Weighto Gol Discovering the Genetics and Biochemistry of Weight



95% = Overweight 90% = High Risk 85% = Lower Risk 50% = Safe 25% = Underweight Risk 10% = Underweight

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KEY TERMS

Adipocyte — fat cell; also known as lipocyte.

Adiponectin — protein which is produced by the body and is associated with heart disease and diabetes when it is produced in lower levels.

Aldosterone — hormone which increases blood pressure.

Amino Acids — the basic building blocks of protein.

Anorectic drugs — prevent hunger.

Arthritis — inflammation of the joints.

Asthma — disease or allergic response characterized by bronchial spasms and difficult breathing.

BMI — Body Mass Index. BMI=weight in Kg / (height in meters)²

BMR — Basal Metabolic Rate, the amount of energy your body needs to carry out the chemical pathways while the body is at rest.

To estimate your BMR:

Women: (your weight in pounds multiplied by 10) + your weight in pounds

Adjust for age: Subtract 2% for each decade past 20 years of age.

Men: (your weight in pounds multiplied by 10) + (your weight in pounds multiplied by 2) Adjust for age: Subtract 2% for each decade past

20 years of age.

Blood pressure — pressure the blood exerts against the inner walls of the blood vessels. Blood pressure is the force that keeps blood circulating continuously even between heartbeats and is measured in millimeters of mercury (mm of Hg).

Systolic — The systolic pressure (the higher and first number) measures the force that blood exerts on the artery walls as the heart contracts to pump out the blood.

Diastolic — The diastolic pressure (the lower and second number) is the measure of forces as the heart relaxes to allow blood to flow into the heart.

Catabolism — the metabolic breakdown of large molecules in living organisms to smaller ones, with the release of energy. Respiration is an example of a catabolic series of reactions. To catabolize is to undergo or cause to undergo catabolism.

Cholesterol — a type of lipid, it is important molecule in cell membranes and a precursor to various other key molecules, including bile salts and steroid hormones.

HDL — High Density Lipoproteins, good cholesterol. Acts as scavengers of cholesterol.

LDL — Low **D**ensity Lipoproteins, bad cholesterol. Delivers cholesterol and triglycerides to body cells for food storage.

Clinical trials — carefully controlled studies that are conducted in humans who volunteer to test the effectiveness and safety of new drugs, medical products or techniques. All drugs in the United States undergo three phases of clinical trials before being approved for general use.

Diabetes — occurs when the body either doesn't make enough insulin or becomes resistant to insulin, preventing it from storing sugar and increasing the body's blood glucose levels.

Type 1 Diabetes — (Insulin-dependent or juvenileonset diabetes) is chronic, incurable, but can be treated with diet and/ or insulin.

Type 2 Diabetes — (non insulin-dependent or adult –onset diabetes) can be controlled by diet, exercise, losing weight, and taking oral medications. Obesity is closely associated with insulin resistance and is the leading risk factor for Type 2 Diabetes.

Epidemic — affecting many people at one time; an epidemic outbreak especially of disease.

Elute — wash out with a solvent, as in chromatography.

Gastric bypass surgery — surgery where the top of the stomach is stapled to the size of a twenty-milliliter pouch (about two tablespoons), and the bottom stomach section still secretes stomach juices but does not "nag" for food.

Gene pool — The combination of all genes and gene variations of a specified group, e.g. species.

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Ghrelin — a chemical messenger (pronounced GRELL-in) discovered only a few years ago stimulates our "need to feed" even in cases where the belly is full. Levels of ghrelin increase during fasting and before meals and fall off after eating. Ghrelin levels rise in people who have lost weight and may be the reason dieters have trouble keeping their weight down long term.

Glucagon — a hormone made in the pancreas that increases blood glucose levels by converting glycogen to glucose in the liver.

Heart Disease — takes many forms; usually, heart disease occurs due to inadequate blood flow to the heart muscle. This occurs when the arteries that supply the heart muscle (the coronary arteries) become partially or completely blocked. Obese people are at increased risk of heart disease due to their higher rates of hypercholesterolemia, diabetes and hypertension.

Homeostasis — the ability of the human body to maintain a constant internal environment even though the external environment changes. Examples include the ability of the human body to maintain a constant internal body temperature about 37° C; a constant water balance; or a constant internal blood sugar balance.

Hormones — chemical messengers (proteins) used to coordinate various parts of an organism.

Hydrophilic — literally, "water-loving;" polar or charged compounds that are soluble in water.

Hydrophobic — literally, "water-fearing;" nonpolar compounds that are immiscible with water. The side chains of some amino acids are nonpolar, and hence protein sequences rich in these amino acids tend to locate to the interior of the protein in its native state, away from the solvent.

Hypertension — high blood pressure, also called hypertension, is simply, elevated pressure of the blood in the arteries. Hypertension results from two major factors, which can be present independently or together:

• The heart pumps blood with excessive force.

• The body's smaller blood vessels narrow, so that blood flow exerts more pressure against the vessel walls.

Hypotension — abnormally low blood pressure, seen in shock but not necessarily indicative of it.

Inflammatory molecular activity — swelling response in fatty tissue which activates the JNK gene. **Insulin** — a hormone (protein) that lowers blood glucose levels by promoting uptake, synthesis, and storage by body cells.

Insulin sensitivity — a body's ability to determine the correct amount of insulin to produce.

JNK gene — a gene that interferes with a body's insulin sensitivity.

Leptin — hormone produced by the ob gene that acts on the hypothalamus of the brain, causing one to feel less hungry.

Lipoproteins — a protein bonded to a lipid.

Liposuction — removal of body fat from the contours of the body via a suction device.

MSH (melanocyte-stimulating hormone) — hormone that increases an organism's resistance to insulin, causing blood sugar levels to be high.

Multifactorial disease — a disease which is caused by a number of different factors.

Negative feedback — a process where various receptors and effectors work to revert the body to its original state, in order to maintain a constant internal environment.

Nuclear receptor — site on the nuclear envelope that receives chemical signals, which tell a cell how to respond.

Obesity — an increase in body weight beyond the limitation of skeletal and physical requirement, as the result of an excessive accumulation of fat in the body.

Phospholipid — one of the group of lipids having both a phosphate group and one or more fatty acids. With their hydrophilic polar phosphate groups and long hydrophobic hydrocarbon 'tails,' phospholipids readily form membrane-like structures in water. They are the major component of cell membranes.

Plaques — proteins which build up on the inside walls of arteries, causing restricted blood flow.

Psychological Disorder — a disease of the mind serious enough to require psychiatric intervention.

POMC gene — gene that makes the MSH hormone. Receptor — a molecule, often found on a cell's surface, which binds to another substance in order to effect a chemical or physiological change.

Stroke — the damage to a group of nerve cells in the brain is often due to interrupted blood flow, caused by a blood clot or blood vessel bursting.

Subcutaneous abdominal fat — fat located between the skin and the abdominal wall.

Supernatant — the soluble liquid reaction of a sample after centrifugation or precipitation of insoluble solids.

Thermogenic drugs — drugs with properties that increase a body's metabolism.

Triglyceride levels — levels of storage fats in the bloodstream.

Visceral fat — fat located in the abdominal cavity.

The Key Components of the 5E Model

DUACE	WHAT THE TEACHER DOES THAT IS			
PHASE	Consistent with the 5E Model	Inconsistent with the 5E Model		
ENGAGE	 Creates interest Generates curiosity Raises questions Elicits responses that uncover what students know or think about the concept/subject 	 Explains concepts Provides definitions and answers States conclusions Provides premature answers to students' questions Lectures 		
EXPLORE	 Encourages students to work together without direct instruction from teacher Observes and listens to students as they interact Asks probing questions to redirect students' investigations when necessary Provides time for students to puzzle through problems Acts as a consultant for students 	 Provides answers Tells or explains how to work through the problem Tells students they are wrong Gives information or facts that solve the problem Leads students step-by-step to a solution 		
EXPLAIN	 Encourages students to explain concepts and definitions in their own words Asks for justification (evidence) and clarification from students Formally provides definitions, explanations, and new labels Uses students' previous experiences as the basis for explaining concepts 	 Accepts explanations that have no justification Neglects to solicit students' explanations Introduces unrelated concepts or skills 		
ELABORATE	 Expects students to use formal labels, definitions and explanations provided previously Encourages students to apply or extend concepts and skills in new situations Reminds students of alternative explanations Refers students to existing data and evidence and asks "What do you already know?""Why do you think?" 	 Provides definitive answers Tells students they are wrong Lectures Leads students step-by-step to a solution Explains how to work through the problem 		
EVALUATE	 Observes students as they apply new concepts and skills Assesses students' knowledge and/or skills Looks for evidence that students have changed their thinking or behaviors Allows students to assess their own learning and group process skills Asks open-ended questions, such as "Why do you think?" "What evidence do you have?" "What do you know about x?" "How would you explain x?" 	 Tests vocabulary words, terms and isolated facts Introduces new ideas or concepts Creates ambiguity Promotes open-ended discussion unrelated to concept or skill 		

(Trowbridge & Bybee, 1990), adapted by Biological Sciences Curriculum Study Available online at http://science.education.nih.gov/supplements/nih1/diseases/guide/module3.htm

2005-06 North Carolina Standard Course of Study for Biology — Grades 9-12

*** Highlighted sections are objectives addressed in the Weigh To Go! module

Strands: Nature of Science, Science as Inquiry, Science and Technology, Science in Personal and Social Perspectives. The strands provide the context for teaching of the content Goals and Objectives.

Competency Goal 1:

The learner will develop abilities necessary to do and understand scientific inquiry.

Objectives

1.01 Identify biological questions and problems that can be answered through scientific investigations.

1.02 Design and conduct scientific investigations to answer biological questions.

1.03 Formulate and revise scientific explanations and models of biological phenomena using logic and evidence.

1.04 Apply safety procedures in the laboratory and in field studies.

1.05 Analyze reports of scientific investigations from an informed, scientifically literate viewpoint.

Competency Goal 2:

The learner will develop an understanding of the physical, chemical and cellular basis of life.

Objectives

2.01 Compare and contrast the structure and functions of the following organic molecules:

- Carbohydrates
- Proteins
- Lipids
- Nucleic acid

2.02 Investigate and describe the structure and functions of cells including:

- Cell organelles
- Cell specialization
- Communication among cells within an organism.

2.03 Investigate and analyze the cell as a living system including:

- Maintenance of homeostasis
- · Movement of materials into and out of cells
- Energy use and release in biochemical reactions

2.04 Investigate and describe the structure and function of enzymes and explain their importance in biological systems.

2.05 Investigate and analyze the bioenergetic reactions:

- Aerobic Respiration
- Anaerobic Respiration
- Photosynthesis

Competency Goal 3:

The learner will develop an understanding of the continuity of life and the changes of organisms over time.

Objectives

3.01 Analyze the molecular basis of heredity including:

- DNA replication
- Protein synthesis (transcription, translation)
- Gene regulation

- 3.02 Compare and contrast the characteristics of asexual and sexual reproduction.
- 3.03 Interpret and predict patterns of inheritance.
- 3.04 Assess the impact of advances in genomics on individuals and society.
 - Human genome project
 - Applications of biotechnology
- 3.05 Examine the development of the theory of evolution by natural selection including:
 - Development of the theory
 - · Fossil and biochemical evidence
 - Mechanisms of evolution
 - Applications (pesticide and antibiotic resistance).

Competency Goal 4:

The learner will develop an understanding of the unity and diversity of life.

Objectives

4.01 Analyze the classification of organisms according to their evolutionary relationships.

4.02 Analyze the processes by which organisms accomplish essential life functions.

4.03 Assess, describe and explain adaptations affecting survival and reproductive success.

4.04 Analyze and explain the interactive role of internal and external factors in health and disease.

4.05 Analyze the broad patterns of animal behavior as adaptations to the environment.

Competency Goal 5:

The learner will develop an understanding of the ecological relationships among organisms.

Objectives

5.01 Investigate and analyze the interrelationships among organisms, populations, communities, and ecosystems.

- 5.02 Analyze the flow of energy and the cycling of matter in the ecosystem.
- 5.03 Assess human population and its impact on local ecosystems and global environments.

North Carolina Standard Course of Study for Chemistry — Grades 9-12

*** Highlighted sections are objectives addressed in the Weigh To Go! module

Strands: Nature of Science, Science as Inquiry, Science and Technology, Science in Personal and Social Perspectives. The strands provide the context for teaching of the content Goals and Objectives.

Competency Goal 1:

The learner will develop abilities necessary to do and understand scientific inquiry.

Objectives

1.01 Design, conduct and analyze investigations to answer questions related to chemistry.

1.02 Analyze reports of scientific investigations from an informed, scientifically literate viewpoint, including considerations of:

- Appropriate sample
- Adequacy of experimental controls
- Replication of findings
- Alternative interpretations of the data

1.03 Analyze experimental designs with regard to safety and use safe procedures in laboratory investigations.

Competency Goal 2:

The learner will build an understanding of the structure and properties of matter.

Objectives

- 2.01 Analyze the historical development of the current atomic theory.
- 2.02 Examine the nature of atomic structure.
- 2.03 Apply the language and symbols of chemistry.

2.04 Identify substances using their physical properties:

- Melting points
- Boiling points
- Density
- Solubility
- 2.05 Analyze the basic assumptions of kinetic molecular theory and its applications:
 - Ideal Gas Equation
 - Combined Gas Law
 - Dalton's Law of Partial Pressures
- 2.06 Assess bonding in metals and ionic compounds as related to chemical and physical properties.
- 2.07 Assess covalent bonding in molecular compounds as related to molecular geometry and chemical and physical properties.
- 2.08 Assess the dynamics of physical equilibria.

Competency Goal 3: The learner will build an understanding of regularities in chemistry.

Objectives

3.01 Analyze periodic trends in chemical properties and use the periodic table to predict properties of elements.

- 3.02 Apply the mole concept, Avogadro's number and conversion factors to chemical calculations.
- 3.03 Calculate quantitative relationships in chemical reactions (stoichiometry).

Competency Goal 4:

The learner will build an understanding of energy changes in chemistry.

Objectives

4.01 Analyze the Bohr model in terms of electron energies in the hydrogen atom.

4.02 Analyze the law of conservation of energy, energy transformation, and various forms of energy involved in chemical and physical processes.

4.03 Analyze the relationship between entropy and disorder in the universe.

4.04 Analyze nuclear energy.

Competency Goal 5: The learner will develop an understanding of chemical reactions.

Objectives

5.01 Identify various types of chemical reactions:

- Single replacement
- Double replacement
- Decomposition
- Synthesis
- Combustion of hydrocarbons

5.02 Apply the law of conservation of matter to the balancing of chemical equations.

5.03 Identify the indicators of chemical change:

- Formation of a precipitate
- Evolution of a gas
- Color change
- Absorption or release of heat
- 5.04 Identify the physical and chemical behaviors of acids and bases.
- 5.05 Analyze oxidation/reduction reactions with regard to the transfer of electrons.
- 5.06 Assess the factors that affect the rates of chemical reactions.

2005-06 North Carolina Standard Course of Study for Healthful Living — Grades 9-12

*** Highlighted sections are objectives addressed in the Weigh To Go! module

Strands: Preparatory, Stress Management, Protecting Self/Others, Relationships, Nutrition/Weight Management, Substance Abuse, Personal Fitness, Healthful Lifestyles, Appreciation for Diversity, Social Wellness, Movement Forms, Fitness and Sport Literacy

Competency Goal 1:

The learner will direct personal health behaviors in accordance with own health status and susceptibility to major health risks.

Objectives

- 1.01 Assess own health status.
- 1.02 Accept responsibility for own health.
- 1.03 Determine individual control over health risks.
- 1.04 Compare relationship of health to quality of life.
- 1.05 Describe the procedures for organ donation, local and state resources, and benefits to society.
- 1.06 Identify the value for personal outcomes acquired from lifelong learning about health education

Competency Goal 2: The learner will apply skills of stress management to the prevention of serious health risks for self & others.

Objectives

- 2.01 Develop awareness of own control over stress.
- 2.02 Replace negative thoughts with positive.
- 2.03 Associate behaviors with personal, family, and cultural values.
- 2.04 Cope with losses appropriately.
- 2.05 Respond to others with empathy.
- 2.06 Identify symptoms of mental disorders and know where to seek professional assistance.

Competency Goal 3:

The learner will interpret health risks for self and others and corresponding protection measures.

Objectives

- 3.01 Interpret the importance of various health risks.
- 3.02 Explain activities taken for disaster preparedness.
- 3.03 Prioritize own health risks and construct a model health risk behavior self-management plan.
- 3.04 Identify risk behavior to manage.
- 3.05 Explain the importance of early detection, including medical examination and self-examination.

3.06 Assess behaviors and decisions as to their likelihood of resulting in infant morbidity and mortality. 3.07* Understand that a mutually faithful monogamous heterosexual relationship in the context of marriage is the best lifelong means of avoiding sexually transmitted diseases, including HIV/AIDS.

3.08* Refine skills and strategies for remaining or becoming abstinent from sexual intercourse, and avoiding sexually transmitted diseases, including HIV/AIDS.

3.09* Understand causes, consequences, and prevention of major health risk behaviors for own age group, including the transmission of HIV/AIDS.

Competency Goal 4:

The learner will apply relationship skills to the promotion of health and the prevention of risk.

Objectives

4.01 Analyze problems stemming from unhealthy relationships.

4.02 Implement skills which develop positive relationships.

4.03 Utilize anger management skills.

4.04 Identify resources for managing relationship problems.

4.05 Demonstrate conflict resolution skills.

4.06 Formulate principles for healthful dating relationships.

Competency Goal 5:

The learner will apply behavior management skills to nutrition-related health concerns.

Objectives

5.01 Provide detailed examples of how nutrition and physical activity can reduce the risk for chronic diseases.

5.02 Develop a personal healthful eating plan that incorporates food choices outside the home setting.

5.03 Develop specific eating plans to meet changing nutritional requirements, such as special dietary needs, athletic training, pregnancy, and food allergies.

5.04 Describe the pharmacological benefits of nutrients such as folic acid.

5.05 Evaluate specific diet plans found in popular magazines and books.

5.06 Design a plan for personal weight management based on a realistic and healthful body image.

5.07 Differentiate between healthful and harmful dietary habits.

Competency Goal 6:

The learner will choose not to participate in substance use.

Objectives

6.01 Recognize and seek help for depression.

6.02 Describe the potential effects on others of substance abuse by individuals.

6.03 Analyze motives for and consequences of steroid abuse.

6.04 Access services for dealing with substance abuse problems.

6.05 Explain behavior change strategies used in the treatment of substance abuse.

6.06 Delineate the risks involved in binge drinking.

6.07 Define "Fetal Alcohol Syndrome" and describe how it is prevented.

Competency Goal 7:

The learner will achieve and maintain an acceptable level of health-related fitness.

Objectives

7.01 Recognize and apply safety techniques, practices, and guidelines as related to fitness and nutrition.

7.02 Identify and analyze the principles of cardiovascular and strength development.

7.03 Complete a health related fitness test and assess personal level of physical fitness, including monitoring of the heart.

7.04 Interpret multiple sets of data in order to determine the best course of action for a healthy personal lifestyle.

7.05 Design and implement a personal activity program that demonstrates the relationship between physical activity, nutrition and weight management.

7.06 Recognize the implications of cardiovascular disease on healthy living.

Competency Goal 8: The learner will exhibit regular physical activity.

Objectives

8.01 Identify resources in the community that can be accessed to maintain regular physical activity.

8.02 Evaluate the benefits of various physical activities.

8.03 Demonstrate and evaluate the importance of regular physical activity and proper diet.

8.04 Use goals and logical steps to develop an action plan to organize resources in order to be physically active. 8.05 Participate regularly in health-enhancing and personally rewarding physical activity outside the physical education class setting.

8.06 Appreciate and value the importance of regular physical activity.

Competency Goal 9:

The learner will demonstrate an understanding and respect for differences among people in physical activity settings.

Objectives

9.01 Execute respect for individual differences in physical activity settings.

- 9.02 Synthesize and evaluate knowledge about the role of physical activity in a diverse society.
- 9.03 Develop strategies for including persons of diverse backgrounds and abilities in physical activity settings.

Competency Goal 10:

The learner will demonstrate responsible personal and social behavior in physical activity settings.

Objectives

10.01 Work productively as a member of a team and contribute to the team's success through the assumption of a variety of noncompetitive duties.

10.02 Set personal goals for the development of skills, knowledge, and social responsibility, and work independently toward those goals.

10.03 Practice acceptable sportsmanship and fair play behaviors in physical activity settings.

10.04 Apply cooperative social skills to partner and group activities such as dance, outdoor activities, team building, problem solving, and cooperation games.

10.05 Demonstrate leadership in physical activities.

Competency Goal 11:

The learner will participate successfully in a variety of movement forms and gain competence towards lifetime physical activities.

Objectives

11.01 Participate at a competent level in small-sided games in at least one team sport.

11.02 Participate at a competent level in small-sided games in at least one individual or dual sport.

11.03 Participate at a competent level in at least one other movement form such as dance, gymnastics, aquatics, and outdoor pursuits.

11.04 Engage in various duties as they pertain to games and sport.

Competency Goal 12:

The learner will demonstrate a competent level of physical activity, sport, and fitness literacy.

Objectives

12.01 Exhibit knowledge of concepts in three different activities by officiating, judging, or refereeing.

12.02 Demonstrate competence in basic offensive and defensive strategies or tactics in team, individual, and dual activities.

12.03 Apply rules, biomechanical or movement principles, problem solving and fitness concepts to game and movement settings.

12.04 Know and apply safe practices in physical activity settings.

12.05 Apply statistical data about personal and group performance to the improvement of game play.

Weigh to Go! Correlation to the National Science Education Standards

The Teaching Standards			
Weigh to Go! Correlation			
Each activity in the module provides short —term objectives for students. There is a conceptual flow of activities and a timeline for teaching the module and helping teachers plan.	 Standard A: Teachers of science plan an inquiry-based science program for their students. In doing this, teachers develop a framework of yearlong and short-term goals for students. select science content and adapt and design curriculum to meet the inter- 		
Use of this module helps teachers to update their curriculum in response to student interest in the topic.	 est, knowledge, understanding, abilities, and experiences of students. select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners. 		
The module's focus is active, collaborative, and inquiry-based.			
Student inquiry is encouraged by all activities in the module.	Standard B: Teachers of science guide and facilitate learning. In doing this, teachers		
The module promotes discourse among students, and challenges students to accept responsibility for their own learning by using hands-on, inquiry-based activities.	 focus and support inquiries while interacting with students. orchestrate discourse among students about scientific ideas. challenge students to accept and share responsibility for their own learning. recognize and respond to student diversity and encourage all students to 		
The use of the 5E instructional model with collaborative learning is an effec- tive way of responding to diversity in student backgrounds and learning styles.	 participate fully in science learning. encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science. 		
There are a variety of assessment components provided in the module, such as group discussion, data collection, and student writing activity. Answers are provided to help teachers analyze student feedback.	 Standard C: Teachers of science engage in ongoing assessment of their teaching and of student learning. In doing this, teachers use multiple methods and systematically gather data about student understanding and ability. analyze assessment data to guide teaching. 		
The answers provided for teachers model respect for diverse ideas, skills, and experiences of all students. Students work collaboratively in teams to complete activities in the module. Discussion activities in this module model the rules of scientific discourse.	 Standard E: Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning. In doing this, teachers display and demand respect for the diverse ideas, skills, and experiences of all students. structure and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse. model and emphasize the skills, attitudes, and values of scientific inquiry. 		

Weigh to Go! Correlation to the National Science Education Standards

The Content Standards		
Weigh to Go! activity		
Pre-lab Activities Wet-lab Activities Additional Activities	 Standard A (Science as Inquiry): As a result of activities in grades 9-12, all students should develop 1. abilities necessary to do scientific inquiry. identify questions and concepts that guide scientific investigations Use technology and mathematics to improve investigations and communications Formulate and revise scientific explanations and models using logic and evidence Recognize and analyze alternative explanations and models Communicate and defend a scientific argument 2. understanding about scientific inquiry. 	
Introduction Wet-lab Activities Pre-lab Activities	 Standard C (Life Science): As a result of their activities in grades 9-12, all students should develop understanding of the cell. Cells store and use information to guide their functions Cell functions are regulated through both the selective expression of genes and changes in protein activity Cells can differentiate, and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells In all organisms, DNA carries the instructions for specifying organism characteristics. 	
Post-lab Activities	 3. biological evolution. Species evolve over time 	
Wet-lab Activities Post-lab Activities Additional Activities	 Standard E (Science and Technology): As a result of activities in grades 9-12, all students should develop understanding of 1. abilities of technological design. 2. understandings about science and technology. Scientists in different disciplines ask questions, use different methods of investigation, and accept different types of evidence to support these explanations Science often advances with the introduction of new technologies Creativity, imagination, and good knowledge base are all required in the work of science and engineering Science and technology are pursued for different purposes 	
Pre-lab Activities Additional Activities	Standard F (Science in Personal and Social Perspectives): As a result of activities in grades 9-12, all students should develop understanding of 1. personal and community health. 5. human-induced hazards. 6. science and technology in local, national, and global challenges.	
All	Standard G (History and Nature of Science): As a result of activities in grades 9-12, all students should develop understanding of 1. science as a human endeavor. 2. nature of scientific knowledge. 3. historical perspectives.	

INTRODUCTION

This module promotes awareness of the obesity epidemic, at a global and an individual level, in order to address several key objectives:

 To recognize obesity as a growing and pressing problem, and to recognize its health and economic implications;
 To comprehend connections between human biochemistry and physiology; to understand how genes work at the molecular level to create changes in how the body functions as a whole;

3. To recognize the significance of genetic engineering for the production of protein;

4. To use information about the chemistry of molecules to understand the process of hydrophobic interactive column (HIC) chromatography;

5. To explain how the structures of macromolecules in the diet relate to their function in the body, and to recognize the important impact diet has on weight;
6. To acknowledge the roles that both genetics and the environment (DNA and personal choice) play with respect to risk factors for disease (cardiovascular disease, diabetes, cancer, etc.) and weight control.

BACKGROUND

According to 2005 statistics from the Centers for Disease Control and Prevention, obesity is the seventh leading cause of preventable death in the United States, representing an epidemic that is growing in the midst of fast-food chains and changes in physical activity for many people throughout the world. It is strongly associated with chronic diseases, including heart disease, diabetes, and cancer; furthermore, obesity often affects psychology and behavior, as evidenced by depression or low self-esteem. In addition to these consequences on physical and mental health, obesity has also taken a financial toll. Economically, it is easier to provide relatively unhealthy foods to a population because they are less expensive; healthy alternatives,

by contrast, tend to cost more. Even though up-front costs may favor diets higher in fat or sugar, the health bills for these individuals and for the health care system in general are enormous. According to the Center for Surgical Weight Reduction at New York Methodist Hospital, American weight loss industry has grown into a \$33 billion-per-year industry. Obesity and physical inactivity result in a yearly U.S. price tag of \$117 billion, as noted by Secretary of Health and Human Services Tommy Thompson in the spring of 2004.

SCIENCE TO THE RESCUE?

The stigma associated with being overweight is all too often encountered in daily life. Magazine covers of underweight models, constant commercials advertising the latest trends in dieting, and the psychological stress of selfimage all contribute to ideals of thinness. Additionally, authors such as Ellen Ruppel Shell (2002) keenly point out stereotypes given to those who are overweight, such as laziness and gluttony. Fortunately, recent genetic strides have been made regarding the science of obesity, and can alter pre-existing perceptions of people who are overweight (Shell, 2002). We now know that the obesity gene, known as ob, plays a crucial role in controlling body weight. When expressed (i.e., when made into a protein), the ob gene codes for a protein known as leptin, a hormone that acts to make a person feel less hungry. Leptin is produced in fat cells, also known as lipocytes or adipocytes. Leptin, however, does not act alone to signal a sense of being full. In fact, obesity is controlled by a powerful biological system of proteins (including hormones such as leptin), neurotransmitters, and genes, all of which regulate fat storage and body weight and tell the brain when, what, and how to eat. Just as important as signals are the receptors, or the places that are receiving the critical messages. An error in either the hormone or the receptor can lead to imbalances in biochemistry and can have potential consequences for weight control.

In the hypothetical scenario of this wet-lab, a modified form of leptin has been produced and manufactured in genetically engineered bacteria. Students will purify this modified protein during the wet-lab using hydrophobic interactive column chromatography. This modified form of leptin lasts longer and would not need to be administered as frequently to mice that have defective alleles for leptin production.

The action of leptin within the body operates according to a **negative feedback** mechanism. Just as a thermostat in a cold house (or human body temperature) rises, hits an ideal temperature, and then shuts off, so, too, do the leptin levels in a hungry person rise, hit a level to make a person feel full, and serve as a signal to stop eating.

Other body functions operate on a similar negative feedback system. The pancreas and liver, for example, use two other hormones, glucagon and insulin, to regulate glucose (sugar) levels in the blood. When blood sugar levels are low, glucagon acts to raise glucose levels by changing glycogen into glucose in the liver. After a person eats, food breaks down into sugars, in the form of glucose in the bloodstream. The release of insulin by the pancreas leads to the uptake of glucose by cells, and results in the change of glucose to glycogen within the liver. People with diabetes have too much glucose in their blood, and not enough glucose taken up by their cells. This is why diabetics with a particular type of diabetes, called type 1 diabetes, have to take insulin shots.

FIGURE 1: GLUCAGON-INSULIN NEGATIVE FEEDBACK SYSTEM



With the rise in numbers of people with obesity, there has been a particular increase in the numbers of people with type 2 diabetes, distinguishable from type 1 diabetes because type 2 is non-insulin-dependent. Because of this relationship between obesity and diabetes, people with type 2 diabetes may be able to control their conditions by altering diet and by exercising, in addition to taking medication.

