|  |  |
| --- | --- |
|  |  |
|  | |
| 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 fourteen hospitals and eighteen hospital campuses statewide. UNC Medical Center is a public academic medical center with more than 950 beds, which is comprised of NC Memorial Hospital, NC Children’s Hospital, NC Neurosciences Hospital, NC Women’s Hospital, the NC Cancer Hospital, the Hillsborough campus and UNC Hospitals at Wakebrook. 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. The newly created role of Vice President Research Officer/Clinical Research Integration Officer reports to both UNC Health and UNC SOM and is responsible for integrating research efforts across both entities. 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 infrastructure 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 4,111 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 (UNC) leads southeastern public universities in the amount of extramural support for its research programs. UNC’s research enterprise has doubled in the last 15 years, and in the most recent NSF rankings (FY21), UNC has surpassed $1.2 billion in annual research expenditures. UNC is ranked 13th nationally among all research institutions in overall research and development expenditures for life sciences, 5th for health sciences, and 10th nationally in overall for federal research and development expenditures.

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 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 280 private businesses that employ an additional 9,645 workers across the state. Survey results show that industry funding for UNC research jumped 13% over the five-year period from 2018-2022, 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 has over 2,000 faculty, and approximately 1,700 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, **Dr. 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 School of Medicine has built a remarkably diverse environment for biomedical research represented by 8 basic science and 20 clinical departments, as well as 57 centers, divisions, and programs. The school’s biomedical research program has grown steadily over the past decade and consistently ranks among the top in the country – 5th in primary care and 25th in research according to *U.S. News & World Report*’s 2023 medical school rankings. The faculty also includes two Nobel Prize Winners: Oliver Smithies (2007, Physiology or Medicine, deceased 2017) and Aziz Sancar (2015, Chemistry, Sarah Graham Kenan Professor of Biochemistry and Biophysics).

The school received $623 million total research funding in fiscal year 2022 and currently ranks19th (Blue Ridge Institute) in NIH funding with $358 million. In fiscal year 2022, numerous School of Medicine departments were ranked among the top 20 in NIH dollars awarded: Biochemistry and Biophysics (8th), Biomedical Engineering (8th), Emergency Medicine (9th), Family Medicine (6th), Genetics (3rd ), Internal Medicine (17th), Microbiology and Immunology (6th), Obstetrics & Gynecology (6th), Pathology (20th), Pharmacology (6th), Physical Medicine and Rehabilitation (18th), Physiology (3rd), Psychiatry (17th), and Radiology (19th). **Dr. Cristen Page**, William B. Aycock Distinguished Professor of Family Medicine, serves as its Executive Dean. The Vice Dean for Research is **Dr. Blossom Damania**, Boshamer Distinguished Professor of Microbiology and Immunology.

# 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, originally led by **Dr. Bill Marzluff.** A few others have held this role; however, most recently in 2021, **Dr. Donita Robinson**, Professor in Psychiatry and Education and Outreach Director of the Bowles Center for Alcohol Studies took on the role of Associate Dean for Education and as leader of the BBSP. 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 six 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. 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. Robinson)**, keeping in mind the desired target number of matriculating students (~ 100 students for all 15 programs). Important to our efforts to recruit outstanding students to our training program, many of our training mentors regularly serve on the admissions committees (113 faculty serviced in the most recent cycle). UNC and BBSP are 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 supports the NSF-funded Summer Undergraduate Research Experience (SURE-REU)program and an NIH-funded Post-baccalaureate program (UNC PREP) to prepare diverse students for graduate research and careers in science.

**BBSP recruitment:** BBSP recruitment takes place from mid-late January through mid-April. In January, applicants are invited to participate in virtual interviews. Applicants interview with five faculty members, primarily of their own choosing, and they interact with current students and faculty in Zoom breakout sessions. Then in March, BBSP hosts students who have received an offer of admission for an in-person visit. These two-day events allow applicants to see UNC labs and facilities, tour the campus, and see some of the local areas. In addition, applicants interact with faculty and current students at poster sessions, during tours and at faculty-hosted dinners. Applicants find these visits vital for making a decision on which program to choose. They get a feel of what it would be like to be a grad student at UNC while having the opportunity to meet faculty and current students in person. Around 75% of the applicants who receive offers attend these in-person visits. **The move to a unified umbrella admissions format under BBSP 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 BBSP students are enthusiastic about the program, as seen by their active participation in the recruitment visits.

**Applicant Statistics Summary**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Total Applicants** | **Offers Made** | **Total # of students accepting our offer (# incoming)** | **Acceptance Rate** |
| 2022 | 1673 | 330 | 104 (101) | 36% |
| 2021 | 1603 | 237 | 91 (95) | 41% |
| 2020 | 1804 | 293 | 117 (106) | 42% |
| 2019 | 1711 | 274 | 95 (95) | 35% |
| 2018 | 1368 | 232 | 78 (78) | 34% |
| 2017 | 1275 | 220 | 91 (93) | 41% |
| 2016 | 1323 | 252 | 79 (79) | 31% |
| 2015 | 1162 | 221 | 80 (81) | 36% |
| 2014 | 1221 | 187 | 65 (65) | 35% |
| 2013 | 1217 | 230 | 91 (89) | 40% |
| 2012 | 1443 | 251 | 85 (86) | 34% |
| 2011 | 1149 | 250 | 84 (83) | 34% |
| 2010 | 1128 | 213 | 76 (74) | 36% |
| 2009 | 1086 | 202 | 86 (86) | 43% |
| 2008 | 1111 | 261 | 121 (122) | 46% |
| 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. Peer mentors (graduate students at different stages of their career) are also assigned to each FYG. In this manner, all students have contact with multiple faculty and peers who provide a supportive community for navigating the first year of graduate school before they join a degree-granting program. Groups build community interactions through social events. These mandatory FYGs meet once a week for 1.5 hours. Skill-building activities in the FYGs include scientific presentations by the students, analysis of the literature, and scientific writing. Responsible conduct of research (RCR) training also occurs within FYGs. These groups 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 to a group of 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: 10 weeks in the fall, 11 weeks in the winter (spanning winter break), and 10 weeks in the spring. This is the mechanism by which students evaluate and decide upon a dissertation 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), review article (rotation 2) or short talk (rotation 3). Students select a laboratory to join in April, after the third rotation. To support first-year students in their choice of laboratory rotations, each PhD program hosts information sessions throughout the year.

Rigor & Reproducibility: BBSP students are required to complete lessons rigor and reproducibility (R&R) during their first year. R&R us offered as a week-long mini-course during which students apply best practices of experimental design to real situations.

**BBSP Financial Support:** Funds for administration, recruitment and first-year support (i.e., stipend, tuition, fees, 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 into a particular unit. Once students join a lab at the end of their first year, 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 15 PhD granting programs in the biological and biomedical sciences, each of which has a strong research portfolio. Together, these programs have enrolled on average 95-105 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; three 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 2022 the School of Medicine received $623M in funded awards, which was 54% of the UNC sponsored research for that year. Four other health affairs schools are in the top 20 for NIH funding (Dentistry, Nursing, 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 19th nationally in NIH funding with $358 million in FY2022. Only 6 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. Jean Cook*** (Department Chair), the Department of Biochemistry received $18.5M in NIH funding in fiscal year 2022, ranking 8th in NIH funding to Biochemistry departments. The Department's 25 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, including from the Keck, Beckman, Sloan, Pew, and Searle foundations.; Dr. Aziz Sancar was a recipient of the Koc Prize (Turkey’s highest scientific honor) and In 2015 he shared the **Nobel Prize in Chemistry**. In a collaborative effort with investigators from Yale and UC-San Francisco, ***Dr. Ronald Swanstrom***, identified a timeline for HIV replication in the brain. Armed with potent tools, experience, and a wealth of new information, scientists in Biochemistry and Biophysics 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, StructuralBioinformatics, and UNC Biomolecular NMR core facilities and hosts the Director of the cryoEM core.

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. Department faculty members teach modules in this program, and also teach courses that support multiple graduate programs such as the Biochemistry and Molecular Biology PhD track, the Curriculum in Genetics, Pharmacology, Cell Biology and Physiology, and Bioinformatics and Computational Biology. The Department currently has approximately 38 graduate students and 66 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 was made permanent Chair in 2022. He 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 8th nationally in NIH departmental funding for FY22 with awards totaling $6.83M. 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 micro technologies, 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 61 primary teaching and research faculty members, approximately 112 graduate students (MS and PhD seeking) and 25 postdoctoral fellows. BME faculty and students have started 31 companies and filed 138 patents and 366 invention disclosures.

## Department of Cell Biology and Physiology

The UNC Department of Cell Biology and Physiology conducts cutting-edge, innovative research that advances the discipline of cell biology and physiology, with an emphasis on topics that contribute to the improvement of human health. The UNC Department of Cell Biology and Physiology The Department of Cell Biology and Physiology is consistently ***ranked in near the top in the country for our level of NIH funding - Top 3 in 8 of the past 10 years, ranging from $12.5-25.7 million*** and is internationally recognized for excellence in biomedical research. This department has brought together over 60 faculty, 20 postdoctoral fellows and 50 graduate students, in addition to numerous experienced administrative, financial, HR, and student services staff. 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. The CBP department has been led by Distinguished Professor and Chair Dr. **Kathleen Caron** since 2013.

