Graduate School Bulletin 2021-2022

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Graduate School of Biomedical Sciences
Baylor College of Medicine
One Baylor Plaza, Suite N204
Houston, TX 77030
Version: 11.15.2021
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GSBS Contact Information

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Dr. Andrew Groves, Program Director
Dr. George Rodney, Program Director
2021-2022 GRADUATE SCHOOL CALENDAR

REGISTRATION 1st Term                         July 5-16, 2021
ORIENTATION                        July 28, 29 and 30, 2021

FIRST TERM - AUGUST 2 – OCTOBER 1, 2021
First Class Day                         August 2
Last Day to Drop/Add                   August 9
Holiday                                September 6 (Labor Day)
Registration for Term 2                September 13-24
Last Class Day                          September 24
Exams                                  September 27–October 1

SECOND TERM - OCTOBER 11 – DECEMBER 10, 2021
First Class Day                         October 11
Last Day to Drop/Add                   October 18
Registration for Term 3                November 22–December 3
Holidays                               November 25 & 26 (Thanksgiving & FTO)
Last Class Day                          December 3
Exams                                  December 6-10
Holiday                                December 24 (Christmas Day observed)

THIRD TERM - JANUARY 3 – MARCH 4, 2022
Holiday                                December 31 (New Year’s Day observed)
First Class Day                         January 3
Last Day to Drop/Add                   January 10
Holiday                                January 17 (Martin Luther King Day)
Registration for Term 4                February 14-25
Holidays                               February 21 (Presidents Day-FTO)
Last Class Day                          February 25
Exams                                  February 28-March 4

FOURTH TERM - MARCH 14 – MAY 13, 2022
First Class Day                         March 14
Last Day to Drop/Add                   March 21
Holiday                                April 15 (Good Friday-FTO)
Registration for Term 5                April 25-May 6
Last Class Day                          May 6
Exams                                  May 9-13

FIFTH TERM - MAY 23 – JULY 22, 2022
First Class Day                         May 23
Holiday                                May 30 (Memorial Day)
Last Day to Drop/Add                   May 31
Holiday                                July 4 (Independence Day)
Registration for Term 1 (2022-23)     July 4-15
Last Class Day                          July 15
Exams                                  July 18-22

11/01/2020
# 2021-22 Graduate School Calendar

## Months

### July '21
- 1: 4
- 2: 5
- 3: 6
- 4: 7
- 5: 8
- 6: 9
- 7: 10
- 8: 11
- 9: 12
- 10: 13
- 11: 14
- 12: 15
- 13: 16
- 14: 17
- 15: 18
- 16: 19
- 17: 20
- 18: 21
- 19: 22
- 20: 23
- 21: 24
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- 27: 30
- 28: 31

### November
- 1: 1
- 2: 2
- 3: 3
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- 10: 10
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### March
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### August
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### December
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### April
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### May
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### June
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### July '22
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- 30: 30
- 31: 31

### Notes
- Registration Period for Next Term
- Exams Week
- Holiday/ Student FTO
- Red: Last Day to Add/Drop
- Green: Faculty Grading Deadline
- Orientation
- Term 1
- Term 2
- Term 3
- Term 4
- Term 5
Class Schedule General Information & Definitions

- Course Number:
  - The first two letters identify courses in the Graduate School (GS)
  - The second two letters designate the graduate program that offers the course; the GS-GS designation indicates courses in the interdisciplinary central curriculum.
  - The first digit indicates whether the course counts toward the 30-credit hour requirement for all PhD students
    - 5 = Does not count toward the 30-credit requirement (non-didactic)
    - 6 = Counts toward the 30-credit requirement (didactic)
  - The second digit indicates the number of credits in the course. A zero denotes a course that has a variable number of credits depending on student scheduling needs.
  - The last two digits are an internal identifier of the course.
  - Example:
    - GS-NE-6205

- ARRA = Schedule to be arranged: Instructional & meeting hours will be scheduled by agreement between the faculty member(s) and students.
- AY = Academic Year. The academic year starts with Term 1 at the Beginning of August. This is AY21 (2021-22). AY21 continues through July of 2022.
- TBA = To Be Announced
- V = Variable credit hours
- Course Notes:
  - P = Partial term course. Class does not meet all 8 weeks of the term. See syllabus.
  - X = Course not offered in the current academic year (also highlighted gray).
  - EO = Course offered every other year
  - R = Course is restricted to students in the academic program.
  - C = Cross-listed course in either School of Medicine or School of Health Professions
  - * = Special note

- Days:
  - M Monday
  - T Tuesday
  - W Wednesday
  - R Thursday
  - F Friday

- Building Abbreviations:
  - A Cullen
  - B Cullen
  - C Cullen
  - CNRC Children’s Nutritional Research Center
  - D Jewish
  - E Anderson
  - M DeBakey
  - N Alkek Tower
  - NRI Neurological Research Institute
  - R Alkek Bldg for Biomedical Research (ABBR)
  - S Smith
  - T Taub
  - TXFC Texas Children’s Feigin Center
# FOUNDATIONAL & INTERDISCIPLINARY CURRICULUM

<table>
<thead>
<tr>
<th>COURSE #</th>
<th>COURSE TITLE</th>
<th>DAY</th>
<th>TIME</th>
<th>RM</th>
<th>COURSE DIRECTOR</th>
<th>NOTES</th>
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<tbody>
<tr>
<td><strong>Terms 1+2 Courses</strong></td>
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<tr>
<td>GS-GS-6600</td>
<td>Foundations A: Molecules to Systems</td>
<td>Lecture: M W F</td>
<td>1:15-2:15</td>
<td>100A</td>
<td>Sifers,R</td>
<td>*</td>
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<tr>
<td>GS-GS-6600</td>
<td></td>
<td>Discussion: F</td>
<td>2:30-3:30</td>
<td>N311/N317/M423</td>
<td></td>
<td>*NOTE: Discussion sessions meet on selected weeks during the term; specific dates to be included on syllabus.</td>
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<tr>
<td>GS-GS-6400</td>
<td>Foundations B: Biostatistics</td>
<td>Lecture: M</td>
<td>2:30-3:30</td>
<td>100A</td>
<td>Hilsenbeck/Minard/Wang</td>
<td>*</td>
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<tr>
<td>GS-GS-6400</td>
<td></td>
<td>Labs: R</td>
<td>12:00-1:30 or 2:00-3:30</td>
<td>N311/N317/M423</td>
<td></td>
<td>*NOTE: Thursday course meetings will be either lectures or labs; dates to be included on syllabus. Students will only be assigned to one lab time.</td>
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<tr>
<td><strong>Term 1 Courses</strong></td>
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<tr>
<td>GS-GS-5101</td>
<td>Responsible Conduct of Research Year 1</td>
<td>T</td>
<td>9:00-10:00</td>
<td>100A</td>
<td>Swindell,E</td>
<td></td>
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<tr>
<td>GS-GS-5111</td>
<td>Strategies for Success in Graduate School</td>
<td>M</td>
<td>11:30-1:00</td>
<td>N315</td>
<td>Samuel,M/Sillitoe</td>
<td></td>
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<tr>
<td>GS-GS-5113</td>
<td>Effective Project Design and Management</td>
<td></td>
<td></td>
<td></td>
<td>Samuel,B</td>
<td>X</td>
</tr>
<tr>
<td>GS-GS-6206</td>
<td>Orientation to Clinical Translational Research</td>
<td>T</td>
<td>1:00-3:00</td>
<td>187A</td>
<td>Suter/Parihar</td>
<td></td>
</tr>
<tr>
<td><strong>Term 2 Courses</strong></td>
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<tr>
<td>GS-GS-5102</td>
<td>Responsible Conduct of Research Year 2</td>
<td>T</td>
<td>9:00-10:00</td>
<td>100A</td>
<td>Swindell,E</td>
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<tr>
<td>GS-GS-5112</td>
<td>Powerful Presentations</td>
<td></td>
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<td>Samuel,M/Watkins</td>
<td>X</td>
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<tr>
<td>GS-GS-5103</td>
<td>Responsible Conduct of Research Year 3</td>
<td>T</td>
<td>10:00-11:00</td>
<td>100A</td>
<td>Swindell,E</td>
<td></td>
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<tr>
<td>GS-GS-5104</td>
<td>Responsible Conduct of Research Year 4</td>
<td>R</td>
<td>10:00-11:00</td>
<td>100A</td>
<td>Swindell,E</td>
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<tr>
<td>GS-GS-5105</td>
<td>Scientific Writing</td>
<td>*This course meets Jan 3 to Jan 31</td>
<td>M</td>
<td>2:00-4:00</td>
<td>100A</td>
<td>Marriott,S</td>
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<tr>
<td>GS-GS-5108</td>
<td>Pharmacoepidemiology &amp; Pharmacogenetics</td>
<td></td>
<td></td>
<td></td>
<td>Scheurer/Bernhardt</td>
<td>X,ED</td>
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<tr>
<td>GS-GS-6181</td>
<td>Neuroscience</td>
<td>*This course meets Jan 3 to Jan 28</td>
<td>M W F</td>
<td>12:00-1:00</td>
<td>N311</td>
<td>Ray,R</td>
</tr>
<tr>
<td>GS-GS-6182</td>
<td>Principles of Immunology</td>
<td>*This course meets Feb 1 to Feb 24</td>
<td>T R</td>
<td>12:30-1:30</td>
<td>N311</td>
<td>Decker,W</td>
</tr>
<tr>
<td>GS-GS-6202</td>
<td>Gene Regulation</td>
<td>M W F</td>
<td>1:00-2:00</td>
<td>M112</td>
<td>Cooper,T</td>
<td></td>
</tr>
<tr>
<td>GS-GS-6203</td>
<td>Data Mining</td>
<td>*This course meets Feb 7 to Feb 18</td>
<td>MTW F</td>
<td>2:00-4:00</td>
<td>301A</td>
<td>Shaulsky,G</td>
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<td>GS-GS-6205</td>
<td>Fundamentals of Epidemiology</td>
<td>M</td>
<td>1:00-3:00</td>
<td>N317</td>
<td>Scheurer/Brown,A</td>
<td>C</td>
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<tr>
<td><strong>Term 4 Courses</strong></td>
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<tr>
<td>GS-GS-5106</td>
<td>Intellectual Property</td>
<td>*This course meets Apr 12 to May 5</td>
<td>T R</td>
<td>11:00-12:00</td>
<td>N311</td>
<td>Turley,P</td>
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<tr>
<td>GS-GS-5107</td>
<td>Leadership Skills</td>
<td>*This course meets Mar 15 to Apr 7</td>
<td>T R</td>
<td>11:00-12:00</td>
<td>N311</td>
<td>Fuqua,S</td>
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</table>

