

## Biology 1017: The Biology of Food

MWF: noon - 1

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This non-science-majors course is based on the premise that almost everything organisms do is ultimately about food (or sex, but this is another course). To understand how the world works, you therefore need to understand food—what it is, how we acquire it, how we modify it, and how it influences human activity on both a large and small scale. This course will begin by dealing with fundamental topics in biology: the chemistry, structure, and physiology of plants and animals, and principles of genetics and evolution as illustrated by the origin and genetic modification of domesticated animals and plants. Next, we will consider the history, practice, and future of agriculture. Finally, we will discuss food distribution and marketing, the place of food in the global economy, and the politics of food production and food security.

### Grading

Grades will be based on two midterms (40%), a final exam (30%), a 3-page paper (10%) and a problem set (20%).

### Lectures

|         |   |   |
|---------|---|---|
| Jan. 15 | Food and humans: a complex interaction  | PDF: Eating Arlene; A vegan manifesto                               |
| 17      | Movie: <i>The Queen of Trees</i>  | PDF: Biology, Chap. 1   |
| 20      | <b>MLK day: No class</b>  |   |
| 22      | Chemistry of food   | P&S, pp. 8-15; 495-497  |
| 24      | Cell structure and function   | P&S, Chap. 2, pp. 16-24   |
| 27      | Metabolism: photosynthesis, respiration, fermentation   | P&S, pp 55-68   |
| 29      | Milk, the perfect food: <i>demonstration (the chemistry of butter, cheese and yogurt, and how to make them)</i> | F&C, Milk   |
| 31      | Meat: structure and function of muscle  | F&C, Meat   |
| Feb. 3  | Vegetables and fruit: the difference is in the details  | P&S, Chap. 3, 5 and 6; F&C, Edible plants; PDF: A quiet evening.... |
| 5       | Supermarket Botany: <i>student presentations</i>  |   |
| 7       | Cooking, and other forms of food processing; making bread   | PDF: The end of food  |
| 10      | Animal nutrition: eating, digesting, defecating   | PDF: Biology, Chap. 41  |
| 12      | Human nutrition   | PDF: The meaning of food<br>PDF: Concepts of energy expenditure;    |
| 14      | The politics of food in America   |   |
| 17      | <b>Midterm 1</b>  |   |
| 19      | Gene structure and regulation   | P&S, pp. 109-115  |
| 21      | Mutations and variation in chromosome number and structure  | P&S, pp. 115-117  |
| 24      | Meiosis and the amazing egg   | P&S, pp. 24-27;74-80  |
| 26      | Mendelian genetics 1: the basics  | P&S, pp. 100-104  |
| 28      | Mendelian genetics 2: more complicated stuff  | P&S, pp. 104-108  |
| March 3 | Population genetics and evolution   | PDF: Biology Chap. 23   |
| 5       | Origin of agriculture   | P&S, Chap. 11   |
| 7       | Plant and animal domestication  | P&S: Chap. 12 & 13; PDF: Documenting domestication                  |

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|---------|---|---|
| 10      | <b>Spring Break</b>                                 |   |
| 12      | <b>Spring Break</b>                                 |   |
| 14      | <b>Sprink Break</b>                                 |   |
| 17      | Cows: evolution, breeding, utilization              | PDF: Dairy genomics   |
| 19      | Chickens: evolution, breeding, utilization          | PDF: Boyd, W. Making meat... Scrambled Eggs...                            |
| 21      | Plant breeding and hybrid corn                      | P&S, 189-196; PDF: The development of hybrid maize                        |
| 24      | The Green Revolution                                | P&S, pp. 236-240; PDF: History of IR8; Norman Borlaug                     |
| 26      | Plant biotechnology: making GM plants               | P&S, pp. 248-261; PDF: The future of food....                             |
| 28      | GMOs—good, bad, or neither?                         | Pringle, <i>Food Inc.</i> ; PDF: Opposition to transgenic technologies... |
| 31      | <b>Midterm # 2</b>                                  |   |
| April 2 | Nutrient cycling in ecosystems                      | P&S, Chap. 26, Biology, Chap. 55  |
| 4       | Agroecology   | PDF: The role of agroecology....  |
| 7       | History of agriculture                              | PDF: After 10,000 years of agriculture....                                |
| 9       | Movie: <i>King Corn</i>                             |   |
| 11      | Sustainable agriculture                             | P&S, pp. 241-245; PDF: Sustainable agriculture: an introduction.          |
| 14      | Fishing and aquaculture                             | PDF: Aquaculture  |
| 16      | Feeding cities/urban agriculture                    | Dominic Vitiello  |
| 18      | Agriculture around the world                        | PDF: Dirt Poor—fertilizer use in Africa<br>PDF: A dying breed             |
| 21      | Global politics of food                             | PDF: Agroimperialism  |
| 23      | Hunger and famines; Food aid                        | PDF: World Hunger   |
| 25      | Movies: <i>Trade trap</i> ; <i>A perfect famine</i> |   |
| 28      | Case study: bananas                                 | PDF: We have no bananas   |
| 30      | <b>Problem set: Discussion; Netter Center</b>       |   |
| TBD     | <b>Final exam</b>                                   |   |