The control of leptin or insulin levels in the body is an example of homeostasis, or the body's attempt to keep its functions in balance. Similar to a house maintaining a steady temperature, the body, too, tries to keep a variety of controls in balance, including temperature, pH levels, and glucose and leptin levels. Homeostasis is one of the important characteristics of life; all organisms (plants, animals, bacteria, etc.) maintain homeostasis. Without this important function, an organism cannot live.

PRE-LAB

The pre-lab of this module introduces students to health issues associated with weight by presenting a case study of a high school student, John, who wants to play high school football. Students develop an understanding of John's medical history and current condition by examining a number of factors. During the course of the lab they review his family history, check for ketones and sugars in John's urine to test for diabetes, calculate his BMI-for-age (body mass index determination for adolescents), determine his body shape using his waist measurement, take blood pressure, and perform a cholesterol test. By looking at all these elements, students assess John's current health condition and make a recommendation as to whether he should participate in football.

WET-LAB

Once a protein such as leptin has been discovered, it has many potential applications. But in order to prepare the protein so that it can be given to those who need it, greater quantities are needed. This is where genetic engineering comes into play. The wet-lab for this module shows students how biotechnology can be used for practical purposes — in this case, to separate the protein leptin from other proteins.

In order to make large amounts of a protein, bacteria are often used because they multiply rapidly. Bacteria can be genetically engineered to contain the leptin protein. Desired genes that are incorporated into their DNA multiply when the bacteria multiply. A gene that codes for leptin can be genetically engineered to fit into the DNA of a bacterial cell, and copies of this gene are made when the DNA replicates (makes copies of itself). Many copies of the ob gene, means many copies of leptin can be made. Bacteria, though, have many proteins. To separate these regular bacterial proteins from the desired leptin protein, the process of hydrophobic interactive chromatography (HIC) is used.

HIC works on the principle of hydrophobic interactions. "Hydro" is Greek for water, and "phobic" means "fearing." Hydrophobic molecules are nonpolar, in contrast to polar molecules such as water. Soaps and oil work on this hydrophobic principle; because soap and oil are both hydrophobic, they work well together when washing dishes, for example. Amino acids, the building blocks of protein, vary in their love (hydrophilic) or fear (hydrophobic) of water. Phospholipid molecules, which are important components of the cell membrane, also contain hydrophilic and hydrophobic components.

Phospholipids have negatively charged phosphate groups, which are polar and attracted to water (hydrophilic). Because they are lipids, they also have fatty acid tails that are "afraid" of the water (hydrophobic). Cell membranes have a bilayer (two-layer) structure, so that hydrophobic tails point toward one another, and hydrophilic phosphate heads point out toward the water.

To model the hypothetical scenario above, students are going to simulate the purification of leptin that has been tagged with a green fluorescent marker by using an actual protein called Green Fluorescent Protein, or GFP. Using column chromatography, students per-

FIGURE 2: BILAYER OF PHOSPHOLIPIDS IN CELL MEMBRANE



form an extraction of GFP (simulated leptin) from bacteria cells. For the extraction of this protein, this module uses Bio-Rad's Green Fluorescent Protein (GFP) Purification Kit. GFP is ideal to use for this simulation for several reasons. First, as its name indicates. the protein gives off a bright green glow that can be easily observed with the naked eye. Second, GFP is hydrophobic because of its water-fearing amino acids. Because of GFP's hydrophobic properties, hydrophobic interactive column chromatography is an especially suitable technique to use to separate GFP from all other bacterial proteins. Thus, during the wet-lab students will be purifying GFP in reality but simulating the purification of leptin that has been tagged with a green fluorescent marker (this modified form of leptin does not yet exist in real life). This way, students will know they have separated "leptin" successfully if they see a green glow at the end of the purification process.

Hydrophobic Interaction Chromatography makes use of the idea that GFP is more hydrophobic than other bacterial proteins. By passing a series of decreasingly strong salt solutions through a column with hydrophobic beads, students will wash away other proteins, leaving the most hydrophobic GFP proteins behind. This happens for two reasons: first, because the hydrophobic GFP proteins are more attracted to the hydrophobic beads; and second, because the stronger the salt wash, the more easily the hydrophobic amino acids can attach to the beads. In the final, weakest salt wash, the GFP proteins wash away as well, because the hydrophobic amino acids no longer stick to the beads as strongly.

POST-LAB/ADDITIONAL ACTIVITIES

Two post-lab activities help reinforce the main points of the Weigh to Go! module. First, the DESTINY Quiz Game provides a fun evaluation activity that allows students to demonstrate their knowledge in the style of the popular TV game, "Jeopardy." Teachers can project the game onto a screen to play interactively or use the printed versions of the quiz questions in class. Second, The Fattest Americans video and question sheet reconnects to the pre-lab scenario of the transfer student from Arizona, John, who wants to try out for football. John is a Native American from the Pima tribe in the Southwest—a tribe that has experienced a significant problem with obesity and diabetes. The Fattest Americans focuses on the Pima to provide an engaging analysis of the interconnected factors that contribute to obesity and diabetes including genes, environment, external forces, and personal choices.

Just as the outcome of a poker game depends both on the cards a person is dealt and the choices the player makes, so too does one's health depend on both genetics and the environment. The Weigh to Go! module emphasizes the crucial role that genes can play in weight regulation, and the wet-lab highlights the importance of leptin to this function. On the other hand, the pre-lab measurements of John's vital signs suggest he may be able to make some personal choices that can change the future direction of these characteristics. Participating in an athletic activity (exercise) and changing what he eats (diet) could help John lower his weight, blood pressure and cholesterol readings, and possibly affect future results of a diabetes test. Also important is that John is young and able to make personal changes in lifestyle that will affect the many adult years in his future.

Many genes are involved in diseases such as heart disease and cancer. The idea that many genes (and not just one) are involved provides evidence for the complexity of the body, and illustrates that the boom of genetic testing can have both positive and negative effects on people. Additional activities that address the genetic and environmental factors of weight include "The Story of Steve and Sara," which uses leptin assessment to rule out genetics as the cause for obesity in one of two siblings; "Morgan: A Case for Diabetes," which focuses on genetics and diabetes; and the NIH activity "Are You Susceptible?" with a special introduction called "The Gambler"; together these look at how genetics and environment interrelate.

Students now know more about the genetic components of weight; however, obesity is also closely related to diet, nutrition, and lifestyle choices. Individuals may not be able to change their genes, but a thorough understanding of the relationship between diet and weight can give them a greater sense of control over their bodies and their health. Important components of dietary health include caloric intake, distribution of calories, and vitamins and minerals.

Several additional activities highlight nutrition and calories. "Energy to Burn" is a hands-on lab that reveals the caloric content of different foods using a simple Calorimeter. "BMR: How Many Calories Do You Need?" provides students the opportunity to calculate their own daily needs; "Calories Count: Do the Math!" and "The Thickburger Math Extension" encourage students to calculate the calories present in common foods and popular fast foods.

Many interdisciplinary activities and additional resources are also provided. "The Science of Fat" poster can be ordered for free to use in the classroom; writing prompt activities follow the basic format of many prompts used in the essay section of the SAT; the book The Hungry Gene provides several tie-ins to leptin and other topics covered in the module; and multiple options examine food and culture.

Extension topics include clinical trials, interventions, diet, surgery, gastric bypass, liposuction, plastic surgery, drug therapy, exercise, genetic testing, right to privacy, and ethics.

OBESITY FACT SHEET

Reviewed December 15, 2005

• Sixty-four percent of Americans over the age of 20 are overweight and 30% are obese (National Center for Health Statistics), nearly twice the percentage of adults who were obese in 1980 (Weight Control Information Network).

• Obesity disproportionately affects minority communities. 40% of Blacks and 34% of Mexican Americans (National Center for Health Statistics) are obese, while American Indians seem to be more obese than other minority populations, with some tribes being well over 50% obese (Am J Clin Nutr 1991; 53:1535-42S).

• According to the World Health Organization, childhood obesity is at epidemic levels in the United States. Among younger Americans, 15% of children and adolescents are overweight. This is triple what the proportion was in 1980 (National Center for Health Statistics).

• Seventy percent of overweight adolescents will be overweight or obese adults (US Surgeon General's Office).

• Incidences of diabetes linked to obesity have jumped significantly in US children in the past few decades. A study of 1,000 schoolchildren in Cincinnati showed a 12% increase in the incidence of type 2, or adult onset, diabetes from 1982 to 1994 (J Pediatr. 1996 May; 128[5 Pt 1]:608-15). "Childhood risk factors carry over into adulthood, and may eventually translate into heart disease and other medical problems such as diabetes. Obesity is a major risk factor for heart disease that should be controlled early in life," said Robert H. Eckel, M.D., an endocrinologist at the University of Colorado Health Science Center, Division of Endocrinology, Metabolism and Diabetes, and president-elect of the American Heart Association.

• Although the prevalence of obesity rose across all age groups, races, and education levels during the 1990s, the largest increases were seen in 18-29 year-olds (from 7.1% to 12.1%), the college-educated (from 10.6% to 17.8%) and Hispanics (from 11.6% to 20.8%) (JAMA 1999; 282:1519-1522).

• Obesity is defined as a body mass index (weight in kilograms divided by the square of height in meters) equal to or greater than 30. A waist circumference greater than 40 inches for men, or 35 inches for women, also puts a person in the obese category (NIH Pub. No. 00-4084).

• Obesity is strongly associated with chronic diseases including cardiovascular disease, atherosclerosis, adult-onset diabetes, and sleep apnea (NIH Pub. No. 00-4084).

• Diabetes is the fourth leading cause of death among American Indians and Alaska Natives. Information from the Indian Health Service shows that rates of diagnosed diabetes rose 29% overall from 1990-1997.

FIGURE 3: ADULT BODY MASS INDEX



• Obese people who smoke or have hypertension, high levels of low-density lipoprotein cholesterol, low levels of high-density lipoprotein cholesterol, or family histories of heart disease have a much higher risk of co-occurring diseases (NIH Pub. No. 00-4084).

• Improving diet and increasing physical activity, along with weight loss that often accompanies such lifestyle changes can reduce the risk of diabetes, especially in adults at high risk for the disease. In some cases, such changes can prevent diabetes from developing altogether (The New England J. of Medicine 2001; 344[18]:1343-1350). Even modest weight loss reduces diabetes risk—the Diabetes Prevention Program found that losing 7% of one's body weight was associated with a 58% reduction in diabetes risk. That means that a 200-pound adult would only need to lose 14 pounds to greatly reduce diabetes risk.

• The direct costs of obesity and physical inactivity account for approximately 9.1% of U.S. health care expenditures. Figures for 2002 estimate the total cost at \$117 billion, which is comparable to the economic costs of cigarette smoking (Weight Control Information Network).

• Fewer than half (42.8%) of obese people who had routine checkups last year were advised by their health care professionals to lose weight (JAMA 2001; 286:1195-1200).

WEIGH TO GO! OVERVIEW QUESTIONS

What is obesity?

• In adults, a body mass index (BMI) greater than 25 is considered overweight; a BMI greater than 30 is obese. (BMI = Wt in Kg/(ht)² in meters)

• It is important to note that BMI calculations may not accurately reflect the amount of body fat in people under 20, competitive athletes or bodybuilders, or pregnant or lactating women. Overweight in children and adolescents is measured using BMI-for-age—a BMI greater than the 95th percentile is overweight.

• Another determination of obesity is a waist circumference greater than 40 inches for men or 35 inches for females.

Who is obese?

Compare the prevalence of obesity and diabetes by race.

• The prevalence of both obesity and diabetes is substantially greater in minorities than in whites.

• Obesity disproportionately affects minority communities. 40% of Blacks and 34% of Mexican Americans are obese (source: National Center for Health Statistics), while American Indians appear to be more obese than other minority populations, with some tribes being well over 50% obese (source: Am J Clin Nutr 1991; 53:1535-42S).

Which state has the highest percentage of obese individuals?

• Mississippi with 28.1% (source: Trust for America's Health, 2005). Also, it is 1st in the US in highest rate of obese and overweight adults combined, at 64.5%.

• Over 25% of adults in 10 states are obese, including in Mississippi, Alabama, West Virginia, Louisiana, Tennessee, Texas, Michigan, Kentucky, Indiana, and South Carolina. Seven of those 10 states are in the Southeastern US. (North Carolina ranks 16th in the US in highest rate of adult obesity at 23.9 %.)

• Adult obesity levels are 16% or more in every state.

Which age groups tend to have higher incidences of obesity and diabetes? How prevalent is obesity in children?

• In 2005, 10.3 million, or 20.9% of all people in the US age 60 years or older had diabetes (source: National Diabetes Fact Sheet, 2005). In 2000, 25.6% of all people aged 50-59 were obese (source: JAMA 2001; 286: 1195-1200).

• According to 1999-2002 data, among children and teens ages 6-19, 16% are overweight. That's triple the proportion who were overweight in 1980 (source: National Center for Health Statistics).

• As a consequence more children and adolescents are being diagnosed with diabetes. Clinically-based reports and regional studies suggest that type 2 diabetes, although still rare, is being diagnosed more frequently in children and adolescents, particularly in American Indians, African Americans, and Hispanic/Latino Americans (source: National Diabetes Fact Sheet, 2005).

Perceptions of Obesity Is there a misunderstanding about the causes of obesity?

• "Prejudice against the obese stems from the widely held belief that getting fat—and certainly staying fat—results from a failure of willpower, a condition that could be remedied if the obese person would simply make a personal choice to eat less" (source: US News & World Report 2004; 136: 50).

• "In addition to personal choices, obesity is controlled by a powerful biological system of hormones, proteins, neurotransmitters and genes that regulate fat storage and body weight and tell the brain when, what and how much to eat" (source: US News & World Report 2004; 136: 50).

• Weight is also affected by environmental factors, such as access to healthy foods and safe places to exercise.

How do people misperceive their own weight?

• In a 2002 study, more than half of all men reported they were normal weight when they were, in fact, overweight. Additionally, almost 20% of men who thought they were normal were obese (source: Obesity Research 2002; 10:345-350).

• On the other hand, some people are so concerned with the possibility of becoming overweight that they starve themselves, exercise constantly, and/or take laxatives or emetics to rid their bodies of food. People with conditions such as anorexia nervosa and bulimia see themselves as heavier than they really are. While anorexia and bulimia affect a much smaller percentage of the population than obesity, they are serious health problems.

• Remember that there is a standard for what is considered obesity: for adults, a BMI of 25-29.9 is considered overweight, 30-39 is considered obese, and over 40 is considered morbidly obese (usually more than 100 pounds overweight).

Consequences of Obesity What are the health consequences of obesity?

• Obesity is strongly associated with chronic diseases including high blood pressure, high blood cholesterol, type 2 diabetes, coronary heart disease, arthritis, asthma, strokes, gallstones, poor female reproductive health, bladder control problems, sleep apnea and other respiratory problems, certain types of cancer, and psychological disorders such as depression and low self-esteem.

What is the connection between obesity and diabetes?

• Both diseases are associated with a wide range of inflammatory molecular activity in fatty tissue. These actions activate the JNK gene that interferes with insulin sensitivity (source: Harvard Gazette Archives).

• Increased blood glucose and insulin levels in mice with JNK 1 on a high-fat diet were closely linked to obesity-induced insulin resistance, leading to type 2 diabetes.

• Diabetes requires a hormone, MSH, which is made by the POMC gene. In studies, mice without the MSH hormone were obese but did not develop diabetes. Administration of MSH to mice increased their resistance to insulin and directly affected blood sugar levels. Therefore, MSH may be a factor in the development of type 2 diabetes.

What is diabetes? How does type 2 diabetes differ from type 1 diabetes?

• Diabetes occurs when the body either doesn't make enough insulin or becomes resistant to insulin, preventing it from storing sugar and increasing the body's glucose levels in the blood. Obesity is closely associated with insulin resistance and is the leading risk factor for type 2 diabetes.

• Type 1 diabetes (insulin-dependent or juvenile-onset

diabetes) is chronic and incurable, but can be treated with diet and/or insulin.

• Type 2 diabetes (non insulin-dependent or adult-onset diabetes) can be controlled by diet, exercise, losing weight, and taking oral medications.

What are the connections among obesity, diabetes, cholesterol, high blood pressure, and heart disease?

• "Fat cells act like an endocrine organ, secreting hormones and other substances that affect metabolism, weight and overall health. . . . Too much fat can act like a poison, spewing out substances that contribute to diabetes, heart disease, high blood pressure, stroke, and cancer" (source: Medical News Today, 2004).

• Fat cells produce a hormone called aldosterone, which increases blood pressure.

• People with diabetes tend to have LDL particles that stick to arteries and damage their walls more easily.

• Glucose latches onto lipoproteins. Sugar-coated LDL remains in the blood stream longer and may lead to plaques or hardening in the coronary arteries.

• People with diabetes tend to have low HDL and high triglyceride levels, both of which boost the risk of heart and artery disease.

• People can reduce their risk of heart disease and blood vessel disease by lowering their cholesterol levels.

What is cholesterol? What are HDL and LDL? What are the optimum levels for each type of cholesterol?

• Cholesterol is a type of lipid. It is an important molecule in cell membranes and a precursor to various other key molecules, including bile salts and steroid hormones.

• Blood cholesterol is measured either as total cholesterol or as its fractions. These two fractions are called:

HDL — High Density Lipoproteins (Good Cholesterol) Act as scavengers of cholesterol

LDL — Low Density Lipoproteins (Bad Cholesterol) Deliver cholesterol and triglycerides to body cells for food storage

What do blood pressure numbers indicate?

• Two numbers describe blood pressure:

o **Systolic:** The systolic pressure (the higher and first number) measures the force that blood exerts on the artery walls as the heart contracts to pump out the blood.

o **Diastolic:** The diastolic pressure (the lower and second number) is the measure of forces as the heart relaxes to allow blood to flow into the heart.

• Blood pressure is measured in millimeters of mercury (mm Hg). High blood pressure, also called hypertension, is simply elevated pressure of the blood in the arteries. Hypertension results from two major factors, which can be present independently or together:

o the heart pumps blood with excessive force; o the body's smaller blood vessels narrow so that blood flow exerts more pressure against the vessel walls.

What are the economic consequences of obesity?

• Obesity accounts for 9.1% of total US health care expenditures or \$117 billion (source: Weight Control Information Network, 2005).

• Americans spend \$33 billion annually on weight-loss products and services.

• Productivity suffers with the loss of 39.3 million workdays annually due to obesity.

Science of Obesity

How is fat used by organisms, and what determines whether fat is stored or used?

• Two molecules act as fat sensors that regulate whether fat is stored or burned in cells. They belong to a class of molecules called nuclear receptors and are found in the nucleus of the cell. These molecules are activated when they bind to fatty acids and thus regulate gene expression.

Is the distribution of fat on the body an important consideration?

• At least three distributions of fat are associated with obesity-related adverse health outcomes. These are the relative amount of body fat (BMI), the amount of subcutaneous abdominal fat (upper body fat), and the amount of visceral fat located in the abdominal cavity.

How does the stomach talk to the brain?

• "It is supposed to be simple; you eat when you are hungry and stop when you are full. It is, of course, more complicated than that. Your appetite stems from more than an empty stomach or need for nutrients" (source: Psychology Today, September 2, 2003).

• "A chemical messenger, ghrelin (pronounced GRELLin,), discovered only a few years ago, stimulates our "need to feed" even in cases when the belly is full. ...Levels of ghrelin increase during fasting and before meals and fall off after eating. ...Ghrelin levels rise in people who have lost weight and may be the reason dieters have trouble keeping their weight down longterm" (source: Psychology Today, September 2, 2003).

What do twin studies tell us about obesity?

• "Obesity does not result from a single gene . . . but rather a variety of genes that interact with environmental influences to increase one's chances of becoming obese. In studies of adult twins, who share many or all of the same genes, BMI, body composition, and other measures of fatness appear to be 20 to 70 percent inherited" (source: US News & World Report, February 9, 2004 – Vol 136, No. 5).

What does scientific research tell us about genes and obesity?

• Research indicates that the ob gene causes the muscle cells to produce leptin and suppresses a gene that produces an enzyme known as acetyl – CoA carboxylase, or ACC – which is essential for fat production.

• The more you eat, the more leptin you produce and the less hungry you are. If you don't produce leptin, you don't receive a signal to indicate you are full.

• Mice with two defective alleles in the ob gene cannot produce leptin, resulting in no signal to stop eating and extreme obesity. Mice with a mutation in the db gene have defective leptin receptors; although they produce leptin, they cannot process it.

• Leptin also appears to act via pathways that are independent of the brain, possibly by inhibiting the synthesis of fat in fat cells and increasing the burning of fat in muscle cells.

What can we do about obesity? What kinds of medications are used for the treatment of obesity?

• Three categories of drugs exist: anorectic drugs (which cause loss of appetite), thermogenic agents (which stimulate the metabolism), and drugs that inhibit the digestion or absorption of food. Many obese patients believe medication is a miracle cure and hold unrealistically high hopes.

How about surgery and liposuction?

• A study published in the Annals of Internal Medicine in April 2005 reported that weight-loss surgery resulted in a loss of 44-66 lbs, which was maintained for up to 10 years (source: Ann Intern Med. 2005; 142:547-559).

• One reason for the success rate is that the surgery gives people a weapon they've never had before—a slight diminution of hunger. They are not obsessed with food.

• There are stigmas attached to the surgery. People can feel shameful if they undergo gastric bypass, thinking that it's the "easy way out." The way the world is, thin people think they're thin because they're doing something right, and obese people are made to feel they're doing something wrong.

• Liposuction is a cosmetic procedure. It is not a good option for weight loss because not enough fat can be removed to make a significant difference. It has also has not been shown to have an effect on diabetes risk.

What behavioral changes can we make to combat the epidemic?

William H. Dietz, M.D., Ph.D. answered this and similar questions in the following interview with the Center for the Advancement of Health, which was published in their newsletter, "Facing the Obesity Epidemic: Developing Strategies for Weight Control." Facts of Life: Issue Briefings for Health Reporters. Vol. 6, No. 7, November 2001. Washington, DC. The newsletter, along with a bibliography, may be found at http://www. cfah.org/factsoflife/vol6no7.cfm.

Dr. Dietz is director of the Division of Nutrition and Physical Activity in the National Center for Chronic Disease Prevention and Health Promotion at the Centers for Disease Control and Prevention. Before joining the CDC, he was professor of pediatrics at Tufts University School of Medicine and director of Clinical Nutrition at Boston's Floating Hospital at New England Medical Center. Dr. Dietz's research has established obesity as a true epidemic in 21st Century America.

Q. How does the current state of obesity in America meet the definition of an epidemic?

A. It meets the definition by the numbers of people affected and the rapidity of its spread. Between 1980 and 1994, obesity increased by 50 percent in adults and doubled in children and adolescents. The most rapid increase has been since the 1980s. These are not hard and fast criteria by which to define an epidemic, but I don't think anyone would argue the definition.

Q. Do people who are obese tend to see their condition more as a cosmetic problem than a health concern?

A. That is a big hurdle. If people are to change their diet and activity patterns, they need a good reason to do so. If they don't see their weight as a health problem, they're less likely to change their behavior. A recent survey done by Discovery Health revealed that fewer than one third of people knew obesity was related to heart attacks. That surprised me.

Q. Is there a misunderstanding about what is considered obesity?

A. Yes. Many people say, "I'm overweight, not obese. If I was obese, then I'd have a problem." There needs to be more education about what is considered obese — body mass index (weight in kilograms divided by the square of height in meters) equal to or greater than 30 or waist circumference greater than 40 inches for men or 35 inches for women). For example, a woman who is 5'4" and more than 175 pounds or a man who is 6' and more than 225 pounds would be obese.

Q. What are the causes of obesity? Is it genetic? Lack of physical activity? Overeating?

A. Yes, yes and yes. Clearly genes affect susceptibility. But single-gene defects are rare. This is an important point. Genes affect susceptibility; they don't cause the disease. The gene pool of our population didn't suddenly start to change 20 years ago. There were environmental changes acting on the same genes that were present all along. Our challenge is to identify what that change is and what caused the sudden changes in obesity.

Q. What do you think are some of the contributing factors?

A. There have been lots of changes in our lifestyle; fast food consumption, increased television viewing, increased variety in supermarkets, meal-skipping by adolescent girls, increased soda consumption and increased portion sizes. Communities don't have sidewalks or central shopping areas. Only one-third of children who live within a mile of their school walk there. And 25 percent of all trips of less than a mile are taken by car.

Q. Are doctors doing enough to help their patients combat obesity?

A. We know that doctor-patient communication is important. For example, in smoking cessation, when physicians comment on smoking the result is the patient makes an effort to stop. So why don't physicians comment on weight or express concern that the patient should do more to control their weight? That's a complicated problem.

One clear obstacle is that physicians don't have ready remedies to point to. We lack effective strategies to implement in primary care. Another part of the problem is that physicians aren't compensated for overseeing this.

Q. How can we begin to address obesity problems effectively and reverse the trend so children are less likely to enter the cycle of obesity?

A. We have to talk about it as a health problem. When it comes to children, there are two successful strategies to prevent obesity. First, parents should take control of the TV set and limit how much TV their children watch. Parents also need to be in charge of what children are offered to eat. Then the kids can either eat it or not.

Q. How do you persuade a parent that taking control of the TV will help fight obesity?

A. You don't necessarily. The strategy may be part of an effort to avoid conflicts or how to avoid exposing your children to violence rather than couching it as a strategy to prevent obesity. Whatever angle works.

Q. So, it doesn't matter how the TV set gets turned off, as long as it does?

A. Yes. Then the parent needs to be in charge of what food is offered. For example, if a parent comes home and says, "I'm so tired, I can't fix dinner, what do you want?" - the child, after watching four or five hours of television, will probably opt for fast food. If the parent says, "I don't think we should do that," there's the potential for conflict. The parent shouldn't have asked in the first place.

Q. What would be a better approach?

A. "I'm tired, would you like a hamburger or a frozen light meal?" The parent is making the decision. And if the child says he does not want either, it's not up to the parents to offer something else. If the child doesn't eat, he or she will be hungry. You want the child to recognize the consequences of not eating what's served.

Q. Should children be prodded to eat all the food on their plate?

A. Absolutely not. Only a child knows when he or she is full. Do not make dessert contingent on what they eat. There should not be a mandatory reward for cleaning the plate. I've never understood why we overfeed our children.

	Total cholesterol	LDL	HDL
Optimal	Not specified	Under 100	Above 60
Desirable	Under 200	100-129	Above 50
Borderline	200-239	130-159	50-40
Abnormal	Over 240	Over 160	Below 40

The National Cholesterol Education Program Issued Guidelines for Abnormal Cholesterol Levels for Adults

The National Heart, Lung, and Blood Institute Guidelines for Abnormal Cholesterol Levels for Children and Adolescents (2-19)

	Total cholesterol	LDL	HDL
Acceptable	Under 170	Under 110	Greater than 35
Borderline	170-199	110-129	Not specified
High	200 or greater	130 or greater	Not specified

"WEIGH TO GO!" IMPLEMENTATION PLAN — PRE-LAB			
Activity	Estimated Time	Materials/Equipment	Purpose/Objectives/ Essential Question
Engagement: Patient Description	5 minutes	Patient Description or "Weigh to Go!" skit	
Exploration: Four Stations	24 minutes	Family History/ Data Sheet Station A: Diabetes Test Information on Diabetes Simulated Urine/ Test Strips Station B: BMI & Waist Measurement Tape Measure; Shape Chart BMI Charts; Instructions for finding BMI Medical History Station C: Blood Pressure /Heart Rate Information on Blood Pressure/Heart Rate Automatic Inflation Blood Pressure Monitor Blood Pressure Ranges Station D: Cholesterol Testing Simulated Blood Cholesterol Comparator Chart Guidelines for Abnormal Cholesterol Levels	Purpose: To engage students in thinking about obesity as an epidemic and to explore the connections between obesity, diabetes, high blood pres- sure and high cholesterol levels Objectives: • To perform a series of tests that will determine the condition of the patient's health • To analyze the data found at each station as it relates to the patient • To predict possible future health problems for the patient Essential Question: How would you evaluate John's
Explanation/ Elaboration: Press Conference at Medi- cal Convention	1 Hour	Questions for the Press Prop: Microphone	general health for participation in an athletic activity?
Evaluation: Completion of Participation Physical Examination Form	Homework	Participation Physical Examination Form	

Alignment with NC Competency Goals			
Biology	Chemistry	Healthful Living	
Goal 1 Objectives 1.01,1.02,1.03 Goal 2 Objectives 2.01,2.02,2.03,2.04 Goal 3 3.03,3.04 Goal 4 Objectives 4.03,4.04	Goal 2 Objectives 2.03, 2.04 Goal 5 Objectives 5.01,5.05,5.06	Goal 1 Objectives 1.01, 1.02, 1.03, 1.04, 1.06 Goal 2 Objectives 2.03, 2.05 Goal 3 Objectives 3.01, 3.03, 3.04, 3.05, 3.09 Goal 5 Objectives 5.01, 5.02, 5.03, 5.04, 5.05, 5.06, 5.07 Goal 7 Objectives 7.01, 7.02, 7.03, 7.04, 7.05, 7.06 Goal 8 Objectives 8.01, 8.02, 8.03, 8.04, 8.05, 8.06	

PRE-LAB ACTIVITIES

PURPOSE

• To explore the connections among obesity, diabetes, high blood pressure and high cho-lesterol levels

OBJECTIVES

• To perform a series of tests that will determine the condition of the patient's health

• To analyze the data found at each station as it relates to the patient

• To predict possible future health problems for the patient

MATERIALS NEEDED

• Patient Description, Family History and Data Sheet

- Station A: Diabetes Test
- Information on Diabetes
- Simulated Urine/ Test Strips
- Station B: BMI and Waist Measurements
- Tape Measure, Shape Chart
- BMI Chart, Instructions for finding BMI
- Medical History
- Station C: Blood Pressure
- Information on Blood Pressure/Heart Rate
- Automatic Inflation Blood Pressure Monitor
- Blood Pressure Ranges
- Station D: Cholesterol Testing
- Dipsticks for John and control
- Cholesterol Comparator Chart
- Guidelines for Abnormal Cholesterol Levels
- Questions for the Press Prop-Microphone
- Participation Physical Examination Form

Ordering Materials for Pre-lab				
ltem	Vendor	Model or Catalog #	Unit	Price
Keto-Diastix test strips	CVS pharmacy (or online)	2883	Box	\$14.19
N, N-Diethyl-acetoacetamide 97%	Fisher Scientific 800-766-7000	AC25543-1000	100 Bottle	\$28.80
Dextrose	Carolina Biological 800-334-5551	85-7430	500g bottle	\$6.95
Reli-On Blood pressure cuff	Various	HEM-741CREL	Each	\$45.00

TEACHER PREPARATION

• Set up stations A-D.

