

The Neurobiology of Food Intake and Overeating (PSY 333)

Disclaimer: Please note that elements of this syllabus are subject to change at the discretion of the professors. Any changes will be provided to students via email or on the course D2L website.

Overview: Humans are experiencing tremendous difficulty in their relationship with food. Food intake can be regulated by precise feeding mechanisms that have evolved allowing for the survival of the human race. However, the environmental conditions our ancestors dealt with differ drastically than those presented in today's society, where obesity and its physical comorbidities (e.g., diabetes, heart disease) continue to place a burden on society in general, and the individual in particular.

Instructional Objectives: This undergraduate course will examine the underlying basis of energy (food) intake, its expenditure; learned and unlearned physiological and neurological mechanisms that drive food intake and overeating, and vulnerabilities to obesity. Information will be presented from a range of disciplines including paleontology, psychology, neuroscience and medicine. The overall goal of the course is to consolidate our understanding of what drives us to eat and why what we eat, and where we eat it is so important. Please be aware that this course deals with a lot of the **biology** underlying how the brain and body influence eating behaviors. If you don't like biology very much, this may not be the course for you.

Time and Location:

1:00-2:20 PM on Tuesday and Thursday throughout Spring Semester 2026 in Olds Hall Room# 111

Office hours on Fridays 9:00-10:00 AM: <https://msu.zoom.us/j/97759330531>**

Meeting ID: 977 5933 0531. **Passcode:** officehour

Instructor and Office Hours

Dr. Alex Johnson

Office hours: Fridays 9-10AM (or by appointment)

E-mail: awj@msu.edu

Graduate TA: Jamie Shi

Office hours: Fridays 11:00AM-12:00PM

Meeting ID: 910 43078954; Passcode: Psychology

E-mail: shijiami@msu.edu

Grades will be assigned on the following scale:

90-100% = 4.0	75-79% = 2.5	60-64% = 1.0
85-89% = 3.5	70-74% = 2.0	< 60% = 0

80-84% = 3.0

65-69% = 1.5

Top Hat:

We will be using Top Hat Pro (www.tophat.com) for class participation and discussion. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets, laptops, or through text message. For instructions on how to create a Top Hat account and enrol in our Top Hat Pro course, please refer to the invitation sent to your MSU email address or consult Top Hat's Getting Started Guide (<https://bit.ly/31TGMIw>).

To connect to Top Hat complete the following:

- Go to <https://app.tophat.com/register/student>
- Click "Search by school" and input the name of our school
- Search for our course with the following join code: **497162**

If a paid subscription is required, it will be listed at checkout when you enrol in Top Hat Pro course. Should you require assistance with Top Hat at any time please contact their Support Team directly by way of email (support@tophat.com), the in-app support button, or by calling 1-888-663-5491. Specific user information may be required by their technical support team when troubleshooting issues

Grading: Grades will be determined from **five** sources:

(i) **Module quizzes** (30%): Throughout the course of the semester a total of four exams will be delivered. These exams will cover material dealt with during lecture periods (lectures, movies, discussion, etc). These exams will be delivered in class, for dates see class schedule.

(ii) **Class participation** (20%): During each class, students will receive several questions based on the material discussed or class activities. Students will receive half credit for providing a response, and half credit if the response is correct.

(iii) **Super taster activity** (5%): Credit will be assigned for completing the in-class activity and providing a brief report about supertasters.

(iv) **Magic berry activity** (5%): Following an in-class activity with Sapotaceae, we will discuss how we detect different foods and a brief report will be required for credit.

(iii) **In class symposium** (15%): Towards the end of the semester, there will be an in-class symposium which may include video presentations, controversial, and contemporary questions on the study of obesity and its impact on our society. Discussion points will be based on material being presented and information that will have been previously discussed in class. Grading will be derived from attendance, engagement and proficient contribution to the symposium.

(iv) **Final exam** (20%): There will be a final exam that covers material dealt throughout the semester. It will be the same format as the module quizzes.

(v) **Class attendance** (5%): Attendance will be monitored throughout the semester; many classes will have overlapping themes, which are designed to help with conceptualizing the topics discussed. Students who attend less than 90% (without genuine mitigating circumstances) of the classes will receive a 5% reduction in their overall grade. If you are unable to attend class on a particular day, you must inform the TA on that day do receive credit.

