General Education Course Information Sheet

Please submit this sheet for each proposed course

Department & Course Number: Dept. of Integrative Biology & Physiology, Physiological Science 7

Course Title: **Science & Food: the physical and molecular origins of what we eat**

Indicate if Seminar and/or Writing II course:

1 Check the recommended GE foundation area(s) and subgroups(s) for this course

Foundations of the Arts and Humanities	
• Literary and Cultural Analysis	
• Philosophic and Linguistic Analysis	
• Visual and Performance Arts Analysis and Practice	
Foundations of Society and Culture	
• Historical Analysis	
• Social Analysis	
Foundations of Scientific Inquiry	
• Physical Science	X
With Laboratory or Demonstration Component must be 5 units (or more)	X
• Life Science	X
With Laboratory or Demonstration Component must be 5 units (or more)	**X**

2. Briefly describe the rationale for assignment to foundation area(s) and subgroup(s) chosen.

This multidisciplinary course demonstrates concepts in the physical and biological sciences using live demonstrations and laboratory exercises through food.

3. "List faculty member(s) who will serve as instructor (give academic rank):
Amy Rowat, Assistant Professor

Do you intend to use graduate student instructors (TAs) in this course? Yes X No

If yes, please indicate the number of TAs **1-2**

4. Indicate when do you anticipate teaching this course over the next three years:

2010-2011	Fall		Winter		Spring	
	Enrollment		Enrollment		Enrollment	
2011-2012	Fall		Winter		Spring	**x**
	Enrollment		Enrollment		Enrollment	**50**
2012-2013	Fall		Winter		Spring	**x**
	Enrollment		Enrollment		Enrollment	**>50**

5. GE Course Units

Is this an ***existing*** course that has been modified for inclusion in the new GE? Yes No X

If yes, provide a brief explanation of what has changed.

Present Number of Units: _____ Proposed Number of Units: _____

6. Please present concise arguments for the GE principles applicable to this course.

❑ General Knowledge	Course will provide general knowledge of concepts in physics, physical chemistry, cell biology, physiology, as well as deeper knowledge of the origins of food: where it comes from and nutritional implications.
❑ Integrative Learning	Using food to teach science is a problem-based learning method that inherently requires students to integrate knowledge from everyday food labels as well as multiple disciplines ranging from physics to biology.
❑ Ethical Implications	Critical thinking about an ordinary topic such as food encourages deeper thought and ethical questioning about where food comes from. Asking critical questions about food labels and advertising will also be incorporated into the class.
❑ Cultural Diversity	Examples of foods from different cultures and cuisines will be used throughout the class; this will promote students from diverse backgrounds to get engaged in learning sciences.
❑ Critical Thinking	Students will use the scientific method to address questions about the physical and molecular origins properties of food. This will incite critical questioning about the media and food propaganda.
❑ Rhetorical Effectiveness	Food is a topic that everyone can relate to, and thus makes it easy to dig into and ask questions about the science of everyday objects.
❑ Problem-solving	Inquiry-based projects will require students to figure out how to answer scientific question about the physical properties of food, to carry out experiments, and to complete a written proposal and presentation.
❑ Library & Information Literacy	Final projects will require scientific literacy, and the ability to seek out, to assimilate, and to present information.

(A) STUDENT CONTACT PER WEEK (if not applicable write N/A)

1. Lecture:	**3**	(hours)
2. Discussion Section:		(hours)
3. Labs: (includes discussion)	**2.5**	(hours)
4. Experiential (service learning, internships, other):		(hours)
5. Field Trips:		(hours)
(A) TOTAL Student Contact Per Week	**5.5**	**(HOURS)**

(B) OUT-OF-CLASS HOURS PER WEEK (if not applicable write N/A)

1. General Review & Preparation:	**1**	(hours)
2. Reading	**1**	(hours)
3. Group Projects:	**2**	(hours)
4. Preparation for Quizzes & Exams:	**2**	(hours)
5. Information Literacy Exercises:		(hours)
6. Written Assignments:	**3**	(hours)
7. Research Activity:	**2**	(hours)
(B) TOTAL Out-of-class time per week	**11**	**(HOURS)**
GRAND TOTAL (A) + (B) must equal at least 15 hours/week	**16.5**	**(HOURS)**

Science & Food: The Molecular and Physical Origins of What We Eat
General Education Course at UCLA, Spring 2012
Physiological Science 7
Instructor: Amy Rowat

