

Fighting Fat — New Ways to Win

Secrets of the Sequence Video Series on the Life Sciences • Grades 9 – 12
Teaching materials developed by VCU Life Sciences.

V i r g i n i a C o m m o n w e a l t h U n i v e r s i t y

Classroom Tested Lesson

Video Description

“Secrets of the Sequence,” Show 122, Episode 1

“Fighting Fat” – approximately 11 minutes viewing time

Scientists love to argue, but there is one thing they agree on: Americans are getting fatter. Obesity is now considered a disease, and it is reaching epidemic proportions all over the world. Researchers at Virginia Commonwealth University are tackling the problem with a novel, genetic approach. By isolating the genes that keep people thin, they identify biological pathways that contribute to high metabolism – raising hopes for therapy for the obese.

Ward Television

Producer: Liz Boggis

Featuring: Karen Wright; Donald Kirby, Gastroenterology, Virginia Commonwealth University; Cynthia M. Bulik, Virginia Institute of Psychiatric and Behavioral Genetics, Virginia Commonwealth University; Richard Arlen Price, Center for Neurobiology and Behavior, University of Pennsylvania; Ben Neal

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National and State Science Standards of Learning

National Science Education Standards Connection

Content Standard A: Science as Inquiry

As a result of activities in grades 9-12, all students should develop:

- understandings about scientific inquiry.

Content Standard C: Life Science

As a result of their activities in grades 9-12, all students should develop an understanding of:

- the cell,
- molecular basis of heredity,
- biological evolution,
- interdependence of organisms,
- matter, energy, and organization in living systems, and
- behavior of organisms.

Content Standard F: Science in Personal and Social Perspectives

As a result of activities in grades 9-12, all students should develop an understanding of:

- personal and community health,
- natural and human-induced hazards, and
- science and technology in local, national, and global challenges.

Content Standard G: History and Nature of Science

As a result of activities in grades 9-12, all students should develop an understanding of:

- nature of scientific knowledge and
- historical perspectives.

Selected State Science Standards of Learning Connection

Use <http://www.eduhound.com> (click on "Standards by State") or a search engine to access additional state science standards.

Illinois

Standard 11: Understand the process of scientific inquiry and technological design to investigate questions, conduct experiments, and solve problems.

Standard 12: Understand the fundamental concepts, principles and interconnections of the life, physical, and earth/space sciences.

Standard 13: Understand the relationships among science, technology, and society in historical and contemporary contexts.

Virginia

BIO.1 The student will plan and conduct investigations in which:

- b. hypotheses are formulated based on observations;
- c. variables are defined and investigations are designed to test hypotheses;
- i. appropriate technology is used for gathering and analyzing data and communicating results; and
- j. research is based on popular and scientific literature.

BIO. 2 The student will investigate and understand the history of biological concepts. Key concepts include:

- c. causative agents of disease and
- e. the collaborative efforts of scientists, past and present.

BIO.5 The student will investigate and understand life functions of animals including humans. Key concepts include:

- d. maintenance of homeostasis; and
- e. human health issues, human anatomy, body systems and life functions.

BIO. 6 The student will investigate and understand common mechanisms of inheritance and protein synthesis. Key concepts include:

- d. prediction of inheritance of traits on the laws of heredity.
- g. exploration of the impact of DNA technologies.

BIO. 8 The student will investigate and understand how populations change through time. Key concepts include:

- b. investigating how variation of traits, reproductive strategies, and environmental pressures impact on the survival of the populations; and
- c. recognizing how adaptations lead to natural selection.