The Department comprises **over** **30 basic science laboratories,** consolidated over thousands of square feet on multiple floors in three main research buildings: Mary Ellen Jones Building (MEJ), Medical Biomolecular Research Building (MBRB), and the Neuroscience Research Building (NRB). Many CBP faculty members are also 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*. The Department of Cell Biology and Physiology also houses **two UNC Core Facilities**: the Hooker Imaging Core and the Histology Research Core Facility, which occupy the 2nd floor of Taylor Hall. CBP researchers have access to **shared departmental space and equipment** including, bacterial culture facilities, cold rooms, conference rooms, dishwasher room, autoclave, ice machine, film developer, infrared imager, radioactivity counters, large-scale ultracentrifuges, real-time PCR, Illumina miniSeq, Biotek Cyt5 multimode plate reader with imaging, LICOR and Odyssey Imaging Systems, to name a few.

**CBP faculty** are affiliated with 8 basic science departments and 7 clinical departments in the UNC School of Medicine, the Department of Biology in the College of Arts and Sciences, and the Department of Nutrition in the School of Public Health. Our faculty are experts in cutting-edge techniques and quantitative methods, are highly productive, well-funded, and consistently recognized with awards for scientific discovery, mentorship, and teaching. Dr. **Mark Zylka**, CBP Professor and Director of the UNC Neuroscience Center, is an NIH Pioneer Award winner and American Academy of Arts & Sciences fellow. Dr. **Gregory Scherrer**, Associate Professor, recently received the NIH HEAL Director’s Award for Excellence in Research. Drs. **Kurt Gilliland, Emily Moorefield, and Edward Kernick** are faculty educators with multiple awards for excellence in teaching across the university.

The CBP breadth of investigation is reflected in our interdisciplinary **Cell Biology and Physiology Curriculum**, which provides a broad, integrated biological foundation and emphasizes rigor, transparency, integrity, and creative scientific reasoning. The CBP Curriculum mission is to develop a diverse pool of responsible and rigorous scientists who acquire the skills to investigate the integrative, regulatory and developmental physiology of higher organisms and their organ systems by elucidating and evaluating the molecular and cellular functional components of these systems. In addition, the CBP Department is home to a multitude of **undergraduate, medical and clinical fellow trainees** who are seeking avenues for intellectually engaging and creative research experiences. Trainees in our Department can capitalize on rapid technological advances and successfully apply their findings to inform the fundamental processes of normal and pathological physiology and cell biological behaviors.

## Department of Genetics

The Department of Genetics was established in 2000 with ***Dr. Terry Magnuson*** as the founding chair. ***Dr. Fernando Pardo-Manuel de Villena***has served as the chair since 2016. The mission of the department is to advance fundamental, translational, and clinical research in genetics and genomics through innovation, education, and collaboration. The graduate programs train students to be creative, sophisticated research scientists prepared to pursue careers focused on genetics and genomics. 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.

The Department of Genetics' primary location is on the 5th Floor of the Genetic Medicine Building (GMB) with ample laboratory space, desk space for graduate students, postdoctoral fellows and staff, office space for faculty, and a newly renovated computational space. The department includes 32 tenure-track and tenured faculty and 38 fixed-term faculty with 11 joint, 15 secondary, and 8 adjunct appointments. More than 300 administrators, research technicians, project managers, postdoctoral fellows, and students round out this complex and highly successful department.

The annual Blue Ridge Institute for Medical Research report on NIH funding (2022) lists the department as the 3rd ranked Genetics Department in US medical schools at $43.5M. Among public universities, the UNC Department of Genetics ranked first in NIH funding for the past six years. Over the last 12 months, the department has secured more than $49M in funding, compared to $46M in the prior 12 months.

The Department of Genetics has a significant educational component that includes two PhD graduate programs – Bioinformatics and Computational Biology (BCB) Curriculum led by Director ***Dr. Will Valdar*** and Past Director ***Dr. Tim Elston*** and the Genetics and Molecular Biology (GMB) Curriculum led by Director ***Dr. Dan McKay***and Past Director ***Dr. Jeff Sekelsky***. The curricula train students to pursue careers focused on 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. BCB and GMB are supported by T32 training grants that were recently renewed in 2021 and 2022, respectively. The department manages a T32 training grant for the Virology Training Program as well (***Dr. Mark Heise***, PI). The department also supports a two-year summer program for undergraduate students that is supported by an R25 grant (UNC Educational Pathways to Increase Diversity in Genomics (EDGE)) awarded to ***Dr. Folami Ideraabdullah*** and ***Dr. Jonathan Berg***. The EDGE program combines career education, mentoring, and research skills training to support students from underrepresented and disadvantaged backgrounds that are interested in careers in genomics.

The Department of Genetics hosts several weekly student and faculty seminars, such that expertise on current research topics and best practices can be shared across labs and programs. There are also weekly seminars that feature world-class researchers from outside of UNC to share their new and cutting-edge work. Additionally, the Department established the Systems Genetics Core Facility to distribute Collaborative Cross mouse, a strategic resource uniquely available through UNC, currently managed by ***Dr. Rachel Lynch***.

The Genetics Department is committed to the faculty’s success and has budgeted strategic resources to support team science proposals, including a dedicated faculty member, ***Dr. Sarah Schoenrock*** as the Assistant Director of Research, and a pool of research project managers to focus on proposal development and project management support. As a result, in 2021, the Clinical Genome Resource Consortium (ClinGen) team at UNC, led by ***Dr. Jonathan Berg***, was renewed, and awarded a five-year U24 grant from NHGRI to scale bio curation and expert evaluation of genes and variants.  ***Dr. Hyejung Won, Dr. Karen Mohlke*** and ***Dr. Michael Love*** were awarded a five-year UM1 grant from NHGRI titled “Systematic *in vivo* characterization of disease-associated regulatory variants”. ***Dr. Patrick Sullivan*** was awarded an R01 from NIMH as part of the ongoing Psychiatric Genomics Consortium titled “Advancing discovery and impact” focused on multiple psychiatric disorders.

Additional team science awards included ***Dr. Yun Li*,** who received a five-year U01 grant from NHGRI to improve utility of polygenic risk scores (PRS) in diverse populations, one of six awards in a new PRS consortium.***Dr. Karen Mohlke*** was awarded a five-year UM1 grant from NIDDK in mid-2020 titled “Bridging the gap between type 2 diabetes GWAS and therapeutic targets”. ***Dr. Mark Heise*** has received significant funding from the Rapidly Emerging Antiviral Drug Discovery Initiative (READDI) program for his project “JAK inhibitors as SARS-CoV-2 therapeutics”.

The Department also has a dedicated resource for a Director of Research, Dr. Chris Gregory, to provide strategic planning, research administration, project management, metrics tracking, mentoring, and policy development for the department and the biomedical research cores. Dr. Gregory also serves the School of Medicine (SOM) as the Director of the Office of Research Technologies, which monitors the effectiveness, resources, and infrastructure of all Core facilities in the SOM.

## Department of Microbiology and Immunology

The faculty of the Department of Microbiology and Immunology focuses on 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 to understand pathogen-host interactions and develop knowledge that will lead to better ways of preventing and treating infectious diseases. Virologists of the Department have contributed substantively and substantially to our current understanding of Severe Acute Respiratory Syndrome Coronavirus 2 and associated disease (COVID-19). Indeed, research led by our faculty has bestowed upon UNC the distinction of being the highest-ranked US university in the world for coronavirus research. In addition to virology research, the department bacterial and fungal infections. Research spans from elucidation of fundamental principles of pathogen molecular and cellular biology to more translational questions impacting clinical outcomes in the realm of infectious disease. acquisition of knowledge pivotal to translational and clinical studies of different infectious diseases. Studies of the human immune system are also well represented in the department, in particular autoimmune disorders. The department chair is ***Dr. Craig E. Cameron***. The department has ranked in the top ten for NIH funding relative to comparable departments in schools of medicine going on two decades now.

The department has 60 students, 30 post-doctoral fellows, and 60 faculty members. Twenty-eight faculty have their primary appointment in the department; the others have primary appointments in other departments of the School of Medicine, especially clinical departments. Over the past few years, ***Dr. Jack Griffith*** and***Dr. Ralph Baric*** were elected to membership in the National Academy of Sciences and ***Dr. Miriam Braunstein*** and ***Dr. Robert Bourret*** were elected as Fellows of the American Academy of Microbiology. ***Dr. Craig E. Cameron*** was elected as the 2020-2021 President of the American Society for Virology. Finally, two of our youngest colleagues, ***Dr. Brian Conlon*** and ***Dr. Helen Lazer*** won the very prestigious award for Investigators in the Pathogenesis of Infectious Disease granted by the Burroughs Wellcome Fund.

Historically, the department has been organized into four disciplinary groups: immunology, microbial genetics and pathogenesis, virology, and molecular biology. However, the department is now moving into a new era, with highly integrated, interdisciplinary teams coalescing around a broad swath of diseases in specific organs. The premise is that understanding how co-infection and corresponding immune response play out in specific tissues will enable better clinical management of these circumstances. The innovative, interdisciplinary, and collegial environment in the department ensures a prominent position in the area of microbiology and immunology for decades to come.

