Food Science Curriculum

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INTEGRATING EDUCATION IN SCIENCE AND TECHNOLOGY

INTRODUCTION

The Illinois State Board of Education, through Scientific Literacy funding, has begun a partnership effort between professional teacher organizations specifically to promote a new collegiality among our teachers based on the newly adopted Illinois Learning Goals and Standards for Science. The organizations initially involved include the Illinois Associations of Biology Teachers, Chemistry Teachers, Family and Consumer Science Teachers, Industrial Technology Teachers, Physics Teachers, Science Teachers, and Vocational Agriculture Teachers along with the Facilitation and Coordination in Agriculture Education team. The partnership provided a unique opportunity to bring together high school teachers of Family and Consumer Science, Agriculture and Principles of Technology with Biology, Chemistry and Physics/Physical Science teachers to focus on integrating pure and applied sciences. These concepts of these sciences must be able to bridge real-life, up-to-date technologies and career-related activities. It is our goal to build professional collegiality and enhance the expertise of one discipline with another. The original planning team, composed of the presidents or representatives of these organizations, decided to work towards enhanced student and teacher learning, using the benchmarks for science at the early and late high school levels in the Illinois Learning Standards. The materials, which were developed by teachers, (some representing their professional organizations) are the focus of the series of one-day workshops during the Spring of 1998 at multiple locations around the state for local review and piloting.

STARTING WITH THE STANDARDS

In July, 1997, the State Board of Education formally adopted the Illinois Learning Standards and endorsed the learning benchmarks for early and late elementary, along with middle and early and late high school levels. The original team of science teachers who worked together to draft the goals, standards and benchmarks, worked hard to promote the unifying strategy of "**All Three—All the Time—In Everything**" for the sciences. We wanted to promote the processes of science in all of the concepts of science, while making direct connections to real life.

We believe that teaching the concepts of science should not be separated from the processes of science or its interactions with society. Neither can the processes of science be isolated from understanding the concepts and the resulting implications to or from technology and society. The interactions and practices of science require the understanding of what science is and how science works in order to be authentically understood. **Goal 11** is accepted as the science processes goal with standards addressing the processes of inquiry and technological design. **Goal 12** is the concepts goal, including two standards each for life, physical and earth/space sciences. **Goal 13** is the connections goal, focusing on the accepted practices of science and the STS (science/ technology/ society) connections. For example, the choice of physical science content from goal 12, standard C or D, should be complemented with the processes of science from goal 11, standard A or B or a combination of both, while making the connections from goal 13 to its two standards. Promoting the students' understanding of **All Three—All the Time—In Everything** as a teaching and learning strategy can allow students to build on their knowledge and skills for science. In addition, their attitudes and behaviors for and from science can mature in an ongoing manner that allows more integrated thinking and problem-solving in the sciences and related fields for lifelong learners.

As the *INTEGRATING EDUCATION IN SCIENCE AND TECHNOLOGY* project evolved, special directional emphasis was made to organize all efforts around the early and late high school science benchmarks. Generally the Agriculture team and the Food Science team proceeded from the Goal 12 standards for Life and Physical Sciences (Standards A, B, C, and D), as they integrated in the processes of Goal 11 and the connections of Goal 13. The Principles of Technology team, however, initially focused on Standard B from Goal 11, the technological design standard, as they connected to Goals 12 and 13. Goal 13 was the starting point for the career interview activity which was included in the Introduction Section of each product. This activity directs the perspective from the connections of science to the concepts and processes of science in Goal 11 and 12.

PRODUCT OVERVIEW

Scientific Literacy funding provided teams of teachers from secondary science, agriculture, food sciences and industrial technology the opportunity to work together to create and pilot the following three products:

Integrating the Sciences and Foods materials brings closer together science and technology relating to the food sciences, including food poisoning, biotechnology research implications, food irradiation, etc. Curriculum materials from the Food Science Experiment and Activity Guide from North Carolina and CORD Applications in Biology/Chemistry were expanded and the team approach to activities was emphasized, as they align to the Illinois Science Goals 11, 12 and 13.

The **Technology and Science** materials consist of activity-based learning to enhance the participants' abilities to use design and creative innovation in the classroom. These materials include experimentation and problem-solving activities especially geared toward the process of technological design described in Goal 11, as it applies to the concepts and connections of Goals 12 and 13.

The Enhanced Biological and Physical Science Applications in Agriculture materials have been designed as extensions of selected experiments in the popular Biological Science Applications in Agriculture (BSAA) and Physical Science Applications in Agriculture (PSAA) curricula currently used in many of Illinois' high schools. Existing lab activities and experiments have been modified for easier understanding. New activities have been developed which connect agricultural management practices with underlying science concepts and principles, aligning with all three Science Learning Goals.

GENERAL FORMAT OVERVIEW

Readers will notice the common format in each of the three products created through this project. Specific benchmarks are noted in the upper left corner of each unit/activity. Key words are used to identify each of these benchmarks. The key words are not intended to be exclusive or definitive, but as thinking starters or organizers for initial understanding. These benchmarks were the starting points for curricular development and enhancement. Key concepts and skills are noted in the upper right hand corner as quick identifiers for the activity, using common unit topics.

(Two tables follow this introduction, intended to be offered for assistance as teachers familiarize themselves with the Illinois Learning Standards. The first table lists some suggested key words for the early and late high school science goals, standards and benchmarks. An additional table noting only the wording of the goals, standards and benchmarks is also offered as a tool for future efforts, potentially resulting from this project.)

There are student instructions and interactions suggested, as well as generalized and more specific teacher preparation directions. Web sites have been suggested for possible connection and extension of classroom activities in the section labeled "Instructional Media Connections." Some popular examples of applicable software have been suggested for classroom use. Suggestions are also offered for connections to careers in each activity. In some cases, additional materials have been provided to enhance the piloting of the activities; most of these materials have been provided at no cost or very low costs from various national professional and commercial sources. Reference citations are noted at the conclusion of each unit.

Three copies of product activity evaluations are included as self-mailing pages following this Introduction. It is hoped that each participant will ‘experiment’ with at least three activities presented within the product received. It is very important to get teacher input for improving this draft version of the **Integrating Education in Science and Technology** products. Please return the form for each activity you are able to test before June 1. Feel free to share the products’ activities with your colleagues; duplicate the evaluations for additional ‘teacher experiments’ as needed.

Each of the professional organizations have been asked to provide information about their organizations and membership. Promoting and maintaining collegiality through the various state organizations can be instrumental in the ongoing professional development for teachers throughout their careers.

Illinois Learning Standards

SCIENCE

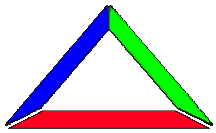
EARLY HIGH SCHOOL

11 Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.	**PROCESSES**
A. Know and apply the concepts, principles and processes of scientific inquiry.	Inquiry
11.A.4 Formulate hypotheses referencing prior research and knowledge.	Hypothesize
11.A.4b Conduct controlled experiments or simulations to test hypotheses.	Test hypothesis
11.A.4c Collect, organize and analyze data accurately and precisely.	Data management
11.A.4d Apply statistical methods to the data to reach and support conclusions.	Statistics + conclusion
11.A.4e Formulate alternative hypotheses to explain unexpected results.	Alternative hypothesis
11.A.4f Using available technology, report, display and defend to an audience conclusions drawn from investigations.	Report/Defend conclusions
B. Know and apply the concepts, principles and processes of technological design.	Technological design
11.B.4a Identify a technological design problem inherent in a commonly used product.	Identify problem
11.B.4b Propose and compare different solution designs to the design problem based upon given constraints including available tools, materials and time.	Propose/Compare solutions
11.B.4c Develop working visualizations of the proposed solution designs (e.g., blueprints, schematics, flowcharts, cad-cam, animations).	Modeling
11.B.4d Determine the criteria upon which the designs will be judged, identify advantages and disadvantages of the designs and select the most promising design.	Determine criteria
11.B.4e Develop and test a prototype or simulation of the solution design using available materials, instruments and technology.	Prototype testing
11.B.4f Evaluate the test results based on established criteria, note sources of error and recommend improvements.	Evaluation
11.B.4g Using available technology, report to an audience the relative success of the design based on the test results and criteria.	Communication
12 Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.	**CONCEPTS**
A. Know and apply concepts that explain how living things function, adapt and change.	Life-function, adaptation, change
12.A.4a Explain how genetic combinations produce visible effects and variations among physical features and cellular functions of organisms.	Genetics

12.A.4b Describe the structures and organization of cells and tissues that underlie basic life functions including nutrition, respiration, cellular transport, biosynthesis and reproduction.	Physiology
12.A.4c Describe processes by which organisms change over time using evidence from comparative anatomy and physiology, embryology, the fossil record, genetics and biochemistry.	Development of organisms over time
B. Know and apply concepts that describe how living things interact with each other and with their environment.	Life-Interactions
12.B.4a Compare physical, ecological and behavioral factors that influence interactions and interdependence of organisms.	Interaction/Interdependence
12.B.4b Simulate and analyze factors that influence the size and stability of populations within ecosystems (e.g., birth rate, death rate, predation, migration patterns).	Population stability
C. Know and apply concepts that describe properties of matter and energy and the interactions between them.	Phys-Matter/Energy
12.C.4a Use kinetic theory, wave theory, quantum theory and the laws of thermodynamics to explain energy transformations.	Energy transformation
12.C.4b Analyze and explain the atomic and nuclear structure of matter.	Structure of matter
D. Know and apply concepts that describe force and motion and the principles that explain them.	Phys-Force/Motion
12.D.4a Explain and predict motions in inertial and accelerated frames of reference.	Inertia/Acceleration
12.D.4b Describe the effects of electromagnetic and nuclear forces including atomic and molecular bonding, capacitance and nuclear reactions.	Electromagnetic/Nuclear forces
E. Know and apply concepts that describe the features and processes of the Earth and its resources.	Earth Systems
12.E.4a Explain how external and internal energy sources drive Earth processes (e.g., solar energy drives weather patterns; internal heat drives plate tectonics).	Earth energy sources
12.E.4b Describe how rock sequences and fossil remains are used to interpret the age and changes in the Earth.	Age of the Earth
F. Know and apply concepts that explain the composition and structure of the universe and Earth's place in it.	Space Sciences
12.F.4a Explain theories, past and present, for changes observed in the universe.	Changes in universe
12.F.4b Describe and compare the chemical and physical characteristics of galaxies and objects within galaxies (e.g., pulsars, nebulae, black holes, dark matter, stars).	Galactic characteristics
13 Understand the relationships among science, technology and society in historical and contemporary contexts.	**CONNECTIONS**
A. Know and apply the accepted practices of science.	Practices of science
13.A.4a Estimate and suggest ways to reduce the degree of risk involved in science activities.	Risk assessment
13.A.4b Assess the validity of scientific data by analyzing the results, sample set, sample size, similar previous experimentation, possible misrepresentation of data presented and potential sources of error.	Data validity
13.A.4c Describe how scientific knowledge, explanations and technological designs may change with new information over time (e.g., the understanding of DNA, the design of computers).	Impact of new information
13.A.4d Explain how peer review helps to assure the accurate use of data and improves the scientific process.	Peer review
B. Know and apply concepts that describe the interaction between science, technology and society.	STS Interactions
13.B.4a Compare and contrast scientific inquiry and technological design as pure and applied sciences.	Inquiry/pure: Design/applied

13.B.4b Analyze a particular occupation to identify decisions that may be influenced by a knowledge of science.	Science in occupations
13.B.4c Analyze ways that resource management and technology can be used to accommodate population trends.	Population trends
13.B.4d Analyze local examples of resource use, technology use or conservation programs; document findings; and make recommendations for improvements.	Local STS issue study
13.B.4e Evaluate claims derived from purported scientific studies used in advertising and marketing strategies.	Science claims in advertising/marketing

New Food Product



Associated Benchmarks

11.B.4a - Identify Problem
12.C.5b - Property Analysis

Key Concept

Food Production and Analysis

Process Skills

Evaluating Consequences

Alternative Solutions

Activity Connections

In this activity, students will develop a recipe for a "new food product," prepare the product in a kitchen/lab, analyze the nutritional and sensory characteristics of the product, and make modifications if desired. Although students cannot exactly replicate the technology used in commercial food production, they can simulate other aspects of food product development such as determining food composition data for labels and evaluating and modifying the sensory characteristics of the product.

If desired, this activity can be extended to include the development of a food label for the product, as well as advertising and marketing strategies. The attached activity (Food Science Lab Planning - pages 1.5-1.9) could also be used in evaluating the student-designed food products.

Time length - Total of 4 weeks. Various portions could be completed in stages or used alone.

Career Connection (13.B.4b)

Through this activity, students will become familiar with some of the activities of scientists working in the food industry.

Teacher Instructions

Prior to this activity, students should have developed some familiarity with commercial food processing techniques. They should recognize that they cannot imitate exactly the commercial processes, but can engage in some of the same activities that are involved in commercial food product development.

Materials needed for this project will vary, depending upon the products selected for preparation by the students. In general, food preparation equipment and food ingredients will be needed. Students will also need access to information on food composition, which is available in text format, via computer software, or via the web site listed below.

Use the Cooperative Laboratory Assessment to evaluate students in company or team work.

Student Interaction

The following general instructions can be used to guide students in this activity:

1. Start the activity by having students look at and discuss some of the newer food products in supermarkets, including the appeal of such products, and the technologies which make these products possible.
2. Ask students to develop an idea for a "new" food product which could be prepared using non-commercial techniques, i.e., which can be produced in a standard kitchen using common ingredients. Students should be aware that there are some ways in which they can simulate, if not replicate, commercial products like reduced-fat baked goods.
3. Next, students should find or develop a recipe for the product they want to produce. In many cases, they can start with a standard recipe and make modifications.
4. Once students have their initial recipe formulated, they should prepare it, and then have fellow students do a sensory analysis of the product, analyzing it in terms of taste, texture, etc.
5. Depending upon the results of the sensory analysis, students may want to modify their original recipe and repeat the preparation and analysis steps.
6. Now students are ready to determine the nutrient composition of their food, and, if desired, an ingredients list which would conform to labeling requirements (i.e., listing ingredients by weight).
7. Finally, students might want to consider the types of food additives that could be used to enhance the quality and safety of their product. They should indicate what additive, or type of additive they would use and for what purpose.

Instructional Media Connections

Institute of Food Technologists http://www.ift.org/
This site includes information on food product development.

Nutrition Analysis Tool http://nat.crgq.com/
This program can be used to determine the nutrient composition of a recipe; input ingredients instead of foods.

Nutrient Analysis System 2: This is one software program which can be used to determine the nutrient contents of foods. It is from DDA Software, P.O. Box 477, Long Valley, NJ 07853, 908-876-5580.

NDSU Extension Service, University of North Dakota http://www.ag.ndsu.nodak.edu/food.htm
A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

References

Food Science Experiment and Activity Guide, Issued by Home Economics Education, Vocational and Technical Education, North Carolina Department of Public Instruction, Raleigh, North Carolina 27601-2825, August 1994.

NAME:_____ DATE:_____ CLASS PERIOD:_____

STUDENT WORKSHEET -Food Production and Analysis - Company Plans

Company Members **Job Title**

_____ Food Scientist

_____ Food Engineer and Flavorist

_____ Marketing

Company Name_____

Product Name_____

Target Audience_____

Brief description of product:

Type of packaging:

Type of marketing:

NAME:_____ DATE:_____ CLASS PERIOD:_____

Food Science Lab Planning - Parliamentary Procedure

EXPERIMENT 20-01

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.

INTRODUCTION:

Regardless of whether you are at home, in the classroom, or on the job, an orderly system for accomplishing your goals or plans is needed. When two or more people are involved, the rights and opinions of each individual need to be considered. Parliamentary Procedure has four principles: courtesy and justice to all, one item of business at a time, the minority must be heard, and the majority must prevail. Knowing proper procedures for handling formal or informal meetings helps things run smoothly. Consider the planning that takes place within your classroom for effective and successful instruction.

PROCEDURE:

1. Select a dessert item to prepare for the entire class to enjoy. Selection must be made through the use of Parliamentary Procedure. You must include in the planning and selection process the use of a motion, debate, and the use of one method of voting - voice vote, roll call, or ballot. Remember the majority rules.
2. Prepare the following:

    - timeline chart - includes task descriptions and assignments, start time, length of task, and finish time
    - materials list - includes supplies, equipment, and facility needs
    - product evaluation form

3. Record information in step 2 in the data tables provided.

DATA TABLE 1: Timeline Chart

Food Item to be Prepared:			
Task Descriptions and Assignments	Length of Task	Start Time	Completion Time

DATA TABLE 2: Materials, Supplies, Equipment, Facilities/Space

Materials/Supplies	In-stock	Need to Order

Equipment Needs	Availability	Condition

Facility/Space Requirements
(Write a brief description of your facility/space requirements for this experiment.)

DATA TABLE 3: Product Evaluation

Product Evaluation

Clean-Up Instructions:

QUESTIONS:

1. What problems, if any, did the class encounter when deciding on the dessert to be prepared?

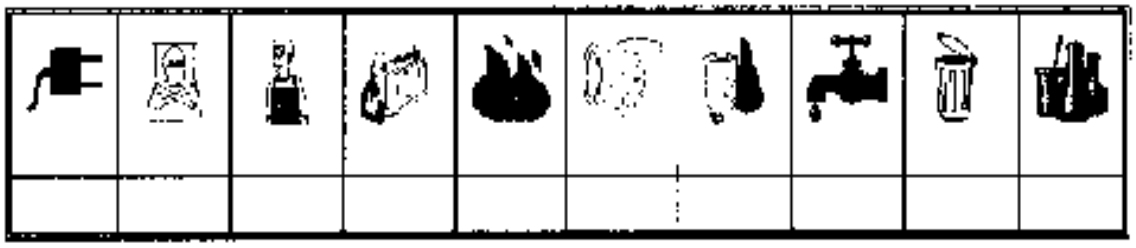
2. Determine the benefits of using parliamentary procedure when group decisions are being made that will affect the entire group.

FOR TEACHER USE
ANSWER KEY

Food Science Lab Planning - Parliamentary Procedure

Time: 2 class periods

Safety: Have students initial the following safety precautions before proceeding with this lab.



(Note: Items listed below are suggested; other items may need to be addressed based on food items selected for this experiment.)

- Electrical Safety - Handle electrical equipment with care; plug and unplug with dry hands and with care.
- Personal and Clothing Safety- Wear an apron to protect clothing.
- Fire Safety- Use care with heat source.
- Hand Safety and Protection - Use hot mitts; handle knives with care.
- Personal Hygiene and Safety - Use sanitary practices in the foods lab.
- Equipment Use and Safety - Use safety practices with all equipment.

Materials and Equipment Needed		
Supplies will vary depending on the recipe selected by the class.		

How can this lab be applied within the home? Within the workplace?

ANSWERS:

1. Answers will vary
2. Minority is heard, majority rules.

TEACHER NOTE:

- Resources: *FHA/HERO Chapter Handbook; Robert's Rules of Order (Newly Revised)*

NAME:_____ DATE:_____ CLASS PERIOD:_____

STUDENT WORKSHEET: FOOD PRODUCTION AND ANALYSIS - TASK/TIME LINE

Completion Date Task

_____ 1. Brainstorm new food product

_____ 2. Feasibility Survey (Is there a need to develop the new product?)

Develop questions

Survey

Summarize results

_____ 3. Market Research (Identify product qualities similar to the product you plan to develop)

Consumer Appeal

Packaging Techniques

Technology Used

Processing

Preservatives

Nutrient Value

Price Variation

Size Availability

Brands

_____ 4. Develop New Product Recipe

_____ 5. Research Report

Processing Techniques

Ingredients

Nutrient Functions

Preservatives

_____ 6. Develop Sensory Evaluation Questions

_____ 7. Prepare Developed Recipe

_____ 8. Determine Weight

Each Ingredient

Total Recipe

Amount of Product in Container

_____ 9. Sensory Evaluation Survey and Summary of Results

_____ 10. Modify Developed Recipe

_____ 11. Develop Accurate Nutrient Label Using Nutrient Analysis Program

_____ 12. Develop Accurate Label for Package

_____ 13. Develop Marketing Scheme

_____ 14. Prepare Display of Company Work

NAME:_____ DATE:_____ CLASS PERIOD:_____

FOOD PRODUCTION AND ANALYSIS - Product Development Evaluation

Score	Possible Points	Content
_____	_____	Cover Page
_____	_____	Recipe
_____	_____	Product Description
_____	_____	Market Research
_____	_____	Internet Research
_____	_____	Feasibility Survey Questions
_____	_____	Feasibility Survey Summary
_____	_____	Sampling Survey Questions
_____	_____	Sampling Survey Summary
_____	_____	Pricing
_____	_____	Appendix Cover Page
_____	_____	Copies of Feasibility Surveys
_____	_____	Copies of Sampling Surveys
Total Score	Total Score	
_____	_____	

NAME:_____ DATE:_____ CLASS PERIOD:_____

STUDENT WORKSHEET: LABEL REQUIREMENTS WORKSHEET

- Common Name of Product:

- Brand Name of Product:

- Company Name:

- Manufacturing Address:

- General Product Information: (opt.)

- Serving Suggestions: (opt.)

- How to Use Product (opt.)

