Instructor
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Office hours: I maintain an open door policy (but email ahead to ensure I will be there.)

Text
There is no text book for this course. Content will be covered primarily through
handouts, etc. That being said, I highly recommend On Food and Cooking (2004) by
Harold McGee; it is a readable survey of the science (and history) of a very wide variety
of foods.

Intent of the Course
This is a course in the physical chemistry of foods. We will investigate how the chemical
composition and molecular structure of specific foods and food ingredients determines
their macroscopic physical properties, interactions with other foods, chemical reactivity,
and response to specific processing operations such as heating, freezing, drying, mixing
and pouring, and pressurizing. The course thus serves as a conceptual bridge between
food chemistry and food engineering. We will emphasize a conceptual as well as
quantitative understanding of how chemical structure results in macroscopic physical
properties, how specific physical chemical mechanisms underlie a food’s response to
specific processing operations, and how physical chemical concepts can be used to
understand, predict, and thus control food quality and stability. Our effort much of the
time will be devoted to describing the molecular mechanisms that underlie the
macroscopic behavior of foods and in explaining these mechanisms in terms of the
physical chemical properties of matter. Since a full coverage of food physical chemistry
is impossible in one semester, or in an introductory course such as this, only selected
topics will be covered.

Course Outcomes
After successfully completing this course, students will:

Be able to apply the thermodynamic principles of enthalpy, entropy, and free
ergy to food systems.

Be able to analyze the thermodynamic and physical properties of simple water
solutions and the thermodynamics of water in foods (activity).

Be able to analyze the composition and structure of milk and the effects of
processing in terms of colloidal particles and interaction forces.

Be able to explain how the concept of surface tension (surface free energy) is used
to understand the properties of food molecules at air/water and oil/water interfaces.

Be able to describe the physical properties of food polymers (hydrocolloids) and
explain how the functional properties of foods reflect polymer dynamics and interactions.

Be able to describe the properties and phase behavior of crystalline solids
(e specially fats) and understand the mechanism of crystal formation and its implications
for food properties.
Be able to describe the properties and state behavior of amorphous solids (especially sugars) and understand the mechanism of amorphous solid formation and its implications for food properties and stability.

Course Policies and Procedures

Course Evaluation: Your grade will be based on daily quizzes, assignments, a term project with presentation, and two exams.

Quizzes: Many classes will begin with a short (5 minute) quiz, usually 1-2 questions, based on previous class material or on a specific assignment for that day. The quiz provides immediate feedback on comprehension, indicates which concepts and topics are considered important, and ensures that everyone comes to class on time.

Assignments: These will include, but may not be limited to, problem sets, short (one paragraph to one page) responses to or analyses of problems or issues, in-class presentations, and/or individual or group projects of varying length.

Term Project: You will choose a specific food or food ingredient and do a detailed physical chemical analysis of it. This analysis will relate the molecular composition and structure (all levels from nanometers to centimeters) to the specific macroscopic properties of the food. The analysis will include how the molecular properties affect manufacture, storage and shelf-life, use, sensory properties, etc. You will summarize your analysis in a well-organized and referenced term paper and in a class presentation. Specific expectations for this project are enumerated below.

Exams: There will be one midterm and a final exam.

Grading: The final grade will be based on the following weighting of the course content.

- Quizzes: 5%
- Assignments & Problem Sets: 25%
- Term project & Presentation: 25%
- Midterm exam: 20%
- Final exam: 25%

Letter grades will be assigned (approximately) as follows:

- A: 90-100
- B+: 87-89
- B: 80-86
- C+: 77-79
- C: 70-76
- D: 60-69

Class Format

Handouts: Much of the information and content in this course will be provided through material provided online (through the Sakai site) or in class.
Class activities: Small group and class discussions, problem solving, case studies, and short lectures will provide the main mechanisms for learning in this class. Class activities will often assume that you have read an assigned reading. If you fail to do so, therefore, you may be bored, confused, and frustrated in class; as a consequence, you almost certainly will not do as well in the course as you would like.