Theme		Week	Date	Concept	Lecture Topics	Lab	Chef	At the end of this week, students should understand:
Origins, Soil, Environment	**Molecules of food**	1	Mon Apr 2	***Length & Energy scales***	Intro to course/Intro to Proteins, fat, carbohydrates	length scales, energy scales, calories		1. how big molecules are; energy scales of covalent bond, non-covalent bond; what is a calorie
			Wed Apr 4		Length scales, energy scales: from sun to individual bonds			2. types of molecules in food; caloric contents of foods
			Fri Apr 6		Manipulating molecules in dessert		Sherry Yard, Spago (to be confirmed)	
	Molecules: from soil to plants	2	Mon Apr 9	***Diffusion***	How plants grow: uptake of soil nutrients, osmosis	measure diffusion coefficient		1.how fast; concept of diffusion; use diffusion equation to calculate timescales, lengthscales
			Wed Apr 11		Conventional vs organic; Molecular composition; microbes in soil			2. impact on food in soil
			Fri Apr 13		Growing veggies, biodynamic agriculture		David Kinch/Manresa, Love Apple Farms	
	Why carrots taste sweeter in the winter	3	Mon Apr 16	***Phase behavior***	phase transitions	sorbet; Freezing pt depression		1. concept of phase transition; freezing point depression;boiling point elevation
			Wed Apr 18		why carrots taste sweeter in winter			2. concepts in physiology: thermal, pressure adaptation
			Fri Apr 20		Manipulating the soil/growing conditions		Dan Barber, Blue Hill/Stone Barns (to be confirmed)	3. applications in food & cooking: making sorbet, pressure cooker
Food Texture	**Milk: from breast to cheese**	4	Mon Apr 23	***Self-assembling structures***	soft materials: mechanisms of self-assembly: hydrophobic effect, electrostatics	milk/cheese		1. mechanisms for self-assembly of molecules; relevant energy scales
			Wed Apr 25		milk: from breast to cheese			2. self-organizing structures in physiology & food:membranes, protein networks
			Fri Apr 27		bread: protein networks; plant cell wall		TBD	
			Mon Apr 30	***Midterm***				
	Why lettuce is crispy	5	Wed May 2	***Pressure***	Force, Pressure			1. concept of force; concept of pressure; how to estimate pressure
			Fri May 4		Why lettuce is crispy, plant texture		TBD	2. role of pressure in plants; food texture
	Meat texture: pig ears to sweetbreads	6	Mon May 7	***Elasticity***	Elasticity: how to measure, molecular level; chemical & physical gels	measure bite force/ force deformation of meat/jello		1. concept of elasticity; how to measure elasticity; how to calculate mesh size
			Wed May 9		Meat: link to physiology, color (dark vs light)	tenderizing		2. role of stiffness in physiology; cell and tissue integrity; relationship to meat
			Fri May 11				Jon & Vinny, Animal	
Molecules for texture and flavor	**Blood is thicker than water**	7	Mon May 14	***Viscosity***	Viscosity: how to measure, molecular level	measure viscosity of solutions with guar gum		1. concept of viscosity; how to measure viscosity; explain what this means at the molecular level
			Wed May 16		blood is thicker than water; coagulants use in physiology, food	role of thickeners and gelling agents in plants, seeds, fish eggs		2. manipulating viscosity in vivo and in food; thickeners
			Fri May 18				TBD	
	Microbes in food	8	Mon May 21	***Exponentials***	fermentation: effects on texture, flavor	Final Projects		1. what is an exponential; exponential growth of microbial populations
			Wed May 23					2. role of microbes in food production and flavor
			Fri May 25				David Chang, Momofuku	
	Physiology of Taste	9	Wed May 30	***Binding affinity***	protein binding; physiology of taste			1. concept of molecular binding affinity; how to quantitatively describe this
			Fri Jun 1		umami; glutamate in food; MSG	Final Projects		2. how to apply this to understand taste; molecules in taste; umami

				Umami (burger)	Adam Fleischman, Umami Burger	
	Review	10	Mon Jun 4	***Review***		At the end of the this course, students should generally:
			Wed Jun 6			1. be able to use equations for qualitative reasoning
			Fri Jun 8	**Science Fair/ Presentations**	Bill Yosses, White House Pastry Chef	2. understand units, dimensional analysis 3. be able to design an experiment to answer a scientific question
	Final Exam		Week of June 10-15			

Science & Food:
The Physical and Molecular Origins of What We Eat

Summary: What makes lettuce crispy and some cuts of meat chewier than others? This course will explore the origins of food texture and flavor. We will use concepts in the physical sciences to explain macroscopic properties such as elasticity and phase behavior, as well as the physiological role of food molecules in the plants and animals we eat. Guests in the classroom will include chefs and farmers who will illustrate practical applications and manipulations of food texture and flavor.