- Weights Grams Pounds

Weight of ingredients & container _____ _____

MINUS Weight of container –_____ –_____

EQUALS Net Weight =_____ =_____

- Ingredients in order of most to least

Name of ingredient Amount Ranked Order

NAME:_____ DATE:_____ CLASS PERIOD:_____

FOOD PRODUCTION AND ANALYSIS - Package and Label Evaluation

Score	Possible Points	Content
_____	_____	Product Common Name
_____	_____	Name of Company
_____	_____	Address of Company
_____	_____	Ingredients Listed in Order
_____	_____	Net Weight
_____	_____	Size Appropriate for Ingredients
_____	_____	Nutritional Label
_____	_____	Attractive pictures
_____	_____	Space coverage of package
Total Score	Total Score	
_____	_____	

NAME:_____ DATE:_____ CLASS PERIOD:_____

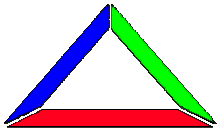
COOPERATIVE LABORATORY ASSESSMENT

	Date:	Date:	Date:	Date:	Date:	Date:
RESOURCES: Use and Care of Facilities and Equipment						
Time Management						
INTERPERSONAL: Team participation						
Negotiation						
Problem Solving						

INFORMATION: Following Procedure						
Interpretation of Data						
Write Up						

Rubric Scale: 5 = excellent 3 = average 1 = poor

Lipids and Proteins



Associated Benchmarks

11.A.4c - Data Management
11.A.4f - Report/Defend Conclusion
12.B.4b - Population Stability
13.A.4a - Risk Assessment
13.A.4b - Data Validity
13.A.4d - Data Validity
13.A.5c - Research Methodologies
13.B.4b - Data Validity
13.B.4c - Population Trends

Key Concept

Process Skills

Activity Connections

Description: This is a unit of three activities on protein and lipids that can be used separately or together. These three activities include:

1. Comparison of Nutritional Information Chart—protein and lipid analysis of published data
2. An experiment to determine the fat content of ground meat and alternate protein sources
3. Sensory evaluation—making tofu burgers

Application: This information could be used in a lesson on fat and protein content, nutrition, alternative food sources including activities such as "hands-on" lab experiments and chart analysis. Field trips can be included that offer the opportunity to explore careers as well as to observe how these different sources of protein are raised. This information can be extended to include information on diet and long-term health effects.

Time Requirements: A minimum of 5 class meetings are required for these activities.

Career Connection (13.B.4b)

Analytical chemist
Agriculture (farmer, etc.)
Dietitian
Nutritionist
Food chemist

Teacher Instructions

See Teacher Notes for each activity in the unit.

The following technology components may be added to these lessons:

1. Use the computer nutrient analysis software or the Internet to determine the protein and lipid content in the food.

2. Use graphing software or data base software to analyze the group results of percentage fat in various samples. This could be accomplished in small groups or with a PC.
3. For additional activities, use the Internet to research protein, lipids, cholesterol, saturated/unsaturated fats, heart disease as it relates to diet, the careers listed on Career Connection and alternative protein sources.

Activities included are: Protein and Lipid Analysis of Published Data, Social and Health Issues, Fat Content of Ground Meat and Alternative Protein Sources and Tofu Burgers.

Student Interaction

See each activity for questions and ideas for student interaction.

Instructional Media Connections

Internet Address: USDA Food Composition Data - http://www.usda.gov
Website Description: Food nutrient analysis of many foods

Internet Address: Gardenburger - http://www.gardenburger.com/
Website Description: Information on protein substitute burger made with soy protein and rice

Internet Address: Soyfoods - http://www.soyfoods.com and http://www.ag.uiuc.edu/~stratsoy/new
Website Description: Information on protein substitutes using soy protein

Internet Address: NDSU Extension Service, University of North Dakota
http://www.ag.ndsu.nodak.edu/food.htm
Website Description: A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

Ag Resource Office, SIU Carbondale, Agriculture Education and Mechanization, Carbondale, IL 62901-4414
Description: Resource people, literature, videos, workshops for teachers

Ag in the Classroom, Illinois Farm Bureau, 1701 Towanda Avenue, Bloomington, IL 61701. ☎309/557-3334
Description: Resource people, literature, field trips, educational kits, possible funding for ag institutes

Illinois Soybean Association, 2422 E. Washington, Bloomington, IL 61704. ☎309/663-7692
Description: Literature, videos

Vocational Agriculture Service, University of Illinois, 1401 South Maryland Drive, Urbana, IL 61801
Description: Information, literature

Illinois Pork Producers Association, 6411 South Sixth Street, Springfield, IL 62707
Description: Literature, funding for some projects

Illinois Beef Council, 93 Clocktower Drive, Springfield, IL 62704
Description: Literature, videos

References

Food Science Experiment and Activity Guide—Food Science #7075
Home Economics Education
Vocational and Technical Education
North Carolina Department of Public Instruction
Raleigh, North Carolina 27601-2825
August l994

Newton's APPLE Teacher's Guide on Body Fat - Newton's APPLE #1403

FOR TEACHER USE

Student Worksheet: Protein and Lipid Analysis of Published Data

Student Worksheet: Social and Health Issue Questions

Materials Needed:

1. *Comparison of Nutritional Information Chart*–1 copy per each group of students (group size 2-4)
2. Student Worksheet 1 - Protein and Lipid Analysis of Published Data - 1 copy per student
3. *Social and Health Issue Questions* Worksheet Teacher only or for each student- Teacher preference
4. Database or graphing software OR graph paper

Information may be found in or on:

1. Textbook
2. Internet (available at USDA food composition data website)
3. Nutrition booklets
4. Diet analysis software

Lesson Order:

1. Assign groups and distribute materials
2. Have student groups study *Comparison of Nutritional Information Chart* and answer questions on student worksheet.

***Enrichment A**—Assign students another protein source and have them complete the comparison chart using the text, internet, diet analysis software, etc. Other protein sources may include various grades of beef, i.e. ground beef, ground chuck, ground sirloin, or ground turkey, Tofu burger, soy burger, veggie burger, ostrich, deer, fish, etc.

***Enrichment B**—Have students construct a bar graph of the percent fat in each protein source. This may be done on computer using either data base or graphing software OR the graph could be constructed on graph paper. This activity may be done as a class or in individual groups depending on the level of student skill.

3. In a large group, teacher will insure that students have correct answers on worksheet
4. Guide students to evaluate the social and health issues (*Social and Health Issue Questions*). These questions may be used by the teacher to lead the discussion or passed out to students to prepare and research.
5. **Extending the Activity** Arrange a field trip to an emu, ostrich, or fish farm OR arrange for a guest speaker to come in to your class. Another option is to show a video of one of these farms. (Outback Emu Ranch at Ava has resources available - see Website Connections). Students may be exposed to these animals for the first time. This presents a good opportunity for career investigation.

Comparison of Nutritional Values*

Serving Size: 100 grams (3.5 oz)

Analysis	Emu	Catfish	Chicken	Turkey	Beef	Buffalo
	Thigh (Raw)	*Channel (Raw)*	*Broilers or Fryers;*	*Fryer-Roaster*	*Round, Bottom Round*	*Round, Bottom Round*
			Breast Meat Only (Raw)	*Flesh Only (Raw)*	*Separable; Lean and Fat*	*Separable; Lean and Fat*
					All Grade (Raw)	*All Grade (Raw)*
Protein	23.3 g	18.2 g	23.1 g	22.3 g	19.9 g	20.4 g
Calories	109 cal	113 cal	110 cal	104 cal	225 cal	99 cal
Sodium	71.6 mg	63 mg	65 mg	61 mg	55 mg	53 mg
Calcium	0.3 mg	40 mg	11 mg	12 mg	5 mg	12 mg
Iron	5 mg	1 mg	0.7 mg	1.4 mg	2.1 mg	1.6 mg
Cholesterol	57.5 mg	58 mg	64 mg	73 mg	65 mg	46 mg
Fat (Sat.+Mono.+Poly)	1.7 g	3.6 g	0.9 g	1.7 g	14.3 g	1.2 g
Saturated Fat	0.6 g	1 g	0.3 g	0.6 g	6.5 g	0.5 g
Monounsaturated Fat	0.7 g	1.6 g	0.3 g	0.7 g	7.2 g	0.4 g
Polyunsaturated Fat	0.4 g	1 g	0.3 g	0.4 g	0.6 g	0.3 g

*Data for catfish, turkey, and beef is from USDA Handbook No. 8. Data for emu is from Silliker Laboratories of Texas, Inc., a food-testing laboratory. Buffalo data is from the USDA Food Composition web page (http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl)

NAME:_____ DATE:_____ CLASS PERIOD:_____

STUDENT WORKSHEET 1: Protein and Lipid Analysis of Published Data

INTRODUCTION: Information on protein and lipids may be analyzed from data charts.

PROCEDURE:

1. Study the Comparison of Nutritional Information Chart (p. 2.5) with the other members of your group.
2. *If directed by your teacher*, fill in the blanks on that chart by using the text, the Internet or other sources.
3. *If directed by your teacher*, prepare a bar graph using a database program or graph paper to visually compare the amount of fat found in various protein sources. Since each sample of meat started with 100 grams, the weight of total fat is numerically equal to the percent of fat in the sample.
4. Analyze protein & lipid information using Comparison of Nutritional Information:

A. What is the sample size of meat on which the results were based?_____

Chart Interpretation. Fill in the columns below with the correct information from the chart.

Analyzing Protein & Lipids

Nutrient	Food with Most Nutrients	Food with Least Nutrients
Protein		
Calories		
Cholesterol		
Total Fat		
Saturated Fat		
Monounsaturated Fat		
Polyunsaturated Fat		

QUESTIONS:

1. Of the meats listed on the Comparison of Nutritional Information Chart (page 2.5), which type of meat would be the healthiest to include in your diet? Explain your answer.

2. Which of the meats listed on the Comparison of Nutritional Information Chart might be found in a heart patient's diet? (HINT: Look at the saturated fats and cholesterol.) Explain your answer.

3. Which of the meats listed on the Comparison of Nutritional Information Chart do you eat the most often?

4. Using the continuum line below, rank the meats in the Comparison of Nutritional Information Chart from the one you eat most often to the one you eat least often.

Most often ++ Least often

5. Do you believe that most people eat too much fat? Why or why not?

6. What are the functions of fat in food preparation?

FOR TEACHER USE

Student Worksheet: Protein and Lipid Analysis of Published Data

Student Worksheet: Social and Health Issue Questions

Materials Needed:

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***Enrichment B**—Have students construct a bar graph of the percent fat in each protein source. This may be done on computer using either data base or graphing software OR the graph could be constructed on graph paper. This activity may be done as a class or in individual groups depending on the level of student skill.

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5. **Extending the Activity** Arrange a field trip to an emu, ostrich, or fish farm OR arrange for a guest speaker to come in to your class. Another option is to show a video of one of these farms. (Outback Emu Ranch at Ava has resources available - see Website Connections). Students may be exposed to these animals for the first time. This presents a good opportunity for career investigation.

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Protein	23.3 g	18.2 g	23.1 g	22.3 g	19.9 g	20.4 g
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Polyunsaturated Fat	0.4 g	1 g	0.3 g	0.4 g	0.6 g	0.3 g

*Data for catfish, turkey, and beef is from USDA Handbook No. 8. Data for emu is from Silliker Laboratories of Texas, Inc., a food-testing laboratory. Buffalo data is from the USDA Food Composition web page (http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl)

FOR TEACHER USE

ANSWER KEY

STUDENT WORKSHEET: PROTEIN AND LIPID ANALYSIS OF PUBLISHED DATA

Analyzing Protein & Lipids

NUTRIENT	Food with Most	Food with Least
Protein	Emu	Catfish
Calories	Beef	Turkey
Cholesterol	Turkey	Emu
Total Fat	Beef	Chicken
Saturated Fat	Beef	Chicken
Monounsaturated Fat	Beef	Chicken
Polyunsaturated Fat	Catfish	Chicken

QUESTIONS:

1. Answer will vary
2. Look at the saturated fats and cholesterol
3. Answer will vary
4. Answer will vary
5. Answer will vary
6. Tenderize, flavor, used to transfer heat, making emulsions

NAME:_____ DATE:_____ CLASS PERIOD:_____

STUDENT WORKSHEET: Social and Health Issue Questions

INTRODUCTION: Social and health issues help determine food selection. Research and answer the following questions.

QUESTIONS:

1. Why is it important to consider new food sources of protein?

2. Why is it important to consider short-term and long-term consequences of eating these protein sources?

3. Why are some of these foods healthier sources of protein than beef?

4. Why are lipids important? Why should all fats not be excluded from a person's diet?

5. Why are some of these protein sources more widely used in some parts of this country (or world)?

6. How would you determine how much fat is in each type of protein?

Teacher's Key

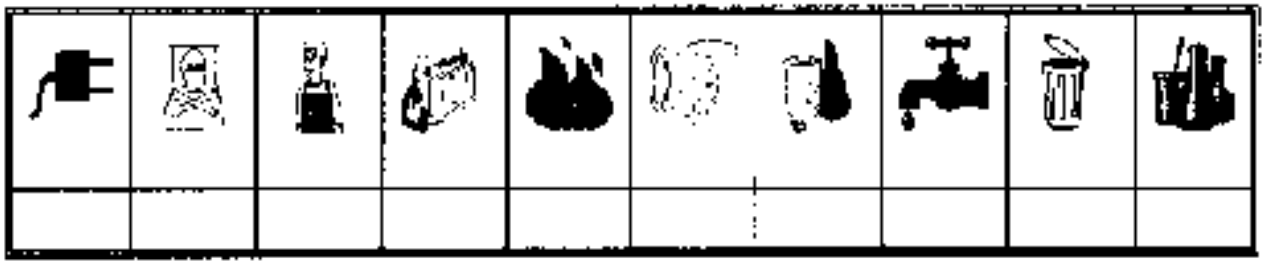
Social and Health Issue Questions

1. As the world's population grows, protein resources are in greater demand (therefore in shorter supply) and medical studies have shown that some people are harmed by consuming high-lipid protein sources.
2. Vegan protein sources are often not complete proteins, so two complementary proteins must be consumed during the day to supply a balanced amino acid supply. Infants and young children are especially vulnerable to this effect and may suffer symptoms of protein deficiency.
3. Some foods are richer in low-density lipoproteins than others and are therefore more likely to lead to health damaging effects.
4. Lipids are essential to the repair and growth of cell membranes, proper nerve functions, synovial fluids, production of steroid hormones and as insulation. Fat is an essential component of our diet to supply these needs.
5. Often proteins are used because they are locally available and cheap. More recently, consumers have become better educated and are beginning to choose protein sources that are healthier even if they are more expensive. As demand increases, usually production follows and prices stabilize.
6. If the protein is processed, read the label. For fresh or frozen foods, sometimes visual inspection reveals quantities of fat (as in beef). Some fat is "hidden" in marbling or is dispersed throughout the protein. Quantities may be determined in the lab using, for example, the Sudan III test for fat.

NAME:_____ DATE:_____ CLASS PERIOD:_____

EXPERIMENT: FAT CONTENT OF GROUND MEAT AND ALTERNATE PROTEIN SOURCES

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

The amount of fat permitted in ground beef is regulated by law: 30% for ground beef and 15% maximum for lean ground beef. In this experiment, let's investigate just how much beef products and other meat and protein sources vary in fat content. You will use 100 g samples of meat and protein products, boil them, collect fat and measure its volume directly in a graduated cylinder.

PROCEDURE:

1. Using a balance, obtain 100g samples of ground beef or protein products. Place samples in separate 800 ml beakers. Record the name of your product on the data table.
2. Add 600 ml of water to the beakers. Stir thoroughly and bring to a boil.
3. Gently boil the samples for 15 minutes. Be careful not to allow any material to spill or spatter.
4. Remove the beaker from the heat. Allow the meat to settle to the bottom. The fat will form a liquid on the top of the water.
5. Carefully pour off the fat layer into a clean, 100ml graduated cylinder. It may be difficult to remove the last traces of fat. When the meat and water mixture cools, pick out the solidified fat particles with a spoon. Add these to the graduated cylinder.
6. Read the volume of fat in the cylinder. You are assuming that 1.0 ml is roughly equivalent to 1.0 g of fat. Since your original sample of meat was 100 g, the volume is also the percent of fat. Record your findings in the data table.
7. Repeat the procedure using other samples assigned to you.
8. Complete the Data Table.
9. Graph the class results using a bar graph to show the average percent of fat in various types of meat.

DATA TABLE: Fat in Ground Meat and Alternate Protein Sources

Samples	Mass	Volume of Fat	Percent of Fat

CLEAN-UP INSTRUCTIONS: (Record your teacher's instructions)

QUESTIONS:

1. What is the relationship between the price per pound of ground meat and the fat content?
2. How does heat affect the fat in ground meat and other protein products?
3. How does heat affect the protein?
4. What properties of fat make this activity possible?
5. How do the experimental results compare to *The Comparison of Nutritional Information Chart?*

FOR TEACHER USE

ANSWER KEY

FAT CONTENT OF GROUND MEAT AND ALTERNATE PROTEIN SOURCES

Time: 1-2 class periods

Safety: Have students initial the following safety precautions before proceeding with this lab.

- Electrical Safety - Handle electrical equipment with care; plug and unplug with dry hands and with care.
- Personal and Clothing Safety- Wear an apron to protect clothing.
- Eye/Vision Safety- Wear goggles throughout this lab.
- Fire Safety- Use caution when heating the meat; use care with heat source; use tongs when handling hot beakers.
- Hand Safety and Protection - Use hot mitts.
- Glassware Safety - Handle glassware with care; there is always a possibility of glassware breaking when heating.
- Personal Hygiene and Safety - Wash hands after handling meat samples.
- Waste Disposal - Discard wastes as directed by your teacher; clean your work area.
- Equipment Use and Safety - Properly and safely use equipment.

Materials and Equipment Needed		
beakers ringstand heat source tongs	graduated cylinders (100 ml) stirring rods	meat: ground beef, ground chuck, ground round, ground sirloin, ground turkey, ground chicken, soy burgers other: emu, buffalo, fish, vegetable protein, ostrich, hot dog meat, etc.

ANSWERS TO QUESTIONS:

1. Answers will vary

2. Heat liquefies the fat so that it can be separated.

3. Heat "cooks" the protein or heat denatures the protein changing its structural conformation.

4. Density, solubility, immiscibility

ADDITIONAL NOTES

- A little consumer chemistry can be done here. Students should be encouraged to bring in samples of ground meat from various markets in town. Have students record the price per pound, if you wish. This can then be correlated with the percent of fat.

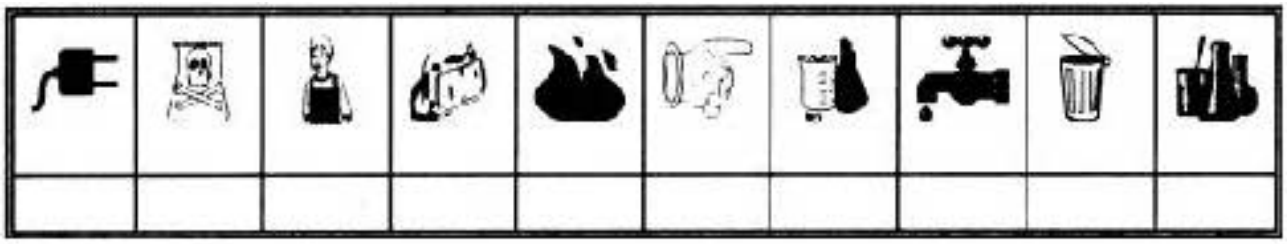
- Remind students that the fat is what they commonly see when leftover chili, beef stew, and so forth, is placed in the refrigerator. The fat separates and comes to the top.

- Sources: *Food Science Experiment and Activity Guide*, North Carolina Department of Public Instruction and *Chemistry of Common Substances*, pp. 127-128

NAME:_____ DATE:_____ CLASS PERIOD:_____

EXPERIMENT: Tofu Burgers

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Everyone knows that protein is an important part of a healthy diet. But simple quantity of protein is not enough. It is the quality of the protein that is important. Quality refers to how well the protein supplies the nine essential amino acids that our body requires for protein synthesis. (Essential amino acids refers to those protein building blocks which our body cannot manufacture and which must be supplied in our diet.)

Animal products such as meat, milk, eggs, and cheese supply complete protein in very much the same proportions that our own bodies require. Most plant products alone are lacking in one or more essential amino acids and must be eaten in combination to meet our nutritional needs (beans and rice, for example.) Soybean protein, however, is a complete protein; its amino acid pattern closely resembles that of milk. Tofu, also known as bean curd, is a soybean product now extensively produced commercially. It is made by curdling the mild white milk of the soybean and forming it into blocks. Besides being an excellent source of protein, it is relatively low in calories, fats, and carbohydrates and contains no cholesterol. It can be used in a wide variety of recipes and is becoming increasingly popular as a meat alternative.

This lab exercise will give you the opportunity to sample and evaluate a "burger" prepared with tofu instead of ground meat.