• Make one copy of the patient description found on Pre-Lab page 38 for each work group. Make one copy of the family history/data sheet (two-sided) found on Pre-Lab pages 39-40 and one copy of the physical exam form (two-sided) found on Pre-Lab pages 64-65 for each student.

ENGAGEMENT (5-10 MINUTES)

Organize students into groups of four or five students. Have each team read the patient description for John Macombo or select students to perform the "Weigh to Go!" skit.

The essential question is, "How you would evaluate John's general health for participation in an athletic activity such as football?"



EXPLORATION (8-10 MINUTES FOR EACH STATION):

Instruct students to make observations and gather information needed to answer the essential question at each of the 4 stations.

Instructions: All group members are responsible for everyone in the group as well as themselves in learning the assigned materials at each station.

Group members divide up the tasks and share in the responsibility equally.

Station A: Test for Diabetes

Students should appoint a leader at each station and assign necessary tasks to group members. Rotate the leadership position at each station.

Each group will spend about 6 minutes at each station (this time may vary, depending on the discretion of the teacher). Students are encouraged to discuss their ideas and develop their own opinions regarding John's health.

Test for sugar and ketones in urine. Provide two samples (John's and a control) of simulated urine and a bottle of Keto-Diastix test strips. Make the samples according to the recipe below.

	Positive Control	Negative Control	John's Urine
50 ml water*	\checkmark	\checkmark	\checkmark
1 drop yellow food coloring*	\checkmark	\checkmark	\checkmark
1 g dextrose	\checkmark		
5 drops of N,N-diethyl-aceto- acetamide	\checkmark		

*Add the food coloring to the water.

Have the students test the urine samples for glucose and ketones using the materials provided. They should read information provided at the station and record their findings.

Station B: BMI and Waist Measurements

Calculate John's BMI (Body Mass Index) to determine whether John has a weight problem. Use the instructions and chart #1 provided to make your determination of John's BMI.

Use the tape measure to determine John's waist measurements. Compare these with chart #2.

Station C: Blood Pressure and Heart Rate

Use the information found at this station to assess John's blood pressure and heart rate. Select one member from your team whose blood pressure and heart rate will serve as a comparison to John's reading. Follow the instructions on how to use the automatic inflation blood pressure monitor.

Read all the information provided before making a decision. Record your findings.

Station D: Cholesterol Test

Analyze the dip sticks provided to determine John's cholesterol levels. Using the information provided, determine and record John's total cholesterol and his LDL reading.



EXPLANATION

The teacher should make 4 columns on the board, one for each station. The teacher will lead the discussion on what the class discovered collectively. Someone should record the major findings or insights from each station in the proper column. The teacher should reinforce the following findings:

Station A: Ketones refer to a class of molecules that are the byproducts of fatty acid metabolism. They are produced in the liver and can be transported to cells where they are catabolized. In diabetes, a lack of insulin prevents glucose from entering the cells. The lower concentration of insulin in cells accelerates the body's breakdown of fat reserves. As a result, the excess ketones build up in the blood and are excreted into the urine. In extreme situations the concentration of ketones become so high that it can be smelled on the patient's breath.

John's urine was negative for both glucose and ketones. If John had tested positive for glucose in his urine, it would have indicated that his body was not metabolizing glucose correctly. However, the darkening around the base of his neck does show signs of early diabetes (or prediabetes). Darkening of the skin, usually on the neck or under the arms, is an early indicator of insulin resistance.

Station B: Body mass index (BMI) is a means of measuring body fat (BMI = Wt in Kg/(ht)² in meters). Adults with a BMI of 25-29.9 are considered overweight. A BMI over 30 indicates obesity. It is important to note that BMI calculations may not accurately reflect the amount of body fat in people under 20, competitive athletes or bodybuilders, or pregnant or lactating women. Because children's body fat levels change as they grow, and because girls and boys differ in their body fat at different levels of maturity, BMI for children and adolescents-also called BMI-for-age-is gender- and age-specific. BMI-for-age is plotted on gender-specific growth charts with curved lines indicating specific percentiles. Children and teens with a BMI-for-age at or below the 5th percentile are considered underweight, from the 85th to 95th percentile are considered at risk of overweight; and at or above the 95th percentile are considered overweight.

Individuals who have a waist measurement greater than 40 inches in men or 35 inches in women are considered to be at risk for obesity-related diseases. The size of your waist circumference is also a good indicator of your overall health risk. Excess fat which is found down in the region of the stomach gives someone an "apple" shape. This is associated with risk factors for conditions such as heart disease, increased blood pressure, diabetes and some types of cancer.

Station C: High blood pressure, also called hypertension, is simply elevated pressure of the blood in the arteries. Hypertension results from two major factors, which can be present independently or together:

- The heart pumps blood with excessive force.
- The body's smaller blood vessels narrow, so that blood flow exerts more pressure against the vessel walls.

Obesity has a number of possible effects that could lead to hypertension. It may prevent certain actions of insulin that open blood vessels, or place excess stress on the circulatory system in general. There is little doubt that obesity, high fat and high cholesterol diets, and lack of exercise contribute to both atherosclerosis (damming up of plaque in arteries) and hypertension.

Heart rate is the number of times the heart beats per minute, while pulse is the rhythmic expansion and recoil of arteries resulting from heart contraction; it can be felt from outside the body. A number of factors including age, gender, exercise, and body temperature influence heart rate.

Station D: Cholesterol is an essential component of the human body. It is not used as an energy source, but provides structural material in a variety of cell parts and is important in the synthesis of various hormones.

Cholesterol is commonly found in our diets, in foods such as liver, egg yolk, cheese, whole


milk, butter and meats. Your body also makes some cholesterol. Cholesterol levels are under metabolic control and are readily affected by diet, illness, drugs, and weight change. Obese individuals tend to have higher levels of bad cholesterol (LDL), probably due to their diet, and are encouraged to reduce their fat intake. There is also a possible genetic link to elevated blood cholesterol levels.

ELABORATION

Students attend a medical conference on the obesity epidemic as physicians and are asked to participate in a special news conference on the topic. The "conference leader" (either the instructor or a selected student) begins the session with an overview of the obesity problem and the reason for the conference.

Some of the students will also act as news reporters from various TV stations in the area and will be given specific questions that the physicians and conference leaders will answer.

Cut out the questions found in the pre-lab materials and give each reporter a question. Any student can answer a question. Pass around a "microphone" (either a real microphone or a created prop) for the questions and answers.

Reporters' questions will help to give students a clearer understanding of the following:

• Assessment for medical complications

• Approximately 65% of US adults and 15% of US children are overweight

FVALUATE

EVALUATION

Students complete the Health Certification Report Form required by the School's Athletic Department, indicating their findings and recommendations in regards to the physical examination.

Heart disease is the primary cause of death in the United States. One of the most common types of heart disease is atherosclerosis, a condition characterized by the accumulation of fatty material, particularly cholesterol, on the inner walls of the arteries. The deposits form plaques; that eventually narrow the openings of the arteries, restricting blood flow.

• Seventh leading preventable cause of death in the US

· Medical and physiological effects (diabetes, heart disease, hypertension [strokes], osteoarthritis, gallbladder disease, cancer, self-esteem, depression, multifactoral disease)

• The connection between obesity, diabetes, high blood pressure and high cholesterol • Contributing factors to obesity (genetics,

including twin studies, and environment)

Research

• Fat cells (research on the reproduction of more fat cells in children and adults)

• Fat cells as endocrine organs

• Defective leptin genes (overweight mice) or leptin receptors

• Adiponectin (fat people make less, lowered levels associated with diabetes and heart disease)

• Body shape (distribution of fat), Visceral vs. Subcutaneous Fat, Liposuction

• Gastric bypass and associated problems

What can be done to reverse the trend of obesity in children and adults?

ELABORATE



PATIENT DESCRIPTION

John Macombo's family has recently moved to North Carolina from Arizona. He is Native American and big for his age. His new friends have encouraged him to try out for the varsity football team. Before being eligible to play, all interested students must have a general physical.

John's mother brought him to a general practitioner recommended by the school for his physical and blood work. She asked John and his mother to fill out a family medical history, noting whether John, his parents, grandparents, or siblings had experienced any of a list of health problems. The doctor noted John's height and weight; took his temperature, heart rate, and blood pressure; and tested his reflexes. The doctor also noticed a velvety darkening of the skin on John's neck. On John's preliminary screening sheet he indicated that he sometimes felt dizzy and was frequently thirsty. Based on her observations and John's personal and family medical histories, the doctor decided to do some additional tests including checking John's cholesterol and blood sugar levels.

You are lab technicians and diagnosticians at the laboratory to which John's doctor has sent his medical information and blood work.

To assist you in your findings, there are four stations set up in the room. At each station, there will be information to assist you in assessing John's health. John's medical history, located on your data sheet, should also be considered.

Go to each station with your group. The directions for each station are given on the station guide sheets. Try to learn as much as you can at each station. Discuss the information and questions at each station. You will be told when to move to a new station.

WEIGH TO GO! SKIT

		Characters				
John	Classmates #1 and #2 (females)	Physician	Nurse	John's Mother	Coach	

Classmate #1 That's the new guy. He just moved here from Arizona.

Classmate #2 He's kind of cute. He's kind of big. Looks like a football player to me. Should we go talk to him?

Both *Classmates* walk over and introduce themselves to John; they ask him where he is from and whether he is going to try out for the football team.

John introduces himself and flirts with the girls. Sure, he'd like to play football. He goes by the coach's office for a participation form

- **Coach** John, we could use a big guy like you to fill up some of our holes. Tell you what, you take this form and get your guardian to take you for a check-up and have this filled out.
- (Scene 2—John and his mom)
- John Hi Mom, guess what, you're looking at the next star football player for Destiny HS.
- **Mother** John, I am so pleased you are making friends and meeting some girls, (sigh), that is wonderful. I'll get an appointment with the doctor for you.
- (Scene 3--Takes John to see a Physician)
- **Doctor** John, before we start, I need you and your Mom to fill out this family history. John, the nurse will get your height, weight, and blood pressure and heart rate. (leaves room)
- Nurse Enters the room and introduces him/herself, and begins to gather the information needed for John's chart (height, weight, blood pressure, heart rate from datasheet).
- Mother Let's see here. We can check no for special diet, and you are not currently taking any medications or drugs. That is right, isn't it John? You are not currently under a physician's care, and, John, you've never been hospitalized. Oh, but your grandfather had diabetes, and both your dad and I do have high blood pressure.
- John Now Mom, you know I'm not taking drugs, but I have been feeling a bit dizzy lately and I know it's been hot here in NC, but I've been very thirsty too.
- Doctor[Enters the room and reads John's height, weight, blood pressure, heart rate and tests his reflexes.]John, I notice that the skin around your neck is a little dark; have you ever noticed that before?I see you also feel dizzy and thirsty. We are going to need some additional tests. Let's get some blood work and a urine sample and send it to the lab to be analyzed.

End of skit

(Begin pre-lab)

Patient Name <u>John Macombo</u>

Medical History

	YES	NO	Explanations for any yes
Are you taking medications, pills or drugs?		\checkmark	
Are you under a physician's care now?		\checkmark	
Have you been hospitalized or had a major operation?		\checkmark	
Are you on a special diet?		\checkmark	

Have you or your family members been diagnosed or experienced the following:

	You	Family member
Diabetes		Grandfather
High Cholesterol		Dad
Heart Disease		Mom
High Blood Pressure		Mom & Dad
Fainting Spells/Dizziness	\checkmark	
Stroke		
Excessive Thirst	\checkmark	
Kidney Problems		Grandfather

|--|

DATA SHEET

Created by Shannon Baggett

Name

Essential Question: "Is John Macombo physically eligible to try out for the varsity football team?"

Instructions: All group members are responsible for everyone in the group as well as themselves in learning the assigned materials at each station. Appoint a leader and rotate leadership at each station. Group members should divide the tasks and share in the responsibility equally.

Record your findings from each station. Be sure to include comments that will assist you in making your final assessment.

Station A: Test for Diabetes

1. What happens to blood glucose levels as a result of diabetes?

2. What is the function of glucose in a body cell?

3. What's the difference between type 1 diabetes and type 2 diabetes?

4. What increases your risk for type 2 diabetes?

5. What is acanthosis nigricans?

6. Conduct Test for Diabetes (Directions on worksheet titled "Station A page 1 of 3").

 $Glucose = \underline{mg/dL} \qquad Ketones = \underline{mg/dL}$

Station B: BMI-for-age and Waist Measurements

1. a. What does BMI stand for?

b. Calculate John's BMI given the information on worksheet titled "Station B page 1 of 4."

John's BMI = _____kg/m²

Obesity class he falls in _____

2) Using the Waist-Height Ratio Chart, which category should John be classified based on his waist measurement?

Station C: Blood Pressure/Heart Rate

1) Describe the difference between systolic and diastolic blood pressure.

- 2) What is hypertension?
- 3) What factors result in hypertension?

4) What is the relationship between obesity and high blood pressure?

5) Select a volunteer from your group and take their Blood Pressure and pulse rate. Carefully read instructions FIRST! Read: How to use the Automatic Inflation Blood Pressure Monitor, How to Apply the Arm Cuff, and How to Take a Reading.

Volunteer's Blood Pressure = _____ mmHg

Volunteer's Pulse Rate = _____beats per minute

6) How does their readings compare with John's?

7) Use the Blood Pressure Ranges and Action Taken chart to see what category John falls into. (Page 2 of 5)

Station D: Cholesterol Testing

1) What is the function of cholesterol?

2) What is the relationship between obese individuals and cholesterol?

3) Explain the difference between HDL and LDL.

4) Analyze the Cholesterol Test for John. Refer to worksheet "Procedure for Cholesterol Test page 2 of 3".

What is John's total cholesterol? _____ (range)

5) Assuming John's total cholesterol is the highest number in the category you selected, what is John's LDL, if it is 70% of his total cholesterol?

STATION A

Test for Diabetes

At this station, you will analyze urine samples for the presences of sugar and ketones.

Directions: There are three urine samples, one taken from John at the hospital marked "patient," one positive control, and one negative control. You are to test each sample for the presence of sugar and ketones using the appropriate dip stick.

1. Dip reagent end of strip in urine sample and remove immediately.

2. While removing, draw the edge of the strip against the rim of the urine container to remove excess urine.

3. Place the strip on a white piece of paper provided at this station.

4. Compare reagent side of test area with corresponding color charts. Record results and comments on your data sheet

Normal urine samples ordinarily give negative results for glucose and ketones.

Small amounts of glucose are normally excreted by the kidneys. These amounts are usually below the sensitivity of this test. Consistent results of 100mg/dL may be considered abnormal.

Detectable levels of ketones may occur in urine during physiological stress conditions such as fasting, or frequent strenuous exercise. If carbohydrates are not being metabolized properly, large amounts of ketones may appear in urine.

Symptoms of Diabetes				
Frequent urination	Unusual weight loss	Excessive thirst	Acanthosis nigricans	
Increased fatigue	Excessive hunger	Irritability	Blurred vision	

Diab	ietes
Type 1 Diabetes Insulin-dependent or juvenile-onset diabetes chronic, incurable, but can be treated with diet and/or insulin	Type 2 Diabetes non-insulin-dependent or adult-onset diabetes can be controlled by diet, exercise, losing weight, and taking oral medications
High Blood Sugar	• Obesity is closely associated with insulin resis- tance and is one of the leading risk factors for type 2 diabetes.

Promotes Insulin Release

Promotes Glucagon Release

Stimulates Breakdown of Glycogen

> Pancreas Releases Glucagon

> > PANCREAS

Pancreas

Releases

Raises Blood Sugar

Lowers Blood Sugar

42

LIVER

Stimulates Formation of Glycogen

timulates Slucose Uptake

rom Blood

TISSUE CELLS

Low Blood Sugar

(Muscle, Kidney, Fat)

• In such instances glucose begins to spill into urine because the kidney tubules cannot reabsorb it fast enough.

• As glucose washes out of the body, water follows, leading to dehydration. When large amounts of fats (instead of sugars) are used for energy, the blood becomes very acidic as ketones (intermediate products of fat breakdown) appear in the urine.

• High blood glucose levels stimulate the release of insulin from the pancreas.

• Insulin increases a cell's ability to transport glucose across its plasma membrane.

• Once inside the cell, glucose is burned to release energy or stored as fat for future energy.

• Insulin speeds up these activities by sweeping glucose out of the blood into the cells.

• Diabetes occurs when the body either doesn't make enough insulin or becomes resistant to insulin, preventing it from storing sugar and increasing the body's glucose levels.



Darkening of the skin (acanthosis nigricans) on the back of John's neck. Acanthosis nigricans indicates hyperinsulinemia, a consequence of insulin resistance that is associated with obesity.

STATION B

Calculate John's BMI-for-age (Body Mass Index-for-age) to determine whether John has a weight problem.

Use the following formula:

BMI= weight in kilograms/height in meters squared; or

$BMI = wt. kg/ (ht. m)^2$

John's weight is 250 lbs and he is 6 ft tall.

Age=16 years

Waist = 42 inches

2.2 lbs = 1 kilogram

1 ft = .3 Meter

Instructions

1. Calculate John's BMI-for-age and compare your findings with the Boys' BMI-for-age Chart and Chart #1 below. Record the results on your data sheet, including his BMI and the percentile and obesity class he falls in.

2. Use the Waist-Height Ratio Chart to identify which category John falls into based on his waist measurements. Record your findings on your data sheet.

Chart #1	Classification	of Overweid	iht by	BMI-for-age
		-	, ,	

Obesity Class	BMI for age (kg/m2)	
Underweight	Less than 5th percentile	
Normal	5th – 85th percentile	
At risk of overweight	85th – 95th percentile	
Overweight	Greater than 95th percentile	

BMI-FOR-AGE CHART: BOYS



95% = Overweight 90% = High Risk 85% = Lower Risk 50% = Safe 25% = Underweight Risk 10% = Underweight

BMI-FOR-AGE CHART: GIRLS



95% = Overweight 90% = High Risk 85% = Lower Risk 50% = Safe 25% = Underweight Risk 10% = Underweight

WAIST-HEIGHT RATIO CHART



The size of your waist circumference is a good indicator of your overall health risk. Why is this?

- Excess fat that is found deep down in the region of the stomach gives someone a large waist circumference and an "apple" shape. This is often associated with risk factors for serious conditions such as heart disease, raised blood pressure, diabetes, and some types of cancer.
- Excess fat that is found under the skin, around the bottom, hips, and thighs gives someone a smaller waist circumference and a "pear" shape. This is generally accepted to be less harmful to h ealth.

STATION C

Blood Pressure/ Heart Rate

John's blood pressure and heart rate readings are as follows:

Blood pressure: 140 mm Hg/90 mm Hg Heart rate: 80

Select one member from your team whose blood pressure and heart rate readings will serve as a comparison to John's readings.

How to use the Automatic Inflation Blood Pressure Monitor

Place the cuff so that it is positioned firmly around your upper left arm. (You use your left arm because it is closest to your heart.)

Sit in a chair with your feet flat on the floor and your left arm on a table so that the cuff is at the same level as your heart.

Relax your arm and turn your palm upward.

Follow directions on "How to take a Reading" sheet

1. How do your classmate's readings compare with John's? Record your findings on your data sheet.

2. Evaluate John's readings using the Blood Pressure Range Chart. Record this information on your data sheet.

If your blood pressure reading seems incorrect, make sure your feet are flat, your left arm is resting on a table no higher than your heart, and look at the "How to Apply a Cuff" instructions to make sure the cuff is positioned properly over the brachial artery.

Blood Pressure Ranges and Action Taken				
Blood Pressure Category	Ranges (systolic/diastolic)	Action Taken after Initial Diagnosis		
Optimal Blood Pressure	120 mmHg/ 80 mm Hg	No action		
Normal Blood Pressure	120 to 130 mm Hg/ 80 to 85 mm Hg	Recheck every two years.		
High Normal Blood Pressure	130 to 139mm Hg/ 85 to 89 mm Hg	Monitor blood pressure at home and evaluate patient for organ damage.		
Hypertension	Above 140 mm Hg/ Above 90 mm Hg	Monitor blood pressure at home and evaluate patient for organ damage.		
Mild Hypertension (Stage 1)	140 to 159 Hg/ 90 to 99 mmHg	Same as High Normal. If no organ damage, retest at least twice a week for several weeks. If organ damage present, start drug therapy.		
Moderate Hypertension (Stage 2)	160 to 179 mmHg/ 100 to 109 mmHg	Same as High Normal. If no organ damage, retest at least twice a week for several weeks. If organ damage present, start drug therapy.		
Severe Hypertension (Stage 3)	180 to 209 mm Hg/ 110 to 119 mm Hg	Same as High Normal. Consider immedi- ate drug therapy regardless of organ damage evidence.		
Very Severe Hypertension (Stage 4)	Greater than 210 mm Hg/ Greater than 120 mm Hg	Same as High Normal. Consider immedi- ate drug therapy.		

BLOOD PRESSURE

Two numbers describe blood pressure

• Systolic — The systolic pressure (the higher and first number) measures the force that blood exerts on the artery walls as the heart contracts to pump out the blood.

• Diastolic — The diastolic pressure (the lower and second number) is the measure of forces as the heart relaxes to allow blood to flow into the heart.

• Blood pressure is measured in millimeters of mercury (mm Hg).

High blood pressure, also called hypertension, is simply elevated pressure of the blood in the arteries. Hypertension results from two major factors, which can be present independently or together:

- The heart pumps blood with excessive force.
- The body's smaller blood vessels narrow, so that blood flow exerts more pressure against the vessel walls.

Obesity has a number of possible effects that could lead to hypertension. It may prevent certain actions of insulin that open blood vessels, or place excess stress on the circulatory system in general. There is little doubt that obesity, high-fat and high-cholesterol diets, and lack of exercise contribute to both atherosclerosis (building up of plaque in arteries) and hypertension.

Heart rate is the number of times the heart beats per minute.

Pulse is the rhythmic expansion and recoil of arteries resulting from heart contraction; it can be felt from outside the body.

A number of factors including age, gender, exercise and body temperature influence heart rate.

The average heart rate of fit young adult females is 72-80 beats per minute.

The average heart rate of fit young adult males is 64-72 beats per minute.

How to Apply the Arm Cuff

- 1. If the cuff is assembled correctly, the sewn hook material will be on the outside of the cuff loop and the metal D-ring will not touch your skin.
- 2. Pass the end of the cuff furthest from the tubing through the metal D-ring to form a loop. The smooth cloth should be on the inside of the cuff loop.
- 3. Put your left arm through the cuff loop. The bottom of the cuff should be approximately 1/2 inch above the elbow. The green artery marker on the cuff should lie over the brachial artery on the inside of the arm. Tube should run down center of arm even with middle finger.
- 4. Pull the cuff so that the top and bottom edges are tightened evenly around your arm.
- 5. When the cuff is positioned correctly, press the sewn hook material FIRMLY against the pile side of the cuff.
- Make certain the cuff fits snugly around your arm. The cuff should make good contact with your skin. You should be able to slide one finger between the cuff and your arm.
- 7. Sit in a chair with your feet flat on the floor and place your arm on a table so that the cuff is at the same level as your heart.
- 8. Relax your arm and turn your palm upward.
- 9. Be sure there are no kinks in the air tubing.

NOTE: If your arm circumference size is 13 inches to 17 inches you will need the large adult cuff. The large adult cuff is an accessory item and is sold separately. You may purchase the large adult cuff at Walmart (model H-003DREL). It is recommended the AC Adapter (HEM-ADPT-1) be used with the large cuff. Do not inflate the arm cuff without being wrapped on the arm.













How to Take a Reading

Be sure to read "A Few Suggestions before Blood Pressure Measurement" and "How to Apply the Arm Cuff" before taking a reading.

- 1. Press the ON/OFF button.
 - a) All display symbols appear for approximately one second. This is the initial LCD test.
 - b) The display symbols disappear and the Deflation Indication symbol (🗢) starts to flash.
 - c) When the monitor completes the necessary preparations before measurement, the Heart Symbol (\heartsuit) appears in the screen.

NOTE: Wait for the Heart Symbol (O) before taking a measurement.

- 2. By pressing the START button the unit automatically inflates the cuff to 170 mmHg.
 - a) If during your measurement the monitor determines that a higher pressure value is required, it will automatically increase the pressure value by 40 mmHg.
 - b) To inflate higher than 170 mmHg, press and hold the Start button until the desired pressure value is reached (approximately 40 mmHg higher than your estimated systolic blood pressure). Do not inflate higher than 280 mmHg
- 3. When the correct pressure value is reached, the cuff starts to deflate automatically. As the cuff deflates, decreasing numbers appear on the display. The Heart Symbol (\mathcal{O}) flashes at every heartbeat.
- 4. When the measurement is complete, the Heart Symbol (O) stops flashing and your blood pressure and pulse rate are displayed alternately. Results will be displayed until you turn the unit off. The unit will automatically shut off in approximately 5 minutes.









Indicated

Value Drops

Reading Display

Pulse Reading Display

REMEMBER TO KEEP A RECORD OF YOUR BLOOD PRESSURE AND PULSE MEASUREMENTS.

STATION D

Cholesterol Testing

At this station you will check John's cholesterol levels. Please follow the instructions provided at this station.

Background information

Cholesterol is an essential component of the human body. It is not used as an energy source, but it provides structural material in a variety of cell parts and is important in the synthesis of various hormones.

Cholesterol is commonly found in our diets, in foods such as liver, egg yolk, cheese, whole milk, butter and meats. Your body also makes some cholesterol. Cholesterol levels are under metabolic control and are readily affected by diet, illness, drugs, and weight change. Obese individuals tend to have higher levels of bad cholesterol (LDL), probably due to their diet, and are encouraged to reduce their fat intake. There is also a possible genetic link to elevated blood cholesterol levels.

Heart disease is the primary cause of death in the United States. One of the most common types of heart disease is atherosclerosis, a condition characterized by the accumulation of fatty material, particularly cholesterol, on the inner walls of the arteries. The deposits form plaques that eventually narrow the openings of the arteries, restricting blood flow.

Blood cholesterol is measured either as total cholesterol or as its fractions.

These two fractions are called
HDL — High Density lipoproteins - Good Cholesterol Act as scavengers of cholesterol
LDL — Low Density lipoproteins - Bad Cholesterol Deliver cholesterol and triglycerides to body cells for food storage

Procedure for Cholesterol Test

1. The following wells are pre-labeled in your reaction plate as follows:

Well #1 Control

Well #2 Patient

2. The reagent pad at the edge of the strip has been completely covered with the Simulated Blood sample. The reagent pad will change color depending on the amount of cholesterol that is present in the sample.

3. Compare the test strips to the color standards on the Cholesterol Comparator Chart. Closely match the color of the reagent pad to one of the color standards on the Simulated Blood Cholesterol Comparator Chart. Using the key on the bottom of your cholesterol comparator chart, provide a diagnosis of the cholesterol status for each sample.

1. What is John's total cholesterol? _____ (range)

2. Assuming John's total cholesterol is the highest number in the category you selected, what is John's LDL, if it is 70% of his total cholesterol?

The National Heart, Lung, and Blood Institute Guidelines for Abnormal Cholesterol Levels for Children & Adolescents (2-19)

	Total cholesterol	LDL	HDL
Acceptable	Under 170	Under 110	Greater than 35
Borderline	170-199	110-129	Not specified
High	200 or greater	130 or greater	Not specified



Bayer	Acutual		Bayer	Tahu's	12125
Bayer	Control	_	Bayer	June 3	
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Bayer			Bayer		

Cut into individual strips, Control and John's

NEWS CONFERENCE

Students are physicians attending a medical conference on the obesity epidemic. On the last day of the conference they are asked to participate in a special news conference on the topic. Some of the students will also act as news reporters from various TV stations in the area and will be given specific questions that the physicians and conference leader will answer.

The "conference leader" (either the instructor or a selected student) begins the session with an overview of the obesity problem and the reason for the conference by summarizing the information in questions I-VIII.

Cut questions 1-11 into strips and give each reporter a question. Any student can answer a question. Pass around a "microphone" (either a real microphone or a created prop) for the questions and answers.

Conference Leader Overview Questions

I. What is obesity?

- II. Is there a misunderstanding about the causes of obesity?
- III. What are the health consequences of obesity?
- IV. What are the economic consequences of obesity?
- V. Compare the prevalence of obesity and diabetes by race.
- VI. Is there a misunderstanding about what is considered obesity?
- VII. Which state has the highest percentage of obese individuals?

VIII. Which age groups tend to have higher incidences of obesity and diabetes? How prevalent is obesity in children?

REPORTER QUESTIONS

CONFERENCE LEADER OVERVIEW QUESTIONS WITH ANSWERS

I. What is obesity?

• In adults, a body mass index (BMI) greater than 25 is considered overweight; a BMI greater than 30 is obese. (BMI = Wt in Kg/ht² in meters)

• It is important to note that BMI calculations may not accurately reflect the amount of body fat in people under 20, competitive athletes or bodybuilders, or pregnant or lactating women. Overweight in children and adolescents is measured using BMI-for-age—a BMI greater than the 95th percentile is overweight.

• Another determination of obesity is a waist circumference greater than 40 inches for men or 35 inches for females.

