clearance, with the goal of eventually being positioned to understand how the system goes wrong. There are currently 75 faculty members in the Marsico Lung Institute.

***Nutrition Obesity Research Center*** – This Center is one of only twelve centers in the country funded by the NIDDK that is specifically designed to provide expertise and support for scientists studying the role of nutrition and obesity in public health. Since its inception in 1999, the center has adapted and translated expertise in community, population-based and clinical studies to facilitate the cross-disciplinary transfer of ideas and information to the laboratory, and vice versa for the development of cutting-edge nutritional sciences and obesity-related research.

The ***Program for Precision Medicine in Health Care*** (PPMH) was established in 2018 under the direction and leadership of Jonathan S. Berg, MD, PhD, to enhance the School of Medicine’s missions in patient care, research, and education by leveraging advances from basic science and technology to improve the diagnosis and management of patients. The program supports evidence-based precision health care interventions including precision screening; precision diagnostics; precision therapeutics; and precision analytics for stratification, decision support, and optimal management. The UNC Health Care System (UNC HCS) committed $10M to initiate the first five years of the program with a focus on implementing precision medicine approaches to improve patient care.

The PPMH collaborates with and coordinate efforts in precision medicine across the School of Medicine and between schools in the wider University, with the primary goal of delivering cutting-edge technology, clinical and research expertise, and data analytics into clinical implementation and translational research projects. High-priority areas of interest include: Working with UNC Health Care’s electronic health record team to enhance the utility and accessibility of genetic/genomic (and other ‘omic’) data for clinicians and researchers; Implementing an adult genomic screening program for a core group of highly actionable conditions; Establishing a precision medicine research cohort and biobank; Providing a clinical genomic analysis and disclosure service for UNC researchers; and Collaborating with North Carolina Translational and Clinical Sciences (NC TraCS) Institute and the health care system’s Enterprise Analytics and Data Sciences group to deploy cutting-edge data analytics and predictive modeling.

The educational component reaches a wide range of learners, including medical students, residents, physicians, and allied health professionals in hospital affiliates across the state.

***Center for Gastrointestinal Biology and Disease (CGIBD)*** – Under the direction of ***Dr. Robert Sandler,*** this center promotes research and teaching on aspects of GI biology, physiology, and epidemiology with special emphasis on inflammatory bowel disease. Members of the center are drawn from the School of Arts and Sciences, the School of Medicine, and the School of Public Health as well as the NC State University's School of Veterinary Medicine. Cores dedicated to development and production of gnotobiotic animals, molecular imaging, advance cell technology and immunotechnology, gene delivery and biostatistics support the broad program in inflammation, proliferation, fibrogenesis and epidemiological/clinical research. There are currently 66 full and associate members of CGIBD

The ***Bowles Center for Alcohol Studies,*** under the direction of ***Dr. Fulton T. Crews*** who received the Marlatt Mentorship Award in 2018 for his work with the center, conducts, coordinates, and promotes basic and clinical research on the causes, prevention and treatment of alcoholism and alcohol abuse. The Bowles Center is one of 14 Alcohol Research Centers supported by the National Institute on Alcohol Abuse and Alcoholism (NIAAA). The Center's research into the causes and mechanisms of addiction provides tomorrow's best hope for improved treatments and, ultimately, finding a reliable cure. Researchers investigate the mechanisms of alcohol tolerance, dependence and withdrawal, as well as damage to the brain, liver, and fetus. Investigators at the Center develop more compounds to be used, alongside standard therapies, to alleviate withdrawal and reduce relapse. The interaction of genetics and environment are studied to better understand the causes of addiction.

***Thurston Arthritis Research Center*** – Under the direction of ***Dr. Richard Loeser,***this Center studies issues relevant to arthritis and other musculoskeletal diseases including autoimmunity. Researchers associated with the center are conducting studies focused on genetics, peptide/MHC structure function relationships, the repertoire of T cell receptor and Ig genes and their role in autoimmunity, inciting agents in autoimmunity (bacterial cell walls, heat-shock proteins, mercury chloride), the biochemistry of osteoarthritis, and studies of inflammation processes and therapy in experimental arthritis, among others. Most recently, researchers have obtained critical new insights into some of the biological mechanisms that cause lupus.

***Carolina Population Center*** - The Carolina Population Center is led by Elizabeth Frankenberg, and for decadeshas served the research and training needs of faculty who wish to conduct population research, both national and international. The Center's elected faculty fellows have primary appointments in a number of Departments and Schools and Colleges across UNC. Faculty, staff, and students in the Center conduct research on population, health, aging, and the environment, and share data and findings that push the field forward and train the next generation of population scholars. Support services provided by the Center include: access to computer networks; information services support including access to an in-house population library collection; support for appropriate research applications using the Geographic Information Systems methodology; statistical consultation; editorial and graphics support for professional publications and presentations; and assistance in preparation of grant proposals.

***Cecil G. Sheps Center for Health Services Research*** - The Sheps Center, directed by **Dr. Mark Holmes**, seeks to understand the problems, issues, and alternatives in the design and delivery of health care services with the goal of improving the health of individuals, families and populations through cutting-edge analysis. The center has an interdisciplinary program of research, consultation, technical assistance and training focused on timely and policy-relevant questions concerning the adequacy, cost, and effectiveness of health care services. Sheps Center principal investigators have faculty appointments in the **UNC School of Medicine** (Family Medicine, Medicine, Geriatric Medicine, Hematology/Oncology, Pediatrics, Psychiatry, and Social Medicine), **Gillings Global School of Public Health** (Health Policy and Management and Maternal and Child Health), **UNC School of Social Work,** **UNC Eshelman School of Pharmacy**, and the **UNC School of Nursing**. The center was one of the early sponsors of research into rural health needs. The center presently holds an AHRQ grant to develop a Center of Excellence on Overcoming Racial Health Disparities in conjunction with NC Central and Shaw Universities. The causes and contributing factors leading to racial inequities in access to health care and health outcomes for prostate cancer, HIV and STD infections, and high blood pressure are studied.

***Center for Environmental Medicine and Lung Biology*** - This long established center integrates multidisciplinary approaches and sophisticated technology to study the effects of inhaled agents on diseased and healthy human subjects following in vivo exposures in environmental chambers. Human cells and cell lines are studied in vitro. The center is led by ***Dr. David B. Peden***. In addition to applied and basic research programs, the Center offers educational and research training opportunities for graduate students and postdoctoral fellows. The Center, which is housed in a dedicated building on the Health Affairs campus (EPA/UNC Human Studies Facility), also facilitates access to the sophisticated animal environmental exposure facilities of the Environmental Toxicology Division of the U.S. Environmental Protection Agency (EPA), located in Research Triangle Park. Twenty-five investigators from several departments in the Schools of Medicine and Public Health have been involved in center activities. Most collaborate closely with EPA scientists in the Human Studies Division, who have adjunct faculty appointments at UNC.

