

Submit originals and one copy and electronic copy to **Governance/Faculty Senate Office**  
(email electronic copy to [fyssenat@uaf.edu](mailto:fyssenat@uaf.edu))

**REQUEST FOR CORE NATURAL SCIENCE DESIGNATOR**

**SUBMITTED BY:**

Department	<b>Biology</b>	College/School	<b>CNSM</b>
Prepared by	<b>Andrea Bersamin</b>	Phone	<b>474-6129</b>
Email Contact	<b><a href="mailto:abersamin@alaska.edu">abersamin@alaska.edu</a></b>	Faculty Contact	<b>Andrea Bersamin</b>

See <http://www.uaf.edu/uafgov/faculty/cd> for a complete description of the rules governing curriculum & course changes.

**1. COURSE IDENTIFICATION:**

Dept	<b>BIOL</b>	Course #	<b>TBD</b>	No. of Credits	<b>4</b>
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**COURSE TITLE** **Introduction to Human Nutrition**

**CONTACT HOURS PER WEEK:** **3** LECTURE hours/weeks **3** LAB hours /week  OTHER specify type

**Note: To meet the natural science requirement, courses must have 4 credit hours and include a laboratory.** See <http://www.uaf.edu/uafgov/faculty/cd/credits.html> for more information on number of credits.

Existing Course	<input type="checkbox"/>	New Course Pending Approval*	<input checked="" type="checkbox"/>
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\*Must be approved by appropriate Curriculum Council.)

**RECEIVED**

**SEP 17 2012**

**Dean's Office**

**College of Natural Science & Mathematics**

**2. CURRENT CATALOG DESCRIPTION AS IT APPEARS IN THE CATALOG: including dept., number, title and credits**

**BIOL 1-- X, Introduction to Human Nutrition, 4 credits.**  
An Introduction to Human Nutrition provides students with an understanding of basic nutritional science and how the principles of nutrition can be used to achieve and maintain optimum health and well-being. Students will consider their own food choices in light of the scientific concepts covered in class. May not be used as a biology elective credit for a major in biological science.  
Prerequisites: ENGL F111X or higher; placement in DEVM F105 or higher; or permission of instructor

**JUSTIFICATION FOR ACTION REQUESTED**

The purpose of the department and campus-wide curriculum committees is to scrutinize course designator applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. Use as much space as needed to fully justify the proposed change and explain what has been done to ensure that the quality of the course is not compromised as a result.

This course will contribute to UAF's growing biomedical program and responds to increasing student interest in health sciences; a recent poll of undergraduate biology students indicated that 39% are interested in a health science track within the department. This course is intended for non-majors who are interested in understanding basic nutritional science and how the principles of nutrition can be used to achieve and maintain optimum health and well-being. The foundation of nutrition science overlaps with knowledge basis of other biological, physical and social sciences which makes this course well-suited as an introductory level science course.

Students will become familiar with applying the scientific process to nutrition. Laboratory exercises will emphasize study design, data collection, hypothesis generation, and experimentation. Students will also

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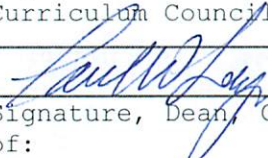
learn the process by which nutrition science research is translated into local and national policies have a direct influence on food choice and health.

I have previously taught a 300 level nutrition course that was well received. In discussions with the Biology department chair, we decided the 100 X course will serve a broader audience and will fill departmental needs.

ALONG WITH THIS FORM PLEASE SUBMIT THE FOLLOWING:

A	A course syllabus (see page 24)
B	Titles of all laboratory exercises.
C	Title of a representative textbook.
D	Detailed outline of 3 laboratory exercises. Please attach an explanation of how these laboratory exercises have been designed to familiarize students with methods for the acquisition and expansion of scientific knowledge, including: a) data collection and analysis, b) hypothesis building, and c) experimentation.
E	A list of the major scientific concepts that the course will convey. The attached syllabus should make it clear that the course is organized around these major concepts rather than their application.
F	An explanation of how the relationship between science and society will be explored in the course. Identify where the course public science policy and its development are discussed.
G	A plan for its effectiveness evaluation.

APPROVALS:

	Date	Sept 17, 2012
Signature, Chair, Program/Department of:	Biology & Wildlife	
	Date	9/25/2012
Signature, Chair, College/School Curriculum Council for:	CNSM	
	Date	9/25/12
Signature, Dean, College/School of:	CNSM	

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE

Signature, Chair, Senate Core Review Committee	Date
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# **CORE DESIGNATOR REQUEST REQUIREMENTS (A-G)**

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## **A. COURSE SYLLABUS**

Please see appended syllabus

## **B. TITLES OF LABORATORY EXERCISES**

Lab 1: Scientific Inquiry, experimental design and graphing

Lab 2: Dietary Assessment: Validity and reliability

Lab 3: Nutrition Labeling Using a Computer Program

Lab 4: Digestion and Enzyme Activity

Lab 5: Macromolecules: personal nutrition portfolio

Lab 6: Energy Balance, Basal Metabolic Rate and Body composition

Lab 7: Energy drinks: What Are You Really Drinking?

Lab 8: Food safety: outbreak investigations

Lab 9: Mapping the community nutrition and physical activity environments

Lab 10: Measurement of oxygen uptake and energy expenditure

## **C. TITLES OF REPRESENTATIVE TEXTBOOKS**

“Discovering Nutrition” Fourth edition, by Insel, Ross, McMahon, Bernstein. Jones and Bartlett publishing.

“The Science of Nutrition” Third edition, but Thompson, Manore and Vaughan. Pearson Publishing

## **D. DETAILED OUTLINE OF 3 LABORATORY EXERCISES**

Please see appended exercises

**E. A LIST OF THE MAJOR SCIENTIFIC CONCEPTS THAT THE COURSE WILL CONVEY.**

- Scientific methods
- Anatomy and physiology
- Energy metabolism
- Essential nutrients
- Microbiology

**F. RELATIONSHIP BETWEEN SCIENCE AND SOCIETY**

This course encourages students to consider how food and activity choices impact society and vice versa. Students will explore the links between food choice and personal, community, and environmental health. They will also consider how local, state, and federal policies affect healthy eating and physical activity. Examples of topics covered include:

- The Farm Bill: impact on food access and choice
- Trans fatty acids: relationship to dyslipidemia and mandatory labeling
- Sugar sweetened beverages: impact on energy balance and school nutrition policies
- Childhood obesity: effect of marketing toward children

**G. A PLAN FOR ITS EFFECTIVENESS EVALUATION.**

Mid- and end- of semester evaluations will be administered. Brief post-lab evaluations will also be administered. Evaluations will include the following types of questions:

- How well did the lab meet the specific learning objectives
- Which part(s) of this lab were the MOST effective?
- Which part(s) of this lab were the LEAST effective?
- What changes would you made to this module and why?
- How confident are you in your knowledge in X as a result of the lab activity?

**BIOLOGY 1-- X**  
**INTRODUCTION TO HUMAN NUTRITION**  
**Spring 2014; 4 Credits**  
**Time: TBD**  
**Location: TBD**  
**CRN: TBD**

**Prerequisites: ENGL F111X or higher; placement in DEVM F105 or higher; or permission of instructor.** This course may not be used as a biology elective credit for a major in biological science.

#### **Instructor Information**

Andrea Bersamin, Ph.D.  
Email: [abersamin@alaska.edu](mailto:abersamin@alaska.edu)  
Office: 234 AHRB, Telephone: (907)474-6129

#### **Office Hours**

TBD. If you have questions about the class or would like to discuss your class performance, I encourage you to come and see me during my office hours (or by appointment).

#### **Course description**

An Introduction to Human Nutrition provides students with an understanding of basic nutritional science and how the principles of nutrition can be used to achieve and maintain optimum health and well-being. Students will consider their own food choices in light of the scientific concepts covered in class.

#### **Course goals**

To provide students with an overview of the fundamentals of human nutrition science.

#### **Learning objectives**

Upon completion of this course, you will be able to do the following:

- Understand how the Dietary Guidelines, Recommended Dietary Allowances (RDA's) and Food Guide Pyramid are used in planning healthy diets for individuals and groups.
- Understand and describe the basic functions, food sources and human requirements of nutrients.
- Understand the digestion, absorption and transport of nutrients.
- Describe the factors influencing energy balance and describe the effectiveness of various weight loss and maintenance strategies.
- Evaluate personal dietary intakes and practices for nutritional adequacy and recommend strategies for improvements
- Understand the role of nutrition in health promotion and disease, particularly chronic disease prevention.
- Describe nutrition issues surrounding food safety and other consumer concerns
- Demonstrate an understanding of the role of food choice in promoting personal, community and environmental health
- Demonstrate an understanding of the scientific process and apply it to current issues in health and nutrition

## Instructional Methods

The course will include lectures, class discussion, in-class activities, text book and journal article readings, and assignments. ***Student participation is important and this requires that all students come prepared having read the required readings in advance.***

This class will focus on teaching scientific concepts in addition to exploring personal decision-making. My goal is for you to consider your own food choices in light of the knowledge you are gaining. Concepts covered in class will use the following types of supplementary activities to accomplish this goal.

- **Health checks:** Activities will guide you to “check” your own behavior or health status based on the lesson content
- **Healthy lifestyle challenges:** Activities will provide ideas for new foods and activities that relate to the lesson content
- **Current controversies:** Activities will encourage you to consider two sides of a debate that relates to the lesson content and decide what side you’re on
- **Systems thinking:** Activities will encourage you to consider how your food and activity choices impact society and vice versa. Specifically you will explore the links between food choice and personal, community, and environmental health. You will also consider how local, state, and federal policies affect healthy eating and physical activity.

## Course Readings

### **Required:**

- “Discovering Nutrition” Fourth edition, by Insel, Ross, McMahon, Bernstein. Jones and Bartlett publishing.
- You will receive a lab manual during your first lab session that is designed to be added to a 3-ring binder (not supplied) .
- Additional readings will be assigned to supplement the main textbook or as part of various homework assignments; these will be made available on Blackboard.

### **Some useful websites:**

Dietary Guidelines for Americans <http://health.gov/dietaryguidelines/>

PubMed database (Medline) <http://www.ncbi.nlm.nih.gov/pubmed/>

My Plate <http://www.choosemyplate.gov/>

Linus Pauling Institute Micronutrient Information Center <http://lpi.oregonstate.edu/infocenter/>

American Dietetic Association [www.eatright.org](http://www.eatright.org)

American Society for Nutritional Sciences [www.asns.org](http://www.asns.org)

ILSI Human Nutrition Institute <http://hni.ilsa.org>

American Heart Association [www.americanheart.org/](http://www.americanheart.org/)

American Diabetes Association [www.diabetes.org/](http://www.diabetes.org/)

## Student Evaluation

### Points Possible:

Exams	3 @100 points
Final Exam	100 points
Reaction cards	2 point each (maximum of 20pts)
Laboratory Assignments	200 points

*Total Possible Points: 620*

### **Grades will be on a straight percentage basis.**

A= 94-100%; A-=90-93.9%

B+= 87-89.9%; B= 84-86.9% ;B-= 80-83.9%

C+= 77-79%; C= 74-76.9% ; C-= 70-73.9 %

D+= 67-69%; D = 64-66.9%; D-= 60-63.9%

F= 59% and below

## Instructor and course evaluation:

Teaching is a learning process and it is impossible to facilitate learning without student feedback. I will be gathering feedback throughout the semester that will allow me to address problems or difficulties while the course is on-going. Unsolicited constructive feedback is welcome anytime.

## Course Requirements

**Exams:** There will be 3 in-class exams and a final exam. Exams will include T/F, multiple-choice, matching, short answer and essay questions. Exams will be based on lectures, readings, labs and assignments. There will be NO make-up exams. Under very unusual circumstances early exams will be offered with approval from the instructor; arrangements must be made well in advance.

**Assignments:** Assignments will be posted on Blackboard and detailed instructions will be provided in class. Paper copies of your completed assignments are due at the **beginning** of class on the due date. No late assignments will be accepted. If you are not able to turn in an assignment due to extenuating circumstances (i.e. medical emergency for which you have a doctor's note), please come and see me during my office hours or by appointment.