PROCEDURE:

1. Taste a small piece of tofu. Record observations in the data table.

2. Mix and mash together in a bowl the following ingredients:

454 g (1 pound) tofu	15 ml (1 T) grated onion
60 ml (1/4 C.) wheat germ	2.5 ml (1/2 t.) garlic powder
60 ml (1/4 C.) whole wheat flour	2.5 ml (1/2 t.) poultry seasoning
30 ml (2 T.) nutritional yeast	2.5 ml (1/2 t.) black pepper

(Makes 6, 3-inch burgers)

3. Divide mixture into six portions and form into 3-inch burger patties. Brown on each side in 15 ml (1 T.) oil.

4. Serve hot on a bun with all the fixings. Record observations in the data table.

DATA TABLE: Tofu Burgers

Tofu	Before cooking into a burger	After cooking into a burger
flavor		
smell		
texture		
appearance		

CLEAN-UP INSTRUCTIONS:

QUESTIONS:

1. What was the predominant taste in the cooked burger?

2. What nutritional advantages does tofu have over meat products?

3. Why do you think the general public is reluctant to try tofu? Give several reasons.

4. What was your overall impression of the tofu burger?

FOR TEACHER USE

ANSWER KEY

MAKING TOFU BURGERS

TIME: 1 hour

SAFETY: Have students initial the following safety precautions before proceeding with this lab.

- Personal and Clothing Safety - Wear an apron to protect clothing.
- Fire Safety - Use care with heat source.
- Personal Hygiene and Safety - Use sanitary practices throughout this lab; wash hands before and after the lab.

Materials and Equipment Needed		
454 g (1 pound) tofu	15 ml (1T) grated onion	oil
60 ml (1/4c) wheat germ	2.5 ml (1/2t) garlic powder	*fixings* for tofu burgers
60 ml (1/4c) whole wheat flour	2.5 ml (1/2t) poultry seasoning	buns
30 ml (2T) nutritional yeast	2.5 ml (1/2t) black pepper	large skillet
heat source	measuring spoons	mixing spoon

CAREERS: Food Technician, Nutritionist, Food Chemist

ADDITIONAL DISCUSSION QUESTIONS:

Some people call tofu burgers a "designer food" because soy beans are designed to take the place of hamburger meat. What else could be labeled as a designer food?

Who designs the food and how is this done?

ANSWERS TO QUESTIONS:

1. Tofu alone, has little or no taste. It takes on the taste of seasoning, marinades, or sauces used to prepare it.
2. Low fat, no cholesterol.
3. Name is a turn-off; misconceptions about taste; don't know how to prepare it, etc.
4. Answers will vary.

ADDITIONAL NOTES:

Sources:

- *Food Science Experiment and Activity Guide*, North Carolina Department of Public Instruction

- Experiment developed by Linda Shoulberg, Science Department-Millbrook High School, Wake County Public School System, Raleigh, North Carolina.

- Recipe by Louise Hagler, Tofu Cooking. The Book Publishing Company, Summertown, TN, 1991.

EXTENDING THE ACTIVITY:

Arrange a field trip to a food development laboratory such as Quaker Oats, Beatrice Foods, Gilster-MaryLee, etc. An alternate activity would be to invite a guest speaker from one of these industries into your classroom.

Some question you may wish your students to research include:

- What does a _____ do?

- What educational background is required for this position?

- What is the salary range for someone engaged in this field?

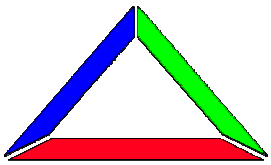
- From where do the ideas for a new food product come?

- Do all of your designer foods get to market? Why/ Why not?

- How does your company insure quality control or that your product is always the same?

- What other careers are necessary to support your work?

Food Additives



Associated Benchmarks

11.A.4c - Data Management
13.B.4a - Inquiry/Pure: Design/Applied

Key Concept

Food Additives

Process Skills

Experimenting

Recognizing Patterns

Activity Connections

Two activities from the reference listed below engage students in investigating the uses and benefits of food additives, including the effects of additives on the physical and chemical characteristics of food products. The activity "What Are You Eating?" could be used as a introduction or research on additives found on the list (pp. 3.3-3.6).

Activity: Food Additives and Desirable Food Additives (p. 3.7)

> For this activity, students locate information on the functions and problems of food additives, and also do experimentation to investigate the effects of certain additives on foods.
> Time length 1 - 2 days

Activity: Determining Food Additives in Prepared Foods (p. 3.10)

> Students utilize food labels to identify food additives used in various foods.
> Time length: 1-2 days

Career Connection (13.B.4b)

Through this activity, students will become familiar with an area of food technology dealt with by individuals in careers such as food chemist and dietitian.

Teacher Instructions

Use "What Are You Eating?" (p. 3.3) as an introduction to the unit. Use the internet to research the function, food sources, and problems associated with various additives. Experiments show students the uses of food additives and the food additives found on food labels.

Student Interaction

Procedures for the activities and student discussion questions are included in the attached materials.

Instructional Media Connections

Food and Drug Administration: http://vm.cfsan.fda.gov/~dms/eafus.html
This is an informational database maintained by the U.S. Food and Drug Administration (FDA) Center for Food Safety and Applied Nutrition (CFSAN) under an ongoing program known as the Priority-based Assessment of Food Additives (PAFA). It contains administrative, chemical and toxicological information on over 2000 substances directly added to food, including substances regulated by the U.S. Food and Drug Administration (FDA) as direct, "secondary" direct, and color additives, and Generally Recognized As Safe (GRAS) and prior-sanctioned substances.

Arbor Nutrition Guide: http://www.arborcom.com
This web site includes nutrition and food science topics.

NDSU Extension Service, University of North Dakota http://www.ag.ndsu.nodak.edu/foodlink.htm
A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

References

Food Science Experiment and Activity Guide, Issued by Home Economics Education, Vocational and Technical Education, North Carolina Department of Public Instruction, Raleigh, North Carolina 27601-2825, August 1994.

WHAT ARE YOU EATING?

Name the food from each ingredient list below.

_____ 1. Sugar, Sweet Dairy Whey, Corn Syrup Solids, Cocoa Processed With Alkali, Partially Hydrogenated Vegetable Oil (May contain one or more of the following oils: Corn, Canola or Sunflower), Nonfat Dry Milk, Cellulose Gum, Salt, Sodium Caseinate (A Milk Derivative), Artificial Vanilla Flavor.

_____ 2. Sugar, Corn Syrup, Chocolate (Chocolate Liquor Processed With Alkali, Sugar, Cocoa Butter, Chocolate Liquor, Cocoa, Clarified Butteroil and Soy Lecithin Added As An Emulsifier), Soya Protein, Salt, Peppermint Oil, Invertase.

_____ 3. Dried Potatoes, Vegetable Oil (Contains One Or More Of The Following: Corn Oil, Cottonseed Oil, and /or Sunflower oil), Maltodextrin, Wheat Starch and Yellow corn Meal. Contains 2 Percent or Less Of : Sugar, Dextrose, Torula Yeast, Salt, Tomato Powder, Malted Barley Flour, Paprika (Color), Monosodium Glutamate, Onion Powder, Garlic Powder, Spices, Paprika Oleoresin (Color), Red Pepper, Citric Acid, and Natural Flavor.

_____ 4. Enriched Bleached Flour (Wheat Flour, Niacin, Reduced Iron, Thiamin Mononitrate, Riboflavin, Folic Acid), Corn Syrup, Sugar, Vegetable Shortening (Partially Hydrogenated Soybean and Cottonseed Oils), Dextrose, Water, Cocoa, Walnuts, High Fructose Corn Syrup, Whey, Eggs, Soy Lecithin, Egg Whites, Salt, Leavening (Baking Soda and Sodium Aluminum Phosphate), Caramel Color, Corn Starch, Artificial Flavors, Red 40, Sorbic Acid (To Retain Freshness).

_____ 5. Sugar, Enriched Flour (Wheat Flour, Niacin, Reduced Iron, Thiamin, Mono-Nitrate, Riboflavin), Water, Egg Whites, Whole Eggs, Corn Syrup, Vegetable Shortening (Partially Hydrogenated Soybean Oil and/or Cottonseed Oil, Mono- and Diglycerides, Skim Milk, Macaroon Coconut (Processed with Sodium Bisulfite) Leavening (Soda, Sodium Acid Pyrophosphate, Monocalcium Phosphate), Whey, Modified Food Starch, Salt, Gelatin, Soy Flour, Cocoa (Processed With Alkali), Natural and Artificial Flavor, Sodium Propionate and Sorbic Acid (Preservatives), Calcium Carbonate, Calcium Sulfate, Agar, Locus Bean Gum, Sodium Phosphate, Red #3 and Red #40.

_____ 6. Non-fat Milk, Water, Sugar, Modified Food Starch, Maltodextrin, Salt, Carrageenan, Sodium Stearoyl Lactylate, Artificial and Natural Flavors, Color Added (Including Yellow 5 and 6)

_____ 7. One set of ingredients - Salt, Monosodium Glutamate, Hydrolyzed Corn and Soy Protein, Dehydrated Vegetables (onions, Garlic), Sugar, Chicken Flavor (Hydrogenated Soybean Oil, Chicken Fat, Chicken Broth Solid), Spices, Chinese Cabbage Extract, Powdered Cooked Chicken, Natural Butter Flavor, Turmeric, Disodium Inosinate, Disodium Guanylate. Second set of ingredients - Enriched Wheat Flour (Wheat Flour, Niacin Reduced iron, Thiamin Mononitrate, Riboflavin), Partially Hydrogenated Vegetable Oil (Contains one or more of the following: Canola, Cottonseed, Palm), Salt, Soy Sauce (Water, Wheat, Soybeans, Salt), Potassium Carbonate, Sodium Phosphates, Sodium Carbonate, Turmeric.

_____ 8. Milk Chocolate (Sugar, Cocoa Butter, Skim Milk, Chocolate, Milkfat, Lactose, Soy Lecithin, Artificial Flavor), Corn Syrup, Sugar, Partially Hydrogenated Soybean Oil, Milk, Less Than 2 % - Cocoa Powder, Malted Barley, Lactose, Wheat Flour, Salt, Egg Whites, Soy Protein, Artificial Flavor.

ANSWERS TO "WHAT ARE YOU EATING?"

1. CARNATION HOT COCOA MIX
2. THIN MINT CANDY
3. BBQ PRINGLES
4. MISS DEBBIE FUDGE BROWNIE
5. CREME FILLED SNO-BALLS
6. HUNT'S FAT FREE VANILLA SNACK PACK
7. CHICKEN FLAVORED RAMEN NOODLES
8. MILKY WAY

NAME:_____ DATE:_____ CLASS PERIOD:_____

Activity: Food Additives

Directions: Most packaged foods contain additives to enhance the taste, appearance, or shelf life of the product. For the following food additives, identify its function in food products, foods it is found in, and any problems associated with its use.

Additive	**Function**	**Food Sources**	**Problems (if any)**
aspartame			
BHA			
BHT			
sodium chloride			
tartaric acid			
sodium benzoate			
saccharin			
fructose			

Additive	**Function**	**Food Sources**	**Problems (if any)**
disodium phosphate			
guar gum			
calcium carbonate			
lecithin			
ascorbic acid			
MSG			
sulfite			
nitrite			
(other)			

Suggested resource: ***Nutrition: Concepts and Controversies*** **5th Ed.**

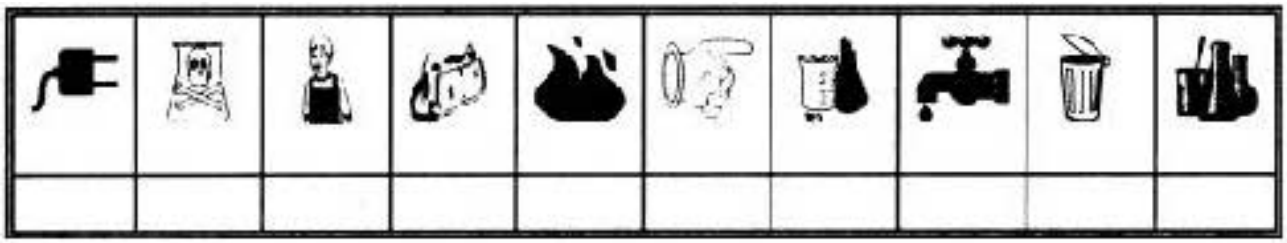
Adapted from: ***Food Science Experiment and Activity Guide*** **- Food Science #7075**
North Carolina Department of Public Instruction

NAME _____ DATE _____ CLASS PERIOD_____

Desirable Food Additives

EXPERIMENT 18-01

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Food additives are intentionally added to foods for specific functions such as anti-microbial agents, antioxidants, artificial colors, artificial flavors, flavor enhancers, nutrient additives, and radiation. The quality of food is preserved by both natural and synthetic preservatives. Often these substances are as common as salt, lemon juice, and Vitamin C. Natural decomposition of the foods due to oxidation is prevented by the use of these food preservatives. With oxidation inhibited, the foods are able to maintain their natural color, texture, and taste much longer. The use of food additives will be explored in this experiment.

PROCEDURE:

1. Label 7 small plastic plates or pieces of aluminum foil with the following:

    a. Control
    b. Untreated/Wrapped
    c. Vitamin C (400 mg/100 ml)
    d. Sugar (3 tsp/100 ml)
    e. Salt (3 tsp/100 ml)
    f. Lemon juice (full strength)
    g. Citric Acid (1/4 tsp/100ml)
    h. Clear carbonated soda

2. Prepare your preservatives. Use 100 ml of distilled water in preparing your Vitamin C, salt, sugar, and citric acid solution.
3. Select one piece of whole fruit or vegetable. Use care not to bruise it. Record its name in the data table.
4. Cut your selected piece of fruit or vegetable into 7 equal parts; place each piece on the labeled plates or foil**. Do not peel your fruit or vegetable.** Immediately treat your fruit/vegetable pieces with the preservatives.
5. Record, in the data table, your observations after 10 minutes, 30 minutes, and 24 hours. Refrigerate food items during the 24-hour period.

DATA TABLE: Condition of Produce: Treated and Untreated

Food:_____ **(name)** **Treatment**	**Appearance of food after 10 minutes**	**Would you eat it?**	**Appearance of food after 30 minutes**	**Would you eat it?**	**Appearance of food after 24 hours**	**Would you eat it?**
Control						
Untreated/Wrapped						
Vitamin C (400mg/100 ml)						
Sugar (3 tsp/100 ml)						
Salt (3 tsp/100 ml)						
Lemon Juice (full strength)						
Citric Acid (1/4 tsp/100 ml)						

CLEAN-UP INSTRUCTIONS:

QUESTIONS:

1. Based on the data from your experiment, which common preservative was most effective in preventing oxidation?
2. What effect does refrigeration have on the browning of fruits and vegetables?

FOR TEACHER USE
ANSWER KEY

Desirable Food Additives

TIME: 1 hour, plus 5 minutes observation time on the second day.

SAFETY: Have students initial the following safety precautions before proceeding with this lab.

- Chemical Safety - Do not taste any of the substances used in this procedure.
- Hand Safety and Protection - Use the knife with care.

Materials and Equipment Needed		
fruits/vegetables: apples, bananas, pears, avocados	lemon juice, reconstituted citric acid beakers, 250 ml	graduated cylinder, 100 ml plastic wrap plastic plates or foil
sugar	distilled water	labels or masking tape
salt	knife and cutting board	pens/pencils
ascorbic acid - powdered or vitamin C tablet	measuring spoons plastic spoons/stirring rods	refrigerator

How can this lab be applied within the home? Within the workplace?

ANSWERS:

1. Extended browning should have occurred in the untreated samples. Samples treated with preservatives should have stayed "fresh" throughout the lab period. After the 24-hour period, most samples may have appeared spoiled, depending on the preservative used.

2. The browning process is influenced by temperature changes; refrigeration slows down the browning, freezing temperatures inhibit enzyme action, and heat such as blanching inactivates food enzymes and discourages browning.

Teacher Note: Adapted from "*Why Are Food Additives Desirable in Our Food?"* by CORD - Nutrition.

NAME_____ DATE _____ CLASS PERIOD_____

Determining Food Additives in Prepared Foods

EXPERIMENT 18-02

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.

INTRODUCTION:

Food additives are substances that are added directly to food. Intentional food additives are added on purpose to give foods desirable characteristics such as color, flavor, texture, stability and resistance to spoilage. Nutrients are often added to increase the nutritional quality of food. Intentional food additives include anti-microbial agents, antioxidants, artificial colors, artificial flavors, flavor enhancers, and nutrient additives. The use of intentional additives is regulated by the government (FDA). Additives must be safe, effective, and measurable in the final product. Incidental food additives get into food unintentionally during production, processing, storage, or packaging. These additives are also well regulated and usually do not present health hazards.

PROCEDURE:

1. Examine the labels of various prepared foods.

2. Determine the food additives present in each item.

3. Record your findings in part A of the data table.

4. Categorize food additives by their function. Record this information in part B of the data table.

DATA TABLE: Food Additives in Prepared Foods

A. Food Labels	Food Additive(s)

B. Categories of Intentional Food Additives by Function	
anti-microbial agents	
antioxidants	
artificial colors	
artificial flavors or flavor enhancer	
nutrient additives	

CLEAN-UP INSTRUCTIONS:

QUESTIONS:

1. Determine if there are any "controversial" food additives listed on your food sample labels. Why are they "controversial"?

2. Differentiate between incidental food additives and contaminants.

FOR TEACHER USE
ANSWER KEY

Determining Food Additives in Prepared Foods

TIME: 1 hour or Research Assignment for out-of-classroom experience.

SAFETY: Have students initial the following safety precautions before proceeding with this lab.

WASTE DISPOSAL: Discard sold wastes in the trash and liquid down the sink. Clean up your work area.

Materials and Equipment Needed		
food labels resource on food additives		

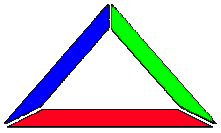
How can this lab be applied within the home? Within the workplace?

ANSWERS

1. Answers will vary.
2. Incidental additives are substances that are not intentionally put into foods and are generally harmless. Contaminants, also not intentionally put into foods, are hazardous to your health.

Teacher Note: An excellent resource is the Food and Drug Administration: **http://fda.gov**

Food Irradiation



Associated Benchmarks

11.A.4a - Hypothesis
11.A.4b - Test Hypothesis
11.A.4f - Report/Defend Conclusions
11.A.5a - Hypothesize
11.B.4d - Determine Criteria
12.C.4a - Energy Transformation
13.A.4a - Risk Assessment

Key Concept

Food Irradiation

Process Skills

Inductive and Deductive Reasoning

Evaluating Consequences

Activity Connections

Two activities introduce students to the process of food irradiation as a means of food preservation, the mechanisms through which this occurs, and the safety issues and consumer concerns related to irradiation.

See attached activity sheets for a description of the activities (Food Irradiation and Simulation of Irradiation, pp. 4.3-4.9). In addition to these activities, students will initially conduct library/Internet research to learn about the process.

Time length - Food Irradiation: 1 day initial lab, additional observation time varies with product.

Simulation of Irradiation: Total of 2 days, 1 day lab work and 1 day to record the growth. Extra teacher preparation will be needed to prepare nutrient agar in petri dishes.

Career Connection (13.B.4b)

Students could research careers involved in the process of food irradiation such as food engineers, food chemists, and food technologists.

Teacher Instructions

See the attached activity guides.

Extensions to these activities could include research on the process of irradiation and its effects on foods and microbes, the safety aspects of irradiation, and consumer concerns related to irradiation. The latter could include a survey of consumer awareness, knowledge, and concerns.

Student Interaction

See the attached activity guides for procedures and questions for students.

Instructional Media Connections

The National Food Safety Database http://www.foodsafety.gov Large set of articles on food irradiation; accurate; reading level OK for high school; also information on obtaining resources such as slide sets

NDSU Extension Service, University of North Dakota http://www.ag.ndsu.nodak.edu/food.htm A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

References

Food Science Experiments and Activity Guide, Issued by Home Economics Education, Vocational and Technical Education, North Carolina Department of Public Instruction, Raleigh, North Carolina 27601-2825, August 1994.

Food Science, Safety and Nutrition, National FFA Foundation, P.O. Box 45205, Madison, Wisconsin 53744, 1993.

Mehas, Kay and Rodgers, Sharon, ***Food Science and You***, Glencoe Division, Macmillan/McGraw-Hill, 3008 West Willow Knolls Drive, Peoria, Illinois 61614-1083, 1994.

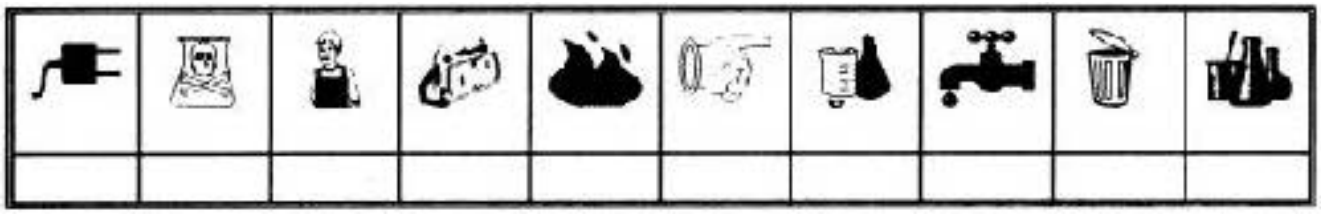
IRRADIATION LOGO

NAME _____DATE _____CLASS PERIOD_____

Food Irradiation

EXPERIMENT 31-01

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Foods are irradiated to destroy insects, food-spoiling and disease-causing bacteria and to lengthen the storage time for foods in warehouses and homes. Hospitals may use irradiation to sterilize foods for immuno-compromised patients. Consider these questions of concern to people when using irradiated food. Does irradiation make food radioactive? Does eating irradiated food present long-term health risks? Will risks of radiation exposure increase significantly if I live next to an irradiator?