II. Is there a misunderstanding about the causes of obesity?

• "Prejudice against the obese stems from the widely held belief that getting fat—and certainly staying fat—results from a failure of willpower, a condition that could be remedied if the obese person would simply make a personal choice to eat less" (source: US News & World Report 2004; 136: 50).

• "In addition to personal choices, obesity is controlled by a powerful biological system of hormones, proteins, neurotransmitters and genes that regulate fat storage and body weight and tell the brain when, what and how much to eat" (source: US News & World Report 2004; 136: 50).

• Weight is also affected by environmental factors, such as access to healthy foods and safe places to exercise.

III. What are the health consequences of obesity?

• Obesity is strongly associated with chronic diseases including high blood pressure, high blood cholesterol, type 2 diabetes, coronary heart disease, arthritis, asthma, strokes, gallstones, poor female reproductive health, bladder control problems, sleep apnea and other respiratory problems, certain types of cancer, and psychological disorders such as depression and low self esteem.

IV. What are the economic consequences of obesity?

• Obesity accounts for 9.1% of total U.S health care expenditures or \$117 billion (source: Weight Control Information Network, 2005).

• Americans spend \$33 billion annually on weight-loss products and services.

• Productivity suffers with the loss of 39.3 million workdays annually due to obesity.

V. Compare the prevalence of obesity and diabetes by race.

• The prevalence of both obesity and diabetes is substantially greater in minorities than in whites.

• Obesity disproportionately affects minority communities. 40% of Blacks and 34% of Mexican Americans are obese (source: National Center for Health Statistics), while American Indians appear to be more obese than other minority populations, with some tribes being well over 50% obese (source: Am J Clin Nutr 1991; 53:1535-42S).

VI. Is there a misunderstanding about what is considered obesity?

Yes. Many people say, "I'm overweight, not obese. If I was obese, then I'd have a problem." There needs to be more education about what is considered obese - body mass index (weight in kilograms divided by the square of height in meters) equal to or greater than 30 or waist circumference greater than 40 inches for men or 35 inches for women). For example, a woman who is 5'4" and more than 175 pounds or a man who is 6' and more than 225 pounds would be obese.

VII. Which state has the highest percentage of obese individuals?

• Mississippi with 28.1% (source: Trust for America's Health, 2005). Also, it is 1st in the US in highest rate of obese and overweight adults combined, at 64.5%.

• Over 25% of adults in 10 states are obese, including in Mississippi, Alabama, West Virginia, Louisiana, Tennessee, Texas, Michigan, Kentucky, Indiana, and South Carolina. Seven of those 10 states are in the Southeastern US.

• Adult obesity levels are 16% or more in every state.

VIII. Which age groups tend to have higher incidences of obesity and diabetes? How prevalent is obesity in children?

• In 2005, 10.3 million, or 20.9% of all people in the US age 60 years or older had diabetes (source: National Diabetes Fact Sheet, 2005). In 2000, 25.6% of all people aged 50-59 were obese (source: JAMA 2001; 286: 1195-1200).

• According to 1999-2002 data, among children and

teens ages 6-19, 16% are overweight. That's triple the proportion who were overweight in 1980 (source: National Center for Health Statistics).

• As a consequence more children and adolescents are being diagnosed with diabetes. Clinically-based reports and regional studies suggest that type 2 diabetes, although still rare, is being diagnosed more frequently in children and adolescents, particularly in American Indians, African Americans, and Hispanic/Latino Americans (source: National Diabetes Fact Sheet, 2005).

REPORTER QUESTIONS WITH ANSWERS

1. Do people who are obese tend to see their condition more as a cosmetic problem than a health concern?

That is a big hurdle. If people are to change their diet and activity patterns, they need a good reason to do so. If they don't see their weight as a health problem, they're less likely to change their behavior. A recent survey done by Discovery Health revealed that fewer than one third of people knew obesity was related to heart attacks. That surprised me.

2. What are the causes of obesity? Is it genetic? Lack of physical activity? Overeating?

• Yes, yes, and yes. Clearly genes affect susceptibility. But single-gene defects are rare. This is an important point. Genes affect susceptibility; they don't cause the disease. The gene pool of our population didn't start to change 20 years ago; there were environmental factors acting on the same genes that were present all along. Our challenge is to identify what has changed to cause the sudden rise in obesity.

What do twin studies tell us about obesity?

• "Obesity does not result from a single gene...but rather a variety of genes that interact with environmental influences to increase one's chances of becoming obese. In studies of adult twins, who share many or all of the same genes, BMI, body composition, and other measures of fatness appear to be 20 to 70 percent inherited" (source: US News & World Report, February 9, 2004 – Vol 136, No. 5).

3. Are doctors doing enough to help their patients combat obesity?

We know that doctor-patient communication is important. For example, in smoking cessation, when physicians comment on smoking the result is the patient makes an effort to stop. So why don't physicians comment on weight or express concern that the patient should do more to control their weight? That's a complicated problem.

One clear obstacle is that physicians don't have ready remedies to point to. We lack effective strategies to implement in primary care. Another part of the problem is that physicians aren't compensated for overseeing this.

4. What kinds of medications are used for the treatment of obesity? How about surgery and liposuction?

• Three categories of drugs exist: anorectic drugs (which cause loss of appetite), thermogenic agents (which produce heat), and drugs that inhibit the digestion or absorption of food. Many obese patients believe medication is a miracle cure and hold unrealistically high hopes.

• A study published in the Annals of Internal Medicine in April 2005 reported that weight-loss surgery resulted in a loss of 44-66 lbs, which was maintained for up to 10 years (source: Ann Intern Med. 2005; 142:547-559).

• One reason for the success rate is that the surgery gives people a weapon they've never had before—a slight diminution of hunger. They are not obsessed with food.

• There are stigmas attached to the surgery. People can feel shameful if they undergo gastric bypass, thinking that it's the "easy way out." The way the world is, thin people think they're thin because they're doing something right, and obese people are made to feel they're doing something wrong.

• Liposuction is a cosmetic procedure. It is not a good option for weight loss because not enough fat can be removed to make a significant difference. It has also has not been shown to have an effect on diabetes risk.

5. What does scientific research, especially concerning mice and leptin, tell us about genes and obesity?

• Research indicates that the ob gene causes the muscle cells to produce leptin and suppresses a gene that produces an enzyme known as acetyl – CoA carboxylase, or ACC – which is essential for fat production.

• The more you eat, the more leptin you produce and the less hungry you are. If you don't produce leptin, you don't receive a signal to indicate you are full.

• Mice with two defective alleles in the ob gene cannot produce leptin, resulting in no signal to stop eating and extreme obesity. Mice with a mutation in the db gene have defective leptin receptors; although they produce leptin, they cannot process it.

• Leptin also appears to act via pathways that are independent of the brain, possibly by inhibiting the synthesis of fat in fat cells and increasing the burning of fat in muscle cells.

6. What is diabetes? How does type 2 diabetes differ from type 1 diabetes?

• Diabetes occurs when the body either doesn't make enough insulin or becomes resistant to insulin, preventing it from storing sugar and increasing the body's glucose levels in the blood. Obesity is closely associated with insulin resistance and is the leading risk factor for type 2 diabetes.

• Type 1 diabetes (insulin-dependent or juvenile-onset diabetes) is chronic and incurable, but can be treated with diet and/or insulin.

• Type 2 diabetes (non insulin-dependent or adult-onset diabetes) can be controlled by diet, exercise, losing weight, and taking oral medications.

7. What is the connection between obesity and diabetes?

• Both diseases are associated with a wide range of inflammatory molecular activity in fatty tissue. These actions activate the JNK gene that interferes with insulin sensitivity (source: Harvard Gazette Archives).

• Increased blood glucose and insulin levels in mice with JNK 1 on a high-fat diet were closely linked to obesity-induced insulin resistance, leading to type 2 diabetes.

• Diabetes requires a hormone, MSH, which is made by the POMC gene. In studies, mice without the MSH hormone were obese but did not develop diabetes. Administration of MSH to mice increased their resistance to insulin and directly affected blood sugar levels. Therefore, MSH may be a factor in the development of type 2 diabetes.

8. What is cholesterol? What are HDL and LDL? What are the optimum levels for each type of cholesterol?

• Cholesterol is a type of lipid. It is an important molecule in cell membranes and a precursor to various other key molecules, including bile salts and steroid hormones.

• Blood cholesterol is measured either as total cholesterol or as its fractions. These two fractions are called:

HDL — High Density lipoproteins (Good Cholesterol) Act as scavengers of cholesterol LDL — Low Density lipoproteins (Bad Cholesterol) Deliver cholesterol and triglycerides to body cells for food storage.

9. What are the connections among obesity, diabetes, cholesterol and heart disease?

• "Fat cells act like an endocrine organ, secreting hormones and other substances that affect metabolism, weight and overall health...Too much fat can act like a poison, spewing out substances that contribute to diabetes, heart disease, high blood pressure, stroke, and cancer" (source: Medical News Today, 2004).

• Fat cells produce a hormone called aldosterone, which increases blood pressure.

• People with diabetes tend to have LDL particles that stick to arteries and damage their walls more easily.

• Glucose latches onto lipoproteins. Sugar-coated LDL remains in the blood stream longer and may lead to plaques or hardening in the coronary arteries.

• People with diabetes tend to have low HDL and high triglyceride levels, both of which boost the risk of heart and artery disease.

• People can reduce their risk of heart disease and blood vessel disease by lowering their cholesterol levels.

10. What do blood pressure numbers indicate?

• Two numbers describe blood pressure: o **Systolic:** The systolic pressure (the higher and first number) measures the force that blood exerts on the artery walls as the heart contracts to pump out the blood.

o **Diastolic:** The diastolic pressure (the lower and second number) is the measure of forces as the heart relaxes to allow blood to flow into the heart.

• Blood pressure is measured in millimeters of mercury (mm Hg). High blood pressure, also called hypertension, is simply elevated pressure of the blood in the arteries. Hypertension results from two major factors, which can be present independently or together:

o The heart pumps blood with excessive force. o The body's smaller blood vessels narrow so that blood flow exerts more pressure against the vessel walls. The National Cholesterol Education Program Issued Guidelines for Abnormal Cholesterol Levels for Adults

	Total cholesterol	LDL	HDL
Optimal	Not specified	Under 100	Above 60
Desirable	Under 200	100-129	Above 50
Borderline	200-239	130-159	50-40
Abnormal	0ver 240	Over 160	Below 40

The National Heart, Lung, and Blood Institute Guidelines for Abnormal Cholesterol Levels for Children and Adolescents (2-19)

	Total cholesterol	LDL	HDL
Acceptable	Under 170	Under 110	Greater than 35
Borderline	170-199	110-129	Not specified
High	200 or greater	130 or greater	Not specified

11. Is the distribution of fat on the body an important consideration?

• At least three distributions of fat are associated with obesity-related adverse health outcomes. These are the relative amount of body fat (BMI), the amount of subcutaneous abdominal fat (upper body fat), and the amount of visceral fat located in the abdominal cavity.

12. How is fat used by organisms, and what determines whether fat is stored or used?

• Two molecules act as fat sensors that regulate whether fat is stored or burned in cells. They belong to a class of molecules called nuclear receptors and are found in the nucleus of the cell. These molecules are activated when they bind to fatty acids and thus regulate gene expression.

13. How does the stomach talk to the brain?

• "It is supposed to be simple; you eat when you are hungry and stop when you are full. It is, of course, more complicated than that. Your appetite stems from more than an empty stomach or need for nutrients" (source: Psychology Today, September 2, 2003).

• "A chemical messenger, ghrelin (pronounced GRELLin,), discovered only a few years ago, stimulates our "need to feed" even in cases when the belly is full. ...Levels of ghrelin increase during fasting and before meals and fall off after eating. ...Ghrelin levels rise in people who have lost weight and may be the reason dieters have trouble keeping their weight down longterm" (source: Psychology Today, September 2, 2003).

14. How do people misperceive their own weight?

• In a 2002 study, more than half of all men reported they were normal weight when they were, in fact, overweight. Additionally, almost 20% of men who thought they were normal were obese (source: Obesity Research 2002; 10:345-350).

15. How can we begin to address obesity problems effectively and reverse the trends?

• We can talk about them as health problems. We must develop healthy lifestyles.

- Healthy diets are a must!! Reduce portion sizes.
- We've got to figure out ways to put physical activity back in our lives.

• It is also an economic issue. People in the insurance industry and managed health care need to face the fact that obesity is a disease and deal with it more effectively in the present as opposed to diabetes and heart disease in the future.

• We need to get people focused on the issues.

• Youth must be targeted in this campaign

Participation Physical Examination Form			
Student's Name: <u>John Macombo</u>		Birth Date: <u>June 16, 1988</u>	
Height: <u>6 ft</u>	Weight: <u>250 lbs</u>	BMI:	
Test for Diabetes Cleared Cleared after completing evaluation/rehabilitation for	or:		
□ Not cleared for: Recommendations:	Reason:		
BMI Cleared Cleared after completing evaluation/rehabilitation for	or:		
□ Not cleared for: Recommendations:	Reason:		

Blood Pressure/Heart Rate		
Cleared after completing evaluation/rehabilitation for:		
Not cleared for:	Reason:	
Recommendations:		
Cholesterol Testing		
Cleared		
\Box Cleared after completing evaluation/rehabilitation for:		
□ Not cleared for:	Reason:	
Recommendations		
Accommendations.		

I certify that I have on this date examined this student and that, on the basis of the examination requested by the school authorities and the student's medical history as furnished to me, I have found no reason that would make it medically inadvisable for this student to compete in supervised athletic activities. (Note exceptions above)

Physician's Signature

Date



Participation Physical Examination Form			
Student's Name: <u>John Macombo</u>		Birth Date: <u>June 16, 1988</u>	
Height: <u>6 ft</u>	Weight: <u>250 lbs</u>	BMI:	
Test for Diabetes ✓ Cleared □ Cleared after completing evaluation/rehabilitatio	n for:		
□ Not cleared for:	Reason:		
 Recommendations: Recheck annually, especially due to prese neck. Recommend exercise to build muscle, kee Make appointment with approved nutrition 	nce of acanthosis negricans (v ep body fat percentage manage nist to discuss diet.	relvety darkening of skin) at back of eable.	
BMI Cleared Cleared after completing evaluation/rehabilitation for: <u>see below</u>			
□ Not cleared for: Recommendations: • Exercise 30-60 minutes 5-7 times per wee	Reason:		
• Limit sugar-filled soft drinks and foods w include vegetables, fruits, and other high-proved nutritionist).	ith high calories and low nutri fiber foods; reduce serving siz	tional value (white rice, sugary foods); zes (discuss details of plan with ap-	

Blood Pressure/Heart Rate Cleared Not cleared for: ______ Reason: **Recommendations:** • Recheck regularly to monitor, especially after strenuous exercise. • Exercise regularly as long as blood pressure does not rise to moderate or severe hypertension. • See dietary notes above; reduce salt intake. **Cholesterol Testing** □ Cleared 🗹 Cleared after completing evaluation/rehabilitation for: _____ Not cleared for: _____ Reason: _____ **Recommendations:** • Recheck cholesterol in 6 months.

• Diet and exercise as above (limit foods with high-fat content; limit fast-food/eating out).

I certify that I have on this date examined this student and that, on the basis of the examination requested by the school authorities and the student's medical history as furnished to me, I have found no reason that would make it medically inadvisable for this student to compete in supervised athletic activities. (Note exceptions above)

Dr. Maxine Van Andersen Physician's Signature

Date

"WEIGH TO GO!" IMPLEMENTATION PLAN — WET-LAB			
Activity	Estimated Time	Materials/Equipment	Purpose/Objectives/ Essential Question
Engagement	5 minutes	Wet-lab scenario; pictures of mice	Purpose: To extract a designer protein from a bacterial substrate, using hydropho- bic interactive column chromatogra- phy (HIC)
Exploration	45 minutes	Collection tubes Pipette Microtube rack Marker HIC chromatography column Column end cap Test tube or beaker to collect waste Wash Buffer Equilibration Buffer TE Buffer UV light	 Objectives: To purify genetically engineered designer proteins from transformed bacteria To understand how chromatography is used in the biotechnology industry for separating and purifying proteins of interest from bacterial proteins. To isolate/purify designer protein with GF marker To practice the use of hydrophobic interactive column chromatography (HIC) To analyze and interpret results from HIC Essential Question: Can the designer protein tagged with GFP (simulated leptin) be extracted from the bacterial substrate using HIC?
Explanation/ Elaboration/ Closure	10 minutes	Review questions Evaluation sheet Figure from the journal <i>, Nature</i>	

Alignment with NC Competency Goals			
Biology	Chemistry	Healthful Living	
Goal 1 Objectives 1.01,1.02,1.03 Goal 2 Objectives 2.01,2.02,2.03,2.04 Goal 3 Objective 3.04	Goal 2 Objectives 2.03, 2.04 Goal 5 Objectives 5.01,5.05,5.06	Goal 5 Objective 5.04	

WEIGH TO GO! WET-LAB Extraction of Protein Using Column Chromatography

Purpose

To extract a designer protein tagged with green fluorescent protein (called GFP) from a bacterial substrate, using hydrophobic interactive column chromatography (HIC)

Objectives

• To examine the basic tools of modern biotechnology in DNA splicing, cutting DNA and linking it to other DNA molecules

• To purify genetically engineered designed proteins from transformed bacteria

• To understand how chromatography is used in the biotechnology industry for separating and purifying proteins of interest from bacterial proteins

Teacher Preparation

Follow directions for preparation of bacterial concentrate found in the teachers' guide of BioRad's Biotechnology ExplorerTM: Green Fluorescent Protein (GFP) Purification Kit.

Catalog Number 166-0005EDU

Engagement Activity

Students should read the wet-lab scenario.

Exploration

Extract the designer protein using HIC.

Explanation

Examine test tubes for the presence of the designer protein tagged with GFP. Complete review questions.

HIC (Hydrophobic Interaction Chromatography)

Proteins are often the molecules we desire to purify in the biopharmaceutical or medical fields of the biotechnology industry. Chromatography is used to separate target proteins. Although several forms of chromatography exist, we will focus on hydrophobic interaction chromatography (HIC).

First, it might help to understand why separating proteins is often a goal for biotechnology researchers. Here is a sample scenario of potential drug research and creation:

- A researcher identifies a protein that may be of therapeutic value (such as leptin).
- The researcher identifies the "target gene" — the gene that encodes the desired protein.
- The researcher isolates this gene and places it into a host cell so that it can grow and produce larger quantities of the desired protein.

• Now that a sizable "colony" of the protein has developed, the researcher must separate out the desired protein from the many other proteins present in the host cells in which it has been growing.

How HIC works: A chromatography column packed with hydrophobic beads is called a hydrophobic interaction matrix. When the sample is loaded onto the matrix in salt water, the hydrophobic proteins in the sample will stick to the beads in the column. The more hydrophobic they are, the more tightly they will stick. When salt is removed, the three-dimensional structure of the protein changes again so that the hydrophobic regions of the protein now move to the interior of the protein and the hydrophilic regions move to the exterior. The result is that the hydrophobic proteins no longer stick to the beads and drip out of the column, separated from the other proteins.

The designer protein tagged with a green fluorescent marker used in this wet-lab, GFP (Green Fluorescent Protein), has several stretches of hydrophobic amino acids, which cause the protein to be very hydrophobic. When the supernatant, rich in GFP, is passed over a HIC column in a highly salty buffer (binding buffer), the hydrophobic regions of the GFP stick to the HIC beads. Other proteins less hydrophobic (or more hydrophilic) pass right through the column. This single procedure allows the purification of GFP from a complex mixture of bacterial proteins.
WET-LAB SCENARIO

Since the discovery in 1994 of the obesity gene (ob gene) in mice and its product, the fat-busting protein leptin, scientists have been racing to understand and apply these new findings.

In 1995 the *ob* gene was inserted into mice: researchers gave some mice regular ob genes and others defective ob genes that could not produce leptin. Mice with defective ob genes became quite obese; the photo of the fat mouse next to the thin mouse that possessed the regular ob gene became a familiar sight to many Americans. When researchers injected the previously obese mouse with leptin, it became as thin as a rodent track star.

Generally, the more one eats, the more leptin one produces. Leptin acts on the hypothalamus of the brain, causing one to feel less hungry. Leptin also inhibits fat synthesis in fat cells and increases the burning of fat in (Some mice have a different defect in the *db* gene, which is the leptin receptor; although they produce leptin, their bodies cannot

"hear" its signal.) Leptin deficiency is not expected to be the magic bullet for weight reduction in all cases of obesity (for which there are many causes). In fact, since its discovery in 1997, only about a dozen people worldwide have been identified with the leptin mutation. However, some humans do have defective genes for leptin production and this research

could offer encouragement for these people. In addition, the leptin breakthroughs demonstrate that genetic components to body weight regulation exist, and these will continue to be researched and developed.

Native leptin is made by the body in fat cells and is short-lived, which requires researchers to give each test mouse a dose of leptin each day. If the current findings from this research were transferred to humans, individuals would have to inject themselves with leptin or take a pill every hour!

After seeing John's preliminary test results, his doctor suggests that it's possible he has a leptin deficiency and might be a good candidate for a clinical trial if a new, longer-lived variety of leptin is successfully engineered.

You are a researcher and your current job is to find a modified form of leptin that will last longer in the body. You have been able to accomplish this task and to produce it in large quantities in genetically engineered transgenic bacteria. Your task today is to extract this new protein, which you have tagged with a green fluorescent marker, from other bacterial proteins.

You will use hydrophobic interactive column chromatography (HIC), a powerful method used in biotechnology for separating and purifying proteins of interest from a mixture of bacterial proteins. Once you have extracted your designer protein, which has been genetically engineered, it can be tested in the laboratory with mice that have two defective alleles for the *ob* gene.



Obese and normal mouse.

muscle cells. In mice with two defective alleles for leptin production, there is no signal to prevent eating and the mice gain weight.

NOTE FOR TEACHERS

After the wet-lab, explain to students that further testing revealed that John does not have a leptin deficiency. True leptin deficiency is very rare and is only occasionally the root cause of obesity.

FIGURE 4: CLONING DIAGRAM



FIGURE 5: ISOLATION AND GROWTH OF GREEN FLUORESCENT COLONIES/ BACTERIAL CONCENTRATION AND LYSIS/REMOVING BACTERIAL DEBRIS



FIGURE 6: LOADING THE TAGGED PROTEIN ONTO THE CHROMATOGRAPHY COLUMN



IS FINDING A NEEDLE IN A HAYSTACK EASIER WHEN IT GLOWS?

Inoculation: Growing a cell culture

- Select one green colony from the transformed colonies
- Grow bacteria in LB broth that contains arabinose ampicillin

Purification Phase 1: Bacterial Concentration and Lysis

Centrifugation to result in pellet and a supernatant

Resuspension of the bacterial pellet

Addition of lysozyme to degrade the bacterial cell wall

Purification Phase 2: Removing bacterial debris

Centrifugation to separate large particles of lysed bacteria (such as cell walls) from smaller proteins, including GFP

Purification Phase 3: Protein chromatography

Equilibration Buffer— salt buffer, used to prime the column for binding of GFP

A high salt buffer $(2 \text{ M} (\text{NH}_4)_2 \text{SO}_4)$

Binding Buffer— high salt binding buffer, causes GFP to bind to column A very high salt buffer $(4 \text{ M} (\text{NH}_4)_2 \text{SO}_4)$

Wash Buffer— medium salt buffer, GFP begins to penetrate the upper surface of the matrix

A medium salt buffer $(1.3 \text{ M} (\text{NH}_4)_2 \text{SO}_4)$

Elution Buffer— low salt buffer, used to wash GFP from the column A very low salt buffer (10 mM Tris/EDTA)

Lesson 4 Purification Phase 2 Bacterial Lysis

2

1. Remove the microtube from the freezer and thaw using hand warmth. Place the tube in the centrifuge and pellet the insoluble bacterial debris by spinning for 10 minutes at maximum speed.

Thaw



Centrifuge

- 2. While your tube is spinning, prepare the chromatography column. Remove the cap and snap off the bottom from the prefilled HIC column. Allow all of the liquid buffer to drain from the column (~3–5 minutes).
- Prepare the column by adding 2 ml of Equilibration Buffer to the top of the column. This is done by adding two 1 ml aliquots with a rinsed pipette. Drain the buffer to the 1 ml mark on the column.

- 4. After the 10 minute spin, immediately remove your tube from the centrifuge. Examine the tube with the UV light. Using a new pipette, transfer 250 µl of the "+" supernatant into a new microtube labeled "+". Again, rinse the pipette well for the rest of the steps of this lab period.
- 5. Using a well rinsed pipette, transfer 250 μl of binding buffer to the "+" supernatant.



Lesson 5 Purification Phase 3 Protein Chromatography

- 1. Label 3 collection tubes 1–3 and place the tubes in the foam rack or in a rack supplied in your laboratory. Remove the caps from the top and bottom of the column and place the column in collection tube 1. When the last of the buffer has reached the surface of the HIC matrix proceed to the next step below.
- 2. Using a new pipette, carefully and gently load 250 µl of the "+" supernatant onto the top of the column. Hold the pipette tip against the side of the column wall, just above the upper surface of the matrix and let the supernatant drip down the side of the column wall. Examine the column using a UV light. Note your observations. After it stops dripping transfer the column to collection tube 2.
- Using the rinsed pipette, add 250 μl of wash buffer and let the entire volume flow into the column. Examine the column using the UV light. Note your observations. After the column stops dripping, transfer it to tube 3.
- Using the rinsed pipette, add 750 μl of TE Buffer and let the entire volume flow into the column. Examine the column using the UV light. Note your observations.
- 5. Examine all three collection tubes and note any differences in color between the tubes. Parafilm or Saran Wrap the tubes and place in the refrigerator until the next laboratory period.



Name

Protein Purification Data Observation Sheet

1. You have used a bacterium to propagate a gene that produces a designer protein tagged with a green fluorescent marker. Identify the function of these items you used to extract the protein:

Centrifuge —

Lysozyme —

Freezer —

2. What color was the pellet after you centrifuged it? What color was the supernatant? What does this tell you?

3. Briefly describe hydrophobic interaction chromatography.

4. What is the function of the Equilibration Buffer?

5. List your predictions and observations for the sample and what happens to the sample when the following buffers are added to the HIC column.

Collection Tube Number	Prediction	Observations Under UV Light (column and collection tube)
Tube 1 Sample in Binding Buffer		
Tube 2 Sample with Wash Buffer		
Tube 3 Sample with Elution Buffer		

6. Which buffers have the highest salt content and which have the least? How can you tell?

7. Were you successful in isolating and purifying the designer protein from the cloned bacterial cells? Identify the evidence you have to support your answer.

Name



Protein Purification Data Observation Sheet

1. You have used a bacterium to propagate a gene that produces a designer protein tagged with a green fluorescent marker. Identify the function of these items you used to extract the protein:

Centrifuge - Functions to pellet the bacteria and separate the bacteria from the growth media

Lysozyme — Functions to enzymatically digest the bacterial cell wall, which in turn weakens the cell wall so that it will rupture upon freezing

Freezer — Functions to freeze the bacteria, which causes the cytoplasm to expand, which completely ruptures the weakened cell wall

- 2. What color was the pellet after you centrifuged it? What color was the supernatant? What does this tell you? The pellet was a whitish or pale green color. The supernatant should fluoresce bright green. The fluorescent green color of the supernatant indicates that the green protein was released from the bacteria and remained in the supernatant.
- 3. Briefly describe hydrophobic interaction chromatography. Protein chromatography is a technique that can be used to separate or purify proteins from other molecules. Hydrophobic interaction chromatography purifies proteins based upon their hydrophobic properties.
- 4. What is the function of the Equilibration Buffer? This buffer prepares the column for the application of the protein. Equilibration buffer raises the salt concentration of the column to match that of the bacterial lysate.

5. List your predictions and observations for the sample and what happens to the sample when the following buffers are added to the HIC column.

Collection Tube Number	Prediction	Observations Under UV Light (column and collection tube)
Tube 1 Sample in Binding Buffer	The protein should stick to the column.	The protein resides as a band at the top of the column.
Tube 2 Sample with Wash Buffer	The protein should stick to the column.	The protein resides as a band at the top of the column.
Tube 3 Sample with Elution Buffer	The protein should elute from the column.	The protein travels down the column as a ring and elutes into tube 3.

6. Which buffers have the highest salt content and which have the least? How can you tell?

Binding buffer>>Equilibration Buffer>>Wash Buffer>>Elution Buffer Binding buffer has the highest concentration of salt because it is needed to raise the salt concentration of the protein lysate. The hydrophobic patches of protein are exposed to high salt buffer. Elution Buffer (TE) has the lowest salt concentration because it causes the protein to elute from the column. The hydrophobic patches of the protein reorient to the interior and the hydrophilic regions are exposed to low salt buffer.

7. Were you successful in isolating and purifying the designer protein from the cloned bacterial cells? Identify the evidence you have to support your answer.

If tube 3 fluoresces green, the student was success in purifying the protein. If the protein is not present in tube 3, examine the column—application of an incorrect buffer would prevent the elution. Alternatively, if the student did not start with a bright green culture, then the tube will not be extremely bright.

Ordering Materials for Wet-lab							
Vendor	Catalog Number	ltem	Unit	Price	Cost per class		
Bio-Rad	166-0005EDU	Explorer Green Fluorescent Protein Purification Kit	1	\$85.00	\$85.00		
Bio-Rad	166-0500EDU	UV Lamps Long Wavelength (need 6)	1	\$28.00	\$168.00		
Bio-Rad	166-0508EDU	Digital Micro Pipettes P1000	1	\$159.00	\$159.00		
Bio-Rad	223-9347EDU	Racked Pipette Tips TBR-35 Tips	1,000 box	\$35.20	\$2.96		
		Microwave	1				
		250 ml flask	1				
		100 ml and 250 ml graduated cylinders	1 each				
		Distilled water (1 gal. from supermarket)	1				
		Thermometer	1				
		Centrifuge	1				
		Beaker of water for rinsing pipettes	1				
		Bleach	1				
		Magic Markers	1				
		Refrigerator/freezer	1				
Optional							
Bio-Rad	166-0709EDU	Rocking Platform	1	\$575.00			
	Use of a rocker or shake	r will speed bacterial growth in liqu	id culture but	is not required.			

