Cancer Biology

The Undergraduate Program in Cancer Biology was established in 2020 as a joint program between the Department of Chemistry in the College of Arts and Sciences and the Department of Cell, Developmental and Integrative Biology (CDIB) in the Heersink School of Medicine. This program is the only one of its kind in the US to specifically train students in cancer biology.

The central mission of the new Cancer Biology undergraduate major is to provide students with a strong educational and research background that maximizes their chances to achieve career goals in cancer biology in particular and life sciences in general. This program is unique in that students will gain a broad background in the biomedical sciences by exposure to courses that support the current requirements of the biomedical enterprise and are applicable to academic, private, and government settings. Furthermore, by requiring a research component, all students within this major will have early exposure to a cutting-edge research environment through participation in current investigator-led programs in multiple research-intensive departments at UAB and in collaboration with the O’Neal Comprehensive Cancer Center.

UAB’s mission includes the promotion of discovery, knowledge dissemination and education. The Cancer Biology major helps to fulfill these goals by training students to take up positions in research and clinical laboratories, by providing a solid foundation for future graduate study, and by providing informed individuals appropriate for employment in multiple health-related settings. Disciplines covered will include not only cell biology and chemistry, but also microbiology, immunology, genetics, pathology, pharmacology and medicine. This interdisciplinary curriculum reflects the diverse nature of the disease itself.

Because of these features, students will be exposed to a robust and flexible educational experience. Undergraduates will have the opportunity to undertake high quality research in laboratory settings across campus. They will receive research training from world-class investigators at an earlier stage than their peers and have exposure to state-of-the-art technologies, which will increase the desirability of these students for both professional careers or post-graduate programs with an exceptional background in cancer biology and laboratory research.

Admissions

The Undergraduate Cancer Biology Program is designed for graduating high school seniors and college freshmen and sophomores with an outstanding academic record and the desire to pursue a career in biomedical research, medicine or the health professions. Successful applicants to the program should meet the admissions criteria below.

First-time freshmen applicants must have a high school cumulative GPA of 3.5 or higher (on a 4.0 scale) and an ACT composite score of 28 or higher (or the SAT combined V+Q score at 1300 or higher). High school students who do not meet these requirements may be accepted into the program as pre-Cancer Biology majors. Any student who is admitted as a pre-Cancer Biology major must have an overall GPA #3.0 after 24 credits of work at UAB, a GPA #3.25 in their Biology, Chemistry, Physics and Mathematics (MA 105 and higher) coursework, and have taken a freshman year curriculum that is compatible with the Program. Current UAB students and transfer students from other institutions who are freshmen or sophomores (non-direct admits) may select Cancer Biology for their major, but must have an overall GPA #3.0 and must have demonstrated excellent academic performance in science/mathematics courses and have a GPA #3.25 in those courses.

Students must maintain an overall GPA #3.0 in order to remain in good academic standing in the Cancer Biology Program. If a student’s overall GPA falls below 3.0, they will have one semester to bring their overall grade to 3.0 or better.

Those who wish to apply to the Program should contact the Program Directors for additional information. The Co-Directors of the Program, Dr. Braden McFarland and Dr. Sadanandan Velu, are available to meet with high school students and their parents, or with current UAB students to discuss the program.

Advising and Information

Program Leadership:
Dr. Braden McFarland
Co-Director, Undergraduate Cancer Biology Program
Assistant Professor of Cell, Developmental and Integrative Biology (CDIB)
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Dr. Sadanandan Velu
Co-Director, Undergraduate Cancer Biology Program
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Academic Advising:
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Bachelor of Science in Cancer Biology

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Cancer Biology Courses

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### Cancer Biology

**CNBY 320** Introduction to Cancer Biology  
**CNBY 410** Proliferation and Carcinogenesis  
**CNBY 420** Genetic Basis of Cancer  
**CNBY 480** Journal Club in Cancer Biology  
**CNBY 495** Undergraduate Research in Cancer Biology  
**CNBY 499** Senior Undergraduate Research Capstone Course

**Other Required Courses**  
PHL 116 Bioethics  
CAS 112 Success in College  
PSDO 200 Research Design  
MA 125 Calculus I  
MA 180 Introduction to Statistics  
or PUH 22 Biostatistics  
PH 201 College Physics I  
or PH 221 General Physics I  
PH 202 College Physics II  
or PH 222 General Physics II

**Major Electives (must take 2)**  
CH 461 Advanced Biochemistry  
CH 463 Biochemistry Laboratory  
or CH 464 Physical Biochemistry Laboratory  
CH 471 Medicinal Chemistry and Drug Discovery  
CH 472 Chemistry of Natural Products  
CNBY 430 Tumor Survival and the Microenvironment  
CNBY 440 Cell Signaling and Cancer  
CNBY 460 Tumor Pathobiology and Immunology  
CNBY 470 Cancer Treatment

**General Electives**  
12

**Total Hours** 121

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1. Area III credit requirements are included with major courses.
2. 1 credit hour per term, must be taken twice.
3. Undergraduate Research: Cancer Biology Majors are required to complete a minimum of 9 semester credit hours [CNBY 495 (6h) + CNBY 499 (3h)] of research under the direction of a faculty member beginning no later than their junior year. However, qualified students may identify a mentor and begin conducting research as early as their sophomore year if prerequisites are met (PSDO 200; pass) and approval by the faculty mentor and the program co-directors.
4. PH 222 requires Calculus II (MA 126). MA 126 is not required for CNBY majors; only Calculus I (MA 125) is required for CNBY majors.
5. Recommended but not required courses include:
   - BY 115/BY 115L, BY 116/BY 116L, BY 245, BY 311, BY 327/BY 327L, BY 408/BY 408L, BY 416, BY 433, BY 440, GGSC 410, GGSC 420, GGSC 491, and MIC 275.

