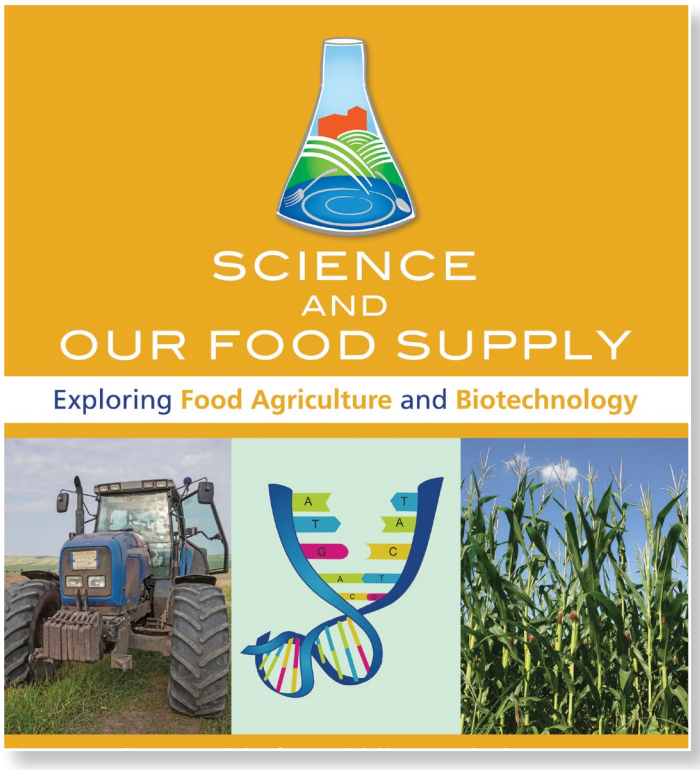
SCIENCE AND OUR FOOD SUPPLY

Student Activity Sheets



Middle Level – 3rd Edition

DEPARTMENT OF HEALTH & HUMAN SERVICES · USA

FDA

SCIENCE AND OUR FOOD SUPPLY

Student Activity Sheets

This document contains all of the current *Science and Our Food Supply* middle level student activity sheets in a **fillable PDF format**. Teachers can send the entire file or individual activity worksheets to students to complete and return, according to the teacher's instructions. The fillable activity sheets support learning on various virtual platforms and help reduce paper use.

The web links provided in this Student Activity Worksheet book were current at the time of publication. In the event that they change and/or are no longer available, we suggest that you visit the "home page" of the named organization and search for topical information.

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STUDENT WORKSHEET

ACTIVITY 1: DISSECTING THE NUTRITION FACTS LABEL

Name _____ Date _____ Class/Hour _____

1. Arrange the cards in order of the food you think has the most protein per serving to the food you think has the least protein per serving. Complete Column 1 in the data table below with that information.
2. After you read the food product nutrition labels, rearrange the foods in the correct order of most to least Protein per Serving – record that in Column B. If you find 2 products with the same information, list them alphabetically.
3. Record the arrangement of the foods according to the amount of Protein per Serving listed on the Nutrition Facts label for each food. In the last column, mark an up arrow (↑) if the actual ranking was higher than you initially recorded, a down arrow (↓) if it was lower than you initially recorded, and an equal mark (=) if it was the same as your ranking. [Note: If you are filling in this worksheet online, you can write Up or Down for the arrow direction.]

Data Table to Rank Foods According to Protein per Serving

A List the foods in order of those you think have the **most** Protein per Serving to the **least** Protein per Serving	**B** Look at the Nutrition Facts label for each product and list the products in order from those with the **most** Protein per Serving to those with the **least** Protein per Serving. Include how many grams of protein for each one.	**C** Compare each food position in column A with the same food's position in column B. Record ↑ if the position in B is higher, ↓ if the position in B is lower, and = if the position is the same in columns A and B.