### **Readings:**

In-class discussions and activities will require that you have completed the required readings. The course reading list is included in the syllabus. Additional readings (e.g. newspaper articles, journal articles, policy briefs, etc.) will be assigned throughout the semester and will be provided as hand-outs or posted on Blackboard. ***Student participation is important and this requires that all students come prepared having read the required readings in advance.***

## Labs

You are required to attend the lab section in which you are officially enrolled. If you need to change lab sections, you must officially change your section enrollment through the Registrar. You are expected to be on time to labs. Assignments are collected at the **start** of lab; work turned in after that is considered late. You must be present for lab in order to earn any credit for the work on that lab; in other words, if you aren't at lab one week, you can't turn in the work for that lab and will receive a zero on it.

## Reaction cards: 2 point each for a maximum of 20 points

At the end of each class session on Thursdays, please write a short (two to three sentences) question or comment pertaining to the class discussion or provide feedback on how the class is going for you. Write your comment or question on a 3x5 card with your full name and date printed clearly at the top of the card. Please give your card to me before leaving the class. You are responsible for buying (or sharing with a friend) a pack of 3x5 cards to use for this purpose.

## Current events (extra credit):

Throughout the course, you have the opportunity to earn up to ten extra credit points by bringing a newspaper or internet article related to a topic covered in class, summarizing its contents for the class, and providing a one paragraph written summary. Current events must have been published within the last year. You will earn five points for each current event article and summary. Written and oral summaries should, at minimum:

- State the objectives of the study
- Summarize the study design and findings
- Provide a copy of original article (if available) to me (preferably as a PDF)
- Provide your opinion on how the "average" reader will respond to the article. Will the article influence decision making or thinking? Does the article leave out any important information?

## Course Policies

**Communication:** Announcements and schedule changes will be made by e-mail or on Blackboard. It is your responsibility to check your e-mail or Blackboard at least twice weekly. I encourage you to contact me with any comments or questions. If you don't understand something please ask.

**Attendance:** Daily attendance and participation are expected.

## Withdrawal:

Feb. 1: Deadline for 100 percent refund of tuition and fees

Feb. 1: Deadline for student-initiated and faculty-initiated drops (course does not appear on academic record)

Mar. 22: Deadline for student-initiated and faculty-initiated withdrawals (W grade appears on academic transcript)

**Honor Code and Plagiarism:** You are expected to uphold the UAF standard of conduct for students relating to academic dishonesty. You assume full responsibility for the content and



integrity of the academic work you submit. For the student code or additional information, please use the following URL <http://www.uaf.edu/catalog/current/academics/regs3.html>

### **UAF Disability Services**

Disabilities Services: The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. I will work with the Office of Disabilities Services (208 WHIT, 474-5655) to provide reasonable accommodation to students with disabilities. **\*\* If you require any assistance due to documented disability, please let me know by the 2<sup>nd</sup> week of classes and I will be happy to make whatever accommodations are necessary.**

## **Detailed schedule of topics, concepts, key terms, readings, and assignments**

Concepts and key terms are provided for each week of the course, and these should be used to ensure that you've understood the reading materials and lectures.

### **Introduction to Nutrition--Food choices: Nutrients and nourishment January 17 and 22**

#### **Objectives:**

- Describe the ecological model and how it can be used as a framework to understand how people choose what to eat
- Define the 6 classes of nutrients and understand the key differences between macro and micronutrients
- Apply the scientific process to nutrition

#### **Readings:**

Chapter 1

#### **Activities:**

*Current controversy:* Food marketing to children

### **Nutrition Guidelines: tools for designing a healthy diet January 24 and 29**

#### **Objectives:**

- Discuss the principles of Nutrition guidelines and assessment
- Explain dietary standards and define the four standards that compose the dietary reference intakes (DRIs)
- Describe the five mandatory components of a food label and discuss how food labels can be used to plan a healthful diet
- Describe nutrition assessment methods

#### **Readings:**

Chapter 2

**Activities:**

*Current controversy:* Menu labeling: good idea for consumers or unnecessary burden on restaurants

**Complementary Nutrition: Functional foods and dietary supplements**

**January 31 and February 5**

**Objectives:**

- Define functional foods and discuss their role in health promotion
- Define food additives and understand their regulation by the FDA
- Evaluate the pros and cons of taking dietary supplements

**Readings:**

Chapter 3

**Digestion, absorption and transport: from food to fuel**

**February 7 and 12**

**Objectives:**

- Describe the organization of the gastrointestinal track
- Review the physical and chemical processes involved in digestion and absorption
- Describe and understand the roles of the assisting organs

**Readings:**

Chapter 4

**EXAM I**

**FEBRUARY 14**

**Carbohydrates**

**February 19 and 21**

**Objectives:**

- Describe the functions, types, food sources and recommendations
- Explain the digestion and absorption
- Discuss the role of carbohydrates in promoting health

**Readings:**

*Health Challenge:* Increase your consumption of whole grains

*Current controversies:* High fructose corn sweetener: just another sweetener or a nutrition demon

*Systems thinking:* The farm bill

*Health Check:* Are you at risk for diabetes

**Readings:**

Introduction to Human Nutrition, Biology 1--X : tentative syllabus (subject to change)

Bersamin Spring 2014

## Chapter 5

### Lipids February 26 and 28

#### Objectives:

- Describe the functions, types, food sources and recommendations
- Explain the digestion and absorption
- Discuss the role of lipids in promoting health

#### Activities

*Systems thinking:* Transfats

*Health check:* Cardiovascular disease, are you at risk?

*Current controversies:* Farm raised or wild caught, which salmon is king?

#### Readings:

Chapter 6

### Proteins March 5 and 7

#### Objectives:

- Describe the functions, types, food sources and recommendations
- Explain the digestion and absorption
- Discuss the role of protein in promoting health

#### Activities:

*Health challenge:* Legumes!

*Health check:* How much protein do you need each day?

*Current controversies:* Organic, free range, grass fed: what does it all mean?

#### Readings:

Chapter 7

### Spring Break March 12 and 14

### Energy Balance March 19 and 21

#### Objectives:

- Discuss the regulation of food intake
- Describe the major components of energy expenditure
- Describe the major issues in defining and measuring body weight and composition
- Discuss the effects and implications of obesity

**Readings:**

Chapter 8

**Activities:**

*Health check:* Mindful vs mindless eating

*Systems thinking/ health challenge:* Make your own 100- calorie packs

Exam II

March 26

**Vitamins: vital keys to health**

**March 28 and April 2**

**Objectives:**

- Compare the water and fat soluble vitamins with respect to their function, digestion, absorption, transport, and requirements
- Explain the function, food sources, and requirements of select vitamins
- Define antioxidants and discuss their food sources and health benefits

**Readings:**

Chapter 9

*Current controversies:* Organic or conventional produce

*Systems thinking:* Community gardens

**Water and Minerals**

**April 4 and 9**

**Concepts and key terms:**

- Describe the functions of water and its recommended intake
- Describe the difference between major and trace minerals
- Explain the function, food sources, and requirements of select minerals

**Readings:**

Chapter 10

**Activities:**

*Health check:* Create a personal beverage clock

*Current controversy:* Tap, filtered or bottled water: which is best?

**Food Safety and Technology**

**April 11 and 16**

**Concepts and key terms:**

- Review major food safety hazards
- Describe the government's and the consumer's role in keeping food safe
- Simulate an investigation of a foodborne illness outbreak

**Readings:**

Chapter 14

**Activities:**

*Current controversies:* Genetically modified foods

*Systems thinking:* Don't waste food, but keep it safe

**Food Systems: linking food choice to personal and environmental health****April 18 and 23****Concepts and key terms:**

- Describe the food system and food supply chain
- Describe the relationships between food, health, justice and the natural and built environments

**Readings:**

Feenstra, GW. (1997) Local food systems and sustainable communities. *American Journal of Alternative Agriculture*. 12;1 pp28-36

Ericksen, PJ. (2008) Conceptualizing food systems for global environmental change research. *Global Environmental Change*. 18 pp 234-245

A Primer on Community Food Systems: Linking Food, Nutrition and Agriculture.

<http://www.discoverfoodsys.cornell.edu/primer.html>

**Physical activity****April 25 and 30****Concepts and key terms:**

- Understand current trends in physical activity levels and national recommendations
- Understand the role of physical activity in human health
- Understand the role of the built environment in promoting physical activity

**Activity:**

*Health check:* Calculate your total daily energy expenditure

**Exam III****May 2**

## LAB 1

### Scientific Inquiry, Experimental Design and Graphing

This lab was adapted from the BIOL 115X Lab Manual

#### Objectives:

By the end of this lab you should be able to:

- Formulate hypotheses and predictions
- Differentiate between observational and experimental studies and discuss the advantages and disadvantages of each.
- Understand basic epidemiological designs.
- Design a basic experiment
- Choose a type of graph that best suits the data you wish to present.
- Make graphs on the computer using Excel
- Statistically test the difference in means between two groups using a t-test

#### 1. Scientific inquiry

We are living in a time when science, including nutrition science, plays an increasingly important role in our everyday lives. Nutrition research can have a profound effect on our daily lives. Important discoveries in nutrition science that affect you include:

- Trans-fatty acids increase LDL-cholesterol. This led to the reformulation of numerous food products and mandatory labeling of trans-fatty acid content.
- Folic acid protects against neural tube defects. This led to the fortification of grains in the US.
- At constant body weight low fat, high carbohydrate diets lower HDL cholesterol and raise serum triglycerides. This has important implications for weight loss strategies.
- Diabetes can be prevented by diet and lifestyle.
- Moderate alcohol consumption may reduce heart disease

“Scientific Inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work.

—National Research Council

Science proceeds by a continuous, incremental process that involves generating hypotheses, collecting evidence, testing hypotheses, and reaching evidence based conclusions. Rather than involving one particular method, scientific inquiry is flexible. Different types of questions require different types of investigations. Moreover, there is more than one way to answer a question. Science uses both observations and experiments. Ongoing research affects how we understand the world around us and

provides a foundation for improving our choices about personal health and the health of our community.

### References:

[http://science-education.nih.gov/Statements/NIH0/Inquiry/guide/nih\\_dome-science.pdf](http://science-education.nih.gov/Statements/NIH0/Inquiry/guide/nih_dome-science.pdf)

Katan MB, et al. (2009) Which are the greatest recent discoveries and the greatest future challenges in nutrition? *Europ J Clin Nutr* 63

#### 1.1 Hypotheses and predictions

Science is a way of finding out how the world works. It is a creative process in which one attempts to explain the formation of patterns in nature by forming and testing hypotheses. The scientific process begins with observation of patterns in nature. The next step is to pose a hypothesis. A hypothesis is a tentative explanation for observed events. For example, one might observe that people in countries where unsaturated fats (e.g. olive oil) is commonly consumed in cooking tend to have lower rates of heart disease than people in countries who consume predominantly saturated fats (e.g. butter). A plausible hypothesis is that unsaturated fats protect the heart, or are at least less harmful than saturated fats. Note that there may be alternative hypotheses for why people in some countries have low rates of heart disease. For example, people in countries where olive oil is commonly consumed may be less sedentary or there may be other lifestyle differences. If, after considering the alternatives a hypothesis still appears

plausible, one may decide to test it. Testing may disprove a hypothesis, but there is not test that can prove it's true.

In other words, **tests can falsify or support a hypothesis, but never prove it.** This is due to the underlying logic of hypothesis testing. When we carry out a test, our results either agree or disagree with what we predicted using our hypothesis. If the results disagree, then we have to reject our hypothesis. If the results agree, this supports our hypothesis. Does this prove that our hypothesis is true? No. Why not? First, when we carry out an experiment, we test one possible explanation. We don't test every possible explanation at once. For example, even if we find that eating olive oil reduces the risk of heart disease, that doesn't rule out the possibility that exercise also has an important effect of heart disease. Just because our results agree with our hypothesis does not rule out the possibility that other hypotheses could better explain the pattern we observed. Second, even if we have a very well-supported hypothesis, the possibility always remains open to disprove at a future point. This is a fundamental part of the scientific method and is true of all sciences. For example, we might find that it is not olive oil, but a particular component of olive oil that is responsible for decreasing heart disease.