Questions, exams and make-up exams

If you are having difficulty with the material, have questions or other concerns, you may come to office hours or make an appointment. Please reach out with any questions to the TA, Jamie Shi: shijiami@msu.edu. Please note that the TA and instructor will endeavor to return e-mails within a 48 hr window.

Make-up exams will **only be given in extreme cases**. This includes a documented serious medical or family emergency (request submitted to MSU). In this case, the appropriate person to contact in your college is usually the Associate Dean of Undergraduate Education. Alternatively, other valid mitigating circumstances for make up exam include a religious holiday or required participation in a university-sanctioned event. Personal/family travel, having to go to work, or lack of planning are not acceptable reasons to receive a make-up exam. If you cannot take the exam because of a university-scheduled event (e.g., a commitment for a sports team), a religious holiday, or some other acceptable event that you could have been foreseen, you must notify the instructor at least one week before the exam. If you cannot take the exam because of a sudden illness or because of a family emergency, you must place your request for a make-up exam within 7 days of the original exam date. Absence from an exam for any other reason will result in a grade of 0 for that exam.

Academic Honesty

Article 2.3.3 of the Academic Freedom Report states that "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Department of Psychology adheres to the policies on academic honesty as specified in General Student Regulations 1.0, *Protection of Scholarship and Grades*; the all-University Policy on *Integrity of Scholarship and Grades*; and Ordinance 17.00, Examinations. (See *Spartan Life: Student Handbook and Resource Guide* (<http://www.vps.msu.edu/SpLife/index.htm>) and/or the MSU Web site: <http://www.msu.edu>). At MSU, General Student Regulation 1.00 states in part that "no student shall claim or submit the academic work of another as one's own." (For the complete regulation, see *Protection of Scholarship and Grades*.) You are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You may not assist anyone or be assisted by anyone on an exam, and you may not use the text or any notes during an exam. Your written work must be your own and you are not authorized to use the www.allmsu.com

web site to complete any course work in this course. Any student caught cheating, plagiarizing or otherwise violating the MSU academic integrity policy may receive the maximum punishment, including a grade of 0.0 in the course. This includes using social-media applications or links (e.g., class group chat) to share information that contributes to a student's class grades (including attendance links, exam questions or Tophat questions).

Please note that any material provided on D2L in this course should not be published elsewhere and disseminated to students that are not part of this class.

The use of generative AI tools (such as ChatGPT, DALL-E, etc.) is not permitted in this class; therefore, any use of AI tools for work in this class may be considered a violation of Michigan State University's policy on academic integrity, the Spartan Code of Honor Academic Pledge and Student Rights and Responsibilities, since the work is not your own. Any student caught using generative AI tools may receive the maximum punishment, including a grade of 0.0 in the course.

Classroom Behavior

Classes begin on time. Students are expected to put away all distractions before class begins, and turn off cell phones etc. It is not appropriate to answer phone calls or text message during lecture. If you arrive late or leave early plan to sit near the back and by an aisle to minimize the disruption to others. **Please stop talking to your neighbor during the lecture.** Please respect your instructors and fellow students by turning off electronic communication devices during class. Laptop use is permitted. However, distracting activities such as instant messaging, writing e-mail, social networking, or playing games is **strictly prohibited during class time.** These behaviors are disruptive and are not conducive to the learning process.

Attendance

In compliance with federal regulations governing financial aid and veterans education benefits, instructors are required to report students who stop attending or who have never attended class. After the first week of classes, and through the semester, attendance will be taken and the PSY department will be notified about non-attending students. Upon receiving a report of non-attendance, the department may initiate administrative drops of those students from the course.

Accommodations for Disabilities

Students with disabilities should contact the Resource Center for Persons with Disabilities (RCPD) to establish clear and reasonable accommodations. For an appointment with a counselor, call 353-9642 (voice) or 355-1293 (TTY). If you require testing accommodations as specified from RCPD, contact the instructor with the appropriate paperwork at least one week prior to the exam date.

Additional information

Reading and other material: Relevant manuscripts, commentaries, opinion articles and reviews will be made available electronically (suggested material can be found below). These readings have been purposely chosen due to their relevance to the material discussed in class. During class you will also be shown carefully selected videos on topics relevant to the study of food intake and overeating.

Suggested reading material. **Please note that these readings are supplementary to class discussion and may cover topics beyond what is described in the lecture material**

Module 1: The origins of Feeding behavior

Kay, R. F. (1985). Dental evidence for the diet of Australopithecus. *Annual Review of Anthropology*, 315-341.