1. What information did your group use to initially rank the foods according to the amount of protein per serving?

2. How accurate was your group's initial ranking of the food products?

3. What food products surprised your group by their ranking and why?

4. Why do you think it is important to understand the Nutrition Facts label?

Nutrition Facts Label Mini-Book

VITAMINS AND MINERALS

NUTRIENTS TO GET LESS OF

NUTRIENTS TO GET MORE OF

% DAILY VALUE

CALORIES

SERVINGS PER CONTAINER

SERVING SIZE

Strawberry Yogurt Smoothie

Nutrition Facts

1 servings per container
Serving size 1 bottle (207 mL)

Amount per serving
Calories **100**

	% Daily Value *
Total Fat 0.5g	**1%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 5mg	**2%**
Sodium 80mg	**3%**
Total Carbohydrate 22g	**8%**
Dietary Fiber 3g	**11%**
Total Sugars 18g	
Includes 14g Added Sugars	**28%**
Protein 6g	

Vit.D 4mcg 20%	Calcium 280mg 20%
Iron 0mg 0%	Potas. 290mg 6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Using the Nutrition Facts Label to Make Healthy Food Choices — Module 1

STUDENT WORKSHEET

ACTIVITY 1: SCAVENGER HUNT (CONTINUED)

Name _____ Date _____ Class/Hour _____

Part C

For this Scavenger Hunt, use your set of **Product Cards** to answer the following questions about the products. You can use the information in your **Mini-Book**, the label on the back of the **Product Card**, and the Interactive Nutrition Facts Label website: www.accessdata.fda.gov/scripts/interactivenutritionfactslabel.

For example: "Find the product that is healthiest for saturated fat." Look through the Nutrition Facts labels on the back of the **Product Cards** and find the one that your group thinks is healthiest for saturated fat. Write the name of that product in the correct space below and then give your group's reason for choosing that particular product.

1. Which products are the healthiest for saturated fat? Explain your answer.

a. Product Name _____ b. Grams of saturated fat _____

c. Explanation _____

2. Which products are the least healthy for saturated fat? Explain your answer.

a. Product Name _____ b. Grams of saturated fat _____

c. Explanation _____

3. Find a product that is a good source of fiber.

a. Product Name _____ b. Grams of fiber _____

c. Explain why you picked this product. _____

4. Which product has the highest amount of added sugars per serving? Would you recommend this product to a classmate? Why or why not?

a. Product Name _____ b. Amount of Added Sugar _____

c. Recommendation and Explanation

_____

5. Which product has the highest amount of sodium per serving? Would you recommend this product to your grandparent who has high blood pressure? Why or why not?

a. Product Name _____ b. Amount of Sodium _____

c. Recommendation and Explanation

_____

continued on next page

STUDENT WORKSHEET
SCAVENGER HUNT (CONTINUED)

6. A general rule is that 5% DV or less of a nutrient per serving is considered low; 20% DV or more of a nutrient per serving is considered high. Select a product and explain why it falls in either category.

a. Product Name

b. Explanation

7. Pick one product and look at the section on the Nutrition Facts label that lists vitamins and minerals. What are the vitamins and minerals listed on the selected food label?

a. Product Name

b. Vitamins

c. Minerals

8. Pick one of the products that you think would be a good source of protein.

a. Product Name

b. Why it is a good source of protein?

Review your responses to the Scavenger Hunt questions and compare them with two other groups. How close were your responses to those of the other groups?

STUDENT WORKSHEET
ACTIVITY 2: ANALYZING SERVING SIZE

Name _____ Date _____ Class/Hour _____

DATA TABLE FOR _____

(Cereal Name)

Complete these questions and the Data Table with information about your chosen cereal.

1. When you eat cereal for breakfast, how much do you estimate you eat (ex: 1/2 cup, 1 cup, 2 cups, etc.)? _____
2. When you pour your bowl of breakfast cereal, how many servings do you think are in the bowl? _____
3. What does the Nutrition Facts label for your breakfast cereal say about Serving Size? _____
4. Compare the amount of cereal you actually poured into your bowl with the amount per serving on the label.
   How many servings are in the original bowl of cereal that you poured? _____

	Nutrition Facts label Information	Our Poured Bowl of Cereal	Our Bowl of Cereal with 1 Cup of 2% Milk
Serving Size			
Calories			
Carbohydrates			
Fiber			
Total Sugars			
Added Sugars			
Protein			

