

**COURSE OVERVIEW:**

Microbiomes and Health

11:680:475

Spring Semester

Meeting Times: TBD

Meeting Location: TBD

**CONTACT INFORMATION:**

Instructor(s):

**Dr. Liping Zhao**

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Office Hours: By appointment

**Dr. Maria Gloria Dominguez**

Office Location: Lipman Hall, Room 333B

Phone: 848-932-5648

Email: [mg.dominguez-bello@rutgers.edu](mailto:mg.dominguez-bello@rutgers.edu)

Office Hours: By appointment

Invited Speakers

**COURSE WEBSITE, RESOURCES AND MATERIALS:**

Reading assignments include selected sections from:

1. Cox, L.M., et al., *Altering the intestinal microbiota during a critical developmental window has lasting metabolic consequences*. Cell, 2014. **158**(4): p. 705-21.
2. Douglas, A., *Fundamentals of Microbiome Science: How Microbes Shape Animal Biology*. 2018, 41 William Street, Princeton, New Jersey 08540: Princeton University Press.
3. HMP, C., *Structure, function and diversity of the healthy human microbiome*. Nature, 2012. **486**(7402): p. 207-14.
4. Diaz Heijtz, R., et al., *Normal gut microbiota modulates brain development and behavior*. Proc Natl Acad Sci U S A, 2011. **108**(7): p. 3047-52.
5. Sonnenburg, E.D. and J.L. Sonnenburg, *Starving our microbial self: the deleterious consequences of a diet deficient in microbiota-accessible carbohydrates*. Cell Metab, 2014. **20**(5): p. 779-86.
6. Sonnenburg, E.D., et al., *Diet-induced extinctions in the gut microbiota compound over generations*. Nature, 2016. **529**(7585): p. 212-5.
7. Zou, J., et al., *Fiber-Mediated Nourishment of Gut Microbiota Protects against Diet-Induced Obesity by Restoring IL-22-Mediated Colonic Health*. Cell Host Microbe, 2018. **23**(1): p. 41-53 e4.
8. Azad, M.B., et al., *Infant Feeding and Weight Gain: Separating Breast Milk From Breastfeeding and Formula From Food*. Pediatrics, 2018. **142**(4).
9. Yassour, M., et al., *Strain-level analysis of mother-to-child bacterial transmission during the first few months of life*. Cell Host Microbe, 2018. **24**(1): p. 146-154 e4.

10. Dominguez-Bello, M.G., et al., *Partial restoration of the microbiota of cesarean-born infants via vaginal microbial transfer*. Nat Med, 2016. **22**(3): p. 250-3.
11. Moeller, A.H., et al., *Rapid changes in the gut microbiome during human evolution*. Proc Natl Acad Sci U S A, 2014. **111**(46): p. 16431-5.

### **COURSE DESCRIPTION:**

This course provides an overview on the role of microbiome in human health and disease. It focuses on conceptual framework and technologies for understanding how microbiome, particularly gut microbiome impact human health and well-being.

Topics covered include the concept of human superorganism; Microbiome and human adaptation/evolution; Ecological principles of microbiomes; Systems thinking and approaches for working on human microbiome; Bioinformatics and statistics tool kits for human microbiome research; Research strategy and experimental/trial design in microbiome study; From correlation to causality of human microbiome in chronic diseases; Nutrition and gut microbiome; Food processing and gut microbiome; Microbiome in pharmacology; Intergenerational, vertical transmission of human microbiomes; Horizontal transfer of human microbiomes; Microbiome and human society; Microbiome and Human-Nature relationship.

### **LEARNING GOALS:**

#### **COURSE LEARNING GOALS**

By the end of the course, students will be able to:

1. Illustrate ecological principles of the human microbiome, and the importance of conservation of the global microbiomes of peoples from different human populations
2. Examine how microbiome may impact human health
3. Summarize the tools and strategies for studying the microbiome
4. Evaluate new developments reported in scientific journals and news media.
5. Assess the potential of the microbiota (probiotics) and diet (prebiotics) to achieve and maintain health

#### **ASSIGNMENTS/RESPONSIBILITIES, GRADING & ASSESSMENT:**

Examinations	2 x 20 points	= 40 pts
Essays	2 x 30 points	= 60 pts
<b>Total</b>		<b>= 100 pts</b>

Two tests and two essays. One test and one essay will cover the lectures by Dr. Liping Zhao, the second test and one essay will cover the lectures by Dr. Dominguez-Bello. Each test will be 20% and each essay (1000 words at least) will be 30% of the total score of 100.

#### **ACCOMODATIONS FOR STUDENTS WITH DISABILITIES**

Please follow the procedures outlined at <https://ods.rutgers.edu/students/registration-form>. Full policies and procedures are at <https://ods.rutgers.edu/>

#### **ABSENCE POLICY**

Students are expected to attend all classes; if you expect to miss one or two classes, please use the University absence reporting website <https://sims.rutgers.edu/ssra/> to indicate the date and reason for your absence. An email is automatically sent to me.