***Carolina Institute for Developmental Disabilities (CIDD) –*** Run by ***Dr. Joseph Piven***, CIDD is a comprehensive program for services, research, and training relevant to individuals with developmental disabilities and their families. CIDD provides a continuum of clinical services from complex, interdisciplinary evaluations on-site to more limited and selected clinical services and training in all 100 counties in North Carolina. The Institute conducts research and research training related to understanding the pathogenesis and treatment of all neurodevelopmental disorders and underlying pathogenetic mechanisms that cause these disorders. Funded in 1967 by a P30 grant from the National Institute of Child Health and Development (NICHD), the CIDD is one of 14 research centers in the U.S. funded to conduct research on mental retardation and developmental disabilities. Funding from the NICHD grant provides support for four research cores that provide cutting edge services to NDRC investigators conducting research relevant to the mission of the center. The Center currently includes over 38 externally funded investigators in research areas ranging from basic developmental neurobiology to translational studies of the pathogenesis and treatment of selected neurodevelopmental disorders such as autism and fragile x syndrome, to basic and applied studies of child development.

***UNC Neuroscience Center*** - The mission of the UNC Neuroscience Center is to promote neuroscience research with a specific emphasis on developmental, cellular, and disease-related processes. The Center is housed in the newest research space on campus in the Mary Ellen Jones Building. Additional neuroscience research groups in both basic (Cell and Molecular Physiology) and clinical (Neurology) departments remain closely associated with the center and in buildings adjacent to the Center. The center researchers are organized into Research Working Teams, each of which includes basic and disease-related interests. The goal is to integrate work in the neuroscience field to advance understanding and to identify and study treatment approaches over a broad group of neurological functions. The Neuroscience Center houses and manages core facilities devoted to advanced neural imaging, bioinformatics, molecular neuroscience, and translational neuroscience. These facilities were established, and are maintained, with support of a center grant from the National Institute of Neurological Disorders and Stroke (NINDS).

***Center for Aging and Health*** *–* The Center for Aging and Healthhosts an interdisciplinary group of professionals. In addition to clinical research, the Program provides protected research time for junior faculty engaged in basic and translational research related to aging. The center is home to the UNC Geriatric Fellowship Program. From providing patient care to finding ways to bring evidence-based research and training to improving clinical care, our faculty, clinicians, researchers, and educators all work to improve the quality of life for our aging population.

***Biomedical Research Imaging Center –*** the Biomedical Research Imaging Center (BRIC) was formed in 2005 to support image-based biomedical research across the UNC System. The BRIC is a statewide resource serving researchers across the state of North Carolina in a central facility that will handle the acquisition, processing, analysis, storage, and retrieval of images. Building on internationally-recognized programs in medical imaging at both Chapel Hill and NC State, the goals of the BRIC are to provide an environment that promotes multi-disciplinary/multi-departmental research interactions that can more effectively address problems in biomedical imaging. The center is located at the Marsico Hall building, one block south of the UNC Hospital building complex and houses a wide array of human and animal imaging equipment. The BRIC supports several core resources including a human imaging core, small animal imaging core, and imaging informatics core.

***Computational Medicine Program*** – is one of UNC’s newest programs which was initiated in 2018-2019. This program builds on UNC expertise in computational medicine by partnering with departments to recruit new faculty,and initiate interdisciplinary team science and collaborative projects. In addition to identifying computational approaches in biological and biomedical research, the Computational Medicine Program provides mentoring for junior faculty, postdoctoral researchers, and graduate students interested in a career in computational biology. Along with research-in-progress seminars and symposia, pilot awards for computational medicine studies are available. The Program is housed in new space in the Mary Ellen Jones Building in the heart of the medial campus.

The **North Carolina Translational and Clinical Sciences Institute (NC TraCS)** is the integrated home of clinical and translational research and education at UNC-CH. NC TraCS provides resources to remove well-documented barriers in the translational continuum, improving speed and efficiency without compromising safety and quality. However, resources are not the only challenge. Accelerating the movement from basic science to public health requires a broad systems perspective, recognizing the complex and bi-directional forces that serve as both barriers and facilitators of translational medicine. We believe the only way to accomplish the fundamental goal “to bring the benefits of science more quickly into patient care” is to develop an integrated academic home. NC TraCS takes a six part approach to accomplishing this goal: (1) create a critical mass of faculty, investigators, academic units and research centers that spans the translational continuum; (2) assemble the full range of research resources with cost-effective access to the most modern equipment and advanced expertise; (3) centralize leadership to support an integrated translational research agenda; (4) commit to collaborate across units and disciplines, moving towards an ethic and practice of team science to solve complicated problems; (5) fully engage with the communities and stakeholders served by translational research to guide our work and assist in dissemination and implementation; and (6) develop and strengthen training programs to prepare and retain the next generation of researchers.NC TraCS offers multiple pilot grants to support research in many forms, as well as multiple resources, services and strategic initiatives such as biomedical informatics services and the Drugs, Devices and Diagnostics Development Strategic Initiative. In order to enhance the clinical research support services offered, NC TraCS offers a Research Coordination and Management Unit, which provides access to professional, experienced study coordinators available to provide as-needed assistance with study tasks or full-scope study management. NC TraCS is under the leadership of ***Dr. John Buse,*** the Verne S. Caviness Distinguished Professor and Chief of the Division of Endocrinology, and Director of the Diabetes Center.

# Core Research Facilities

The University of North Carolina has made a major effort to make easily available the essential core research technologies required by our students and faculty. Recognizing the importance of these facilities to the research enterprise, the School of Medicine established the Office of Research Technologies, which reports to the SOM Vice Dean for Research and monitors the effectiveness of core facilities, in addition to making recommendations for central support and resources for core infrastructure and improvement. The philosophy of each core facility is straightforward. It provides access to the appropriate technology for the entire campus essentially on a first-come, first-served basis. There is a recharge mechanism that recovers a majority of the costs of the facility. Those expenses that are not covered from the recharge mechanism are covered by the administrative units and the School of Medicine from various funds. Additionally, many core facilities have substantial core funding from various Center and Program core grants. Each core facility is directed by a skilled professional (usually a Ph.D.) who is not a tenure-track faculty member, and whose job is to manage the core. These facility managers are a critical resource and they routinely participate in teaching and training students and fellows in the technology, attend appropriate scientific meetings and are often involved in collaborative research with faculty. Cores are generally classified in one of five areas: Animal, Biochemistry, Clinical, Genomics and Imaging. Rigor and reproducibility are vital to the success of the cores and the projects they support. To support the highest standards of research, the cores have developed rigor and reproducibility standards and protocols to guide the core and the end user. Listed below are a number of the long-standing successful core facilities that enrich the research environment of our faculty and trainees.