5. Compare the portion size of the bowl you poured with that of 2 other groups. If their portion sizes are different, why do you think they are different?
   _____
6. One of the entries in your **Mini-Book** is **Nutrients To Get Less Of**. One of these nutrients is added sugar.
   a. How much added sugar is in one serving of your cereal? _____
   b. How much added sugar is in the portion of cereal that you poured into the bowl without measuring? _____
   Look at the ingredients for your selected cereal and answer the following questions.
   c. What added sugars are in the cereal? _____
   d. Why should you try to limit added sugars? _____
   e. What could you do to make your cereal choice more healthy?
   _____

STUDENT WORKSHEET

ACTIVITY 3: CREATING A NUTRITION FACTS LABEL

Name _____ Date _____ Class/Hour _____

Smoothie Name _____

Ingredients: Base _____ Volume _____ Added Sugars (if any, see page 27)

Fruit _____ Volume _____

Sweetener/flavoring (if any) _____ Volume _____ Added Sugars (if any, see page 27)

A Nutrition Calculator Values for Combined Ingredients from www.verywellfit.com/recipe-nutritionanalyzer-4157076

_____ serving per container	
Serving size	
Calories/serving	
Total Fat	g
Saturated Fat	g
Cholesterol	mg
Sodium	mg
Total Carbohydrates	g
Dietary Fiber	g
Total Sugars	g
Protein	g
Vitamin D	mcg
Calcium	mg
Iron	mg
Potassium	mg

Assume 0g *Trans* Fat

Added Sugars/Serving _____ g

B Label from Label-Making Tool at www.onlinelabels.com/tools/nutrition-label-generator

Nutrition Facts

_____ servings per container

Serving size _____

Amount per serving

Calories _____

	% Daily Value *
Total Fat _____ g	_____ %
Saturated Fat _____ g	_____ %
Trans Fat _____ g	
Cholesterol _____ mg	_____ %
Sodium _____ mg	_____ %
Total Carbohydrate _____ g	_____ %
Dietary Fiber _____ g	_____ %
Total Sugars _____ g	
Includes _____ g Added Sugars	_____ %
Protein _____ g	
Vit.D _____ mcg _____ % • Calcium _____ mg _____ %	
Iron _____ mg _____ % • Potas. _____ mg _____ %	

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Check Rounding Rules for These Select Nutrients

	Vit. D	Calcium	Iron	Potas.	Added Sugars
Daily Value	20 mcg	1,300 mg	18 mg	4,700 mg	50 gm
Rounded Amount for Label	Express to nearest 0.1 mcg	Express to nearest 10 mg	Express to nearest 0.1 mg	Express to nearest 10 mg	< 0.5 g express as 0 < 1 g express as "Contains less than 1 g" or "less than 1 g" > 1 g express to nearest 1 g
Un-rounded %DV	%DV = (actual amount (g)/DV) X 100				
Rounded %DV for Label	≤10% level: express to the nearest 2% >10% to ≤ 50% level: express to nearest 5% >50% level: express to nearest 10%				Round to the nearest 1% Round down if ≤ 0.49% and up if ≥ 0.50%
Low %DV option for specific nutrients	If less than 2%, may be declared by a zero or by the use of an asterisk (or other symbol) that refers to another asterisk (or symbol) that is placed at the bottom of the table that is followed by the statement "Contains less than 2 percent of the Daily Value of this (these) nutrient (nutrients)."				If less than 1 gm, may not be included on the Nutrition Facts label, but (in such cases) the statement "Not a significant source of added sugars" is required as a footnote below the table of nutrients.

Use the Rounding Rules to revise the values for Added Sugars, Vitamin D, Calcium, Iron, and Potassium, if needed.

1. Is your recipe a good source for nutrients? If yes, which ones?

2. Are there any nutrients in your recipe that should be limited? If yes, which one(s) and give the reasons for each one.

3. Which nutrients in your recipe would you change to make it a healthier choice? Experiment with your recipe: change an ingredient and/or the amount of the ingredient in the recipe and explain how the nutrients change on the label.

STUDENT WORKSHEET

ACTIVITY 1: HOW MUCH ADDED SUGAR IS IN YOUR BEVERAGE?

Name _____ Date _____ Class/Hour _____

This activity will help you to visualize how much sugar is in a beverage.

1. Make a list of your group's top 6 favorite beverages and then respond to these questions:

a. Which beverages on your list do you think have the most added sugars?

_____

b. Which do you think have the least added sugars?