# CANCER AND CELL BIOLOGY

<table>
<thead>
<tr>
<th>COURSE #</th>
<th>COURSE TITLE</th>
<th>DAY</th>
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<tr>
<td>GS-CC-5100</td>
<td>Student Research Seminar</td>
<td>M</td>
<td>4:00-5:00</td>
<td>100A</td>
<td>Neildson,J</td>
<td>R</td>
</tr>
<tr>
<td>GS-CC-5301</td>
<td>NRS Grant Writing &amp; Project Development 1</td>
<td>M W</td>
<td>2:00-3:30</td>
<td>N311</td>
<td>Pereira/Pangas</td>
<td>R</td>
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<tr>
<td>GS-CC-6607</td>
<td>Ethics &amp; Regulatory Prep for Research with Animal Models</td>
<td></td>
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<td></td>
<td>Seavitt/Ward</td>
<td>X</td>
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<tr>
<td><strong>Term 2 Courses</strong></td>
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<tr>
<td>GS-CC-5100</td>
<td>Student Research Seminar</td>
<td>M</td>
<td>4:00-5:00</td>
<td>100A</td>
<td>Neildson,J</td>
<td>R</td>
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<tr>
<td>GS-CC-5101</td>
<td>Reading &amp; Evaluating Scientific Literature</td>
<td>M</td>
<td>11:00-12:30</td>
<td>N317/N302</td>
<td>Pereira/Pangas</td>
<td>R</td>
</tr>
<tr>
<td>GS-CC-5302</td>
<td>NRS Grant Writing &amp; Project Development 2</td>
<td>M W</td>
<td>2:00-3:30</td>
<td>N311</td>
<td>Pereira/Pangas</td>
<td>R</td>
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<tr>
<td>GS-CC-6180</td>
<td>Biology of Aging</td>
<td>M</td>
<td>10:00-11:00</td>
<td>187A</td>
<td>Catic/Dang</td>
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<tr>
<td>GS-CC-6201</td>
<td>Translational Cancer Biology</td>
<td>R</td>
<td>1:00-3:00</td>
<td>M112</td>
<td>Yustein,J</td>
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<tr>
<td>GS-CC-6205</td>
<td>Translational Breast Cancer Research</td>
<td>M W</td>
<td>1:00-2:00</td>
<td>N311</td>
<td>Fuqua,S</td>
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<td><strong>Term 3 Courses</strong></td>
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<tr>
<td>GS-CC-5100</td>
<td>Student Research Seminar</td>
<td>M</td>
<td>4:00-5:00</td>
<td>100A</td>
<td>Neildson,J</td>
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<tr>
<td>GS-CC-6101</td>
<td>Cancer</td>
<td>*This course meets Jan 31 to Feb 25</td>
<td>M F</td>
<td>12:00-1:00</td>
<td>N311</td>
<td>Pangas,S</td>
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<tr>
<td>GS-CC-6202</td>
<td>Explorative Data Analysis</td>
<td>T R</td>
<td>11:00-12:30</td>
<td>M616</td>
<td>Lanz,R</td>
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<tr>
<td>GS-CC-6203</td>
<td>Integrated Microscopy</td>
<td>R</td>
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**CHEMICAL, PHYSICAL, & STRUCTURAL BIOLOGY**

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**CLINICAL TRANSLATIONAL RESEARCH CAQ PROGRAM**

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# NEUROSCIENCE

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### Neuroscience Courses

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### Quantitative & Computational Biosciences Courses

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### RESEARCH & SPECIAL COURSES (Legacy)

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### POST-BACCALAUREATE COURSES†

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<td>Wellbeing &amp; Burnout Maintenance for Healthcare Professionals</td>
<td>RF</td>
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<td>111A</td>
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<td>GS-GS-4601</td>
<td>Clinical Biochemistry</td>
<td>TWR</td>
<td>1:30-2:30</td>
<td>N315</td>
<td>Hultén,K</td>
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<td>GS-GS-4202</td>
<td>Introduction to Health Disparities</td>
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<td>Introduction to Biostatistics</td>
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<td>11:00-12:30</td>
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<td>GS-GS-4302</td>
<td>Principles of Genetics</td>
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<td>Fundamentals of Research Methods</td>
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† Not available to Graduate Students
### TERM 1 COURSES

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<td>Neillson,J</td>
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<td>GS-CC-5301</td>
<td>NSRA Grant Writing &amp; Project Development 1</td>
<td>M W</td>
<td>2:00-3:30</td>
<td>N311</td>
<td>Pereira/Pangas</td>
<td>R</td>
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<tr>
<td>GS-CC-6207</td>
<td>Ethics &amp; Regulatory Prep for Research with Animal Models</td>
<td>M W</td>
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<td>N311</td>
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<td>4:00-5:00</td>
<td>N315</td>
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<td>Thinking Like a Scientist 1</td>
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<td>GS-CP-6304</td>
<td>Molecular Biophysics 1</td>
<td>M W</td>
<td>10:45-11:50</td>
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<td>Responsible Conduct of Research for Clinical Investigators</td>
<td>MTWR</td>
<td>5:30-7:30</td>
<td>N315</td>
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* This class meets in weeks 4 of the term
* This class meets during weeks 5 to 9 of the term

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<td>Strategies for Success in Graduate School</td>
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<td>Effective Project Design and Management</td>
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<td>Orientation to Clinical Translational Research</td>
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<td>GS-GY-5105</td>
<td>Seminars in Immunology &amp; Microbiology Research</td>
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<td>N315</td>
<td>Kimata/Lemon</td>
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<td>Literature Review in Immunology &amp; Microbiology</td>
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<td>Brain Cell Biology &amp; Development</td>
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<td>Advanced Topics in QCB</td>
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<td>Practical Introduction to Programming for Scientists</td>
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### TERMS 1+2 COURSES

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<td>GS-GS-6600</td>
<td>Foundations A: Molecules to Systems</td>
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<td>N311/N317/M423</td>
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*NOTE: Discussion sessions only meet on selected weeks during the term; dates to be included on syllabus

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*NOTE: Thursday course meetings will either be lab or lecture; dates to be included on syllabus. Students will only be assigned to one lab group/time.

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<td>Concepts in Host Immune System-Microbe Interactions</td>
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### TERM 2 COURSES

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<td>GS-CC-5101</td>
<td>Reading &amp; Evaluating Scientific Literature</td>
<td>M</td>
<td>11:00-12:30</td>
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<td>Pereira/Pangas</td>
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<td>NSRA Grant Writing &amp; Project Development 2</td>
<td>M W</td>
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<td>GS-DD-6302</td>
<td>CICS 2: Clinical Trials for Clinical Investigators</td>
<td>T R</td>
<td>4:00-5:00</td>
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<td>3:00-4:00</td>
<td>N317</td>
<td>Samuel/Arenkliel</td>
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<tr>
<td>GS-DD-6201</td>
<td>Development</td>
<td>M W</td>
<td>11:30-12:30</td>
<td>N311</td>
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<td>Human Physiology 1</td>
<td>M W F</td>
<td>9:00-10:00</td>
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<td>3:30-5:00</td>
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### TERM 3 COURSES

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* These courses do not meet every week; see syllabus for meeting dates.
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<td>GS-QC-5105</td>
<td>Seminar in Quantitative Biosciences</td>
<td>W</td>
<td>12:00-1:00</td>
<td>187A</td>
<td>Lichtarge/Sugcang,R</td>
<td></td>
</tr>
<tr>
<td>GS-QC-5301</td>
<td>QCB Research Design</td>
<td>T</td>
<td>12:30-3:30</td>
<td>N302/N317</td>
<td>Young,N/Prasad,R</td>
<td></td>
</tr>
<tr>
<td>GS-QC-6202</td>
<td>Computer-Aided Discovery Methods</td>
<td>W F</td>
<td>10:00-12:00</td>
<td>N317</td>
<td>Milosavljevic/Koth</td>
<td></td>
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</tbody>
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## TERM 5 COURSES

<table>
<thead>
<tr>
<th>COURSE #</th>
<th>COURSE TITLE</th>
<th>DAY</th>
<th>TIME</th>
<th>RM</th>
<th>COURSE DIRECTOR</th>
<th>NOTES</th>
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<tbody>
<tr>
<td>GS-CC-6210</td>
<td>Tumor, Technology, Therapy</td>
<td>T R</td>
<td>1:00-2:00</td>
<td>N317</td>
<td>Chang/Ira</td>
<td></td>
</tr>
<tr>
<td>GS-CP-6206</td>
<td>Drug Discovery: From Bench to Bedside</td>
<td>T</td>
<td>2:00-4:00</td>
<td>N311</td>
<td>Song,Y</td>
<td></td>
</tr>
<tr>
<td>GS-CT-6205</td>
<td>CICS 5: Evaluating a Completed Career Development Grant</td>
<td>T R</td>
<td>4:00-5:30</td>
<td>N317</td>
<td>Pereira,F,R,P</td>
<td></td>
</tr>
<tr>
<td>GS-DD-5100</td>
<td>Student Research Seminar</td>
<td>T</td>
<td>4:00-5:00</td>
<td>100A</td>
<td>Thevananther,S</td>
<td></td>
</tr>
<tr>
<td>GS-DD-6203</td>
<td>Animal Models of Human Disease</td>
<td>M W F</td>
<td>10:00-11:00</td>
<td>N311</td>
<td>Ward,C</td>
<td></td>
</tr>
<tr>
<td>GS-DD-6404</td>
<td>Advanced Topics in Vascular Pathophysiology &amp; Disease</td>
<td>MTWR</td>
<td>9:00-10:00</td>
<td>N317</td>
<td>Wehrens/Lagor</td>
<td></td>
</tr>
<tr>
<td>GS-GG-5105</td>
<td>Genetics &amp; Genomics Journal Club</td>
<td>T</td>
<td>3:45-5:00</td>
<td>111A/187A</td>
<td>Jafar-Nejad/Yamamoto,R</td>
<td></td>
</tr>
<tr>
<td>GS-GS-5110</td>
<td>Clinical Translational Research Seminars</td>
<td></td>
<td></td>
<td></td>
<td>Thevananther/Craigten,R</td>
<td></td>
</tr>
<tr>
<td>GS-JY-6205</td>
<td>Microbiome Methodology &amp; Data Analysis</td>
<td>W</td>
<td>1:00-4:00</td>
<td>N317</td>
<td>Petrosino,J</td>
<td></td>
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<tr>
<td>GS-JY-6304</td>
<td>Clinical Aspects of Immunology</td>
<td>T R</td>
<td>10:30-12:00</td>
<td>N311</td>
<td>Decker,W</td>
<td></td>
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</table>

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**Interpreting Course Numbers:** The first digit indicates if the course counts toward the 30-credit didactic hour requirements for all graduate students. Courses starting with 5 are non-didactic and do not count toward the 30-credit requirement. Courses starting with 6 are didactic and do count toward the 30-credit requirement. Courses starting with a 4 are designated for post-baccalaureate students and are not open to graduate students. The second digit indicates the number of credits in the course. (Zero denotes a course with a variable number of credits depending on student scheduling needs.) The last two digits are an internal identifier of the course.