*Animal Models Cores*

The **Animal Histopathology** facility, directed by Dr. Stephanie Montgomery and Dawud Hilliard, provides histopathology analysis—high-quality processing of fixed tissues into hematoxylin and eosin-stained paraffin slides as well as preparation of frozen tissue sections -- for investigators studying various animal mutants and genetic models. The facility also provides immunocytochemistry, standard histochemistry, and in situ hybridization techniques. It is very common for a “gene knockout” to have unexpected or subtle phenotypes and the typical investigator, student or postdoctoral fellow may not be able to interpret the abnormalities in the animals, especially if the phenotype is expressed in an unexpected tissue. The facility provides consultation as well as technical services allowing interpretation of the experiment. With the increasing use of animal models for studies of gene function, this facility has been invaluable in assisting UNC investigators in analyses of the phenotypes of rodents and will continue to be so in the future. Jointly supported by the UNC Lineberger Comprehensive Cancer Center and the Division of Laboratory Animal Medicine, the Histopathology Core also helps educate inexperienced researchers regarding the appropriate harvesting and fixation of tissues, histopathologic procedures, stains, etc.

The **Animal Metabolism Phenotyping Core** provides contemporary phenotyping techniques for metabolism and energy balance in mouse models of nutrition and disease. The facility offers technical support and expertise for measuring traits related to metabolism in mouse models of obesity and nutritionally relevant diseases. It provides state-of-the-art methods, equipment and populations to support high quality and high throughput phenotyping of energy balance components in mice. Services and technologies include calorimetry, voluntary running wheel, MRI, treadmill, and study design and data interpretation.

The **Animal Models Core** provides mouse and rat genetic modification services, reagents and related technologies. Directed by Dr. Dale Cowley, the facility also develops new approaches to creating genetically

defined mice and has most recently added production, validation and use of CRISPR/Cas9 custom nucleases for production of mutant mice, rats or cell lines. Other services of the Animal Models Facility include BAC recombineering, transgene fragment isolation, targeted ES cells for PCR screen or for Southern, homozygous ES cells, Cre or Flp treatment of ES cells, karyotyping of ES cells, pronuclear microinjection, gene-targeted chimeras, tail DNA purification, PCR screening, Southern blot, embryo cryopreservation, embryo thaw and implant, sperm cryopreservation, in vitro fertilization with implant, and ovary transplant.

The **Animal Studies Core** offers a variety of services under the direction of Faculty Director Dr. Bernard Weissman and Facility Director Charlene Santos. Services include orthotopic injections, tumor passage, injections (s.c., i.p., i.v., i.d., i.m.), aspectic surgery, intra-cardiac injections, animal identification, laboratory coordinator services, tissue/blood collection, colony management, drug dosing/oral gavage, IVIS imaging, and protocol assistance.

The **Animal Surgery Core,** under the direction of Dr. Brian Cooley, provides a variety of established and experiment-specific animal surgical/microsurgical models and non-invasive procedures for a broad range of research applications. The core focuses on murine models, but models from other species can be done through arrangement, with applications from invertebrates to primates. Standard procedures include heart injury models (e.g. LAD ligation/ischemia-reperfusion, transaortic constriction) and echocardiography, vascular repair/grafting/injury models, physiologic recordings (e.g. BP, pressure/volume loops, ECG, pulse-oximetry, laser Doppler tissue perfusion, and vascular flowmetry), many models for thrombosis and hemostasis assays, several types of organ transplantation and/or partial/complete resection, and custom-designed fluorescence imaging applications.

The **Gnotobiotic Mouse Core,** directed by Dr. R. Balfour Sartor, receives support from a National Gnotobiotic Rodent Resource Center P40 grant andmaintains several inbred and outbred strains of germ-free and Gnotobiotic rodents. The core’s mission is to support animal model and basic research projects of UNC investigators to examine physiologic and pathophysiologic differences in germ-free, gnotobiotic, and specific pathogen free colonized mice of various genetic backgrounds. Investigators can precisely manipulate the microbiota by selectively colonizing germ-free rodents with single or multiple commensal or pathogenic bacterial or fungal species, using isogenic wild type or genetically engineered bacterial strains. Such studies help to define the physiologic and pathophysiologic relevance of bacterial genes. Mice and rats can be purchased and shipped to investigators or experiments can be carried out in the facility.

The **Histology Research Core Facility** provides structural and quantitative histology data for mouse/animal models. The facility has the equipment and expertise to produce reliable, high-quality sections from fixed and unfixed tissues, frozen and paraffin-embedded tissues. The staff also provides a unique serial interrupted sectioning technique that allows analysis of the full length of 4mm vessels or tissues, collected on multiple slides with each slide containg serial sections representing a specific distance through the full length of that tissue. Special stains and immunohistochemical assays are routinely performed in the facility. The Histology Research Core just received a grant to acquire the training and equipment to perform *in situ* hybridization using RNASCope and BaseScope technology that will be available in the Fall of 2018. The Faculty Advisory to the core is Dr. Kathleen Caron, Chair of Cell Biology & Physiology. The Core Director is Ashley Ezzell.

The **Human Pluripotent Stem Cell Core Facility** is under the direction of Dr. Adriana Beltran. The purpose of the core is to provide UNC scientists and outside collaborators with the services to successfully conduct basic as well as translation research using human embryonic stem cells and human induced pluripotent stem cells. The ability to generate induced pluripotent stem (iPS) cells represents a unique and very important source of cells for individualized therapy. Because these cells are derived from a patient’s own cells, the problems associated with tissue rejection are eliminated. The iPS cells generated from patients with various diseases are an important research resource to study how these diseases develop. This core also offers cell derivation and characterization services, such as the generation of hiPS cells using integration-free methods, and genome editing services including CRISPR-mediated point mutation introduction and/or repair to create isogenic cell lines. Also available to investigators are the federally approved human embryonic stem (hES) cell lines that the core can expand using the latest protocols in the field.

The **Mammalian Genotyping Core** is a high-throughput facility. Its primary goal is to assist researchers in elucidating genetic components of complex diseases. Two genotyping platforms offer flexibility to type a wide range of SNPs, from 1 to 1,000 at a time. The core uses industry-leading Illumina BeadArray and Infinium microarray assay technologies, for SNP Genotyping, copy number variant, loss of heterozygosity insertions-deletions, structural variant, and DNA methylation analysis The facility services both human and mouse analyses.

The **Mouse Behavioral Phenotyping Laboratory**, directed by Dr. Sheryl Moy, provides investigators with a wide variety of mouse behavioral tasks for studies in genetic, environmental, and pharmacological models of human disorders; and for pre-clinical efficacy testing of novel therapeutic agents. The core includes a state-of-the-art laboratory for the measurement of mouse phenotypes, and offers training and consultation regarding the utilization of rodent models. Available testing includes a standardized battery for measures of general health, home cage behavior, and neurological reflexes. Sensory abilities and motor functions are evaluated with a sequence of simple tasks. Multiple tests regimens include a standardized battery for measures of general health and neurological reflexes, procedures for sensory and motor abilities, and evaluations of social interaction, sensorimotor gating, cognitive function, and abnormal repetitive behavior. The core can also determine behavioral profiles in neonatal mouse pups.