WET-LAB EVALUATION — TEACHER DESCRIPTION

During the wet-lab, students isolated the protein leptin from a mixture of proteins found in bacteria cells that were genetically modified to produce this hormone. The goal of this evaluation activity is to give each student a chance to summarize what he/she has learned about leptin and its influence on weight in humans. It is important that students understand why scientists would want to isolate this protein and how they could use this protein to study obesity.

Please choose one or more of the following evaluation activities to conduct with your students:

EVALUATION ACTIVITY 1: EXPLAIN OBSERVATIONS (BIOLOGY OBJECTIVE 1.03):

Researchers studying leptin levels in humans have found that some obese individuals have high levels of leptin while others have low levels of leptin. In your own words, describe the function of leptin in the body and tell how both of these situations could result in obesity based on what you have learned.

Leptin is a hormone produced by fat cells that acts on brain cells to trigger a reduction in appetite; ideally, the more leptin present in the blood, the less likely one is to over eat and gain weight. Obese individuals with high levels of leptin are likely insensitive to leptin's effects and thus do not receive the signal to stop eating so they gain weight. Obese individuals with low levels of leptin do not produce enough of the signal to stop eating and so they, too, gain weight.

EVALUATION ACTIVITY 2: DESIGN A SCIENTIFIC INVESTIGATION (BIOLOGY OBJECTIVE 1.02)

Now that you have isolated leptin, describe how you would design an experiment to determine whether leptin injections can lead to weight loss in obese individuals.

- Describe what your hypothesis would be and how you would design an experiment to test this hypothesis.
- Describe the control and experimental groups that you would use to test your hypothesis.

• Describe the variables that would need to be controlled for during this experiment.

• Describe the experimental results that you would predict if your hypothesis were true.

Possible Hypothesis: Injections of leptin into obese humans will result in weight loss.

Control Group: Obese individuals are injected with a placebo

Experimental Group: Obese individuals are injected with leptin (experimental variable) Different concentrations of leptin could be administered.

Variables: (possible answers) Participants should be on identical diets and should receive injections at the same time each day.

Predicted results: Obese patients receiving leptin will lose weight to a greater extent than those individuals in the control group.

Research Extension: Do an Internet or literature search to determine whether studies like this have been attempted and what the results indicated about leptin's role in the human body, particularly its effect on weight.

EVALUATION ACTIVITY 3: ANALYZING SCIENTIFIC DATA* (BIOLOGY OBJECTIVE 1.05)

Refer to figure 1 in the results from a 2001 study (Metabolism: partial leptin deficiency and human adiposity. (2001). *Nature*. Vol. 414, 34-35) where leptin levels were measured in individuals' heterozygous for the ob mutation (Δ G133). Study this figure and in your own words summarize what you think these data indicate. (Teachers: you may provide students printed copies of the figure without the legend, showing the actual figure legend later so that students can check the accuracy of their interpretations.)

Figure 1 shows that individuals heterozygous for the ob mutation have significantly reduced levels of leptin in their blood, and this correlates with an increase in bodyfat percentages and BMI values for these individuals.

The figure can be found at: http://www.nature.com/nature/journal/v414/n6859 /fig_tab/414034a0_F1.html To share the complete article with students, access it at http://www.nature.com/nature/journal/v414/n6859/ full/414034a0.html.

*This activity can be supplemented by having students read chapter 6 of *The Hungry Gene*, which tells the story behind this study.

WET-LAB EVALUATION

During the wet-lab, you isolated the protein leptin from a mixture of proteins found in bacteria cells that were genetically modified to produce this hormone. The goal of this evaluation is to give you a chance to summarize what you have learned about leptin and how it influences weight in humans. It is important that you understand why scientists would want to isolate this protein and how they could use this protein to study obesity.

Evaluation Activity 1: Explain observations

Researchers studying leptin levels in humans have found that some obese individuals have high levels of leptin while others have low levels of leptin. In your own words, describe the function of leptin in the body and tell how both of these situations could result in obesity based on what you have learned.

Evaluation Activity 2: Design a scientific investigation

Now that you have isolated leptin, describe how you would design an experiment to determine whether leptin injections can lead to weight loss in obese individuals.

- Describe what your hypothesis would be and how you would design an experiment to test this hypothesis.
- Describe the control and experimental groups that you would use to test your hypothesis.
- Describe the variables that would need to be controlled for during this experiment.
- Describe the experimental results that you would predict if your hypothesis were true.

Research Extension: Do an Internet or literature search to determine whether studies like this have been at-tempted and what the results indicated.

Evaluation Activity 3: Analyzing scientific data

Refer to figure 1 in the results from a 2001 study (Metabolism: partial leptin deficiency and human adiposity. (2001). *Nature*. Vol. 414, 34-35) where leptin levels were measured in individuals' heterozygous for the ob mutation (Δ G133). (Your teacher may provide you this figure or you may access it online at http://www.nature.com/nature/journal/v414/n6859/ fig_tab/414034a0_F1.html.

Study this figure and in your own words summarize what you think these data indicate. Your teacher will discuss with you the figure legend so that you can check the accuracy of your interpretation.

"WEIGH TO GO!" IMPLEMENTATION PLAN — POST-LAB						
Activity	Estimated Time	Materials/Equipment	Purpose/Objectives/ Essential Question			
Review results of wet-lab	5 minutes	Test tubes from the previous day	Purpose: To engage students in thinking about obesity as an epidemic and to explore connections between obesity, diabetes, high blood pressure and high cholesterol levels			
The Fattest Americans Video and question sheet	30 minutes	Video from 60 minutes and Review Questions sheet	 Objectives: To recognize obesity as a growing and pressing problem, and to recognize its health and economic implications To comprehend connections between human biochemistry and physiology; to understand how 			
"Weigh to Go!" Quiz Game	20 minutes	CD provided, also located on DESTINY web site (http://www.destiny.unc.edu)	genes work at the molecular level to create changes in how the body functions as a whole • To recognize the significance of genetic engineer- ing for the production of protein			
Or select from activities in the Additional Activities and Resources section or the Interdisciplin- ary Bridges section			 To use information about the chemistry of molecules to understand the process of hydrophobic interactive column (HIC) chromatography To explain how the structure s of macromolecules in the diet relate to their function in the body, and to recognize the important impact diet has on weight To acknowledge the roles that both genetics and the environment (DNA and personal choice) play with respect to risk factors for disease (cardiovas-cular disease, diabetes, cancer, etc.) and weight control Essential Question: What are the connections between obesity and associated chronic diseases such as diabetes, high blood pressure and high cholesterol levels? 			

Alignment with NC Competency Goals						
Biology	Chemistry	Healthful Living				
Goal 1 Objectives 1.01,1.02,1.03 Goal 2 Objectives 2.01,2.02,2.03,2.04 Goal 3 3.03,3.04 Goal 4 Objectives 4.03,4.04	Goal 2 Objectives 2.03, 2.04 Goal 5 Objectives 5.01, 5.05, 5.06	Goal 1 Objectives 1.01,1.02,1.03,1.04,1.06 Goal 2 Objectives 2.03,2.05 Goal 3 Objectives 3.01,3.03,3.04,3.05,3.09 Goal 5 Objectives 5.01, 5.02, 5.03, 5.04, 5.05, 5.06, 5.07 Goal 7 Objectives 7.01, 7.02, 7.03, 7.04, 7.05, 7.06 Goal 8 Objectives 8.01,8.02,8.03,8.04,8.05,8.06				

THE FATTEST AMERICANS 60 MINUTES II Video Questions

Answer the following questions while viewing the video.

- 1. What disease is becoming prevalent among the Pima Indians of the American Southwest?
- 2. What happened to the Pima Indians post-1950s to dramatically change their lifestyle, leading to the problem of obesity?
- 3. What other medical ailments are now associated with obesity, other than diabetes?
- 4. What is suspected to be the reason that the Pima Indians are gaining weight faster than other Americans given the same diet?
- 5. What is the percentage of Native Americans who have diabetes compared to the general population?
- 6. Describe the theory about the two mutant genes and what they may trigger in the Native Americans.
- 7. Have any chromosomes been isolated that could be responsible for the problems of diabetes and obesity?
- 8. As small as a 7% reduction in body weight seems to be effective in helping the Pima Indians with the onset and treatment for diabetes. What steps are being taken to help the adults and the children with weight reduction?
- 9. What is the idea behind traditional farming? How could this idea be effective in helping the Pima Indians?
- 10. How are the Tepary beans supposed to be beneficial in the diets of the Native Americans of the Southwest?

THE FATTEST AMERICANS 60 MINUTES II Answers to Video Questions



Answer the following questions while viewing the video.

- 1. What disease is becoming prevalent among the Pima Indians of the American Southwest? Diabetes
- 2. What happened to the Pima Indians post-1950s to dramatically change their lifestyle, leading to the problem of obesity?

The river was dammed and the land where they grew crops was flooded so they could no longer grow their own food. The men left to fight in WWII and no one was left to farm the land. The US government stepped in and gave surplus food supplies which were not native foods for the Pima Indians.

- 3. What other medical ailments are now associated with obesity, other than diabetes? Blindness, circulation problems in the feet, death
- 4. What is suspected to be the reason that the Pima Indians are gaining weight faster than other Americans given the same diet?

Genetics—they have mutant genes

- 5. What is the percentage of Native Americans who have diabetes compared to the general population? More than 50 %, probably as high as 70%, compared to 6-8% in the general population.
- 6. Describe the theory about the two mutant genes and what they may trigger in the Native Americans. Researchers believe that the Pima Indians have 2 mutant genes; one mutant gene makes them overeat and become obese, while the 2nd mutant gene triggers diabetes.
- 7. Have any chromosomes been isolated that could be responsible for the problems of diabetes and obesity? Chromosome 1 seems to have the diabetes susceptibility gene and Chromosome 11 appears to have the obesity susceptibility gene.
- 8. As small as a 7% reduction in body weight seems to be effective in helping the Pima Indians with the onset and treatment for diabetes. What steps are being taken to help the adults and the children with weight reduction? For adults, a new workout facility has been built at the reservation hospital. For the children at St. Peter Indian Mission School, Sister Margaret Mary Carpenter has developed a running program where the children run each morning in order to start the day with exercise. She has also asked the Federal School Lunch Program for permission to modify the diets of the Indian children to include more fruits and vegetables, low-fat milk, and foods with zero sugar.
- 9. What is the idea behind traditional farming? How could this idea be effective in helping the Pima Indians? The Pima Indians would grow natural and native foods in the desert, especially traditional foods grown 100 years ago when obesity did not exist in their culture. The idea would give the people a choice in their diet for healthier eating as well as bringing back a part of their culture and heritage.
- 10. How are the Tepary beans supposed to be beneficial in the diets of the Native Americans of the Southwest? The beans are a traditional food that composed a major part of the diet of these people years ago before obesity and diabetes became a way of life. By growing the beans and using them in cooking, the Indians would no longer be dependent on the refined flour and high fat foods more commonly used today.

"WEIGH TO GO!" Quiz Game Questions

	Obesity: Fact or Fiction	Health Effects	Weigh to Go	Causes of Obesity	What Can You Do?	Hodge Podge
200	Fact or fiction? Americans spend over \$30 billion per year on weight loss products and services.	Obesity is the leading risk factor for type 2 diabetes. Define type 2 diabetes.	What process is used in the wet lab to separate and purify leptin from the other proteins?	What are two factors contrib- uting to obesity that people can control?	T or F: The best way for most people to com- bat obesity is to take medication.	What group of Americans was the subject of the 60 minutes video "The Fat- test Americans"?
400	Fact or fiction? Obesity is de- fined as having a Body Mass Index (BMI) of 40 or greater.	T or F: Obe- sity can lead to psychological disorders.	Why was leptin tagged with a bioluminescent marker in the wet lab?	Researchers discovered a gene in humans that produced a hormone called leptin. People who have a de- fective version of this gene may be more susceptible to obesity. Name this gene.	What are ther- mogenic drugs?	Compared with other states, where does North Carolina rank in terms of percentage of obese people?
600	Fact or fiction? Obesity is the fourth leading cause of prevent- able death in America.	Obese people are at increased risk of heart disease. What is heart disease?	What is hydrophobic interaction chro- matography?	T or F: Genes cause obesity.	What is liposuc- tion, and should it be used to treat obesity?	State what BMR stands for, and define BMR.
800	Fact or fiction? Over 60% of Americans over the age of twenty are overweight.	Obesity has been linked to hyper- tension. What blood pressure is considered hypertension?	During the purification phase of the wet lab, what was the function of the lysozyme?	Some obese people do not produce enough of a hormone called leptin. What does leptin do in our bodies?	The safest way to lose weight is to consume less energy (calories) than you burn. List three healthy things you can do to either consume fewer calories or burn more calories.	What formula is used to calculate BMI?
1000	Fact or fiction? A higher percentage of White Americans are obese than minorities. Only about 10% of overweight adolescents will be overweight as adults.	Obese people are more likely to have high blood cholesterol. What are HDL and LDL, and which is the good choles- terol?	Four buffers were used in the wet lab: equilibration buffer, elution buffer, wash buffer, and bind- ing buffer. Put those in order of salt content, with highest salt content first.	A hormone in humans' bodies that stimulates our need to feed has been linked to overeating. Name this hormone.	What is gastric bypass surgery?	What range of BMIs represents a healthy weight?

"WEIGH TO GO!" Quiz Game Answers

	Obesity: Fact or Fiction	Health Effects	Weigh to Go	Causes of Obesity	What Can You Do?	Hodge Podge
200	Fact, specifically \$33 billion per year.	Adult Onset Diabetes. Type 2 diabetes can be controlled by diet, exercise, losing weight and taking oral medications	Hydrophobic In- teractive Column Chromatography (HIC)	Overeating, inactivity, poor nutrition, etc. Other answers may vary, but they must be linked to personal choice to be correct	False. The best way for most people to combat obesity is a healthy diet and exercise.	The Pima Tribe of Native Americans.
400	Fiction. Obesity is having a BMI of 30 or more.	True. Obesity can lead to low self-esteem and depression.	So that the leptin could be seen	The <i>ob</i> gene, or the obesity gene.	Drugs that increase a body's metabolism	North Carolina ranks 16th high- est in percentage of obese adults.
600	Fiction. Obesity is actually the seventh leading cause of prevent- able death in the US today.	Heart disease is a condition that occurs due to inadequate blood flow to the heart, which happens when the arteries become partially or completely blocked.	A technique where the hydrophobic properties of protein are used to separate or purify proteins from other molecules	False: Genes can affect how sus- ceptible a person is to becoming obese but do not directly cause the disease.	Liposuction is the removal of body fat via a suction device. It is not a good option because not enough fat can be removed. It also doesn't help diabetes.	Basal Meta- bolic Rate is the amount of en- ergy your body needs to carry out the chemical pathways while the body is at rest.
800	Fact: 64% of Americans are overweight, and 30% are obese.	140/90 is consid- ered hyperten- sion.	Enzymatically digested the bacterial cell wall so it would rupture during freezing	Leptin is a hormone that works on the hypothalamus, causing one to feel less hungry.	Eat lower-calorie food, exercise more, reduce portion size, etc. Skipping meals is INCORRECT; this is NOT healthy.	BMI = weight in kilograms/ (height in meters squared)
1000	Fiction: The prevalence of both obesity and diabetes is sub- stantially greater in minorities than in whites. 70% of overweight adolescents will become over- weight adults.	High Density Li- poprotein (HDL) is considered good cholesterol because it acts as a scavenger of cholesterol. Low Density Li- poprotein (LDL) is considered bad cholesterol be- cause it delivers triglycerides and cholesterol to cells for storage.	Highest to lowest: Binding, Equilibration, Wash, Elution.	Ghrelin (pronounced GRELL-IN) is the hormone that stimulates our "need to feed".	A surgery where the top of the stomach is stapled, leaving a stomach that will hold roughly 2 tablespoons.	BMIs of 19-24 represent a healthy weight.

"WEIGH TO GO!" IMPLEMENTATION PLAN — ADDITIONAL ACTIVITIES						
Activity	Estimated Time	Materials/Equipment	Purpose/Objectives/ Essential Question			
Energy to Burn: Measuring the Energy in Food	50 minutes	Balance, cork, large graduated cylinder (10ml), matches, ring stand, paper clip, test tube (large), test tube clamp, thermometer, various foods, water, and 2 twist ties or flat-coated wires	Biology, Chemistry			
Calories Count, Basal Metabolic Rate Activity, Thickburger Math Exten- sion (any one or combination of above three activities)	1 class period	Worksheets for determining # of calo- ries and BMR for each student Fast food menus and/or Internet access Hardee's article (reprinted by permis- sion of <i>The News and Observer</i> of Raleigh, NC) and Thickburger Math Extension worksheet for each student	Biology, Health, Math, Social Studies, Technology			
Are you Susceptible?, with Gambler Introduction	30 minutes	Worksheets from NIH Human Genetic Variation Curriculum Supplement Se- ries - Grades 9-12 Music: "The Gambler" by Kenny Rogers (optional)	Biology, Health, Art, Social Studies			
The Story of Steve and Sara	30 minutes	Copies of case study for each student	Biology Arts, Psychology			
Morgan: A Case of Diabetes	30 minutes	Copies of the case study for each stu- dent from www.sciencecases.org	Biology, Health			
Additional Resources: www.biointeractive.org; www.americanheart.org/presenter.jht?identifier=297 ; http://academy.d20.co.edu/kadets/lundberg/obesity.html DVD: HHMI Holiday Lecture Series "The Science of Fat" Books: Fatland; Fast Food Nation HHMI Poster: "The Science of Fat"—order free copy at www.ifcweb.com/lecture2004						

Online article: "Scientists sprint to understand fat-busting protein leptin" www.purdue.edu/UNS/html14ever/9611.Kim.leptin.html

ENERGY TO BURN

Living organisms require energy to carry out life processes. The food an organism takes in provides the energy requirements it needs. In order to determine the amount of energy stored in a particular food, scientists use a calorimeter, a device that measures how much heat is given off when a particular food is burned. In a calorimeter, when food is burned energy is given off in the form of heat. This heat can then be used to change the temperature of a given amount of water. The change in the temperature of the water can enable scientist to compute the energy change in units called calories.

One calorie is the amount of heat needed to raise the temperature of 1 gram of water 1oC. The energy in food is commonly expressed in kilocalories, also called Calories (with an uppercase C). One kilocalorie (Calorie) equals 1000 calories, or the amount of heat needed to raise the temperature of 1kg of water by 1oC.

Remember: 1ml (cc) of water has a mass of 1 g.

The apparatus used in this experiment is not completely efficient; therefore, some heat will be lost to the environment.

Objectives

To construct a simple calorimeter
 To measure the amount of energy stored in various foods

Procedure

Construct a simple calorimeter as shown in the figure.

Attach the test tube to the ring stand. Attach the heatproof test tube to the clamp, so that the clamp is tight enough to hold the test tube, but loose enough that the test tube can be turned within the clamp. This will provide room for the test tube to expand when it is heated.

Prepare the thermometer by fastening two twist ties to the middle of the thermometer, leaving the extended ends outward on each side. The twist ties will help to suspend the thermometer in the water. Lower the thermometer into the test tube until the bulb is 1cm from the bottom of the tube.

Prepare the food platform for the calorimeter by bending the free end of a small paper clip so that it is at a right angle to the clip. Place the bottom of the test tube 1.5 cm from the top of the food platform. Add 10 ml of water to the test tube. Record this on your data table. Place the food on the platform and find the combined mass of the food plus the food platform. (Record the combined mass of the food and food platform in the space provided on your data table.) Place the food platform near the calorimeter and check to see that the food is well balanced on the platform.

Use a match to ignite the food. It may take a few seconds for the food to begin to flame.

CAUTION: Wear safety goggles. Handle the matches and burning the food carefully.

Allow the food to burn completely. Check the reading on the thermometer and record the reading before and after the food burns. Calculate and record the change in water temperature. Find the mass of the food when it is no longer burning. (Use the balance to find the combined mass of the food and the food platform. Be sure to handle the food carefully; it may still be hot.) Record the mass on your data table. Find the mass of the food before and after burning and record on the data table. **Repeat this procedure using a fresh food sample and room temperature water several times.**

Materials Needed

Balance Graduated cylinder, 10ml Ring stand Test tube (large) Thermometer Aluminum foil Water (beaker with 500ml) 2 Twist ties (flat plastic coated wires) Large cork Matches Paper clip Test tube clamp

Various food:

Nuts, dry marshmallows, popcorn, potato chip, puffed rice shredded wheat



Calculating the Energy						
kcalories in food	= mass of water	· X change in	water ten	nperature 2	specific heat	
(kcal)	(g)		(G°C)		(kcal/kg°C) of water	
		Example:				
Cal	lories = mass of wate	er X temperature	e change X h	eat of water		
Кса	al .02ka 10a = .01 ka	' 2°C	5	1 kcal/kg°C		
	5 5 5			J		
Remember that 1ml (cc) of water has water by 1°C. In the formula, specific	s a mass of 1 g. The specific c heat of water is expresse	c heat of water is th d as 1 kcal/kg oC.	e number of ca	alories needed t	o raise the temperature of 1g of	
 To find the number of kilocalories per food sample. 	r gram of food, divide the	number of kilocalor	ries calculated	in the formula a	bove by the change in mass of the	
					1	
kilocalories pe	er gram = number of kilo	calories calculated/	change in the	mass of the foo	d sample	
Example:	: .02k	ical X	5	= .10 kc	al/g	
 Remember that 1ml (cc) of water has a mass of 1 g. The specific heat of water is the number of calories needed to raise the temperature of 1g of water by 1°C. In the formula, specific heat of water is expressed as 1 kcal/kg oC. To find the number of kilocalories per gram of food, divide the number of kilocalories calculated in the formula above by the change in mass of the food sample. kilocalories per gram = number of kilocalories calculated/ change in the mass of the food sample. 0.02kcal X S .10 kcal/g 						

Show your calculations here:

Sample 1

Sample 2

ENERGY TO BURN ANALYSIS

Calculations Of Calories							
Sample And Trial	Mass of sample and platform before burning	Mass of sample and platform after burning	Change in mass of sample	Initial water tempera- ture	Final water tempera- ture	Change in water tempera- ture	kcalories in food sample (kcal)
Sample 1 Trial 1							
Trial 2							
Sample 2 Trial 1							
Trial 2							

1. What is the relationship between calories and chemical energy stored in foods?

2. Why is it important to prevent the thermometer from resting on the bottom of the test tube?

3. When you calculated the number of calories per 100 grams of food sample, did you get the same number for the two samples? If not, explain why not.

4. How could you improve this procedure to get more accurate measurements?

5. Grizzly bears are known to eat fatty parts of many animals. What properties of the fatty tissues make them good food sources for bears?

6. Why are snack foods sometimes called junk foods?

Going Further

1. Study a calorie chart. What kinds of foods are especially high in calorie content? What foods are low?

CALORIES COUNT: DO THE MATH!

A calorie is a unit of energy. The term calorie used in nutrition is more accurately a kilocalorie (kcal) — the amount of energy necessary to raise the temperature of 1000 ml of water 1 0 Celsius.

Carbohydrates, proteins, and fats provide the calories in our diet:

- 1 gram of pure carbohydrate provides 4 kcal.
- 1 gram of pure protein provides 4 kcal.
- 1 gram of pure fat provides 9 kcal.

Very few foods are pure carbohydrate, protein or fat: a. 17 grams of American cheddar cheese contain 68 calories. Study the example below to see how each component contributes to the total calories.

 0.4 g carbohydrate
 X 4 kcal = 1.6

 4.3 g protein
 X 4 kcal = 17.2

 5.5 g fat
 X 9 kcal = 49.5

Total = 67.8 kcal

b. Calculate the calories in one slice of banana bread which contains:

23.0 g carbohydrate	X 4 kcal =
2.4 g protein	X 4 kcal =
3.9 g fat	X 9 kcal =

Name of fast-food restaurant: ____

Total =

c. Calculate the calories in one cup green beans which contains:



EXTENSION

Visit the website from one of your favorite fast food restaurants and calculate the total calories for a typical lunch or dinner. Don't forget the drink and dessert.

www.bk.com www.dominos.com www.mcdonalds.com www.wendys.com www.chick-fil-a.com www.pizzahut.com www.tacobell.com



Food Item	Total Calories	g total fat X 9 kcal	g carbohydrate X 4 kcal	g protein X 4 kcal
McDonald's Crispy Chicken Breast Filet	503 kcal	23 g X 9 kcal = 207 kcal	50 g X 4 kcal = 200 kcal	24 g X 4 kcal = 96 kcal

Compare your menu with the new Dietary Guidelines for Americans 2005 that were released January 12, 2005. Please visit www.healthierus.gov/dietaryguidelines/ for more information on the 2005 Guidelines.

Visit www.caloriesperhour.com, to calculate your caloric needs based on your activity level.

- *** Social Studies Connection: Examine menus to see how they vary by country.
- *** Technology Extension: Students should create a spreadsheet that calculates the number of calories for each category: carbohydrates, proteins, fats.

BMR: HOW MANY CALORIES DO YOU NEED?

A. Basal metabolic rate (BMR) is the amount of energy the body needs to maintain vital functions while the body is at rest. To estimate your BMR:

```
Females: BMR = 655 + (4.35 x weight in pounds) + (4.7 x height in inches) - (4.7 x age in years)
Example: 127 pound female, 64 inches tall, 15 years old
BMR= 655 + (4.35 x 127) + (4.7 x 64) - (4.7 x 15)
BMR= 655 + 552.45 + 300.8 - 70.5
BMR= 1437.75
Males: BMR = 66 + (6.23 x weight in pounds) + (12.7 x height in inches) - (6.8 x age in year)
Example: 136 pound male, 67 inches tall, 15 years old
BMR= 66 + (6.23 x 136) + (12.7 x 67) - (6.8 x 15)
BMR= 66 + 847.28 + 850.9 - 102
BMR= 1662.18
```

1. Calculate your BMR.

B. In order to estimate your daily caloric need, you must also take into account your physical activity. First, determine your activity level, then multiply your BMR by the appropriate amount.

1. Calculate your daily caloric need.

Low Energy: If your highest level of activity during an average day is sitting, reading, etc., multiply your BMR x 1.3

Medium Energy: If your highest level of activity during an average day is at least an hour of walking, dancing, skating, bowling, etc., multiply your BMR x 1.7.

High Energy: Your highest level of activity during an average day is at least an hour of running, biking, playing basketball, soccer, etc., multiply your BMR x 1.9.

2. For comparison, you can also calculate your caloric needs based on your activity level by visiting this website, www.caloriesperhour.com. Reminder: If you were to burn 500 calories more than you consume each day, you would lose one pound each week. 3,500 calories = one pound of body fat

EXTENSION

Using your favorite fast food restaurant websites, plan a personal menu for the day or an entire week that meets your daily caloric needs. Compare your menus with others in the class.

www.bk.com www.wendys.com	www.chick- www.pizzał	fil-a.com nut.com	www.mcdonalds.com www.dominos.com	www.tacobell.com
Day/Meal			Food Items	Total Calories

Dietary Guidelines for Americans 2005 was released January 12, 2005. Visit www.healthierus.gov/dietaryguidelines/ for more information on the 2005 Guidelines.

Technology Extension: Create a spreadsheet that calculates the number of calories for each food item in your menu above. You can also include a column to calculate the difference between your daily total calories and you daily caloric needs.

THICKBURGER MATH EXTENSION

Source: www.fda.gov/fdac/special/foodlabel/dvs.html

According to the FDA, Daily Reference Values (DRVs) are calculated on the following:

- fat based on 30 percent of calories.
- saturated fat based on 10 percent of calories.
- carbohydrate based on 60 percent of calories.
- protein based on 10 percent of calories. (The DRV for protein applies only to adults and children over 4. RDIs
- [Recommended Daily Intake] for protein for special groups have been established.)
- fiber based on 11.5 g of fiber per 1,000 calories.

Standard percentages given on packaging are usually provided based on a daily caloric intake of 2,000 calories. However, if you consume more or less calories in a day (an active teenage athlete might consume 3,000 calories, for example), you can calculate your daily value percentages for yourself using the information above. To calculate, you must know the following:

- 1 gram of pure carbohydrate provides 4 calories.
- 1 gram of pure protein provides 4 calories.
- 1 gram of pure fat provides 9 calories.

So to calculate the daily value of protein for that active teen, multiply 3,000 (calories per day) by .1 (protein's recommended percentage of calories) and divide result by 4 (the number of calories in a gram of protein). The answer: 75g. Likewise, to calculate DRV of fat for a standard adult, multiply 2,000 (calories per day) by .3 (fat's recommended percentage of calories) and divide result by 9 (the number of calories in a gram of fat). The answer: 66.

However, because of the links between certain nutrients and certain diseases, DRVs for some nutrients represent the uppermost limit that is considered desirable, regardless of calories consumed. Eating too much fat or cholesterol, for example, has been linked to an increased risk of heart disease. Too much sodium can heighten the risk of high blood pressure in some people.

Therefore, food labels will show Daily Values (DVs) for fats and sodium as follows:

- total fat: less than 65 g
- saturated fat: less than 20 g
- cholesterol: less than 300 mg (milligrams)
- sodium: less than 2,400 mg

Calculate the percentage of daily values of a Hardee's Thickburger based on a 2,000 calorie-per-day diet (considered standard for adults and children over 4). Round to the nearest whole number.

Nutrient Amount in Thickburger	DRV based on 2,000 calories	Percentage daily value of Thickburger
Calories: 1420		
Total Fat: 107g		
Saturated Fat: 46g		
Cholesterol: 230mg		
Sodium: 2,650mg		
Protein: 64g		

For further fun, go to www.hardees.com and recalculate the daily values for a meal consisting of a double Thickburger, large fries, and small Coca-Cola.