Irradiated foods such as strawberries, onions, and poultry are available to consumers. Although irradiated foods cannot be recognized by sight, smell, taste or feel, they will be labeled with an irradiation logo plus the words **"Treated with Radiation,"** or **"Treated by Irradiation."** In this lab we will explore whether or not irradiation makes a difference in appearance or taste.

PROCEDURE:

1. Obtain food samples; label either as **irradiated** or **not irradiated**.
2. Examine the appearance of each sample. Record differences in appearance.
3. Taste each sample. Record differences in taste.
4. Store food samples according to package directions or as typically recommended, depending on the food sample.
5. Observe and record changes in the stored foods on a regular basis, depending on the food samples. Length of observation times will vary with types of food samples. **Strawberries will deteriorate rapidly; onions or potatoes may take weeks for deterioration to begin.**

DATA TABLE: Comparison of Irradiated and Non-irradiated Food

Food Samples	Observations			
	Appearance	Taste	Stored Observations	Irradiation Yes or No
Strawberries			1st 2nd 3rd	
Apple			1st 2nd 3rd	
Potato			1st 2nd 3rd	
Onion			1st 2nd 3rd	
_____ *(other)*			1st 2nd 3rd	

CLEAN-UP INSTRUCTIONS:

QUESTIONS:

1. Does irradiation alter the appearance and/or taste of the food you tested?

2. Make personal recommendations for or against irradiation based on outside reading. Justify your response.

FOR TEACHER USE

ANSWER KEY

Food Irradiation

TIME: 1 hour plus observation time

SAFETY: Have students initial the following safety precautions before proceeding with this lab.

- Personal and Clothing Safety - Wear an apron to protect clothing.
- Hand Safety and Protection - Handle knife with care when cutting food samples.
- Personal Hygiene and Safety - Wash hands and food samples before tasting.
- Waste Disposal - Dispose of samples as directed by your teacher.

Materials and Equipment Needed

fruits and vegetables: (irradiated and not irradiated) onions, strawberries, potatoes, apples, garlic, mango, papaya, others - *You will find some irradiated foods in large cities in the produce department. Look for the irradiation logo on the label. This experiment can not be used if irradiated food is not available.*	paring knife for cutting food samples napkins	refrigeration

How can this lab be applied within the home? Within the workplace?

ANSWERS:

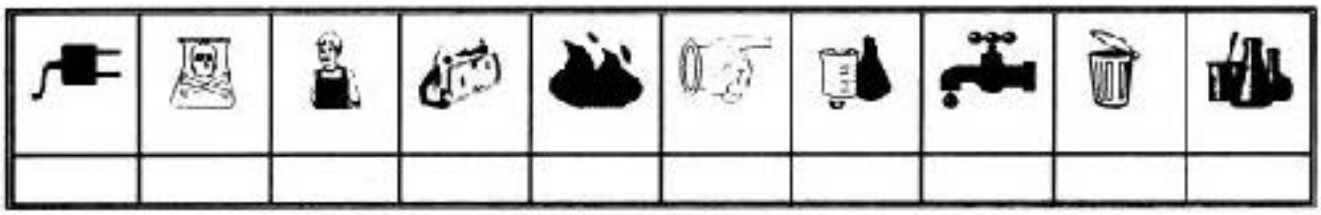
1. Appearance and taste are not altered.
2. Answers will vary.

NAME _____ DATE_____ CLASS PERIOD_____

Simulation of Irradiation

EXPERIMENT 31-02

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

One of the newest methods of food preservation, **irradiation**, uses a radioactive source to produce beta particles and gamma rays. When food is exposed to this radiation, bacteria, which cause food to spoil and produce disease, can be destroyed. The radiation will also destroy insects and larvae that can contaminate foods. Irradiation is a somewhat controversial method of food preservation. Some people fear the effects of the radiation on foods; others are opposed to the increased number of sites which use radiation.

Since radioactive materials are not safe to handle, we will simulate the effects of irradiation by using ultraviolet light instead of the beta and gamma radiation. Both gamma rays and UV light are types of electromagnetic radiation. In this lab, you will try to determine the effects of this radiation on bacteria growth.

PROCEDURE:

1. Obtain five petri dishes which contain nutrient agar.
2. Label dishes as A, B, C, D, or E.
3. Using a cotton swab, streak each plate in two directions with either *Serratia marcescens* or *Bacillus subtilis*. **(CAUTION - Be careful to lift lid only slightly and replace quickly to avoid airborne contaminants.)** Replace the lid.
4. Incubate dish A in the dark at 22° Centigrade. Incubate dish B with the lights on at 22° Centigrade.
5. For the remaining dishes, place each plate directly under ultraviolet light - **about 5 cm away from the light** - with the cover off and agar side up. **(WARNING: Do not look directly at UV light!)**

    - Plate C should be exposed for 10 seconds and put in an incubator at 22° Centigrade in the dark.
    - Plate D is to be exposed for 10 seconds and incubated at 22° Centigrade in the light.
    - Plate E should be exposed for 40 seconds and placed in a dark incubator at 22° Centigrade.

6. Examine the dishes the following day. Record your results. **(CAUTION. On both days, make sure your work area has been washed down with ethyl alcohol. Plates should be returned to your teacher for proper disposal at the end of this experiment.)**

DATA TABLE: Simulation of Irradiation

Plate	Description of Growth
A	
B	
C	
D	
E	

CLEAN-UP INSTRUCTIONS:

QUESTIONS:

1. What was the main difference between the control plates (A, B) and the experimental plates (C, D, and E)?

2. Which set of conditions produced the greatest amount of bacteria? The least amount? Why?

3. Based on your observations, do you think that using radiation is an effective method for protecting food from bacteria growth? Justify your response.

FOR TEACHER USE

ANSWER KEY

Simulation of Irradiation

TIME: 2 days

SAFETY: Have students initial the following safety precautions before proceeding with this lab.

- Electrical Safety - Use caution handling electrical equipment.
- Chemical Safety - Bacteria in this experiment require safe handling.
- Personal and Clothing Safety - Wear an apron to protect clothing
- Eye/Vision Safety - **DO NOT** look directly at the ultraviolet light.
- Hand Safety and Protection - Wear rubber gloves when working with the bacteria.
- Personal Hygiene and Safety - Wash hands after handling bacteria.
- Waste Disposal - Return bacteria samples and petri dishes to your teacher for proper disposal.
- Equipment Use and Safety - Properly and safely use equipment.

Materials and Equipment Needed

5 petri dishes containing nutrient agar sterile cotton swabs	cultures: *Serratia marcescens* or *Bacillus subtilis*	ultraviolet light incubator autoclave

How can this lab be applied within the home? Within the workplace?

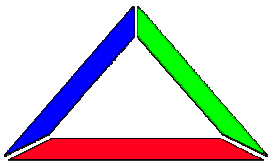
ANSWERS:

1. A and B should show heavy growth. C, D, and E should show light or zero growth.
2. E should be the lightest amount of growth and B the greatest. E was exposed to UV light the longest and incubated in the dark. No UV and incubation in the light produced optimal conditions for the bacteria.
3. Individual responses, but should be correlated to student's actual data.

Teacher Notes:

- Adapted by Robin Hipsher, chemistry teacher at Ben Smith High School, Greensboro, North Carolina.
- Pre-prepared petri dishes or petri film plates can be obtained from a biological supply company.

Food Packaging



Associated Benchmarks

11.A.4a - Hypothesis
11.A.4c - Data Management
11.A.5a - Hypothesize
11.A.5c - Conduct Test
12.C.5b - Property Analysis

Key Concept

Food Packaging

Process Skills

Accumulating and Interpreting Data

Activity Connections

Methods of packaging foods continually change as technological advancements are made and as needs and wants are expressed by consumers. For this activity, students will develop an experiment to test a minimum of one aspect of packaging material.

See the attached activity guide for more details:

Experiment Design: Food Packaging Technology (p. 5.3)

Time length: 3 days - 1 day planning, 1 day experiment and 1 day writing and typing experiment.

Career Connection (13.B.4b)

In this activity, students engage in activity which would be similar to a task performed by a food technologist or engineer.

Teacher Instructions

This activity is most appropriate for students who have experience in developing their own experiments. It is not necessary for students to have taken physics, but if they have, then the activity should be done at a higher level of sophistication.

See the attached activity guide for additional information. Materials needed will vary depending upon the student design for the experiment.

Student Interaction

See attached activity guide for student instructions.

Instructional Media Connections

In Good Taste: Careers in Food Science. This is a 14:22 minute IFT career video on food science and technology. Available from the Institute of Food Technologist, 221 North LaSalle Street, Chicago, IL 60601, (312) 782-8424. This comes with a packet of material entitled "Don't Be Puzzled about Your Future".

Also available from IFT:
The World's Largest Industry - 16-page brochure
Food Science Experiments - 36-page booklet
Food Scientist - 4-page career brief

NDSU Extension Service, University of North Dakota http://www.ag.ndsu.nodak.edu/food.htm
A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

References

Food Science Experiment and Activity Guide, Issued by Home Economics Education, Vocational and Technical Education, North Carolina Department of Public Instruction, Raleigh, North Carolina 27601-2825, August 1994.

NAME _____ DATE _____CLASS PERIOD _____

Experiment Design: Food Packaging Technology EXPERIMENT 36-02

INTRODUCTION:

Methods of packaging foods continually change as technological advancements are made and as needs and wants are expressed by consumers. Consider **aseptic packaging**. Juice boxes are an example. To slow down bacterial growth, the atmosphere is modified within the package with the addition of a mixture of CO_2, O_2 and N_2. This example illustrates how consumer demands impact technological advancements and developments in packaging. Packaging materials are subjected to extensive testing before they are released to the American public. These materials have to meet standards that will hold up to the typical "use and abuse" within the processing plants as well as American homes. Listed below are examples of tests used on various types of packaging materials.

PACKAGING MATERIAL TESTS

Bursting Strength - to see how much pressure will cause the package to burst.

Compression Strength - to determine how many items can be stacked before damage occurs.

Impact Strength - to determine what happens to a package when it is dropped.

Penetration of Fats - to determine if fats will move across barriers.

Seal Integrity Tests - to determine if packaging materials will hold printed inks and will not bleed, fade or rub off.

Stiffness Test - to determine how much force is needed to push an object that will not yield.

Tear Force - to determine force necessary to pull a package apart.

Tensile Strength - to determine force required to pull materials apart.

Transmission of Water - to determine if the material will allow the migration of water as well as gas across barriers.

Vacuum Testing -to determine if seals will hold or if they are defective.

Adapted information from - *Food Science, Safety & Nutrition,* Draft; Unit 3. p. 107. (Original source: Mason, A.C.(1992*). Producer through Consumer: Partners to a Safe Food Supply*. Purdue University Cooperative Extension Service, West Lafayette, IN.)

STUDENT DIRECTIONS:

Use the scientific method to develop your experiment to test a minimum of one aspect of packaging material. Perform the experiment after the written experiment has been approved by your teacher. Submit your findings to the class. Use the following format for your experiment.

A. State the Problem *Describe the problem you want to solve; the statement may be written as a question.*
B. Gather Information *Examine known information; use it to help form hypothesis.*
C. Form a Hypothesis *Prediction of what you think will happen.*
D. Collect Data through Experimentation

- *Test one variable at a time.*
- *Compare variable to the control.*
- *Record observations carefully.*
- *Calculate data accurately.*

E. Analyze Data *Examine results of experiment; do they agree with your hypothesis?*
F. Form a Conclusion *Summarize your results and explain them.*

Items listed below include the minimum requirements and the scoring scale for your experiment design project.

1. Written Report of Experiment (1 - 60 Points) _____

- Problem stated
- Hypothesis formed
- Components organized using scientific method
- Data, calculations, and conclusions
- Well-organized; proper use of language conventions and composing characteristics

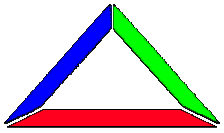
2. Lab Performance (1 - 40 Points) _____

- Execution of experiment
- Condition of lab station and equipment
- Breakage (if any)
- Conduct

_____

Total (100 points possible)

Food Biotechnology



Associated Benchmarks

11.B.4a - Identify Problem
12.C.5b - Property Analysis
13.B.4e - Scientific Claims in Advertising/Marketing

Key Concept

Food Biotechnology

Process Skills

Communicating

Activity Connections

This activity involves the investigation and simulation of food product development. Students start by selecting a currently available processed food. For this product, the students determine the (a) raw materials needed; (b) the processing steps utilized and their impact on the physical and chemical characteristics of the food; (c) the additives used in the food and their purposes; and (d) problematic or controversial aspects of this food product development process (issues). Students then investigate current food products; develop an idea for a new food product; and indicate the processes, additives, and issues involved in producing this product. Through this activity, students will learn about and apply science principles within a familiar, everyday context.

This activity could stand alone or could be used as the introductory activity for a unit on food product development. Additional topics for investigation/experimentation include food packaging, food labeling and food composition analysis, food marketing, actual food product production, and sensory evaluation.

Activities useful in this lesson are Food Preservation Techniques, Evaluating a Food and Making It Better, and Genetic Engineering (William Harless, 1995, *Continuity of Life*, CORD Communications, 166-187).

Evaluating a Food and Making It Better is an activity to look at food products on the market and look at biotechnology, processing, and packaging improvements that could be used. "How Does Genetic Engineering Work" could be used as a reading assignment.

Example of extension is the activity Analysis of Marketing a Food Product.

Time length: 2 days to 2 weeks. This depends on the scope of the project and how the final copy will be presented.

Career Connection (13.B.4b)

Knowledge of the food product development process will familiarize students with the tasks of food scientists working in the public sector.

Examples of careers are quality control specialist, food production specialist and chemist.

Teacher Instructions

This activity assumes that students have some familiarity with the chemistry of foods and food components, as well as library/Internet research skills. The Internet sites listed below are good starting points if using the Internet as an information source. Internet can be used to research food preservation techniques. "Evaluating a Food and Making it Better" could be a group activity to incorporate biotechnology and problematic aspects with food development.

Student Interaction

The following general instructions can be used to guide the students in writing a research paper or can be used to develop information sheets for students to fill in.

Assessing a Currently Available Product

1. What is the name and general description of the product you have selected?
2. What are the raw ingredients needed to make this product?
3. What are the steps involved in manufacturing this food product? For each step, what are the potential effects on the chemical and physical characteristics of the product?
4. What ingredients in this food would be considered additives? Describe the physical/chemical properties of each additive and its purpose in this product.
5. Identify aspects of the development of this food product which might be considered problematic or controversial (i.e., identify issues). For example, consider nutrient content, safety of food additives, energy use, etc. List the pros and cons related to this issue.

Development of a New Food Product

1. What is the name and general description of your proposed new food product?
2. What are the raw ingredients needed to make your product?
3. What are the steps required to manufacture this product?
4. What additives (or kinds of additives) might be used in the product and why?

Website Connections

Internet Address: International Food Information Council http://ific.org/food/
Website Description: Source of information on food safety, food technology, and nutrition. Information is generally appropriate for high school students.

Internet Address: U.S.D.A. Food and Nutrition Information Center
http://www.nalusda.gov/fnic/
Website Description: Includes both consumer and professional information on foods and nutrition

Internet Address: Institute of Food Technologists http://www.ift.org/
Website Description: Scientific papers and press releases related to food technology topics

Internet Address: Food and Drug Administration http://www.fda.gov
Website Description: The Food and Drug Administration regulates food additives and food labeling. The site includes information related to these topics as well as other food and nutrition topics.

Internet Address: U.S.D.A. Department of Agriculture Food Composition Data http://www.nal.usda.gov/fnic/foodcomp
Website Description: Includes the U.S.D.A. food composition data base; can be used to find the nutrient content of specific food items.

Internet Address: Nutrition Analysis Program http://www.ag.uiuc.edu/~food-lab/nat/
Website Description: Site has a diet analysis program which can be used to analyze the nutrient composition of diets or recipes.

Internet Address: U.S.D.A. Food Safety and Inspection Service http://www.usda.gov/agency/fsis/homepage.htm
Website Description: Information of the activities of the agency, as well as news and information for both consumers and professionals related to food safety.

Internet Address: Food Marketing Institute http://www.fmi.org/
Website Description: Limited information on food marketing, links to other sites

Internet Address: NDSU Extension Service, University of North Dakota http://www.ag.ndsu.nodak.edu/food.htm
Website Description: A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

References

Food Science Experiment and Activity Guide, issued by Home Economics Education, Vocational and Technical Education, North Carolina Department of Public Instruction, Raleigh, North Carolina 27601-2825, August 1994.

Food Science, Safety & Nutrition, National FFA Foundation, P.O. Box 45205, Madison, Wisconsin 53744, 1993.

Mehas, Kay and Rodgers, Sharon. ***Food Science and You***, Glencoe Division, Macmillan/McGraw-Hill, 3008 West Willow Knolls Drive, Peoria, Illinois 61614-1083, 1994.

NAME:_____ DATE:_____ POSSIBLE POINTS:_____

FOOD PRESERVATION TECHNIQUES

1. Aseptic canning

2. Controlled-atmosphere packaging (CAP)

3. Curing

4. Drying

5. Fermentation

6. Freeze drying

7. Freezing

8. Hermetically sealed container

9. Irradiation

10. Modified atmosphere packaging

11. Pouch canning

12. Retort canning

13. Smoking

14. Ultra High Temperature (UHT)

NAME:_____ DATE:_____ POSSIBLE POINTS:_____

EVALUATING A FOOD AND MAKING IT BETTER

Evaluating a Food

Name of food product on the market:

General description:

Raw materials needed:

Processing used:

Physical properties of the product:

Chemical properties of the product:

Additives used:

Name	Function

Problematic or controversial aspects of the product (examples - nutrient content, safety of food additives, energy use, production process, others):

Web sites used:

Making It Better

New name for the food product:

General description of proposed new product:

Raw ingredients needed:

Physical properties of the new product:

Chemical properties of the new product:

Processing techniques of the new product:

Additional food additives used in the production of the new product:

Name	**Function**

Biotechnology included in the new food product:

Problematic or controversial aspects in production of new product:

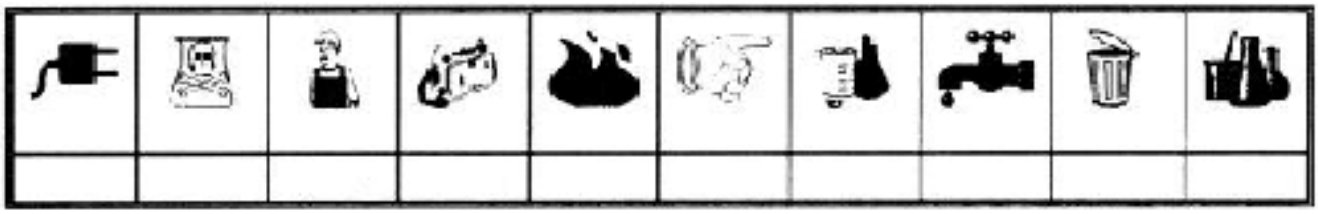
Web sites used:

NAME:_____**DATE:**_____**CLASS** **PERIOD:**_____

Analysis of Marketing a Food Product

EXPERIMENT 19-03

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Consumers rely on the food industry to produce food products that are safe, economical, and good tasting. Individual companies compete with each other to provide the foods that will meet consumer demands. Within a company, employees must work cooperatively to accomplish these goals. Working on teams encourages members to share ideas and problem-solving techniques so that every member of the team will benefit from the skills and talents of other team members. Every member of the team is responsible for the end product.

In this activity, you will work in teams. Each team will represent a different food product company trying to produce a new snack food. Your job is to produce, package, and price a food that consumers will want to buy. Field-test your new product within the school environment.

PROCEDURE:

1. Divide into teams/groups
2. Each member of the team will assume one of the following roles:

    - **Marketing Manager** will determine the taste preferences of consumers and propose ideas for the type of snack food the company should produce. He/she will also identify the projected market.
    - **Manufacturing Manager** will determine what materials and equipment are necessary for preparation of the new product. He/she will report any problems in the manufacturing process or suggest changes to make an improved product. He/she will also obtain any necessary materials.
    - **Packaging Manager** will determine the type of packaging material required and the method of packaging and distributing the product.
    - **Safety Manager** insures that the ingredients and process will produce a safe product. He/she also compares the product's composition to FDA guidelines.
    - **Finance Manager** will determine the costs involved in purchasing materials, labor, and equipment. He/she will also determine the sales price of the product and the projected profit to the company.
    - **Other** (Define role and title of position as needed by your company.)

3. Use the *Food Product Company Report Form* as a sample format to provide information for this project. You may choose to develop your own form(s); however, include the same type of information requested on the form provided.
4. Develop a field-test form for your product. Consider including the following information as it applies to your product.