_____

2. Watch these two videos that introduce Total Sugars and Added Sugars:

Added Sugar on the Food Label www.youtube.com/watch?v=PygjyyWvqhU

Hy-Vee KidsFit at Home – Rethink Your Drink www.youtube.com/watch?v=eu9BgqCqIa8.

3. Your teacher has prepared some numbered beverage containers and bags with various amounts of sugar that represent the amount of added sugars in the various beverages. As you look at the containers and bags of sugar, match the bags of sugar you think represents the amount of added sugars in each beverage.

SUGAR IN BEVERAGES DATA TABLE

BEVERAGE	SUGAR BAG (letter)	GRAMS OF ADDED SUGARS	GRAMS OF TOTAL SUGARS	PERCENT OF TOTAL SUGARS FROM ADDED SUGARS (i.e., ADDED SUGARS/TOTAL SUGARS x 100%)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

continued on next page

STUDENT WORKSHEET

HOW MUCH ADDED SUGAR IS IN YOUR BEVERAGE? (CONTINUED)

4. Look at the Nutrition Facts labels for the beverages in this activity and record the Total Sugars and Added Sugars for each on your Worksheet.

In which beverages were the amounts of Total Sugars and Added Sugars the same?

5. Review the completed data table with your class to learn how well your group matched the beverages with the bags of sugar, and make corrections as needed.

a. List which beverages had the most Added Sugars:

b. Which findings surprised your group the most?

6. Read the **Total and Added Sugars** and **Total Carbohydrates** Fact Sheets and review the videos, *Added Sugar on the Food Label* and *Hy-Vee KidsFit at Home – Rethink Your Drink*, to answer the following questions.

a. Sugar belongs to a group of chemical compounds called carbohydrates. What are the different kinds of carbohydrates that are used by your body?

b. Why are carbohydrates important for your health?

c. The calories in sugary beverages are said to be "empty calories." What does this mean?

d. What is the difference between naturally occurring sugars and Added Sugars?

e. For a 2,000-calorie daily diet, the Daily Value for Added Sugars is 50 grams. For a person with this diet, which of the drinks in this activity would you recommend and why?

f. Why is milk called a "nutrient dense" food?

g. Why is it important to read the labels on the foods and beverages you consume?

h. What are some ways to limit your added sugars intake?

7. When all groups have completed their responses to the questions, review the answers with the class.

STUDENT WORKSHEET
ACTIVITY 2: SODIUM IN SNACK FOODS

Name _____ Date _____ Class/Hour _____

What is sodium and why do you think sodium is included in the list of nutrients on the Nutrition Facts label?

1. Watch the video, *Sodium on the Food Label* www.youtube.com/watch?v=wY11olmXrOg and read the FDA Facts Sheet **Sodium in Your Diet** and then answer the following questions:

a. According to the Fact Sheet what is sodium?

b. How does this definition compare with your group's definition?

c. How is sodium different from salt?

d. Why is sodium called an essential nutrient?

e. When you look at the Nutrition Facts label on the **Sodium in Your Diet** Fact Sheet, you see there are 430 mg (milligrams) of sodium in that food. If you could visualize 430 milligrams, what do you think it might look like?

f. One teaspoon of salt contains 2,300 mg of sodium. What is the volume for salt (measured by teaspoon) with 430 mg of sodium, and how does this compare with your previous visualization for 430 mg of sodium?

2. In the **Sodium in Your Diet** Fact Sheet, savory snacks are listed as one of the food categories that contributes about 40% of the sodium you eat. Make a list of your group's favorite snacks.

a.

b.

c.

d.

e.

f. Which snacks on your list do you think contain the most sodium? Remember, a snack does not need to taste salty to contain a lot of sodium.

3. Your **Snack Food** cards show pictures of snacks or information about the amount of sodium in a person's diet. Your teacher has shown you a set of bags of salt that represent the amount of sodium in the items on the cards. Match the picture on the card with the bag of salt that you think represents the amount of sodium in the product in the picture. When you finish matching all of the pictures with bags of salt, record the name of the item on the card in the column beside the amount of salt listed on the **Sodium in Snack Foods Data Table.**

continued on next page

STUDENT WORKSHEET

SODIUM IN SNACK FOODS (CONTINUED)

SODIUM IN SNACK FOODS DATA TABLE		
	SNACK FOOD	
MILLIGRAMS OF SODIUM	OUR ANSWER	CORRECT ANSWER
1 mg		
40 mg		
160 mg		
170 mg		
250 mg		
400 mg		
450 mg		
920 mg		
1,500 mg		
1,910 mg		
2,300 mg		
3,440 mg		

When everyone has completed their data tables, review your group's answers with the rest of the class. If you had any incorrect responses, write the correct answer in that column in the data table.