### Books

P&S: Levetin, E. and K. McMahon. Plants and Society, 6<sup>th</sup>-8<sup>th</sup> edition

F&C: McGee, H. (2004) On Food and Cooking: the Science and Lore of the Kitchen. 2<sup>nd</sup> edition.

Pringle, P. (2003) Food, Inc : Mendel to Monsanto - the promises and perils of the biotech harvest

### Term papers

#### Supermarket Botany:

Write a 3 page, double-spaced description of a food plant of interest, covering the following points. You may use Wikipedia as a starting point, but you should consult other sources as well. References should be numbered in the order in which they are cited, and should be cited in the text using this number.

- 1 Latin name.
2. Part of the plant (leaf, stem, fruit, etc).
3. Where did it originate (historically), and where is it grown now?
4. Does it contain any interesting/dangerous chemicals?
5. How do we use it?

6. Anything else you find interesting.

10 students will be asked to volunteer to present a 3-minute description of their plant to the class.

### **Problems**

Answer the following questions. You may consult with your classmates and use any source EXCEPT ChatGPT. You should list whatever source, or sources, you used at the end of each question. If you came up with the answer on your own, this is OK too. I am not looking for a correct answer--just evidence that you have thought carefully about the question. You will be down-graded if it is obvious that you blew this assignment off, or waited until the last minute to do it. Each question can be answered in less than half a page, but you can use more space if you want. Answers are due on the last day of class.

1. How many calories are in a single square of wheat chex? Explain how you got this answer.
2. Which has a larger carbon footprint, a porkchop or a lambchop of the same size? Describe the factors you need to consider to answer this question. The information on the packaging of these items in a supermarket is useful in answering this question.
3. If you order sea bass at a restaurant, there is a 50% chance that you will secretly be served a different, cheaper species of fish. How would you determine if your sea bass dinner is really sea bass?
4. Why does low-carb beer have fewer calories than regular beer; i.e. what is done to make this beer low carb? Do low-carb and high-carb beer have the same amount of alcohol?
5. How are indica rice (jasmine rice, basmati rice) and japonica rice (sushi rice) similar, and how are they different?
6. Seed companies usually provide a variety of information about the seeds they sell. Consider the tomato. What is the difference between an heirloom tomato and an F1 tomato? What do the letters (e.g. V F2 ) after a cultivar name mean? Are vegetable seeds that are produced “organically (OG)” genetically or biochemically different than seeds that are produced by conventional means?
7. Deciding what to plant each year is one of a farmer's biggest problems. Purdue University publishes an annual cost and return table for various crops (<https://ag.purdue.edu/commercialag/home/paer-article/2023-purdue-crop-cost-and-return-guide/>) Based on these data and the current price for a bushel of these crops, would you plant corn, soybeans, or wheat this year? You plan to sell your crop in November, 2025. What current conditions (weather, economy, international events/politics, etc) might help you predict whether this price will be lower or higher at this time?
8. You are the chief nutritionist at the Hospital of the University of Pennsylvania. Your job is to plan a set of meals (breakfast, lunch, dinner) for all the patients in the hospital. What would be your primary considerations?
9. Chocolate has become so expensive that candy companies are producing fewer chocolate snacks for Halloween. Why has it become so expensive?
10. Food is often used as a political weapon. Discuss one example.