FOOD PRODUCT EVALUATION
Field-Test

Packaging

- Appeal
- Convenience
- Recycling Capability
- Cost
- Feasibility
- Nutrition

Product Taste and Appearance

- Audience Appeal
- Taste
- Others
-
-
-

Food Product Company Report Form

_____

(Name of Food Product Company)

_____	_____
(Marketing Manager)	*(Safety Manager)*
_____	_____
(Manufacturing Manager)	*(Finance Manager)*
_____	_____
(Packaging Manager)	*(Other)*

Product Name and Description:

Projected Market:

Manufacturing Procedure:

Safety Considerations:

Packaging Methods

Distribution Methods:

Financial Analysis:

- Cost of Materials -
- Cost of Production -
- Sale Price -
- Net Profit -

Product Evaluation: (Results from product sampling survey)

FOR TEACHER USE
ANSWER KEY

ANALYSIS OF MARKETING A FOOD PRODUCT

TIME: 2-3 days (project to be completed by teams out of class)

SAFETY: Have students initial the safety precautions before proceeding with this lab.
Will vary with student projects.

Materials and Equipment Needed: To be determined by students.
How can this lab be applied within the home? Within the workplace?

ANSWERS
Students will develop these.

Teacher Note:
This activity requires independent thought and planning by the students. Expect students to "flounder about" in the early stages with questions such as, "What are we supposed to do?" Students could research suggested websites to get ideas for a project. The “Science in Your Shopping Cart” booklet could be used for additional ideas.

WHAT IS GENETIC ENGINEERING?

As you have learned in previous units, DNA is the central molecule of the cell, encoding information that is used to make proteins essential to the cell. All of life on this planet is controlled by DNA (or in the case of some viruses, by RNA).

In recent years, scientists have learned new techniques to get at the DNA and, therefore, the genes of organisms. They have learned how to isolate individual genes from a DNA molecule and to transfer them from one kind of organism to another. The ability to change the genetic instructions of an organism has opened the door to many new discoveries, many of which are expected to benefit humans. For example, some rare and expensive disease-fighting hormones can be manufactured in the laboratory using organisms. Some plants and animals that are used for food can be genetically altered to make them easier to grow or more nutritious. Microorganisms that engulf and break down toxic waste materials can be developed. We likely will learn many other possibilities as we learn more about DNA and how the cell functions. The set of techniques used to manipulate DNA is known as genetic engineering.

THE STORY OF B. t. COTTON

In the late '70s, scientists discovered that a bacterium, *agrobacterium tumefaciens*, was capable of inserting its own plasmids (a plasmid is a ring of DNA) into the DNA of plants. *Agrobacterium tumefaciens* proved to be capable of doing its own "natural" genetic engineering on a broad range of host plants, including tobacco, petunias, soybeans, and cotton.

The discovery of *agrobacterium tumefaciens'* ability to insert itself into a plant coincided with increased interest in another group of bacteria - ones that produced insecticides. The insecticides are proteins, the direct products of DNA and RNA. Microbial insecticides usually are considered harmless to people, to organisms other than the larger pests, and to the environment. Microbial insecticides are often applied to crops to control particular insects. Because of this, they have become especially popular among farmers who want to get away from using commercial chemical pesticides.

Many plant scientists began to think, "Here we have one bacterium that can insert its genetic material into many useful plants, and here we have another type of bacterium that can produce insect-killing proteins. What if we could put the abilities of these two bacteria together in one bacterium. The new bacterium would be able to insert its genetic material into a plant, thereby giving the plant the ability to make an insect-killing protein. There you have it--a genetically engineered insect-resistant plant!"

Several groups of scientists in different companies and research centers went to work on the problem. By 1990, a pest-resistant cotton was being field-tested in many places across the country. To produce it, researchers took a gene from the bacterium *Bacillus thuringiensis* (B.t). B.t. produces a protein that is lethal to certain kinds of caterpillars, including the cotton bollworm. (B.t. often is applied directly to cotton crops to control bollworm infestations.) Using *agrobacterium tumefaciens*, they inserted the toxin-producing gene into the cotton plant to make a pest-resistent cotton. As of this writing, B.t. cotton has not been approved for the marketplace, but the field tests are promising.

ACTIVITY 6-1

B.t. cotton has been hailed by many as a great advancement. Others have been more cautious about accepting it. They feel that introducing a new, genetically engineered species may have unknown consequences.

Divide the class into groups, each group representing one of the following occupations:

- large cotton farmers
- small cotton farmers
- environmentalists
- chemical pesticide manufacturers
- plant geneticists

Each group should develop answers to the following questions and discuss the questions together from the point of view of their interest group.

1. What are the advantages of using B.t. cotton over the application of pesticides to a cotton crop threatened by the cotton bollworm?
2. What advantage does the use of B.t. cotton have over the direct application of *Bacillus thuringiensis* to a field of cotton threatened by the cotton bollworm?
3. What is likely to happen to the population of caterpillars after a few B.t. cotton growing seasons?
4. How might you expect natural selection to work against the efforts of the B.t. cotton farmers?
5. How might other plants and insects in the environment be affected by the presence of B.t. cotton?

Note: All groups may check back to Subunit 5 of this unit and may consult other sources of information provided by your teacher. The plant geneticists should act as the biological experts in solving the problem. As a class, write a recommendation to either approve or reject B.t. cotton for the marketplace, including recommendations for any restrictions on its use.

How Does Genetic Engineering Work?

Genetic engineering refers to a set of techniques used to change the characteristics of organisms. One of these techniques is called recombinant DNA technology.

Recombinant DNA Technology

In recombinant DNA technology, precise sequences of DNA can be removed from the cell, using proteins known as restriction enzymes. Restriction enzymes act a little like a knife or a pair of scissors. They cut up the DNA at specific points along the length of the DNA strand. Many different restriction enzymes exist, and they all have specific points where they cut the DNA.

Human proteins like insulin can be made using bacteria as miniature factories. Bacteria are used by scientists in genetic engineering because they are relatively simple organisms, and they reproduce rapidly. Also, scientists have ways of inserting human genes into bacteria.

By using a restriction enzyme, researchers can isolate a given sequence of DNA. For example, if a researcher wants to cut out the gene for insulin production, he/she will use a specific restriction enzyme that breaks the bonds of DNA immediately before and after the sequence that causes insulin production.

Once researchers have the gene they are looking for, they can do a number of things with it. In the above example, they take the human gene for insulin production and insert it into the DNA of another organism. Specifically, researchers insert the human gene for insulin into the DNA of bacteria, which is actually a three-step process.

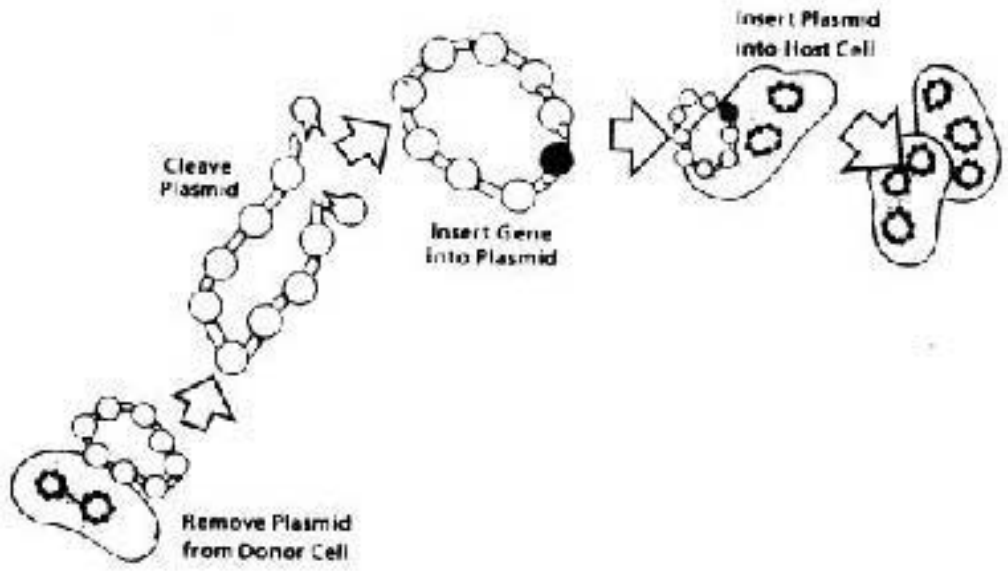
First, using restriction enzymes, they cleave DNA plasmids of bacterial cells at specific sites on the plasmid. (Plasmids are circles of DNA found in bacterial cells that are small enough to pass easily from one cell to another, even if the cells are from two different species.)

Second, they insert the insulin gene into the open plasmid ring.

Third, they insert the plasmids into living bacterial cells. Once the human gene for insulin production is inserted into the bacteria, researchers can grow the bacteria and allow them to reproduce in a nutrient-rich medium. As the bacteria produce their own proteins, the bacteria will synthesize human insulin from the instructions contained in the inserted gene for insulin. Finally, researchers can remove the insulin from the bacteria and use it to treat diabetes.

This process of isolating and inserting a new gene is called gene splicing.

FIGURE 6-1 Three steps involved in recombinant DNA technology



ACTIVITY 6-2

Demonstrate insertion of a human gene for insulin production into a bacterial cell.

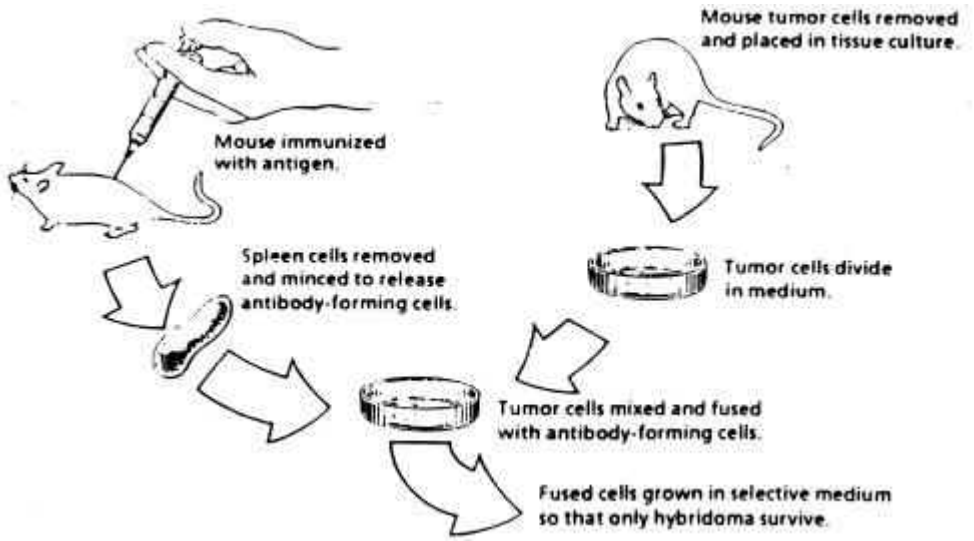
- Get instruction handouts from your teacher.
- Using Paper models provided by your teacher, demonstrate the three-step process illustrated in Figure 6-1.

Monoclonal Antibody Technology

Monoclonal (cloned all alike) antibody technology involves the process of combining special white blood cells with tumor cells (that have the ability to grow permanently in the appropriate culture medium). These special blood cells produce proteins called antibodies. Antibodies are proteins that respond to antigens. Antigens are foreign substances, such as those produced by disease-causing bacteria, that invade the body. Antibodies are highly specific; each one forms in response to a specific invader.

In monoclonal antibody technology, a mouse is injected with an antigen, which causes specific antibodies to form in the mouse's spleen (an organ that filters and stores blood). The spleen cells then are removed and minced (chopped up into very small pieces) to release the antibody-forming cells. Mouse tumor cells then are mixed in a culture tube with the antibody-forming cells. Tumor cells are used because they reproduce easily. The antibody-forming cells and tumor cells fuse (join) into new cells called hybridomas. The hybridomas can be used to produce antibodies that may be used in disease-preventing vaccines. Monoclonal antibodies also are used to diagnose illnesses and to study cells.

Figure 6-2 Monoclonal antibody technology



How Can Genetic Engineering Benefit Us?

As you have seen, genetic engineering benefits us by making useful protein products. For example, bacteria are currently being used to make products such as insulin, vaccines, antibodies, and other proteins to prevent or treat disease.

The most current information on biotechnology is available from the USDA at website http://www.nal.usda.gov/pgdic/. The Plant Genome Data and Information Center provides access to a variety of information on products and services related to plant and animal genome mapping. Biotechnology for the 21st Century can be accessed through the website http://www.nal.usda.gov/bic/bio21/. This site gives examples of new biotechnology including industrial use of recombinant DNA, cell fusion, novel bioprocessing techniques and bioremediation.

Another way genetic engineering can benefit humans is in the development of organisms with the ability to do useful things. For example, the genes of one species of bacterium have been changed to permit it to engulf and break down oil into substances that are less harmful to the environment. Scientists hope that this new "oil-eating" bacterium can help man combat pollution from oil spills. For this purpose, a type of bacterium will be used that dies out quickly after it completes the oil-eating job.

From genetically engineering bacteria that can clean up fuel spills today, we may progress to genetically engineering microorganisms that can make fuel in the future. In Brazil inexpensive alcohol fuel is now being made from sugarcane juice. In the future, scientists might solve the world's energy problems by inserting amylase (the enzyme that breaks down starch into sugar) into yeast, a microorganism. The genetically engineered yeast could help us make great strides toward solving the world's energy problems by enabling us to produce extremely inexpensive alcohol fuel from virtually any plant material.

Alcohol fuel has not yet replaced fossil fuel, but alcohol has been a useful raw material in the chemical industry for decades. Currently alcohol and other industrial organic chemicals such as acetone and glycerol (used in producing such useful products as plastics, fibers, and resins) are derived primarily from fossil fuels. Research dating back to the First World War already has provided the biotechnology to produce these useful raw materials from plant sugar. In the future, industrial chemists hope to genetically engineer enzymes that can produce other useful industrial chemicals.

As you have seen with B.t. cotton, genetic engineering also can enhance agricultural productivity. Genetically engineered bacteria can help crops resist drought, frost, and such pests as hornworms and cutworms. For example, a frost-resistant strain of bacterium (genetically mutated for that purpose) would be applied to plant surfaces, and a different bacterial mutant (engineered to be a natural pesticide) would be added to plant roots. In the near future, genetic engineering also may improve farm animals and their products. Currently the genetic engineered food projects include genotypes of soybeans, grain and animal genome data, and research on saccharomyces or baker's and budding yeast. To learn more about genotypes for some soybean varieties the homepage for SoyBase is helpful at http://129.186.26.94/. This site lets you learn more about SoyBase, view graphical genotypes for some soybean varieties, and view maps of the duplicated regions in soybeans. The USDA has a site on graingenes. This site at

http://wheat.pw.usda.gov/graingenes.html offers information on various types of grains and the current genetic engineering.

Genetic disease is responsible for causing a large number of illnesses in the human population. Many of these illnesses are fatal; some can be treated using medicines. Some genetic diseases can now be detected by a genetic engineering technique. Human DNA sequences put together in the laboratory can be inserted into cells and used as probes. The cells may be those taken during amniocentesis and chorionic villi sampling. Once the DNA probes enter cells, they "look for" natural DNA sequences on the chromosomes with which they can pair. (Remember that the DNA molecule is made up of two strands that are complementary.) Such a DNA probe is being used now to detect sickle-cell anemia in a fetus to be born to carriers. The probe will pair up with the abnormal sickle-cell gene identifying its presence.

Genetic engineering techniques, known as gene therapy, may permit doctors to cure some of these genetic defects in the near future. In the process that scientists are trying to develop, normal genes would be inserted into the cells of people who suffer from a particular genetic defect. Already, foreign genes are being inserted into animals, and a genetic disease in mice has been cured using gene therapy.

Table 6-1: Sampling of Present and Future Benefits from Genetic Engineering

Application	Benefit	In Use Today	Projected for the Future
Medicine	Useful protein	Insulin; vaccines; antibodies	New Vaccines
	DNA probe for detecting genetic diseases	Detection of sickle-cell anemia in fetus to be born to carriers	Curing genetic diseases with gene therapy, such as correcting the defect in phenylketonuria (PKU) patients that prevents them from forming an essential enzyme
Industry	Making raw materials for the chemical industry, such as alcohol, acetone, glycerol	Currently possible with biotechnology techniques	Genetically engineering enzymes for use in producing industrial chemicals
Energy	Inexpensive alcohol fuel	Currently being made from sugarcane juice, a renewable raw material	Genetically inserting amylase into yeast to enable the production of alcohol fuel from starch, a raw material found in virtually all plants
Environment	Cleaning up oil spills and disposing of waste	Genetically engineered oil-eating bacteria; mixtures of natural microbes; and enzymes used for breaking down paper-mill waste and oil	Genetically engineering a microbe that will replace mixtures of several natural microbes
Agriculture	Helps crops resist drought, frost, and pests; enables plants to make their own fertilizer	Currently limited to cross-breeding and grafting to produce hybrids with desirable traits from both plant species	Applying a frost-resistant strain of bacteria to plant surfaces; adding a natural pesticide to plant roots (bacterial mutant); genetically altering plants to be drought-resistant; genetically engineering corn cells with bacterial cells to produce corn plants that self-fertilize
	Improves animals and their products; produces new medical products in cow's milk	Currently limited to selective breeding, using such techniques as *in vitro* fertilization and artificial insemination	Genetically altering an animal embryo to produce disease-resistance, better milk, bigger animals in a shorter period of time, less fat in hogs, and farm animals whose milk contains medicines such as tPA (used to dissolve blood clots in humans after a heart attack) and blood-clotting Factor IX for use by hemophiliacs; diagnosing disease and improving vaccines

ACTIVITY 6-3

Using research materials available to you in your school library or community library, research the latest advances being made in genetic engineering. These advances might include the following:

- The engineering of new proteins.
- The engineering of bacteria with new and useful traits.
- The advances being made in gene therapy.

Make a poster that explains one of these advances that you think the class will find particularly interesting.

Make a display of posters (created by a number of students) to advertise the advances science is making in genetic engineering.

CONCERNS RELATED TO GENETIC ENGINEERING

Concerns about genetic engineering range from fear of potential misuse, such as biological warfare, to concerns about the consequences of genetic therapy on human sperm and ova. The website http://home1.swipnet.se/~w-18472/indexeng.htm addresses the safety problems of genetically engineered foods. This site also gives a beginners guide to biotechnology.

Environmental Concerns

Some fears relate to possible unknown consequences of introducing mutants such as dangerous microbes into natural environments. So far, however, genetic engineering has proved to be a safe technology, mainly because laboratory microbes have lived in a protected environment that makes them weak competitors in harsher natural environments. In addition, many microbes are engineered to die out after they have accomplished the task for which they were designed.

Legal Concerns

In addition to environmental concerns, legal questions have led to court action. In 1980, a United States court ruled that genetically engineered microbes may be patented. This has opened the door for patented animals.

Also, the legal rights of people have to be considered when biotechnology is applied to them. For instance, if your blood or tissue samples are taken for a routine purpose and during their analysis it is found you have a genetic disease such as Huntington's, should you be told? Should insurance companies have the right to refuse to insure you or your potential offspring?

Ethical Issues

Gene therapy and other uses of genetic engineering raise some moral questions for our society. As humans perfect the techniques of genetic engineering, we soon may be able to insert genes into human cells to produce all kinds of traits. It may become possible to insert genes that would

affect traits such as athletic agility or physical appearance. We surely want to use genetic engineering to cure illness, but what about other uses of genetic engineering? The ability to alter our genes gives us the ability to alter ourselves.

Researchers in the Human Genome Project already are taking the first step toward enabling us (humans) to alter ourselves. They have begun a generation-long intensive effort to map the complete blueprint for making a human. At the beginning of the project scientists estimated that human DNA contains as many as 100,000 genes. At that time, they had assigned labels to only a few thousand human genes and accurately mapped even fewer. The latest information on the Genome Project can be accessed using a search engine on the Internet.

Scientists believe the large-scale effort and financial burden of the project will pay off in many gains for humans and other species. Specifically, they hope the knowledge they gain will enable them to correct flaws in the human genetic system, to solve some mysteries of human heredity, and, indirectly, to save some endangered nonhuman species from extinction. However, the Human Genome Project presents its own special ethical issue: "Do we have the right to tamper with the human blueprint'?"

ACTIVITY 6-4

In class, discuss or debate ethical or moral issues associated with the advances in genetic engineering and other biotechnologies as follows:

- Divide the class into groups of three or four students.
- Each group will be presented with several reports of the ethical issues involved with the various advances being made in biotechnology.
- Have each group make a list of the important points raised by the articles that they reviewed.
- Within each group, debate the ethical issues raised by the articles.

LOOKING BACK

Genetic engineering refers to certain procedures used to manipulate the DNA of various organisms to benefit mankind. One technique of genetic engineering, known as recombinant DNA technology, relies on restriction enzymes, molecules which cut up the DNA, to get at needed genes. Once these genes are isolated, scientists can insert them into various organisms to get desired results. In another technique of genetic engineering, known as monoclonal antibody technology, antibody-producing cells are fused with tumor cells to form new cells that make large quantities of antibodies (disease-fighting proteins).