The **Mutant Mouse Regional Resource Center** distributes and cryopreserves scientifically valuable, genetically engineered mouse strains and mouse ES cell lines with potential value for the genetics and biomedical research community. It is part of a national network of breeding and distribution facilities plus an information coordinating center serving together as NIH's premier repository of spontaneous and induced mutant mouse and cell lines.

The **Systems Genetics Core** in the School of Medicine provides Collaborative Cross (CC) mice and genotypes to investigators at UNC and around the world. The CC is a unique reference population for mapping multigenic traits free of population structure. This mouse resource is comprised of a diverse panel of recombinant-inbred lines generated by randomizing the genetic diversity of existing inbred mouse resources utilizing eight founders strains. Many labs around the world are using the resource for the genetic analysis of complex traits modeling a number of human disease states.

The **Zebrafish Aquaculture Core Facility** provides resources for UNC investigators to use zebrafish as a model organism. Services offered include stock maintenance, quarantine facility, embryo production, microinjections (morpholino and mis-expression), transgenesis, and phenotypic evaluation. In 2015, the facility acquired new equipment from Tecniplast, including a ZEBTECH housing system, Tritone automated feeders, iSpawn high density synchronized embryo collected, 650A Tank washer, and a Genotyping rack system. A new Tecniplast RAS that is twice the size of the 2015 system is scheduled for installation in Summer 2020 to accommodate the growth in zebrafish research on campus.

*Biochemistry and Structural Biology Cores*

The **High-Throughput Peptide Synthesis and Array Facility** in the School of Medicine provides researchers with high quality services for synthesis, purification and characterization of synthetic peptides and preparation of custom designed peptide arrays. It specializes in synthesis of multiply modified peptides containing PTMs, unnatural amino acids, and fluorescent tags. Research applications include synthetic peptides containing standard, post-translationally modified (e.g., acetylation, methylation, phosphorylation) and/or unnatural/nonstandard amino acids and fluorescent tags (e.g., 6-Cl-Trp, FAM-, TAMRA-) that can be synthesized for a wide range of biological and biophysical applications, including FP, ITC, NMR, X-ray crystallography, mass spectrometry (with or without stable isotopes such as 2H, 13C, 15N), enzyme inhibition/competition assays, protein-protein interaction studies, cell permeable peptide reagents, antigen/antibody production including synthesis of Multiple Antigenic Peptides (MAPs), and high density peptide arrays.

The UNC **Macromolecular X-ray Crystallography Facility** directed by Dr. Nathan Nicely, provides resources and training to UNC macromolecular crystallographers for single crystal data collection and processing. They facilitate and assist UNC researchers not trained in X-ray crystallography in carrying out simple crystallographic analyses (including crystallization) of their biological molecule. Equipment includes crystallization robots; Rigaku Micromax 007HF x-ray generator (Cu anode, 4.54a wavelength); Left Port: Rigaku Saturn 944+ CCD with ACTOR sample changing robot, AFC-11 experimental station, VariMAX HF optic, X-STREAM2 cryostat; Right Port: R-Axis IV++ detector, VariMAX HR optic, inverted Phi goniostat and X-STREAM2 cryostat. UNC is a member of the **SER-CAT,** which operates 2 beamlines (22ID and 220BM) located in the advanced photon source at Argonne National Labs. This facility manages access to and charges for the beamlines. The **Protein Expression and Purification Core** is under the same direction and specializes in the production of pure, functional proteins for structural, biophysical, and biochemical studies. It is specifically designed as a “front-end” interface to other components of the Center for Structural Biology. Three categories of service are offered: 1) Protein Expression, 2) Protein Purification and 3) Scientific Consultation, Mentoring and Training.

The **Macromolecular Interactions Facility** (Mac-In-Fac) provides instrumentation and resources for biophysical characterization of interactions of biological macromolecules. The capabilities include measurement of affinity, stoichiometry, kinetics and thermodynamics of interactions among proteins, DNA and their cognate ligands. Resources exist for analyzing the biophysical characteristics of molecular weight, shape, and conformations of proteins and DNA; and for exploring bimolecular interactions in real-time. The facility is directed by Dr. Ashutosh Tripathy, who assists investigators in the design and performance of experiments and interpretation of the results. Often the students (and faculty) do not have the appropriate biophysical background to easily develop these analyses themselves and thus the facility has been broadly useful to a large number of research groups. The students are trained to use the instrumentation and the Director regularly gives presentations to interested groups explaining the types of problems applicable for investigation using the instrumentation in the facility. Equipment available in the Macromolecular Interactions Facility includes a Biacore 2000, 3 Beckman Analytical Centrifuges (XL-I, XXL-F and XL-A), SLM-Aminco 8100 Fluorimeter, Microcal VP-ITC Isothermal Titration Calorimeter, Microcal VP-DSC Differential Scanning Calorimeter, Applied Photophysics and AVIV CD Spectropolarimeters, and Wyatt Multi-angle Light Scattering Equipment

The **Michael Hooker** **Proteomics & Mass Spectrometry** **Facility** under the direction of Dr. Laura Herring and faculty director Dr. Lee Gravesprovides UNC with a state-of-the-art facility to identify proteins and to assist in the characterization of protein modification and differential expression. The core serves the greater university community by providing a resource for training, education, and consultation in modern proteomic techniques. Services include protein Identification (identification of separated proteins and identification of proteins in 1 and 2-D gels), protein characterization (molecular weight, and characterization of posttranslational modifications such as phosphorylation and glycosylation) and protein quantitation (differential gel electrophoresis using cy-dyes and 2D-PAGE). Equipment includes three state-of-the-art systems: a Sciex 5800 MALDI-TOF/TOF, a Thermo Easy nLC 1200-QExactive HF, and a Waters nanoAcquity-Thermo LTQ-Orbitrap Velos.

The **UNC Biomolecular NMR Facility** directed by Dr. Stuart Parnham, PhD was created to support research into the structure and dynamics of biological molecules. The Lab offers a variety of services to academic and industrial users. The lab manager trains new users, consults with prospective users to determine whether NMR will be useful in their research, and helps users design an experimental plan to obtain the information they need. In 2015 the Lab moved into a new building and acquired a Bruker Avance II 850 four channel spectrometer to augment the Inova 700, 600, and 500 MHz Spectrometers.