## Department of Pathology and Laboratory Medicine

Led by ***Dr. Russell Broaddus*** (Department Chair), the missions of the Department of Pathology and Laboratory Medicine are to: 1) advocate for our patients by promoting excellence in the diagnosis and treatment of the disease; 2)actively promote the practice of evidence-based medicine. When evidence is lacking, we will work to provide it through basic and translational science using innovative preclinical models of disease and clinical investigation; 3) honor our Department’s rich history by continuing to lead research in understanding mechanisms of disease; 4) motivate our students, residents, and fellows to challenge dogma by encouraging an inquisitive and open learning atmosphere; and 5) champion a diverse and inclusive clinical, research, and educational environment. The department is both a basic science department with substantial extramurally funded research ($13.7million in FY22; ranked 9th in NIH funding amongst public universities) 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 has its own graduate student training program, Pathology and Translational Sciences, which supports the PhD training of ~20 graduate students. Department faculty (~100) are involved in a wide array of basic, translational, and clinical research. The current leading areas of research emphasis are cancer, vascular pathology, 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, Blood Research Center, Cystic Fibrosis / Pulmonary Research and Treatment Center, Kidney Center, and Lineberger Comprehensive Cancer Center. Department faculty lead two NIH-funded T32 training programs, Integrative Vascular Biology and the Graduate Training Program in Translational Medicine. The Department oversees important core research facilities including the Microscopy Services Laboratory and the Experimental Animal Clinical 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.

## 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 $21.2 million in fiscal year 2022, and the department currently ranks6th in NIH funding amongst Pharmacology departments in the country. Furthermore, UNC has been ranked10th in the world for Pharmacology and Toxicology (U.S. News). There are 25 full-time tenured and tenure-track primary faculty, as well as 26 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. Two departmental faculty members, ***Dr. Bryan Roth and Dr. Terry Kenakin,*** are recipients of the 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 approximately 60 graduate students, 60 postdoctoral fellows, and 22 research-track faculty.

## Department of Social Medicine

Chaired 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 encompass an extraordinary range of fields in the humanities, social sciences and clinical medicine. They conduct research on issues such as health disparities and equity, reproductive health, health care reform, the ethical implications of genomics research and pharmaceutical clinical trials, immigrant health, the health of gender and sexual minorities, medical aid-in dying and end-of-care life, psychiatric care, medical technology and the production of medical knowledge, narrative medicine, and ethical issues surrounding HIV prevention, treatment, and cure research. The Department also has three affiliated centers directed by departmental faculty: the Center for Bioethics (directed by ***Arlene Davis, JD***);the 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 17 Primary and Full Joint Faculty, 26 secondary faculty, and 3 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 Neurodiagnostic 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 addition 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

The UNC Department of Dermatology is currently led by Interim Chair ***Margaret Helton, MD,***andhas over 25 faculty members with clinics in Chapel Hill, Hillsborough, and Raleigh, and inpatient consultations at UNC Hospitals. Excellent clinical care is supported by a CLIA- and CAP-certified dermatopathology laboratory with faculty experienced in complex cases including immunodermatology with cutting, embedding and staining frozen tissues for purposes of clinical diagnosis (particularly for bullous disorders) and research. The Department has an established research program, with multiple NIH awards and research expertise in melanoma, skin autoimmunity and inflammation, and cell adhesion, as well as a clinical trials unit. The Department ranked 26th in NIH funding among dermatology departments in 2022. Teaching programs span the education of medical students, residents, fellows, and graduate students. The three-year residency program has six positions per year and provides robust clinical training. Fellowship training is offered in Moh’s surgery, pediatric dermatology, and dermatopathology.

## Department of Emergency Medicine

Led by ***Dr. Jane Brice*,** the Department of Emergency Medicine consists of approximately 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 is currently ranked #13 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 is chaired by ***Margaret Helton, MD,*** and is consistently ranked as a top program in the nation by US News & World Report. The Department provides robust clinical training for exemplary young doctors including two training tracks at Piedmont Health Services, which is the regional federally qualified health center, providing health care to rural underserved communities. Residents on both the academic and the underserved track receive robust clinical training in inpatient medicine at UNC Hillsborough Hospital, as well as high-volume of perinatal and delivery care, procedures, preventive care, and chronic disease management. The Department has an established and growing research program and currently ranks 6th nationally in NIH funding among family medicine departments.

## Department of Medicine

***Dr. Ronald Falk*** became the Chair of the Department of Medicine in 2015. In addition to his Chair responsibilities, he is also the co-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 19th in NIH funding for fiscal year 2021 with $103M 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, the Carolina Center for Developmental Disabilities, the Bowles Center for Alcohol Studies, and the Lineberger Comprehensive Cancer Center.  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 three NIH-funded Research Centers: the Neurology Clinical Trial Unit, the Alzheimer’s Disease Research Center, and the Center for Animal MRI, which support faculty and trainees for a diverse range of clinical and basic science studies.

## Department of Neurosurgery

Under the leadership of ***Dr. Nelson Oyesiku*,** 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.24 physicians within the Department were selected to the 2019-2020 Best Doctors in America Lis, and 16 providers from the department were named in the 2015-16 U.S. News and World Report Top Doctors list. Additionally, the Department 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 4th among Obstetrics & Gynecology departments in NIH funding, with over $10M 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 #3 in the nation in the 2021-22 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 Ophthalmology

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 FY2021 the department was ranked 20th among Otolaryngology departments (11th among public university departments) with $2.2M 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. 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 is made up of ~230 faculty, every one of whom is dedicated to the care of children, from the tiniest premature infant to the critically injured adolescent to the young adult with a chronic condition transitioning to more independent adult-based care.  Several 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*** oversee the Children’s Research Institute, which supports the overall research enterprise within the Department through programmatic support, clinical research staffing, physician-scientist development, promoting cross-disciplinary interactions and a variety of other services to advance the pediatric research mission at UNC. The Department ranked 22nd in NIH funding nationally, in 2022,  and has seen an almost doubling in research funding over the past 5 years (2018-2023). Housing several cutting-edge research programs such as the UNC Gene Therapy Center, the UNC Food Allergy Initiative, the Rare and Genetic Lung Diseases program, amongst many others, the UNC Department of Pediatrics continually makes ardent strides in fulfilling its overall mission: to improve the lives of children in NC, and beyond!

## 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 18th 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 2021, the department was ranked 19th among Psychiatry departments with $18.4M 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 ***Dr. Ellen Jones***, 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. The department has numerous stellar researchers conducting cutting-edge research related to radiation oncology and cancer. For example, ***Dr. Shekinah Elmore*** found that only 33% of women eligible for post-mastectomy radiation in Zimbabwe received this treatment and more research is needed to assess the survival benefit that would occur if utilization of this treatment were to increase. ***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

***Dr. Maureen Kohi***assumed the role of Chair in December 2020. 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, and highly advanced angiography suites.  A variety of sophisticated and advanced image-guided treatment procedures, such as radiofrequency, cryoablation 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 19th among Radiology Departments, and 8th among public Radiology Departments in 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. The Department was previously directed by Distinguished Professor ***Dr. Melinda Kibbe****,* who was inducted into the National Academy of Medicine in 2016 and is now led by Chair ***Dr. Caprice Greenberg***. The department has approximately 70 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. Booker King*** 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. Bob Duronio***, the Department of Biology, in the College of Arts and Sciences, 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. The department received $23.2M in total extramural funding for FY 2022, $5.9M in NIH funding. Currently Biology occupies four buildings, in the center of campus that are physically juxtaposed to the Health Affairs School, including the School of Medicine. The Genomic Sciences Building, our most modern building finished in the Spring of 2012, 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 state-of-the-art microscopy and genomics capabilities. For instance, ***Dr. Corbin Jones*** is the Faculty Advisor to UNC High-Throughput Sequencing Core facility, which was developed into a major facility used by faculty across campus. ***Dr. Nat Prunet*** was recently hired to direct the Biology Microscopy Core, which houses state of the art Zeiss and Nikon instruments that provide both high resolution confocal and super-resolution STORM imaging capabilities to the Department of Biology and broader UNC community. 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 invertebrate animals including the nematode *C. elegans* and the fruit fly *Drosophila*, model vertebrate animals including zebrafish and mice, 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 of Biology's faculty and students are taking advantage of this new information as they continue to focus on fundamental biological questions. 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.

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 UNC School of Medicine. Many Biology faculty, including Chair, ***Dr. Bob Duronio,*** and HTSF Director, ***Dr. Corbin Jones***, have formal ties with the School of Medicine through membership in the Integrative Program for Biological and Genome Sciences which bridges the College of Arts and Science and the School of Medicine by hiring faculty jointly appointed in, and jointly supported by, each school. The Department of Biology has a very active undergraduate research program that trains a significant fraction of our undergraduate majors for future careers in research and medicine. The ties between Biology and the School of Medicine also include faculty participation in interdepartmental graduate training programs, such as the Curriculum in Genetics and Molecular Biology, Bioinformatics and Computational Biology, Neuroscience, and Cell Biology and Physiology. Most of the Department of Biology faculty members who are involved in molecular, cellular and developmental biology research participate in one or more of these interdepartmental graduate training programs. The faculty in the Department advise and mentor about 60 graduate students and 40 postdoctoral fellows in molecular and cellular Biology.