Some of the ways genetic engineering can benefit mankind include the production of medically important proteins such as insulin and the manufacture of special bacteria that may help us clean up the environment. Genetic engineering also is being used to develop plants that grow more easily under difficult conditions or agricultural animals that grow faster. One day, perhaps the techniques of gene therapy--the insertion of normal genes into the cells of human beings suffering from genetic disease--can be used to treat the wide variety of genetic diseases.

Legal, environmental, and ethical issues surround the use of genetic engineering. The ability to manipulate the DNA gives humans tremendous power to change nature. By changing our genes, we are becoming able to change who we are. In addition, the manufacture of genetically engineered organisms conceivably could affect the environment in a negative way. In summary, the techniques of genetic engineering can be used in many different ways. They create difficult decisions about how we want to control our very nature and the world around us.

Vocabulary

The words and phrases below are important to understanding and applying the principles and concepts in this subunit. If you don't know some of them, find them in the text and review what they mean. They're listed in the order in which they appear in the subunit.

genetic engineering	antibody
recombinant DNA technology	monoclonal antibody
insulin	antigen
diabetes	spleen
restriction enzymes	hybridoma
plasmid	gene probe
gene splicing	gene therapy
food engineering	genetically modified food
cell fusion	bioprocession
bioremediation	genetic code
genetic manipulation	

Further Discussion

- Research career opportunities in the field of biotechnology. List specific job titles and describe both the duties and the level of education and training associated with each, using “Science in the Shopping Cart” booklet, for example.
- Discuss concerns you have about the application of genetic engineering on microorganisms, higher animals, and humans. What guidelines would you set for approval of genetic engineering projects?

ACTIVITIES BY OCCUPATIONAL AREA

GENERAL

Need for Genetic Engineering

Divide into groups and brainstorm ways that genetic engineered food might solve current food problems.

- For a period of time designated by your teacher, brainstorm as many problems as you can that you think might be solved by genetic engineered food.
- When the time is up, rank the problems you listed, from most important to least important.

Compile all of the group lists into a master list and, through class discussion, form a consensus on the following:

- Eliminate from the list problems that you determine cannot be solved by genetic engineering.
- Rank the remaining problems from most important to least important.

Try to apply the procedure you just completed to a business or industrial setting, and evaluate it on that basis.

AGRICULTURE AND AGRIBUSINESS

Agricultural Applications of Genetic Engineering

- Contact your county or state Agriculture Extension Service, or the agriculture department of a local university, and ask for materials or information on how either genetic engineering (altered at the gene level) or biotechnology (using organisms or natural or synthetic parts thereof--to make or modify commodities or provide services) is currently being applied to the field of agriculture.
- Report to the class on one or more of these applications that you think are particularly important or interesting.
- The website http://wheat.pw.usda.gov/graingenes.html contains current information on genetically engineered grain.

Self-Fertilizing Corn

- Research is being conducted on transferring the genes from nitrogen-fixing bacteria into corn cells.
- Review information that your teacher will provide on this research.

- Survey local farmers to learn the percentage that is aware of this research and the percentage that understands the specific genetic-engineering process.

- As a class, discuss the following questions relating to that specific research:

    - What type of benefit(s) would the genetically engineered corn provide the farmer?

    - How would they help the environment?

FAMILY AND CONSUMER SCIENCE

A Solution for World Hunger

- As background research for this activity, read accounts in newspapers and popular magazines about the problem of world hunger.

- Envision a new food item or an altered version of an existing food that:

    - might be created with the help of some application of either genetic engineering or biotechnology (see definitions in the Agriculture and Agribusiness activities.)

    - might be processed into forms that would appeal to the tastes of people from a variety of ethnic backgrounds.

- Share your new food idea with other students in your class or others working on the same activity.

    - Ask for opinions about any political, economical, ethical, or social problems they foresee with your idea.

    - If more than one student is working on the activity, vote on the best idea.

Historical Application of Biotechnology to Food Production

- Choose an application of biotechnology in food production that has been used for many centuries (for example, processing the many varieties of cheese or using fermentation to produce bread).

- Research the history of the process in the library.

- Share your findings with the class in an oral report accompanied by either a demonstration or a poster illustration of the process. (For example, demonstrate making yeast bread or making cheese.)

HEALTH OCCUPATIONS

Diagnosing Hereditary Diseases

- Research and illustrate on pasteboard the biotechnique that is used for diagnosing hereditary diseases. (On the Internet, research topics such as recombinant DNA technology, PKU, cholesterol and diabetes.)

- Explain your illustration for the class, and ask the following questions:

    - In what health-care procedure would this process be applied?

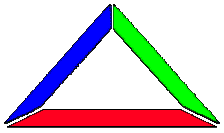
    - Do you think the procedure could lead to ethical or social problems? Explain.

Large-Scale Genetic Engineering of Insulin

- Research the process of producing insulin with genetic engineering techniques. (In the library, look in indexes on science and technology under subjects such as insulin, genetic engineering, diabetes, etc.)

- Pretend that you want to use the technique you researched to manufacture insulin on a large scale, and illustrate with a flowchart the process you would use to get from the laboratory development stage to a marketable product.

Food Poisoning



Associated Benchmarks

11.A. - Inquiry Replication/Review
12.B.4b - Population Stability
12.B.5b - Adaptation
13.A.4a - Risk Assessment
13.A.4b - Data Validity
13.A.4c - Impact of New Information
13.A.4d - Peer Review
13.A.5a - Risk Reduction
13.A.5b - Evaluation of Validity
13.A.5c - Research Methodologies
13.A.5d - Necessity of Replication/Review
13.B.4b - Science on Occupations
13.B.4c - Population Trends
13.B.4d - Local STS Issue Study
13.B.4e - Science Claims in Advertising/Marketing
13.B.5a - Effect of International Competition
13.B.5b - Process and Effects of Breakthroughs
13.B.5d - Cost/Benefit Analysis of S/T Policies
13.B.5e - Impact of S/T Progress

Key Concept

Food Poisoning

Process Skills

Recognizing Patterns and Interdependencies
Evaluating Consequences
Inductive and Deductive Reasoning

Experimenting
Accumulating and Interpreting Data

Activity Connections

Food Poisoning Outbreak Scenario and accompanying activities

Glitter dissemination

Hand washing lab and lab write-up

Typhoid Mary article and questions

Surface Cleanliness lab and lab write-up

Food Safety Research assignment

Bacteria on Fresh Food Lab and write up

Food Science/Technology Team Event - Proficiency Event for FHA/HERO

Career Connection (13.B.4b)

Through this activity, students will become familiar with areas of food technology dealt with by individuals in careers such as pathologist, microbiologist, food service, health department worker, sanitation instructor, doctor, nurse, lab technician, Center for Disease Control personnel, science teacher and family and consumer science teacher.

Teacher Instructions

Experiments - (see attached)

Poisoning Scenario - (see attached)

Rubrics for research projects (see attached)

Safety guidelines

Equipment and supplies list

Transparency masters

Quizzes

Student Interaction

Typhoid Mary questions

Food Poisoning Outbreak scenario

Glitter dissemination

Instructional Media Connections

Website: http://www.cuphd.org
Description: This is a site from the Champaign-Urbana Public Health District. It has a division in environmental health containing food safety information. Other divisions are communicable diseases, nutrition and health education.

Website: http://www.bio.umass.edu/micro/
Description: This site is from the University of Massachusetts Amherst. The sites gives a lot of information about the Microbiology Department.

Website: http://www.microbiology.adelaide.edu.au/
Description: Expansive site with a great link to bugs in the news and microbiology departments all over the world.

Website: http://www.imsa.edu/
Description: The Illinois Mathematics and Science Academy with information on problem based learning and Impact II.

Website: http://www.ag.ndsu.nodak.edu/food.htm
Description: NDSU Extension Service, University of North Dakota A very large list of links covering:

- Emphasis on Nutrition
- Nutrition Directories
- Food Safety
- Food/Agriculture
- Health
- Resources for Kids
- Other Internet Resources

References

A variety of references may be accessed through your local library. Some examples of titles useful to the topic are listed below.

"Spoiled" Dateline video

Jeremy Rifkin (1991) Where's the Beef

"Danger Zone" video

"Food Safety Is No Mystery" video

"Food Science and You" video

TUESDAY, MAY 22 **MARION STAR**

Marion, Illinois

SALAD MAKES 350 STUDENTS SICK

On Monday, 350 students and 3 teachers from Gonzo High School called in sick. "I woke up Monday morning with a headache, cramps, and diarrhea. I never felt so lousy in my whole life," said Joe Greene, senior at Gonzo High School. "My friends were all sick, too. The only thing we did together was to go to the senior picnic."

Gladys Crump, of Sal's Catering, confirmed by telephone, that a picnic consisting of hot dogs, hamburgers, baked beans, potato salad, cole slaw, and ice cream was served to the senior class on Saturday.

Mr. Binkley, Gonzo High School principal, became suspicious when almost half of the senior class called in sick. The city and state health department inspectors have been called in to investigate.

Ms. Weakly, city health inspector, stated "Either the salads or the hamburger were most likely the culprits. We have not confirmed anything yet; however, we have contacted the meat packing plant as well as Sal Monella, the owner of the deli where the salads were prepared."

Sal said, "Couldn't be the salads because I make them fresh everyday."

Results from lab tests should be available tomorrow.

CHUCK

FRIDAY

6:00 a.m. Chuck's employees removed the ground chuck from the walk-in refrigerator and set it on the counter.

6:30 a.m. The employees set up the hamburger patty machine to make 400 hamburgers for the picnic.

7:00 a.m. Chuck realized his employees were having trouble with the machine. He proceeded to help run the machinery.

7:15 a.m. Chuck went to the restroom and hurried back to the machinery because Joe, an employee had cut himself and had to be taken to the hospital. Chuck filled in for Joe.

10:00 a.m. After many breakdowns, all the hamburger patties were made and placed in the walk-in refrigerator in stacks of 25 in an open pan, on the bottom shelf.

SATURDAY

10:00 a.m. Chuck delivered the hamburgers and hot dogs to the picnic.

10:30 a.m. Ms. Crump cooked the hamburgers and hot dogs, then keeping them in a warming tray.

11:30 a.m. The students began going through the buffet line and choosing their food.

SAL

FRIDAY

6:00 a.m. Sal received fresh cabbage, onions, potatoes, celery and carrots from the Midtown Produce Distributors.

6:30 a.m. All produce had been inventoried and stored in the walk-in refrigerator.

9:00 a.m. Sal washed his hands and all produce and began to prepare the cole slaw.

9:30 a.m. Sal put the completed cole slaw in a covered shallow container in the walk-in refrigerator.

9:45 a.m. Sal put the potatoes and eggs on to cook for the potato salad. He washed his hands again and began to chop the remaining ingredients for the potato salad. When he was finished, he placed these ingredients in a covered container and placed the container in the walk-in refrigerator.

10:30 a.m. The potatoes and eggs were done. Sal removed the potatoes and eggs and drained them and placed them in a shallow container and placed the container in the walk-in refrigerator to cool completely.

11:30 a.m. Sal washed his hands and removed the potatoes, eggs and chopped vegetables from the walk-in refrigerator. He then chopped the potatoes and eggs and combined them with the vegetables, added the mayonnaise and seasonings, mixed thoroughly and placed the potato salad in a clean shallow container and covered it and placed the container in the walk-in refrigerator.

SATURDAY

11:00 a.m. Sal delivered the salads to the senior picnic. The salad containers were placed in containers full of ice.

11:30 a.m. The students began going through the buffet line and choosing their food.

STUDENT VICTIMS

Name	Symptoms
Joe Greene	Diarrhea, abdominal cramps, vomiting
Sue Brown	Diarrhea, abdominal cramps, dehydration
Bob Sweeny	Diarrhea, vomiting, listlessness
Jane Wall	Diarrhea, vomiting, irritability
Peter Sullivan	Diarrhea, abdominal cramps, vomiting, dehydration
Ann Bates	Diarrhea, vomiting, listlessness

FOOD-BORNE ILLNESS TABLE

Illness, Organism and Incubation Period	Symptoms	Sources	Causes
Salmonella *Salmonellosis* 1-3 days	Abdominal pain, diarrhea, chills, fever, nausea, vomiting	Eggs, egg-based food, chicken or potato salad, pork, cream fillings, milk products	Inadequate refrigeration; holding food at warm, bacterial-incubating temperatures; inadequate reheating; cross-contamination
Listeriosis *Listeria monocytogenes* 2-14 days	Abortion and brain inflammation in livestock, meningitis, fever, headaches, vomiting	Raw milk, products made with raw milk	Lives in extreme temperatures, salt and acidic conditions, unpasteurized milk
Trichinosis *Trichinella spiralis* 2-24 days	Parasite grows in intestine, diarrhea, fever, fatigue, heart and brain damage	Raw or undercooked pork	Fattening pork on human uncooked garbage; cooking pork to internal temperatures of less than 77°C
Clostridium Perfringens *C. Perfringens* 8-22 hours	Abdominal pain, diarrhea, muscle pain, headache, fever	Cooked meat, poultry, potatoes, gravy, custards	Inadequate refrigeration; holding foods at warm, bacterial-incubating temperatures; inadequate reheating
Staphyloccocus *Staphylococcus aureus* usually 2-4 hours 1-8 hours	Nausea, vomiting, retching abdominal pain, diarrhea	Ham, meat, poultry products, cream-based food, mixtures	Touching food with skin exposed to infections, wounds; warm, bacterial-incubating temperatures; inadequate refrigeration
Botulism *Clostridium botulinum* 2 hours-8 days	Death, nausea, vomiting, general weakness, constipation, headache	Home-canned low-acid foods, fermented fish, and fish eggs	Under processed canned meats and low-acid vegetables; uncontrolled fermentations
E. Coli *Escherichia coli* 12-72 hours	Watery diarrhea, abdominal cramps, vomiting, listlessness, irritability, can progress to fever, severe dehydration, acidosis and shock	Ingestion of contaminated food or water, contact with infected person, or contact with contaminated utensils	Undercooked food, contaminated water, directly from infected person, contact with contaminated utensils

(Based on a table in Lisa Kramer Taylor's (1994) *Nutrition*, Center for Occupational Research and Development Publications. Waco, TX, 131.)

INVESTIGATION ACTIVITY

In groups of four, assume the role of Ms. Weakly, city health inspector. Answer these questions about your investigation:

1. What food was served to Gonzo High School students and faculty?

2. What further information do you need to help you understand this problem?

3. List the procedures you will follow to investigate this problem?

4. How will you respond to the press? Will you contact the Marion Star editor concerning the conclusion stated in the story headline?

5. What would you expect your boss to say regarding your statement to the press?

6. Use the information sheets for Sal and Chuck to determine the possible cause of the food poisoning outbreak.

7. What agencies would you contact to help you determine the cause of the food poisoning? What would each of their roles be in the investigation of this incident?

8. Examine the survey of the victims' symptoms provided by your teacher and compare the prevalent symptoms to those of the illnesses shown in the Food-Borne Illness Table. Which food-borne illness do you think the students' had and which food item caused the illness? What other information do you need to confirm you answer?

TEACHER KEY
INVESTIGATION ACTIVITY

1. Food served included: hot dogs, hamburgers, baked beans, potato salad, cole slaw and ice cream.

2. Information about incubation time and symptoms caused by food borne pathogens, as well as interview of food workers and lab tests on food.

3. Gather information about food borne illnesses; interview food workers separately; arrange for and interpret the results of lab tests on food.

4. Answers may vary.

5. The targets of the investigation should not be identified; general responses are usually recommended.

6. Chuck's hamburger patty machine distracted Chuck from proper sanitary precautions. He did not report washing his hands after going to the bathroom. Also, Ms. Crump placed the meat in a warming tray a full hour before serving.

7. The USDA is responsible for meat and poultry inspections; their role is to inspect facilities and procedures. The USDA can also conduct food sample safety tests. The state Public Health Department must be notified of mass food poisonings and can conduct interviews regarding the outbreak.

8. Escherichia coli, a common enteric pathogen. The meat was the source. Chuck's trip to the bathroom could have been the inoculant. A laboratory Petri dish with E. coli bacteria could be confirmed by Gram staining and microscopic examination. (The USDA and Public Health labs use special media to confirm the source(s) more quickly.)

ALL THAT GLITTERS IS NOT GOLD

This is an attention-getting activity aimed at making students aware of how easy germs are passed from one person to another.

As your students enter your classroom greet them at the door, shake their hands, pat them on the back, etc. As you do this have a small plastic bag of glitter - clear in your pocket. Periodically reach in and get a small amount of glitter on your hand. Be sure to get some glitter on each student.

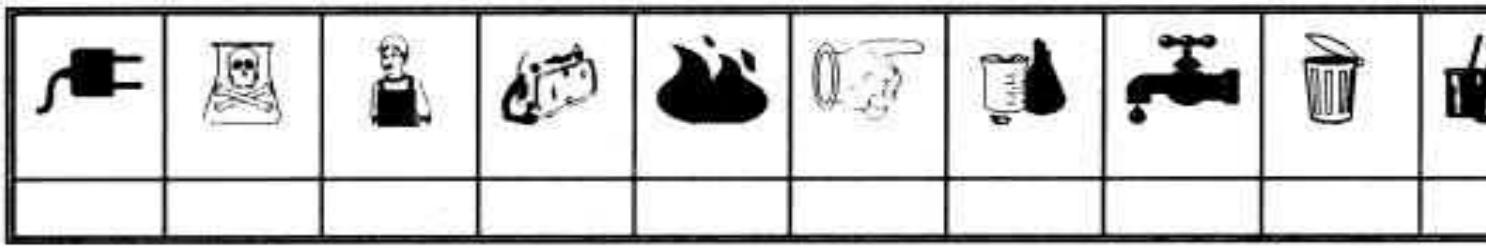
When class starts draw the students' attention to all the glitter that is on them. They may see some glitter but probably not all. Impress upon them that all you did was shake their hands and pat them on the back. You could even start by saying "I forgot to wash my hands after I cleaned my office," or "I have a terrible head cold today and everyone with glitter now has my germs."

NAME _____**DATE** _____ **CLASS PERIOD** _____

Effectiveness of Handwashing

EXPERIMENT

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Each of us is responsible for personal hygiene. Some are responsible for the health of others as well (health care practitioners, food service workers and parents are some examples).

Dr. Semmelweis of Austria (1847) is generally credited with noting that cases of puerperal fever among patients at a hospital were closely related to the failure of medical students to wash their hands before assisting in childbirth. These students were given periodic vacations from the teaching hospital and, while they were gone, the incidence of puerperal fever among previously healthy women and their babies almost disappeared! Nurses would assist while the students were gone and, since nurses were not permitted to perform autopsies and had a habit of washing their hands, the transmission of infection was rare. Dr. Semmelweis insisted that students wash their hands in disinfectant before attending women in labor, dramatically reducing the rate of infection from 12 percent to 1 percent in a single year!

MATERIALS:

nutrient agar plate marking pen antibacterial soap

PROCEDURE:

1. Mark the nutrient agar plate (on the outside of the half with agar) into four sections. Label the plate with your names, today's date and number the sections 1-4.
2. Wet the hand of a volunteer who will touch the agar in section one. This allows us to account for resident skin bacteria and tap water bacteria.
3. Have the volunteer wash his/her hands thoroughly for two minutes using antibacterial soap and cold water. Touch the agar in section two. This shows the effect of soap alone.
4. Have the volunteer wash his/her hands thoroughly for at least two minutes using antibacterial soap and hot water (be careful not to burn your skin). Rinse with hot water. Touch the agar in section three. This shows the effect of temperature and soap. Section four is reserved as a negative control to show that the plate was not contaminated.
5. Fasten the plate shut with transparent tape and incubate in a drawer (at least out of direct sunlight).
6. After 48 hours, count the number of colonies formed. **Do not open the plate.**

DATA TABLE: Colony counts

Group	Number of Colonies
1	
2	
3	
4	
5	

CLEAN UP INSTRUCTIONS:

Check with the current safety guidebook for the suggested procedures for disposing of contaminated petri dishes.

QUESTIONS:

1. Research how people must clean their hands for their occupations. Choose from among these:

a) dental hygienist b) nurse c) food service worker

Write the approved procedure here:

2. Was there evidence of contamination on any of the plates? From where do you think it came?

3. Was there evidence of bacteria in tap water?

4. Hot water is often recommended for hand washing. Is that supported by our data?

5. Most people do not spend two minutes washing their hands before eating. Is this a serious health hazard? Why or why not?

6. What sources of error might there have been in our investigation?

7. If you make an error, should you report it? Why or why not?

THE CASE OF THE UNSUSPECTING MURDERER

On August 27, 1906 the daughter of Charles Warren, a New York banker, fell sick. The Warrens were renting a summer house in Oyster Bay on Long Island, NY.

For the first few days the illness was mild. Then the doctor noticed alarming symptoms—a high fever, low pulse rate, nosebleeds, nausea, and diarrhea. A rash appeared on the girl's stomach. Her stomach was puffy and sensitive when touched.

Her symptoms were classic—typhoid fever.

Typhoid fever is one of the most contagious diseases. Eighty years ago, thousands of people were stricken by typhoid. In 1906 nearly 25,000 people died from it in the United States alone.

The Warren girl was moved to a hospital. She died four days later. Five other people in the Warren house got typhoid. And one of them died.

This outbreak of typhoid was surprising. There had been no typhoid in the town for 16 years.