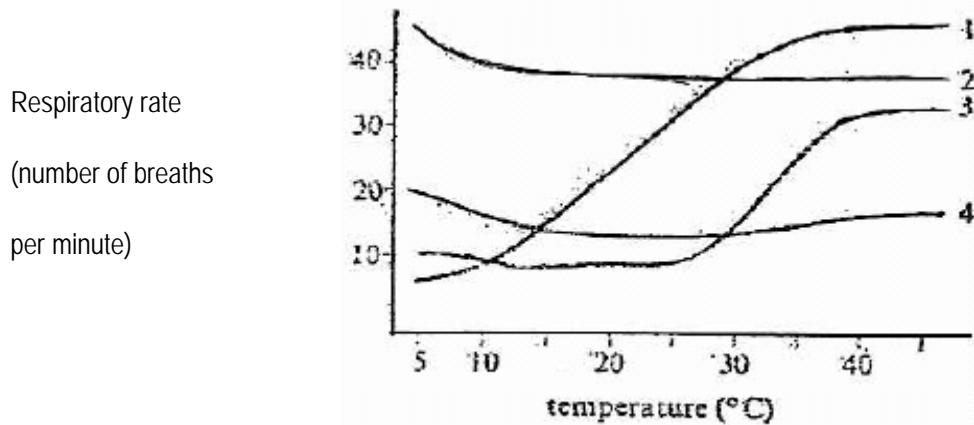
Overview

In this lesson students learn that fat is fuel - a battery that we use to run our bodies. Fat is key to our survival. However, in the last 10 years the average American has increased in size by 8 lbs. 65% of our population is overweight; leading to an increase of health problems. But what is responsible for our increased weight in recent years - genes, lifestyle, or the over-marketing of fatty foods? Scientists are

searching for genes that maintain a healthy body weight no matter what we eat. In the meantime we need to eat a better diet and exercise more.

Testing: A sample related multiple choice item from State Standardized Exams

Four different animals were placed in environments at various temperatures. After 5 minutes at each temperature tested, the average number of breaths per minutes was determined for each of the 4 animals while they remained at rest. Respiratory rate is often used as an indicator of cellular respiration or metabolic rate (a measure of energy use by the cell). The data from the experiment are shown in the following graph.



The utilization of food by the animals requires oxygen for respiration. According to the data in the graph, which of the animals would use less food at 5 degrees C than they would at 25 degrees C.

- A) 1 only*
- B) 2 only
- C) 4 only
- D) 1 and 2 only

Source: Illinois (ACT Test) State Standardized Exam

Video Preparation

Preview the video and make note of the locations you will need later to pause the video for discussion.

Before Viewing

1. Have students work in groups of 3 or 4 to answer the following questions.
 - What is a healthy diet?
 - How do you check to see if your diet is healthy?
 - How does advertising affect your food intake? Name some fast food commercials and explain their purpose.
 - List diseases that are associated with being overweight?
 - List these diseases on the board and challenge the students to see if they can find any others that are mentioned in the video. Also have students name any factors that can

- potentially cause these diseases. (Note: include eating disorders such as anorexia and bulimia)
2. Write the following questions on the board or prepare a handout for students to complete while watching the video:
 - Name three forms of fuel for our bodies.
proteins, fats and carbohydrates
 - What does BMI mean?
Body Mass Index. Weight in kilograms divided by height in meters squared. BMI > 30 is obese. (Do some sample calculations with the class.)
 - Currently, what are the ways to lose weight?
Diet, exercise, gastrectomies and liposuction

During Viewing

1. **START** the video.
2. **PAUSE** the video (5:51 minutes into the video) when the narrator says, "Americans just keep getting bigger."

Ask: "Why have so many people become overweight in the last twenty years?"
TV, video games, more fast food meals, more jobs that require less activity, and convenience foods that are easy to prepare but laden with fat

3. **RESUME** the video.
4. **PAUSE** the video (7:25 minutes into the video) when the narrator says, "a difficult challenge for scientists to pin point obesity genes in this heterogeneous environment."

Ask: "Why is it so difficult to find 'the gene' that causes us to store fat?"
There are 10-15 genes that scientists know are involved in fat storage. There may be as many as 250 genes or locations and many different pathways.

5. **RESUME** the video and play to the end.