## Department of Chemistry

The Department of Chemistry is under the leadership of ***Dr. Wei You,*** and has a distinguished faculty of 50 that includes one member of the National Academy of Engineering, one member of Popular Science’s Brilliant 10 of 2021, 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, ranked 17th by US News and World Report, with more than 300 publications published annually and over 100 patents filed within the last 10 years. Current faculty bring in over $25 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. Our faculty members collaborate with the Lineberger Comprehensive Cancer Center and the Schools of Medicine, Pharmacy, and Public Health. 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 270 graduate students and ~40 postdoctoral fellows.

The department’s existing shared facilities include the (1) Chapel Hill Analytical and Nanofabrication Laboratory (CHANL) that contains state-of-the-art nanofabrication, analytical, thin-film characterization, and nanoscale imaging equipment, (2) NMR core facility, (3) Mass spectrometry core laboratory, (4) Engineering Innovations Laboratory with design and fabrication expertise for electronic equipment and software and (5) X-ray Core Laboratory. The shared facilities at UNC (1) provide cost-effective access to analytical and fabrication instrumentation, (2) assist researchers in designing experimental plans and acquiring/interpreting data, (3) promote education by offering instrument training and hands on experience, and (4) foster an environment of collaborative and inclusive research that extends beyond individual teams, disciplines, and institutions. They occupy ~20,000 ft2 of laboratory space, have approximately 10 PhD-level staff members, support more than $30M in annual research expenditures, sustain more than 400 individual users, assist more than 10 industrial users, and facilitate >100 publications annually.

## School of Pharmacy

The UNC Eshelman School of Pharmacy, founded in 1897, is an internationally recognized leader in pharmacy practice, education, and research committed to developing leaders in pharmacy education, pharmacy practice, and pharmaceutical sciences who make a difference on human health worldwide. The school has built a reputation for cutting-edge research, rigorous programs, and outstanding faculty, staff, and students. It has five distinct academic Divisions (Chemical Biology and Medicinal Chemistry (CBMC), Pharmacoengineering and Molecular Pharmaceutics (DPMP), Pharmacotherapy and Experimental Therapeutics (DPET), Practice Advancement and Clinical Education (PACE), and Pharmaceutical Outcomes and Policy (DPOP)). Faculty lead research programs that range from the search for new drugs and delivery methods to assessments of the effectiveness of existing drugs and treatment regimens. This unique environment has inspired a number of collaborative centers that provide faculty and students with access to sophisticated equipment and numerous opportunities for interdisciplinary research.

CBMC, chaired by ***Dr. David Lawrence***, is engaged in the education and research of the principles of drug discovery, with a focus on identifying new therapeutic agents and targets. DPMP, chaired by ***Dr. Kristy Ainslie*,** focuses on drug delivery options to optimize the therapeutic efficacy of pharmacologically and immunologically active agents. The chair of DPET, ***Dr. Craig Lee***, leads the division in optimizing drug therapy through the generation, integration, and translation of scientific information between the bench and the bedside, the patient and the population. PACE, chaired by ***Dr. Stefanie Ferreri,*** is engaged in research to advance the future of the profession while improving patient-centered, team-based care delivery. DPOP, chaired by ***Dr. Ronny Bell***, is committed to excellence in research, education, and service that advances the optimal use of medications with the goal of improving human health.

The Eshelman School of Pharmacy offers both a professional pharmacy program leading to the PharmD degree and a graduate program in Pharmaceutical Sciences leading to MS and PhD degrees. The U.S. News & World Report has ranked the UNC Eshelman School of Pharmacy as the No. 1 Doctor of Pharmacy program in the nation two times consecutively, in 2016 and 2020, and 2nd among schools and colleges of pharmacy in total external research funding ($60.8M in FY 2022) and in NIH research funding (28.6M in FY 2022). The School is ranked No. 3 among Best Global Universities in Pharmacology and Toxicology, and 10th among Best World Universities in Pharmacy and Pharmacology by QS World University Rankings. The School’s proximity to Research Triangle Park, NC, and other research campuses spurs academic and industrial collaborations and partnerships. The School’s research has spawned more than 62 active, issued patents and over 46 start-ups, which have contributed significantly to UNC’s overall startup success. In addition, the School’s faculty lead Co-PIs on three NIH-funded training grants.

The School is part of the University of North Carolina at Chapel Hill, a major research university with a large teaching hospital and schools of medicine, public health, nursing, and dentistry. UNC anchors one corner of North Carolina’s famed Research Triangle Park, which hosts an abundance of pharmaceutical, biotech, and health-care companies. This environment offers abundant opportunities for collaboration in research, education, and patient care with partners in academia, industry, and health care.

Research Centers at the Eshelman School of Pharmacy include the Center for Integrative Chemical Biology and Drug Discovery (CICBDD), directed by ***Dr. Kenneth Pearce***, and the Center for Nanotechnology in Drug Delivery (CNDD), directed by ***Dr. Alexander Kabanov***. The mission of the CICBDD is to bring dedicated high throughput screening and medicinal chemistry expertise to bear on biological targets of therapeutic relevance under investigation by UNC faculty. Synthetic and computational chemists, and assay development/compound profiling scientists work in the Center and create interdisciplinary project teams to progress targets through the probe and drug discovery process. The CNDD focuses on safely and efficiently translating new therapeutic and imaging agents from bench to bedside, with the goal of improving human health. Focus areas of the CNDD are the treatment of cancer, stroke, neurodegenerative and neurodevelopmental disorders (such as Parkinson’s disease and Alzheimer’s), nerve agent and pesticide poisoning and other diseases and injuries.

# 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 33 full professors, 14 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 60 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 91-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 approximately 80 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.

## 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 75 faculty members in 12 departments and 5 specialized research centers. The faculty is highly competitive in receiving extramural grant support, with over $125 million in funding to UNC neuroscientists (as of January 2023). 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 Mary Ellen Jones 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. Thirty-seven students are currently enrolled in the Neuroscience Curriculum.

## Curriculum in Toxicology & Environmental Medicine

The Curriculum in Toxicology & Environmental Medicine (CiTEM) 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 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 and environmental health.  Students are exposed to general techniques that cut across disciplines, such as molecular biology, genomics, animal models and biomarkers of exposure and learn to integrate basic biomedical science and next-generation research tools to advance environmental health and toxicology in the 21st century.  CiTEM focuses on four overarching research areas of training: A) cancer, genetic toxicology, and mutagenesis, B) metabolism and liver/drug toxicology, C) organ-centric toxicology, and D) genetic models, systems/computational toxicology.

## Curriculum in Cell Biology and Physiology.

## The mission of the Ph.D. program in Cell Biology and Physiology is to provide students with a rigorous, individually tailored educational experience to prepare them for research and teaching careers in the biomedical sciences. In this graduate program, graduate students learn current concepts in modern cell biology and physiology across varied levels and organ systems and develop the skills necessary to formulate sophisticated strategies for analysis of contemporary problems in cell biology and physiology. Building on a solid foundation of coursework in cell biology and physiology, students will further complement their training by selecting courses in bioinformatics/statistics, genetics, pharmacology, neurology, immunology and/or biochemistry that best support and enhance their specific area of research interest. Dissertation research enables students to apply these tools to a problem of intellectual and biomedical interest. Students receive strong training in the rigorous and reproducible practice of the scientific process and apply their skills to probe the mechanistic basis of biological problems at molecular, cellular, and systems levels. A strong emphasis is placed on career development, such as oral and written presentation skills, and mentoring students in a way that enables them to explore the diverse job opportunities available to them in the post-graduate biomedical workforce. Graduates will be well prepared to continue their research careers in a number of academic or non-academic disciplines.

## The Department of Cell Biology and Physiology has 51 primary faculty members. Faculty research expertise is fairly evenly distributed across neuroscience (NS), cardiovascular physiology (CV), cell motility (CM), cellular cytoskeleton (CCSK), cancer research (CR), pulmonary biology (PB) and gastrointestinal biology (GI). Assignment of faculty to one particular research category is somewhat artificial, particularly given the large number of laboratories that perform interdisciplinary research or have areas of strength in non-traditional cell biology & physiology categories, such as computational biology (CB), microbiome research or developmental biology (DB). Most of our Faculty can be cross listed comfortably in one or more categories.

## The tradition of collaborative science at UNC‐CH has allowed the CBP curriculum to flourish. CBP faculty participate in the numerous interdisciplinary training efforts at UNC‐CH and are integral parts of many team science research projects. Interdisciplinary graduate training programs at UNC‐CH can be divided into two groups: those that offer certificates or concentrations in conjunction with a PhD program (e.g., Cell and Molecular Biology, Molecular and Cellular Biophysics, Cancer Cell Biology, Developmental Biology, and Integrative Vascular Biology, Translational Medicine and Cardiovascular Sciences), and those that are standalone, degree‐granting curricula (e.g., Genetics and Molecular Biology, Toxicology, Neurobiology). Our faculty and students are involved in many team science projects within UNC‐CH, such as the Collaborative Cross, and are actively involved in university centers, such as the Neuroscience Center, Lineberger Comprehensive Cancer Center, McAllister Heart Institute, Center for Gastrointestinal Biology and Disease, and Cystic Fibrosis Center. Currently, there are 50 predoctoral and twenty post-doctoral trainees in the program.