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**Courses**

**CNBY 210. Colloquium in Cancer Biology. 1 Hour.**  
This course will introduce students to current topics in cancer biology. The goal is to cover a wide range of subjects, with speakers from UAB and if appropriate from outside institutions. Topics covered will be very broad and range from basic science to clinical and translational medicine, and if appropriate will also address some of the ethical issues surrounding cancer treatment and the sociological impact of chronic disease. The goal will be to build interest in the topic and for students to gain a broad appreciation of the many facets of the disease.

**CNBY 320. Introduction to Cancer Biology. 3 Hours.**  
This course will introduce students to cancer biology. Topics will include the history of cancer, hallmarks of cancer biology on a cellular level, common cancers in the body, cancer treatment, and prevention and risk factors. This course will serve as a foundation and prerequisite to the more advanced upper level CNBY courses.

**Prerequisites:** BY 123 [Min Grade: C] and BY 124 [Min Grade: C]
CNBY 410. Proliferation and Carcinogenesis. 3 Hours.
This course will cover the basic tenets of cell biology as they apply
to cancer. Topics to be covered will include the cell cycle, how cells
normally grow and divide, how they stop growing and how that process
is disrupted in cancer; the normal processes associated with cell death
such as autophagy, apoptosis and necrosis; the concepts of “stemness”
and immortalization in relation to cancer cells and the role of telomerase,
mutagens, environmental toxins and DNA repair.
Prerequisites: CNBY 320 [Min Grade: C]

CNBY 420. Genetic Basis of Cancer. 3 Hours.
This course will provide an overview of genomic organization transcription
and translation, prior to commencing an in-depth study of cancer genetics
and the roles of oncogenes, tumor suppressors, RNA, DNA methylation,
gene amplification and the control of gene expression and the viral
causes of cancer. Students will also be introduced to basic concepts in
bioinformatics and database mining using The Cancer Genome Atlas
(TCGA) as a model.
Prerequisites: CNBY 320 [Min Grade: C]

CNBY 430. Tumor Survival and the Microenvironment. 3 Hours.
This course will examine cancer cell physiology in terms of the tumor
microenvironment, nutrients and angiogenesis and will explore how these
influence cancer cell survival, invasion and metastasis.
Prerequisites: CNBY 320 [Min Grade: C]

CNBY 440. Cell Signaling and Cancer. 3 Hours.
In this course the major cell signaling pathways involved in cancer cell
development will be examined. An initial overview of signaling (cytosolic,
nuclear, dual-address), receptors and basic second messenger pathways
(PKA/PKC) will be followed by an in-depth study of pathways of particular
relevance to cancer such as receptor tyrosine kinases, RAS, PI3 kinase/
PTEN, growth factors (e.g. EGF, TGF-β), integrins, Wnt/β-catenin and
JAK/STAT pathways. The role of post-translational modifications of
proteins, such as glycosylation will also be discussed.
Prerequisites: CNBY 320 [Min Grade: C]

CNBY 460. Tumor Pathobiology and Immunology. 3 Hours.
This course will examine the pathological changes that occur in cancer
cells and tissues. The course will start with a brief overview of normal
histology and will then focus on pathological changes that occur in
some select cancers, e.g., colon, lung and breast. This will be followed
by exploration of the roles of infection and immunity in cancer that
will involve the role of innate and adaptive immunity and cancer cell
defenses. The course will conclude by discussing cancer staging and
classification of different cancers.
Prerequisites: CNBY 320 [Min Grade: C]

CNBY 470. Cancer Treatment. 3 Hours.
Major advances have been made in the diagnosis and treatment of
multiple cancers. This course will review current therapeutic approaches
to cancer treatment including radiotherapy, chemotherapy, surgery and
gene therapy. This course will also include an introduction to the role of
personalized medicine in cancer treatment. The course will conclude by
considering other facets of caring for the patient with cancer including
maintenance of nutrition, mental health and palliative care.
Prerequisites: CNBY 320 [Min Grade: C]

CNBY 480. Journal Club in Cancer Biology. 1 Hour.
This journal club will be appropriate for senior students. Students, either
individually or in small groups will select, read and present articles from
the current cancer literature as guided by their instructor.

CNBY 495. Undergraduate Research in Cancer Biology. 0-6 Hours.
In this major, students will be required to undertake a research project
and register for 6 credit hours of CNBY 495 Undergraduate Research,
as well as this CNBY 499 Senior Research Capstone course during their
final semester of research.
Prerequisites: PSDO 200 [Min Grade: P]

CNBY 499. Senior Undergraduate Research Capstone Course. 3
Hours.
In this major, students will be required to undertake a research project
and register for 6 credit hours of CNBY 495 Undergraduate Research,
as well as this CNBY 499 Senior Research Capstone course during their
final semester of research. This latter course will serve as the opportunity
for students to write their research into a manuscript for publication,
present a poster or give an oral presentation describing their research for
presentation at the UAB EXPO or another scientific meeting. Students
will work closely with faculty mentors to ensure quality of research and
writing.
Prerequisites: CNBY 495 [Min Grade: P]