THICKBURGER MATH EXTENSION



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Nutrient Amount in Thickburger	DRV based on 2,000 calories	Percentage daily value of Thickburger
Calories: 1420	2000	71%
Total Fat: 107g	less than 65g	165%
Saturated Fat: 46g	less than 20g	229%
Cholesterol: 230mg	less than 300mg	77%
Sodium: 2,650mg	less than 2400mg	110%
Protein: 64g	50g	130%

For further fun, go to www.hardees.com and recalculate the daily values for a meal consisting of a double Thickburger, large fries, and small Coca-Cola.

BIG BURGERS ARE KEY TO HARDEE'S PLAN Reprinted by permission of The News & Observer of Raleigh, N.C.

By DUDLEY PRICE, Staff Writer

While its fast-food rivals retool their menus to entice the salad crowd, Hardee's is rolling out its highest-calorie hamburger ever.

The aptly named Monster Thickburger features two, one-third pound slabs of Angus beef, three slices of American cheese, four strips of bacon and mayonnaise on a buttered sesame seed bun. The tally: 1,420 calories, 107 grams of fat.

Executives at CKE Restaurants, the California company that owns Hardee's, aren't worried that the monstrous burger contains more than double the recommended daily dose of saturated fat. Indeed, a company news release says the Monster Thickburger "takes decadence to a new level."

"Our future is big burgers," said executive vice president for marketing Brad Haley. "This focus on burgers is pretty good for us," he said, adding that Hardee's sales are up 7.8 percent for the year.

CKE has lost hundreds of millions of dollars since buying Hardee's, then based in Rocky Mount, in 1997. Executives are banking that a focus on burgers — big burgers — in a menu revamp started last year will turn things around.

The Monster Thickburger, which sells for \$5.49, hit restaurants Monday. The rollout comes amid concerns that the fast-food industry could be held liable for the country's much-publicized obesity epidemic. Last year, a class-action lawsuit that blamed McDonald's for making children fat was dismissed by a New York court, but not before the judge opined that the company's McNuggets were a "McFrankenstein creation."

NUTRITION FACTS

Serving size: 1 sandwich (412g) Servings Per Container: 1 Amount Per Serving Calories: 1,420 Calories from Fat: 970 Total Fat: 107g Saturated Fat: 46g Cholesterol: 230mg Sodium: 2,650mg



Hardee's, however, now has nine burgers besides the Monster Thickburger with more calories than the former bigburger standard, McDonald's 600-calorie Big Mac. Four other Hardee's burgers top 1,000 calories.

"It looks great, and I like a lot of cheese and bacon," said Sedrick Baskett, a student at St. Augustine's College who chose a Monster Thickburger at the Hardee's on Raleigh's Avent Ferry Road on Tuesday. "You've got to die one day of something, and life is too short to worry about what other people say you should eat."

Restaurant consultant Jerry McVety said Hardee's is trying to carve a niche in a crowded fast-food market.

Hardee's "problem is they've never really had an identity," McVety said. "Now, all of a sudden, in what I think is great marketing strategy, they've become the focus of the burger industry."

Staff writer Dudley Price can be reached at 829-4525 or dprice@newsobserver.com.

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THE GAMBLER (by Kenny Rogers)

A song to serve as an introductory complement to Additional Activity, "Are You Susceptible?"

Objective: To illustrate the roles that both environment and genetics play in adolescent and adult health.

Introduction

Ask students if they have ever played card games (or other games), or if they have ever watched poker on TV. Some sample questions:

- 1. What sorts of games are you familiar with?
- 2. How does the game(s) work?
- 3. What parts of the game are already determined and out of your control? (Possible answers include the rules, the cards that are dealt to you, etc.)
- 4. What parts of the game can you control? (The moves you make or the choices you make, for example).

Activity

Play an excerpt from the song The Gambler (key lyrics below). Ask students what the song is about.

"You got to know when to hold 'em, know when to fold 'em, Know when to walk away and know when to run." — Kenny Rogers

Sample Questions:

What can the gambler control? What is out of his/her control?

This would be a good time to consult students who can explain what "holding" and "folding" are in poker.

How can these actions translate to personal decisions that we make in life in general? How can "holding," "folding," "walking away", and "running" serve as analogies to choices we make in terms of choosing the foods we eat and the amount of physical activity we engage in each day?

Conclusion

Note how The Gambler's behavior changes based on the cards he's dealt. How does this relate to the genetic risk factors he might be dealt, in combination with the personal decisions he can make to change his behavior?

ARE YOU SUSCEPTIBLE

Activity 4 of the Human Genetic Variation NIH Curriculum Supplement Series — Grades 9-12 Available online at http://science.education.nih.gov/supplements/nih1/genetic/activities/activity4.htm

AT A GLANCE

Focus: Students play a game to explore the relationship between genetic variation and environmental factors in the onset of heart disease and consider the implications for disease prevention of increased knowledge about genetic variation.

Major Concepts: Studying the genetic and environmental factors involved in multifactorial diseases will lead to increased diagnosis, prevention, and treatment of disease.

Objectives: After completing this activity, students will

- understand that all disease, except perhaps trauma, has both a genetic and environmental component;
- recognize that certain behaviors can increase or reduce a person's risk of experiencing certain medical outcomes; and
- understand that the ability to detect genes associated with common diseases increases the prospects for prevention.

Prerequisite Knowledge: Students should understand the concept of a gene.

Basic Science-Health Connection: The last few years of research have seen a gradual transition from a focus on genes associated with single-gene disorders to an increasing focus on genes associated with multifactorial diseases such as cancer, heart disease, and diabetes. In this activity, students investigate the contribution that genes associated with heart disease might make to its development in an individual's life and consider the implications of this knowledge for behavior.

INTRODUCTION

Activity 3, Molecular Medicine Comes of Age, and Activity 4, Are You Susceptible?, focus students' attention on the practical, medical applications of understanding human genetic variation at a molecular level. Activity 3 looks at treatment options that become possible with the discovery and sequencing of a disease related gene. In contrast, Activity 4 focuses on the likelihood that genetic testing for common, multifactorial diseases will increase in the future and invites students to consider the prospects for this information to help individuals make wise decisions about their personal health. Specifically, Activity 4 uses heart disease as an example of the common, multifactorial diseases that constitute the bulk of the health care burden in the United States and other developed countries. The activity builds on the treatment of variation in the prior activities and sets up the discussion of ethics that is central to Activity 5, which deals with genetics and cancer.

For the most part, the treatment of genetics in the high school curriculum focuses on single-gene traits. In addition, most of the single-gene traits discussed in the curriculum are disorders, because they provide reasonably straightforward examples of Mendelian patterns of inheritance. Research in human genetics, however, increasingly addresses multifactorial traits, that is, traits that result from the interaction of multiple genes and environmental factors. Among the multifactorial traits that come most quickly to mind are those behavioral characteristics that are controversial and that often attract media attention, for example, intelligence, sexual preference, aggression, or basic personality traits such as novelty-seeking behavior or shyness. Research into the relative genetic and environmental contributions to behavioral traits has been uneven and is confounded by the difficulty of defining and measuring the phenotypes in question with any degree of accuracy and reliability.

A more productive area of active investigation involves the multifactorial diseases that are among the leading causes of sickness and death in developed countries, for example, heart disease, cancer, diabetes, and even psychiatric disorders such as schizophrenia and bipolar disease (manic-depressive illness). Already, research has uncovered genetic markers, and in some cases specific genes, that are associated with the development of these maladies; more genetic associations are sure to emerge as research into human genetic variation expands.

The identification of more genetic associations raises the virtual certainty of genetic testing for common, multifactorial diseases. Genetic testing is not a new phenomenon; it is done routinely to determine the risk for or presence of a number of single-gene disorders, including examples of Mendelian inheritance in the high school curriculum: Tay-Sachs disease, cystic fibrosis (CF), Huntington disease, phenylketonuria (PKU), and Duchenne muscular dystrophy. The predictive power of these tests lies in their technical reliability and the direct connection between gene and phenotype. Although there is considerable variation in symptomology for many single-gene disorders, the presence of the gene (or genes) does result in the generally recognized phenotype.

Our knowledge of the biological relationship between gene and phenotype is much less certain for multifactorial diseases. It is clear, for example, that genetic factors contribute to the risk for early onset heart disease, but the exact relationship is as yet unclear, as is the case for the relationship between certain genetic markers and the risk of schizophrenia. In these cases, the distance between gene—or genes—and phenotype is greater than it is in single-gene disorders, likely because of a host of environmental variables whose influences on phenotype are difficult to discern.

Genetic testing for common, multifactorial diseases will affect more people than does testing for relatively rare, single-gene disorders. Many of the same ethical and policy questions will apply-privacy and confidentiality, for example-but the uncertainty inherent in genetic testing for multifactorial disease will introduce some new challenges for the public, chief among them the notions of susceptibility and risk. One may learn from a "positive" test that one is susceptible to developing the disease in question, but that will not mean that one is destined to develop the disease. Nor will a "negative" test mean that one definitely will not develop the disease. In addition, while one may learn that there is an increased relative risk of developing a given disease-that is, a risk that is increased above the risk for the general population-the absolute risk may still be quite low.

It is likely that a deeper understanding of both the molecular basis of common, multifactorial diseases and the advent of genetic testing for these diseases will improve the climate for the development of more focused clinical interventions and for preventive medicine. Multifactorial diseases tend to develop later in life than do single-gene disorders, which generally exact their toll in infancy, childhood, or adolescence. There is, therefore, more opportunity to ameliorate the effects of multifactorial disease through a combination of medication and environmental modification. That, of course, requires a partnership between patients and health care providers to identify and modify the environmental variables that magnify one's genetic risks. That is the ultimate message of this activity.

MATERIALS AND PREPARATION

You will need to prepare the following materials before conducting this activity:

- Master 4.1, Rolling the Dice (make 1 copy per student)
- Master 4.2, Thinking About the Game (make 1 copy per student)
- dice (1 die per student)
- relevant genes envelopes (make 1 envelope per student)

To make a classroom set of relevant genes envelopes, first make as many copies of Masters 4.3-4.6 as you need to provide one-fourth of your class with the genetic risk indicated on each master. To minimize copying, each master contains four of the same statements. Insert one statement into each envelope and label the envelope "Relevant Genes."

PROCEDURE

1. Begin the activity by asking students to suggest definitions of the term "risk." You might prompt the discussion by asking the students to think about risky behaviors that are a part of adolescence. Write three or four of their definitions on the board.

Students may suggest that "risk" refers to the chance that something bad or negative will happen, as, for example, "the risk" involved with dangerous behaviors. Help students see that one way to think about risk is in terms of one's chance of experiencing a particular event. For example, if a person performs aerial acrobatics on skis, he or she has some "risk" of getting hurt.

2. Ask students whether they think risks can be **modified.** For example, ask them if there is any way they can modify their risk of being robbed or their risk of heart attack or cancer.

Answers will vary.

3. Read the following story to the students:

Death of an Olympic Champion* Ekaterina Gordeeva and Sergei Grinkov, young Russian figure skaters, had won two Olympic gold medals in the pairs competition and were expected to continue dazzling audiences and judges for years into the future. In November 1995, however, 28-year-old Sergei suddenly collapsed and died during a practice session. He was a nonsmoker, he was physically fit, and there had been no warning signs. What happened to cause this young athlete's early death?

*Source: Courtesy of Sinauer Associates, Inc., from Mange and Mange: Basic human genetics, Second Edition, 1999. **4. Explain that Sergei Grinkov was born with a mutation [called PL(A2)] in a single gene that affects the formation of blood clots.** The mutation causes clots to form in the wrong places at the wrong time. If such a clot forms in one of the arteries that supplies the heart, a heart attack can result. Ask the students to consider whether this mutant allele influenced Sergei Grinkov's risk of a premature heart attack.

The mutant allele increased Grinkov's risk of premature heart attack relative to the risk for the general population. Relative risk is the risk for any given person (or group) when considered in relation to the rest of the population. One may have an elevated relative risk, but still have a low absolute risk. For example, one may have an increased risk of 20 percent above the risk for the general population, but may still only have a 5 percent risk of suffering the disease in question by, say, age 50.

5. Ask the class to suggest ways that Sergei Grinkov could have modified his behavior had he known he was at increased risk for premature heart attack.

Given that this single-gene disorder affects the clotting process, it likely would have been difficult to reduce the risk of heart attack by modifying the environment. There is some indication that the PL(A2) mutation can interact negatively with increased cholesterol levels. If, for example, plaques formed by excess cholesterol break off from the lining of a coronary artery and create a lesion in a blood vessel, the PL(A2) mutation can cause the formation of a clot that impedes blood flow, resulting in a heart attack. Maintaining low cholesterol levels through diet and exercise, therefore, might reduce the risk of premature heart attack for a person who carries the PL(A2) mutation.

6. Explain to the students that premature heart attacks resulting from single-gene disorders are uncommon. Most heart attacks occur later in life and result from a combination of genetic and environmental factors that produce atherosclerosis, the build-up of cholesterol deposits in the arteries. In this activity, students will have an opportunity to explore the idea of medical risk and learn how genetic analysis is helping us understand and define people's risks in new ways.

7. Distribute one copy of Master 4.1, Rolling the Dice, to each student and direct the students to work in teams of three to play the game described.

Give the students about 10 minutes to finish the game.

8. Ask how many students suffered a fatal heart attack. Determine at which life stages the heart attacks occurred and record this information on the board.

9. Ask the students how the game is and is not like real life.

The game is like real life in that life expectancy depends on many risk factors. The game is not like real life because students rolled the die to determine what their risk factors would be instead of making personal choices. The game also involved only environmental risk factors, not genetic factors. If students fail to mention that the game does not address genetic risk factors, try to elicit that response by asking about Sergei Grinkov.

10. Acknowledge the importance of considering genetic risk factors in the development of heart disease and ask students what effect(s) factoring this information into the game might have.

Answers will vary. Because of the example of Sergei Grinkov and because of their own sense that sometimes heart disease tends to "run in families," students may think that including genetic factors in the game will inevitably have a negative effect. You may choose to point out that for some people, the effect might be positive, or let students discover this in Step 11.

11. Distribute one relevant genes envelope to each student and explain that this envelope contains information about his or her genetic risk for a fatal heart attack. Ask the students to open the envelopes and share their heart points until you have addressed all four values: -10, 0, +10, +40. Point out that the genetic risk falls off rapidly as genetic relatedness decreases, from 40 points for first-degree relatives to no points for third-degree relatives. Explain that this is the case generally for multifactorial diseases.

12. Distribute one copy of Master 4.2, Thinking About the Game, to each student and ask students to complete the worksheet to compare the results of the game with and without considering genetic factors.

13. Conclude the activity by inviting each team to offer its answer to one of the questions on Thinking About the Game. Then, invite other teams to contribute additional insights or information or to challenge ideas expressed by the team answering.

Question 3 Remember, if you exceeded 85 points in any life stage, you have had a fatal heart attack.

What effect did including your points for genetic risk have on your outcome?

Answers will vary. Including the genetic data may have pushed some students over the threshold to a heart attack. Others may have escaped a heart attack because of the protective effects of their genes, while still others may have experienced no change. The important point is that the environmental risks—the choices they made—have been played out against a genetic background, which differs for each person.

Question 4 Think about the choices you made in each life stage.

a. Did everyone make the same choices?

No, each person made somewhat different choices.

b. Were all of the choices equally risky?

No, some of the choices carried greater risks than others, and some decreased the risks.

c. Were the risk factors associated with the choices reversible?

Most of the risk factors were reversible--smoking, exercise, and stress, for example.

d. Were the choices under personal control?

In the game, choices were made on the basis of a roll of a die. In life, however, most of these choices are under personal control.

Question 5 Now, think about the effects of genetic risk factors in each life stage.

a. Does everyone have the same genes?

No, each person (except identical twins) has different genes.

b. Did all of the genetic factors have the same effect?

No, some genetic factors had negative effects, some were neutral, and some provided protection.

c. Were the genetic factors reversible or under personal control?

We cannot change the genes with which we are born. We can, however, sometimes modify the effects of those genes by modifying the environment, for example, by changing some of our behaviors.

Question 6 Assume that genetic testing showed that you were at increased risk for a fatal heart attack 20 years from now. Would you want to know? Why or why not? Would that information cause you to change your behavior? If not, what kind of information or event would cause you to change your behavior?

Answers will vary, but the assumption is that knowledge of increased genetic risk would cause one to modify his or her behavior to reduce the environmental risk factors. A very important point here is that a family history of heart disease is an indication of increased genetic risk, even if we are not yet able to identify predisposing genes and attach some risk figure to them. The literature on health and behavior—and personal experience—demonstrates that people do not always change their behaviors in the face of well-documented risk. Cigarette smoking is perhaps the classic example that applies well to adolescents. Some people will not change their behavior even in the face of serious illness.

Question 7 We know about only a few genes that affect the likelihood of a heart attack, and we have the ability to test for even fewer of them. In the future, we certainly will learn about more of these genes. How will an increased knowledge of the genetic factors associated with heart disease have a positive impact on individuals and society? How will it have a negative impact?

Increased knowledge about such genes will lead to increased testing and the development of new clinical interventions. Our ability to test for genes that predispose to heart disease will mean that we can detect those genetic susceptibilities sooner and act on them more quickly, for example, with drugs targeted at the specific biochemical defects involved and with modification of risky behaviors.

The frequency of heart disease, and other common, multifactorial diseases, means that genetic testing will be applied to many more individuals, with attendant concerns about how we use the results of genetic testing. In addition, genetic testing for multifactorial diseases will require education of the public and health care providers about the meaning of susceptibility and predisposition. Activity 5 explores some of these issues in more detail.

Question 8 Our ability to detect genetic variations

that are related to common diseases will improve. How might that ability shift some of the responsibility for health care from physicians to individuals?

If we know that we are at increased genetic risk for a particular disease, we can try to avoid those environmental factors, such as risky behaviors, that increase the risk further. Many health care professionals think that increased understanding of genetic variation will provide an important impetus to preventive medicine. Prevention will require a close partnership between health care providers and consumers. Health care specialists may be able to provide us with tests to uncover our genetic predispositions, but it will be up to each one of us to avoid increasing those risks by engaging in high-risk behaviors. In short, each of us will have to assume more responsibility for our own health. This requires active participation by the individual and is very different from the prevailing model, which is based not on prevention but on treatment after the disease occurs. In the current model, the individual (the patient) generally is a rather passive recipient of health care.

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ROLLING THE DICE

Imagine that you are going to live your entire life — your teen years, your adult years, and your senior citizen years-in the next 10 minutes and that your choices in life are going to be made by a roll of the dice. Begin with your teen years and roll one die to discover your behavioral choices in each category for each life stage. Use the information provided to determine how many points you receive for each behavior. Record the result in the blanks provided.

By the way, the object of this game is to stay alive to a ripe old age. You do this by keeping your "heart points" below the threshold level of 85. Once you exceed 85 points at any life stage, you're out (you've had a fatal heart attack).



Life Stage 1: Choices as a Teenager

1. Diet. Roll one die. If you rolled:

1 or	2 You eat a well-balanced, low-fat diet (subtract 10 points).
3 or	4 You eat some high-fat fast food and junk food (add 5 points).
5 or	6 You eat a lot of high-fat fast food and junk food (add 10 points).
2. Exerc 1 or	 ise. Roll the die again. If you rolled: 2 You're a couch potato! You get little or no exercise beyond walking from the TV to the refrigerator (add 15 points).
3 or	4 You get a moderate amount of exercise (subtract 5 points).
5 or	6 You exercise regularly (subtract 15 points).
3. Schoo 1	I/Job/Relationships. Roll the die again. If you rolled: You feel that your life is pretty stress free (subtract 10 points).
6	You are under a great deal of stress at home, at school, and at work (add 10 points).
For	any other rolls, add no points.
4. Smok 1 or 2	ng. Roll the die again. If you rolled: You don't smoke and are rarely exposed to those who do (subtract 20 points).
3 or 4	You don't smoke, but you are around many people who smoke (add 10 points).
5 or 6	You smoke one or more packs of cigarettes a day (add 20 points).
Total ris	k points from choices made as a teenager:

If the total is more than 85, you've had a fatal heart attack

Life Stage 2: Choices as an Adult (Ages 20–50) (Start from zero points.)

1. Diet. Roll one	die. If you rolled:	
1 or 2	You eat a well-balanced, low-fat diet (subtract 10 points).	
3 or 4	You eat some high-fat fast food and junk food (add 5 points).	
5 or 6 You ea	at a lot of high-fat fast food and junk food (add 10 points).	
2 E		
1 or 2	You're a couch potato! You get little or no exercise beyond walking from the TV to the refrigerator (add 20 points).	
3 or 4	You get a moderate amount of exercise (subtract 5 points).	
5 or 6	You exercise regularly (subtract 15 points).	
3 Joh/Relations	hins Roll the die again. If you rolled:	
1 You fee	I that your life is pretty stress free (subtract 10 points).	
6 You are	under a great deal of stress at home and at work (add 10 points).	
For any othe	er rolls, add no points.	
4 Smoking Rol	l the die again. If you rolled.	
1 or 2	You started smoking during your teen years (add 20 points)	
1 01 2	You did not start smoking during your teen years (add no points).	
3 or 4	You smoked during your teen years, but you have stopped smoking (subtract 20 points). You did not smoke during your teen years (subtract 5 points).	
5 or 6	You smoke one or more packs of cigarettes a day (add 20 points).	
Total risk points	s from choices made as an adult:	
Point		
Total risk points	s from choices made as a teenager:	
Total Points:		
If the total is mo	ore than 85, you've had a fatal heart attack.	

Life Stage 3: Choices as a Senior Citizen (Over Age 50) (Start from zero points.)

1 or 2 You eat a well-balanced, low-fat diet (subtract 10 points). 3 or 4 You eat some high-fat fast food and junk food (add 5 points).	
3 or 4 You eat some high-fat fast food and junk food (add 5 points). 5 or 6 Ver set a late a fibiale fast food for d and junk food (add 10 points).	
5 or 6 You eat a lot of high-fat fast food and junk food (add 10 points).	
2. Exercise, Roll the die again, If you rolled:	
1 or 2 You're a couch potato! You get little or no exercise beyond walking from the TV to the refrigerator (add 20 points).	
3 or 4 You get a moderate amount of exercise (subtract 5 points).	
5 or 6 You exercise regularly (subtract 15 points).	
 3. Retirement/Relationships. Roll the die again. If you rolled: 1 You feel that your life is pretty stress free (subtract 10 points). 	
5 or 6 You are under a great deal of stress (add 10 points).	
For any other rolls, add no points.	
4. Smoking. Roll the die again. If you rolled:	
1 or 2 You smoked before, but you stopped smoking (subtract 20 points).	
You did not smoke before (subtract no points).	
3, 4, 5, You started smoking as a teenager or an adult (add 20 points).	
or 6 You did not start smoking as a teenager or an adult or you stopped smoking as an adult (add no points).	
Total risk points from choices made as a senior citizen:	
Total risk points from choices made as an adult:	
Total risk points from choices made as a teenager:	
Total Points:	

If the total is more than 85, you've had a fatal heart attack.
THINKING ABOUT THE GAME

Complete the following steps to compare the results of the game with and without considering genetic factors.

1. Transfer your heart points from Rolling the Dice into the left-hand column below.

2. Your relevant genes envelope contained heart points related to your genetic risk. Enter that number in the righthand column below and recalculate your total points for each life stage.

Review - Risk from Behavioral Choices Only	Recalculate - Risk from Genes and Choices	
Life Stage 1: Teen years	Relevant genes	
Life Stage 2: Adult years +	Life Stage 1: Teen years +	
Subtotal	Subtotal	
Life Stage 3: Senior citizen years +	Life Stage 2: Adult years +	
Total	Subtotal	
	Life Stage 3: Senior citizen years +	
	Total	

3. Remember, if you exceeded 85 points in any life stage, you have had a fatal heart attack. What effect did including your points for genetic risk have on your outcome?

- 4. Think about the behavioral choices you made in each life stage. a. Did everyone make the same choices?
 - b. Were all of the choices equally risky?
 - c. Were the risk factors associated with the choices reversible?
 - d. Were the choices under personal control?
- 5. Now, think about the effects of the genetic risk factors in each life stage. a. Does everyone have the same genes?
 - b. Did all of the genetic factors have the same effect?
 - c. Were the genetic factors reversible or under personal control?

6. Assume that genetic testing showed that you were at increased risk for a fatal heart attack 20 years from now. Would you want to know? Why or why not? Would that information cause you to change your behavior? If not, what kind of information or event would cause you to change your behavior?

7. We know about only a few genes that affect the likelihood of a heart attack, and we have the ability to test for even fewer of them. In the future, we certainly will learn about more of these genes. How will an increased knowledge of the genetic factors associated with heart disease have a positive impact on individuals and society? How will it have a negative impact?

8. Our ability to detect genetic variations that are related to common diseases likely will improve. How might that ability shift some of the responsibility for health care from physicians to individuals?

HIGH GENETIC RISK

High Genetic Risk

_ _ _ _ _ _ _ _

You have a parent or sibling who had a fatal heart attack. ADD 40 HEART POINTS.

High Genetic Risk

You have a parent or sibling who had a fatal heart attack. ADD 40 HEART POINTS.

High Genetic Risk

You have a parent or sibling who had a fatal heart attack. ADD 40 HEART POINTS.

High Genetic Risk

You have a parent or sibling who had a fatal heart attack. ADD 40 HEART POINTS.

MODERATE GENETIC RISK

Moderate Genetic Risk

You have an aunt or uncle who had a fatal heart attack. ADD 10 HEART POINTS.

Moderate Genetic Risk

You have an aunt or uncle who had a fatal heart attack. ADD 10 HEART POINTS.

Moderate Genetic Risk

You have an aunt or uncle who had a fatal heart attack. ADD 10 HEART POINTS.

Moderate Genetic Risk

You have an aunt or uncle who had a fatal heart attack. ADD 10 HEART POINTS.

LOW GENETIC RISK

Low Genetic Risk

There is no history of fatal heart attacks among your close relatives. ADD NO HEART POINTS

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Low Genetic Risk

There is no history of fatal heart attacks among your close relatives. ADD NO HEART POINTS

Low Genetic Risk

There is no history of fatal heart attacks among your close relatives. ADD NO HEART POINTS

Low Genetic Risk

There is no history of fatal heart attacks among your close relatives. ADD NO HEART POINTS

GENETIC PROTECTION

_ _ _ _ _ _ _ _ _ _ _ _

Genetic Protection

You have high HDL cholesterol levels. SUBTRACT 10 HEART POINTS. BUT IF YOU SMOKE, SUBTRACT NO HEART POINTS

Genetic Protection You have high HDL cholesterol levels. SUBTRACT 10 HEART POINTS. BUT IF YOU SMOKE, SUBTRACT NO HEART POINTS

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_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

THE STORY OF STEVE & SARA – A PROBLEM OF OBESITY By Brian Rybarczak, PhD

In addition to being siblings, Steve and Sara Jones are best friends, born only one year apart. Steve is 10 and Sara is 9 years of age. They do everything together. Both children resemble their parents in hair color, eye color, personality, and friendly smile. However, Steve and Sara differ in one aspect. Sara began gaining weight excessively at about four months of age. Sara's body-mass index (BMI) is 35 kg/m2. Sara's condition has become a serious problem for her since she began going to school. Both Steve and Sara's parents are slightly overweight but would not be considered obese.

Sara's condition prompted her parents to take her to seek advice and help from two specialists: Jack Morris, MD, a pediatrician specializing in nutritional disorders; and Rebecca Field, PhD, a scientist at the forefront of scientific research investigating molecular mechanisms of obesity.

PART 1

Dr. Morris asked Sara's parents what types and quantity of food Sara ate during her childhood.

"Dr. Morris, I don't understand Sara's condition. Neither her father nor I are obese and her brother Steve is within a normal weight range for boys his age," Mrs. Jones said.

"Mr. and Mrs. Jones, let me explain some possibilities why Sara is dealing with obesity at her age. Recent research has shown that the protein leptin, which is secreted by adipocytes into the bloodstream, acts like a molecular switch to tell the brain when a person should eat and when to stop eating. Leptin sends these messages by binding to another molecule called a leptin receptor."

Dr. Morris recommended altering Sara's diet, but, based on the fact that Sara's sibling Steve and Sara's parents are not obese, Dr. Morris decided to consult with Dr. Field for further assistance.

"I cannot be sure what exactly is going on with Sara until we do more tests on her. I will refer you to a colleague of mine, Dr. Field, who is doing research on obesity at the University. She may be able to narrow down what is wrong with Sara and possibly suggest some solutions," Dr. Morris said.

Questions

1) (+1) Suggest TWO reasons why Sara is obese and Steve is not.

PART 2

Mr. and Mrs. Jones meet with Dr. Field. Dr. Field decides to perform a Western blot. In this case, the Western blot was only used to see whether Sara's leptin protein and leptin receptor proteins are of normal size.



Western Blot Analysis:

Lane 1: Molecular Weight Marker. The size of each marker is indicated on the gel in kDa.

Lane 2: Leptin protein from a normal patient.

Lane 3: Leptin protein from Sara.

Lane 4: Leptin receptor from normal patient.

Lane 5: Leptin receptor from Sara.

Questions

2) (+1) What are your observations from the data above?

3) (+1) Using the data above, predict TWO possible molecular causes of Sara's obesity.

PART 3

Dr. Field and her colleagues in her laboratory have completed preliminary laboratory work and have presented the following data to Mr. and Mrs. Jones:

	normal	Sara's measurement
plasma glucose levels	75-115 mg/dl	120 mg/dl
plasma insulin levels	5-20 U/ml	25 U/ml
Serum leptin concentration	100 g/ml	2 g/ml
leptin receptor	100 g/ml	101 g/ml

Questions

4) (+1) What do you conclude from the data above?

5) (+1) Looking at the values for glucose and insulin, what other disease do you predict Sara could be predisposed to?