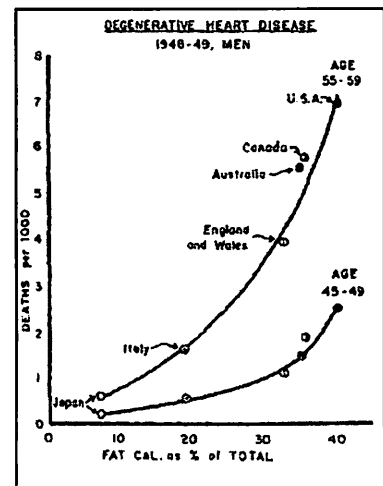


Figure 1: Data from the Seven Countries

The first step in testing a hypothesis is to make predictions. Predictions are often posed as “if... then” statements: “If the hypothesis is true, then...”. Many predictions may extend from a single hypothesis. For example, if olive oil protects against heart disease, then we might predict that people who consume mostly olive oil will have lower levels of LDL cholesterol, which has been associated with the formation of plaques in blood vessels. Another prediction might be that people whose diets are supplemented with olive oil will be less likely to suffer heart disease in the future than those whose diet is not supplemented with olive oil.

**Hypotheses** are a statement of the relation between two variables.

**Predictions** are a specific statement about what will occur in a particular research investigation (e.g., an experiment).

### *1.2 Observational and experimental studies*

Predictions can be tested using observational or experimental studies. The key difference between these two types is that experimental studies can control the conditions in the study, whereas observational studies cannot.

In an **observational study** (sometimes called a correlational study, the investigator observes a range of natural conditions to determine whether the predicted pattern is upheld. For example, one might test the prediction that olive oil intake is negatively associated with LDL cholesterol levels by asking 100 people about their diet (independent variable) and analyzing their blood for LDL cholesterol levels (dependent variable). The problem with this type of study is that one cannot be certain that the butter caused the high LDL cholesterol levels. All we can say is that the two variables are associated, or correlated. In other words, we cannot separate correlation from causation with an observational study.

In an **experimental study**, the investigator manipulates one or more variables of interest (treatments), holding other sources of variation constant. For example, we might test the second prediction above by asking a group of people to consume capsules containing olive oil on a daily basis, and compare their future health to a group that took capsules filled only with water (a placebo). There may be more than one level of treatment in an experiment; for example, the investigator may give some people a high dose of olive oil, other a moderate dose, and other none at all (the water placebo). Using an experiment, one can be more confident that the two variables are causally related.

Every experiment must have a **control**, in which the manipulated variable is omitted or held at an established level. The control acts as a benchmark for assessing whether the treatment had an effect. In our olive oil experiment, the



control group is the group of people consuming the water placebo. Other than the contents of the capsule, the participants in the control group should be treated the same as those in the treatment groups. Sometimes more than one control is necessary. For example, if there is reason to believe that the capsule itself might affect health (the “placebo affect”), another group that is given no capsule at all could serve as the capsule control.

Nutrition science is often concerned with the effects of diet on human health. Epidemiology is the study of the patterns, causes and effects of health and disease in defined populations. Nutritional epidemiology involves research to: examine the role of nutrition in the etiology, or cause, of disease; monitor the nutritional status of populations; develop and evaluate interventions to promote health in defined populations.

There are a number of observational and experimental study designs that are commonly used in epidemiological studies. Four important study designs are described below.

#### **Observational studies:**

- **Ecological studies** examine the relationship between an exposure (e.g. olive oil intake) and an outcome of interest (e.g. disease, weight loss) in **groups** (e.g. different countries).
- **Cross-sectional studies** examine the relationship between an exposure (e.g. olive oil intake) and an outcome of interest (e.g. disease, weight loss) in **individuals** at one point in time.
- **Cohort (longitudinal studies)** A cohort is defined as a group of people with a common characteristic or experience. In a cohort study participants are classified according to their exposure status (e.g. whether they consume olive oil or not) and are then followed over time to determine whether they experience the outcome of interest (e.g. develop a disease, recover, lose weight).

#### **Experimental studies:**

- **Randomized control trials** are controlled studies in which participants are randomly assigned to a treatment/intervention group (e.g. a supplement or diet program) or a control group (e.g. a placebo). Participants are followed over time to determine whether they experience the outcome of interest (e.g. develop a disease, recover, lose weight).

### *1.3 Variables*

When designing a study it is important to specify the dependent and independent variables.

The **dependent variable** (or outcome variable) is the variable of interest. In the olive oil example, the dependent variable is LDL cholesterol (or heart disease). Investigators can

choose to measure one or several dependent variables. You can think of the dependent variable as the “effect” is cause and effect.

The **independent variable** (or predictor variable) is the variable represents the hypothesized “cause”. In an experimental study, an investigator manipulates the independent variable. In the olive oil example, the olive oil is the independent variable.

Variables can be categorical or continuous.

**Categorical variables** are discrete and contain information that can be sorted into categories. Examples of categorical variables include education (no high school, HS degree, some college, etc.), agreement (strongly agree, agree, neutral, disagree, etc.), frequency (always, often, sometimes, never), sex. Example of categorical variables from the olive oil study could be frequency of olive oil consumption (every day, once a week, a few times a month), whether someone consumed less than 1 tablespoon a day (yes/no), or level of olive oil intake (high, medium, low).

**Continuous variables** are always numeric and theoretically can be any number, positive or negative (in reality, this depends upon the variable). Examples of continuous variables are age in years, weight, blood pressure readings, and cholesterol levels. Examples of continuous variables from the olive oil study could be grams of olive oil consumed and LDL cholesterol levels.

#### *1.4 Correlation vs. causation*

Causal inference - the science of making a causal claim about the relationship between two variables - is at the heart of research. Under most circumstances if we observe an association between two variables of interest, we would like to answer the question: is one causing the other? An observed association may be due to chance, it may be due to confounding by another factor or it may have arisen because of flaws in study design or execution. Only after these possible explanations have been considered and excluded is it possible to infer that the association may be causal.

Sometimes we are interested in how two variables are related, without a clear prediction of what causes what. This is particularly true at the beginning of a study, when we are trying to visualize patterns in nature. In this case we are not concerned about which variable is dependent and which is independent, but rather whether the two variables are correlated. When variables are correlate, one changes in magnitude as the other changes. Correlations can be positive (as one variable increases the other increases) or negative (as one variable increases the other decreases).

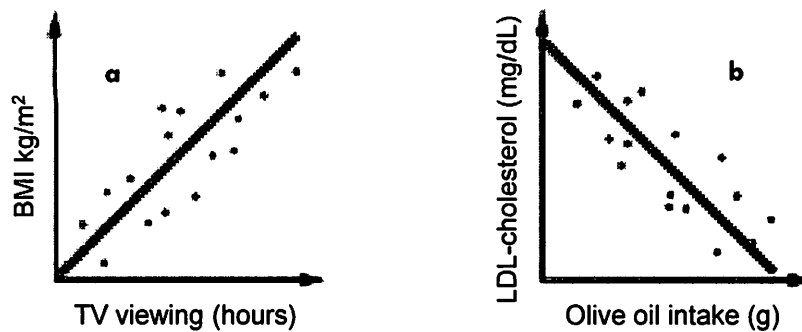


Figure 2: Examples of correlations between two variables.  
a) positive correlation; b) negative correlation

It is important to understand the difference between correlation and causation. Two variables can be correlated without one causing the other. A classic example that illustrates the importance of understanding the difference between correlation and causation is a study of pancreatic cancer. The study found a strong correlation between coffee drinking and pancreatic cancer. The two variables, however, are not causally related. It turns out that most smokers tend to also be coffee drinkers. The true causal relationship is between smoking and pancreatic cancer.

Establishing a causal relationship between two variables is difficult, if not impossible. Experimental studies provide stronger evidence of causality than observational studies. Bradford Hill developed a set of minimal conditions necessary to demonstrate evidence of causality in epidemiological studies. These are listed in figure 3. Note that these criteria were not developed to be used as a checklist for evaluating whether a particular association could be interpreted as causal. Rather, they were meant to help by making explicit the considerations that are important when inferring causality. For each criterion (except temporality), it is possible to find at least one example of a causal association that does not meet the criterion.

Criterion	Comment
Temporality*	Cause must precede effect. This is a necessary condition for causality.
Biological gradient*	Causality is supported when higher levels of exposure lead to more severe disease or higher incidence of disease.
Magnitude of the association*	Strong associations are more likely to be causal than weak associations.
Consistency	If an association is causal, findings should be consistent with other data.
Biological plausibility	If an association is causal, it should be plausible in light of scientific knowledge about the biological mechanisms involved.
Coherence	A causal interpretation should not conflict with what is known of the natural history and biology of the disease.
Experimental evidence	The existence of experimental evidence supports a causal interpretation.
Analogy	Analogy with other known associations strengthens the credibility of a causal association.

Figure 3: Hill's criteria for causation

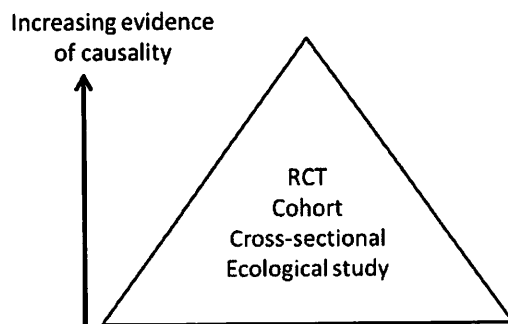


Figure 4: Epidemiological study designs in order of their ability to provide evidence of causality

**References:**

[http://media.collegeboard.com/digitalServices/pdf/yes/4297\\_MODULE\\_03.pdf](http://media.collegeboard.com/digitalServices/pdf/yes/4297_MODULE_03.pdf)

*1.5 Exercise: Hypothesis, predictions, and experimental design*

Working with one lab partner:

1. Suggest a hypothesis to explain one of the following observations. Note that a hypothesis is NOT merely a restatement of the observation: your hypothesis should address the underlying cause of the observation.
2. Make at least two testable predictions that extend from the hypothesis.
  - The incidence of multiple sclerosis is lower near the equator
  - Vegetarians have a low incidence of heart disease
  - Children who watch a lot of tv have a higher BMI

Hypothesis:

Prediction 1:

Prediction 2:

Design one observational and one experimental study to test each of your predictions.

**Observational study to test prediction 1:**

Dependent variable(s):

Independent variable(s):

**Experimental Study to test prediction 1:**

Dependent variable(s):

Independent variable(s):

Treatment:

Control:

**2. Making graphs**

In order to communicate scientific results to a reader, one must summarize quantitative information in a form that is both relevant and accessible. Tables and graphs are the best ways to display quantitative information. Graphs can be more visually powerful than tables, but the type of graph must be carefully chosen to show the pattern you wish the reader to see.

**2.1 Basic rules for graphs**

1. Label both the x and y-axes
2. Specify units
3. Provide a title that describes the graph (e.g. the relationship between olive oil and heart disease)
4. Keep graphs as simple and readable as possible
5. When showing average responses

## 2.1 The importance of variation

Showing variation in data is important because it helps the reader decide how much confidence to place in the results.

**Standard deviation** provides an indication of the variability in your data – how spread out all your values are. Standard deviation for a sample is calculated as the sum of the squared difference between each individual value and the mean for the sample divided by the degrees of freedom (number of samples minus 1):

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{N - 1}}$$

$s$  = the standard deviation,  $x$  = the value for a given individual,  $\bar{x}$  = the mean for the sample,  $N$  = the sample size

**Standard error** – more precisely, the standard error of the mean - does something slightly different - it provides an indication of the margin of error around the mean you calculated. It is calculated as the standard deviation divided by the square root of the sample size.