# 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, was initially 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. Currently, the Office is overseen by ***Dr. Joyce Tan*.** 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 | 35 |
| Biomedical Research Imaging Center (BRIC) | SOM | Weili Lin, PhD | NIH | 61 |
| Bowles Center for Alcohol Studies | SOM | Thomas Kash, PhD | NIH/NIAAA | 21 |
| Carolina Center of Cancer Nanotechnology Excellence | SOP | Leaf Huang, PhD | NIH/NCI | 20 |
| Carolina Institute for Developmental Disabilities | SOM | Joe Piven, MD | NIH/NICHD | 67 Research faculty |
| Carolina Population Center | UNC | Karen Benjamin Guzzo, Ph.D. | NIH/NICHD | 99 |
| Cecil G. Sheps Center for Health Services Research | UNC | Mark Holmes, PhD | NIH, Other Federal | 221 |
| Center for Aging and Health | SOM | Jan Busby-Whitehead, MD | NIH, HRSA | 19 |
| Center for AIDS Research (CFAR) | SOM | Ronald Swanstrom, MD and  Ada Adimora, MD, MPH | NIH/NICHD;NIAID;  NCI; CIDA; NIMH;NHLBI | 89 |
| Center for Environmental Medicine, Asthma & Lung Biology | SOM | Ilona Jaspers, PhD | US EPA Cooperative Agreement; NIH | 12 |
| Center for Gastrointestinal Biology and Disease | SOM | Robert Sandler, MD | NIH/NIDDK | 78 |
| Cystic Fibrosis/Pulmonary Research and Treatment Center/ Marsico Lung Institute/ | SOM | Richard Boucher, MD | NIH/NHLBI | 74 |
| Gene Therapy Center | SOM | Jude Samulski, PhD | NIH | 6 |
| Global HIV Prevention and Treatment Clinical Trials Unit (ACTU) | SOM | Joseph Eron, MD | NIH, HRSA, SPNS, SAMSHA, FRAM | 33 |
| Institute for Global Health and Infectious Diseases | UNC | Myron S. Cohen, MD | NIH/NIAID | 94 |
| 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 | 452 |
| McAllister Heart Institute | SOM | Victoria Bautch, PhD and Rick Stouffer, MD | NIH/NHLBI | 125 |
| Neuroscience Center | SOM | Mark Zylka, PhD | NIH/NIMH, NINDS | 29 |
| Nutrition Obesity Research Center | SPH | Elizabeth Mayer-Davis, PhD  Raz Shaikh, PhD | NIH/NIDDK | 140 |
| Program in Computational Medicine | SOM | Tim Elston, PhD  Charles Perou, PhD | NIH | 68 |
| Program in Precision Medicine and Health | SOM | Jonathan Berg, MD, PhD | NIH | 24 |
| Thurston Arthritis Research Center | SOM | Richard Loeser, MD | NIH/NIAMS | 64 |
| UNC Kidney Center | SOM | Ron Falk, MD, Abhi Kshirsagar, MD, MPH, and Prabir Roy-Chaudhury, MD, PhD | NIH/NIDDK | 89 |

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 35 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. The 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. The center is co-directed by **Dr. Ronald Swanstrom**, Professor of Biochemistry and Biophysics, and **Dr. Adaora Adimora**, Sarah Graham Kenan Distinguished Professor of Medicine and Professor of Epidemiology.

***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. 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. **Dr. Stephanie Davis**, Professor and Chair, Department of Pediatrics, is the center’s interim director.

***Global HIV Prevention and Treatment Clinical Trials Unit-***

The Global HIV Prevention and Treatment Clinical Trials Unit 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 AIDS Clinical Trials Units in the nation. Among its foci are antiretroviral therapies, immunomodulators, opportunistic infections, HIV-related malignancies, the wasting syndrome, neurologic complications of HIV, and HIV-related GI illnesses. Patients are enrolled in clinical trials in cooperation with 36 other centers. There are 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. **Dr. Joseph J. Eron, Jr.**, Herman and Louise Distinguished Professor of Medicine and Chief of the Division of Infectious Disease, directs the unit. The Retroviral Research Laboratory is housed in the Departments of Pathology and Laboratory Medicine and Microbiology and Immunology.

***Integrative Program for Biological and Genome Sciences (IBGS)*** - 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. IBGS is led by Interim Director ***Dr. Greg Matera,***  Professor of Biology and Genetics

***Institute for Global Health and Infectious Diseases (IGHID) –*** 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 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. The center includes 324 faculty researchers from more than 50 academic departments across campus participate in the center, and UNC Lineberger members hold more than $64 million in NCI funding (11th nationally in 2020) and about $161 million direct I sponsored funding. . 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 42 members and administers approximately $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.

***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. While continuing to pursue cutting-edge Cystic Fibrosis research, recently the team has also used their expertise to conduct pressing COVID-19 research. For example, the team has worked to map the entry sites for SARS-CoV-2 in the respiratory tract and many investigators have been involved in preclinical studies to identify biomarkers to predict the trajectory of the disease and treatment strategies for patients. There are currently 75 faculty members in the Marsico Lung Institute and is co-directed by **Dr. Richard C. Boucher**, James C Moeser Eminent Distinguished Professor of Medicine, and **Dr. Michael R. Knowles**, Distinguished Professor of Pulmonary Medicine.

***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.

***Odum Institute for Research in Social Science****-* Founded in 1924, the H.W. Odum Institute is the oldest university-based interdisciplinary social-science research institute in the world.  The mission of the institute is to foster groundbreaking social research that improves the lives of people in North Carolina and around the world. It provides education and support for planning, implementing, and disseminating research; working to advance rigorous and reproducible research across the data, social and health sciences, while building collaborative, trans-disciplinary research networks. Services include consultations and support for research methods and data analysis. Services include comprehensive data management, archive, and preservation. The Institute’s consulting groups deliver hands-on assistance and instruction to faculty, graduate students, and others on advanced quantitative and qualitative methods, research design, survey methodology, and development of new technologies to assist social scientists in sharing their data, analyzing new data types, and archiving their data within the UNC Dataverse. Through UNC Dataverse, the Institute houses one of the oldest and largest catalogs of machine-readable data in the United States, including an extensive collection of U.S. Census data, and one of the most complete holdings for 1970 Census files. Other sources of data include the North Carolina State Data Center and the National Center for Health Statistics.

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. Thomas Kash,*** *John Andrews Distinguished Professor of Pharmacology and Psychiatry,* who 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 20 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,*** Joseph P. Archie, Jr. Eminent Professor of Medicine,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. The center also helps members integrate statistical and data analysis, genomic and proteomic research, bioinformatics, and clinical and social research.

***Carolina Population Center*** - The Carolina Population Center is led by ***Dr. Karen Benjamin Guzzo,*** and for decades has served the research and training needs of faculty who wish to conduct population research, both nationally and internationally. 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 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, Asthma, 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. Investigators use a diverse range of experimental models, including in silico simulations, in vitro models, animal in vivo experiments, and human clinical studies to examine the effects of substances like endotoxin, tobacco products, ozone, wood smoke and other ambient pollutants on human health.

The center is led by ***Dr. Ilona Jaspers,***Professor of Pediatrics, Environmental Sciences and Engineering, and Microbiology and Immunology.  In addition to applied and basic research programs, the Center offers educational and research training opportunities for graduate students, postdoctoral fellows, visiting scientists, and physician scientists.  The Center, which is housed in a dedicated building on the Health Affairs campus (EPA/UNC Human Studies Facility) as well as space in Mary Ellen Jones, 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. Investigators from several departments in the Schools of Medicine and Public Health are involved in center activities and collectively or individually collaborate closely with EPA scientists.

***Carolina Institute for Developmental Disabilities (CIDD) –*** The CIDD is a comprehensive program for services, research, and training relevant to individuals with developmental disabilities and their families. The CIDD provides a continuum of clinical services from complex, interdisciplinary evaluations on-site to more limited and selected clinical services. The Institute conducts research and research training related to understanding the pathogenesis and treatment of all neurodevelopmental disorders. The CIDD is one of a handful of Centers around the U.S. that includes all three national programs of significance in neurodevelopmental disorders an Intellectual and Developmental Disabilities Research Center (IDDRC), a University Center of Excellence in Developmental Disabilities (UCEDD) and a Leadership Education in Neurodevelopmental Disorders (LEND) Program. IDDRC funding from the National Institute of Child Health and Development (NICHD) provides support for research cores that provide cutting edge services to NDRC ~ 45 investigators conducting research 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. The institute also offers services to community agencies through contractual arrangements. Faculty are engaged in numerous on-site and community-based services throughout the year, including, but not limited to, direct service, technical assistance, consultation, continuing education, project evaluation, needs assessments, and policy and planning activities. Clinical and research training are supported by the LEND Program grant and a T32 post-doctoral research training grant from NICHD.

***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). **Drs. Mark Zylka and Ben Philpot direct the Center.**

***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. The center is directed by **Dr. Jan Busby-Whitehead**, M. Andrew Greganti Distinguished Professor of Medicine, and Professor and Chief of the Division of Geriatric Medicine.