## Foundational & Interdisciplinary Courses (GS-GS)

**GS-GS-5010**
**MSTP Reading**
MSTP Reading provides MSTP students early in their combined physician-scientist training with in-depth exposure to critical reading of the current biomedical literature in order to improve their ability to identify and design research strategies for solving current biomedical problems.

- **Credits:** Variable
- **Terms:** 1, 2, 3, 4, 5
- **Director:** Sharon Plon

**GS-GS-5100**
**Graduate Teaching Practicum**
The Graduate Teaching Practicum course is designed to provide students with a directed teaching experience. Graduate students enrolled in this course will obtain practical teaching experience by serving as Teaching Assistants (TAs) in Graduate School courses. Students must identify a TA position and obtain approvals from Course Director, Advisor and Program Director prior to enrollment.

- **Terms:** 1, 2, 3, 4, 5
- **Director:** Eric Swindell

**GS-GS-5101**
**Responsible Conduct of Research-Year 1**
The Responsible Conduct of Research (RCR) series of courses combine the National Institutes of Health curriculum for RCR education for pre-doctoral trainees with topics promoting personal and professional development for graduate students. The course consists of a series of lectures and small-group discussions with faculty members. Attendance is mandatory at all sessions. During year one, topics include data acquisition, authorship, public policy, rigor, reproducibility, menteeship, goal setting, and resilience.

- **Term:** 1
- **Director:** Eric Swindell

**GS-GS-5102**
**Responsible Conduct of Research-Year 2**
The Responsible Conduct of Research (RCR) series of courses combine the National Institutes of Health curriculum for RCR education for pre-doctoral trainees with topics promoting personal and professional development for graduate students. The course consists of a series of lectures and small-group discussions with faculty members. Attendance is mandatory at all sessions. During year two, topics include research with animal subjects, research misconduct, safe laboratory practices, and conflict resolution.

- **Term:** 2
- **Director:** Eric Swindell

**GS-GS-5103**
**Responsible Conduct of Research-Year 3**
The Responsible Conduct of Research (RCR) series of courses combine the National Institutes of Health curriculum for RCR education for pre-doctoral trainees with topics promoting personal and professional development for graduate students. The course consists of a series of lectures and small-group discussions with faculty members. Attendance is mandatory at all sessions. During year three, topics include peer review, collaborative research, collaboration with industry, authorship, conflicts of interest, rigor, reproducibility, and motivation.

- **Term:** 3
- **Director:** Eric Swindell

**GS-GS-5104**
**Responsible Conduct of Research-Year 4**
The Responsible Conduct of Research (RCR) series of courses combine the National Institutes of Health curriculum for RCR education for pre-doctoral trainees with topics promoting personal and professional development for graduate students. The course consists of a series of lectures and small-group discussions with faculty members. Attendance is mandatory at all sessions. During year four, topics include research with human subjects, the Scientist as integral part of society, tools for completing the dissertation, and a review of the requirements for graduation with the PhD degree.

- **Term:** 3
- **Director:** Eric Swindell

**GS-GS-5105**
**Scientific Writing**
This course increases student knowledge and skills in effective scientific writing. Students will learn basic principles of scientific writing that they can put into practice immediately such as selecting high impact words, building effective sentences and paragraphs, and structuring individual sections of a scientific manuscript. The course, which centers on the concept of writing with clarity and brevity, includes exercises to build skills.

- **Term:** 3
- **Director:** Susan Marriott

**GS-GS-5106**
**Intellectual Property**
So you now have a great discovery or idea, how can you protect and market it? In this course we will learn about intellectual property law and technology transfer. We will cover different types of intellectual property, such as patents, trademarks, copyrights, etc., with an emphasis on genetic and biotechnology patents, both in the USA and internationally. We will also discuss copyrights: their nature, acquisition, and how to avoid infringing them, with an emphasis in instructional activity and educational settings.

- **Term:** 4
- **Director:** Patrick Turley

**GS-GS-5107**
**Leadership Skills**
This course provides students with knowledge regarding the importance of leadership skills in their training and future career development. While leadership skills are essential components in career development, it is appreciated that leadership skills can’t be taught and imparted upon students in a short didactic lecture-based setting. Therefore, the objective of this course is to introduce students to the basic concepts of leadership skills.

- **Term:** 4
- **Director:** Suzanne Fuqua

**GS-GS-5108**
**Pharmacoepidemiology & Pharmacogenetics**
The purpose of this course is to outline strategies to avoid serious systemic toxicities from chemotherapy and radiotherapy. This course will review the principles of pharmacogenetics and pharmacogenomics, pharmacodynamics and pharmacokinetics, and will outline the impact of genetic polymorphisms in drug metabolism and other pathways on the toxicity of anti-cancer agents and other therapies. The emphasis is on research concepts and applications and the interdisciplinary nature of the field.

- **Term:** (every other year)
- **Directors:** Michael Scheurer & Brooke Bernhard

**GS-GS-5110**
**Clinical Translational Research Seminars**
Students attend four Bench-to-Bedside seminars and four additional one-hour translational research seminars, conferences or meetings that are relevant to clinical translational research or are of general educational value for the conduct of clinical translational research. The student is expected to submit a brief summary of the attended seminar or conference to the course directors.

- **Term:** 5
- **Directors:** Sundararajah Thevananther & William Craigen

**Prerequisite:** Admission to CTR-CAQ program
GS-GS-5111
**Strategies for Success in Graduate School**  
This course prepares incoming students to become scientific and professional leaders by developing skills for a successful graduate career early in their training. The objectives are to understand the expectations of a professional lab environment; take ownership over your training and graduate career; identify your scientific and personal working style and motivations; discuss how to evaluate potential mentors and thesis labs; learn how to successfully manage the mentor-mentee relationship; discuss scientific and personal support services at BCM, and develop networking skills.  
Term: 1  
Director: Melanie Samuel & Roy Sillitoe

GS-GS-5112
**Powerful Presentations**  
This course develops scientific communication skills to effectively convey your ideas to both experts and non-experts. Effective presentation is the basis for career advancement at all levels in science. Topics covered include the fundamentals of effective talk design, how to construct potent slides, how deliver information effectively, and in class presentations.  
*This course is offered twice per year  
Term: 2  
Directors: Melanie Samuel & Trent Watkins

GS-GS-5113
**Effective Project Design & Management**  
This course develops skills in designing and executing your thesis research. The course will discuss the scope of a thesis and what it means to make an original scientific contribution. Students will also be exposed to and practice using effective tools and approaches for managing and developing their thesis projects. Topics covered include: how to design your own project, the challenges and opportunities of hypothesis driven and hypothesis independent research, and how to turn projects into papers through project management and time management.  
*This course is available to students in year 2 & above  
Term: 1  
Directors: Buck Samuel & Swathi Arur

GS-GS-5114
**Clinical Translational Research Experience 1**  
Students accompany their clinical translational research (CTR) mentor in the clinical research environment where they will learn about the care for individuals with diseases relevant to their translational thesis research and gain knowledge on how clinical translational research, and in the general field of medicine, is conducted. Students will then work with their CTR mentor to develop a clinical translational capstone project.  
*Course is offered twice per year  
Terms: 1-2, 3-5  
Directors: Ignatia Van den Veyver & Frederick Pereira  
Prerequisite: Admission to CTR-CAQ program

GS-GS-5115
**Clinical Translational Research Experience 2**  
Students will work with their clinical translational research (CTR) mentor in the clinical research environment on their clinical translational capstone project, that they developed in CTR1.  
*Course is offered twice per year  
Terms: 1-2, 3-5  
Directors: Ignatia Van den Veyver & Frederick Pereira  
Prerequisite: 2 credits of GS-GS-5114

GS-GS-6101
**Neuroscience**  
This is an introductory course covering fundamental aspects of modern neuroscience. The lecture series begins with a discussion of neural development, evolution and the resulting organization of the mammalian nervous system, and then progresses into the molecular and structural specializations that allow neurons to process and transmit information via electrical current. The course next explores how neurons contribute to autonomic functions that keep us alive and higher brain functions such as learning and memory. The course will close on an examination of how neural dysfunction leads to common neurological disorders such as developmental pathophysiologicals, autism, and Alzheimer’s disease.  
Term: 3  
Director: Russell Ray

GS-GS-6102
**Principles of Immunology**  
In the field of biology, the immune system is unique in that it crosses all organ boundaries and affects a vast number of processes critical for organismal function and survival. This short course introduces the basic cellular and molecular mechanisms of immunity. These include: the innate immune system (molecular “danger” patterns); the acquired immune system (B and T cell receptor gene rearrangement and their effector functions); the cross-talk between innate and acquired immunity; an overview of the principles of immune tolerance exemplified by mechanisms of transplant rejection and cancer immunity; and a discussion of autoimmunity diseases & immunotherapies.  
Term: 3  
Director: William Decker

GS-GS-6202
**Gene Regulation**  
This course covers the mechanisms of regulated gene expression with a focus on eukaryotes beginning at the gene and chromatin, processing of pre-RNA and mRNA through protein turnover.  
Term: 3  
Director: Thomas Cooper

GS-GS-6203
**Data Mining**  
Data mining provides practical approaches and tools that allow biomedical researchers to analyze and understand their data and to craft new hypotheses. The course focuses on data mining essentials and covers standard approaches to clustering, classification, regression and model selection, along with several domain-oriented techniques such as gene enrichment analysis.  
Term: 3  
Director: Gad Shaulsky

GS-GS-6205
**Fundamentals of Epidemiology**  
This course introduces the basic principles and methods of epidemiology, with an emphasis on critical thinking, analytic skills, and application to clinical practice and research. Topics include outcome measures, methods of adjustment, surveillance, quantitative study designs, and sources of data. The course is designed for professionals intending to engage in, collaborate in, or interpret the results of epidemiological research as a substantial component of their career.  
*This course is cross-listed as GCFEP 62000 in the School of Health Professions  
Term: 3  
Directors: Michael Scheurer & Austin Brown

GS-GS-6206
**Orientations to Clinical Translational Research**  
This course teaches introductory insight into the bioethical conduct and practical aspects of clinical research, including types and categories of clinical trials, different phases of translational research, and regulatory considerations of clinical and translational research. The course consists of interactive didactic lectures and homework assignments for all enrolled students. The objective is to provide a broad understanding of practical, regulatory and bioethical issues of clinical translational research and of the complex relationship between investigators, their designees, and research subjects.  
Term: 1  
Director: Melissa Suter & Robin Parihar

GS-GS-6207
**Practical Skills in Translational Research**  
Workshops 1  
The course workshops are designed to provide active learning opportunities for the students who will gain practical skills using “hands-on scenarios” guided by the components needed to translate bench-research to the bedside research. In addition, they will learn how to develop research programs that will address clinical questions related to human health and disease.  
Terms: 3-5  
Directors: Susan Hilsenbeck & Farrah Kheradmand  
Prerequisite: Admission to CTR-CAQ program