## 2.2 Some common types of graphs

### Showing a correlation between two variables

The best way to display this kind of data is a scatterplot. Figure 2 is a scatterplot that shows an example of a positive and negative correlation between two variables.

### Showing the average value of a dependent variable

Often in biology we compare the average intake of a nutrient or food (e.g. fiber) in different categories or groups (eg. age group).

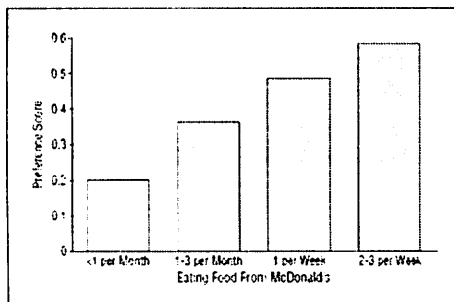


Figure 2. Frequency of eating at McDonald's as a moderator of taste preferences. Total preference scores may range from -1 (preferred the unbranded food in all comparisons) to +1 (preferred the McDonald's branded food in all comparisons).

In the bar graph (left), the dependent variable is the preference score (whether the participant preferred McDonald's or an un-branded food). The independent variable is the frequency of eating at McDonald's.

*Arch Pediatr Adolesc Med.* 2007;161(8):792-797

### **2.3 Exercise- using Excel to make graphs**

In this exercise you will use Excel to construct two simple graphs. The first two graphs will illustrate data you collect. Instructions for using excel to create graphs can be found in appendix A. **(Note: this will be provided to students)**

#### **2.3.1 Make a scatterplot showing the relationship between to categorical variables**

1. Come up with a hypothesis about the relationship between two variables related to nutrition or and/or physical activity that you can measure. Be creative! The measurements can be length volume, weight, time counts, survey responses, etc. The data can come from students in the class (participants), food prices in Wood Center, etc. Record your measurements in the data table on the next page. Make at least 2 measurements on at least 5 participants, foods, etc.

**Record your hypothesis about the relationship between two variables and briefly state why you expect a relationship.**

2. Create a scatterplot to illustrate the correlation. E-mail a copy to yourself and your instructor. Also print a copy to turn in with your worksheet.

**Do your data appear to support or reject your hypothesis? Explain your reasoning.**



*2.3.2 Graph the average and variation of a categorical variable measured in two groups and run a t-test to compare the means of the two groups.*

1. Generate a new nutrition hypothesis. This one should be a hypothesis about how two groups will differ for a particular variable that you can measure. To test your hypothesis, you will measure a continuous variable from at least 10 participants in two groups. For example, you might measure BMI in people who eat breakfast on a regular basis compared to those who don't.

**Record your hypothesis and briefly justify your expectation. .**

2. Graph your data in excel. Make sure you include error bars. E-mail a copy to yourself and your instructor. Also print a copy to turn in with your worksheet.
3. Using your data file, run a 2-sample t-test in excel. E-mail a copy of your analysis to yourself and your instructor. Also print a copy to turn in with your worksheet.

**What was the P-value for your data?**

**Did your t-test provide support for your hypothesis of a difference between the two groups, or does your t-test indicate that you have to reject your hypothesis? Explain your reasoning.**

## POST-LAB QUESTIONS

### USING A CLINICAL TRIAL TO TEST THE EFFECTIVENESS OF EPHEDRA

*This lab was developed by Drs. Huang and Stolley for the Young Epidemiology Scholars Program (YES) and was supported by The Robert Wood Johnson Foundation and administered by the College Board.*

Ephedra is one of the many herbal supplements that claim to help people burn fat, build muscle and increase endurance. As a result, many athletes are taking it, in the hope it will give them a cutting edge against their competitors. The question is “are these claims really true?” If they are, by how much? If they are not, why are these manufacturers allowed to make these claims? Look at the advertisements that are included. Both were taken from the Internet.

In this activity you and your group members will have the opportunity to design your own experiment that can determine if these claims are true. You and your partners are research scientists, and you are being paid by an independent consumer rights advocate group to see if this product really does what it claims to do. This type of experiment is called a randomized controlled trial, commonly known as a clinical trial. These types of experiments must be done by drug manufacturers in order to get approval from the Food and Drug Administration (FDA). Manufacturers must prove that their product is both safe and effective (effective means that the product does what it claims to do). However, supplements have a loophole to evade these requirements because they are regulated more like a food product than a drug.

1. In every experiment, a scientist must have a hypothesis and a method of testing the hypothesis. To test a hypothesis, a scientist must understand what the experimental variable is. In the space below write a hypothesis and briefly describe how to test this hypothesis. In this explanation indicate what your experimental variable is.

2. When testing the experimental variable, a researcher must understand the possible association of one factor with another—in this case the effect of taking ephedra and its effect on the body's metabolism, body weight and available energy. These associations that may be found are labeled as the independent and dependent variables. What is the independent variable in this experiment? What are the dependent variables? Explain the relationship between the independent and dependent variables.

3. Clinical trials are experiments that involve human test subjects. Because of this there are ethical issues that must be dealt with. What are the ethical issues that a researcher must face when conducting an experiment such as this? How can these issues be resolved?

4. Every experiment requires a comparison (control) group and an experimental group, which receives the intervention. What characteristic distinguishes members of the comparison group from those of the experimental group? What similar characteristics should both the control group and the experimental group members have? Why is it important for the groups to have similar characteristics? What are some characteristics of participants who should be excluded from this study? (Hint: Read the labels of the product.)

5. In a clinical trial, subjects are randomly assigned to either the experimental or the comparison group. Another requirement is that the participants do not know which group they are placed in, so the participants do not know whether they are taking the placebo or the actual drug. This procedure is called **blinding**. In addition to the subjects of the experiment not knowing which group they are in, the researchers may not know who is in each group. This is known as **double blinding**. Why is it important to use double blinding and randomization, when feasible?

6. How would you measure the outcome of your experiment? (Hint: Refer back to Question 2, which asked you about the dependent and independent variable). How would you determine whether your hypothesis was confirmed? How does research such as this help the public learn more about the products they buy and use?

## Sample Advertisements for Ephedra-Containing Products

### Nature's SUPER CAP

850 mg Ephedra Extract

Because of Super Cap's high yield of ephedrine, it has many of the benefits of a bronchodilator, opening the airway and dramatically enhancing breathing performance. It is also a preferred product among serious bodybuilders looking to achieve greater endurance and greater strength levels.

8% Ephedra Alkaloids per Capsule, delivering 68 mg of naturally occurring Ephedrine

#### Supplement Facts

**Serving size:** One capsule

**Amount per serving:** *Ephedra sinica* extract (aerial parts)—883 mg

\* Daily value not established

**Other Ingredients:** Calcium sulfate, gelatin, maltodextrin, magnesium stearate, and silica

**Directions (adults only):** Take one capsule daily as a dietary supplement. **Not for use by minors.**

**Warning:** Ephedra contains naturally occurring ephedrine. If you are pregnant or nursing, or if you have heart disease, thyroid disease, diabetes, high blood pressure, depression or other psychiatric conditions, glaucoma, difficulty in urinating, prostate enlargement, or seizure disorder, consult a health care provider before using this product. Do not use if you are using monoamine oxidase inhibitors (MAOI) or for two weeks after stopping an MAOI drug; certain drugs for depression, psychiatric or emotional conditions; drugs for Parkinson's disease; methyl dopa; or any product containing ephedrine, pseudoephedrine, or phenylpropanolamine (ingredients found in allergy, asthma, cough/cold, and weight control products). Stop use and call a health care professional immediately if dizziness, severe headache, rapid and/or irregular heartbeat, chest pain, shortness of breath, nausea, tremor, loss of appetite, sleeplessness, noticeable change of behavior or loss of consciousness occurs. Do not exceed recommended serving.

Manufactured under authority of D&E Pharmaceuticals, Inc.

**Source:** From the D&E Pharmaceuticals, Inc. Web site. Available at: <http://d-n-e.com/epsucap85.html>

\*From the bottle label of the product Ephedra: Nature's Super Caps (24 capsules).

## Ultimate Energizer, High Potency Ephedra and Caffeine

(*Young Again 2002 Web site*)

The Ultimate Energizer has 100 capsules with 257 mg of ephedra and 100 mg of caffeine and a proprietary blend of fat melting herbs. It packs a wallop, and it is not for everyone! Read our cautions and full description. This fat burning supplement is 3 times more potent than Metabolife.

Please note the following cautions about the ULTIMATE ENERGIZER and other products that contain ephedra: Ephedra, also known as ma huang, is a common ingredient in herbal weight-loss products. It has been shown to be generally safe and effective. It is also used to treat depression, asthma, colds, and other respiratory complaints. Ephedra should not be used by people with anxiety disorders such as panic attacks, or by those with glaucoma, heart disease or high blood pressure. Avoid this herb if you are taking medication for depression. Since it stimulates the central nervous system, avoid caffeine, St. John's Wort, and over-the-counter decongestant medications while taking ephedra.

**Source:** From the Young Again 2000 Web site, Available at:

<http://www.youngagain2000.com/marcella75/nlen50100cap.html> 2002 Version\*

\*The most recent version of this Website includes another weight loss product that is "Ephedra-free", since the Food and Drug Administration has recently banned all products containing ephedrine alkaloids.

## GRADING FOR SCIENTIFIC INQUIRY, STUDY DESIGN AND GRAPHING

<b>Points</b>	<b>Item</b>
____/1	Hypothesis
____/1	Prediction 1
____/1	Prediction 2
____/2	Test 1
____/2	Test 2
____/3	Data and graph 1
____/3	Data and graph 2
____/3	t-test and evaluation of hypothesis
____/9	Post-lab questions
<b>____/25</b>	<b>Total</b>

## LAB 3

### Digestion and Enzyme Activity

This lab is from the Biology 13A Lab Manual.

#### Objectives:

By the end of this lab you should be able to:

- list the essential nutrients found in food
- describe the basic chemical composition of carbohydrates, proteins, fats, and vitamins
- identify nutrient content in foods and test for nutrients in unknown samples
- learn the parts of the digestive system
- explain functions of major nutrients in the body

#### 1. Introduction

Food, glorious food! Movement, processing information and responding to the environment, and maintenance of homeostasis all require energy. Ultimately, energy is derived from food. In addition, food provides building material for cells and tissues.

The job of the **digestive system** is to break down food and absorb **nutrients: carbohydrates, proteins, and lipids** and smaller quantities of **vitamins and minerals**. Most of the water we need also comes from food. Few foods combine all six nutrients. As primates, we are **omnivores**, adapted to eat a wide variety of foods to obtain a full complement of necessary nutrients. Our digestive system anatomy and physiology reflects the eclectic diet for which we are adapted.

Releasing nutrients from food requires **mechanical digestion** where large pieces are crushed and ground primarily by teeth, with the aid of tongue and saliva. This increases the surface area for chemical digestion in which digestive enzymes break down complex large molecules such as proteins and carbohydrates to their basic components (e.g. amino acids and simple sugars).

Chemical digestion is performed by many organs: for example, salivary glands produce amylase, an enzyme that breaks down starches (polysaccharides) to disaccharides; the pancreas and small intestine produce numerous enzymes that complete the breakdown of proteins, lipids, and carbohydrates to forms usable by cells. The nutrients are absorbed through the lining of the small intestine and are then transported throughout the body.

Today we will examine nutrients in food and review the structures of the digestive system.

**Pre-lab questions:** Answer the following questions based on your reading of the introduction.

1. List the five nutrients found in food.

2. What is an omnivore? How does the fact that humans are omnivores influence our anatomy and behavior?

3. Where and how does mechanical digestion occur?

4. What enzymes are necessary for chemical digestion? Give examples of organs that perform chemical digestion.

## *2. Food chemistry and nutrition*

Carbohydrates, proteins, lipids, and vitamins and minerals are the nutrients in food.

**Carbohydrates** are either simple sugars (monosaccharides) consisting of a single sugar molecule such as glucose, or disaccharides, two monosaccharides joined together (e.g. sucrose, or table sugar), or polysaccharides (complex carbohydrates), large chains of monosaccharides. Starch and glycogen are polysaccharides. They are major sources of energy for cellular work. Common sources of carbohydrates in the diet are breads, cereals, fruits and vegetables.