***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 as well as the development of novel molecular probes that serve dual functions: disease diagnoses and therapies. 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 Directed by ***Dr. Weili Lin*,** and 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 as well as equipment/infrastructure for developing novel molecular probes for both pre-clinical and clinical applications. The BRIC supports several core resources including a human imaging core, small animal imaging core, radiochemistry and radiopharmacy core, study coordinators 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 best way to accomplish the fundamental goal “to bring the benefits of science more quickly into patient care” is through an integrated academic home, with an experienced staff who provide campus investigators with a wide array of expertise in all facets of clinical and translational research – essentially a “one stop shop” for the execution of high-quality research. 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 resources, services and strategic initiatives such as biomedical informatics services, dissemination and commercialization services, community and stakeholder engagement platforms, and a proposal development core.. 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 an engine of original research in translational science and operates a robust program of research into the ways to facilitate clinical and translational research, removing barriers to successful completion and translation of science to the bedside. This program includes research support for campus investigators ranging from pilot grants to substantial multi-year funding. NC TraCS is under the leadership of ***Dr. Nicholas Shaheen***, the Bozymski-Heizer Distinguished Professor and Chief of the Division of Gastroenterology & Hepatology and ***Dr. John Buse***, the Verne S. Caviness Distinguished Professor, and Director of the Diabetes Center.

The **Center for Women’s Health Research** at UNC is dedicated to learning more about diseases, disorders, and conditions that affect women only, women predominately, and women differently than men.  This is a small, lean organization adept at leveraging existing resources to bring research dollars to the university—since 1999 more than $50 million in grants, contracts and clinical trials. They work across departments, schools, centers, institutes and colleges to identify new areas for research and facilitate proposal development and submission through the use of efficient and effective processes.  New research translates into increased potential for research dollars for the university.  Additionally, they have conducted several program evaluations for agencies receiving state funds. Their evaluations focus on program outcomes and are instrumental in helping ensure that state dollars are being well spent. They provide exemplary research services to women’s health investigators across the campus, regardless of department, division, school or college.

# 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 for cores who are not funded through larger program projects or center grants. Those expenses that are not covered by 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 **Metabolic 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 a Seahorse XFe96 which provides cellular metabolic analysis 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 **Preclinical Research Unit** 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.), aseptic surgery, intra-cardiac injections, animal identification, laboratory coordinator services, tissue/blood collection, colony management, drug dosing/oral gavage, IVIS imaging, and protocol assistance. The PRU also provides access to Genetically Engineered Mouse Models (GEMMS) and syngeneic models for cancer research.

The **Cardiovascular Physiology and Phenotyping Core** under the direction of Dr. Aung Mo Zaw and supported by the McAllister Heart Institute, 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 both animal and human models. The facility has the equipment and expertise to produce reliable, high-quality sections from fixed and unfixed tissues, and 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 contains serial sections representing a specific distance through the full length of that tissue. Special stains and immunohistochemical assays, including immunofluorescence are routinely performed in the facility. The core can also perform *in situ* hybridization using RNASCope and BaseScope technology. 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 **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 Pathology Services Core, directed by Charlene Santos and managed by Gabriela de la Cruz, 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 **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. Housed within the Department of Genetics, Dr. Fernando Pardo Manuel de Villena is the faculty director, and it is directed by Dr. Rachel Lynch.

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 was installed in 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 directed by Dr. Krzysztof Krajewski 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 gonio stat 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 biospecimen from population, clinical and other studies. The core lies within the purview of the Gillings School of Global Public Health with support from the Lineberger Comprehensive Cancer Center and is directed by Dr. Patricia Basta. 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. Rose Mary Xavier 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 **Metabolism and Exposome Laboratory (MEL)** with faculty from the Gillings School of Global Public Health encourages and facilitates application of metabolomics in a broad range of basic, clinical, and translational sciences.  The MEL is experienced in analysis of a wide range of biospecimens derived from human and model systems, including urine, plasma, serum, stool, cecal, sweat, and breast milk, as well as cells and organ tissue. The MEL investigators have applied metabolomics approaches in a wide range of disease and therapeutic areas in studies of precision medicine, precision nutrition, and environmental health. The MEL offers a) quantitative targeted analysis of choline and choline related metabolite, b) targeted analysis using Biocrates p180 and MxP Quant 500 kits for analysis of up to 630 analytes of host and microbial metabolism, c) untargeted metabolomics analysis using high resolution mass spectrometry for the capture of 10s of 1000s of signals from metabolites of host and microbial metabolism, drugs and medications, and a wide range of environmentally relevant analytes, with automatic algorithms for matching 10s of 1000s of signals to an inhouse physical standards library of over 2,400 compounds, and over 1.7M spectra from public databases, d) cytokine arrays, e) nuclear magnetic research spectroscopy for metabolomics and metabolite identification, f)  isotopic tracing experiments, and g) statistical analysis, modeling, pathway mapping, and biological interpretation. The MEL facility is located at the UNC Chapel Hill Nutrition Research Institute (UNC NRI) on the North Carolina Research Campus which primarily focuses on nutrition research, including the use of metabolomics to inform the development of nutritional intervention strategies.  The MEL includes university approved rates for metabolomics services and welcomes virtual and on-site training.

The **Tissue Procurement Facility (TPF)** in the School of Medicine’s Lineberger Comprehensive Cancer Center 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 and 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 **Pathology Services Core (PSC)** in the School of Medicine is 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, DCM, and DPLM personnel and offers support to all UNC investigators to enhance translational research. The PSC is designed to meet the needs of basic, clinical and population scientists who require analysis of human tissues. The PSC provides:

* Histopathology services including preparation of formalin-fixed paraffin-embedded (FFPE) and frozen samples, routine and special staining, immunohistochemistry and immunofluorescence, *in situ* hybridization, spatial biology services (using Visium, Phenocycler-Fusion, and Geo-MX technologies),
* 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 digital pathology services through slide scanning and pathology review 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 **Respiratory TRACTS** Core (RTC) is in the Marsico Lung Institute and directed by Mandy Bush. The Respiratory TRACTS Core provides turnkey services to clinical and biomedical investigators at the University of North Carolina at Chapel Hill as well as off-site investigators. The core’s main focus is kickstarting translational research projects by aiding investigators in:

· Logistics: study design, methodological planning, and data analysis consulting

· Sample Management: collection, processing, and storage of biological samples along with dedicated technical personnel for assay performance

· Analysis: generating data using a wide range of unbiased and targeted approaches and state-of-the-art technologies

The RTC can also support clinical trials or studies concerning Covid-19.

## Genomics Cores

The **Advanced Analytics Core (AAC)** provides support services for epithelial organoid research and high-quality, quantitative solutions for studying nucleic acids at both the bulk and single-cell level. The Core offers a wide variety of services, including: single cell -omics (10x Genomics/Fluidigm C1 scRNA-Seq and scATAC-Seq), high-throughput RNA-seq (Fluidigm Advanta), high-throughput qPCR/dPCR (Fluidigm BioMark HD), cell sorting (Sony SH800), spatial transcriptomics (10x Genomics Visium), library preparation (both manual and automated), sequencing (Illumina NextSeq 1000), ready-made conditioned media, and 2D/3D organoid culture support.

The **High Throughput Sequencing Facility** (HTSF) focuses on next generation sequencing. UNC-Chapel Hill maintains several core facilities focused on genome sciences. Part of UNC’s success in maintaining an exciting research atmosphere is its open-door policy for core research facilities. Most importantly for this project, our lab has extensive positive collaborations with the UNC High-Throughput Sequencing Facility (HTSF, http://www.unc.edu/htsf/), which is supported by the School of Medicine and the Cancer Center. They operate state-of-the-art next generation sequencing instruments. The HTSF has 1 NovaSeq 6000(Illumina**)**,, 2 NextSeq2000(Illumina**)**, 4 MiSeq(Illumina**)**,, 1 GridION(Oxford Nanopore) and 1 PromethION P2 (Oxford Nanopore) Systems, as well as associated equipment necessary for efficient operation, including a capillary electrophoresis systems – 2 LabChipGX (Perkin Elmer), 2 Tape Stations (Agilent), 2 Bioanalyzes (Agilent); DNA shearing devices Covaris LE220, S2, and a host of other equipment including a Chromium system (10x Genomics) for single cell analysis and Saphyr (BionanoGenomics) for optical mapping of the genome.