Academic Integrity
All students are expected and required to be familiar with the rules and regulations of Rutgers University dealing with academic integrity and issues of cheating and/or plagiarism of intellectual material from either printed or electronic sources. Any suspected instance of a violation of these rules will be reported to the appropriate university officials and will be handled strictly in accordance with established university policies.

Such a violation can result in consequences ranging from receiving zero credit for an assignment or test to receiving a failing grade in this class to permanent expulsion from Rutgers University with an indication of this action placed on your permanent University record. Further information is available at the Office of Student Judicial affairs web site: http://academicintegrity.rutgers.edu/integrity.shtml

Term Project
This capstone project will allow you to practice what you have learned in the course by performing a detailed physical chemical analysis of a specific food or food ingredient: peanut butter, whipped cream, Twinkie, banana cream pie, guar gum, etc.

Your description of the food should cover (where appropriate):
  Method of manufacture (as relates to structure)
  Composition (main functional ingredients)
  Structures found in the food (from macro to nano-scale levels)
  How generated
  How maintained
  Physical properties of the food important for
  Manufacturing
  Storage and shelf-life
  Sensory appeal
  “Making it the food it is” (specific properties)
  Molecular basis for these structures and physical properties
    Roles of specific food components
    Generating/maintaining structure and physical properties
    Interactions among components
    Role these interactions play in structure/properties
  Specific physical chemical principles at work in the food

Suggested paper format:
  Introduction
  Manufacture
Food Physical Systems: Fall 2011

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 9/7</td>
<td>Class Logistics</td>
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<tr>
<td></td>
<td>Thermodynamic systems</td>
</tr>
<tr>
<td>Th  9/8</td>
<td>Heat &amp; Enthalpy</td>
</tr>
<tr>
<td>M  9/12</td>
<td>Entropy</td>
</tr>
<tr>
<td>W  9/14</td>
<td>Free Energy &amp; Equilibrium</td>
</tr>
<tr>
<td>M  9/19</td>
<td>Free Energy as f(T): Phases and Phase Changes</td>
</tr>
<tr>
<td>W  9/21</td>
<td>Food Acids: pKa</td>
</tr>
<tr>
<td>M  9/26</td>
<td>Carbonation</td>
</tr>
<tr>
<td>W  9/28</td>
<td>Water Activity &amp; Chemical Potential</td>
</tr>
<tr>
<td>M  10/3</td>
<td>Colligative Properties</td>
</tr>
<tr>
<td>W  10/5</td>
<td>Colloidal Dispersions</td>
</tr>
<tr>
<td>M  10/10</td>
<td>Milk &amp; Milk Properties</td>
</tr>
<tr>
<td>W  10/12</td>
<td>Yoghurt and Cheese: Colloidal Instability</td>
</tr>
<tr>
<td>M  10/17</td>
<td>Colloidal Interactions: Theory</td>
</tr>
<tr>
<td>W  10/19</td>
<td>Review/Catch up</td>
</tr>
<tr>
<td>M  10/24</td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>W  10/26</td>
<td>Surfaces: Principles</td>
</tr>
<tr>
<td>M  10/31</td>
<td>Surfaces: Implications</td>
</tr>
<tr>
<td>W  11/2</td>
<td>Surface Active Molecules: Surface Adsorption</td>
</tr>
<tr>
<td>M  11/7</td>
<td>Air Bubbles, Thin Films &amp; Foams</td>
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<tr>
<td>W  11/9</td>
<td>Food Polymers: Hydrocolloids</td>
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<tr>
<td>M  11/14</td>
<td>Polymers in Solution: Viscosity</td>
</tr>
<tr>
<td>W  11/16</td>
<td>Polymers in Solution: Gelation</td>
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<tr>
<td>M  11/21</td>
<td>Crystalline Solids</td>
</tr>
<tr>
<td>M  11/28</td>
<td>Chocolate</td>
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<tr>
<td>W  11/30</td>
<td>Amorphous Solids</td>
</tr>
<tr>
<td>M  12/5</td>
<td>Individual Presentations</td>
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<tr>
<td>W  12/7</td>
<td>Individual Presentations</td>
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<tr>
<td>M  12/12</td>
<td>Individual Presentations</td>
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<tr>
<td>TBA</td>
<td>Final Exam</td>
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