**Proteins** have numerous functions. They are the basis for tissue and organ structure; some are capable of movement (socalled "motor proteins") while others act as enzymes. All proteins are chains of amino acids. Twenty amino acids combine to form thousands of different proteins. Twelve amino acids can be assembled in the body but eight must be obtained directly from the diet. Dietary sources of proteins include fish, soybeans, meat, and dairy products.

**Lipids** are hydrophobic (insoluble in water). They include fats, oils, waxes, phospholipids, and steroids. Concentrated sources of energy, each gram of lipid has more calories than a gram of protein or carbohydrate. Lipids are components of plasma membranes and provide support for joints, tendons, and internal organs. Dietary sources of lipids include nuts, meat, butter and cheese, and vegetable oils.

Although only minute quantities of **vitamins** and **minerals** are required, a deficiency can have devastating effects. Vitamins help control chemical reactions, often facilitating the actions of enzymes. They are necessary for normal growth and metabolism. Thirteen vitamins are essential for health—four of those are fat soluble and are stored for months at a time in adipose tissue; nine are water soluble and must be regularly replaced. Minerals such as calcium and phosphorus are also derived from the diet and perform vital functions. Vitamins are obtained from a wide variety of foods. For example, vitamin C is obtained from citrus fruits and tomatoes whereas vitamin B is found in nuts, whole grains, and beans. Vitamin pills may supplement the diet. Each vitamin has specific functions in the body, leading to particular symptoms if there is a lack. The first symptom of vitamin C deficiency is fatigue, followed by anemia, back and joint pain, bleeding of the gums, and poor wound healing. With time, death ensues, as was the fate of numerous sailors who succumbed to "scurvy."

**Pre-lab questions:** Answer the following questions based on your reading.

1. Define monosaccharide, disaccharide, and polysaccharide, and give examples of each.
2. What is the basic building block of proteins? What are dietary sources of proteins?
3. List several functions of lipids.

### 3. Testing for the Presence of Nutrients

Simple chemical tests using indicators can be used to determine the presence of nutrients in food. A color change of an indicator is usually a positive test for the presence of a certain nutrient. In this experiment, you will use several indicators to test for the presence of nutrients in solutions. The purpose of this lab is to demonstrate how different foods can contain one, some, or all of the organic compounds that are important to cells.

#### Summary of Activities

1. Make a hypothesis about the content of food samples you and your lab partners have brought from home.
2. Test each food, along with the appropriate positive and negative controls, for protein, monosaccharide, and complex carbohydrate.

We will be using three different tests to identify protein, monosaccharide (glucose and/or fructose), and complex carbohydrates (starch) in various foods. Monosaccharides and starch are both carbohydrates. Monosaccharides are the small organic molecules that are the subunits used to build large starch macromolecules. **Bring one food or drink to lab that you think contains one of these compounds as an experimental sample.**

Some examples of what to bring:

- juice or milk
- fruit or vegetables
- flour, or tofu, or bread
- anything that can mix with water

**NO:**

- oily foods
- uncooked beans or pasta, or other dry unhydrated food
- dark-colored foods or drinks
- acidic, or sour foods like orange juice

These items will not react well with the test chemicals.

Foods will contain at least one type of organic compound. Before beginning, make a prediction about which type of compound or compounds you think your experimental sample contains. Record your prediction on your RESULTS page.

You will perform three different tests on the same four experimental samples (share with your lab partners). Each test will use a different **indicator reagent** that will change color in the presence of the particular organic compound that is being tested for. As part of the experimental method, you must include **control samples** to insure the validity of your results. A control is a test sample with a known result. If your control samples do not give

you the expected result, then your experimental results are not valid and you must reevaluate your experimental set-up (maybe your test chemicals are no good).

A **negative control** will result in no change in color. It will either contain no sample at all or it will contain a nonreactive sample like water. For example, if you are testing for the presence of monosaccharides, the test chemical, called Benedict's solution, will remain the original color blue when mixed with water.

A **positive control** will result in a color change indicating the presence of the compound you are testing for. For example, a 5% glucose solution will react with Benedict's solution and change it from blue to rust (brown-red). You can compare your experimental results to your control results to determine if you obtained a positive reaction.

**Pre-lab questions:** Define the following terms and give an example of each from today's lab exercise:

1. Macromolecule:

2. Positive experimental control:

3. Negative experimental control:

**To Prepare Your Samples:**

1. If your experimental sample is **solid**, chop or break it up into the smallest pieces possible using a razor blade or glass rod, whichever is appropriate. Use a pinch of sample small enough so that the material can be easily suspended in 1.5 ml of water and does not fill the bottom of the tube.
2. Add 1.5 ml distilled water to your sample and mix it well.
3. If your sample is a **liquid**, add 1.5 ml of the liquid to the appropriate tube.
4. Each tube should have the same volume of fluid, regardless of the type of sample.

**Part I. Identification of Protein****Materials:**

- test tube rack
- test tubes
- tape for labeling your tubes
- 0.5% CuSO<sub>4</sub>
- 10% NaOH
- albumin protein solution (egg white)
- distilled water
- four different experimental samples (share with the people at your table)

The test chemicals used in this experiment react with the covalent bonds that link amino acids together in protein chains. In the presence of protein, the chemicals will turn varying shades of purple.

**NOTE:** NaOH (sodium hydroxide) is very caustic and will burn your skin and damage your clothes. Handle it with caution. If you do come into contact with it, notify the instructor and flush the area thoroughly with running water. NaOH is the ingredient in hair removal products. It works by dissolving protein, which is what hair is made of.

**Procedure:**

1. Predict which organic compounds your experimental samples might contain.
1. Record your predictions in Table 1.
2. Label your tubes 1 through 6.
3. Prepare your sample following the instructions from above.
4. **CAUTIOUSLY** add 20 drops of 10% NaOH solution to each tube. Agitate the tube gently. See instructor for demonstration.
5. Add 4 drops of 0.5% CuSO<sub>4</sub> to each tube. Agitate the tubes again.
6. Let the tubes sit at room temperature a few minutes, until you see a color change in your positive control.
7. Record the results in Table 2.

**Table 1: Before you begin, predict which organic compounds may be found in each of your samples.**

Experimental Samples	Color of Sample Predicted	Organic Compounds
#1:		
#2:		
#3:		
#4:		

Table 2. Identification of Protein

Tube #	Solution in Tube:	Color of reaction	Presence of Protein? (yes or no)
1	1.5 ml albumin solution		
2	1.5 ml distilled water		
3	Sample #1		
4	Sample #2		
5	Sample #3		
6	Sample #4		

## Part II. Identification of Monosaccharides

### Materials:

- hot plate
- 400 ml beaker half filled with boiling water
- test tube clamp for picking hot test tubes
- Benedict's solution
- 5% glucose solution
- 5% fructose solution
- 5% sucrose solution
- distilled water
- 4 experimental samples

Benedict's solution is a blue solution that will change color in the presence of monosaccharides, such as glucose or fructose. Benedict's changes from blue --> green --> orange --> brown, depending on the amount of monosaccharide present. Any change in color indicates the presence of monosaccharides.

### Procedure:

1. Set up a boiling water bath using a 400 ml beaker filled with approximately 150 ml of tap water on a hot plate. Add **2 or 3** boiling chips to the water in the beaker. These will prevent boiling water from slashing up when you add your test tubes. Set the hot plate on high to get the water boiling, then reduce the temperature to a setting of "2" to keep the water simmering. The water should be boiling **BEFORE** you place your tubes in it.
2. Label your tubes 1 through 8. If you are using tape, make sure the tape is high enough on the tube so that it does not get wet in the water bath. Otherwise, the tape will fall off and you will not be able to identify your samples.
3. Prepare your samples as before.
4. Add 1.5 ml of Benedict's solution to each test tube, for a total of 3 ml.
5. Agitate your tubes so that the sample and Benedict's is well mixed. See instructor for demonstration.
6. Place all the test tubes **at the same time** in the boiling water bath for 5 minutes.

7. Remove the tubes using the test tube clamp and record the resulting color.
8. Do not mix the tubes again once they have been boiled. If your sample was a solid, note the color change in the immediate vicinity of your sample. The rest of the Benedict's may stay blue since a solid cannot mix well.
9. Record your results in Table 3.

**Table 3. Identification of Monosaccharides**

Tube #	Solution in tube:	Color of Reaction		Presence of Monosaccharides? (yes or no)
		Before Heating	After Heating	
1	1.5 ml 5% glucose solution			
2	1.5 ml fructose solution			
3	1.5 ml 5% sucrose solution			
4	1.5 ml distilled water			
5	Sample #1			
6	Sample #2			
7	Sample #3			
8	Sample #4			

**Part III. Identification of Starch (Complex Carbohydrate)****Materials:**

- Iodine solution (IKI)
- Starch suspension
- distilled water
- 4 experimental samples

Iodine will react with starch and turn from a yellow/brown color to purple/black color. Only the purple/black color is an indication of starch.

**Procedure:**

1. Number your tubes.
2. Prepare your samples as before. Remember, each tube should have 1.5 ml of liquid.
3. Add 2-3 drops IKI to each tube. Agitate your tubes.
4. Record your results in Table 4.

Table 4. Identification of Starch

Tube #	Solution in Tube:	Color of reaction	Presence of starch? (yes or no)
1	1.5 ml albumin solution		
2	1.5 ml distilled water		
3	Sample #1		
4	Sample #2		
5	Sample #3		
6	Sample #4		

**Questions**

1. What is the indicator reagent for each of the following organic compounds and what color change will tell you that the organic compound is present?
  - Monosaccharides
  - Starch
  - Protein
2. What is the purpose of the samples containing albumin, glucose, fructose and boiled starch solution?
3. What is the purpose of using the water only sample in each of the experiments?





## POST-LAB QUESTIONS

### *Parts of the Digestive System*

The previous experiment explored some of the nutrients in food. How are nutrients extracted from the food we eat? In this activity, we will follow a bite of food through the digestive system and identify the structures that it passes through.

1. Use the torso model to examine the parts of the system. Beginning at the mouth, follow an imaginary bite of food through the system.
2. On the figure of the human digestive system, label the indicated structures:
  - Mouth
  - Pharynx
  - Esophagus
  - Stomach
  - Small intestine
  - Large intestine
  - Rectum
  - Liver
  - Gall bladder
  - Pancreas
  -