County health experts claimed that the outbreak was due to the Warren girl. She might have gotten the fever from contaminated water or milk. Or she may have gotten it from shellfish from polluted water. Spoiled food or seepage from sewage pipes could also have caused the disease. Typhoid, the experts believed, was caused by dirt.

After tests, they found that the water and sewage were not the cause. Those who supplied the Warren house with food were also cleared.

The experts were still sure that the Warren girl had been infected by one of the listed causes. But they were unable to pinpoint the source of the typhoid.

This typhoid outbreak might have remained a mystery. But George Thompson, the owner of the Warren house, was afraid it would be impossible to rent the house the next summer unless the cause was found.

So he called in George Soper, a sanitary engineer for the New York City Department of Health. Soper was a well-known epidemic fighter. He was famous for his work in typhoid epidemics in Watertown and Ithaca, NY.

At first Soper did not want to take the case since there was no epidemic. "But it was so mysterious and had been investigated by so many good men without result," he said later, "that it intrigued me."

Soper's investigations quickly ruled out the usual sources of typhoid. He then began to work on a new theory developed by the German scientist Robert Koch. Koch thought that a seemingly healthy person with an immunity to typhoid germs could spread the disease. With an amateur's love of detective work, Soper was the first man in America to test Koch's theory.

Soper suspected that each case of typhoid in the Warren house was new. He didn't think typhoid was spread by the Warren girl.

Once infected, it usually takes 10 to 14 days for the disease to appear. So Soper figured that all the victims were stricken by contaminated food or drink on or before August 20.

THE CASE OF THE UNSUSPECTING MURDERER (continued)

Soper studied the medical history of every person in the Warren home. But the most obvious suspect, the cook, was missing.

Mary Mallon, a handsome Irish woman, was hired as the Warren's cook on August 4. She was an excellent cook, according to Mrs. Warren. But Mary wasn't very clean. She seemed to be in excellent health.

Mary disappeared, without a word, about three weeks after the typhoid began. Going on little more than a hunch, Mary Mallon was Soper's target.

Mary was an innocent victim of her body chemistry. In her body, deadly bacteria found a good spot to breed and multiply. She then infected the people she came in con tact with. Mary was, simply, a walking killer. She became "Typhoid Mary," the first disease carrier ever identified in America.

Soper was afraid that Mary was killing unsuspecting people at that very moment. He was also afraid that she would panic and run if the police were called in.

So Soper (with a few health department investigators) began his search quietly. They were looking for a tall woman, about 40 years old, light hair, blue eyes, prominent cheekbones, and a sharp nose.

Soper started with employment agencies that worked with wealthy families. He interviewed dozens of people and collected every scrap of information about her.

Mary had worked in several homes from 1896-1906. In seven of these homes, 28 victims of typhoid were found. Nine died and four were permanent invalids. In the eighth home, Soper found proof that Mary could kill hundreds.

Mary worked for a banker in Ithaca, NY, in 1903. Typhoid struck the house, spread, and became an epidemic. Mary fled, but she left 1,300 victims.

In each of the eight houses, typhoid broke out soon after Mary entered the home. She escaped illness each time. And, in almost every case, Mary ran when the sickness appeared. There had never been any typhoid before she arrived in any of the homes or towns in those 10 years.

Soper knew he could prove Mary was guilty if he had a sample of her body waste. But finding Mary was hard.

He discovered that she'd worked in a New York suburb a few weeks after the Warren job. During her brief stay, 3 people died. Soper was sure Mary was in New York—still working as a cook.

On March 1, 1907, a Park Avenue mansion was hit by typhoid. Soper rushed to the house. There was no "Mary Mallon" working there. But her description fit the cook.

Soper calmly began to explain to the cook that he suspected her of being a typhoid carrier. It was necessary, he said, to have samples of her blood, urine, and feces. Without warning, she grabbed a large carving fork and threatened Soper.

"Certainly," he said, "you must realize that typhoid cripples and kills wherever you go. Do you think the fever chases you, that it's all bad luck?"

"You won't touch me," she screamed, "and I'll tell you nothing. I'm clean...healthy. I had nothing to do with the fever. You're persecuting me!"

There was no real proof that the cook had the disease. But Soper knew there was only one solution—to force her into a hospital for observation.

The cook was fired from her job. Soper had one of his men tail her. During the night, Mary shook the investigator and disappeared.

Someone tipped Soper off. Mary was again working as a cook. It took five men to capture the clawing, biting woman. Soper was not sorry about capturing Mary—two children in the house were dying of typhoid.

Mary was taken to a health department hospital. She was locked in an isolation ward. She refused to give the doctors her medical history.

Samples of Mary's body wastes contained large amounts of typhoid bacteria. Billions of germs were hatched daily in her gall bladder. The germs escaped in her waste. Her hands became soiled from the waste and the germs passed into the food she prepared.

Doctors suggested she have her gall bladder removed. At that time, it was a risky operation. But it was the only way to rid a carrier of typhoid germs.

Soper explained to Mary, "You don't need a gall bladder any more than you need an appendix. There are many people living without them."

Mary's response was, "The health department wants to use this operation as an excuse to murder me!"

She was taken to a city hospital on North Brother Island in the East River. The gall bladder operation was not performed. But Mary was not allowed to handle food. She ate under guard. And she was searched before and after meals for hidden food.

Mary was bitter. She thought she was persecuted and mentally tortured. She often went into fits and had to be quieted by male nurses.

On February 10, 1910, the health department announced a new policy for disease carriers. There would be no more isolation. Mary Mallon was going to be turned loose.

Soper tried to prevent her release. He argued with officials but couldn't convince them. He rushed to the hospital and told Mary:

"You are never to work as a cook again, or in any job where you handle food. You are never to touch anyone's food but your own. And you will report to the health department every month."

She promised to follow these orders. But within three months she broke her parole. It took Soper almost five years to find her again.

In late 1914, typhoid broke out in a New Jersey sanitarium. Mary had been there—and left.

In January, 1915, the fever swept the Sloane Hospital in New York. There were 47 cases with eight deaths, most of them doctors and nurses. A cook named Mary Brown had worked there and left when typhoid struck. Her description fit Mary Mallon. Soper began to think she was insane.

Soper called in the police. Her trail was followed to New Jersey, then Maine, back to Manhattan, and to suburban Westchester County.

Then, one night, Mary was spotted entering a house on Long Island. She was carrying a bowl of gelatin to a friend. Police broke in, put irons on her hands and legs, and carried her to a waiting car.

On March 27, 1915, Mary was taken back to North Brother Island. She again refused to have the gall bladder operation. Her body would never be free of the germs.

Mary stayed on North Brother Island for the rest of her life. She was permitted to have visitors. But, when mealtime came, her guests left. Mary cooked and ate alone.

She was examined regularly. Her typhoid problem never improved. By the time Mary died in 1938, her bitterness had disappeared. But she was always bewildered by what happened to her.

(Adapted from *A Walking Killer Called Mary* by Mark Surfrin. Chicago Tribune Magazine, April 8, 1979. pp. 56-63)

NAME_____ DATE_____ CLASS PERIOD_____

TYPHOID MARY QUIZ

Circle T for true and F for false

1.	Microbes are spread by contact, air, water, food, insects and animals.	T	F
2.	All microbes are harmful and cause disease	T	F
3.	All microbes require water and high temperatures to survive	T	F
4.	Typhoid Mary was very sick throughout her life.	T	F
5.	Symptoms of typhoid include nosebleed, fever and reduced pulse.	T	F
6.	Typhoid is commonly caused by dirt (from sewage).	T	F
7.	Typhoid is spread only by direct contact	T	F
8.	Once typhoid has been eliminated for ten years, it cannot return.	T	F
9.	A rash and diarrhea are common in typhoid cases.	T	F
10.	The trailing of Mary began so Mr. Thompson could rent his house!	T	F

Short Answer. Be brief but answer the question completely.

11. Once infected, how long does it take for an ordinary person to show symptoms of typhoid?

12. How many people died of typhoid in 1906 in America alone?

13. What are some reasons that typhoid has become uncommon today?

14. What kind of medical information might be included in a medical history?

15. What kind of operation could have cured Mary of her chronic typhoid infection?

Extra credit: Why was Mary's fear of the operation that Mr. Soper proposed a legitimate fear in the early 1900's?

TEACHER'S KEY
TYPHOID MARY QUIZ

1. T
2. F
3. F
4. F
5. T
6. T
7. F
8. T
9. T
10. T

11. 10 - 14 days

12. 25,000

13. Requirements for hand washing, mandatory reporting, better sewage sanitation.

14 Disease incidents, vaccination history, injuries, family medical history.

15. Gall bladder operation

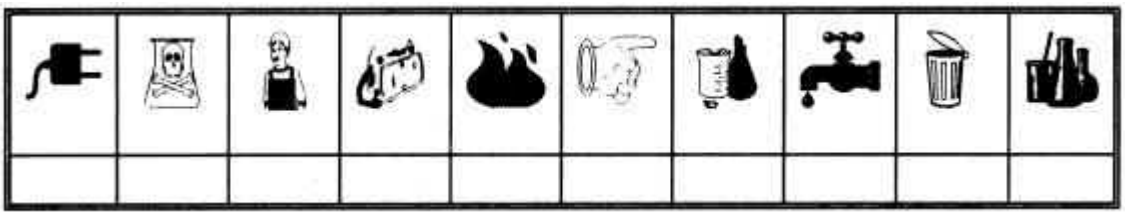
EXTRA CREDIT: Sanitation was poor even among physicians. Mary could have died of an infection caused by the operation.

NAME _____DATE _____ CLASS PERIOD _____

Surface Cleanliness

EXPERIMENT

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Microbiology is the study of microbes, which are microscopic organisms such as algae, bacteria, fungi, protozoa or viruses. Microbes are ubiquitous, and although most are innocuous, some can cause us serious harm. If we have healthy immune systems, sterilization of our environment is unnecessary. Disinfectants usually destroy microbes, but some products merely halt the growth of organisms. Sterilization is complete destruction of microbes on a surface or in a media. This lab will explore how clean routine cleaning is.

MATERIALS:

nutrient agar plate disinfectant paper towels marker Q-tips

PROCEDURE:

1. Gather your materials and disinfect the table top as usual.

2. Label your agar plate on the bottom with your initials and divide it into up to six regions by drawing lines on the bottom of the plate.

3. Use a Q-tip to swab the table top and brush one area of your plate. Label that section.

4. Use other Q-tips to swab other surfaces, cleaned or not.

5. Seal the nutrient agar plate closed with tape. Turn it upside down (so condensation won't spoil your experiment) and incubate the plate out of sunlight.

6. Examine the plate (**DO NOT OPEN IT**) after 24 hours and again after 48 hours.

RESULTS TABLE

List Your Results In This Table

Section	Appearance of	Number @ 24 hrs	Number @ 48 hrs

	Colony		

QUESTIONS:

1. Which surface had the least microbial growth?

2. Which surface had the most growth?

3. Did any surface surprise you by the quantity of microbes there? Which?

4. What steps could be taken to reduce the population of microbes from the surface with the most growth?

5. List lab safety rules that try to minimize infection by surface microbes.

FOR TEACHER USE
ANSWER KEY

SURFACE CLEANLINESS LAB

Time: 3 days. 30 minutes the first day, 15 minutes for the second and third days.

Safety: Have students initial the following safety precautions before proceeding with this lab.

- Personal and Clothing Safety- Wear an apron to protect clothing.
- Personal Hygiene and Safety - Wash hands after handling disinfectant.
- Waste Disposal - Discard wastes as directed by your teacher; clean your work area.

Materials and Equipment Needed		
Nutrient agar plates or strips disinfectant	paper towels marker	Q-tips

ANSWERS TO QUESTIONS:

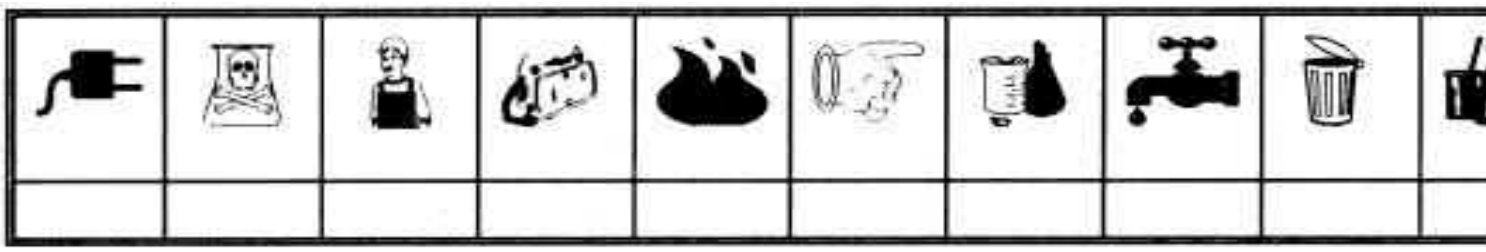
1. Answers will vary
2. Answers will vary
3. Answers will vary
4. Review cleaning techniques and consider the effectiveness of various disinfectants.
5. Suggested answers include: One use wiping towels for cleaning surfaces. Antibacterial cleaning solutions.

NAME:_____ DATE_____ CLASS PERIOD_____

Bacteria On Fresh Foods

EXPERIMENT

SAFETY: Write your initials under the symbols that represent safety precautions for this lab.



INTRODUCTION:

Microbes are ubiquitous and, although most are innocuous, some can cause us serious harm. Ordinary people with healthy immune systems are at small risk in sanitary environments, but some people require sterile conditions due to medical conditions. Even their food may put them at risk! Our nation's food supply is the most abundant, varied and healthy in the world, yet occasionally we hear of people being poisoned by their food. Food processors and handlers are required by law to be trained in sanitation, but what about the millions of Americans who prepare their own food? This lab is your opportunity to see what comes with your food.

MATERIALS: (Do not use prepared foods.)

nutrient agar plate disinfectant paper towels markers toothpicks fresh foods

PROCEDURE:

1. Gather your materials and disinfect your work surface as usual.

2. Label your agar plate (on the bottom beneath the agar) with your initials and today's date and mark lines dividing the plate into up to six regions.

3. Use a toothpick (they come relatively sterilized) to rub or prick one of the food samples, and then smear one section of your agar plate. Label that section and discard the toothpick in a cardboard box or can provided (to protect the custodians).

4. Repeat step three until all but one area has been inoculated with whatever is on the food. That empty section is the negative control which shows the agar was sterile.

5. Seal the plate shut and incubate it out of direct sunlight.

6. Examine the plate after 24 and 48 hours for bacteria or fungi. **(Do not open the plate.)**

7. Discuss with your instructor and peers proper food handling techniques.

RESULTS TABLE

Section	Number of Colonies

QUESTIONS:

1. Which food sample had the least microbial growth?

2. Which food sample had the most microbial growth?

3. Did any food samples surprise you by the quantity of microbes found there?

4. If these microbes are pathogens, what advice could you give to people who handle fresh foods during preparation so they won't make others ill or become ill themselves later when they eat?

FOR TEACHER USE
ANSWER KEY
BACTERIA ON FRESH FOODS

TIME: 3 days, 30 minutes first day, 10 minutes second and third days.

SAFETY: Have students initial the following safety precautions before proceeding with this lab.

- Personal and Clothing Safety - Wear an apron to protect clothing.
- Hand Safety and Protection - Be careful when handling the knife; always point the blade away from you.
- Personal Hygiene and Safety - Wash your hands well after handling disinfectant.
- Waste Disposal - Discard wastes as directed by your teacher, clean you work area.

Materials and Equipment Needed		
Nutrient agar plat or strip	disinfectant	markers
fresh foods (do not use prepared foods)	paper towels	toothpicks

ANSWERS:

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. Possible answers include: Do not cross contaminate cutting boards. Use disinfectant on cutting boards after use. Replace cutting boards when groves can not be disinfected effectively. Use antibacterial soaps to wash hands.

Food Science/Technology

TEAM (2-5)

(Entries must meet all specifications to qualify)

Event No. 16 - Grades 10, 11, 12

Purposes:

1. To demonstrate how food science/technology contribute to the health and wellness of individuals, families and society.
2. To research and increase knowledge in the study of foods, science, and technology.
3. To demonstrate and apply a variety of scientific principles in working with food.
4. To apply science principles to the production or processing and utilization of food.

Specifications:

1. The participant team will be composed of 2 to 5 members.
2. The team will prepare and present an innovative food science/technology project in one of the following areas:

    - Biotechnology
    - Food Microbiology
    - Food Packaging
    - Quality Assurance
    - Refrigerated and Frozen Foods
    - Toxicology and Safety Evaluation
    - Food Production

3. The project must include:

    - Lab experiments
    - Application of food science techniques
    - Equipment used
    - Results of study and research
    - Explanation of how this food process/product has improved health through some aspect of nutrition
    - Documentation of the project should be included in the formal presentation

4. Information will be presented in an **8-10 minute presentation**. The presentation must include the following:

- Title of the project
- Purpose
- Materials and equipment used
- Results of study
- Explanation of processes used
- Evaluation
- Resources used

5. Participants must bring all equipment, supplies and materials used in the presentation. Participants may use any technique, visual aid, display, and/or equipment necessary.
6. **During the formal presentation only**, viewing will be **open** to the public. (No participants in this event may view the presentations). Audience will remain silent and seated during the presentation. No interaction with the audience will be permitted. The audience will leave during the question and answer period. This portion of the event will remain closed until the evaluators are finished interacting with each team.
7. The team will be assigned a time for the presentation. The participants are to register with the advisor in charge 30 minutes in advance of the assigned presentation time.
8. **Three typed copies of a work plan/summary placed in one file folder** shall be given to the advisor in charge at the beginning of the set-up period.
9. The team will be given a **maximum of 8 minutes** in which to **set up** at a time specified by the event lead consultant. Only the participants may set up for the presentation. Others are not allowed in the area during set-up time.
10. Within the formal presentation, the team must include the following information on a visual or as part of a display:

    - Names of team members
    - Grade level
    - School
    - Title of activity or project

11. Note cards may be used. Oral summaries may **not** be pre-recorded and must be presented equitably by members of the team. Group interaction is evaluated.
12. The participants will receive a signal from the adviser in charge when to begin the **8-10 minute presentation**. A one-minute warning will be given by the adviser in charge. Participants will be stopped at 10 minutes.
13. A **5-8 minute question and answer period** will follow concerning the following points:

    - The research: how it was conducted and information gained.
    - Preparation of the project.
    - How this information can impact team members and the public.

14. At an assigned time after the final judging, the displays will be available for public viewing for 1 hour. Participants will remain with the project to answer questions from the public. **Failure to attend or remain with the display during viewing time will result in a 10-point deduction from the total score.** Participants assume responsibility for the safety of the display.

Work Plan/Summary

(complete both sides)

Names of Team Members:

Title of Project:

Description of Project:

Materials and Equipment Used:

Explanation of Processes Used:
(Procedures, Lab Experiments)

Results of Study/Research:

Self-Evaluation:

Resources Used/Works Cited:

Documentation/Signature of Adviser:_____

Evaluation
Food Science/Technology

Assigned No._____

Name of Participants_____ **School**_____

Category ☐**Senior** (Event 16) **Grades 10-12**

Instructions: Write in the appropriate rating under the "score" column. Where information or evidence is missing, assign a "0". Total the points. Make comments on the following form to help participants identify strengths and suggestions for improvements.

Evaluation Criteria	Excellent	Very Good	Good	Fair	Poor	Score
Project						
1. Work Plan/Summary* ▪ Mastery of Science & Home Economics principles ▪ Detailed information						
2. Research ▪ Appropriate and complete						
3. Lab Experiment(s) ▪ Scientific methodology ▪ Home Economics principles & application ▪ Results						
4. Planning Process ▪ IMPACT process used ▪ Follow up (Self-evaluation)						
5. Community Impact ▪ Product/process affects on health ▪ Need met						

Formal Presentation

6. Oral Summary** ▪ Clarity & organization ▪ Highlights important points ▪ Visual aids						
7. Food Science Principles ▪ Accurate information ▪ Proper procedure						
8. Teamwork ▪ Equal participation						
9. Questions ▪ Informative Answers ▪ Correct information						

Deductions

* First Tie Breaker

Total

**Points _____

**Second Tie Breaker

Circle rating achieved:

3 Star (blue ribbon) 90-100 points

2 Star (red ribbon) 70-89 points

1 Star (white ribbon) 0-69 points

Verification of Total Score (Please initial)

Evaluator _____

Room Consultant _____

Final verification _____

Food Science/Technology Feedback

Strengths

Suggestions For Improvement

Food Science Laboratory Report Form

INTRODUCTION: A *sample* Food Science Laboratory Report Form with suggested scoring information is provided on the following page. Each phase in reporting experimental results is addressed. When reporting laboratory results, be sure you are aware of the definitions of the following terms and how they relate to writing the laboratory report form.

Purpose — A statement defining the goal for the experiment or the problem to be solved. This information can be found in the INTRODUCTION of each experiment in this guide.

Procedure — A brief summary of the steps in which the experiment is to be performed. DO NOT copy the procedural steps word-for-word.

Observations — This is *your* record of what happened during the experiment. Write your observations in descriptive statements that are brief and to the point. *Observations* are made through the use of the five senses: *sight*, *sound*, *odor*, *touch*, and *taste*. Sometimes you may find your observations do not agree with the expected outcome of the experiment.