Instructor: Amy Rowat, PhD (rowat@ucla.edu, x54026)
Dept of Integrative Biology & Physiology

Course: Physiological Science 7

Format: Classroom lectures: 3 hours per week; Laboratory Investigation & Discussion: 2.5 hours per week. Designed for non-science students.

The 2.5-hour section will include both laboratory exercise and discussion time. Ordinarily, the first hour and a half will consist of a laboratory, which will both illustrate the main scientific concepts of the week and culminate in a weekly recipe, which you will both make and eat! Recipes will range from homemade cheese to umami burgers. The last half hour of section will be devoted to addressing questions related to homework problems and the scientific concepts of the week. Sections/labs will take place in a food-grade laboratory in the Life Sciences Building. Write-ups with sections will be combined with the course homework. Each week there will be at least one homework problem that builds on what you did in section and lab.

Enrollment: Capped at 50 students.

Quarter: Spring 2012

Units: 5

Grading: Letter grade

Prereqs: High school math, chemistry, physics.

Readings: "*On Food & Cooking*", McGee H, Scribner, 2004

McGee is a classic text that gives a general overview of the scientific concepts underlying food and cooking. More specific texts covering physiology, as well as scientific aspects of cooking, are listed below. Each week there will be assigned readings from *On Food and Cooking* as well as supplementary readings to cover additional aspects of science and cooking related to the topic of the week from the following texts:

1. *Human Physiology*, 6th ed., Sherwood L, Thomson Brooks/Cole, 2007.
2. *Physiology of Taste*, Brillat-Savarin, JA, translated by Fisher MFK, Counterpoint, 1949.

Additional resources that may be useful for Final Projects include:

<u>*Other books on science and cooking:*</u>
1. *Cookwise*, Corriher S
2. *The Curious Cook*, McGee H
3. *Kitchen Mysteries: Revealing the Science of Food*, This H
4. *The Science of Chocolate*, Beckett ST
5. *The Science of Ice Cream*, Clarke C
6. *Ratio: The simple codes behind the craft of everyday cooking*, Ruhlman M
7. *The Science of Cooking*, Barham P

<u>*Books on physiology:*</u>
1. *Seeley's Essentials of Anatomy and Physiology*, 7 th. ed., VanPutte C et al
2. *Eckert's Animal Physiology*, 5th ed., Randall DJ et al
3. *Bones: structure and mechanics*, Currey JD
4. *Comparative Biomechanics*, Vogel S
5. *Structural Biomaterials*, Vincent JM
6. *Biomechanics: Structures and Systems*, Biewener A & Full B

Assignment: Weekly problem sets will be due in class. You are allowed to drop your lowest homework during the semester.

Exams: There will be an in-class midterm exam. A final exam will be given during final exam period.

Grading:

Weekly Assignments	20%
Section and lab participation	20%
Midterm examination	15%
Final Project	25%
Final examination	20%

Important Note: The course involves the preparation and (optional) consumption of food. If you have specific food allergies or needs, be in touch with the instructor to discuss arrangements that might be appropriate.

Final Project: Will involve investigating a question of interest, with clearly stated scientific objective and motivation. Projects will be evaluated on the basis of scientific approach, experiments done with proper controls, data and quantitative analysis, as well as thoughtfulness and interpretation. As a rule of thumb, you should present at least one graph of your data. As in scientific research, more than one approach or type of experiment is valued.

Projects can be conducted in student teams of 1-3 people per team. Project proposals must be submitted and approved prior to commencing project research.

Projects will be evaluated in terms of both written submission and presentation. There will also be a science fair/ oral presentations.

Examples of Project Ideas:
*How to minimize sticking of the membrane to a hard-boiled egg?
*Pig ear elasticity and ways to tenderize it
*Ikijime: fish preparation and role of the nervous system
*Scientific misconceptions – Myth or Reality? Choose a topic that is described in the popular media (Probiotics; Raw Enzymes; Sugar and how it impacts your health), and explore the scientific evidence.