6) (+1) What treatments could you recommend to help Sara with her obesity problem?

PART 4

After the diagnosis, Dr. Field recommended leptin treatment therapy. Leptin treatment is the administration of recombinant leptin to a leptin-deficient patient. Sara received this treatment. Below is a graph showing measurements taken during the 12 month period following administration of leptin:



Questions

7) (+1) What are your observations from the treatment data?

8) (+1) Do you consider the treatment "successful"? Why or why not?

9) (+1) What if Sara continued to lose weight for an additional 12 months of treatment then began to gain weight again? How do you explain these results at a molecular level?

Resources of interest:

http://www.cdc.gov/genomics/info/perspectives/obesity.htm

American Obesity Association: http://www.obesity.org/

Obesity Research: http://www.obesityresearch.org/

Science, vol. 299 (5608), February 7, 2003

THE STORY OF STEVE & SARA - A PROBLEM OF OBESITY



In addition to being siblings, Steve and Sara Jones are best friends, born only one year apart. Steve is 10 and Sara is 9 years of age. They do everything together. Both children resemble their parents in hair color, eye color, personality, and friendly smile. However, Steve and Sara differ in one aspect. Sara began gaining weight excessively at about four months of age. Sara's body-mass index (BMI) is 35 kg/m2. Sara's condition has become a serious problem for her since she began going to school. Both Steve and Sara's parents are slightly overweight but would not be considered obese.

Sara's condition prompted her parents to take her to seek advice and help from two specialists: Jack Morris, MD, a pediatrician specializing in nutritional disorders; and Rebecca Field, PhD, a scientist at the forefront of scientific research investigating molecular mechanisms of obesity.

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"Dr. Morris, I don't understand Sara's condition. Neither her father nor I are obese and her brother Steve is within a normal weight range for boys his age," Mrs. Jones said.

"Mr. and Mrs. Jones, let me explain some possibilities why Sara is dealing with obesity at her age. Recent research has shown that the protein leptin, which is secreted by adipocytes into the bloodstream, acts like a molecular switch to tell the brain when a person should eat and when to stop eating. Leptin sends these messages by binding to another molecule called a leptin receptor."

Dr. Morris recommended altering Sara's diet, but, based on the fact that Sara's sibling Steve and Sara's parents are not obese, Dr. Morris decided to consult with Dr. Field for further assistance.

"I cannot be sure what exactly is going on with Sara until we do more tests on her. I will refer you to a colleague of mine, Dr. Field, who is doing research on obesity at the University. She may be able to narrow down what is wrong with Sara and possibly suggest some solutions," Dr. Morris said.

Questions

1) (+1) Suggest TWO reasons why Sara is obese and Steve is not.

Sara could be sneaking snacks so her parents are unaware of her eating habits. Genetically, she could be predisposed to a more severe form of obesity. Estrogen or other hormone interactions may play a role. Other eatingrelated hormones could be off balance besides leptin. Leptin could be deficient or her leptin receptors could be non-functional.

PART 2

Mr. and Mrs. Jones meet with Dr. Field. Dr. Field decides to perform a Western blot. In this case, the Western blot was only used to see whether Sara's leptin protein and leptin receptor proteins are of normal size.

Western Blot Analysis:

- Lane 1: Molecular Weight Marker. The size of each marker is indicated on the gel in kDa.
- Lane 2: Leptin protein from a normal patient.
- Lane 3: Leptin protein from Sara.
- Lane 4: Leptin receptor from normal patient.
- Lane 5: Leptin receptor from Sara.



Questions



3) (+1) Using the data above, predict TWO possible molecular causes of Sara's obesity.

Possibilities include: leptin deficiency (quantity), leptin quality, leptin receptor quantity. Other hormones could be off balance (insulin). Leptin resistance, all proteins are present just not responsive.

PART 3

Dr. Field and her colleagues in her laboratory have completed preliminary laboratory work and have presented the following data to Mr. and Mrs. Jones:

	normal	Sara's measurement
plasma glucose levels	75-115 mg/dl	120 mg/dl
plasma insulin levels	5-20 U/ml	25 U/ml
Serum leptin concentration	100 g/ml	2 g/ml
leptin receptor	100 g/ml	101 g/ml

4) (+1) What do you conclude from the data above?
 Slightly higher glucose levels and insulin levels which might predispose Sara to diabetes. Leptin concentration severely depleted. She is leptin deficient. Leptin receptor concentrations are fine.

- 5) (+1) Looking at the values for glucose and insulin, what other disease do you predict Sara could be predisposed to? Type II diabetes
- 6) (+1) What treatments could you recommend to help Sara with her obesity problem? Leptin replacement therapy. Inject leptin. Alter diet to reduce glucose levels.



PART 4

After the diagnosis, Dr. Field recommended leptin treatment therapy. Leptin treatment is the administration of recombinant leptin to a leptin-deficient patient. Sara received this treatment. Below is a graph showing measurements taken during the 12 month period following administration of leptin:



Resources of interest:

http://www.cdc.gov/genomics/info/perspectives/obesity.htm

American Obesity Association: http://www.obesity.org/

Obesity Research: http://www.obesityresearch.org/

Science, vol. 299 (5608), February 7, 2003

Questions

7) (+1) What are your observations from the treatment data above?

This treatment reduced Sara's fat mass and total weight over the 12 month period.

8) (+1) Do you consider the treatment "successful"? Why or why not?

This treatment was successful at least for this 12 month period because it did reduce Sara's weight and fat mass. However, it is yet to be proven long-term effective.

9) (+1) What if Sara continued to lose weight for an additional 12 months of treatment then began to gain weight again? How do you explain these results at a molecular level?

Leptin resistance probably was the cause. Injecting foreign leptin as well as an unregulated or improperly balanced amount may have resulted in Sara not responding to the leptin anymore and beginning to gain weight. There could also have been some cross-talk with insulin pathways leading to diabetes and weight gain.

STEVE AND SARA: CASE TEACHING NOTES

OBJECTIVES

- 1) Explain the molecular basis of obesity and the supporting scientific evidence.
- 2) Analyze scientific data and propose a solution to the problem.
- 3) Predict potential problems associated with obesity and its treatment.

SYNOPSIS

This case is based on a true medical case (NEJM: 341(12), 1999). The case concerns a young girl who has congenital leptin deficiency. She is treated with recombinant leptin, and, after a year of treatment, the girl has lost weight as predicted.

USE OF THE CASE

This case was originally designed for an undergraduate Molecular Basis of Disease course but it also can be used for a General Biology or Genetics course as part of a discussion about inheritance, a Human Biology course to explain receptor/ligand interactions, an Anatomy and Physiology course and a Nutrition course.

Discussion topics associated with this case might include congenital diseases, inheritance, signal transduction cascades, feedback mechanisms with the brain, the laboratory technique of Western blotting, receptor-ligand binding, and obesity and its relationship to diabetes.

FACILITATING THE CASE

The case was originally designed to be an interrupted case study. Students are given the information as they complete the previous section.

Options for Classroom management:

Assign students the following questions to research before the next class session:

- Gather statistics on obesity rates in the US.
- What are causes of obesity?
- What is leptin and how does it function?
- What is leptin receptor and how does it function?
- Explain & describe animal models involved in obesity research.

These questions will begin the discussion for the next session so everyone has background on the topic. This will provide the students an opportunity to contribute knowledge to the class and apply it to the case story.

Variation 1: In the next session, the students will be given each part of the case in succession like a traditional interrupted case with time in between for individual group discussion and class discussion before proceeding to the next part of the case.

Variation 2: (Jig-saw). Split the class into four groups. Each group gets a different part of the case to discuss and answer the question with each section. A representative from each group would then travel to another group and present their findings. Once each group has had a chance to share and collaborate with other groups, the entire class will now have all the pieces to the puzzle.

PITFALLS TO AVOID

Students will need some specific background on how leptin works as well as specifics on the Western blot technique. This case is new and has not been field tested yet.

REFERENCES

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MORGAN: A CASE OF DIABETES

by Lisa M. Rubin and Clyde Freeman, Herreid University at Buffalo, State University of New York

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PART I

On Morgan Water's Oklahoma Indian reservation, one fourth of her tribe had diabetes. Of course, she knew that. Everyone had heard that.

Morgan had no family history of diabetes, heart disease, or other serious conditions; she never imagined she was at any risk. However, she overlooked the fact that environmental factors as well as genetic factors play a crucial role in the development of diabetes.

At the age of 27, Morgan was obese and led a sedentary lifestyle. In the past few months, she had been experiencing unusual thirst, dizziness, blurred vision, and an awkward feeling of numbness in her right foot. Following her parents' advice, she finally visited the family doctor. She was worried, but never suspected what she would hear.

"I'm sorry, Morgan, but the tests I've conducted unfortunately reveal that you have Type 2 diabetes. Your symptoms are exactly like those we see in many Native Americans. You have high blood sugar. In people who aren't diabetic, the food that is digested gets taken into the blood. A lot of it is in the form of sugar. The blood sugar then is taken into their body tissues with the help of a hormone, called insulin, made by the pancreas organ."

"Yes, I have heard about that."

"In your case, you are making enough insulin but your cells don't act like it is there. Your cells don't seem to recognize it. So what happens is that when you eat, the sugar in your food doesn't get inside your cells; it stays in your blood, and so the cells starve. All of that sugar that's in your blood from your meal gets eliminated in your urine. We can measure it easily. Usually this disease doesn't occur until after the age of 45, but both your sedentary lifestyle and Native American background increased your risk. It appears you've been living with diabetes for almost a year now."

Morgan sat back in silence. Her eyes rested on the floor for a moment. Then quietly she said, "No. How can it be? How could it be that I did not know? A year? How could I not tell the symptoms for so long?"

"It comes upon people slowly, Morgan. There are about 16 million Americans that are diabetic, but a third of them don't know they have it." While the doctor continued to detail Morgan's condition, she was hardly listening. How would her life change? Would she now have to take insulin shots for the rest of her life? So many of her friends, so many of her people, had suffered from this terrible disease. What would happen to her now?

Questions

Research the general facts of diabetes to better address Morgan's concerns. Concentrate on addressing the following:

- 1. What is the function of insulin and how is it involved with diabetes?
- 2. Distinguish between Type 1 and Type 2 diabetes by comparing and contrasting their definitions, bodily effects, warning signs, target groups, and current treatments. (Consider using a table to present this information.)
- 3. What are some statistics about diabetes that you find interesting?
- 4. Recent studies on mice have shown that fat cells produce a hormone called resistin that leads to insulin resistance. Researchers believe the gene that regulates the production of resistin is overactive in those suffering from obesity. How does this discovery correlate with Type 2 diabetes?

Originally published at http://www.sciencecases.org/ diabetes/diabetes.asp

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PART II

Morgan continued to sit in the doctor's office, hearing but not listening. Her doctor had explained how diabetes would increase her risk of heart disease and stroke, risks she already had from obesity, as well as kidney disease (diabetic nephropathy) and blindness. How could this happen to her, just now before her marriage?

"Morgan, I understand this news is devastating for you,

but I want to clarify that Type 2 diabetes is easily controllable through exercise, good nutrition, and weight loss."

"You mean if I lose weight I'll be OK?"

"Yes. If you are careful, weight loss will help manage your disease, and exercise will help your cells take in blood glucose. I want you to take a day or two to clear your mind for the road ahead, and read this literature. Then schedule an appointment with our nutritionist, Dr. Navarro. Losing weight will be easier for you, in my opinion, with the guidance of a professional. Come back in one month for a checkup, OK? Will you do that for me?"

Morgan went home that afternoon in a state of frustration and denial. She said nothing to her parents, but that was hardly unusual. The next day, she spoke of the bad news to her family and friends and explained how weight loss was supposed to be an effective treatment.

"I know just what you should do," said Morgan's close friend, Savannah. "You know how I've been losing weight? Well, I've been on the Atkins' Diet. I heard about it on TV. It's great! You get to eat steak, chicken wings, and all the good stuff. All you have to do is limit carbohydrate intake. You should definitely give it a try. This diet has been around for years and it has worked for lots of people, including me."

"I don't know," said Morgan's brother, Alan. "There's a lot of argument about the Atkins' Diet. I think the best thing for you to do is exercise and stop eating all of that pizza and candy and food filled with fat. Our people never used to eat that junk. I say eat meals that are nutritionally balanced and high in fiber and low in refined sugars and saturated fats. And run a lot. Stop sitting around the house."

Morgan sat silently, listening to the family debate. Finally, she looked over to the corner of the room where her grandfather had also been sitting quietly. "Grandfather, what do you think? You are health-conscious, you exercise regularly, and you know a lot about nutrition. What do you say?"

He said nothing for a long moment and then, "Morgan, it is true that it is best to live in harmony and balance—to eat a nutritionally balanced diet that includes carbohydrates, proteins, and 'good' fats to meet your body's needs. That is good. But look to your heritage. Our people were never overweight before we started eating 'civilized' food. Look to our native diet. I think you should look to traditional herbal remedies for help. What Alan says is true. Exercise is good. But it is sometimes not enough. Our people have always looked to the natural medicine for cures. They will lift your spirits and energize you. Then you will lose weight and you will be healthy again."

"Do you mean I should take those herbs from the diet shop?"

"Yes. I hear they are safe and good. But you must take them like the medicine label says. It can't hurt to try them."

Activity

What should Morgan do? Research the pros and cons of the Atkins' Diet, a diet high in fiber and low in saturated fat. Also, research health store supplements containing the herb ephedra (ephedrine). Find out what major healthcare organizations say about these. And learn about the possible effects of exercise to control weight. Be prepared to be split into three groups where each group will role-play and defend the viewpoint of Savannah, Alan, or the grandfather in a debate. You should learn about the pros and cons of each viewpoint in order to understand their strengths and weaknesses.

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"WEIGH TO GO!" IMPLEMENTATION PLAN — INTERDISCIPLINARY BRIDGES							
Activity	Arts	English	Health	Math	Science	Social Studies	Provided materials
Culture and Food: Ideas for Integrated Learning	Х	Х	Х	Х	Х	Х	Handout with ideas for lesson plans
A Cultural Revolution? Explor- ing the Ways in Which Diet Reflects Culture and Health	Х	Х	Х	Х		х	Lesson Plan
A Discovery-Based Approach to Understanding Clinical Trials		X	X		X	Х	Lesson Plan, with handouts
Prosecuting Fat as a Menace to Society			Х		Х	Х	Ideas for a classroom trial
Writing/Discussion Prompts		X	X			Х	Questions for discussion, involving the social, political, economic, and psychological implications of obesity
"Why Have Americans Become More Obese?"				Х		Х	Article, with discussion questions and sug- gested activities

Culture and Food Ideas for Integrated Learning



o a human, the ritual of eating... is one of the most primal of shared activities. We eat together when we celebrate, and we eat together when we grieve; we eat together when a loved one is preparing to leave, and we eat together when the loved one returns. We solve our problems over the family dinner table, conduct our business over the executive lunch table, entertain guests over cake and cookies at the coffee table.

> — "Why We Eat" by Jeffrey Kluger, Christine Gorman, and Alice Park

Obesity is growing in the United States and abroad. It's the seventh leading cause of preventable death in America. While the epidemic may be recent, the condition is not. In 1908, an archaeologist found a 25,000 year old figurine of an extremely obese female, subsequently titled the "Venus of Willendorf." Records tell of an ancient Roman senator who was so obese that he was only able to walk when two slaves carried his belly. A 1988 French article by Chouard, et al, suggests that Napoleon may have had obesity-induced sleep apnea which led to error in judgment, his failure to capture Moscow, and his defeat at Waterloo. It is rumored that William Howard Taft, the 27th (and largest) president of the United States, became stuck in the White House bathtub!

Restrictions on food and consumption are also not new. Christianity, Judaism, Islam, Hinduism, and Buddhism have ancient regulations about food that are still observed today. Ancient Rome, medieval Europe, and Japan are just a few places that had well-established sumptuary laws, which are regulations restricting extravagance in food, drink, and dress. Scientists have, for centuries, been trying to determine the perfect combination of diet and exercise.

In diet terms, food is something to be "fought" or "battled." But, it is essential for survival, and it's the centerpiece for most holidays and celebrations. How did we arrive at this love/hate relationship with food? The suggested topics below are a few ways to explore this relationship. Just as food permeates our lives, these topics may be incorporated into most classrooms, including social studies, English, fine arts, science, and health.



CULTURAL ICEBERG

"Culture has been likened to an iceberg; nine-tenths of it lies beneath the surface, out of our immediate awareness."

> — Sharon Ruhly, Orientations to Intercultural Communication

Ruhly uses the analogy of an iceberg to explain the way in which we understand our culture. The tip is our conscious understanding. The submerged portion is the larger subconscious influence of culture. Explore the subconscious influence of culture by researching the roles of geography, history, and economic status in our traditional diet and attitudes towards food.

Geography: Students choose a geographic region, investigate the typical diet, and determine what geographic factors played a role in its development. Additionally, students explore the ways in which the inhabitants of the region have adapted to their environment. An interesting case study is the Pima Indians of Arizona. Scientists posit that the Pima developed a "thrifty gene" over time that allowed them to survive off the food that they could find or grow in the desert. Now, they eat like the average American but their obesity rate is more than twice that of Caucasian Americans. Information on the Pima may be found at:www.pbs.org/saf/1110/features/fighting.htm

Students may also discuss the impact of globalization and immigration on diet and health. (McDonald's is now in over 100 countries/markets!)

History: Trace the history and origins of commonly consumed food. Online resources for food history:

- BBC's "everwondered food" www.open2.net/everwondered_food/culture/ culture global view.htm
- Food Timeline (food history lesson plans) www.foodtimeline.org/food2a.html
- History and Legends of Favorite Foods www.whatscookingamerica.net/History/ HistoryIndex.htm

Economics: According to the World Health Organization (WHO), "malnutrition is the single most important risk factor for disease...and diet-related diseases, such as diabetes, cardiovascular disease, hypertension, stroke, and cancer — previously regarded as 'rich men's diseases' — are now escalating in developing countries...." The WHO (www.who.org) lists two main causes of malnutrition: poverty-driven hunger and development-driven obesity, or globesity. Explore the role poverty and wealth plays in health, nutrition, and food choices in countries around the globe.

Oxfam America offers a 10-minute online game at www.hungerbanquet.org, which gives players "a chance to learn about hunger from the point of view of those who experience it every day." Players assume the role of an impoverished worker from Guatemala, Ecuador, Cambodia, Mali, Mozambique, or Vietnam.

A CULTURAL REVOLUTION?

In the January 23, 2005, New York Times article, "Four Days on the Uncle Sam Diet...," William Grimes writes about the new USDA dietary guidelines: "The new guidelines are not just health policy, they're cultural policy, too. To comply fully, Americans will have to rethink their inherited notions of what makes a meal, and what makes a meal satisfying." Students explore what makes a meal in their family and in the families of their classmates by comparing and contrasting typical daily and celebratory meals. Discussions center on how their typical meals fit within these dietary guidelines, and whether Americans can eat healthily without changing their idea of a meal.

For a global perspective, students subsequently research (or cook!) and compare typical meals from other countries and discuss the characteristics of foreign meals. Also, they determine how well these meals fit within the relevant country's dietary guidelines (International dietary guidelines may be found at www.nal.usda.gov/fnic/etext/000039.html).

Further assignments may include devising a pictorial representation of the new US guidelines, researching and comparing rates of disease in various countries, and writing stories associated with a particular family food or meal.

FOOD AND THE LAW

Should the government be involved in the health and diet of the individual? Religious and sumptuary laws regarding food have existed for centuries. While the U.S. government doesn't enforce a prescribed diet, it does make recommendations. And it's involved in many other aspects of what goes into our body. A brief look at the United States Department of Agriculture's website (www.usda.gov) shows topics on dietary health, food assistance, food distribution, food labeling and packaging, food quality, food recalls, food safety, food security, food technology, and homeland security. Students explore the role of government, at home and abroad, in shaping its citizens' diets.

PERCEPTIONS OF BEAUTY

In a 1997 article for The New England Journal of Medicine, Dr. Michael Rosenbaum of Rockefeller University writes, "Look for a body weight in which risk factors such as cardiovascular disease, stroke, diabetes and so forth are diminished. Not necessarily a weight that is arbitrarily dictated 'by the societal cosmetic ideal."" What is the current societal cosmetic ideal? How does popular culture and the media influence this ideal? Is obesity viewed more as an image problem or a health problem? Discuss the often unhealthy drugs, surgeries, and diets that people use to emulate this ideal. Students may also research representations of the body in art throughout history and across cultures.

ONLINE SOURCES FOR PREPARED LESSON PLANS Key Ingredients: America by Food

(www.keyingredients.org)

Key Ingredients: America by Food is a traveling exhibition sponsored by the Smithsonian Institution Traveling Exhibition Service (SITES) which "explains the little known, the everyday, and the obvious through an entertaining and informative overview of our diverse regional cooking and eating traditions." The Teacher's Guide (click on "For Teachers" at the bottom of the homepage) may be used to accompany the exhibit or as a separate resource. The plan includes the following five classroom lessons: Recipes for Tradition, American Menus, What Do Time Travelers Eat?, We'll Be Right Back after These Messages (food advertising), and Mind Your Manners (19th Century dining).

The New York Times Learning Network

(www.nytimes.com/learning)

Provides plans for topics in social studies, mathematics, science, health, and language and fine arts. All lesson plans are accompanied by a relevant NY Times article. Browse the archives for classes on "Consuming History: Investigating Foods from Different Times and Places Around the World," "Soul Food: Exploring Connections Among Geography, Culture and the Foods We Eat," "A Meat By Any Other Name...Social Views Towards the Animal We Eat: A Lesson for the Social Studies Classroom," and "Bigger Than Life, But Not Necessarily Better: Evaluating Images of Health in American Society."

PBS.org

(www.pbs.org/teachersource/health_fitness/ high_diet_and_nutrition.shtm)

Lesson plans on diet and nutrition that range from the basics of fitness, nutrition and health, to analyzing song lyrics for messages about self-esteem, to exploring the self-improvement writings of Benjamin Franklin.

A Cultural Revolution? Exploring the ways in which diet reflects culture and health

Subjects: World History, US History, Sociology, Healthful Living (Additional activities listed for English, Fine Arts, and Science and Statistics)

OVERVIEW

In the January 23, 2005 New York Times article "Four Days on the Uncle Sam Diet...," William Grimes writes about the new USDA dietary guidelines: "The new guidelines are not just health policy, they're cultural policy, too. To comply fully, Americans will have to rethink their inherited notions of what makes a meal, and what makes a meal satisfying." Students explore what makes a meal in their family and in the families of their classmates by comparing and contrasting typical daily and celebratory meals. Discussions center on how their typical meals fit within the new dietary guidelines, and the ways in which Americans can eat healthily.

For a global perspective, students subsequently research and compare typical meals from other countries and discuss the characteristics of foreign meals. Also, they determine how well these meals fit within the relevant country's dietary guidelines.

OBJECTIVES

- Explore eating practices in the United States and other countries.
- Explore the ways in which food reflects culture.
- Research and discuss the importance and relevance of governmental nutrition guidelines.
- Discuss ways to encourage healthy eating.

RESOURCES

- United States Department of Agriculture new dietary guidelines (www.nutrition.gov)
- International Dietary Guidelines (www.nal.usda.gov/ fnic/etext/000039.html)

ACTIVITIES/PROCEDURES

1. Either at the beginning of class or prior to class, ask students to draw (or cook!) one of their family's typical daily and celebratory meals. In class, students will share and compare their meals. Topics for discussion: What



DESTINY

family, regional, and cultural traditions do their meals represent? If students share similar, traditional foods, are they prepared differently in different families? (e.g. Eastern versus Western North Carolina barbeque)

2. Provide copies of the USDA's new dietary guidelines to the students. Discuss the William Grimes quote (from the "Overview," above) with the students. Topics for discussion: What common characteristics make a typical American meal? How do typical US meals fit within these dietary guidelines? Can Americans eat healthily without changing our idea of a meal? Students discuss what they can do individually to eat better.

3. Students, individually or in groups, prepare a presentation (or meal!) on traditional food from another country. Topics for discussion: How do these meals compare with the typical American meal? What do the meals reflect about each country's geography and history?

4. Students research and present governmental dietary guidelines from their chosen country (see "Resources" above). Topics for discussion: How closely do the foreign guidelines reflect their culture? (Note: The Chinese Nutrition Society doesn't recommend a sugar intake in their food pagoda because the consumption of sugar by the Chinese is so low. The Filipinos do not include a separate category for milk and dairy because that is not traditionally part of their diet. The Greeks list olive oil as an entirely separate food group!) How closely does each country's typical meal fit within its guidelines? How do the guidelines compare? Which countries seem to eat the healthiest meals? What can Americans learn from the culture and food of other countries? What can other countries learn from us?

ADDITIONAL ACTIVITIES

Art: Discuss the multitude of shapes used in the various government guidelines. There are circles, pyramids, a rainbow, and pagodas. Which representation seems the most effective?

Based on the discussion in Activity 2, design a poster that either persuades Americans to change their culturally established eating habits or provides healthy guidelines that better reflect the traditional American meal.

English: Write stories associated with a particular family food or meal. Stories may focus on celebrations, holidays, religious observances, or rites of passage.

Health, Science, and Statistics: Research, graph, and compare rates of heart disease, cancer, and obesity in various countries and find any connections with traditional diet.

A Discovery-Based Approach to Understanding Clinical Trials



Subjects: English, Health, Science, Social Studies

Overview: In modern society, the drugs we take and the medical procedures we undergo are the result of extensive research. Most people have seen the ads for clinical trials, recruiting people with heart disease or high blood pressure or some other possible mental or physical ailment. Yet, many don't fully understand the procedures involved in clinical research. According to the U.S. National Institute of Health website, ClinicalTrials.gov, clinical research is the "fastest and safest way to find treatments that work in people and ways to improve health." This lesson plan, designed to be covered in one 90 minute class (or at the end and beginning of two successive classes), will help students to learn about the make-up of clinical research and the provisions in place to ensure the safety of the human participants.

The lesson will also be useful in teaching critical reading and informational writing skills. Social Studies teachers may wish to expand on the content provided here by focusing on the history, ethics, and regulations of clinical trials. General information may be found at "The history of clinical testing and its regulation" (http://www.roche.com/pages/facets/18/histclinte.htm).

Objectives: Students think critically about the ways in which scientific researchers approach health problems, while also learning to analyze texts and write informational, science-based compositions.

RESOURCES

• 3 Handouts (attached): Engagement Activity, FAQ and Glossary (Understanding Clinical Trials), Exploration Activity ("Effects of Leptin Treatment on Weight Loss")

• Students and teachers may also wish to consult the website ClinicalTrials.gov.

ACTIVITIES/PROCEDURES

I. Engagement Activity (15 minutes)

a. At the beginning of class, provide each student with a copy of the attached "Engagement Activity" handout, which lists four different clinical trials. (Alternatively, place the handout on an overhead projector.)



PHOTO BY PETER WERNER

- b. Ask the students to look over the handout and jot down answers to the following questions:
 - i. What is the purpose of each of these trials?
 - ii. Would you consider participating in one of these trials, if you met the requirements? Why?
 - iii. Would you do it if you got paid?
 - iv. What questions would you want to ask the researchers before you agreed to participate?
 - v. Would you be interested in the results of any of these trials? Why?

II. Explore (this activity may also be assigned as individual or group homework) (45 minutes)

- a. Divide students into small groups and provide each group with copies of the attached "Exploration Activity" handout — "Effects of Leptin Treatment on Weight Loss" and the attached "FAQ and Glossary" handout — "Understanding Clinical Trials" (or direct them to the Clinical-Trials.gov website).
- b. Ask students to complete the "Student Activities" section of the "Exploration Activity" handout.

III. Explain (15 minutes)

a. Students share the answers to the "Student Activities" section of the "Exploration Activity" handout with the entire class.

IV. Elaborate (homework) – choose a or b

- a. Students may locate 2 additional clinical trial descriptions from either the unchealthcare.org website (clinical trials are listed under "Health & Patient Care") or the ClinicalTrials.gov website, and use the descriptions to answer questions 2, 3, and 4 from the "Student Activities" section of the "Exploration Activity" handout.
- b. Using the "Effects of Leptin Treatment on Weight Loss" as a model, students devise their own proposed clinical trial. They, of course, will not conduct this trial but will outline the protocol, exclusion/inclusion criteria, time-line and include a description of the proposed trial.

ENGAGEMENT ACTIVITY

Think You Might Have Gum Disease?

RESEARCH PATIENTS NEEDED

UNC Center for Inflammatory Disorders -and-UNC Center for Oral and Systemic Diseases

Male and female subjects with periodontal (gum) disease are needed for a clinical research study. This study will assess the effect of gum treatments on general health. Eligible subjects will receive certain treatments at reduced fees or no charge.

For information please call or e-mail the UNC School of Dentistry GO Health Center.

Genetic Study of Anorexia Nervosa in Families

We are seeking families with at least two members who have or had anorexia nervosa, and who would be willing to participate. Experts from around the world are working to help identify the genes that might predispose individuals to develop anorexia nervosa.

UNC Eating Disorders Program

Suggestions for possible trials:

- i. The effect of video games on violence in teenagers
- ii. The effect of fast food advertising on teenage food purchases
- iii. The correlations between wearing sandals and blistered and calloused feet

V. Evaluate

a. Teachers may choose to evaluate students based on class participation and completion of the homework assignment(s)

Lung study

Do you currently smoke cigarettes?

Have you quit smoking, but smoked for at least 10 years?

The Center of Environmental Medicine at UNC is looking for individuals for a research study. This study involves 1 visit and a total of 1½ hours of your time.

You will be reimbursed for completion of the study. If you participate, you will have a breathing test and learn more about your lungs. Participants that are interested in quitting smoking will be given information and guidance to help them quit.