* **NovaSeq 6000 and NextSeq2000** are state-of-the-art sequencing systems from Illumina. It combines patterned large scale flow cells with new 2 color chemistry (combination of colors for each of 4 nucleotides). It can provide maximum sequencing output of the 20 billion clusters in 4 days. Output depends on the type of flow cell and can be used for both medium and large-scale sequencing projects. Our tests indicate no technology bias for RNAseq comparing to the HiSeq4000 system. Therefore, we can predict that this technology soon become dominant for counting applications as well as resequencing of the genomes.
* **MiSeq** system is small scale sequencing system useful for amplicon sequencing and QC sequencing for large pool of RNAseq libraries form difficult material (FFPE). It can produce variety of reads length and scale dependent on type of used flow cell. It uses random clustering technology and 4 color chemistry therefore it is resistant for low complexity and low-quality sequencing libraries.
* **GridIon and PromethION P2** from Oxford Nanopore system is state-of-the-art single molecule sequencing technology. It is using nanopores as an electric current detector for sequencing single stranded DNA or cDNA. It is used in our laboratory for Whole Genome Sequencing of small and medium size genomes since can produce around 10Gb of large sequencing reads (more than 100Kb). Recently we started experiments with low and high input RNAseq on samples prepared from high quality RNA (fresh/frozen RIN >8). Using nanopore technology we are able to produce sequencing data from around 5 million full length transcripts which opens new opportunity in reproducible analysis of transcription level with detection of real splicing variants present in the sample. This application can be extended to single cell level and expanded by transition to PromethION larger scale production system.
* **Chromium system** from 10x Genomics is the most popular system for single cell applications. It rapidly and efficiently combines large partition numbers with a massively diverse barcode library to generate >100,000 barcode containing partitions in a matter of minutes. Therefore, system is capable to perform reproducibly single cell barcoding for many samples per day. We are using it for genome fazing, single cell ATACseq, V(D)J and 3’ end expression profiling.
* **Saphyr** system from BionanoGenomics is state-of-the-art optical mapping system for detection structural variation in the genomes. It can also assist in genome assembly for de novo projects. Currently we are not using this system for any type of RNAseq applications, but it can be used for verification gene fusions and other abnormalities detected in RNAseq experiments.

All sequencers are associated with on-board computers for real-time data processing, with one server dedicated to data analysis.

To increase efficiency and reproducibility of library preparation and pooling we are utilizing six robotic systems supporting unique and overlapping applications—two Genesis systems 150 and 200 (TECAN), one Biomek (Becman Coulter), one Bravo (Agilent), one Sciclone G3 (Perkin Elmer) and Mantis (Formulatrix). Library preparation process for RNAseq application can be performed on more than one system to assure redundancy in our workflow. Additionally, we have dedicated PhD level employees extensively trained by both Tecan and Perkin Elmer to install new protocols, test them, prepare new scripts or adjust existing scripts according to current needs. We are collaborating with Tecan on development scripts for library preparation protocols on their Genesis NGS Workstation series. Our scripts for TruSeq RNA applications are released and distributed by Tecan. Here is short description of our automation systems:

* **Genesis** 150 (8 tip) and 200 (8 tip and 96 head) air displacement systems which are dedicated for everyday liquid handling solutions. We prepared scripts for loading 96 well plates, handling dilutions, Pico Green DNA assay and all other custom applications. Additionally, if needed, our Genesis systems are capable of TruSeq (mRNA, total RNA and RNA exome - Illumina) and NEBNext Ultra II (NEB) Stranded mRNA and total RNA library preparation up to 48 samples per batch. New library preparation protocols can be easily automated on these systems.
* **Bravo** from Agilent is our dedicated system only for TruSeq mRNA and TruSeq total RNA seq library preparation. We have already used it for more than 15000 samples including TCGA and other large RNAseq projects. This system is capable of preparing around 384 libraries per month in full production scale. If necessary, as a redundancy for workflow, we can support production of TruSeq RNAseq libraries using both Tecan and Beckman Coulter liquid handling systems.
* **Biomek** (Beckman Coulter) is supporting system for our TruSeq RNAseq production on Bravo instrument. It is capable of customized liquid handling functions necessary for large production. This system is also able to prepare KAPA Stranded mRNAseq and total RNAseq libraries per our customers request.
* **Siclone G3** from Parkin Elmer is high capacity 96 head system design for large volume library preparation. It is our main system for NEXT flex Small RNA library production (miRNA). We are also utilizing this system for KAPA DNA/RNA and Lexogen RNA library preparation. We can produce around 800 libraries per month in our standard production capacity. Since this system has only 96 head it is dedicated only for projects of over 48 samples per batch. It is also our redundancy system for TruSeq library preparation if Bravo and Beckman system are during the service.
* **Mantis** is miniature system dedicated for small volume liquid handling. It allows us reproducibly handle volume 0.5ul up to 20ul for selected number of processed samples at 96 plate and high speed of pipetting. Therefore, we are able to construct KAPA Hyper DNA and KAPA Hyper mRNA (during validation) libraries using portions of the reagents what reduce cost of our operation. Our R&D is planning to use this system for single cell, amplicon and RNAseq applications.

Twenty full-time personnel, in addition to the Technical Director, Dr. Piotr Mieczkowski, staff the HTSF. UNC Center for Bioinformatics (see below) staff is responsible for data processing, data management, initial analysis and distribution of all data generated at UNC HTSF. We have accumulated considerable experience with analysis of data from Illumina sequencers since 2007. Through collaborations with the UNC labs, RAM-Lab core and G-PATH core, we also have access to a Rhapsody (BD), additional robotics, and two NextSeq 500s.

Information Technology Services (ITS) is the campus provider of leading-edge information technology service and support. The ITS division of Research Computing develops and maintains computing infrastructure for research support, while also directly engaging researchers to develop and deploy the needed tools and capabilities. Among the computing resources available for researchers at UNC-Chapel Hill are a 64-processor SGI Origin 3800 server; a 24-processor statistical computing domain in a Sun Fire 15K; a 352-processor Beowulf Linux cluster; a 32-processor SGI Origin 2400 server; and a 32-processor IBM Regatta P690 server. ITS operates several other large-scale computer systems, which are available for data management, statistical computing, and communications. An extensive library of centrally provided and managed software applications are available for use. More than two hundred software packages and utilities are offered for use on the central systems. By relying on ITS to maintain the hardware, security environment and software builds of computing systems, researchers are free to devote their time to science and research rather than to system administration. The faculty director of the HTSF, has secured the purchase of an additional 64, 8 processor nodes and ~900 Tbyte of hard disk space to be dedicated to the processing and analysis of NextGen sequence data. *[A general description of the services provided by Information Technology Services that is less specific to the HTSF can be found on page 42]*

The **Bioinformatics and Analytics Research Collaborative (BARC)** has provided Information technology and bioinformatics analysis support for the UNC-HTSF since its inception. Bioinformatics staff are responsible for data processing, data management, initial analysis and distribution of all data generated at UNC HTSF. They have worked with a number of open-source software tools (including but not limited to SAMTOOLS, Bowtie, TOPHAT, BWA, SOAP2, MAQ etc.) that are used for analysis of deep-sequencing data. Hardware support for the facility includes four Dell Poweredge 2950 servers running Redhat enterprise Linux (EL4) (each with 2 x 2.66 GHz Quad core Xeon CPU’s, 32 GB RAM, 6 TB of disk storage) available for management/analysis of data from the next-gen sequencers within the Center, and a 30TB iSCSI SAN for next-gen sequence data analysis and storage. A small Linux cluster (20 node) was recently installed shortly to help facilitate large-scale analysis of sequence data. In addition to open-source software programs meant for analysis of next-gen sequence data (maq, ChIP-seq, mosaik, phred/phrap/consed) there are two network licenses for CLC Genomics Workbench. Dr. Tristan De Buysscher, a senior bioinformatics scientist in the Center, provides dedicated programming support for informatics for high throughput sequencing projects. *[A general description of the services provided by the Bioinformatics and Analytics Research Collaborative (BARC) that is less specific to the HTSF can be found on page 40]*

The **Mammalian Genotyping Core** is a high-throughput facility and is part of the Integrated Genomics Core overseen by Gregory Bowen and is managed by Amanda Gerringer. 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 **UNC Microbiome Core Facility** is equipped to perform standard and high throughput isolation of nucleic acids from samples of diverse origins using the KingFisher™ Flex Magnetic Particle Processor (Life Technologies). The laboratory also holds the instrumentation to conduct standard, high throughput and digital qPCR assays. Equipment includes 2 Q-PCR machines (ABI), 5 PCR machines (ABI), and QuantStudio 3D™ Digital PCR system (ThermoFisher Scientific). Instruments for standard microbiology techniques include a WASP 2 Spiral plater and ProtoCol Colony Counter (Microbiology International), Gene pulser Xcell Total System (BioRad), CX43 Biological Microscope (Olympus), 2 incubators (Thermo Scientific), 2 anaerobic chambers (Coy Laboratory products), 3 laminar flow hoods (Thermo Scientific), Glo Plate Blue- LED illuminator (Biotum, inc) and VirTis Advantage Lyophilizer (SP Scientific). The core is equipped to perform barcoding and sequencing of complex microbial samples with the Ion S5 and Ion Chef system (ThermoFisher) and direct access to Illumina sequencers through the UNC High Throughput Sequencing Facility.  Finally, the laboratory is equipped with other standard instruments for sample processing and DNA QC and quantification: Infinite M200 Monochromator Microplate reader (Tecan), NanoDrop (Thermo Scientific),4 centrifuges (Eppendorf), -80 Freezer (Thermo Scientific), -80 Freezer w/nitrogen backup (Thermo Scientific), imaging system (Fotodyne), Tissuelyser II (Qiagen), 2200 Tapestation (Aligent) and Z1 Single Threshold Particle counter (Beckman-Coulter). Services include nucleic acids isolation, IonS5 – amplicon library preparation with barcoding, IonS5 – genomic library preparation with barcoding, Illumina – amplicon library preparation with barcoding, Illumina – genomic library preparation with barcoding, Illumina – RNA library preparation with barcoding, high throughput qPCR, qPCR, Digital PCR, consultation, and bacterial cultivation (strain culture collection).