Lecture Schedule

	Weekly Theme	***Scientific Concepts***	***Physiology Concepts***	***Demo/Lab***
1	**The Molecules of food:** [Readings: On Food and Cooking "The four basic food molecules" pgs. 792-809; "A chemistry primer" pgs. 811-816]	**Basic units of food: length and energy scales.** Proteins, fats, carbohydrates, nucleic acids. From sun to individual bonds (intermolecular and intramolecular interactions); what is a calorie? Structure of polymers; Carbohydrates are polymers of sugars. Proteins are polymers of amino acids. Enzymes break down polymers into smaller units.	Role of molecules in physiology	*DEMO: Manipulating molecules in dessert.*
2	**Molecules: from soil to plants** [Readings: On Food and Cooking "Edible plants" pgs. 243-255]	**Diffusion.** Osmosis. Timescales for growth. Soil texture and composition.	Plants uptake nutrients; soil and growth conditions impact the plant; conventional vs organic	*DEMO: measure diffusion coefficient*
3	**Why carrots taste sweeter in the winter** [Readings: On Food and Cooking "The phases of matter" pgs. 816-818]	**Phase behavior**. Molecular structure determines phase behavior. Fluid and solid states; phase diagrams for "simple materials" water, ethanol; entropy, energy, enthalpy; Effects in physiology; homeostasis; phase transitions in food & cooking (boiling point elevation: pressure cooking)	Phase transitions in organisms: molecular composition to maintain homeostasis. Pressure & temperature adaptation; Effect of free-range diets and environment on lipid composition (e.g. Iberico pig is rich in omega-3 fatty acids)	*LAB: fat melting temperatures with different compositions; sorbet freezing depends on % sugar*
4	**Milk: from breast to cheese** [Readings: On Food and Cooking "Milk and dairy products" pgs. 16-21, 55-67]	**Self Assembling Structures**. Mechanisms of self-assembly in soft materials: hydrophobic effect, electrostatics. Relevant energy scales; Protein folding & membrane assembly; Interactions between complex food molecules. Electrostatics is	Lipid, protein, & carbohydrate networks for cellular organization (bone, muscle) and in food (milk, cheese, &	*LAB: Housemade cheese; quantitative image analysis of milk components, coagulation DEMO: bread*

		the most important and controllable physical interaction. Effects of salt and pH. Protein denaturation.	bread); effect of electrostatics on structure & mechanics of collagen; protein aggregation gone awry: amyloids	*making.*
5	**Why lettuce is crispy** [Readings: On Food and Cooking, "The composition and quality of fruits and vegetables" pgs. 261-266]	**Pressure.** Force, pressure. Osmotic pressure.	Plant, vegetable texture. Pickling, dehydrating.	*DEMO/LAB: measure vacuole size as function of osmolarity, determine pressure.*
6	**Meat texture and Elasticity** [Readings: On Food and Cooking, "Meat" pgs. 149-154]	**Elasticity**: how squishy or stiff a material behaves. Moduli to describe elasticity. How to measure elasticity and what this means at the microscopic level. Elasticity regulated by the organization of material. Chemical gels (e.g. using transglutaminase); physical gels (e.g. alginate, gelatin, eggs)	Muscle structure and elasticity and the role of physiology; Tenderizers (from pounding to Kobe beef massage); common gels, their role in physiology & food: gelatin, collagen	*LAB: mechanical properties of cartilage (pig ear); effect of enzymes; simple elasticity measurements on gelatin* *DEMO: measure bite force*
7	**Blood is thicker than water: Viscosity** [Readings: On Food and Cooking, "Sauces", pgs. 591-625, optional: 582-590]	**Viscosity**: how easily a material flows. Viscosity regulated by the organization of material, and can be manipulated using food thickeners and additives. Viscoelastic materials.	Biological fluids: blood, clotting, and the role of transglutaminase from physiology to haute cuisine; mucopolysaccharides. Role in physiology from seeds to fish eggs; origins of gelatin; pectin in plant walls; alginate and agar in seaweeds	*LAB: Experimental methods to measure viscosity; Transglutminase effect on viscosity of protein solution; measure viscosities*
8	**Microbes in Food.** [Readings: On Food and Cooking, "Yeast" pgs. 531-532; "Making yogurt" pgs. 48-49; "Fermentation and pickling" pgs. 291-295]	**Exponentials**: Describing growth of bacterial population. Science of fermentation.	Role of microbes in food production, flavor and texture.	*DEMO/LAB: count colonies during bacterial growth.*