## Clinical Cores

**Biospecimen Processing Facility (BSP)** provides a centralized facility to process biospecimens from population, clinical and other studies. While there is an emphasis on DNA isolation, the facility also provides blood product separation and other specimen processing. In addition to laboratory services, the facility provides a scientific resource for investigators seeking advice on study design including specimen collection and storage methods. Additionally, the facility is facilitating the establishment of a UNC-wide DNA Bank.

**Biobehavioral Lab** was initiated in 1989 as part of the research infrastructure for the School of Nursing. The term Biobehavioral refers to the interface of biological and psychosocial factors that underlie individual responses to acute and chronic illness. The BBL has expanded its mission to enhance knowledge and skills in Biobehavioral science, physiological measurement and instrumentation, with an emphasis on non-invasive monitoring and use of portable instruments. Equipment is capable of monitoring physiologic parameters such as electrical brain activity, cardiac output, oxygenation, body composition and heart rate responses. The laboratory facility supports **on-site sleep research and** has been expanded to include a **nutritional research** and **behavioral observation suite**. Under the direction of Dr. Patricia Silveyra, the facility is committed to assisting and promoting faculty and graduate student efforts in the use of Biobehavioral measures and psychological parameters in their research.

The **Interdisciplinary Human Movement Science Lab** in the Center for Human Movement Science in the School of Medicine strives to understand the neurophysiological and biomechanical causes of altered muscle function and movement patterns for individuals who have had a stroke. To meet its goal of improving functional mobility (primarily walking) in people who have had a stroke, the lab develops and assesses the effects of novel walking rehabilitation strategies in individuals with a variety of pathologies. The lab has an 8 camera Vicon MX40+ motion capture system, Bertec dual-belt instrumented treadmill, Motion Lab Systems 16-channel EMG system, GaitRite mat, Cybex Norm, custom-designed projection and head-mount immersive virtual environment and dynamic body weight support system.

The **Nutritional Biochemistry and Molecular Biology Core** in the Gillings School of Global Public Health encourages and facilitates application of molecular biology and biochemistry tools in nutritional research. Molecular biology services include DNA and RNA isolation and purification, Western blot, *in situ* hybridization, RT- PCR *in situ* hybridization, probe preparation, RT-PCR, PCR. Other assays provided are serum and plasma separation, lymphocyte isolation, virus isolation, and protein estimation by the BCA method. The facility is located in laboratory space (approximately 900 sf.) in the Michael Hooker Research Building. This site is used for training in molecular biology and for the majority of the biochemical assays.

The **Tissue Procurement Facility (TPF)** in the School of Medicine works in conjunction with the Biospecimen Processing Facility to provide issue procurement from UNC Hospitals and Rex HealthCare Hospital: This includes general procurement and specific investigator-directed procurement of fresh, frozen tissue in OCT or RNALater, formalin-fixed paraffin embedded malignant and non-malignant tissue (including tumor tissue and adjacent or distant non-tumor tissue from the same surgery, when possible) from consenting adult patients.

* Blood procurement and processing: Collection and preparation of blood components from peripheral human blood (plasma, serum, buffy coat and packed red blood cells). Serum, matched to malignant and normal tissues, is now routinely collected at UNCH as part of our general tissue procurement activity for proteomic applications. In addition, hematology samples from peripheral blood and bone marrow are banked as cryopreserved cells and cell pellet. Cheek swabs are collected for future DNA isolation.
* Quality assurance/histopathologic review: Preparation of quality control sections from each specimen and evaluation by the facility pathologist to ensure that appropriate and representative diagnostic tissue is procured. Confirmation of morphology of all tissues banked prior to distribution to any researcher to ensure representative tissue is used in research.
* Support of oncology clinical trials: Specimen collection, handling and processing of tissues, blood, other fluids in support of institutional and national clinical trials, coordinated in collaboration with the UNC LCCC Clinical Protocol Office and the PI of the protocol. This service includes banking and shipping to appropriate researchers, clinical trials groups.
* Other biospecimen collection and banking: In addition to tissues and blood specimens, the facility collects, processes, banks and distributes other biospecimens, such as toenails, fat biopsies, urine, other fluids, largely in support of population-based studies. The facility maintains inventory and surveillance of these study-specific specimen collections.
* Tissue sectioning: For paraffin blocks that are processed by the facility and those archived in Surgical Pathology, the facility interacts with the Translational Core Facility (below) to provide tissue sectioning for thick and thin sections for multiple applications (IHC, FISH, molecular assays, LCM, tissue microarrays).
* Nucleic acid isolation: DNA/RNA is isolated from snap frozen tissue or cheek swabs upon requests from the PI. Samples are quantified by Nanodrop spectrometry.
* Database management and tissue bank searches: The facility manages the bank of tissue and blood for general use and also provides this as a service for individual projects with restricted-use specimen collections. Facility personnel perform searches to determine feasibility and logistical needs for investigators developing pilot studies, hypothesis generating, preliminary data collection, as well as methods development and optimization purposes.

The **Translational Pathology Laboratory (TPL)** in the School of Medicine is a core facility jointly sponsored by the Lineberger Comprehensive Cancer Center (LCCC), the Department of Pathology and Laboratory Medicine (DPLM) and the Center for Environmental Health Sciences (CEHS). It is managed by LCCC and DPLM personnel and offers support to all UNC investigators to enhance translational research. The TPL is designed to meet the needs of basic, clinical and population scientists who require analysis of human tissues. The missions of the Translational Pathology Core are:

* To provide UNC investigators access to annotated formalin-fixed, paraffin-embedded (FFPE) human tissues from the UNC Hospitals surgical pathology archive
* To provide histopathology, tissue microarray (TMA) and cell line microarray (CLA) design and construction, slide staining and morphological evaluation services
* To provide morphological assay development and training services
* To provide archived human FFPE tissue samples for subsequent purification of molecular analytes (DNA, RNA)
* To develop digital image analysis technologies for spatial quantification of molecular analytes in intact tissue sections
* To develop informatics infrastructure, in collaboration with the Bioinformatics Core Facility, for pathology bio-banking, digital imaging and image analysis in order to facilitate integration of data derived from genomics, proteomics, and tissue-based analyses
* To collaborate with the Tissue Procurement (TPF) and Biospecimens (BSP) and Animal Histopathology Cores to enhance services and informatic approaches to tissue-based research.

The core is the only centralized facility on campus providing new generation instrumentation to qualitatively and quantitatively analyze fresh, frozen and formalin-fixed paraffin embedded tissues and cell lines using morphology-based assays of DNA, RNA and proteins with fluorescent *in situ* hybridization (FISH), *in situ* hybridization (ISH) and immunohistochemistry (IHC)/immunofluorescence (IF), respectively.