The **Functional Genomics Core** has been in operation since 2000. The core performs expression profiling, SNP genotyping and copy number microarray services utilizing Thermo Fisher/Affymetrix microarrays. We currently have Beckman Coulter's Biomek FXP Target Prep Express robot and the GeneTitan Instrument from Affymetrix which allow the processing of hundreds of microarray samples in a week. Also, we have the Affymetrix GeneChip Scanner 3000 7G Plus Targeted Genotyping System in the Core. It has the ability to scan all research arrays manufactured by Thermo Fisher/Affymetrix including the high-density expression arrays which place an entire genome on one GeneChip. This equipment includes 2 Fluidics Station 450s and the GeneChip Hybridization Oven 645.

The **Vector Core** was created to ensure that investigators would have promising gene vectors available in the quality and quantities needed for preclinical studies. 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. .

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.

The **Lenti-shRNA and Lenti-cDNA Core Facility** is premised on three libraries: a human cDNA library in lentiviral vector to overexpress human genes under the control of a CMV promoter and two Open Biosystems’ TRC1 shRNA libraries to knockdown either mouse or human genes. The shRNA libraries are cataloged as single lentiviral-vector shRNA expression clones directed to ~16,000 human and mouse genes. Each gene is targeted by 4-5 different shRNAs driven by the U6 promoter. Furthermore, control vectors bearing scrambled shRNAs or shRNAs directed against GFP are available. The shRNA core provides lentiviral shRNA vectors in the form of glycerol bacterial stocks or vector particle preparations (~10mL). The shRNA core also provides consulting in designing and optimizing shRNA-encoding lentiviral vectors. Upon request, the core can also provide alternate platforms for shRNA delivery, employing a variety of promoters and other cis elements to improve shRNA expression. As mentioned above the core provide lentiviral vectors expressing human cDNAs included in the ORFeome V8.1 library. In addition, the core provides packaging of non-concentrated (10e to 10e8 IU/ml) and concentrated/purified vectors (10e9-10e11 IU/ml) for in vivo applications. Included in  concentrated-vector production are 3 safety assays to rule out the emergence of replication competent retroviruses (RCRs) and tittering of vector physical particles by p24 gag ELISA. The core provides tittering services by qPCR, antibiotic selection assays and by fluorescence microscopy.

## Imaging Cores

The **Chapel Hill Analytical and Nanofabrication Laboratory** (CHANL) in the Department of Chemistry 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.  Characterization equipment includes atomic force microscopy (AFM), Fourier transform infrared (FTIR) spectroscopy, energy dispersive spectroscopy (EDS), scanning and transmission electron microscopy (SEM and TEM), micro spectrophotometry, nanoindentation, spectroscopic ellipsometry, powder X-ray diffraction (PXRD), and x-ray photoelectron spectroscopy (XPS). Fabrication equipment includes atomic layer deposition (ALD), electron beam evaporation, metal sputtering, plasma enhanced chemical vapor deposition (PECVD), deep reactive ion etching (DRIE), focused ion beam (FIB) milling, maskless laser writing, and electron beam and optical lithography.

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 spinning disk confocal microscope, 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 basic and advanced light microscopy access and electron microscopy sample preparation, imaging service and user training. Users receive thorough instruction on how to set up and use the required instrumentation with emphasis targeted to the specific requirements of their experiment. Careful attention is also paid to how to optimally obtain accurate data. The newest acquisitions are a Leica Stellaris 8 FALCON STED confocal and super-resolution microscope, an Evident Scientific VS200 slide scanner and Keyence BZX-810 widefield fluorescence and color imaging. Other instruments include a Zeiss LSM 880 with Airy scan FAST, Zeiss LSM 800 upright confocal, GE Healthcare INCell Analyzer 2200 high content imaging system, and Leica MZ16FA fluorescence stereo macroscope. Transmission electron microscopy is performed with an FEI Tecnai 2 transmission electron microscope with Gatan Rio 16 camera. Image analysis is facilitated by a high-speed workstation with many sophisticated analysis programs, including Imaris and QuPath. Light microscopy resources are under the direction of Wendy Salmon and Paul Risteff provides electron microscopy expertise and services. Wendy also teaches in graduate courses and spearheads an informal seminar series on topics of microscopy theory and application.

The **UNC Mass Cytometry Core**, directed by Marie A. Iannone, provides researchers with access to the Helios CyTOF system by Standard Biotools and the CellRaft AIR, a cell isolation instrument from Cell Microsystems. Mass Cytometry combines elements from flow cytometry and inductively coupled plasma mass spectroscopy. Also called CyTOF (for time-of-flight cytometry), this powerful new technology enables massive multiparametric analysis of single cell suspensions to investigate cellular responses in heterogeneous populations. Cells are stained with 40 or more antibody probes that are each coupled to unique transition elements and lanthanides. The presence and abundance of the metal tags on surface epitopes and intracellular markers of individual cells are used to understand cell responses such as cytokine production, phosphoprotein signaling, or nuclear antigen expression in such complex and heterogeneous populations as hematopoietic and cancer cells. The facility offers comprehensive expertise and support to enable successful mass cytometry experiments. The core provides assistance with mass cytometry panel design, protocol support, antibody procurement, data acquisition and basic support for single cell data analysis using Cytobank and Astrolabe Diagnostics. The facility is open to all UNC clinical and scientific researchers as well as to external universities and commercial researchers and is located in the basement of Marsico Hall.

The UNC **CryoEM Core Facility** was established in 2019 and provides investigators technical assistance with all aspects of cryoEM in a supportive collaborative environment.  The core is under the direction of ***Dr. Joshua Strauss*,**and has already enabled many scientific breakthroughs, such as the development of optimized mythologies for cryoEM and the structural determination of different macromolecular complexes including GPCRs, Nucleosomes, lipoprotein lipase, Anaphase promoting complex, AP2 clathrin adaptor complex, to name a few.  This core supports a large and diverse group of researchers in North Carolina from both academia and industry, across multiple life science disciplines.  The core offers access to cutting edged high-resolution 3D imaging techniques and specimen preparation for biological and non-biological samples.  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 **Bioinformatics and Analytics Research Collaborative (BARC)** was established in 2019 by Drs. Corbin Jones and Christopher Gregory. They continue to provide executive leadership as faculty advisors for BARC. Dr. Hemant Kelkar is BARC operations manager and serves as its director. BARC provides consultations, bioinformatics analysis, data analysis, application development, and training services to support the growing bioinformatics needs of researchers in the School of Medicine. BARC helps connect the numerous bioinformatics resources across the university. BARC thus works closely with ITS-Research Computing, School of Medicine Research IT and Information security groups. BARC manages licenses for several commercial bioinformatics software packages that are made available to UNC-CH researchers. BARC also provides local installation and technical support for these packages. BARC provides extensive and cost-effective bioinformatics expertise to entire UNC-CH campus and its many schools . *[A description of how Bioinformatics and Analytics Research Collaborative (BARC) supports the HTSF can be found on page 37]*

# Renovation/Construction of Laboratory Space

A major new building and renovation program is continuing in the School of Medicine. During the past 20 years, the School have opened and / or renovated the buildings listed in Table 1 and has 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 in 2014 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. 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. In 2020, Berryhill Hall was demolished making way for the new Roper Hall Medical Education Building which is anticipated to open in the spring of 2023. UNC is also evaluating design and construction for a new Translational Research Building which would provide vivarium expansion and allow for large animal studies.

## 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 | 230,975 | 2019 | $114 M |
| Roper Hall Medical Education Building | 175,970 | 2023 | $107 M |
| Glaxo/MBRL Bldg CryoEM Renovation | 1,200 | 2019 | $3.6M |
| Burnett-Womack 4th and 5th Renovation | 14,000 | 2020 | $3.3M |
| Marsico Hall Large Animal Vivarium Renovation | 4,500 | 2020 | $2.8M |
| Marsico Hall – BRIC 3T MRI Renovation | 4,000 | 2021 | $3M |

# 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 planning to build 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 Gigabit network backbone, virtual server infrastructure, and enterprise storage), Learning Management, Production Services, Research Computing, Software Acquisition, Training, and Enterprise Content Management.

**ITS Research Computing** - Information Technology Services (ITS) is the campus provider of leading-edge information technology service and support. The ITS division of Research Computing develops and maintains computing infrastructure for research support, while also directly engaging researchers to develop and deploy the needed tools and capabilities. Among the computing resources available for researchers at UNC-Chapel Hill are a 64-processor SGI Origin 3800 server; a 24-processor statistical computing domain in a Sun Fire 15K; a 352-processor Beowulf Linux cluster; a 32-processor SGI Origin 2400 server; and a 32-processor IBM Regatta P690 server. ITS operates several other large-scale computer systems, which are available for data management, statistical computing, and communications. An extensive library of centrally provided and managed software applications are available for use. More than two hundred software packages and utilities are offered for use on the central systems. By relying on ITS to maintain the hardware, security environment and software builds of computing systems, researchers are free to devote their time to science and research rather than to system administration. *[A description of how ITS supports the HTSF can be found on page 37]*

***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, digital photography and video recording, production and editing.

***Personal Computing*** – Wireless network access is available in many common areas throughout the school and data ports 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.