After Viewing

1. Fat is implicated in numerous diseases, high blood pressure, osteoarthritis, diabetes, and arteriosclerosis to name a few.

Ask:

- a) "How could genes that cause a person to be fat have survival value?"
Fat can save us from death during a famine. According to the American Obesity Association (http://www.obesity.org/subs/fastfacts/obesity_US.shtml) 28% of men and 34% of women in the U.S. are obese.
- b) Develop a hypothesis to explain why more women than men are obese.
Women are child bearers and care givers. By natural selection women who stored more fat would live through famines and reproduce, thus passing on the genes for the ability to store more fat.

NOTE: The importance of these questions is that students can develop a hypothesis for why something we view as bad (e.g., fat) has survival value.

2. Conduct the following activities:
 - Student Activity 1: What's in it for me? This activity gives students experience in reading a nutritional label and judging their choice of a snack food.
 - Student Activity 2: Too much of a good thing? This activity gives students a hands-on experience discovering the effect of serving size on daily calorie intake as well as reinforces the "What's in it for me?" activity. To save class time you may wish to assign this as a homework activity. If you have never tried a take-home activity, this is a good one to try. Students report that they enjoy doing "kitchen table science activities" with their families.
 - Student Activity 3: Extending the Investigation – Using the Internet. Students "order" from a fast-food restaurant and use the Internet to determine the calories and fat content of the items they ordered.

NOTE: Activity 1 is best done individually but Activity 2 and Activity 3 can be conducted in groups.

3. If time allows in class or as an activity to do as homework, have students research the typical diets of other cultures and their obesity rates. This research could provide significant comparisons for class discussions.

Teacher Notes for Student Activities 1, 2, and 3

Activity 1: What's in it for me?

In this activity students bring in a nutritional label from their favorite snack food or have them bring in labels from one food they consider "healthy" and one they consider to be "junk food". They will calculate the nutritional values for their food choice and decide if their choice of a snack food is a good one.

Materials

- Copies of the student handout, "What's in it for me?"
- Nutritional labels from students' favorite foods (Have some additional labels available for students who forget or bring in a label from non-snack foods or water.)
- Calculators

Procedure

1. Distribute copies to the Student Handout, "What's in it for me?"
2. Remind the students that the sample label and answers in the handout are provided as an example.
3. Have students use their own label to complete the activity.

Discussion

- After the activity emphasize the high fat content in most snack foods.
- Discuss the idea of "empty calories" - foods that have calories but very little nutritional value.
Other resources to help understand nutritional labels: <http://www.cfsan.fda.gov/~dms/foodlab.html>
Download a video on how to read a label: <http://www.cfsan.fda.gov/~comm/vltlabel.html>

Activity 2: Too much of a good thing?

In this activity students investigate the effect of cereal serving size on daily calorie intake. The activity is recommended as a take-home investigation. Or if you prefer, it can be conducted in class. If students are doing this activity at home, encourage them to involve other family members.

Materials (per group if conducted in class):

- Copies of the student handout, "Too much of a good thing?"
- Nutritional labels from students' favorite cereals
- 2 bowls
- Calculator
- Cereal
- Measuring cup

Note: If you are conducting this activity in class, you will also need at least 3 different types of cereals. When purchasing different cereals, be sure to choose a "healthy" cereal like Granola that has a small serving size but is high in calories, a cereal that is sugar coated, and a healthier cereal, such as Total Raisin Bran. If the students take this home, suggest that they use at least 2 different types of cereals (one "healthy" and one of their favorites).

Procedure

1. See the Student Handout; modify as necessary if you are conducting this activity in class.
2. Optional variation: If you are conducting this activity in class, you may wish to add the variable of different size bowls. Without comment, distribute 2 different size bowls so that some groups use a small bowl, while others use a larger bowl. Distribute the bowls so that different groups using the same cereal use different size bowls.

Discussion

If you distribute different size bowls, have students determine if the size of the bowl affected the serving size selected by students.