GS-GS-6208
**Practical Skills in Translational Research**  
Workshops 2  
This course is a continuation of the course Practical Skills in Translational Research Workshops 1. The workshops are designed to provide active learning opportunities for the students who will gain practical skills using “hands-on scenarios” guided by facilitators who are experts in the field. It covers the components needed to translate bench-research to the bedside research.  
Terms: 3-5  
Directors: Melissa Suter & Susan Hilsenbeck  
Prerequisite: GS-GS-6207
Cancer & Cell Biology (GS-CC)

GS-CC-5000
Special Topics
Scholarly study directed by a faculty member. Special topics allows a faculty member to develop individualized courses for students. Special topics cannot be used to satisfy the 30 hr. course requirement.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CC-5010
Readings
Faculty directed literature projects that survey a specialized topic of interest.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CC-5030
Research Rotation
Faculty mentor directed research for students who have not yet selected a faculty advisor.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CC-5040
Special Projects
Faculty mentor directed research for students who have selected their thesis advisor but not been admitted to candidacy.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CC-5050
Dissertation
Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CC-5100
Student Research Seminar
The objective of the course is for students within the Graduate Program to have an opportunity to present their ongoing research to a diverse group of colleagues, and to receive feedback from these colleagues on the quality of their presentation and research.
Terms: 1, 2, 3, 4
Director: Joel Neilson

GS-CC-5000
Foundations A: Biostatistics
This course introduces biostatistical principles and technology most likely to be useful to laboratory scientists interested in basic and translational research. Topics include ANOVA, linear regression, contingency table analysis, logistic regression, survival analysis, and nonparametric statistics. The course also introduces basic experimental design principles and designs for clinical trials. The R software environment will be introduced and used for statistical analysis of real-life problem sets.
Terms: 1+2
Directors: Susan Hilsenbeck, Charles Minard & Tao Wang

GS-CC-5101
Reading & Evaluating Scientific Literature
This course assists students in developing an understanding of scientific research and foster skills in reading and evaluating the scientific and medical literature. Discussion include the philosophies of scientific inquiry, the scientific methods/approaches, the factors and aspects that contribute to exemplary scientific publications.
Term: 2
Directors: Frederick Pereira & Stephanie Pangas

GS-CC-5301
NRSA Grant Writing & Project Development 1
In this course, students learn to discuss the basic principles of grant proposal organization with an emphasis on the formulation of specific aims, how to develop a NRSA grant proposal using outlining, and how to present an elevator pitch and chalk talk of the proposal, while enhancing their collaboration and oral and written communication skills.
* This course is restricted to second-year students in the CCB program
Term: 1
Director: Frederick Pereira & Stephanie Pangas

GS-CC-5302
NRSA Grant Writing & Project Development 2
In this course, students learn to refine scientific writing skills used in developing a NRSA grant proposal, the basic principles of oral presentations; and to orally defend a grant proposal. Students will get practical experience in scientific writing of a grant proposal and oral defense of the proposal.
* This course is restricted to second-year students in the CCB program
Term: 2
Directors: Frederick Pereira & Stephanie Pangas

GS-CC-5101
Prerequisite: GS-CC-5301

GS-CC-6101
Cancer
This is a short course on the biology of cancer. The course objective is to introduce students to basic mechanisms that lead to tumor initiation, progression, and metastasis. A history of oncogenes and tumor suppressor genes and their modern definitions are presented. Current concepts of cancer stem cells, tumor microenvironment, mouse models, and cancer therapeutics are discussed. Class includes lecture and group discussion of key recent papers in which students are expected to participate.
Term: 3
Director: Stephanie Pangas

GS-CC-6103
Biology of Aging
This course familiarizes students with the biology of aging, including mechanisms, models, and clinical applications. Focus will be on understanding current research and clinical correlations in particular cancers. Each week will have a particular cancer focus and the meeting time will include a clinically focused lecture, a basic science focused lecture, and a journal club article presented by students.
Students will attend a minimum of two tumor board sessions during the term, which include a patient case presentation followed by discussion detailing the background, treatment, outcomes, and research avenues of the patient’s malignancy. These tumor boards can be attended at any time during the course.
* This course is cross-listed as MECLB 550 in the School of Medicine
Term: 2
Director: Andre Catic & Weimei Dang

GS-CC-6201
Translational Cancer Biology
This course integrates the basic science and translational aspects of research with clinical applications, thus enhancing student understanding of current research and clinical correlations in particular cancers. Each week will have a particular cancer focus and the meeting time will include a clinically focused lecture, a basic science focused lecture, and a journal club article presented by students.
Students will attend a minimum of two tumor board sessions during the term, which include a patient case presentation followed by discussion detailing the background, treatment, outcomes, and research avenues of the patient’s malignancy. These tumor boards can be attended at any time during the course.
* This course is cross-listed as MECLB 550 in the School of Medicine
Term: 2
Director: Jason Yustein

GS-CC-6202
Explorative Data Analysis
Explorative Data Analysis will teach concepts of statistical learning and of data integration in database systems that together will enable students to explore and learn from large and complex datasets to generate new and unique biological insights. The approach to teaching will emphasize methods of statistical learning and their conceptual underpinnings rather than their mathematical properties, and will use a
hands-on approach to progressive ‘omics’-data integration and mining by using community-based resources for data analysis rather than on writing codes.

Term: 3
Director: Rainer Lanz

**GS-CC-6203 Integrated Microscopy**

The course is composed of a set of lectures that cover basic and advanced forms of light and electron microscopy, and an accompanying set of practical labs where students receive hands-on training on all the available instruments. The main topics addressed in the class are: basic optics, light- and fluorescence-based microscopy (i.e., brightfield, DIC, phase contrast, deconvolution, confocal, live cell imaging), fluorescence-based molecular tools (i.e., FRET, FRAP, fluorescent proteins), transmission electron microscopy, super-resolution microscopy (i.e., SIM, STORM), and specialized automated high throughput microscopy and image analysis.

Term: 3
Directors: Michael Mancini & Fabio Stossi

**GS-CC-6204 Regulation of Energy Homeostasis**

Regulation of Energy Homeostasis addresses the control of metabolism in health and disease, and how energy balance is signaled among organs. Emphasis will be placed on defining regulatory mechanisms and pathways, with particular attention to abnormalities occurring with disease. The approach will be interdisciplinary, including metabolic, biochemical, genetic and cellular aspects.

*This course is also listed as MECLB 570 in the School of Medicine*

Term: 4
Directors: Robb Moses & Brian York

**GS-CC-6205 Translational Breast Cancer Research**

This course provides an introduction into current issues in translational breast cancer research. The course encompasses a series of lectures on problems in clinical breast cancer diagnosis and treatment, breast development, and evolution of breast cancer, and approaches to translational breast cancer research. The purpose of the course is to provide a broad understanding of clinical issues and problems in breast cancer, familiarize students with breast cancer from the clinician’s standpoint, and with research areas of active development in the field.

Term: 2
Director: Suzanne A. W. Fuqua

**GS-CC-6206 Cell Death in Development & Disease**

This course will discuss the most updated molecular mechanisms of different forms of cell deaths (apoptosis, necrosis, and autophagy) identified in invertebrate model organisms and in mammals, and the functions and regulation of cell death in human diseases. It will also cover the history, methods, and logic of cell death studies in model organisms.

Term: 3
Director: Zheng Zhou & Lisa Bouchier-Hayes

**GS-CC-6207 Ethics & Regulatory Preparation for Research with Animal Models**

This course combines lecture-discussion co-learning as well as hands-on sessions to instruct trainees on the regulatory and oversight requirements, guidelines for developing and reporting results, and sampling and delivery procedures employed when performing research involving animal models.

Term: 1
Directors: John Seavitt & Christopher Ward

**GS-CC-6208 Cellular Signaling**

Cellular signaling covers major cellular signaling pathways, actions of intracellular kinases and nuclear receptors, and strategies for regulating cell signaling. The pathways covered include those regulated by GPCR, receptor tyrosine kinases, TGFβ, Notch, Hedgehog, WNT, Hippo and nuclear receptors. In addition, signaling pathways regulated by small molecules including calcium, phospholipids, cAMP, cGMP, and AMP are discussed.

Term: 3
Directors: Brian York & Sean Hartig

**GS-CC-6210 Tumor, Technology, Therapy**

“Limitless replicative potential” is the key cancer hallmark that is widely recognized including by non-scientists. Furthermore, de-regulated replicative controls often create genomic instability, which accelerates the evolution within cancer cells to reach a more aggressive state. This course will focus on the use of molecular biology and new advances in bioinformatics to define the mechanisms driving these events, and how basic science findings have guided the development of life-saving drugs.

Term: 5
Directors: Eric Chang & Grzegorz Ira

**GS-CC-6302 Molecular Carcinogenesis**

The course explores the fundamental concepts and experiments in tumor biology, cancer virology and oncogenes and growth control. This course provides a broad based introduction to students who have an interest in modern cancer research. Faculty from four departments (Cell Biology, Molecular Virology, Pharmacology and Biochemistry) serve as instructors.

Term: 4
Director: Yi Li

**GS-CC-6303 Reproductive Biology**

Reproductive Biology covers mammalian reproductive processes at all levels of biological organization (anatomical, physiological, cellular, biochemical and molecular). The course is taught with a comparative approach analyzing findings in different animal model systems and clinical studies to ensure that clinical issues affecting reproductive success are presented, and to also demonstrate how basic science is moving toward understanding the causes and treating reproductive failure and diseases.

Term: 4 (every other year)
Directors: Stephanie Pangas & Joanne Richards

**GS-CC-6304 Biology & Mechanisms of Age-Related Disease**

This course provides students and post-docs with the up-to-date information and current understanding of the aging process and age-related human disorders. The course covers molecular aspects of aging research, models and theories of aging, and clinical perspectives of aging processes. This advanced graduate elective course is offered for trainees who will specialize in or have a strong background in the interrelated areas of development, aging and age-related diseases.

Term: 4
Director: Frederick Pereira

**GS-CC-6401 Technologies for Cancer Drug Discovery & Development**

The course covers a variety of disciplines and topics important to cancer drug discovery and development. The course starts by covering pharmacology and basic cancer biology, then will transition to introductions of assay design, lead compound identification, medicinal chemistry and pharmaceutics. Finally, preclinical animal models and clinical assessments are presented.

Terms: 3+4
Directors: Jason Yustein & Rachel Schiff
Thinking Like a Scientist 1

This is the first in a series of 4 courses that aim to help first year graduate students develop the critical thinking, speaking and writing skills that are necessary for their professional success in graduate school and beyond. In this term, students set short-term professional goals around courses and laboratory rotations and gain strategies to improve their skills in technical writing and critical evaluation of the literature. Learning is achieved through group-based problem solving.