## Genomics Cores

Under the direction of Dr. Scott Magness*,* the **Advanced Analytics Core** provides high-quality and quantitative solutions for studying proteins and nucleic acids at the bulk or single-cell level. Additionally, the Advanced Analytics Core offers a high-throughput real-time qPCR services on its Fluidigm BioMark HD system which allows analysis of up to 96 samples for up to 96 genes from cDNA generated from bulk cell preparations or single-cells. There are also two platforms available for single-cell RNA sequencing (the Fluidigm C1 and Biorad/Illumina ddSEQ). The Advanced Analytics Core also has an immunotechnologies component, which provides consultation, order, and assay service and support for many commercially available kits in both traditional ELISA/EIA and bead-based multiplex formats.

The **High Throughput Sequencing Facility,** under the supervision ofDr. Piotr Mieczkowski***,*** was established in 2008 in reaction to fast developing sequencing technology that is currently in high research demand. Deep sequencing technology allows performing applications like *de novo* genome sequencing, genomes re-sequencing, chip-seq, cDNA sequencing, digital expression and microRNA. HTSF gives UNC researchers an access to this edge-cutting technology by delivering to them about 200 million sequences of 36 nucleotides per week. This result is obtained primarily on 6 Illumina GAII sequencers, and supported by long reads sequencing using a Roche Genome Sequencer FLX 454. The facility stays responsive for any updates of the technology the market offers, and plans for constant growth to assure delivery of top quality data. Data produced by Illumina and Roche instruments are processed and returned to end users by the UNC Bioinformatics Center. In order to continue providing cutting edge technologies to investigators at UNC, HTSF now offers a NovaSeq 6000 Sequencing System, currently the most powerful Illumina sequencing platform, and the Bionano Genomics Saphyr System.

The **UNC Microbiome Core Facility** was established in 2008 under the direction of Dr. Andrea Azcarate to provide the research community with the expertise to characterize complex microbial communities in a variety of environments. Instruments include Qiagen BioRobot Universal System, Genetix QPix2 XT Colony Picker System, Applied Biosystems Real-Time PCR System, QuantStudio3D Digital PCR System, Roche Genome Sequencer FLX System and Ion Torren Personal Genome Machine. Services include library preparation, clone library creation and barcoding; RNA, small RNA and mRNA sequencing; and large-scale, real-time qPCR analysis.

The **Functional Genomics Core** is a heavily used facility serving the entire research campus at UNC. Currently this core provides the only Affymetrix platform on the UNC-Chapel Hill campus. Expression profiling with Affymetrix arrays allows investigators to study the expression pattern of an entire genome at one time. This powerful tool enables researchers to study everything from transcriptional changes during development to disease progression. In addition to continued usage of expression arrays, this facility has seen a dramatic increase in the number of single nucleotide polymorphism (SNP) mapping arrays being used. These arrays have many uses including identifying specific mutations in the population that track with a particular disease or the differential effects of a particular drug on a patient population. The facility houses Beckman Coulter’s Biomek® FXP Target Prep Express robot and the GeneTitan Instrument from Affymetrix which allows the processing of hundreds of microarray samples in a week, and processing of high throughput expression peg arrays and Axiom genotyping high throughput peg arrays. In addition, the Affymetrix GeneChip® Scanner 3000 7G Plus Targeted Genotyping System in the core provides the ability to scan all research arrays manufactured by Affymetrix including the high density expression arrays which place an entire genome on one GeneChip®. This equipment suite includes 2 Fluidics Station 450s and the GeneChip® Hybidization Oven 640.

The **Vector Core** was created to ensure that investigators would have promising gene vectors available in the quality and quantities needed for preclinical studies. Research in the laboratory has centered on the molecular biology of adeno-associated virus (AAV) in order to exploit the unique features of this virus to develop an efficient viral vector system for use in human gene therapy. The Vector Core has recently developed a suspension cell based production platform that utilizes serum-free media to increase efficiency and purity. In addition to keeping a collection of AAV vectors in stock, the core also offers custom vector production. Continued efforts in understanding the mechanism of viral replication and integration for both wild-type and recombinant AAV and Adenovirus vectors are being pursued in order to create more efficient gene transfer vectors.

The **Vironomics Core** in the School of Medicine has a main research focus of understanding viral tumorigenesis, especially that associated with Kaposi's Sarcoma Herpesvirus (KSHV). Expertise is provided in whole genome sequencing (WGS), de novo assembly, STR cell line verification, targeted amplicon sequencing, plasmid verification, strand-specific RNAseq, and exome sequencing. The core offers RT qPCR arrays that include anywhere from 5 to 768 primer-pairs per assay and include: KSHV, EBV, HCMV, HSV-1, HSV-2, RRV, Viral Load, microRNA, NFkappaB, and P53response. The Vironomics Core facilitates research needs for long-read length next generation sequencing using the Ion GeneStudio S5 Prime System, and

companion Ion Torrent Chef.

## Imaging Cores

The **Analytical and Nanofabrication Laboratory** in the Institute for Advanced Materials, Nanoscience and Technology operates as a shared instrumentation laboratory open to UNC researchers from all departments as well as to researchers from other universities, government labs and industry. The lab (1) provides cost-effective access to analytical and nanofabrication instrumentation that would not otherwise be available in individual research labs, (2) provides expertise and technical resources to assist researchers in designing experimental plans, acquiring appropriate data and interpreting data, (3) promotes education by working closely with students and postdocs to provide instrument training and hands on experience and (4) fosters an environment of collaborative research that extends beyond departmental boundaries. Equipment includes an electron beam evaporator, a deep reactive ion etcher, an atomic layer deposition, a plasma enhanced chemical vapor deposition system, a magnetron sputtering system, an electron beam evaporator, a mask aligner, a hot embosser, instrumentation for laster ablation, a pulsed laser deposition system, a profiling system, a thin-film mapper, an oxygen plasma system, an atmospheric oven, and an optical microscope..

The **Neuroscience** **Microscopy Core** makes available a series of confocal instruments: the Olympus FV3000RS, Zeiss LSM 780, Zeiss LSM 710 as well as a Zeiss LSM 7MP multiphoton microscope, and series of widefield microscopes including an Olympus MVX10 and Nikon Eclipse Ti2. This facility is hosted by the Neuroscience Center and is available for use by members of the neuroscience and research communities at the University of North Carolina. The facility, directed by Dr. Michelle Itano, provides a full spectrum of advanced systems for cellular and molecular imaging of in vitro and in vivo samples. It also implements new imaging technologies related to real time and tissue clearing based imaging of neurodevelopment and neural functions, provides training, consultation, data analysis, image processing, and centralized technical expertise. Dr. Itano is a recent recipient of the Chan-Zuckerberg Imaging Scientist Award that supports her work developing new tools and increasing interactions between biologists and technologists to advance the applications of imaging.