Create a table for students to record the results of their investigation at home or in class. Use the following column headings:

Cereal Name	Recommended Serving Size	Converted Serving Size	Calories
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Discuss students' responses to questions on their handout.

Ask, "Do bigger serving sizes make us eat more?"

Yes, says Brian Wansink, director of the Food and Brand Research Lab at the University of Illinois at Champaign-Urbana. Wansink sent 79 parents home with a video and either one- or two-pound bags of M&Ms plus either a "medium" or "jumbo" movie-theater-sized tub of popcorn for each family member. "On average, people ate 112 M&Ms from the one-pound bag and 156 from the two-pound bag," says Wansink. Likewise, the average person ate roughly half a tub of popcorn, whether it was medium or jumbo (which held twice as much). "People can often eat about 50 percent more of hedonistic foods like candy, chips, and popcorn when they come in bigger packages," says Wansink (http://www.cspinet.org/nah/7_98eat.htm)

Activity 3: Extending the Investigation – Using the Internet

In this activity students “order” from a fast-food restaurant and use the Internet to determine the calories and fat content of the items they ordered. Depending upon expected length of assignment, students could also make a comparison with an “order” from a sit-down restaurant, such as one of the restaurants with a pick-up menu.

Materials

- Copies of the student handout, “Extending the Investigation – Using the Internet”
- Computers with Internet access
- List of Web sites for nutritional information from fast-food restaurant

Procedure

1. Adjust the Web site list to include fast-food restaurants in your area.
2. Make arrangements for students to have access to computers with Internet capability.

Note: Some of the food calculators on the fast food Web sites may be difficult to use. Nutritional information for food items can also be obtained by searching for them on a search engine, such as www.google.com and typing in, for example, “McDonalds ¼ pounder with cheese”.

Discussion

Discuss students’ responses to the questions on their handout.

Ask: “Has this activity affected what you might order the next time you visit a fast-food restaurant?”

Student Handout 1: What's in it for me?

In this activity you will learn to read a nutritional label and judge the nutritional value of your chosen snack food. Note: Sample answers are based on the example of a nutritional label on the right.

- What is the total number of calories in a serving? _____
In the example: 170 calories
- What is the number of grams of fat on your nutritional label? _____
In the example: 1g
- What is the number of grams of protein on your nutritional label? _____
In the example: 4g
- To find the number of usable grams of carbohydrate subtract the dietary fiber from the total number of carbohydrates. Carbohydrate grams? _____
In the example: 41g - 5g = 36g
- Multiply the grams of fat by 9 calories (why?) _____
This is your total fat calories. *In the example: 9c*
- Multiply the grams of protein by 4 calories (why?) _____
This is your total protein calories. *In the example: 16c*
- Multiply the grams of carbohydrates by 4 calories (why?) _____
This is your total carbohydrate calories. *In the example: 144c*
- To find the percent of fat found in this food divide the answer to number 5 by the answer to number 1. My food is _____% fat.
In the example: 9c divided by 170c = 5%
- To find the percent of protein found in this food divide the answer to number 6 by the answer to number 1. My food is _____% protein.
In the example: 16c divided by 170c = 9%
- To find the percent of carbohydrates found in this food divide the answer to number 7 by the answer to number 1.
Your snack food is _____% carbohydrate
In the example: 144c divided by 170c = 83%

Analyzing the data

The United States Department of Agriculture (www.cnpp.usda.gov) recommends 10-30% protein, 45-65% carbohydrate, and 20-30% fat in your diet. How does your food compare? _____

Extending your investigation

How much of your daily calorie intake is one serving of this food? To find out divide the answer to number 1 by 2,000 (the average calorie intake). _____
In the example 170 divided by 2,000 = .085 or 8.5%

Below the heavy black line there is a list of the percent of vitamins and minerals contained in this food item. How do these values compare to the percent of calories in eating this food?