Term: 1
Director: Nicolas Young

Thinking Like a Scientist 2

The goal of this term is to develop critical reading skills for evaluating the scientific literature. For a set of assigned papers, student will learn to identify the gap in knowledge and the hypothesis that was tested, and analyze the experimental outcomes in relation to the hypothesis. Students will also develop reasonable future directions in the form of a new set of hypotheses that follow from the results of each paper. Each week one student will present an assigned paper in the style of a journal-club. The other students will write a summary of the same paper, highlighting the logical flow of the paper.

Term: 2
Directors: Timothy Palzkill & Jin Wang

Prerequisite: GS-CP-5101

Advanced X-ray Crystallography

This course discusses in-depth theoretical and practical techniques in structural biophysics with a particular emphasis on electron imaging and crystallography. The topics include cryo-specimen preparative techniques, electron microscope optics, image contrast theory, specimen radiation damage, single particle image reconstruction, tomographic reconstruction, density based modeling, 3-D visualization, biological knowledge discovery from cryo-electron imaging.

Term: 4 (every other year)
Director: Francis Tsai

Pharmacology Concepts in Drug Discovery & Development

Topics include an introduction to general pharmacology, pharmacokinetics and pharmacodynamics, and an overview of therapeutics in three disease areas, including infectious diseases, cancer, and central nervous system diseases. The course content emphasizes understanding the mechanisms of therapeutics instead of memorizing drug names and serves as an introduction for students who are interested in translational research.

Term: 4
Directors: Timothy Palzkill & Jin Wang

Prerequisite: GS-CP-5101
Clinical Scientist Training Program (GS-CT)

GS-CT-5010
Readings
Faculty directed literature projects that survey a specialized topic of interest.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CT-5040
Special Projects
Faculty mentored research for students that have selected their thesis advisor but not been admitted to candidacy.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CT-5050
Dissertation
Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-CT-5101
Responsible Conduct of Research for Clinical Investigators
The RCRCI course is designed for the early career scientist/clinical or translational investigator, and will provide students with a fundamental competency and appreciation for the core topics within the ethical dimensions of biomedical research. During this one-week course, students will receive lectures from faculty with expertise in each of these core topics, to be followed by small group case study discussions illustrating ethics topics from the preceding lecture.
Term: 1
Director: Maria Gramatges

GS-CT-6201
CICS 1: Grant Development for Clinical Investigators
This course provides students with the skills to develop an important research question, formulate strong hypotheses and specific aims, and begin to draft the components of a career development grant proposal.
Term: 1
Director: Ashok Balasubramanyam

GS-CT-6205
CICS 5: Evaluating a Completed Career Development Grant
This course provides students with an appreciation of the NIH study section review process and a completed career development award.
Term: 5
Director: Frederick Pereira

GS-CT-6300
Fundamentals of Clinical Investigation
The objective of this course is to train students to interpret the results of other clinical investigators and to use the knowledge for providing state-of-the-art care for their patients. The course includes three modules reflecting specific areas relevant to a clinical researcher. These modules are: principles of clinical research; statistical methods in clinical research; special topics.
Term: 1
Director: Farrah Kheradmand

GS-CP-6306
Thinking Like a Scientist 3
The goal of this term is to build up on the analytical and presentation skills students develop through critical reading of the literature in Term 2. Students will continue to use the concept of the framing funnel to identify an existing gap in knowledge, and formulate a hypothesis/model that makes specific predictions that can be critically tested experimentally. Each student will write an abstract of a research proposal that will be discussed and revised in response from feedback from students and faculty.

Term: 3
Directors: Ming Zhou & Lynn Zechiedrich
Prerequisite: GS-CP-6202

GS-CP-6307
Thinking Like a Scientist 4
The goal of this term is to build upon the activities of Term 3 that culminated in writing a proposal abstract based on a published paper. Students will do additional literature-based research to add both depth and breadth to each component of the abstract using the concept of the framing funnel, and develop one new specific aim building off of published results.

By the end of the course, each student will have written a full research proposal, whose specific aims, outline and early drafts will be presented to the class in written and oral form. They will receive feedback from students and faculty in the process of finalizing the proposal. Each student will also present a final presentation on the full proposal in a format similar to that of the qualifying examination.
Term: 4
Director: Zheng Zhou
Prerequisite: GS-CP-6306

GS-CT-6201
CICS 1: Grant Development for Clinical Investigators
This course provides students with the skills to develop an important research question, formulate strong hypotheses and specific aims, and begin to draft the components of a career development grant proposal.
Term: 1
Director: Ashok Balasubramanyam

GS-CT-6205
CICS 5: Evaluating a Completed Career Development Grant
This course provides students with an appreciation of the NIH study section review process and a completed career development award.
Term: 5
Director: Frederick Pereira

GS-CT-6300
Fundamentals of Clinical Investigation
The objective of this course is to train students to interpret the results of other clinical investigators and to use the knowledge for providing state-of-the-art care for their patients. The course includes three modules reflecting specific areas relevant to a clinical researcher. These modules are: principles of clinical research; statistical methods in clinical research; special topics.
Term: 1
Director: Farrah Kheradmand

GS-CT-6302
CICS 2: Clinical Trials for Clinical Investigators
This course provides students with an understanding of the theory and practice of conducting scientifically rigorous clinical trials. Building on the work of the previous CICS I course and from knowledge gained from the Fundamentals in Clinical Investigation course, students will fully develop the hypothesis, specific aims, and experimental design of their projects.
Term: 2
Director: Farrah Kheradmand
Prerequisites: GS-CT-6201 and GS-CT-6300

GS-CT-6303
CICS 3: Translational Research for Clinical Investigators
This course provides students with an understanding of the theory and practice of conducting bench-to-bedside translational research. Building on the work of the previous term, students will continue the development of a K-type grant proposal, focusing on the career development plan and mentor’s letters.
Term: 3
Director: Jesus Vallejo
Prerequisites: GS-CT-6201 and GS-CT-6302

GS-CT-6304
CICS 4: Health Services Research for Clinical Investigators
This course provides students with an understanding of the theory and practice of health services research. Building on the work of the previous term, students will continue the development of a K-type grant proposal.
Term: 4
Director: Frederick Pereira
Prerequisites: GS-CT-6201 and GS-CT-6303

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Development, Disease Models, & Therapeutics (GS-DD)

GS-DD-5000
Special Topics
Scholarly study directed by a faculty member. Special topics allows a faculty member to develop individualized courses for students. Special topics cannot be used to satisfy the 30 hr. course requirement.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-DD-5010
Readings
Faculty directed literature projects that survey a specialized topic of interest.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-DD-5030
Research Rotation
Faculty mentored research for students who have not yet selected a faculty advisor.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-DD-5040
Special Projects
Faculty mentored research for students that have selected their thesis advisor but not been admitted to candidacy.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-DD-5050
Dissertation
Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-DD-5100
Student Research Seminar
Students who have been admitted to candidacy will present a seminar yearly on the topic of their ongoing thesis research project with emphasis on the translational aspects of their research project. The purpose of this course is to provide a forum for students to improve their knowledge and skills in planning, preparing and effectively presenting their scientific research to an inter-disciplinary audience.
Terms: 2, 3, 4, 5
Director: Sundararajah Thevananther

GS-DD-5101
Effectively Writing & Reviewing Proposals
This course will explain the requirements and expectations of the qualifying exam. The course is geared specially towards second year students who have successfully completed their first year coursework and several months' work in their chosen thesis lab. The course will cover the format of the written and oral exams, tips for structuring the aims and scope of the written proposal, and provide students with opportunity to develop and deliver their oral presentation for feedback from the group. The goal of the course is to help students begin thinking about their work independently and to present their research problem and experimental goals clearly. Ultimately, this course is intended to encourage independent NRSA or other fellowship applications from those students who qualify.
Term: 2
Directors: Melanie Samuel & Benjamin Arenkiel

GS-DD-5110
DDMT Journal Club
This course is required of all first and second year students enrolled in the Development, Disease Models & Therapeutics Graduate Program. The course is conducted as a journal club to study current literature, to practice critical analysis of the literature and to refine presentation techniques. First year students present papers from the current literature, all students join in discussion of the paper presented.
Terms: 3, 4, 5
Director: Daniel Gorelick & Hyun-Kyoung Lee

GS-DD-6201
Development
The Development of a mature organism from a single cell is one of the most fascinating problems in biology. Understanding development can shed light on fundamental processes such as gene regulation and control of the cell cycle, and on translational problems such as the origins and progression of cancer and the possibility of tissue engineering and regeneration to treat human disease. This course is designed as an introduction to some of the concepts of modern developmental biology.
Term: 2
Director: Andrew Groves

GS-DD-6203
Animal Models of Human Disease
This course is designed to expose students to methodologies employed in generating animal models for human diseases and in analyzing these models. The major emphasis is on mouse models, but other model organisms will be discussed as well.
Term: 5
Director: Christopher Ward

GS-DD-6206
Pathophysiology and Mechanisms of Human Disease
This course will provide students with an understanding of the basic mechanisms of human disease with a systems biology perspective. Molecular defects at different levels including the gene, RNA, protein, cell, tissue, and organ will be covered. The focus is on helping students develop critical thinking skills that will help them approach complex scientific problems.
Term: 4
Director: Daniel Lacorazza

GS-DD-6207
Advanced Topics in Muscle Physiology
This course will focus on skeletal muscle and integrate current information on molecular structure of muscle, its function, signaling pathways controlling its development, growth and response to disease. The course consists of lectures by faculty, presentations by students of assigned papers with student participating and a final exam.
Term: 3 (every other year)
Director: George Rodney

GS-DD-6208
Evolutionary Conservation of Developmental Mechanisms
This course focuses on the similarities and differences of developmental mechanisms between vertebrates and invertebrates. Invertebrates, such as Drosophila and C. elegans, have allowed scientists to isolate many genes that are required for proper development through genetic screens. Vertebrate homologs of many of these genes have been identified, and their role is being studied through a variety of approaches, including manipulations in chick and zebrafish as well as through mouse knockouts. The view of vertebrate and invertebrate developmental biologists on a series of topics like segmentation, Hox and Polycomb-group genes, limb development, and cell death is presented in this course. In addition, the lecturers discuss and compare the function of proteins required for specific developmental pathways in invertebrates whose homologs are involved in tumorigenesis in vertebrates. Additional topics include: evolution, evolutionary trees, and the evolution of developmental pathways, as well as how during evolution numerous molecular players are conserved and how they are deployed in various developmental processes in diverse organisms.
Term: 3
Director: Ronald Parchem

GS-DD-6210
Cardiovascular Diseases
This course provides a general overview of the main common cardiovascular diseases and their causes. Topics covered include atherosclerosis, hypertension, congenital heart disease, ischemic heart disease, cerebral stroke, cardiac arrhythmias, and the effects of aging on the cardiovascular system. The course will be taught by a combination of clinicians, basic scientists, and physician scientists throughout the Texas Medical Center.
Term: 3
Director: Xander Wehrens