An Evolutionary Whodunit: How Did Humans Develop Lactose Tolerance?
<https://www.npr.org/sections/thesalt/2012/12/27/168144785/an-evolutionary-whodunit-how-did-humans-develop-lactose-tolerance>

Bouchard, C., Tremblay, A., Després, J.-P., Nadeau, A., Lupien, P. J., Thériault, G., et al. (1990). The Response to Long-Term Overfeeding in Identical Twins. *The New England Journal of Medicine*, 322(21), 1477–1482.

Module 2: Genes that affect your Jeans

O'Rahilly, S., & Farooqi, I. S. (2006). Genetics of obesity. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 361(1471), 1095–1105.

Module 3: Epigenetics of ingestive behavior and obesity

Heijmans, B. T., Tobi, E. W., Stein, A. D., Putter, H., Blauw, G. J., Susser, E. S., et al. (2008). Persistent epigenetic differences associated with prenatal exposure to famine in humans. *Proceedings of the National Academy of Sciences*, 105(44), 17046–17049.

Module 4: Taste and feeding

Scott, K. K. (2005). Taste recognition: food for thought. *Neuron*, 48(3), 455–464.

Module 5: The chemosensation of feeding

Prescott, J. (2012). Chemosensory learning and flavour: Perception, preference and intake. *Physiology & Behavior*, 107(4), 553-559.

Module 6: The gut-brain axis—the hunger signal ghrelin

Ariyasu, H. (2001). Stomach Is a Major Source of Circulating Ghrelin, and Feeding State Determines Plasma Ghrelin-Like Immunoreactivity Levels in Humans. *Diabetes*, 86(10), 4753–4758.

Cummings, D. E., Purnell, J. Q., Frayo, R. S., Schmidova, K., Wisse, B. E., & Weigle, D. S. (2001). A preprandial rise in plasma ghrelin levels suggests a role in meal initiation in humans. *Diabetes*, 50(8), 1714-1719.

Module 7: The gut-brain axis—satiety signals

Le Roux, C. W., Batterham, R. L., Aylwin, S. J. B., Patterson, M., Borg, C. M., Wynne, K. J. & Bloom, S. R. (2006). Attenuated peptide YY release in obese subjects is associated with reduced satiety. *Endocrinology*, 147(1), 3-8.

Lieverse, R. J., Jansen, J. B., Masclee, A. A., & Lamers, C. B. (1995). Satiety effects of a physiological dose of cholecystokinin in humans. *Gut*, 36(2), 176-179.

Module 8: The gut-brain axis—regulators of body fat and glucose

Kahn, S. E., Hull, R. L., & Utzschneider, K. M. (2006). Mechanisms linking obesity to insulin resistance and type 2 diabetes. *Nature*, 444(7121), 840–846.

Ruhl et al., (2007). Body mass index and serum leptin concentration independently estimate percentage body fat in older adults. *The American journal of clinical nutrition*, 85(4), 1121-1126.

Müller, T. D., Finan, B., Bloom, S. R., D'Alessio, D., Drucker, D. J., Flatt, P. R., ... & Tschöp, M. H. (2019). Glucagon-like peptide 1 (GLP-1). *Molecular metabolism*, 30, 72-130.

Module 9: The history of the brain's feeding and satiety centers

Brobeck, J. R. (1946). Mechanism of the development of obesity in animals with hypothalamic lesions. *Physiological reviews*, 26(4), 541-559.

Module 10: Cutting-edge science and contemporary feeding mechanisms

Arora, S., Anubhuti. (2006). Role of neuropeptides in appetite regulation and obesity – A review. *Neuropeptides*, 40(6), 375–401.

Beutler, L. R., Corpuz, T. V., Ahn, J. S., Kosar, S., Song, W., Chen, Y., & Knight, Z. A. (2020). Obesity causes selective and long-lasting desensitization of AgRP neurons to dietary fat. *Elife*, 9, e55909.

Module 11: Hedonic, reward and stress-based feeding

Wyvell, C. L., & Berridge, K. C. (2000). Intra-accumbens amphetamine increases the

conditioned incentive salience of sucrose reward: enhancement of reward “wanting” without enhanced “liking” or response reinforcement. *Journal of Neuroscience*, 20(21), 8122-8130.