**COURSE SCHEDULE:**

Lecture 1, Introduction: human superorganism and ecology of the microbiome	Liping Zhao M Gloria Dominguez-Bello
Lecture 2, Systems biology for human microbiome research	Liping Zhao
Lecture 3, Causality in human microbiome research: Koch's postulates still apply	Liping Zhao
Lecture 4, Multi-omics approach and data-mining strategy	Liping Zhao
Lecture 5, Nutritional modulation of the gut microbiome for metabolic health: animal models	Liping Zhao
Lecture 6, Nutritional modulation of the gut microbiome for metabolic health: human obesity	Liping Zhao
Lecture 7, Nutritional modulation of the gut microbiome for metabolic health: human type 2 diabetes	Liping Zhao
Lecture 8, Nutritional modulation of the gut microbiome for healthy longevity: animal models	Liping Zhao
Lecture 9, Pharmaceutical modulation of the gut microbiome for metabolic health	Liping Zhao
Lecture 10, The gut microbiome and host immunity: animal models	Liping Zhao
Lecture 11, Are probiotic bacteria probiotic?	Liping Zhao
Lecture 12, Can dietary fiber cause liver cancer?	Liping Zhao
Lecture 13, Human microbiome research in nutrition: what's next? <b>1st test (one hour)</b>	Liping Zhao
Lecture 14, Evolution of microbiomes	M. Gloria Dominguez-Bello
Lecture 15, Microbiomes other than digestive	M. Gloria Dominguez-Bello
Lecture 16, Microbiome functions	M. Gloria Dominguez-Bello
Lecture 17, Microbiota transmission: pregnancy and birth	M. Gloria Dominguez-Bello
Lecture 18, Microbiota transmission: postnatal	M. Gloria Dominguez-Bello
Lecture 19, Microbiota development	M. Gloria Dominguez-Bello
Lecture 20, Microbiota functions in early life	M. Gloria Dominguez-Bello
Lecture 21, Urbanization, microbiome and disease risks: microbial role	M. Gloria Dominguez-Bello
Lecture 22, Microbiota perturbations: medical practices	M. Gloria Dominguez-Bello
Lecture 23, Microbiota perturbations: hygiene and antibacterials	M. Gloria Dominguez-Bello

Lecture 24, Human microbiota degradation: evidence consequences	M. Gloria Dominguez-Bello
Lecture 25, Human microbiota degradation: solutions- One health	M. Gloria Dominguez-Bello
Lecture 26, Future of the microbial planet: one health. <b>2nd test (one hour)</b>	M. Gloria Dominguez-Bello

### FINAL EXAM/PAPER DATE AND TIME

Two tests and two essays. One test and one essay will cover the lectures by Dr. Liping Zhao, the second test and one essay will cover the lectures by Dr. Dominguez-Bello. Each test will be 20% and each essay (1000 words at least) will be 30% of the total score of 100.

### ACADEMIC INTEGRITY

The university's policy on Academic Integrity is available at <http://academicintegrity.rutgers.edu/academic-integrity-policy>. The principles of academic integrity require that a student:

- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work.
- make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that

- everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- all student work is fairly evaluated and no student has an inappropriate advantage over others.
- the academic and ethical development of all students is fostered.
- the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

### STUDENT WELLNESS SERVICES

Just In Case Web App <http://codu.co/cee05e>

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ [www.rhscaps.rutgers.edu/](http://www.rhscaps.rutgers.edu/)

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy,

group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

**Violence Prevention & Victim Assistance (VPVA)**

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / [www.vpva.rutgers.edu/](http://www.vpva.rutgers.edu/)

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

**Disability Services**

(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / <https://ods.rutgers.edu/>

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: <https://ods.rutgers.edu/students/registration-form>.

**Scarlet Listeners**

(732) 247-5555 / <https://rutgers.campuslabs.com/engage/organization/scarletlisteners>

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.

## Course Assessment Plan

Assignments and exams are designed to measure learning outcomes as well as providing the basis for grading.

### *Course Learning Goals*

### *Assessment*

Illustrate ecological principles of the human microbiome, and the importance of conservation of the global microbiomes of peoples from different human populations	<p>Essay with a critical approach to the subject. Assays will be evaluated and scored.</p> <p>Example Exam questions: What is ecosystem resilience and resistance? What are possible reasons of the degradation of the human microbiome in modern lifestyles?</p>
Examine how microbiome may impact human health	<p>Example Exam question: Discuss mechanisms by which the microbiome affects disease risk.</p>
Summarize the tools and strategies for studying the microbiome	<p>Example Exam question: Describe different sequencing approaches to study the microbiome.</p>
Evaluate new developments reported in scientific journals and news media.	<p>Essay with a critical approach to the subject. Essays will be evaluated and scored with grading rubric.</p>
Assess the potential of the microbiota (probiotics) and diet (prebiotics) to achieve and maintain health	<p>Essay with a critical approach to the subject. Essays will be evaluated and scored.</p> <p>Example Exam question: Describe the effect of dietary substrates on shaping the microbiome.</p>