GS-DD-6211
Model Systems in Developmental Biology & Disease
This course introduces the classical experimental methods and animal models used to address fundamental questions in developmental biology. Examples are provided which highlight specifically how developmental principles have been tested by choosing the best suited model system. These examples will allow the students to grasp how these earlier investigations directly inform their own future injury into the cellular and molecular mechanisms of development and disease.
Term: 1
Directors: Ross Poche & Shinya Yamamoto
GS-DD-6212
Topics in Cell Physiology
This course will introduce students to a variety of topics related to cellular physiology while also providing instruction as to how one critically evaluates primary research literature. The topics covered will include Neurophysiology, Metabolism and Physiology, Cancer Physiology, Cardiovascular Physiology, Muscle Physiology and Biophysics/Bioengineering.
Term: 1
Directors: Ross Poché & Jason Karch

GS-DD-6301
Human Physiology 1
This course will provide students with the basic knowledge of organ systems and integrative physiology in humans upon which the pathophysiology of human diseases can later be expanded. Lectures are intended to educate students about the current research being performed in each field and to elicit ideas about future research and human applications. Topics covered in this course, which is the second of two Human Physiology courses include: the immune system, renal physiology, bone, the endocrine system, the reproductive system, the gastrointestinal system and liver.
Term: 3
Directors: Frank Horrigan & Ross Poché

GS-DD-6302
Human Physiology 2
This course will provide students with the basic knowledge of organ systems and integrative physiology in humans upon which the pathophysiology of human diseases can later be expanded. Lectures are intended to educate students about the current research being performed in each field and to elicit ideas about future research and human applications. Topics covered in this course, which is the second of two Human Physiology courses include: the immune system, renal physiology, bone, the endocrine system, the reproductive system, the gastrointestinal system and liver.
Term: 4
Directors: Frank Horrigan & Ross Poché

GS-DD-6403
Advanced Topics in Cardiac Pathophysiology & Disease
Topics covered include cardiac cycle, cardiac contractility, neural, and nonneural control of the circulation, biomedical instrumentation, and physical analytical methods. The various components of the cardiovascular system is integrated to define its basic control functions.
Term: 4
Directors: Xander Wehrens & Na Li

GS-DD-6404
Advanced Topics in Vascular Pathophysiology & Disease
This course explores cause and mechanism of cardiovascular disease. Specific topics include mechanistic discussion of atherosclerosis (lipids and lipoproteins, inflammation, oxidatively modified LDL), hypertension (epidemiology, mechanisms, and consequences), hemostasis (thrombosis and bleeding disorders), cerebral stroke, heart failure (synergistic and diastolic dysfunction), cardiac arrhythmias, myocardial ischemia (healing and remodeling, cardiogenesis, myocarditis, laterality in heart disease and aging in the cardiovascular system.
Term: 5
Directors: Xander Wehrens & William Lagor

Genetics & Genomics (GS-GG)

GS-GG-5000
Special Topics
Scholarly study directed by a faculty member. Special topics allows a faculty member to develop individualized courses for students. Special topics cannot be used to satisfy the 30 hr. course requirement.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-GG-5010
Readings
Faculty directed literature projects that survey a specialized topic of interest.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-GG-5030
Research Rotation
Faculty mentored research for students who have not yet selected a faculty advisor.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-GG-5040
Special Projects
Faculty mentored research for students that have selected their thesis advisor but not been admitted to candidacy.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-GG-5050
Dissertation
Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-GG-5100
Student Research Seminar
Student Seminar.
Terms: 1, 2, 3, 4, 5
Directors: Christophe Herman & Herman Dierick

GS-GG-5101
Clinical Genetics
The course is aimed at training graduate students in the applied aspects of clinical genetics. Students will learn how Human Geneticists address medical genetic problems in the clinic, interact with genetic fellows and learn how to design tests and experiments to address clinical problems.
*This course is cross-listed as MEGNT 500 in the School of Medicine.
Term: 1
Director: Daryl Scott

GS-GG-5105
Genetics & Genomics Journal Club
This course is required of all first and second year students enrolled in the graduate programs in Genetics & Genomics. The course is conducted as a journal club to study current literature, to practice critical analysis of the literature and to refine presentation techniques. First year students present papers from the current literature, all students join in discussion of the paper presented.
Credits: 3, 4, 5
Directors: Hamed Jafar-Nejad & Shinya Yamamoto

GS-GG-6102
Genetic Epidemiology and Population Genetics
*This course is cross-listed as GCEPG 61000 in the School of Health Professions
Term: 4
Directors: Philip Lupo & Michael Scheurer

GS-GG-6103
Genetics and Genomics in Vision Research

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This course provides graduate students and postdoctoral fellows with broad exposure to the molecular genetics underlying normal and abnormal visual system development and function. This course offers an in-depth analysis of normal vertebrate and invertebrate development, genetic causes of disease, as well as the use of animal models for genetic analysis of normal and abnormal development and function.

Term: 4 (every third year)
Director: Graeme Mardon

GS-GG-6202 Mammalian Genetics
This course describes the contribution of mammalian molecular genetics techniques to understanding the function of genes and the impact of genetic and epigenetic factors on human disease. The first half of the course focuses on historical aspects and advanced technologies used in mouse genetics. The second half of the course explores topics such as the human genome project, primate genetics, epigenetics, comparative sequence analysis and RNAi-based screens in the mammalian systems.
Term: 3
Directors: Hamed Jafar-Nejad & Jason Heaney

GS-GG-6203 Gene and Cell Therapy
This course covers various approaches to somatic and germ cell gene therapy, with emphasis on vector systems and other methods for gene delivery and targeting; model systems for specific applications of gene therapy; and the status of current therapeutic strategies for various inherited and acquired disorders.
Term: 4
Director: Philip Ng

GS-GG-6204 Method and Logic in Genetics & Genomics
This course is intended to train first year graduate students how to read and interpret the primary literature. In particular, we will teach students to discern what conclusions can be drawn from experimental data without over-interpretation. Students will learn what constitutes a well-designed experiment with proper controls. In addition, students will learn the fundamental experimental principles that pervade biological science, such as complex representation, assigning function and specificity.
Term: 3
Directors: Ross Poché, Shinya Yamamoto, Jennifer Posey & Joshua Wythe

GS-GG-6205 Single Cell Methods & Analysis
Single cell omics methodologies are intended to understand whole genome scale variations in individual cells. This course focuses on the methods, the analysis and interpretation of these types of data as well as the strengths and limits of single cell approaches.
Term: 3
Director: Chuck Zong

GS-GG-6301 Bioinformatics and Genomic Analysis
This course is intended to provide a background in the theory and application of standard computational methods for molecular biology research. The topics to be discussed include databases, sequence comparison, phylogeny, pattern inference and matching, RNA secondary structure, and protein structure. The course will also address computational issues for the Human Genome Program in the areas of large-scale DNA sequencing, chromosome mapping, and gene recognition. During the term, a seminar speaker, with expertise in an area relevant to the subject area of the course, is invited as a guest lecturer. Students are required to attend this seminar.
Term: 4
Director: Kim Worley

GS-GG-6302 Human Genetics

The goal of this course is help graduate students learn the fundamental principles of human genetics they will need to be effective contributors to the field of human genetics. By the end of the course, students will have an increased ability to comprehend the human genetics literature, conduct human genetics research, accurately interpret genetic data obtained from human subjects and communicate these findings to other researchers and the general public.

Term: 4
Directors: Daryl Scott & Kevin Glinton

GS-GG-6304 Career Development in Medical Genetics
Diagnosis of genetic diseases is important for students to understand how to apply their scientific knowledge into the practice of medicine. By focusing on case studies of various types of human disease, this course focus on teaching students how to transfer the fundamental genetic knowledge and principles into the practices of human disease diagnosis.
Term: 4
Directors: Chuck Zong, Fan Xia & Pengfei Liu

GS-GG-6305 Model Systems Genetics
This course covers the core methodology used in the design and analysis of host-associated microbial communities, termed the ‘microbiome’, in health and disease. Students learn about the key factors in study design and methods used to characterize and quantitatively analyze microbiome sequencing datasets. Each session includes a hands-on practicum for data processing and analysis using publicly available tools. This class is intended to provide the basic methodological know-how to be able to integrate microbiome studies into any research program.
Term: 2
Directors: Christophe Herman & David Bates

Immunology & Microbiology (GS-IY)

GS-IY-5000 Special Topics
Scholarly study directed by a faculty member. Special topics allows a faculty member to develop individualized courses for students. Special topics cannot be used to satisfy the 30 hr. course requirement.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-IY-5010 Readings
Faculty directed literature projects that survey a specialized topic of interest.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-IY-5030 Research Rotation
Faculty mentored research for students who have not yet selected a faculty advisor.
Credits: Variable

GS-IY-5040 Special Projects
Faculty mentored research for students that have selected their thesis advisor but not been admitted to candidacy.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-IY-5050 Dissertation
Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.
Credits: Variable
Terms: 1, 2, 3, 4, 5

GS-IY-5100 Student Research Seminar
Graduate students will attend and present in a weekly research seminar series with presentations by Immunology & Microbiology Graduate students to discuss new developments and findings in their thesis research and develop networks. Students having passed their Qualification Exam will present their laboratory research once per year. Student evaluators will provide student presenters with constructive feedback on their presentations.
Terms: 2, 3, 4
Directors: Jason Kimata, Katherine Lemon & Sasirekha Ramani

GS-IY-5105 Seminars in Immunology & Microbiology Research
Graduate students will attend the combined seminar series supported by Immunology/Immunobiology/Molecular Virology and Microbiology. Presentations will be primarily scientists from other institutions along with BCM faculty and postdocs. Seminar topics or speaker suggested readings will be coordinated
with the Literature Review in Immunology & Microbiology and Student Research in Immunology & Microbiology Seminar courses.

Terms: 1, 2, 3, 4
Directors: Jason Kimata & Katherine Lemon

**GS-IY-5110 Literature Review in Immunology & Microbiology**

Immunology and Microbiology graduate students will critically evaluate and present current research articles in areas of immunology, vaccine and immune therapy, microbiology, virology, parasitology and microbiome research. First and second year graduate students will give oral presentations (generally twice a year) of research articles to an audience comprised of fellow graduate students, postdocs, faculty and other scientists. Presenting students will be evaluated and receive feedback from fellow attendees, including students and faculty. 

Terms: 1, 2, 3, 4
Director: Antony Rodriguez

**GS-IY-6201 Cells, Tissues and Organs**

The Cells, Tissues and Organs course focuses on analysis of structure/function relationships in tissues and organs. This will include correlating tissue histology with organ physiology. Interactive lectures and discussions occur simultaneously with direct observation of human and some animal model tissues by the students through multi-head microscopes with a pathologist. Students participate in weekly essays and presentations.

Term: 4
Director: David Rowley

**GS-IY-6202 The Microbiome**

This course will facilitate deeper understanding of a host-associated community of microbes, termed the ‘microbiome’. Through examination of a series of landmark and cutting edge papers, students will learn what constitutes a microbiome both in form and functions it provides to the host, plus the many molecular ways that it can influence health and progression of a wide range of diseases.