The **Microscopy Services Laboratory**, directed by Dr. Pablo Ariel, is a core facility whose mission is to help scientists with their research when it involves light microscopy, electron microscopy and image analysis, providing assistance and training in all three areas, and extensive sample preparation services for electron microscopy. MSL functions as a cost recovery center and is open to all researchers. State-of-the-art equipment in the facility includes widefield epifluorescence and transmitted light microscopes, laser scanning confocals, a light-sheet microscope, a transmission electron microscope, a scanning electron microscope, and a high-end analysis workstation. MSL advises researchers on which instruments will most advance their research, trains them on the relevant equipment and provides continued assistance. MSL staff have decades of combined experience in light microscopy, electron microscopy, and image analysis.

The **Hooker Imaging Core** provides users access to advanced light microscopy, digital image acquisition and image processing capabilities under the co-direction of Dr. Jerry Gordon and Robert Currin***.*** Users receive thorough instruction on how to setup and use the required instrumentation with emphasis targeted to the specific requirements of their experiment. Careful attention is also paid on how to optimally obtain accurate data. The newest acquisition is the Zeiss 880 confocal microscope. Other instruments include: Olympus FV100 confocal, Zeiss LSM 510 Meta Confocal, Nikon 2000E inverted widefield microscope and Leica MZ16FA fluorescence stero macroscope.

The **Flow Cytometry Facility** at UNC-CH exists to provide biomedical investigators with all aspects of research flow cytometry -- analytical and high speed sorting instrumentation, data analysis, and expertise. The Facility instrumentation has been obtained with funds primarily from the North Carolina Biotechnology Center, NIH, the School of Medicine, the Lineberger Comprehensive Cancer Center, the Department of Microbiology and Immunology, the Gene Therapy Center, the Center for Gastrointestinal Biology and Disease, and the Thurston Arthritis Research Center. Operating support is provided by The Lineberger Comprehensive Cancer Center and The Department of Microbiology and Immunology. The Facility supplies access to flow cytometry instrumentation either in an investigator-operated format or Facility staff-operated format. Training to become competent in design of flow cytometry experiments, in operation of certain of the equipment, and in data analysis and interpretation is an essential component of the Core’s goals. Equipment includes a 2 Becton-Dickinson FACScans, a FACSCalibur, a Cytomation MoFlo, LSR II, LSR Fortessa a Laser Scanning Cytometer (LSC), an Intelligent Imaging Innovations Digital Deconvolution Microscope, and PC and Mac off-line data analysis computers with a variety of flow cytometry data analysis software. The Facility recently acquired a Fluidigm Helios CyTOF Mass cytometer which offers high parameter data acquisition. The FACScan and FACSCalibur instruments are available to be run by the user, following appropriate training. This core has also recently purchased a Reflection from iCyt Visionary Bioscience that will be devoted to use with human cells, expanding our translational capabilities. This April (2015) the core received an NIH SIG to purchase an ImageStreamX Mark II.

The CyTOF Core, directed by Marie Iannone, provides UNC researchers with Fluidigm Helios CyTOF system. The Cy-TOF is a powerful new technology that uses flow cytometry coupled with mass spectrometry to enable high-throughput single-cell quantitative proteomics. 135 different detection channels allow investigators to use antibody panels that can quantify more than 40 proteins per cell in a single experiment. Because of the flow component, more than 10,000 cells may be evaluated in a given sample and experiments of multiple samples may be run from 96-well plates. As the cells are vaporized during the process, this approach can be used to characterize both surface and intracellular proteins. Because of the ability for high level discrimination using a small number of samples, the technology is particularly beneficial for the analysis of human immune cells in different disease and treatment conditions. The core will be housed adjacent to the Flow Cytometry Core in Marsico Hall and the equipment is expected to be available in early summer 2018.

The UNC **CryoEM Core Facility** was established in 2019 and provides researchers access and technical assistance with all aspects of cryoEM including consultation, specimen preparation, and training on use of the Talos Arctica transmission electon microscope for screening and high resolution data collection for single-particle cryoEM. UNC is also a founding member of the **Molecular Microscopy Consortium** (MMC), a partnership between the cryoEM resources at UNC, Duke and NIEHS which to increase access to cryoEM technologies and expertise to researchers at these institutions.

*Bioinformatics*

The **Center for Bioinformatics** provides assistance to students and faculty in dealing with the immense influx of new information coming from the genome projects. Dr. Hemant Kelkar is the Core director and helps promote the use of computational tools for molecular biology, genetics, protein chemistry, and biochemistry research at the University of North Carolina. The center instructs in-depth workshops on topics ranging from DNA, RNA and protein sequence analysis to database searching, genomic predictions and molecular modeling. The center also contributes to selecting and providing computational programs, through Academic Technologies and Networks (ATN), such as GCG, SYBYL and Insight II/Discover. As a bioinformatics analysis resource, the UNC-CH Center for BioInformatics also provides expert analysis on database searching, phylogenetics, protein structure prediction, sequence analysis and molecular modeling. Dr. Brenda Temple directs the **R.L. Juliano Structural Bioinformatics Core** where she assists students in molecular graphics for analysis of structures of proteins, and in “threading” techniques for deducing the structure of protein based on known structural homologues. Hemant and Brenda serve as liaisons to the central computing facility at UNC Hill, and are responsible for maintaining a large set of program licenses that are available to all UNC investigators. These facilities have been invaluable to researchers in accessing the vast amount of data now available.

The **Bioinformatics and Analytics Research Collaborative (BARC),** is a new core established in 2019 under the leadership of Dr. Corbin Jones. BARC provides consultations, bioinformatics analysis, data analysis, application development, image analysis and training services to support the growing bioinformatics needs of researchers in the School of Medicine. BARC also helps connect the numerous bioinformatics resources across the university. Overall, the BARC provides extensive and cost-effective bioinformatics expertise.

# Renovation/Construction of Laboratory Space

A major new building and renovation program is continuing in the School of Medicine. During the past 15 years, we have opened a new Genetics Medicine Building, new Neuroscience Research Building, new Medical Biomolecular Research Building, new Bioinformatics (office) Building, new Physicians Office Building (office), renovated Taylor Hall (research) and Bondurant Hall (offices and classrooms) and provided more than $1 million for renovation of the Department of Biochemistry laboratories. When added to the construction program underway for the UNC Health Care System, the combined facilities available for research and clinical studies as shown in the attached table has dramatically increased capacity and state-of-the-art technology for UNC researchers. The School of Medicine completed construction on Marsico Hall, that provides 10 floors of new research space, for groups including the Biomedical Research Imaging Center (BRIC), Microbiology and Immunology, the Marsico Lung Institute, and Cancer Immunology and Immunotherapy. The College of Arts and Sciences built the Genomic Science Laboratory Building, 210,000 sq ft of laboratory and office space. It opened in 2012 and houses many non-SOM faculty working on biomedical research. Most recently, the total reconstruction of the Mary Ellen Jones Building, which opened in March 2019, houses Children’s Research Institute (floors 3, 4, and 5), Neurosciences Center, Hemophilia and Thrombosis Center (8th floor) the Department of Biomedical Engineering (floors 9 and 10), and the Computational Medicine Program (11th floor). The building provides substantial shared conference room and collaboration spaces and a vivarium. Design and construction for two additional buildings, the SOM Medical Education Building (Medical Education and Administration) and a Translational Research Building (vivarium expansion and large animal studies), which provide critical new space for SOM research and education.

