

Exploring Gut, Brain, and Immunity

(BIOL590 Section 001)

Fall 2019

Dr. Celia Shiau

TIME: THURSDAY 2:00-4:45PM

LOCATION: Genome Sciences Building GS 2101

COURSE TYPE: 3-credit hour lecture and interactive learning course

Have you ever wondered if there was a scientific basis for a gut feeling or butterflies in one's stomach? We will be exploring topics that relate to how the brain and the gut communicate with one another. These will also relate the brain-gut axis to the immune system and the microbiota. Students will survey these exciting topics and critically think, critique, and understand the experimental evidence for what we understand today about the gut and the brain relationship.

Instructor:

Dr. Celia Shiau

Email: shiauce@unc.edu

Office location: 4352 GSB

Office Hours: TBA

Sakai Site:

You must have your onyen to log on. Lecture materials, required readings, homework assignments, and announcements mentioned in class will be posted here. *It is your responsibility to check it regularly.*

Required Reading and Homework (30% of your final grade):

See syllabus and check Sakai site for posting. There are no required textbooks. Book chapters, primary literature, and review papers will be assigned for homework to be read **prior** to each class. You will be given guided reading assignments (posted on Sakai) to help guide you through the assigned readings, which you will complete and turn in at the beginning of each class for credit. Completing the assigned readings and guided reading assignments will be essential for participating in-class activities. No make-up work will be allowed!

Required Prerequisite:

Strong academic knowledge of molecular and cellular biology as demonstrated by a B- or above in BIOL 205. Exceptions are made for highly motivated students.

Participation and in-class activities (15% of your final grade):

Your participation score will be determined by your engagement and active role in a mix of different types of discussions, group activities, Poll Everywhere questions, and attendance for each class. **IMPORTANT NOTE:** missing just 1 class can quickly affect your participation grade—no make-up work will be allowed!

Student Presentations (15% of your final grade):

There will be two Student presentations, each will weigh 7.5% of the total course score.

Tests (40% of your final grade):

There will be one midterm and one final exam given in class this semester. The questions will be a mix of multiple choice, short answer, and open-ended formats. The final exam is a cumulative test. For all exams, you will need your PID number as identification on your exam sheet. Exams must be taken on the

dates indicated on the syllabus during regular class period; no make-up exams except in special medical or family emergencies documented by the dean's office in writing prior to missing exam.

How is your grade determined at the end of the semester?

Total Grade % = (0.20 x midterm%) + (0.20 x final exam%) + (0.15 x participation score%) + (0.075 x presentation 1 %)+ (0.075 x presentation 2 %)+ (0.30 x required reading assignments%)

Digital etiquette:

This course will require you to use your laptop and/or cell phone during class time. Please be respectful of your classmates and restrict your use of digital devices to course content. You will learn more if you concentrate on the course while you are here and your classmates will thank you for not impeding their ability to learn.

What you should bring to each class:

1. Printed or digital version of the assigned reading articles
2. Outlines from Sakai when available (either printed or on laptop)
3. Extra blank paper for drawings, notes, and activities (or tablet computer for drawing)
4. POLLEVERYWHERE device: electronic device with internet access
5. Your open and curious mind!

Diversity statement: The Department of Biology values the perspectives of individuals from all backgrounds reflecting the diversity of our students. We broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. We strive to make this classroom and this department an inclusive space for all students.

Honor code: All work done in this class must be carried out within the letter and spirit of the UNC Honor Code. You are expected to maintain the confidentiality of all exams by divulging no information about any exam to a student who has not yet taken that exam. No plagiarism allowed in any work related to this course. You are also responsible for consulting with your professors if you are unclear about the meaning of plagiarism or about whether any particular act on your part constitutes plagiarism. Please talk with the professor if you have any question about the Honor Code.

Copyright policy: All course materials including your class notes and in-class assignments are covered by University Copyright Policy @ <http://www.unc.edu/campus/policies/copyright%20policy%2000008319.pdf>. ***This means it is illegal and an honor code offense to share your notes or any other course materials items with anyone not directly affiliated with this particular class. No uploading to non-class sharing sites.***