Term: 3
Directors: Buck Samuel & Katy Patras

**GS-IY-6203 Mechanisms of Autoimmunity & Inflammation**

In this course, students learn in depth about the immune mechanisms driving autoimmunity and inflammation, systemically, and in different organs. The course will be combination of lectures and discussions of the scientific literature.

Term: 1
Director: Christine Beeton

**GS-IY-6204 Vaccinology**

This course facilitates a deeper understanding of translational vaccinology linking the bench to the bedside (or shot in the arm), spanning the scope of pre-clinical vaccine design, phase 1,2,3 clinical vaccine trials, to post-clinical marketing and vaccine safety.

Term: 2

**GS-IY-6205 Microbiome Methodology & Data Analysis**

This course covers the core methodology used in the design and analysis of host-associated microbial communities, termed the ‘microbiome’, in health and disease. Students learn about the key factors in study design and methods used to characterize and quantitatively analyze microbiome sequencing datasets. Each session includes a hands-on practicum for data processing and analysis using publicly available tools. The course is intended to provide the basic methodological know-how to be able to integrate microbiome studies into any research program.

Term: 5
Director: Joseph Petrosino

**GS-IY-6301 Immunology**

This is a series of lectures stressing basic concepts in immunology. These include immunooanatomy and cytology, innate immunity, development of the immune system, immunoglobulin structure and genetics, antigen-antibody reactions, the major histocompatibility complex and antigen presentation, T cell receptors (genetics, structure, selection), T cell activation and effector functions, cell trafficking, phagocytic cell functions, immune responses to infections organisms and tumors, autoimmunity, allergies and immunodeficiency. The course includes weekly reviews led by senior graduate students that help to explore and clarify concepts.

Term: 3
Director: Miguel Cruz

**GS-IY-6304 Clinical Aspects of Immunology**

This course is designed for immunology students to learn more about the roles and importance of immunology in various human diseases and animal models, including cancer immunology, autoimmune diseases, infectious/tropical diseases, allergy and immunodeficiency. The goals of this course are to introduce students to these active research topics, to bridge basic immunology to clinical immunology, and motivate them for the selection of their own research topics related to important human diseases.

Term: 5
Director: William Decker

**GS-IY-6305 Experimental Immunology & Microbiology**

This course will utilize primary literature to provide students an understanding of how important challenges in Immunology & Microbiology are addressed with a particular focus on rationale, thoughtful experimental design and rigorous methodologies are leveraged to answer the biggest questions in Immunology and Microbiology. The session topics will be organized around Grand Challenges in the fields of Immunology & Microbiology, such as Vaccines, Antimicrobial Resistance, Autoimmunity, HIV, Cancer Immunotherapy, and the like.

Term: 3
Directors: Margaret Conner & Ronald Javier

**GS-IY-6401 Concepts in Host Immune System-Microbiome Interactions**

This course facilitates an integrated understanding of host immune system-microbe interactions, including how they are established, maintained in health, and altered in disease states. Students will develop a conceptual understanding of the primary components and functions that drive these interactions from both a host and microbial perspective and will apply this understanding to real-world problems using student-centered and team-based learning approaches.

Terms: 1-2
Directors: Margaret Conner & Ronald Javier

**GS-IY-6402 Concepts in Microbial Pathogenesis**

Microbial Pathogenesis will provide interested graduate students or postdoctoral fellows with knowledge of the basic and clinical aspects of mechanisms and consequences of microbial (bacterial and viral) pathogenesis. This course will provide students with the knowledge to understand how bacteria and viruses cause disease, insights into research approaches used to answer questions on microbial pathogenesis, and a forum for in depth discussion of data from selected papers and enhance their ability to critically analyze, discuss, and present data.

Term: 4
Directors: Margaret Conner, Job Lopez & Shital Patel

**GS-IY-6403 Fundamentals of Effective Grant Writing**

An ability to conceive significant and innovative research questions and to communicate them clearly is essential to achieve grant funding. This course is designed to introduce 1st or 2nd year graduate students to the fundamentals of successful grant writing including grant organization, strategy, and the review process using NIH as the model funding agency. Students will learn to strategically design at least two specific aims and to expand one of those aims into a fully developed research strategy section. During the course, students will present their aims and rationale, several times with written and oral feedback from peers and faculty. This course is intended to develop skills in critical thinking, written presentation of complex scientific information, as well as preparing students for their qualifying exam, and encouraging independent NRSA or other fellowship applications.

Term: 4
Director: Susan Marriott
Neuroscience (GS-NE)

**GS-NE-5000**
**Special Topics**
Scholarly study directed by a faculty member. Special topics allow a faculty member to develop individualized courses for students. Special topics cannot be used to satisfy the 30 hr. course requirement.
Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-NE-5010**
**Readings**
Faculty directed literature projects that survey a specialized topic of interest.
Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-NE-5030**
**Research Rotation**
Faculty mentored research for students who have not yet selected a faculty advisor.
Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-NE-5040**
**Special Projects**
Faculty mentored research for students that have selected their thesis advisor but not been admitted to candidacy.
Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-NE-5050**
**Dissertation**
Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.
Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-NE-5100**
**Seminar Journal Club in Neuroscience**
This course is required of all first and second year students enrolled in the Neuroscience Graduate Program. The course is conducted as a journal club to study the scientific literature, to practice critical analysis of the literature, and to develop and refine presentation skills. This course is coordinated with the Department of Neuroscience seminar series such that second-year students present papers from the laboratory of the upcoming seminar speaker. All students join in discussion of the paper and evaluation of the journal club presentation.
Terms: 2, 3, 4
Directors: Javier Medina & Jeannie Chin

**GS-NE-5101**
**Preparing for Your Neuroscience Qualifying Exam**
This course will explain the requirements and expectations of the qualifying exam in Neuroscience. The course is geared specifically towards second year students who have successfully completed their first year coursework and several months’ work in their chosen thesis lab. The course will cover the format of the written and oral exams, tips for structuring the aims and scope of the written proposal, and provide students with opportunity to develop and deliver their oral presentation for feedback from the group. The goal of the course is to help students begin thinking about their work independently and to present their research problem and experimental goals clearly.

* Open to second-year Neuroscience students.
Term: 2
Directors: Joanna Jankowsky & Kimberly Tolias

**GS-NE-5111**
**Neuroscience Lab 1**
Students will be introduced to basic approaches of molecular and cellular neuroscience including learning how to model biological systems and how to perform basic laboratory techniques. Primary focus will be on understanding how to break complex neuronal systems down to enable useful computational analyses as well as the importance of design and controls in different experimental approaches. Students will be exposed to a combination of problem solving, practical demonstrations, and discussions of pluses and minuses for different approaches.
Term: 1
Director: Francois St-Pierre

**GS-NE-6101**
**Core Concepts in Computational Neuroscience**
How do brains compute? This course covers the basic concepts underlying neuronal computation, from individual neurons up to networks of neurons in circuits. The focus will be on achieving a computational level understanding: how populations of neurons compute tasks critical for the organism’s survival from sensory input. Students will also be exposed to key ideas from the field of Deep Machine Learning wherein artificial neural networks are employed to solve difficult real-world tasks.
Term: 4
Director: Ankit Patel
Prerequisites: GS-NE-6301 (GS-NE-6302 can be taken concurrently)

**GS-NE-6112**
**Neuroscience Lab 2**
This course extends the practical laboratory demonstrations begun in GS-NE-449 with hands-on demonstrations in systems and computational neuroscience. Methods to be covered include classical and modern neuro-anatomical techniques, in vivo pharmaco- and opto-genetics, model systems behavioral assays, fMRI, and computational modeling among others. One hour lecture and 3 hour laboratory demonstration per week.
Term: 2
Director: Russell Ray

**GS-NE-6201**
**Analyses of Neuronal Function**
This course will cover the basic concepts of synaptic biology. The topics include the organization of the synapses, neurotransmitter release, neuronal plasticity in learning and memory, synaptic organization of microcircuits, and synaptic dysfunction in diseases. Students will learn synaptic biochemistry, cell biology, and physiology and how to study synapses.
Term: 2
Director: Mingshan Xue

**GS-NE-6202**
**Anatomy of the Nervous System**
The course will cover the basic concepts in neuroanatomy in a combined lecture, demonstration, and hands-on lab format. The emphasis will be on the structural organization of the nervous system. A large part of the course will consist of lectures that cover a structure or region of the brain augmented by simultaneous hands-on dissection of fixed sheep brain tissue, histological photographs, and representative MRIs. The students will be divided into small teams and will dissect a sheep brain along with the instructor. It is expected that the teams will interact with the instructors as the lecture/demonstration progresses. Additional lectures and demonstrations will be used to compare and contrast mammalian brains with other species’ brains commonly used in neuroscience research.
Term: 2
Director: Roy Sillitoe

**GS-NE-6204**
**Neurobiology of Disease**
This course will cover important and scientifically tractable disorders of nervous system function. The course will expose the students to the incidence, clinical manifestations, pathophysiology and current scientific models of the causes and mechanisms of some of the most common disorders of brain and nervous system function and development throughout the lifespan. This is an advanced course assuming basic knowledge of neuroscience. Completion of an introductory course is required. Students outside the Neuroscience Graduate Program must receive permission from course director to register, as registration is limited to 20 students.
Term: 4
Director: Jeffrey Noebels

**GS-NE-6205**
**Visual Neuroethology of Prey Capture & Predator Avoidance**
Visual neuroethology of prey capture & predator avoidance covers the following topics for invertebrates and vertebrates: how visual stimuli are detected by the nervous system; how visual information is stored and recalled by the nervous system for the generation of appropriate behavior; i.e., movements of the body parts; the common—as well as unique—neural attributes used by animals to survive using the visual sense; and the adaptive changes exhibited by animals vis-à-vis prey capture and predator avoidance over an animal’s lifespan and how this has shaped the evolutionary history of animals.
Term: 2
Director: Fabrizio Gabbiani & Edward Tehovnik
Director: Jeffrey Yau

The course will cover the key roles played by sensory systems in processing sensory information by the brain. This course will also introduce students to in depth analysis of important papers in systems neuroscience to better assist their development of critical reading skills. Following completion of this course student will understand the locations, functional organization, and functional significance of the main motor pathways as well as key findings linking brain function to complex cognitive behaviors.

Term: 3
Director: Paul Pfaffinger

**GS-NE-6301**

**Neural Systems 1**

This course introduces students to the transformation of sensory inputs into motor actions by the brain. The course will also introduce students to in depth analysis of important papers in systems neuroscience to better assist their development of critical reading skills. This course will prepare students for Neurom Systems 2 which will cover how sensory inputs are transformed into motor actions by the brain. Following completion of this course students will understand the locations, functional organization, and functional significance of the main sensory processing streams in the central nervous system.