Use the back of this sheet to write a few sentences explaining why you think this snack is or is not a good food choice.

The example is a good food choice because for only 8.5% of your daily calories you get 100% of many vitamins and minerals. The rest of the day you need to be sure to eat foods that have vitamins C and D, as well as Phosphorus, Magnesium, and Copper.

Nutrition Facts		
Serving Size 1 cup (55g)		
Servings Per Container About 9		
Amount Per Serving	Total Raisin Bran	with 1/2 cup skim milk
Calories	170	210
Calories from Fat	10	10
% Daily Value**		
Total Fat 1g*	1%	2%
Saturated Fat 0g	0%	0%
Polyunsaturated Fat 0g		
Monounsaturated Fat 0g		
Cholesterol 0mg	0%	1%
Sodium 250mg	10%	13%
Potassium 350mg	10%	16%
Total Carbohydrate 41g	14%	16%
Dietary Fiber 5g	20%	20%
Sugars 20g		
Other Carbohydrate 16g		
Protein 4g		
Vitamin A	10%	15%
Vitamin C	0%	0%
Calcium	100%	110%
Iron	100%	100%
Vitamin D	10%	25%
Vitamin E	100%	100%
Thiamin	100%	100%
Riboflavin	100%	110%
Niacin	100%	100%
Vitamin B ₆	100%	100%
Folic Acid	100%	100%
Vitamin B ₁₂	100%	110%
Pantothenic Acid	100%	100%
Phosphorus	10%	25%
Magnesium	10%	10%
Zinc	100%	100%
Copper	8%	8%

*Amount in Cereal. A serving of cereal plus skim milk provides 15g total fat, less than 5mg cholesterol, 310mg sodium, 360mg potassium, 47g total carbohydrate (25g sugars) and 8g protein.

**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Potassium		3,500mg	3,500mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Student Handout 2: Too Much Of A Good Thing?

In this activity you will investigate the effect of serving size on daily calorie intake. If you are doing this activity at home, you may wish to involve other family members.

Purpose

To determine what is a serving size.

Materials

- cereal
- measuring cup
- nutritional label from your favorite cereal
- calculator
- 2 bowls

Procedure

1. Fill your bowl to what you think is an acceptable serving size. *Do not read the nutritional label on the cereal box yet.*
2. Carefully measure the amount of cereal you put in your bowl. Use a measuring cup to measure and transfer the cereal to another bowl. Don't pack down the cereal or overfill the measuring cup.
3. Now check the cereal's nutritional label and see how your serving size compares with theirs. Did you have more or less than the recommended amount? How much more or less?
4. Use your calculator to determine the calories in your bowl of cereal.
5. Using your measuring cup measure out a recommended serving size and put it in an empty bowl.
 - How does your serving size compare with the recommended serving size?
 - Which is more typical of what you usually eat?

Analyzing the Data

1. How does serving size affect the number of calories?
2. Convert your cereal's recommended serving size into one cup as a serving size. Example: if your cereal has 150 calories in a $\frac{1}{2}$ cup serving, you would convert it to 300 calories for 1 cup.
3. In class add your information (cereal name, recommended serving size, and converted serving size and calories) to the class data table so the class can easily compare many different kinds of cereals.
4. Do you think that the recommended serving size for cereals is realistic? Why do you think they make such a small serving size? How does serving size affect the amount of calories eaten in a day?

Cereal Name	Recommended Serving Size	Converted Serving Size	Calories

Student Handout 3: Extending the Investigation – Using the Internet

Your friend has just volunteered to pick up your favorite fast food meal. What would you order?

1. Select a restaurant from the following: Arby's, A&W, Burger King, Hardee's, Kentucky Fried Chicken, Long John Silver's, McDonalds, Pizza Hut, Taco Bell, or Wendy's and write your order.

Order item	Number of Calories and % Fat
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Total Calories: _____

2. Now that you have your order, go to the nutritional information Web page for your selected restaurant. Web addresses of popular fast-food restaurants are on the next page.
3. On the lines next to each item you ordered, write the number of calories and percent fat for that item.