Abizaid, A., Liu, Z.-W., Andrews, Z. B., Shanabrough, M., Borok, E., Elsworth, J. D., et al. (2006). Ghrelin modulates the activity and synaptic input organization of midbrain dopamine neurons while promoting appetite. *Journal of Clinical Investigation*, 116(12), 3229–3239.

George, S. A., Khan, S., Briggs, H., & Abelson, J. L. (2010). CRH-stimulated cortisol release and food intake in healthy, non-obese adults. *Psychoneuroendocrinology*, 35(4), 607-612.

Module 12: Understanding the basis of our food-related decisions

Robinson, T. N., Borzekowski, D. L., Matheson, D. M., & Kraemer, H. C. (2007). Effects of fast food branding on young children's taste preferences. *Archives of pediatrics & adolescent medicine*, 161(8), 792-797.

Johnson, A. W. (2013). Eating beyond metabolic need: how environmental cues influence feeding behavior. *Trends in Neurosciences*, 36(2), 101-109.

Grabenhorst, F., Rolls, E. T., & Bilderbeck, A. (2008). How cognition modulates affective responses to taste and flavor: top-down influences on the orbitofrontal and pregenual cingulate cortices. *Cerebral Cortex*, 18(7), 1549-1559.

Module 13: The obesogenic environment—the how, what, and where

Contreras-Rodriguez, O., Solanas, M., & Escorihuela, R. M. (2022). Dissecting ultra-processed foods and drinks: Do they have a potential to impact the brain?. *Reviews in Endocrine and Metabolic Disorders*, 23(4), 697-717.

M. Ng, T. Fleming, M. Robinson, B. Thomson, N. Graetz, C. Margono, et al., Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013, *Lancet* 384 (2014) 766–781.

Drewnowski, A. (2004). Obesity and the food environment. *American Journal of Preventative Medicine*, 27(3), 154–162.

Module 14: Diet, exercise, anti-obesity drugs, and allostasis

Müller, T. D., Blüher, M., Tschöp, M. H., & DiMarchi, R. D. (2022). Anti-obesity drug discovery: advances and challenges. *Nature Reviews Drug Discovery*, 21(3), 201-223.

Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: exercise effects on brain and cognition. *Nature reviews neuroscience*, 9(1), 58-65.

Sterling, P. (2012). Allostasis: a model of predictive regulation. *Physiology & behavior*, 106(1), 5-15.

Class schedule

Week beginning	Course topic(s)	Activities
1/12/26	- Introduction - The origins of feeding behavior	- Module 1 reading material
1/19/26	- Genes that affect your Jeans	- Module 2 reading material Video: Can't stop eating
1/26/26	- Epigenetics of ingestive behavior and obesity	- Module 3 reading material - Supertaster activity
2/2/26	- Quiz 1: Modules 1-3	- No class: 2/3/26 - Quiz 1: 2/5/26
2/9/26	- Taste and feeding	- Module 4 reading material
2/16/26	- The chemosensation of feeding	- Module 5 reading material
2/23/25	- The gut-brain axis: The hunger signal ghrelin Satiety signals CCK and PYY	- Module 6 and 7 reading material
3/2/26	- Spring Break	- No classes
3/9/26	-Regulators of body weight and glucose: Leptin, insulin and GLP-1 - Quiz 2: Modules 4-7	- 3/12/26 Quiz 2 (Modules 4-7) - Module 8 reading material
3/16/26	- Regulators of body weight and glucose: Leptin, insulin and GLP-1 - The history of the brain's feeding and satiety centers	- Module 8 and 9 reading material - Video: Leptin video
3/23/26	- The history of the brain's feeding and satiety centers - Cutting-edge science and contemporary feeding mechanisms	- Module 9 and 10 reading material
3/30/26	- Hedonic, reward and stress-based feeding - Quiz 3: Modules 8-10	- Module 11 reading material - 4/7/26 Quiz 3 (Modules 8-10)
4/6/26	- Understanding the basis of our food-related decisions	- Module 12 reading material - Magic Berry Activity
4/13/26	- The obesogenic environment—the how, what, and where	- Module 13 reading material - 4/16/26 Quiz 4 (Modules 12-14)
4/20/26	- Diet, exercise, anti-obesity drugs, and allostasis - The obesity symposium	- Module 14 reading material - Obesity Symposium (4/23/26) - Videos, class discussion
4/27/26		- Final Exam, 4/29/26 @ 10AM-12PM