### **Part 2: Mechanical Digestion**

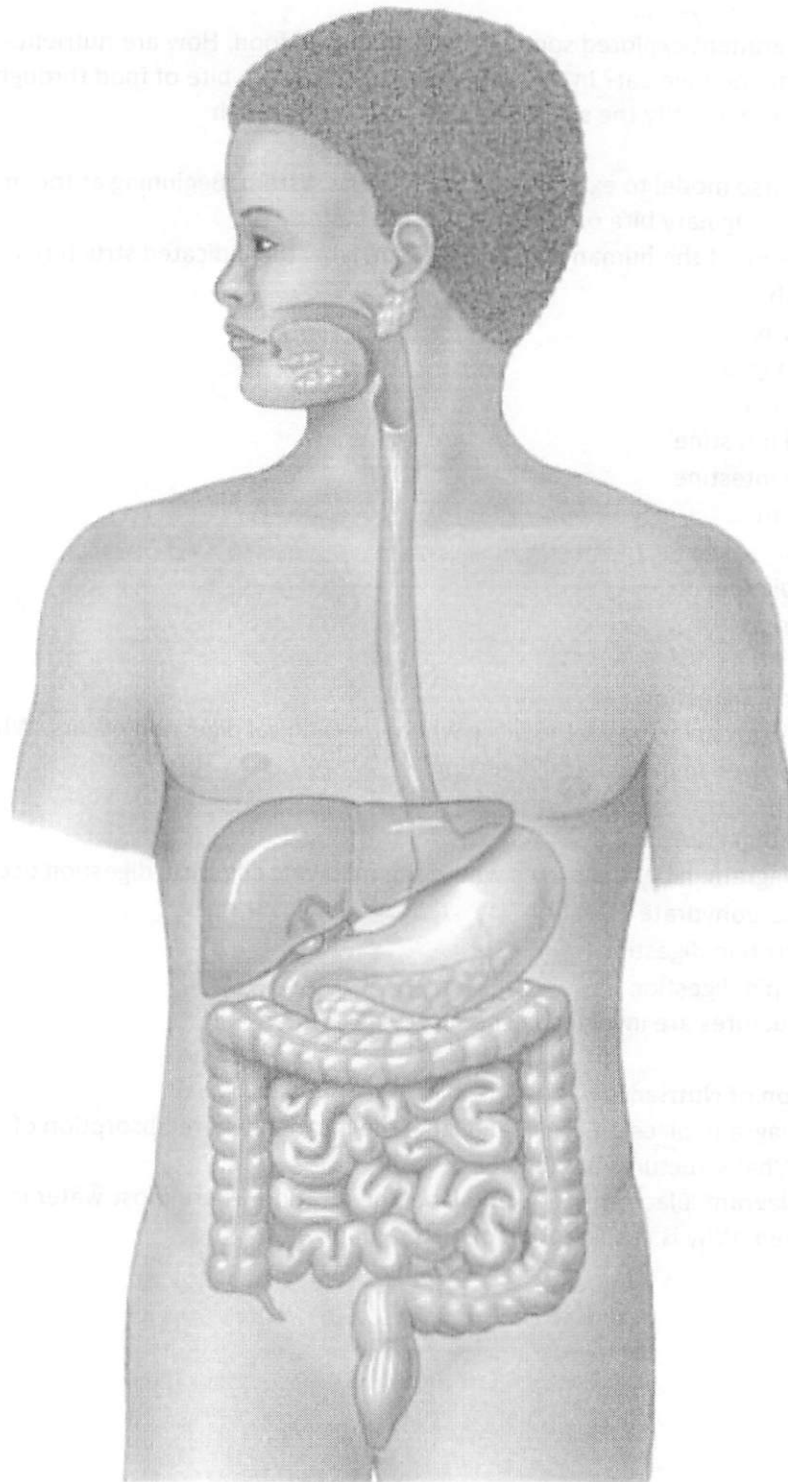
On the diagram, draw an arrow to the place where mechanical digestion occurs. What structures are involved in mechanical digestion?

### **Part 3: Chemical Digestion**

1. On the diagram, label the places where the following chemical digestion occurs.
  - Carbohydrate digestion
  - Protein digestion
  - Lipid digestion
2. What structures are involved in chemical digestion?

### **Part 4: Absorption of Nutrients**

1. On the diagram, place an arrow and label the location where absorption of nutrients occurs. What structures are involved?
2. On the diagram, place an arrow and label the location where most water is reabsorbed. Why is reabsorption of water important?



**Figure 13.2. Human Digestive System**

## GRADING FOR DIGESTION AND ENZYME ACTIVITY

<b>Points</b>	<b>Item</b>
____/5	Pre-lab questions
____/7	Questions
____/2	Table 1
____/2	Table 2
____/2	Table 3
____/2	Table 4
____/10	Post-lab questions
____/30	<b>Total</b>

## LAB 7

### Food Safety:

This lab is from the Food Systems Project from the Johns Hopkins Center for a Livable Future

#### Objectives:

By the end of this lab you should be able to:

- Identify potential sources of contamination in the food system
- Give examples of how foodborne pathogens and chemical contamination of food can impact health
  - Describe the steps involved in a foodborne illness outbreak investigation, and the rationale for each
- Calculate the attack rate for a foodborne illness outbreak
- Graph the epidemic curve and determine the median time of onset of a foodborne illness
- Use the attack rate, epidemic curve and symptoms to determine the probable food and associated pathogen responsible for a foodborne illness outbreak
- Describe ways to prevent foodborne illness

#### 1. Background

**Food safety** is the science of protecting our food supply from contamination. Disease-causing bacteria, viruses, chemicals and other threats to health can enter the food supply at many points along the **supply chain**, including food production, processing, distribution, storage, preparation and retail. Contaminated food poses serious risks to those who are exposed, causing fever, nausea, diarrhea, chronic illness and, in some cases, death. Approximately 48 million people (one in six) in the United States alone become sick each year from **foodborne illnesses**, and almost 3,000 die.<sup>1</sup> Vulnerable populations—very young or old people or those with weakened immune systems—are at an increased risk of poorer health outcomes from food-related illnesses.<sup>2</sup>

#### Foodborne pathogens from field to plate

Our food supply is susceptible to contamination by **pathogens**—microorganisms that can infect people and cause illness. *Salmonella*, for example, is a bacterium that lives in the intestines of animals, such as chicks and other young birds.<sup>3</sup> Certain strains of *E. coli*, another bacterium, are also known to cause foodborne illness.<sup>4</sup> People can become infected with *Salmonella*, *E. coli* and other pathogens by eating foods that have been contaminated by animal waste. The conditions in **industrial food animal production (IFAP) facilities** (refer to *Food Animal Production*) promote the spread of these types of pathogens through the transport and management of animal waste.<sup>4-6</sup> **Fertilizing** produce crops with **manure** that has not been properly treated, for example, may introduce pathogens into the

food supply; this is often how bean sprouts, lettuce and other fresh produce become contaminated.<sup>7</sup> **Waste treatment** methods such as **composting** can be used to destroy or inhibit some pathogens present in waste.<sup>7</sup> Farmers, workers and any other people coming into contact with food animals or manure have a greater chance of being exposed to and spreading *E. coli* and other pathogens.<sup>5,8</sup> Feeding large amounts of grain to beef and dairy cattle, another standard IFAP practice, may also increase food safety risks by altering the animals' digestive systems in ways that foster greater populations of a disease-causing strain of *E. coli*.<sup>9</sup>

The scale at which industrialized **food processing** facilities operate can increase food safety risks. For example, the meat from many different animals is often processed in a single central facility.<sup>10</sup> If a single piece of meat entering that facility is contaminated, the entire batch may also become contaminated depending on factors such as the hygiene of the facility, the persistence of the pathogen and the type of meat being processed.<sup>11</sup> Since ground beef, for example, is generally mixed and processed at these types of plants, contaminants that were originally found outside the beef, like *E. coli* from animal manure, may taint the entire supply.<sup>11</sup> If the beef is undercooked, or if the raw beef contaminates other food products or food preparation surfaces, illness may result.<sup>11</sup>

Tracing the contamination can often be difficult because the meat arrives at the central processing facility from many sources. As these plants have become larger, the area over which they distribute an immense volume of products has become broader,<sup>10</sup> increasing the risk of widespread exposure to contamination.<sup>10,12</sup> For more information, refer to *Food Processing*.

Food can also be contaminated by pathogens during distribution and transport. When transported or stored, perishable food must be kept under specific conditions, such as a controlled temperature, to prevent contamination. Even the containers used to ship food may be the cause of contamination. Studies conducted on some of the trucks that carry dairy products in the United States showed evidence of both *Salmonellae* and *Listeria monocytogenes*, which are bacterial causes of foodborne illness. If these tankers had been cleaned and disinfected between deliveries, the risk of transmitting these pathogens would be reduced.<sup>13</sup>

Any surface that comes into contact with food should be washed or disinfected to remove pathogens before and after food preparation.<sup>14,15</sup> Some pathogens can spread from one contaminated surface to another. For example, if a cutting board was not properly washed after preparing raw poultry, a salad that is next chopped could become contaminated as well.<sup>14,15</sup> *Campylobacter*, a common foodborne pathogen found on uncooked poultry, can be spread in households and restaurants.<sup>14</sup> *Norovirus*, a virus that causes illness, is also easily transmitted from people to food, usually by whoever has prepared it.<sup>15</sup>

#### **Chemical contaminants in food**

In addition to pathogens, toxic chemicals can contaminate our food supply. Both human activities and natural processes can be responsible for chemical contamination.

The use of chemical **pesticides** allows farmers to exert some control over crop **pests** like weeds and certain insects (at least in the short term; refer to *Agriculture and Ecosystems*), but this practice can leave pesticide residues on and inside fruits and vegetables. Even at low levels, some pesticides can have harmful effects on our reproductive and nervous systems, and may put people at a higher risk for cancer.<sup>16</sup>

Mercury is a heavy metal that can contaminate seafood.<sup>17</sup> When people eat foods contaminated with mercury, such as tuna and other large predatory fish, the metal accumulates in their bodies and can cause brain and kidney problems later in life.<sup>18</sup> Burning coal, mining and incinerating waste release mercury into the atmosphere, waterways and soil.<sup>17</sup> Roughly half of all mercury emissions are thought to come from human activities; the rest are caused by naturally occurring events like volcanic eruptions.<sup>17</sup>

Practices common to industrial food animal production can also contaminate our food with harmful chemicals (refer to *Food Animal Production*). Arsenic, for example, is a chemical sometimes present in the feed of food animals, such as poultry and swine, partly to make them grow faster. This can leave residual amounts of arsenic in the meat, putting consumers at a greater risk of heart disease, diabetes and cancer. When animal waste is used as **fertilizer**, arsenic can also pollute groundwater and contaminate crops.<sup>19</sup>

## **Prevention and education**

### ***Commercial***

It is possible to reduce the risks posed by food safety hazards. Commercially, one of the most common food safety measures is the Hazard Analysis and Critical Control Point (HACCP) process, a prevention-based approach that identifies and monitors food safety hazards at critical control points along the supply chain. At each of these points, HACCP officers usually play a monitoring role, checking temperature and sanitary conditions and testing for the presence of pathogens.<sup>20,21</sup> Critical control points can be established during the production, processing, transport or preparation of food. Before milk is **pasteurized**, for example, bacteria like *Salmonella* may be present. During pasteurization, a HACCP officer may check to ensure that the milk is heated at the proper time and temperature intervals to destroy the remaining bacteria.<sup>22</sup> The U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA) may also be involved in this process.<sup>23</sup>

While HACCP is an important tool in reducing the risk of foodborne illness, it is not a guarantee against contamination along the entire supply chain. It must be used in conjunction with other food safety measures, such as training employees, maintaining sanitary facilities and handling products properly during preparation.<sup>24,25</sup> It can also be a difficult program to implement, particularly for smaller businesses, which may need to invest considerable time, money and training in order to adopt HACCP procedures.<sup>26,27</sup> Businesses that believe they are already producing safe food may be deterred by these barriers.<sup>26</sup> Since HACCP is mandatory only for meat, poultry, seafood and juice products,<sup>28</sup> many businesses may choose not to adopt it.<sup>26</sup>

### **Household**

The USDA suggests four steps to help prevent foodborne illness at home: clean, separate, cook and chill. The first step, “clean,” encourages people to wash their hands, countertops and any utensils that may be used before touching any food. The second, “separate,” means keeping raw meat separate from ready-to-eat food (such as salad) when preparing meals or even in the refrigerator. “Cook” refers to cooking food thoroughly by using a food thermometer when necessary and making sure to stir or rotate dishes when cooking. The last step, “chill,” includes chilling leftover food within two hours of consumption and always thawing meat in the refrigerator.<sup>29</sup>

### **Conclusion**

People are vulnerable to pathogens and chemicals that can contaminate food at every stage along the supply chain. In many cases, however, opportunities exist to minimize the risks to our health.

By following safe, hygienic practices, both industries and consumers can help prevent contamination, reduce the spread of foodborne illness and protect our health.