Analyzing the Data

1. Total the calories of your meal. _____
2. How much of your recommended daily calories (2,000) did you use on this one meal?

3. How many calories do you have left for two more meals and any snacks? _____
4. Did you stay within the recommended amount of fat (less than 30% of calories from fat)? _____

Extension

Go to the Web site www.smartmouth.org. Click on "Choose UR Chews." You have 2,000 calories to spend. See if you can design a healthy diet for the day; be sure to include breakfast, lunch, dinner, and two snacks.

Meal	Food Items	Calories/Item	Subtotal for Meal
Breakfast			
Snack			
Lunch			
Snack			
Dinner			

Total Calories: _____ : 2000

Websites for Nutritional Information from Selected Fast-Food Restaurants

Because Web sites frequently change, some of these resources may no longer be available. Use a search engine and related key words to locate new Web sites

Arby's http://arbys.com/print_nutrients_all.html

A&W <http://www.yum.com/nutrition/default.htm>

Burger King <http://www.burgerking.com/Food/Nutrition/NutritionWizard/index.aspx>

Hardee's <http://www.hardeesrestaurants.com/nutrition/>

Kentucky Fried Chicken <http://www.yum.com/nutrition/default.htm>

Long John Silver's <http://www.yum.com/nutrition/default.htm>

McDonald's <http://www.mcdonalds.com/countries/usa/food/nutrition/categories/nutrition/index.html>

Pizza Hut <http://www.yum.com/nutrition/default.htm>

Taco Bell <http://www.yum.com/nutrition/default.htm>

Wendy's <http://www.wendys.com/food/BAMMain.jsp>

Websites for Nutritional Information from Selected Sit-Down Restaurants

Applebee's http://www.applebees.com/menu/menu_ww.php, only offers nutritional info on Weight Watcher items

Ruby Tuesday <http://www.rubytuesday.com/smartEating/pdf/smartEatingGuide.pdf>, only offers nutritional info on their healthier choices

Additional Resources

Because Web sites frequently change, some of these resources may no longer be available. Use a search engine and related key words to locate new Web sites.

<http://www.cyberdiet.com/>

This site offers nutritional information and interactive modules to help visitors calculate their calorie intake, target heart rate, and plan daily menus. Visitors begin by entering their personal data (height, weight, age, and gender) into the Nutritional Profile, which generates their daily calorie and nutrient requirements.

<http://www.fda.gov/>

Free book from the Food and Drug Administration. This reprint discusses junk food consumption among teenagers, especially soda drinking, and the need to observe sound dietary guidelines to balance nutrition for good health. The need for fiber in a person's diet, the risks in drinking alcohol, vegetarianism, and healthy weights are also discussed. (Author/KSR)

<http://www.fns.usda.gov/tn/>

This site offers information about the Team Nutrition (TN) initiative, developed by the Food and Nutrition Service (FNS) of the United States Department of Agriculture (USDA). The purpose of the initiative is to improve the well being of children by facilitating healthy eating and physical activity.

<http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/bodyfat03.html>

This Web lesson has more activities for understanding nutrition. Is all fat bad? What's the best way to lose fat? What is fat? Why is it good for you? How does a fat cell function?

<http://www.iemily.com/> Click>Healthy Eating

Emily gives advice to teens on such topics as: Can I eat fast food and be healthy? Which fast foods are healthy? Can I eat fast food without gaining weight? What are the unhealthiest fast foods? Can you give me tips for healthy ordering?

Genomic Revolution

http://www.ornl.gov/sci/techresources/Human_Genome/education/education.shtml

The Web site to the government-funded Human Genome Project with links about genomics, the history of the project, and more.

Secrets of the Sequence Videos and Lessons

This video and 49 others with their accompanying lessons are available *at no charge* from www.vcu.edu/lifesci/sosq