Data Table — Often observations are written in a table format. You will find data tables have been designed for use with each experiment in this guide. Attach the data table to lab report form. *Data* can be classified as either *quantitative* or *qualitative*.

- *Quantitative Data* are numerical measurements such as volume, mass, or length.
- *Qualitative Data* are observations such as color, odor, and texture.

Calculations — Solutions to problems often involve mathematical calculations. Formulas for these calculations are provided with the experiments.

Questions — Each experiment will ask specific questions. Answer the questions based on results from the experiment or information gathered to perform the experiment. Sometimes outside research will be necessary to answer a question.

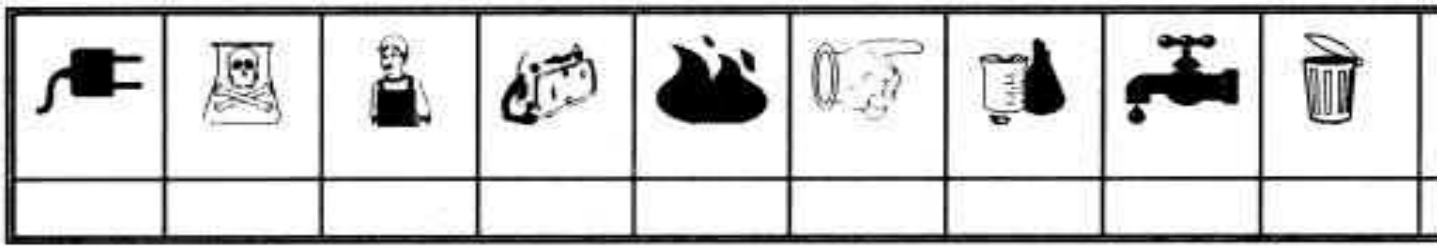
Conclusions — Judgments are based on observations and analysis of data. The following examples show a distinction between observations and conclusions:

a. If you taste a white, crystalline substance, your observations will be that it tastes sweet - your conclusion is that it is sugar.
b. You can observe properties of substances, but you conclude the identity of substances.

Experiment Name_____ Number:_____ Total Points:_____

I. PRE LAB: (Complete this part before conducting the experiment.)

A. Safety: Identify safety precautions for this lab. _____ points



B. Student Data:

Name:_____ Class Period_____ Date Performed: _____

Lab Partners:_____

C. Purpose: _____ points

D. Procedure: _____ points

II. LAB: (Complete this part during the experiment. Attach a data table to this report. _____ points)

E. Observations: _____ points

F. Data Summary: _____ points

G. Lab Completion and Clean up: _____ points

III. POST LAB: (Complete this part after the experiment.) **Date Due:** _____

H. Questions/Calculations: _____ points

I. Conclusions: _____ points

STUDENT GUIDELINES - FOOD SCIENCE SAFETY

ELECTRICAL SAFETY: This symbol alerts students to use electrical safety practices with electrical equipment throughout this laboratory experience.

- Electrical equipment should be handled with dry hands. Remember to keep work areas dry also.
- Pull plugs, not cords, when inserting and removing electrical plugs. *(Keep one hand free when plugging and unplugging appliances - your body is an excellent conductor of electricity.)*
- Do not overload electrical circuits.
- Keep electrical cords away from traffic paths.
- Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, loose connections. DO NOT use damaged electrical equipment.
- Avoid putting electrical equipment or cords too close to a heat or water source.
- Inspect electrical equipment for proper grounding.
- Unplug electrical equipment that is not in use; store in proper and safe location.
- Do not touch metal conductors.

CHEMICAL SAFETY: This chemical safety symbol warns students that substances/chemicals used in the laboratory experience are dangerous and require safe handling practices.

- Never eat or bring food into the laboratory or work space.
- DO NOT eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult.
- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read labels carefully; unused chemicals should be returned to properly labeled containers.
- Avoid chemical contact with skin and eyes. *Wear goggles, aprons, and gloves.*
- Do not touch chemical solutions.
- DO NOT touch your mouth to pipette; use a suction bulb.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly; report to the teacher.
- DO NOT use laboratory glassware and containers for eating or drinking. These items should be stored separately from kitchen containers.
- Always add strong acids to water instead of adding water to the acids.
- Dispose of chemicals according to all local, state, and federal laws.
- Clean up all residue and dispose of properly.
- DO NOT dispose of materials in sink unless instructed to do so.
- *IF* mercury thermometers are used and *IF* one is broken - *DO NOT* play with the mercury. Notify your teacher for proper disposal.

PERSONAL AND CLOTHING SAFETY: This clothing safety symbol warns that laboratory conditions require certain precautions that are to be taken to protect clothing.

- Locate exits, fire blanket and extinguisher, master gas and electricity shut offs, eye wash and first aid kit.
- Make sure there is adequate ventilation.
- *DO NOT* horseplay.
- *KNOW* the hazards of the experiment and anticipate dangers.
- Wear and apron or lab coat during laboratory experiences.
- *DO NOT* wear jackets and open shoes in the laboratory; confine loose clothing, hair and jewelry.

EYE/VISION SAFETY: This symbol represents the need for eye protection during the laboratory experience.

- When instructed, approved safety goggles should be worn.
- *KNOW* where and how to use the eye wash station and equipment.
- Contact lens wearers should inform their teacher for special precautions.

FIRE SAFETY: The symbol alerts students that safety precautions must be taken when working with heat and fire.

- KNOW location and use of fire blankets, extinguisher, and the master gas and electricity shut offs.
- Use goggles, apron and gloves when working with boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave hot plates, ranges, or Bunsen burners unattended.
- Use tongs and dry, heat-resistant mittens/pot holders.
- Turn off hot plates, ranges, Bunsen burners and gas when you are done.
- Keep flammable substances away from heat.
- USE only heat-resistant glassware.
- Test tubes with heated substances should ALWAYS be pointed away from people.
- Heat only chemicals and substances specified by laboratory procedures and under the supervision of the teacher.

HAND SAFETY AND PROTECTION: This symbol alerts the student that precautions need to be taken to protect the hands.

- Use tongs or clamps while heating and handling hot containers.
- Handle heated glassware with caution; it appears the same, cool or heated.
- Wear gloves as needed to protect hands.
- Observe the following rules when using knives and other sharp instruments:
    - Use knives and other sharp or pointed instruments with caution.
    - Carry with tips and points pointing down and away.
    - Always cut away from your body.
    - Never try to catch falling sharp instruments.
    - Take sharp instruments by the handles.

GLASSWARE SAFETY: This symbol indicates safety precautions that should be used when handling glassware.

- Use only alcohol thermometers, not mercury.
- Clean glassware before and after use. Use only dry glassware.
- Check glassware for scratches, cracks, and sharp edges.
- Return broken or cracked glassware to your teacher.
- Clean up broken glassware immediately using a damp paper towel. If the broken glassware is hot, allow it to cool before clean-up.
- Avoid putting hot glassware on an unprotected surface or in cold water.

PERSONAL HYGIENE AND SAFETY: This water symbol will alert students to personal hygiene and safety.

- Begin all labs by washing hands with soap and water.
- Assume all microorganisms are infectious; wash hands after handling.
- Keep your hands away from your face and mouth.
- Wash hands thoroughly with soap and water after handling food, chemicals, containers and supplies.

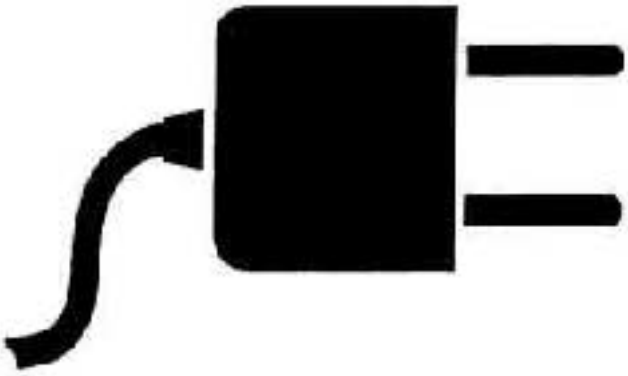
WASTE DISPOSAL: This symbol represents the proper and safe disposal of wastes and/or chemicals.

- All chemicals and wastes must be disposed of according to local, state, and federal laws.
- Clean up residue and place in container for proper disposal.
- DO NOT dispose of materials in sink unless instructed to do so.
- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.

EQUIPMENT USE AND SAFETY: This symbol requires that the equipment be handled safely and used properly. Instruction on the proper use of the equipment may also be implied.

- Know how to properly and safely use the equipment required for a laboratory experiment.
- Observe safety precautions required of lab equipment.
- Set up equipment far from the edge of the table, desk, or counter.
- DO NOT use reflected sunlight to illuminate your microscope.

SAFETY PRECAUTION SYMBOLS



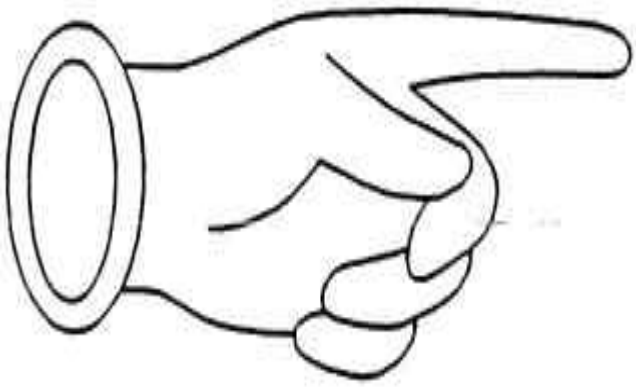
Electrical Safety

Chemical Safety

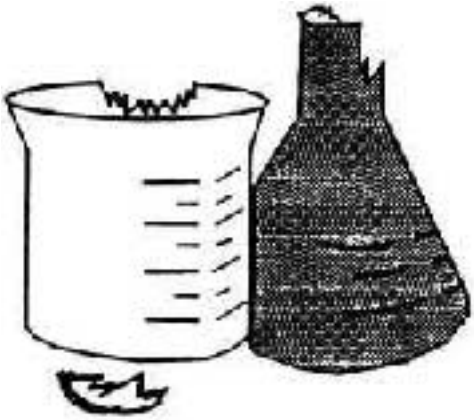
Personal and Clothing Safety

Eye/Vision Safety

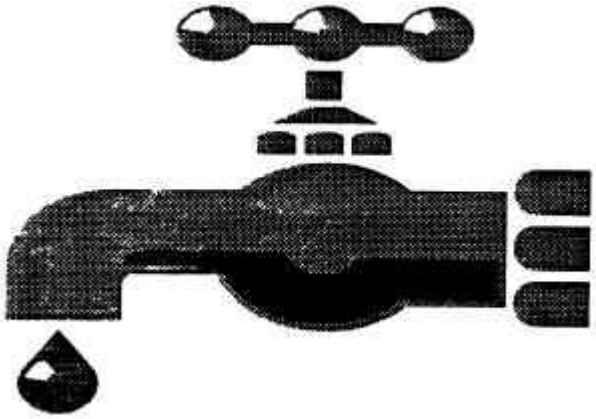
Fire Safety



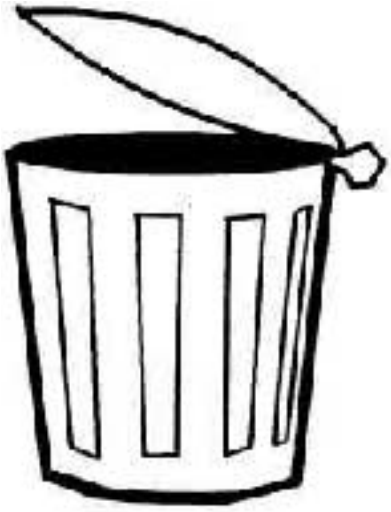
Hand Safety and Protection



Glassware Safety



Personal Hygiene and Safety

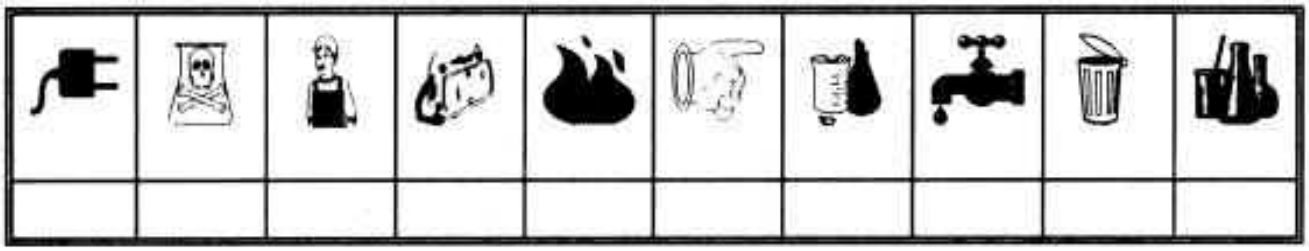


Waste Disposal

Equipment Use and Safety

Safety Precautions



Working in a science laboratory is normally very safe. To ensure your personal safety and the safety of others, you need to reduce the risks associated with laboratory work. Risk in the science lab can come from either physical or chemical hazards. By examining these hazards, you will understand why the following rules have been developed for working in scientific laboratories.

Chemical hazards result from exposure to hazardous chemicals from absorption through skin or eye contact, inhalation, ingestion, or injection. Physical hazards include falls, cuts, eye injury, electrical shock, and fire.

1. **Protect your eyes.** Appropriate eye protection must be worn **<u>at all times</u>** in the laboratory. Chemical splash goggles provide maximum protection from splashes. Contact lenses should not normally be worn unless approved by your teacher. Unventilated goggles are essential if contact lenses are to be worn.
2. **Wear appropriate protective clothing**. Chemicals can burn or irritate the skin. Some chemicals are readily absorbed through the skin and enter your body. Your clothing should cover your legs to the knees. Shorts are not appropriate for the laboratory. Laboratory coats or aprons can protect good clothing. Loose clothing should not be worn because it may dip into chemicals or fall into a flame and catch fire.
3. **Wear shoes that cover your feet.** Sandals and open-toes shoes do not protect your feet from broken glass that is frequently found in science laboratories. Also, leather shoes protect your feet from chemical spills, canvas shoes do not.
4. **Do not apply cosmetics, eat, or drink in the laboratory.** These activities are ways by which you can accidentally ingest harmful chemicals.
5. **Do not tasteany chemical.**
6. **Do not smell chemicals directly**. Smell a chemical only if your teacher specifically tells you to do so, then use your hand to fan the vapor to your nose.
7. **Do not pipette solutions by mouth.** Use a rubber suction bulb or other device to fill a pipette.
8. **Washyour hands with soap and water before leaving the laboratory.** This ruleapplies even if you have been wearing gloves.
9. **Knowthe hazards of the materials being used.** Read the labels carefully to makesure you are using the right chemical. Know how to interpret data from a MSDS. Remember that hot and cold glassware look the same, so allow ample time forcooling.
10. **Tieback loose hair.** Dangling hair can fall into a Bunsen burner and catch fireor can fall into a chemical solution.
11. **Knowthe safety equipment.** Know the location of eyewash fountains, safetyshowers, fire blankets, fire extinguishers, first-aid kits, and emergencyexits. Know how to respond in case of an emergency. Know how to use the safetyequipment.
12. **Carryout only the experiments assigned by your teacher.** Never performunauthorized experiments.
13. **Neverremove chemicals from the laboratory.**
14. **Neverwork in the laboratory unless authorized to do so by your teacher.** Neverwork alone in the laboratory. In case of a problem, you may need another personto prevent injury or even save your life.

15. **Neverengage in horseplay, games, or pranks in the laboratory.** Remember that thelaboratory is a place for serious work. Careless behavior can endanger yourselfand others and will not be tolerated.
16. **Demonstratesafe behavior.** Obey all safety instructions given by your instructor orfound in your experimental procedure. Clean up spills immediately if you knowhow. If you are uncertain how to clean up a spill or if a large spill occurs,notify your instructor immediately. Before leaving the laboratory, returnequipment and chemicals to their proper places. Clean up your work area.
17. **Disposeof all waste materials according to your teacher's instructions.**
18. **Reportany accidents or unsafe conditions to your teacher immediately.**

SAFETY CONTRACT

Students will be removed from the laboratory by the teacher if:

- their personal appearance or dress is such that they can cause injury or distraction to themselves or others;
- they are behaving in such a manner that they can cause injury to themselves or others;
- they are not following the prescribed safety rules for the laboratory or the particular activity being conducted;
- they have not completed the pre-lab activities that are needed for them to work safely in the laboratory.

I, _____, a student in science at _____ High School, have read and agree to follow all safety rules and regulations given by my teacher. I realize that following these rules is necessary to ensure the safe operation of the school laboratory and to provide a safe environment not only for myself, but for my fellow students and my teachers as well. I will, therefore, cooperate fully with teachers and students to assure that all of us work safely. I will act responsibly to look for possible safety hazards and will immediately point out these hazards to the instructor. I realize that, as a student, much of the responsibility for safety is in my hands. I understand that violation of these rules may result in the loss of laboratory privileges and possible disciplinary measures.

Contact Lens Wearers

Wearing contact lenses in the laboratory is the subject of controversy because of the extra risk they create in case chemicals enter the eye. Some experts believe that contacts should never be worn in the laboratory. Other experts believe that contact lenses can be worn with proper eye protection.

I will wear contact lenses in the laboratory. ❒ Yes ❒ No. If yes, I realize the hazards associated with the use of contact lenses and will strictly adhere to the eye protection requirement.

Signed: _____ (student)

Date: _____

I, _____, parent or guardian of _____have read this safety contract and the attached rules. I give my permission for my child or ward to enroll in this science course.

Classroom Assessment List for Oral Presentation _____ Activity

	Assessment Points Possible	Earned
1. The speaker can be heard easily.		
2. The speaker shows interest and enthusiasm.		
3. The speaker makes eye contact with individuals in the audience.		
4. The presentation is organized with a beginning, body of information, and conclusion.		
5. There is a clear focus to the presentation and the focus is maintained.		
6. The main ideas support the focus and the transitions between the main ideas are clear.		
7. Appropriate support and elaboration are given to the main ideas.		
8. The speaker has a clear understanding of the subject matter.		
9. The presentation communicates effectively with the intended audience.		
Total		

Oral Presentation Rubric for _____ Activity

Superior The presentation is outstanding. The speaker shows a flair for communicating with the audience. The speaker is confident and at ease and has a clear understanding of the concept.

Excellent The presentation is organized with a beginning, a body of information, and a conclusion. There are clear main ideas with transitions between them. Information is complete and accurate.

Good The presentation is generally well done. Some elements are not complete.

Poor The presentation is not well organized or focused to communicate the concept.

COMMENTS:

Classroom Assessment List for Writing

		Assessment Points PossibleEarned
1.	The student uses appropriate concepts correctly.	_____
2.	Appropriate vocabulary is used.	_____
3.	The writing is organized and focused.	_____
4.	Higher-order thinking is evident.	_____
5.	Appropriate information is used to support concept.	_____
6.	Language mechanics are correct.	_____
7.	The writing is organized and focused.	_____
8.	References, if needed, are properly made	_____
9.	The writing is neat and presentable.	_____
Total		_____

Writing Rubric for _____ Activity

Superior The work is complete, clear and unusually thoughtful. It shows a very high level of conceptual understanding and ability to communicate with a specified audience. Spelling and other language mechanics are excellent.

Excellent The work is very well organized and focused throughout. It is relevant and appropriate to the concept.

Good The work is generally well done. Some elements are not complete.

Poor The work is not well organized or focused to communicate the concept.

COMMENTS

A REVIEW OF THE SCIENTIFIC METHOD

Problems may be approached from different perspectives by different scientists. All, however, use a logical approach that is generally termed the "scientific method." Tasks of this approach should be learned by students of science and include:

Defining the Problem - Limit the problem investigated so it can be tested by an experiment which gives clear-cut results. As part of this approach, researchers gather information about prior investigations of the same type of problem. Not only does this help focus the investigation, but it helps eliminate unnecessary duplication.

Hypothesis - Regularities in data may be used to propose a trial explanation of a natural phenomenon. Sometimes researchers must investigate quite extensively before forming a hypothesis or many hypotheses may be formed and disproved before one is found that can be supported by investigation.

Design an Experiment - Many paths lead to truth, so it's up to the researcher to design a procedure that will demonstrate that the suspected cause and effect relationship is true…or not. This gets into being careful to set up controls. Negative controls are those that show the effect of the absence of the suspected cause agent. Positive controls show what happens if another, established cause is present but not our new suspect. It is not always possible to set up both positive and negative controls. Independent variables are those that are influenced by the experiment (time, weather, etc.) and dependent variables are those which "depend" on the experimental variable.

Observation - Often done as part of an experiment, this goes beyond just looking. The experimenter must correctly record and repeat observations.

Measurement - Precise, quantitative measurements using accurate instruments make our observations more reliable and make it possible for others to check our scientific accuracy.

Analysis - Patterns may be discovered in data. If the experiment has been repeated often enough, trends are revealed.

Theories - Explanations that apply to a broad range of observations are called theories. Theories require testing (just as hypotheses) but many investigations are required to explore the range of the theory's explanation to support a theory.

Reporting - Careful records of our research findings including related research by prior investigations, our experimental design, observed measurements, and the reasoning used to interpret them allow others to learn and, if they want, to repeat our experiment.