### **References**

1. Centers for Disease Control and Prevention. CDC reports 1 in 6 get sick from foodborne illnesses each year. 2010. Available at: <http://www.cdc.gov/media/pressrel/2010/r101215.html>.
2. McCabe-Sellers BJ, Beattie SE. Food safety: emerging trends in foodborne illness surveillance and prevention. *Journal of the American Dietetic Association*. 2004;104(11):1708-1717.
3. Centers for Disease Control and Prevention. Salmonellosis: general information. 2009. Available at: <http://www.cdc.gov/nczved/divisions/dfbmd/diseases/salmonellosis/>.
4. USDA Agricultural Research Service. *National Program 206: Manure and Byproduct Utilization*. 2005.
5. Centers for Disease Control and Prevention. Escherichia coli O157:H7. 2010. Available at: [http://www.cdc.gov/nczved/divisions/dfbmd/diseases/ecoli\\_o157h7/index.html#where](http://www.cdc.gov/nczved/divisions/dfbmd/diseases/ecoli_o157h7/index.html#where).
6. Pew Commission on Industrial Farm Animal Production. *Putting Meat on the Table: Industrial Farm Animal Production in America*. 2008.
7. Solomon E, Yaron S, Matthews K. Transmission of Escherichia coli O157:H7 from contaminated manure and irrigation water to lettuce plant tissue and its subsequent internalization. *Applied and Environmental Microbiology*. 2002;68(1):397-400.
8. Keiger D. Farmacology. *Johns Hopkins Magazine*. 2009.
9. Callaway TR, Elder RO, Keen JE, Anderson RC, Nisbet DJ. Forage feeding to reduce preharvest Escherichia coli populations in cattle, a review. *Journal of Dairy Science*. 2003;86(3):852–860.
10. Woteki CE, Kineman BD. Challenges and approaches to reducing foodborne illness. *Annual Review of Nutrition*. 2003;23:315-44.
11. USDA. Fact sheets: ground beef and food safety. 2011. Available at: [http://www.fsis.usda.gov/factsheets/ground\\_beef\\_and\\_food\\_safety/index.asp](http://www.fsis.usda.gov/factsheets/ground_beef_and_food_safety/index.asp).
12. Gouveia L, Juska A. Taming nature, taming workers: constructing the separation between meat consumption and meat production in the US. *Sociologia Ruralis*. 2002;42(4).

13. Kessel J Van, Karns J, Gorski L, McCluskey B, Perdue M. Prevalence of salmonellae, listeria monocytogenes, and fecal coliforms in bulk tank milk on US dairies. *Journal of Dairy Science*. 2004;87(9):2822-2830.
14. Centers for Disease Control and Prevention. Campylobacter: general information. 2010. Available at: <http://www.cdc.gov/nczved/divisions/dfbmd/diseases/campylobacter/>.
15. Centers for Disease Control and Prevention. Norovirus: Q&A. 2010. Available at: <http://www.cdc.gov/ncidod/dvrd/revb/gastro/norovirus-qa.htm>.
16. Alavanja M, Hoppin H, Kamel F. Health effects of chronic pesticide exposure: cancer and neurotoxicity. *Annual Review of Public Health*. 2004;25:155-197.
17. UNEP Chemicals Branch. *The Global Atmospheric Mercury Assessment: Sources, Emissions, and Transport*. Geneva, Switzerland; 2008.
18. U.S. Department of Health and Human Services. *Agency for Toxic Substances and Disease Registry ToxFAQs: Mercury*. 1999.
19. Silbergeld EK, Nachman K. The environmental and public health risks associated with arsenical use in animal feeds. *Annals of the New York Academy of Sciences*. 2008;1140:346-57.
20. HACCP Alliance. HACCP questions and answers. 2011. Available at: <http://haccpalliance.org/alliance/haccpqa.html>.
21. Food Safety and Inspection Service. Key facts: microbial testing programs--FSIS testing for salmonella and plant testing for E. coli. *FSIS*. 2011. Available at: <http://www.fsis.usda.gov/oa/background/keymicro.htm>.
22. Brennan J ed. *Food Processing Handbook*. Weinheim, Germany: Wiley-VCH; 2006:367.
23. Food and Drug Administration. Hazard analysis and critical control point principles and application guidelines. 2009. Available at: [http://www.fda.gov/oc/ohrt/food/food\\_safety\\_hazard\\_analysis\\_and\\_critical\\_control\\_point\\_principles\\_and\\_application\\_guidelines.pdf](http://www.fda.gov/oc/ohrt/food/food_safety_hazard_analysis_and_critical_control_point_principles_and_application_guidelines.pdf).
24. Sperber W. HACCP does not work farm to table. *Food Control*. 2005;16(6):511-514.
25. Brown M. *HACCP in the Meat Industry*. Boca Raton, FL: Woodhead Publishing Limited; 2000.
26. Taylor E. HACCP in small companies: benefit or burden? *Food Control*. 2001;12(4):217-222.
27. WHO. FAO/WHO guidance to governments on the application of HACCP in small and/or less-developed food businesses. 2006.
28. USDA. Common questions: HACCP. 2011. Available at: [http://fsrio.nal.usda.gov/nal\\_display/index.php?tax\\_subject=604&topic\\_id=2377level3=0&level4=0&level5=&info\\_center=1&tax\\_level=2&placement\\_default=4&ref\\_id=31&faqs\\_id=225](http://fsrio.nal.usda.gov/nal_display/index.php?tax_subject=604&topic_id=2377level3=0&level4=0&level5=&info_center=1&tax_level=2&placement_default=4&ref_id=31&faqs_id=225).
29. USDA Food Safety and Inspection Service. Be food safe: four easy lessons in safe food handling. 2007. Available at: [http://www.fsis.usda.gov/Food\\_Safety\\_and\\_Inspection\\_Service/Food\\_Safety/Be\\_Food\\_Safe/Four\\_Easy\\_Lessons\\_in\\_Safe\\_Food\\_Handling.cfm](http://www.fsis.usda.gov/Food_Safety_and_Inspection_Service/Food_Safety/Be_Food_Safe/Four_Easy_Lessons_in_Safe_Food_Handling.cfm).

## 2. OUTBREAK INVESTIGATION: DESCRIPTION OF THE OUTBREAK

### Scenario:

On Wednesday, June 5, a local community organization held a fundraising crab feast for cancer research. Roughly 100 people attended the event. The menu included fresh steamed crabs, egg salad, macaroni salad, creamy coleslaw and ice cream.

On Thursday, June 6, a woman who had attended the crab feast woke up feeling ill. She scheduled an appointment with her doctor. She described her symptoms as nausea, fever, chills and body aches.



On Friday, June 7, the physician noticed that during the morning of her shift she had seen several people with similar symptoms. She began asking questions about their previous activities and found that they had all attended the crab feast. The doctor called the local health department to report her observations.

**Start of the investigation:**

The health department immediately began an investigation. A district health officer contacted patients and confirmed the doctor's report of their illnesses, as well as their attendance at the crab feast. The investigators suspected that the crab feast may be the source of the illness.

The health department also prepared a questionnaire, which was distributed a week after the crab feast to as many people as possible who had attended the event. The questionnaire asked for the following information:

- Whether the person became ill
- Symptoms of the illness
- Time the symptoms began
- What foods the person ate

Out of the 100 people who attended the event, 45 responded to the questionnaire. The results are given in *Outbreak Investigation: Questionnaire Data*. Each row represents a different person.

## OUTBREAK INVESTIGATION: QUESTIONNAIRE DATA

Number	Date sick	Crabs	Macaroni	Egg Salad	Cole Slaw	Ice Cream
1	7 <sup>th</sup>	Ate	Ate	Ate	Did not eat	Ate
2	6 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Ate
3	7 <sup>th</sup>	Ate	Ate	Ate	Ate	Did not eat
4	Not sick	Ate	Did not eat	Ate	Ate	Ate
5	8 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Did not eat
6	7 <sup>th</sup>	Ate	Ate	Ate	Ate	Did not eat
7	Not sick	Did not eat	Ate	Did not eat	Ate	Ate
8	8 <sup>th</sup>	Did not eat	Did not eat	Ate	Did not eat	Ate
9	7 <sup>th</sup>	Ate	Ate	Ate	Did not eat	Ate
10	10 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Did not eat
11	8 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Ate
12	8 <sup>th</sup>	Ate	Ate	Ate	Ate	Ate
13	7 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Ate
14	8 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Did not eat
15	7 <sup>th</sup>	Ate	Ate	Ate	Did not eat	Did not eat
16	Not sick	Ate	Ate	Did not eat	Ate	Ate
17	7 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Ate
18	8 <sup>th</sup>	Ate	Ate	Ate	Ate	Ate
19	8 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Did not eat
20	8 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Did not eat
21	9 <sup>th</sup>	Ate	Ate	Ate	Ate	Ate
22	Not sick	Ate	Ate	Ate	Ate	Ate
23	8 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Did not eat
24	9 <sup>th</sup>	Ate	Ate	Ate	Ate	Ate
25	7 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Ate
26	Not sick	Did not eat	Ate	Did not eat	Ate	Ate
27	8 <sup>th</sup>	Ate	Did not eat	Did not eat	Did not eat	Ate
28	7 <sup>th</sup>	Did not eat	Did not eat	Ate	Ate	Did not eat
29	8 <sup>th</sup>	Ate	Ate	Ate	Did not eat	Did not eat
30	7 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Ate
31	Not sick	Did not eat	Ate	Ate	Ate	Ate
32	8 <sup>th</sup>	Did not eat	Did not eat	Ate	Did not eat	Did not eat
33	8 <sup>th</sup>	Ate	Ate	Ate	Ate	Ate
34	8 <sup>th</sup>	Did not eat	Did not eat	Ate	Did not eat	Did not eat
35	Not sick	Ate	Ate	Did not eat	Ate	Ate
36	8 <sup>th</sup>	Ate	Did not eat	Did not eat	Ate	Ate
37	8 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Ate
38	8 <sup>th</sup>	Ate	Did not eat	Ate	Ate	Did not eat
39	Not sick	Ate	Ate	Did not eat	Ate	Ate
40	Not sick	Did not eat	Did not eat	Did not eat	Did not eat	Ate
41	Not sick	Did not eat	Ate	Ate	Ate	Ate
42	Not sick	Ate	Ate	Did not eat	Ate	Ate
43	8 <sup>th</sup>	Ate	Did not eat	Ate	Did not eat	Did not eat
44	Not sick	Did not eat	Did not eat	Did not eat	Ate	Ate
45	Not sick	Ate	Did not eat	Did not eat	Did not eat	Ate

**2.1 OUTBREAK INVESTIGATION: ATTACK RATE**

What percent of people who attended the event got sick?

**Instructions:** Using the *Questionnaire Data*, count how many people became sick and how many did not. In order to determine the attack rate (the percentage of people who became sick), divide the number sick by the total number of people who answered the questionnaire. Write your results in the table below.

Number of people who got sick:	Number of people who did <i>not</i> get sick:	Total number of people who responded to the questionnaire:	Attack rate:

**OUTBREAK INVESTIGATION: ATTACK RATE BY FOOD**

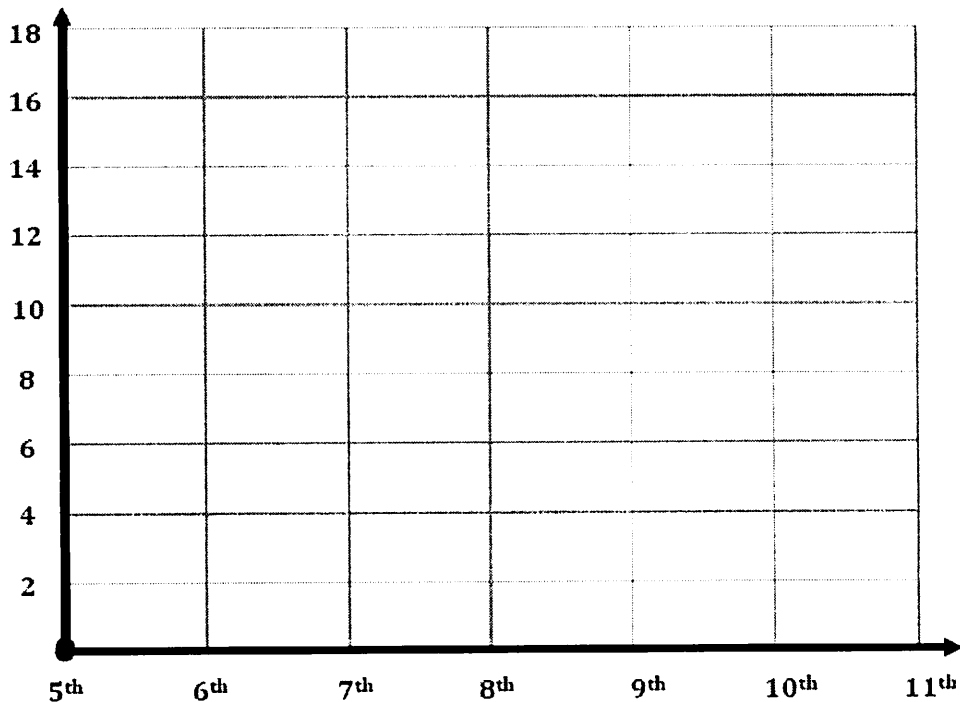
Which food at the lunch had the highest attack rates?