Term: 3
Director: Jeffrey Yau

**GS-NE-6302**

**Neural Systems 2**

This course covers the mechanisms involved in transforming sensory inputs into motor action and higher brain functions. The course will cover the spinal, cortical, limbic and cerebellar systems involved in motor planning and execution, behavioral control, and learning and memory. This course will cover the key topics in translation of sensory inputs into patterns of motor behavior as well as brain circuits involved in higher cognitive functions. The course will also introduce students to in depth analysis of important papers in systems neuroscience to better assist their development of critical reading skills. Following completion of this course student will understand the locations, functional organization, and functional significance of the main motor pathways as well as key findings linking brain function to complex cognitive behaviors.

Term: 4
Director: Joshua Shulman

**Prerequisites: GS-NE-6301**

**GS-NE-6303**

**Electrical Signaling in the Brain**

This course covers the basics concepts of electrical signaling from the chemical and physical principles involved, to the biological components involved in generating, modulating and transmitting electrical signals in the brain. Students will learn about the foundations of electrical signaling, how ion channel function and regulation actively regulate membrane potential, how to analyze membrane potential using circuitry methods, and how to understand how electrical signals propagate across long distances. Finally this course will explore some of the new methods to measure and manipulate electrical signaling in awake behaving animals.

Term: 1
Director: Paul Pfaffinger

**GS-NE-6304**

**Brain Cell Biology & Development**

This course covers the basic molecular and cellular organization of the Nervous system. The first 2/3 of the course provides an overview and focal lectures on topics of particular importance to understanding molecular and cellular organization of neurons. The last third of the course covers aspects of neural development that integrates principles learned in the first 2/3 of the course.

Term: 1
Director: Matthew Rashband

**GS-NE-6305**

**Concepts of Learning & Memory**

This course is designed to introduce graduate students to the field of learning and memory. The course will introduce the student to classical and modern concepts of learning and memory across all levels at which learning and memory is studied, including behavioral, anatomical, cellular, molecular and genetic levels of analysis. The basic concepts of learning and memory will also be related to known diseases of learning and memory.

Term: 4
Directors: Mauro Costa-Mattioli & Daoyun Ji

**GS-NE-6307**

**Physiology of the Visual System**

This is an advanced level course on the physiology of the visual system. It covers the biochemistry, physiology and biophysics of phototransduction, synaptic transmission in the retina and functional architecture of the retina and central visual pathways. Additionally, principles of visual information processing in the eye and in the brain, mechanisms controlling eye movement and gaze stabilization are discussed.

Term: 4
Director: Samuel Wu

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**Quantitative and Computational Biosciences (GS-QC)**

**GS-QC-5000**

**Special Topics**

Scholarly study directed by a faculty member. Special topics allows a faculty member to develop individualized courses for students. Special topics cannot be used to satisfy the 30 hr. course requirement.

Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-QC-5010**

**Readings**

Faculty directed literature projects that survey a specialized topic of interest.

Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-QC-5030**

**Research Rotation**

Faculty mentored research for students who have not yet selected a faculty advisor.

Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-QC-5040**

**Special Projects**

Faculty mentored research for students that have selected their thesis advisor but not been admitted to candidacy.

Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-QC-5050**

**Dissertation**

Thesis research directed by a faculty mentor and advisory committee. Open only to candidates for the Ph.D. or M.S. degree.

Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-QC-5100**

**Student Research Seminar**

QB student research seminars will attend the course weekly where upper level student who have passed their qualifying exam will present their research. These research presentations will be presented to an audience of 1st year students and a faculty member to help develop their oral communication and research presentation skills. Following each student's presentation, constructive advice from faculty and students will be provided in a survey about improving

oral and presentation skills and about producing effective presentation materials.

Credits: Variable
Terms: 1, 2, 3, 4, 5

**GS-QC-5105**

**Seminar in Quantitative Biosciences**

This course introduces graduate students to the diversity of biological and clinical research problems that benefit from computational approaches. On alternating weeks the students will be exposed to speakers, or they will present a journal club. The speakers are drawn from across BCM, the TMC, Rice University and the greater Houston area and occasionally will include outside seminar speakers. During this one hour, a format of two short talks from two different speakers will discuss some of the most salient current problems studied in their laboratories, often with a significant emphasis on computational aspects. Style and content vary but, generally, the level is introductory and accessible to all members of the audience. Topics range from genomics to clinical text-mining and from bioengineering to public
health, representing the rich diversity of computational biology research in the Gulf Coast area.

Terms: 1, 2, 3, 4
Directors: Oliver Lichtarge & Richard Sucgang

GS-QC-5110 Advanced Topics in QCB
QCB 1st year graduate students will attend the course weekly where QCB faculty will present their research. Each presentation will be 15 minutes, plus 5 minutes for discussion, and cover an advanced topic on recent development from the faculty’s lab. Following each presentation, the students will discuss with the faculty any potential rotation projects in the lab. The course is aimed to supply the students with the topics for their rotations and research projects.
Terms: 1, 2
Directors: Aleksandar Milosavljevic & Zhandong Liu

GS-QC-5301 QCB Research Design
This course is designed to guide the student through the process of identifying a research problem, developing specific hypotheses and designing well-controlled experiments to test them. It will be taught in small groups of ~8 students/class. A faculty mentor helps formualize and organize the process, but students will develop their ideas through literature searches and discussion. The terms and discussion will center around the NIH format for grant applications (Specific Aims, Background and Significance, Experimental Design).
Term: 4
Directors: Nicolas Young & B. V. Venkatar Prasad

GS-QC-6201 Applications to Biology of Computation
The course will offer a broad survey of different topics from a computational perspective: genomics, epigenomics, population genetics, transcriptomics, proteomics, structure-function, systems biology, networks, cellular imaging, phylogenomics, pattern discovery, drug design, medical informatics, the microbiome, the cancer genome and neurosystems. The objectives are to become familiar with basic computational challenges in these fields and with the current algorithmic solutions.
Term: 3
Director: Olivier Lichtarge

GS-QC-6301 Practical Introduction to Programming for Scientists
In this course students will learn Python, one of the most widely used scripting languages in scientific computing. The course is primarily aimed at students with little or no programming background, but those with some programming experience in other languages wishing to learn Python are also welcome. The course covers basic programming concepts and data structures, and students will learn to write simple programs to improve their data processing productivity. We will also cover a number of open source scientific libraries available in Python (Biopython, SciPy, Matplotlib, etc.). Some basic familiarity with using a computer will be expected, and each student must have a laptop computer for use in class by the beginning of the term.
Term: 1
Director: Steven Ludtke

GS-QC-6302 Computer-Aided Discovery Methods
The objective of this course is to introduce students to the concepts, methods and tools relevant for computer-aided discovery using data collected using high-throughput technologies. The course will focus on the methods of integration of data, tools, and discovery processes and the methods of computational pattern discovery, hypothesis generation and testing. The students will master advanced applications of computing that enable new methods of discovery in a field of focus, which will initially be cancer biology. The course will not focus exclusively on technical, algorithmic or mathematical aspects nor will it focus on biology alone. Instead, the focus will be on genuine integration of the two fields.
Term: 4
Directors: Aleksandar Milosavljevic & Matthew Roth

GS-QC-6401 Quantitative & Computational Methods for Biosciences 1
This is the first in a series of two courses that introduces essential computational, statistical and mathematical concepts to students who are interested in computational biology. It is intended that each of the concepts will be taught in the context of the real biological problems. In this course, we will cover the probability theory, stochastic process, regression model, model regularization, and dimensionality reduction algorithms.
Term: 2
Director: Zhandong Liu

GS-QC-6402 Quantitative & Computational Methods for Biosciences 2
This is the second in a series of two courses that introduces essential computational, statistical and mathematical concepts to students who are interested in computational biology. In this course, we will focus on unsupervised learning, deep neural networks, methods in image analysis as well as genomic sequence analysis.
Term: 3
Director: Zhandong Liu

GS-GS-4201 Wellbeing & Burnout Management for Healthcare Professionals
This course focuses on the knowledge base and techniques used to alleviate and manage burnout, and enhance wellbeing.
* This course is cross-listed as MEPSY 567 in the School of Medicine.
Prerequisite: Admission to the Post-baccalaureate Certificate of Completion program in Biomedical Sciences & Health Equity.
Term: 2
Director: Kimberly Lopez

GS-GS-4203 Introduction to Biostatistics
This course offers students introductory topics in applied biostatistics with an emphasis on hands-on basic data analysis using an appropriate statistical package. The class focuses on the practical application of statistical methods to study design and analysis including ability to interpret results.
Prerequisite: Admission to the Post-baccalaureate Certificate of Completion program in Biomedical Sciences & Health Equity.
Term: 3
Director: Charles Minard

GS-GS-4204 Fundamentals of Research Methods
This course introduces students to quantitative and qualitative methods for conducting meaningful inquiry and research. They will gain an overview of research intent and design, methodology and technique, format and presentation, and data management and analysis informed by commonly used statistical methods. Topics include introduction to research design, planning a research study, bio-statistical considerations, epidemiological considerations, survey research methods, and ethical issues of research.
Prerequisite: Admission to the Post-baccalaureate Certificate of Completion program in Biomedical Sciences & Health Equity.
Terms: 4+5
Director: Antonie Rice
GS-GS-4301
Molecular Cell Biology
This course provided students with foundational knowledge in Cellular Biology and focuses on the understanding of basic cellular mechanisms that occur in all cells. The format includes a series of lectures, small group active-learning sessions where students work in groups to solve problem-based questions, and instructor-led review sessions that will promote both mastery of content and development of critical thinking skills necessary for a developing scientist.
Prerequisite: Admission to the Post-baccalaureate Certificate of Completion program in Biomedical Sciences & Health Equity.
Term: 3
Director: Charles Foulds

GS-GS-4302
Principles of Genetics
This course provides students with foundational knowledge in areas of biotechnology and genetics and focuses on the understanding of current research methodologies and the fundamentals of heredity and molecular genetics. The format includes a series of lectures, small group, active-learning sessions where students work in groups to solve problem-based questions, and instructor-led review sessions that will promote both mastery of content and development of critical thinking skills necessary for a developing scientist.
Prerequisite: Admission to the Post-baccalaureate Certificate of Completion program in Biomedical Sciences & Health Equity.
Term: 4
Director: Debra Murray

GS-GS-4601
Clinical Biochemistry
This course provides students with the foundations of clinical biochemistry in order to prepare them for their further studies. The course reviews basic organic chemistry pertinent to understanding metabolic pathways with emphasis on different aspects of clinical biochemistry, including structure and function of proteins, enzyme kinetics, and the metabolism of carbohydrates, lipids and amino acids. Special attention is given to the nutritional needs of humans.
* This course is cross-listed as HPBIO 63121 in the School of Health Professions.
Prerequisite: Admission to the Post-baccalaureate Certificate of Completion program in Biomedical Sciences & Health Equity.
Terms: 1+2
Director: Kristina Hultén