Class Schedule for BIOL 590 Section 001

| Date | Class meeting # | Assignments to be completed BEFORE this class (due at the beginning of each class) | Topics covered |
|---|----------------------------|---|--|
| Thurs 8/22 | Please complete assignment | Complete Guided Reading Assignment for due 8/27 Tues: Review paper: Rao and Gershon 2016 The bowel and beyond: the enteric nervous system in neurological disorders News and views paper: Koelle, 1986 Otto Loewi 1873-1961 | Read syllabus and check out course website on Sakai |
| Tues 8/27*** *** Special class date | 1 | Complete Guided Reading Assignment for: Review paper: Rao and Gershon 2016 The bowel and beyond: the enteric nervous system in neurological disorders News and views paper: Koelle, 1986 Otto Loewi 1873-1961 | Overview: The nervous system (CNS, PNS (ANS/ENS and sensory nerves)); The brain-gut axis Scientific methods: thinking like a scientist Dissecting research papers ---- -Autonomic nervous system and the hypothalamus -Vagus nerve -Neurotransmitters overview -Discovery of Acetylcholine |
| Thurs 9/5 | 2 | Complete Guided Reading Assignment for: Review paper: Peeters, 2005 Ghrelin: A new player in the control of gastrointestinal functions Primary paper: Kojima et al., 1999 Ghrelin is a growth-hormone-releasing acylated peptide from stomach | -Historical perspective and experiments leading to discovery of Ghrelin: Appetite regulation -Enteric nervous system: "the second brain" |
| Thurs 9/12 | 3 | Complete Guided Reading Assignment for: Review paper: TBD Primary paper: TBD | Enteric nervous system: Structural organization Sensory and Motor Functions Neural connections to the brain |
| Thurs 9/19 | 4 | Complete Guided Reading Assignment for: Review paper: Grainger et al., 2017 Macrophages in gastrointestinal homeostasis and inflammation | Intestinal macrophages I: -Functional diversity -Regional specialization -Development |

| | | | |
|-------------|---|---|---|
| | | Primary paper: Shaw et al., 2018 Tissue-resident macrophages in the intestine are long lived and defined by Tim-4 and CD4 expression | |
| Thurs 9/26 | 5 | Prepare a presentation that follows the guidelines provided in class. Email your powerpoint slides .ppt to Dr. Shiao by 5pm Wednesday 9/25 to receive credit for this assignment. Each student will provide a feedback assessment of each proposed experiment in class. | <u>Student presentation:</u> Propose an experiment |
| Thurs 10/3 | 6 | Complete Guided Reading Assignment for: Review paper: Velga-Fernandes and Mucida 2016 Neuro-immune interactions at barrier surfaces Primary paper: Gabanyi et al., 2016 Neuro-immune interactions drive tissue programming in intestinal macrophages | Intestinal macrophages II: -Macrophages as mediators of the gut-neuroimmune dialogue -Current active research -Experimental methods and designs |
| Thurs 10/10 | 7 | Midterm | In-class Midterm |
| Thurs 10/17 | | NO CLASS—Fall break! | |
| Thurs 10/24 | 8 | Complete Guided Reading Assignment for: Primary paper: Li et al. 2011 Essential Roles of Enteric Neuronal Serotonin in Gastrointestinal Motility and the Development/Survival of Enteric Dopaminergic Neurons Primary paper: Yano et al., 2015 Indigenous Bacteria from the Gut Microbiota Regulate Host Serotonin Biosynthesis | How brain and gut talk overview Role of gut microbiota in brain-gut interactions: insights from serotonin Research Highlights |
| Thurs 10/31 | 9 | Complete Guided Reading Assignment for: Primary paper: Stanley et al., 2016 Bidirectional electromagnetic control of the hypothalamus regulates feeding and metabolism Primary paper: Bellono et al., 2017 Enterochromaffin cells are gut chemosensors that couple to sensory neural pathways | Communication between brain and gut 1) A key physiological process: control of feeding and appetite 2) One key cellular mediator: serotonin-producing enterochromaffin cells |

| | | | |
|---|----|--|---|
| Thurs 11/7 | 10 | Complete Guided Reading Assignment for: Review paper: Carabotti et al., 2015 The gut-brain axis: interactions between enteric microbiota, central and enteric nervous systems Primary paper: Heijtz et al., 2011 Normal gut microbiota modulates brain development and behavior | Extensive attention on gut microbes in the gut-brain axis 1) reciprocal interactions between gut microbiota and brain 2) possible effect of gut microbiota on brain development and behavior |
| Thurs 11/14 | 11 | Prepare a presentation that follows the guidelines provided in class. Email your powerpoint slides .ppt to Dr. Shiao by 5pm Wednesday 11/13 to receive credit for this assignment. | <u>Student presentation:</u> Teach the class about a recent gut-brain, gut, or brain research topic |
| Thurs 11/21 | 12 | Complete Guided Reading Assignment for: Primary paper: Perry et al., 2016 Acetate mediates a microbiome-brain-B-cell axis to promote metabolic syndrome Primary paper: Vadder et al., 2014 Microbiota-generated metabolites promote metabolic benefits via gut-brain neural circuits | From gut disruption to altered brain function and disorders 1) Changes to gut microbiota alters brain function leading to obesity 2) Associated with various diseases: allergies, autoimmune diseases, metabolic disorders and neurological diseases Review of class topics |
| Thurs 11/28 | | NO CLASS—Thanksgiving Holiday! | |
| FINAL Saturday December 7th 12:00 pm (noon) | | | |