African American Couples Needed for a Research Study

If you have been living with your partner for at least 9 months, are not taking anti-hypertensive or anti-depressant medications, are between the ages of 18 and 50, and are willing to have blood samples and blood pressure taken, then you may qualify for a study about the benefits of partner relationships.

Receive up to \$200 per couple for completion of 2 lab visits.

If interested, please call the UNC Stress and Health Research Program.

All advertisements on this page were retrieved on April 27, 2005, from unchealthcare.org

UNDERSTANDING CLINICAL TRIALS FREQUENTLY ASKED QUESTIONS

What is a clinical trial? (*from* University of Maryland's brochure "Thinking about Enrolling in a Clinical Trial")

A clinical trial is an experimental research study that evaluates the effect of a new drug or medical device on human beings. Clinical research is a process of discovery that is intended to improve medical care. Researchers attempt to answer questions such as "Which medication works better?" or "What is the best way to treat a medical problem?"

Who can participate in a clinical trial? (*from* University of Maryland's brochure "Thinking about Enrolling in a Clinical Trial")

All participants in a clinical trial are volunteers who have agreed to participate in a particular study. Some volunteers seek out clinical trials, and some are referred to clinical trial opportunities by their physicians. There are research opportunities in clinical trials for persons with specific diseases and conditions and for persons in generally good health. Volunteers participating in a study are referred to as "subjects" or "participants." Volunteers can leave a study at any time for any reason.

What are the benefits and risks of participating in a clinical trial? (*from* ClinicalTrials.gov)

Benefits

- Play an active role in personal health care.
- Gain access to new research treatments before they are widely available.
- Obtain expert medical care at leading health care facilities during the trial.
- Help others by contributing to medical research.

Risks

• There may be unpleasant, serious or even life-threatening side effects to experimental treatment.

• The experimental treatment may not work for the participant.

• The trial may require more time and attention than standard treatment, including trips to the study site, more treatments, hospital stays or complex requirements.

• The participant may be placed in the "placebo" group

How is the safety of the participant protected? (*from* ClinicalTrials.gov)

The ethical and legal codes that govern medical practice also apply to clinical trials. In addition, most clinical research is federally regulated with built in safeguards to protect the participants. The trial follows a carefully controlled protocol, a study plan which details what researchers will do in the study. As a clinical trial progresses, researchers report the results of the trial at scientific meetings, to medical journals, and to various government agencies. Individual participants' names remain secret and are not mentioned in these reports.

Every clinical trial in the U.S. must be approved and monitored by an Institutional Review Board (IRB) to make sure the risks are as low as possible and are worth any potential benefits. An IRB is an independent committee of physicians, statisticians, community advocates, and others that ensures that a clinical trial is ethical and the rights of study participants are protected.

What should people consider before participating in a trial? (*from* ClinicalTrials.gov)

People should know as much as possible about the clinical trial and feel comfortable asking the members of the health care team questions about it, the care expected while in a trial, and the cost of the trial. The following questions might be helpful for the participant to discuss with the health care team.

- What is the purpose of the study?
- Who is going to be in the study?
- Why do researchers believe the experimental treatment being tested may be effective? Has it been tested before?
- What kinds of tests and experimental treatments are involved?
- How do the possible risks, side effects, and benefits in the study compare with my current treatment?
- How might this trial affect my daily life?
- How long will the trial last?
- Will hospitalization be required?
- Who will pay for the experimental treatment?
- Will I be reimbursed for other expenses?
- What type of long-term follow up care is part of this study?
- How will I know that the experimental treatment is working?
- Will results of the trials be provided to me?
- Who will be in charge of my care?
- What happens if I'm injured because of the study?

GLOSSARY

Blind — A clinical trial is "Blind" if participants are unaware on whether they are in the experimental or control arm of the study; also called masked.

Control group — In many clinical trials, one group of patients will be given an experimental drug or treatment, while the control group is given either a standard treatment for the illness or a placebo (See Placebo).

Double-blind study — A clinical trial design in which neither the participating individuals nor the study staff knows which participants are receiving the experimental drug and which are receiving a placebo (or another therapy). Double-blind trials are thought to produce objective results, since the expectations of the doctor and the participant about the experimental drug do not affect the outcome; also called double-masked study.

Efficacy — The maximum ability of a drug or treatment to produce a result regardless of dosage. A drug passes efficacy trials if it is effective at the dose tested and against the illness for which it is prescribed.

Expanded access — Refers to any of the FDA procedures that distribute experimental drugs to participants who are failing on currently available treatments for their condition and also are unable to participate in ongoing clinical trials.

Food and Drug Administration (FDA) — The U.S. Department of Health and Human Services agency responsible for ensuring the safety and effectiveness of all drugs, biologics, vaccines, and medical devices. The FDA also works with the blood banking industry to safeguard the nation's blood supply.

Inclusion/exclusion Criteria — The medical or social standards determining whether a person may or may not be allowed to enter a clinical trial. These criteria are often based on age, gender, the type and stage of a disease, previous treatment history, and other medical conditions. Inclusion and exclusion criteria are not used to reject people personally, but rather to identify appropriate participants and keep them safe.

Informed consent — The process of learning the key facts about a clinical trial before deciding whether or not to participate. It is also a continuing process throughout the study to provide information for participants.

Peer review — Review of a clinical trial by experts chosen by the study sponsor. These experts review the

trials for scientific merit, participant safety, and ethical considerations.

Phase I trials — Initial studies to determine the metabolism and pharmacologic actions of drugs in humans, the side effects associated with increasing doses, and to gain early evidence of effectiveness; may include healthy participants and/or patients.

Phase II trials — Controlled clinical studies conducted to evaluate the effectiveness of the drug for a particular indication or indications in patients with the disease or condition under study and to determine the common short-term side effects and risks.

Phase III trials — Expanded controlled and uncontrolled trials after preliminary evidence suggesting effectiveness of the drug has been obtained, and are intended to gather additional information to evaluate the overall benefit-risk relationship of the drug and provide and adequate basis for physician labeling.

Phase IV trials — Post-marketing studies to delineate additional information including the drug's risks, benefits, and optimal use.

Placebo — An inactive pill, liquid, or powder that has no treatment value. In clinical trials, experimental treatments are often compared with placebos to assess the treatment's effectiveness. In some studies, the participants in the control group will receive a placebo instead of an active drug or treatment. No sick participant receives a placebo if there is a known beneficial treatment.

Protocol — A study plan on which all clinical trials are based. The plan is carefully designed to safeguard the health of the participants as well as answer specific research questions. A protocol describes what types of people may participate in the trial; the schedule of tests, procedures, medications, and dosages; and the length of the study. While in a clinical trial, participants following a protocol are seen regularly by the research staff to monitor their health and to determine the safety and effectiveness of their treatment.

Randomized trial — A study in which participants are randomly (i.e., by chance) assigned to one of two or more treatment arms of a clinical trial.

Single-blind study — A study in which one party, either the investigator or participant, is unaware of what medication the participant is taking; also called single-masked study.

Information on this page was retrieved on April 28, 2005, from the National Library of Medicine's website, ClinicalTrials.gov.

EXPLORATION ACTIVITY: EFFECTS OF LEPTIN TREATMENT ON WEIGHT LOSS

Sponsored by:	Rockefeller University
Information provided by:	Rockefeller University

PURPOSE

This is a double-blind placebo controlled clinical study designed to determine the effects of leptin on the changes that occur in the body during weight loss achieved by a very low calorie diet.

Condition	Treatment or Intervention	Phase
Obesity	Drug: Leptin Procedure: Very Low Calorie Diet	Phase II

• Study Type: Interventional

• Study Design: Treatment, Randomized, Double-Blind, Placebo Control, Expanded Access Assignment, Efficacy Study

• Official Title: Leptin Treatment for Prevention of the Metabolic and Endocrine Sequelae of a Decreased Caloric Intake: Studies of Patients on a Very Low Calorie Diet

Further Study Details:

- Expected Total Enrollment: 40
- Study start: March 2001
- Expected completion: November 2005

Leptin is a hormone that is produced by the fat tissue and acts on the brain. Leptin plays a key role in regulating energy balance and body weight in animals and in humans. When a person loses weight, leptin concentration in the blood is reduced. Reduction in blood leptin levels has been found to be related to a decreased metabolic rate (the rate in which the body burns its calories), an increased appetite, and to many other physiological and hormonal changes that may lead to failure in dieting.

This study is aimed to test if maintaining leptin in the pre-diet level range will ameliorate the changes that occur in the body during weight loss. If these changes are reduced the process of weight loss could be easier and faster when adhering to a low calorie diet. In this study leptin or placebo are administered by an injection under the skin, in a way that is similar to injections of insulin to diabetic patients. 50% of the subjects participating in the study are treated by leptin and 50% are treated by placebo. Blood leptin levels are maintained in the pre-diet range in leptin treated subjects by leptin treatment. Subject's treated by placebo will also lose

weight if they adhere to the liquid diet provided by The Rockefeller University Bio-nutrition Department. The investigators and the participants don't know if leptin or placebo is used since this is a double blind study.

To participate in this study subjects have to stay at The Rockefeller University Hospital as inpatients for about two months and continue the study as outpatients for 4 more months. During the outpatient period subjects have to attend a clinic visit once a week. During the first 3 weeks of the study subjects are introduced to a weight stabilization liquid diet. During this time the initial weight is maintained and baseline study tests are performed. When testing is completed a very low calorie liquid diet and leptin or placebo administration are initiated. Weight is monitored until 10% weight loss is achieved. At this time a second testing period is performed in an inpatient setting. When testing is completed weight loss and leptin or placebo treatment continue at home in an outpatient setting until 20% weight loss is achieved. When this period is completed a third testing period is performed in an inpatient setting. The last month of the study is dedicated to a transition from the liquid diet to solid food, and to weight maintenance education provided by the hospital staff in an outpatient setting. A solid food weight maintenance diet is provided to participants during this period. At the end of this period two days of testing are performed and leptin/placebo administration is discontinued. Study testing periods are performed over 12 days in an inpatient setting and include a variety of blood draws, urine collection, metabolic and behavioral tests that are known to be affected by weight loss.

ELIGIBILITY

Ages Eligible for Study: 20 Years-45 Years Genders Eligible for Study: Female Accepts Healthy Volunteers

Criteria: Healthy overweight women BMI 29-45 no other acute or chronic illnesses

LOCATION AND CONTACT INFORMATION

Please refer to this study by ClinicalTrials.gov identifier NCT00050791

New York Rockefeller University Hospital, New York, New York, 10021, United States; Recruiting Lanie Fleischer, CSW 800-872-2737 obesity@mail.rockefeller.edu Sagit Zolotov, MD, Sub-Investigator Health Authority: United States: Food and Drug Administration

ClinicalTrials.gov processed this record on 2005-04-25

Student Activities

1. Visit the "Resources" page of ClinicalTrials.gov, and click on "Glossary of Clinical Trial Terms" (or use the handout provided by your teacher). Using this glossary, write down definitions for both the words which are underlined on page 1 of this handout.

- 2. Additionally, write down definitions for each of the following words a. Randomized Trial
 - b. Control Group
 - c. Inclusion/Exclusion Criteria
 - d. Protocol
- 3. Answer the following questions:a. What are the inclusion criteria for this study?
 - b. What are the exclusion criteria?
 - c. Who is sponsoring this trial?
 - d. What is the trial's protocol?
 - e. Why is protocol important?

4. On the front of the "Understanding Clinical Trials" handout, there is a list of questions that people should consider before participating in a clinical trial. Read over this list. (On the website, this list is under the question "What should people consider before participating in a trial?")

a. Using the information provided in the description of the "Effects of Leptin on Weight Loss" clinical trial, answer the list of questions that people should consider before participating in a clinical trial.

- b. What questions can you not answer?
- c. What could you do to find the answers?

5. What are the possible benefits of conducting this trial, both to the participants and to the general public?

Prosecuting Fat as a Menace to Society Ideas for a Classroom Trial



Overview: Your class will put "fat" on trial as being a menace to society. Or, alternatively, "fat" may sue society for libel. This lesson plan is designed to help students think critically about society's views about obesity, diet, and health. Students research the good and bad characteristics of fat and possibly analyze the marketing propaganda of various diet and food-related industries. This activity is suitable for social studies, as well as health and science, as much of the content of the trial will be science-based.

Objectives: To encourage students to think critically about messages portrayed in advertising and the media and understand the science of both "good" and "bad" fat, while simultaneously learning about the US legal system.

Resources:

• "Why Do We Need to Eat Fat?" is a fact sheet produced by the Center for Young Women's Health at the Children's Hospital in Boston: http://www.youngwomenshealth.org/fat.html

• "What's the Skinny on Fats?" is a website that lists both the good and the bad characteristics of fat: http://www.cyberparent.com/nutrition/skinnyonfats.htm

• http://criminal.findlaw.com/crimes/criminal_stages/ criminal_trial.html provides a thorough introduction to criminal trials and provides many other useful references on the legal system.

Activities/Procedures:

1. Divide students into two teams. One will work for the prosecution, and one will work for the defense.

• The prosecuting attorney is Mr. Leptin. (Note: Leptin is a hormone that acts on the hypothalamus of the brain, causing one to feel less hungry.)

• The defense attorney is Mr. Ghrelin. (Note: Ghrelin is a chemical messenger that stimulates our "need to feed" even in cases where DESTINY the belly is full. Ghrelin levels rise in people who have lost weight and may be the reason dieters have trouble keeping their weight down

• Judge Brain (aka the teacher) will preside.

2. Trial Preparation

long-term.)

- a. Individual Exploration (homework)
 - i. Ask individual members of the prosecution to research the harmful effects of fat. Emphasize that students must cite the sources of their research.
 - ii. Individual members of the defense team will research the benefits of fat. Emphasize that students must cite the sources of their research.
- b. Group Exploration (1-2 classes)
 - i. The students work together in groups to compare their individual research and decide which aspects to focus
 - on in their trial. 1. Each group compiles

their research and submits it to the teacher for review. Emphasize that students must cite sources.

ii. Students will also compile a list of witnesses that will be testifying for their "side."
1. This list will be given to the teacher and then shared with the opposing side. (Suggestions for witnesses include doctors, diet founders, exercise fanatics, the "heart," representatives from the fast food industry, thin actresses, etc.)
2. Students will decide which member of

2. Students will decide which member of their group will play the role of each of the witnesses.

iii. Students work together to compose an opening statement for their side.

1. Guidelines on the length and scope of the opening statement will be determined by the teacher.

2. The opening statement will be submitted to the teacher, and given back to the group with suggestions and edits.

3. Students will choose which member of their team will present the statement.



iv. Student work together to compose a list of questions to ask each of the witnesses. The teacher may or may not wish to review this list before the "trial.

3. Trial

a. Group Explanation (1 class)

i. The prosecution and the defense each present their opening statements.

ii. Witnesses for the prosecution are called to the stand and questioned by both Mr. Leptin and Mr. Ghrelin.

iii. Witnesses for the defense are called to the stand and questioned by both Mr. Ghrelin and Mr. Leptin.

4. Verdict

a. Individual Elaboration (homework)
i. Instead of a jury verdict, students write an essay reflecting on their views about fat and its role in the human body and society.

Writing/Discussion Prompts For English, Health, and Social Studies Classes



The following exercises were developed as writing prompts that follow the basic format of many prompts used in the essay sections of the new SAT, but they can also be used as discussion questions. You might also split the class into groups and ask each group to present a response to a different prompt.

Stick Figure, by Lori Gottlieb

1. Stick Figure is an actual collection of diary entries



a actual collection of diary entries written by Lori Gottlieb when she was young. Imagine that you are so concerned about your weight that you have dieted until you are severely underweight. You like the way you look, but your friends, teachers, and parents are growing increasingly concerned. Yesterday at soccer practice, you fainted on the field. You've just been informed that you won't be allowed to stay

on the team until your weight returns to a healthy level. Write a diary entry that describes your feelings.

And/or:

Do schools have the right to exclude students from activities because they are overweight or underweight? Why or why not, and under what circumstances would this be all right?

2. Imagine two characters in any situation. Choose an age, sex, and name for each of them, and a setting (The cafeteria? At school? The park? At home?). One of the characters has just insulted the other—imagine a very hurtful insult, something you've been called, have called someone else, or that you've heard. Now write a short diary entry from the point of view of each of the characters, right after the event. How does each feel about what happened? Be as detailed as possible.

Wasted: A Memoir of Anorexia and Bulimia, by Marya Hornbacher

1. In her memoir, *Wasted*, Marya Hornbacher writes, "In our culture, thinness is associated with wealth, upward mobility, success." What about in your com-



munity? Do you agree? Do you feel a great deal of pressure to be thin or fit? How much do you think the way you look determines your success—socially and otherwise—at school?

2. In *Wasted*, Marya Hornbacher writes, "Becoming a woman means

becoming someone dissociated from, and spiteful toward, her body. Someone who finds herself always wanting." What does Hornbacher mean by this?

What about becoming a man? Do young men face similar pressures? Are young men pressured to look a certain way? How are the pressures young men face similar to those young women face, and how are they different?

Fast Food Sold at School Lunch Means More Fat Children

In the March 10, 2004, article, "Fast Food Sold at School Lunch Means More Fat Children," the author, Aleta Watson, argues that "nutritionists fear that schools are reinforcing everything that's wrong with the American diet when they need to be promoting healthy habits more than ever," because of the rise in obesity among young people. On the other hand, a student insists that "I don't like to eat stuff, even if it's healthy, if it doesn't taste good."

Write a 3-4 paragraph response to this debate. Do you think it's important to encourage healthy eating habits in school cafeterias? Why or why not? Are good eating habits learned in school or at home? What if your school were to replace the pizza, vending machines, nachos, and chicken nuggets with other, healthier choices? Would it be successful? Why or why not? What if it cost less? What if it cost more?

Healthier Food at Your School?

In response to the rising national obesity rate, your school is considering replacing its ordinary lunch fare with healthier choices. Pizza, hot dogs, cookies, and fries are out; whole wheat bread, vegetables, fresh fruit, baked potatoes, and an improved salad bar are in. The cost of a typical hot lunch will increase by fifty cents to two dollars, depending on the student's choices.

Do you think your school should adopt this plan? Why or why not? Write a letter to the editor of your hometown newspaper describing and arguing for your position. Remember that in an argumentative essay, you aren't only arguing your point—you're also arguing against someone else's ideas—so make sure to acknowledge the opposing viewpoint and tell us why you believe that viewpoint is wrong.

Economics of Obesity

In the February 7, 2003 *Science* editorial, "The ironic politics of obesity," Marian Nestle, professor of nutrition and food studies at New York University, writes, "The U.S. food supply provides 3800 kilocalories per person per day, nearly twice as much as required by many adults. Overabundant food forces companies to compete for sales through advertising, health claims, new products, larger portions, and campaigns directed toward children. Food marketing promotes weight gain. Indeed, it is difficult to think of any major industry that might benefit if people ate less food; certainly not the agriculture, food product, grocery, restaurant, diet, or drug industries."

1. Do you think that "food marketing promotes weight gain"? Why or why not? Provide some specific examples for each of the various ways in which companies compete: advertising, health claims, new products, larger portions, and campaigns directed toward children.

2. The supposed purpose of the diet industry is to help us lose weight, yet Dr. Nestle insinuates that the diet industry would lose money if we ate less. Do you agree with that? Why or why not? How does the diet industry make money?

Politics of Obesity

Dr. Eric Oliver is a University of Chicago political scientist who is writing a book on the politics of obesity. In the April 29, 2005 *New York Times* article "Still Counting on Calorie Counting," he states, "If you are on the political right, obesity is indicative of moral failure. If you are on the left, it means rampaging global capitalism."

What you do think Dr. Oliver means by this statement? Why would obesity be considered a "moral failure"? What morals does the political right in America advocate? How is obesity linked to capitalism? Why are some members of the political left against "rampaging global capitalism"? What is implied by use of the adjective "rampaging"?

Discussion Questions, Activities, and Guided Reading for "Why Have Americans Become More Obese?"



"Why Have Americans Become More Obese?" is the most accessible of eight articles included in the Economic Research Service's electronic publication "The Economics of Obesity: A Report on the Workshop Held at USDA's Economic Research Service." All of the articles may be found at http://www.ers.usda.gov/ publications/efan04004/.

The "class discussion" and "activities" provided here may be assigned in most Civics and Economics classrooms. The actual article is high-level and would work best in an advanced class. Questions for a guided reading of the article are also provided in this handout.

CLASS DISCUSSION

According to page 3 of "Why Have Americans Become More Obese?", "By 1999, the food supply had risen to 3,900 calories per person."

In the February 7, 2003 Science editorial, "The ironic politics of obesity," Marian Nestle, professor of nutrition and food studies at New York University, writes, "The U.S. food supply provides 3800 kilocalories per person per day, nearly twice as much as required by many adults. Overabundant food forces companies to compete for sales through advertising, health claims, new products, larger portions, and campaigns directed toward children. Food marketing promotes weight gain. Indeed, it is difficult to think of any major industry that might benefit if people ate less food; certainly not the agriculture, food product, grocery, restaurant, diet, or drug industries."

1. Do you think that "food marketing promotes weight gain"? Why or why not? Provide some specific examples for each of the various ways in which companies compete: advertising, health claims, new products, larger portions, and campaigns directed toward children.

2. Why would companies direct campaigns toward children, when their parents or guardians are the ones buying the food?

3. The supposed purpose of the diet industry is to help us lose weight, yet Dr. Nestle insinuates that the diet industry would lose money if we ate less. Do you agree with that? Why or why not? How does the diet industry make money?

ACTIVITIES

1. Watch an hour of television targeted at people under the age of 18. Each time you see an advertisement for food, write down the name of the product and the slogan or mascot used to sell the product. If you only ate the food advertised during that hour, how healthy would your diet be?

2. Make a collage of at least four different print advertisements (from newspapers, magazines, and the web) that advertises food. There should be one example of an ad that makes health claims about food, one that markets a new food product, one that promotes larger portions, and one that targets children.

3. According to the authors of "Why Have Americans Become More Obese?" Americans are gaining weight because we're eating too many calories. "As a primary cause for the increase, the authors identify the technological innovations that have given rise to the mass production of ready-to-eat meals, which in turn have supplanted food preparation at home. The advances in food preparation technology... [have] lowered average cost and eventually reduced the retail price of [ready-to-eat] food."

During a visit to the grocery store, compare the costs of at least five different "ready-to-eat" foods with the costs of various fruits and vegetables. (e.g. a bag of potato chips to a head of fresh broccoli, a package of cookies to a bag of apples). If possible, make a chart that compares the cost and nutritional values (one source for nutritional values is www.fitday.com) of the various foods. Also, you may wish to compare these costs with the cost of a fast food meal (most fast food restaurants provide nutritional values on their websites).

GUIDED READING Background

1. What are the three ways that people expend (burn) calories?

2. What do the authors hypothesize is the major factor behind increased obesity?

3. According to the article, how many calories would the typical person have to cut out of his or her diet per day in order to not gain any weight?

Methods and Findings

1. Where are the increased calories coming from?

2. Are we eating more at dinner now, or less?

3. What do the authors say about restaurant portion sizes?

4. What do they say about fast food?

5. What has happened to the food supply since 1965?

6. How many calories per person, per day, does the current food supply provide?

Discussion

1. In the authors' view, what better explains the rise in obesity?

2. What does "reduced caloric expenditure" mean?

Why Have Americans Become More Obese?



David M. Cutler, Edward L. Glaeser, and Jesse M. Shapiro, Harvard University

BACKGROUND

Over the past 20 years, the average weight of American men increased from 168 to nearly 180 pounds, while the average weight of American women grew from 142 to 152 pounds. This increase means that the amount of calories ingested must have grown faster than the calories expended. Individuals burn calories in three ways. The first is through basal metabolism, the energy cost associated with keeping the body alive and at rest. The energy cost of basal metabolism depends on weight, and the more a person weighs, the more energy required to sustain basic bodily functions. The second source of energy expenditure is the thermic effect of food — i.e., the energy required to process food that has been ingested. The third source is physical activity. Based on these biological relationships, one can derive the daily amount of calories that a person requires to maintain a given weight in the steady state. Specifically, the 10- to 12-point increase in median weight observed in recent decades implies that a typical person has a net caloric balance (that is, excess of caloric intake over expenditure) of about 100 to 150 calories per day.

Cutler, Glaeser, and Shapiro hypothesize that increase in caloric intake, not decline in physical activity, is the major factor behind increased obesity, which in turn, is related to technological innovations in food production and transportation that have reduced the real cost of prepared foods. The authors use several indirect measures of changes in intake and energy expenditure to support their hypothesis.

METHODS AND FINDINGS

A comparison of the 1977-78 and 1994-96 food intake surveys conducted by the U.S. Department of Agriculture (USDA) reveals that reported consumption increased by 268 calories for men and 143 calories for women between the two periods. This increase is more than enough to explain the rise in the average weights of men and women over the same period. Most of the increase in calories is attributable to more calories having been consumed as snacks, while dinnertime calories actually fell somewhat. The fact that snacking accounts for most of the increased caloric intake leads the authors to reject the thesis that obesity is a result of increased portion sizes in restaurants. If this theory were true, calories at main meals, particularly dinner, would have increased. Similarly, the evidence also works against the view that fattening meals at fast food restaurants have caused the rise in obesity.

Additional indirect evidence on caloric intake can be gleaned from data on total calories available for consumption that are published by USDA's Economic Research Service. The data are from production sources and are adjusted for exports, imports, and feedstock. In recent years, the data have also been adjusted for wastage. Since 1965, the food supply has increased markedly, particularly in the last two decades. In 1978, the food supply was 3,200 calories per person. By 1999, the food supply had risen to 3,900 calories per person. Adjusted for wastage, the increase is 418 calories, again more than required to explain the observed weight gain over the same period.

Trends in caloric expenditure can be inferred from time diaries. The authors use data from Robinson and Godbey (1997) for typical time use in 1965, 1975, and 1985, and provide their own calculations for 1995. An energy expenditure index can be computed as a weighted average of the different levels of energy expenditure associated with the various activity patterns recorded in the diaries. The estimated value of this index fell between 1965 and 1975, but has been quite stable since then.

An important component of caloric expenditure is the energy spent on the job and commuting to work. Between 1980 and 1990, the share of the population in highly active occupations declined from 45 to 42 percent. While it is true that over the past 100 years cars have replaced walking and public transportation as means of commuting, this change had largely run its course by 1980. In 1980, 84 percent of people drove to work, 6 percent walked, and 6 percent used public transportation. In 2000, 87 percent drove to work, 3 percent walked, and 5 percent used public transportation. From these observations the authors conclude

²Some of the increase in calories observed for this period could be due to changes in interviewing methods and other survey procedures

that neither changes in the occupational structure of the economy nor commuting patterns can account for the recent increase in obesity.

Similarly, children do not work now, and they did not work in 1980. However, obesity has increased substantially among children and adolescents.

DISCUSSION

In the authors' view, increased caloric intake better explains the rise in obesity than reduced caloric expenditure. As a primary cause for the increase, the authors identify the technological innovations that have given rise to the mass production and preparation of ready-toeat meals, which in turn have supplanted food preparation at home. The advances in food preparation technology have allowed manufacturers to exploit economies of scale by producing ready-to-eat foods centrally, which has lowered average cost and eventually reduced the retail price of industrially prepared food.

In order to produce food in one location that will be nearly ready for consumption in another one, five main technological obstacles had to be overcome (Kelsey, 1989): controlling the atmosphere, preventing spoilage due to microorganisms, preserving flavor, preserving moisture, and controlling temperature. Innovations in food processing and packaging over the last three decades have improved food manufacturers' ability to address each of these issues.

As the primary cost of food may well have been the time spent in household preparation, rather than the cost of the ingredients, the substitution of "preprepared" foods for home-produced foods led to a decline in both the fixed and variable costs of preparing meals.

Reductions in the time cost of food preparation give rise to several predictions: First, the lower costs of food preparation mean that individuals should eat a wider range of products more often during the day. The increasing frequency and importance of snacks, which are often preprepared, corroborate this prediction.

Second, the increase in food consumption should come mostly in foods that have had an improvement in mass preparation technology (along with complements to those foods). Indeed, food items with low farm value share—a low share of the retail price going to farmers instead of other food preparers—and branded foods, which are more likely to be preprocessed than unbranded foods, registered the largest growth rates over the past decades.

Third, individuals who have taken the most advantage

of the new technologies should have had the biggest increase in obesity. Obesity prevalence rose most for married women, who reduced their time preparing food more than any other group.

Fourth, obesity rates should be higher in countries with greater access to technological changes in the food supply. Countries that regulate the food industry more heavily by imposing price controls, tariff and non-tariff barriers to trade in agricultural products, and food laws, and that pose more delays to opening a new business, are found to exhibit lower obesity rates than less-regulated countries.

The lower time cost associated with food preparation increases consumers' options and should therefore make them better off. An exception is consumers with self-control problems for whom the high cost of food preparation provided a device that helped them curb an urge to eat that they would later regret. The authors conclude that while the rise in obesity has significant health costs, those costs are likely offset by the dramatic savings in time of food preparation.

FUTURE RESEARCH

Implicit in the technical change model is the notion that technology for food preparation has evolved and continues to evolve with sizable improvements in mass production. The switch from individual to mass preparation has lowered the time price of food consumption and led to increased quantity and variety of food eaten, while energy needs have remained stable. As a consequence, body weight increases.

The key idea is that consumers respond to changing costs both in cash and time. The increasing body weight is expected, given changes in economic conditions: the price of food fell, the cost of preparing foods fell, energy needs for work and home fell, and the value of women's time rose.

Future research, will need to consider other economic factors that may affect weight increases, such as food stamps and other feeding programs, which reduce the cost of food for key population groups; reductions in smoking from increasing tobacco prices, and concomitantly, the rise in the cost of appetite control; the lower cost of illness (e.g., heart disease is less costly to the individuals over time); and the improved efficiency of grocery distribution and retailing.

Source: http://www.ers.usda.gov/publications/ efan04004/efan04004b.pdf *The Economics of Obesity* / E-FAN-04-004 Economic Research Service/USDA