**Instructions:** For each food that was served, determine how many of the people who ate that food became sick. Divide this by the total number of people who ate that food. The result is the attack rate for the particular food.

Food:	Number of people who ate this food and got sick:	Number of people who ate this food but did <i>not</i> get sick:	Total number of people who ate this food:	Attack rate by food:

**2.2 OUTBREAK INVESTIGATION: EPIDEMIC CURVE****Instructions:**

Determine when each person first reported his or her sickness. Graph your results below to determine when the majority of people became ill. Label the X-axis as "date of onset" and the Y-axis as "number of people."



1. On what date did the most people become sick?
2. What is the mode incubation period? Hint: The time from exposure to the day when the most people became sick is the mode incubation period.
3. What is the median incubation period? Hint: The median incubation period can be found by making a list of the individual incubation periods, from shortest to longest. The middle value in the list (or the average of the two middle values if there is an even number of cases) is the median incubation period.

**2.3 OUTBREAK INVESTIGATION: IDENTIFYING THE PATHOGEN AND CONTAMINATED FOOD**

**Instructions:**

Work as a group to answer the questions below about the pathogen and food that probably caused the outbreak. Consider the results of your investigation so far: the symptoms of people who became ill, the attack rate and the median incubation time. Compare these against the descriptions of each pathogen in the handout labeled *Outbreak investigation: Pathogens*.

1. Which pathogen do you suspect caused the illness?

2. Which food do you suspect was contaminated by the pathogen?

3. Some of the people who said they ate this food did not get sick. What could be some possible explanations for this?

**OUTBREAK INVESTIGATION:**

**PATHOGENS Salmonella**

Incubation period: 1-3 days

Signs and symptoms:

- Fever
- Vomiting
- Diarrhea

Commonly associated foods:

- Eggs
- Poultry
- Cheese
- Unpasteurized milk or juice
- Raw fruits and vegetables<sup>1</sup>

**Norovirus**

Incubation period: 1-2 days

Signs and symptoms:

- Nausea
- Vomiting
- Large volume diarrhea

Commonly associated foods:

- Poorly cooked shellfish
- Ready to eat foods handled by infected persons like salads or sandwiches
- Contaminated water<sup>3</sup>

**Campylobacter**

Incubation period: 2-5 days

Signs and symptoms:

- Fever
- Vomiting
- Diarrhea
- Abdominal cramps

Commonly associated foods:

- Raw and undercooked poultry
- Unpasteurized milk
- Contaminated water<sup>2</sup>

**E. coli**

Incubation period: 1-8 days

Signs and symptoms:

- Vomiting
- Severe diarrhea
- Abdominal cramps

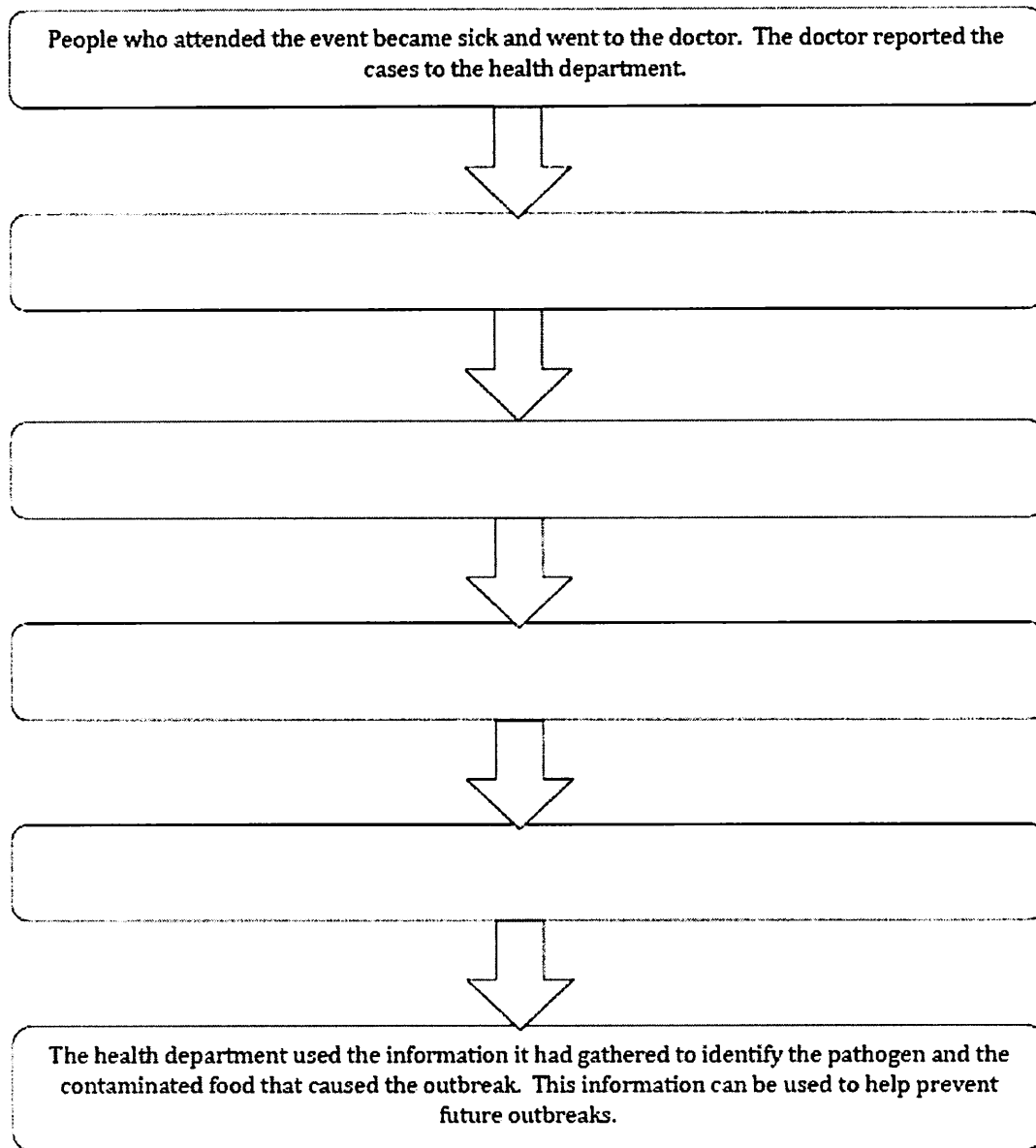
Commonly associated foods:

- Undercooked beef, salami
- Contaminated water
- Unpasteurized milk or juice<sup>4</sup>

### 3. OUTBREAK INVESTIGATION: SUMMARY OF ACTION STEPS

**Instructions:**

How do health departments respond to an outbreak of a foodborne illness? Think about the steps you took to determine the cause of the outbreak. For each step in the investigation of an outbreak, write a sentence describing the activity that took place at that step.

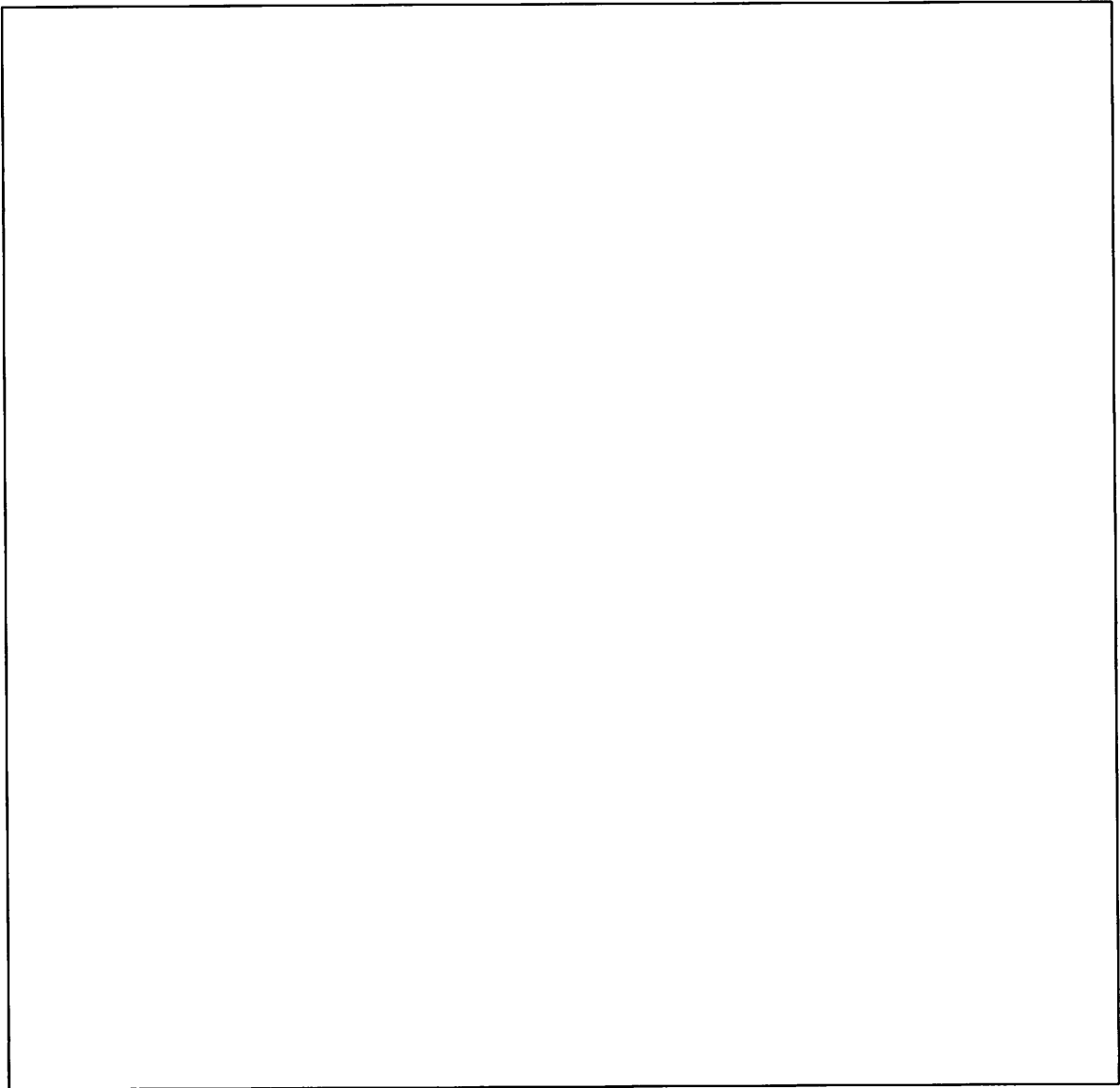


**POST-LAB QUESTIONS**

**OUTBREAK INVESTIGATION: PRESS RELEASE**

**Instructions:**

Draft a press release (about a paragraph in length) for the local newspaper about the outbreak. Summarize the outbreak in terms of who, what, where, when, why and how. Include recommendations for how to prevent foodborne outbreaks at future community events.





## GRADING: FOOD SAFETY

<b>Points</b>	<b>Item</b>
____/2	Attack Rate
____/3	Attack Rate by Food
____/4	Epidemic Curve
____/4	Identifying the pathogen and contaminated food
____/4	Summary of Action Steps
____/8	Post-lab questions: Press release
____/25	<b>Total</b>