## School of Medicine Construction Programs

|  |  |  |  |
| --- | --- | --- | --- |
| **Project** | **Sq. Footage** | **Completion** | **Cost** |
| Bioinformatics Building | 153,000 | 2002 | $ 33 M |
| Medical Biomolecular Research | 229,000 | 2003 | $ 65 M |
| Community Health Bldg | 40,000 | 2005 | $ 18 M |
| Glaxo/MBRL Bldg | 26,500 | 2004 | $ 1.8 M |
| Med Science Research Bldg | 82,000 | 2005 | $ 12.9 M |
| Burnett-Womack Bldg | 171,000 | 2005 | $ 25 M |
| Bondurant Hall | 82,000 | 2007 | $ 12.9 M |
| Genetic Medicine Research | 220,000 | 2008 | $ 65 M |
| Marsico Hall | 342,000 | 2014 | $240M |
| Mary Ellen Jones Building | 221,000 | 2019 | $117 M |
| Medical Education Building | 145,000 | 2022 | $90 M |
| Translational Research Building | 160,000 | 2023 | $148 M |

# Animal Research Resources

The animal care and use program at the University of North Carolina School of Medicine is centered in the Division of Comparative Medicine (DCM), which houses animals in sixteen separate buildings on the Chapel Hill campus. The Division's program is reviewed semi-annually by the Institutional Animal Care and Use Committee, and has been accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care International (AAALAC) since 1973. DCM and the University also meet U. S. Department of Agriculture and Public Health Service standards and regulations. A major responsibility of the Division's eleven veterinarians, eleven veterinary technicians and two laboratory technicians is the health care and humane use of all animals. As laboratory animal specialists they provide a comprehensive program of veterinary care, offer technical advice and assistance, and provide needed laboratory and pathology services for diagnostic and research purposes. A support staff includes 175 animal husbandry personnel. All orders for research animals from vendors or other institutions must be arranged through DCM. The Institutional Animal Care and Use Committee (IACUC) oversees the University’s animal care and use program and is responsible for reviewing all animal care applications using vertebrate animals, ensuring compliance with federal animal welfare regulations, inspecting animal facilities and investigator laboratories, investigating animal concerns, and overseeing training and educational programs. Additionally, UNC is building a new Translational Research Building (TRB) that will consolidate approximately 100,000 square feet of vivarium and include about 40,000 square feet of space to allow for additional research growth. The TRB will replace multiple older facilities, and will support UNC’s initiatives to be amongst the top biomedical academic research institutions.

# Computing Resources

***UNC-Chapel Hill*** - The University offers a full range of extensive computing resources through Information Technology Services (ITS), including: Application Development and Support, Communication and Collaboration, Community-Hosted Services, Customer Support and Engagement, Enterprise Information Security, Identity and Access Management, Infrastructure Services (including 10 Gigbit network backbone, virtual server infrastructure, and enterprise storage), Learning Management, Production Services, Research Computing, Software Acquisition, Training, and Enterprise Content Management.

**ITS Research Computing** - provides a world-class computing infrastructure and tools to support the research needs of the UNC members. As part of this goal, the ITS Research Computing provides a number of cutting-edge resources, such as two Linus-based computing systems (Longleaf Cluster and Dogwood Cluster), a Virtual Computing Lab, a Secure Research Workspace that is specifically designed for the management of and interaction with high-risk data. ITS Research Computing also provides the Xsede (Extreme Science and Engineering Discovery Environment) Campus Champions program: a national partnership of computational centers which provides UNC access to large national compute, visualization and I/O intensive resources and allows testing and preliminary exploration of projects.

***School of Medicine Computing* -** The Office of Information Systems (OIS), a division of Medical School Administration, provides centralized computer services and information systems resources for the entire School of Medicine community, from medical students to faculty to administrative staff. Services provided by OIS include: central network and server infrastructure support, applications support for administrative and clinical applications, applications development, helpdesk support, Information Security, resources supporting research activities, support for departmental Local Area Networks (LANs) and network access to resources available on campus and the Internet. OIS also provides extensive web/graphics development and support, including design and development of the primary School of Medicine web site (www.med.unc.edu) and development of numerous web-based database projects. Other services include a variety of digital media services including video conferencing, support of classroom video systems, still digital photography and video recording, production and editing.

***Personal Computing*** – Wireless network access is available in many common areas throughout the school and dataports are available in all laboratories.

# Other Didactic Resources

**The UNC Library system** comprises nearly three dozen libraries, including the Walter Royal Davis Library, which is the main Academic Affairs library, the House Undergraduate Library, and the Health Sciences Library, which is the main Health Affairs library. Campus libraries have more than three hundred staff, and the library’s combined holdings exceed 5,000,000 volumes, 4,000,000 microforms, 2,000,000 printed government publications, 16,000,000 manuscripts, hundreds of thousands of audiovisuals, maps and photographs, and thousands of electronic titles. In scope, campus libraries cover most areas of the fine arts, biomedical and physical sciences, humanities, law, and social sciences.

The **UNC Health Sciences Library (HSL)**, part of the UNC Library system, is the primary library for the University’s schools of dentistry, medicine, nursing, pharmacy, and public health. It also serves the UNC Medical Center and the North Carolina Area Health Education Center. It is considered to be among the best medical school libraries in the United States and Canada. The HSL workforce includes more than 55 FTE, annual budget and expenditures of approximately $8 million, as well as planning and policy formulation around collection development programs, facilities, infrastructure, technology innovation, cooperative activities, and outreach to the five Health Affairs schools and the hospital. The six-story building has seating capacity for 716 users. The HSL has a total of 333,493 volumes, 4,116 periodicals, and 1,442 electronic resources. The number of electronic resources held has doubled since the 1997-98 academic year. A total renovation of the library building was completed in early 2005. The HSL is now fully wireless and equipped with 42 public computer workstations, 19 small group study rooms, 2 Media Kitchens, 2 teaching labs with a total of 45 workstations and a campus equipped computer lab with 28 workstations. The HSL and the School of Medicine’s Office of Information Services jointly support multiple databases. These systems are available free of charge to all members of the University health affairs community and are easily accessible from any location on or off campus. One of the HSL online systems provides information about material available at the other area institutions of higher learning. Information about other resources and databases can be obtained at the library’s Internet Desk, which is staffed on a full-time basis by technical experts. The HSL is also a participant in faculty and student education related to the retrieval of electronic information and use of specific computer applications software.