4. Complete the following questions. You can review the video, *Sodium on the Food Label* www.youtube.com/watch?v=wY11olmXrOg and the **Sodium in Your Diet** Fact Sheet.

a. What did you find surprising about the snack foods?

b. How can eating foods high in sodium affect your health?

c. How much sodium does the body need in order to function each day?

d. How much sodium should we consume daily?

e. What is the average daily intake of sodium by Americans over 2 years of age?

f. From where does most of the sodium in your diet come?

g. Name 3 foods that you eat that are high in sodium.

h. Name 3 foods that you eat that are low in sodium.

5. Watch the video, *Eating Too Much Salt? 4 Ways to Cut Back…Gradually* www.youtube.com/watch?v=OG8RCuZNbeA.

Describe 3 things you will do to reduce the amount of sodium that you eat.

6. Refer to your list of snacks. Which do you think are the most healthy and why?

A

Crunchy Cheese Snack
(1 ounce)

B

Vegetable Juice
(11.5 ounces)

C

Pretzels
(1 ounce)

D

Diet Soda
(12 ounces)

E

Medium Banana
(7 - 7.9 inches)

F

Regular Potato Chips
(1 ounce)

G

Baked Potato Chips
(1 ounce)

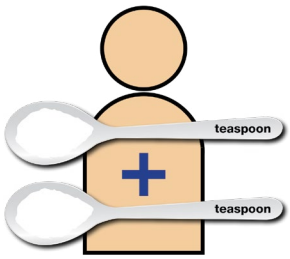
H

Sunflower Seeds
(1 ounce)

I

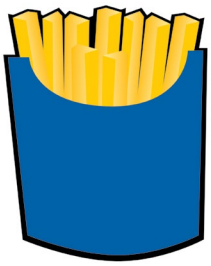
Recommended
Amount Per Day

J



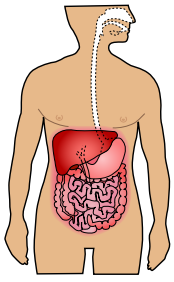
Average American
intake of Sodium

K



Large Fries
(5.3 ounces)

L



Amount of Sodium
Your Body Needs

STUDENT WORKSHEET
MEAL PLANNING – BREAKFAST

Name _____ Date _____ Class/Hour _____

1. Watch *Reading the Food Label*. www.youtube.com/watch?v=s5zroZfMn0I
2. Create a healthy breakfast that will be part of a 2,000-calorie daily plan; aim for about 500-600 calories (total) for this meal.
3. Determine your own calorie needs with the MyPlate Calculator: www.myplate.gov/myplate-plan.
4. Write the names of the foods you choose across the top row of the table below and complete the information about each food in the column below the food. Include the number of servings you plan to consume for each food, and multiply the calories and nutrients by the number of servings.

Use the Nutrition Facts label on your chosen foods to determine the amount of nutrients in each food and how each nutrient contributes to the %DV. To learn more about nutrients to get more and less of, explore the many online resources such as FDA's *Nutrition Information for Raw Fruits, Vegetables, and Seafood* www.fda.gov/food/food-labeling-nutrition/nutrition-information-raw-fruits-vegetables-and-fish.

Food Name(s)								
Servings Per Container								
Serving Size								
# of Servings Consumed								
Totals: (nutrient value x number of servings)								
Calories								
Total Fat (%DV)								
Saturated fat (%DV)								
Trans fat*								
Cholesterol (%DV)								
Sodium (%DV)								
Total Carbohydrate (%DV)								
Dietary Fiber (%DV)								
Total Sugars* (g)								
Added Sugars (%DV)								
Protein* (g)								
Vitamin D (%DV)								
Calcium (%DV)								
Iron (%DV)								
Potassium (%DV)								

*While the Nutrition Facts label does not list a %DV for *trans* fat, Total Sugars, or protein, you can record the grams of each of these three components for a food.