9	**Physiology of Taste.** [Readings: The Physiology of Taste, "On Taste" pgs. 34-48; On Food and Cooking, "Umami" pg. 342; "Amino acids and peptides" pgs. 806-807; Human Physiology "Chemical senses: taste and smell" pgs. 221-227.	**Binding affinity**: Protein binding. Chemical reactions, and quantifying reaction rates.	Sensory perception. Taste profiles, the role of taste receptors, and umami*;* Quantitative analysis of glutamate concentrations in foods	*Lab: FINAL PROJECTS. DEMO: constructing the Umami Burger.*
10	**Review**			*Lab: FINAL PROJECTS.*
11	**Final Exam**			

New Course Proposal

	Physiological Science 7 **Science and Food: The Physical and Molecular Origins of What We Eat**
Course Number	**Physiological Science 7**
Title	**Science and Food: The Physical and Molecular Origins of What We Eat**
Short Title	**SCIENCE AND FOOD**
Units	Fixed: **5**
Grading Basis	**Letter grade only**
Instructional Format	**Lecture - 3 hours per week** **Laboratory - 2.5 hours per week**
TIE Code	**LECS - Lecture (Plus Supplementary Activity) [T]**
GE Requirement	**Yes**
Major or Minor Requirement	**No**
Requisites	**High school math, chemistry, and physics**
Course Description	**What makes lettuce crispy and some cuts of meat chewier than others? This course will explore the origins of food texture and flavor. We will use concepts in the physical sciences to explain macroscopic properties such as elasticity and phase behavior, as well as the physiological role of food molecules in the plants and animals we eat.**
Justification	**The importance of nutrition and its effects on physiological processes is becoming increasingly important in today's world. This course will provide a general education to make prudent dietary decisions based on the science of food and its physiological effects on health.**
Syllabus	File *Phy Sci 7 Syllabus.docx* was previously uploaded. You may view the file by clicking on the file name.
Supplemental Information	
Grading Structure	**Weekly Assignments: 20%** **Laboratory Assignments: 20%** **Midterm Exam: 15%** **Final Project: 25%** **Final Exam: 20%**
Effective Date	**Spring 2012**
Instructor	Name: **Amy Rowat** — Title: **Assistant Professor**
Quarters Taught	☐ Fall ☐ Winter ☑ Spring ☐ Summer
Department	**Integrative Biology and Physiology**
Contact Routing Help	Name: **MICHAEL CARR** — E-mail: **mcarr@physci.ucla.edu**

ROUTING STATUS

Role:	Registrar's Scheduling Office
Status:	Pending Action

Role:	FEC School Coordinator - Soh, Michael Young (msoh@college.ucla.edu) - 65282
Status:	Returned for Additional Info on 8/26/2011 10:59:28 AM
Changes:	No Changes Made
Comments:	Routing to Registrar's Office

Role:	FEC Chair or Designee - Knapp, Raymond L (knapp@humnet.ucla.edu) - 62278
Status:	Approved on 8/25/2011 8:34:43 AM
Changes:	No Changes Made
Comments:	No Comments

Role:	L&S FEC Coordinator - Soh, Michael Young (msoh@college.ucla.edu) - 65282
Status:	Returned for Additional Info on 8/23/2011 5:01:10 PM
Changes:	No Changes Made
Comments:	Routing to FEC Chair Ray Knapp for approval

Role:	Dean College/School or Designee - Hwang, Sandra Se Mi (shwang@college.ucla.edu) - 54673
Status:	Approved on 8/23/2011 4:48:27 PM
Changes:	No Changes Made
Comments:	No Comments

Role:	L&S FEC Coordinator - Soh, Michael Young (msoh@college.ucla.edu) - 65282
Status:	Returned for Additional Info on 8/11/2011 2:59:17 PM
Changes:	No Changes Made
Comments:	Routing to Sandra Hwang acting on behalf of Dean Sork for approval

Role:	Department Chair or Designee - Carr, Michael (mcarr@physci.ucla.edu) - 53891
Status:	Approved on 8/9/2011 1:48:38 PM
Changes:	No Changes Made
Comments:	Approved for Barney Schlinger, Chair, Integrative Biology & Physiology Dept.

Role:	Initiator/Submitter - Carr, Michael (mcarr@physci.ucla.edu) - 53891
Status:	Submitted on 8/9/2011 1:47:19 PM
Comments:	Initiated a New Course Proposal

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Comments or questions? Contact the Registrar's Office at
cims@registrar.ucla.edu or (310) 206-7045