What is your cumulative breakfast %DV for each of the following?

Vitamin D _____
Calcium _____
Iron _____
Potassium _____

What is your cumulative breakfast %DV (or milligrams/grams) for each of the following?

Saturated fat _____
Sodium _____
Added Sugars _____

STUDENT REVIEW WORKSHEET
MEAL PLANNING

Name _____ Date _____ Class/Hour _____

1. Where on the Nutrition Facts label can you find serving size and servings per container?

2. Why are these important to know?

3. Where can you find how many calories you can get from a food?

4. Why is it important to know the amount of energy (calories) you get from a food?

5. How do you use %DV to determine which nutrients in the food are low and which are high?

6. How would you define the phrase 'nutrient-dense foods'?

7. Which of the foods in your breakfast meal was the most nutrient-dense?

8. Which was the least nutrient-dense food?

9. What values did you use to determine this?

STUDENT WORKSHEET

ACTIVITY 1: GET THE FACTS ABOUT FATS! — INTERACTIVE LABEL RESEARCH

Name _____ Date _____ Class/Hour _____

The Interactive Label website has some great information to help you make healthier choices. This activity will help you learn more about fats.

1. Open up the link below, click on the Fact Sheets tab, and read the following Fact Sheets: Monounsaturated and Polyunsaturated Fats; Saturated Fat; *Trans* Fat.
2. When you finish reading the Fact Sheets, complete the table and the questions that follow.

Use information found at this link to complete this chart: www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/

Kind of Fat	Health Benefits	Health Risks	Sources	Characteristics
Saturated				
Monounsaturated				
Polyunsaturated				
Trans				

1. Fat is called the best source of energy. Why?

2. How is the amount of energy that you get from fats different from the amount of energy that you get from proteins and carbohydrates?

3. Why are fats important for proper growth and health?

4. What are the major sources of fats in the diet?

5. To reduce the amount of saturated fat in your diet, which foods would you limit and why?

6. Create a Venn diagram to compare and contrast saturated and unsaturated fats. (Use a blank sheet of paper if needed.)

7. Explain the differences in carbon bonds in saturated fat, monounsaturated fat, and polyunsaturated fat.

8. What are typical food sources for cholesterol? What kind of fats do these same foods typically have more of?

9. At the beginning of this activity, you were asked if you thought most Americans consumed too much fat. Based on what you have learned about fats in this lesson, what is your opinion now of this statement? Explain the reasons for your opinion.

STUDENT WORKSHEET
ACTIVITY 2: GREASE SPOT TEST

Name _____ Date _____ Class/Hour _____

GREASE SPOT TEST DATA TABLE

For each sample food tested, record its name, your prediction for its fat content, and your observations.

Food Tested	Prediction	Fat Present: Yes or No	Amount of Fat Present

1. Before doing this test, what evidence was there that any of the foods contained fat?
2. Which foods did you predict would contain fat?
3. How did you ensure that all foods were tested equally?
4. Why was butter included as one of the test items?
5. Why was water included as one of the test items?
6. What does the size of the grease spot tell you about the amount of fat in the food?
7. Do the results of this test indicate what kind of fat is found in the foods? Why or why not?
8. How else could you determine which kind of fat is present in the food?
9. Compare your results with your predictions. What surprises did you find, if any?

CONTINUED ▶ ▶ ▶

STUDENT WORKSHEET

ACTIVITY 2: GREASE SPOT TEST (CONTINUED)

Name _____ Date _____ Class/Hour _____

Comparison of Food Samples Tested Using the Nutrition Facts Label

Food Sample	Serving Size (g)	Saturated Fat (g), %DV	*Trans* Fat (g)	Cholesterol (mg), %DV	Mono unsaturated Fat (g) (if shown)	Poly unsaturated Fat (g) (if shown)	Total Fat (g), (% DV)

1. Look at the Nutrition Facts label for the foods that you tested. Were there any foods that contained fat that did not test positive for fat?

2. Why do you think this happened?

3. Why is it important to know about the amount and kind of fats in food?

4. Which food tested was lowest in:
   a. Saturated fat? _____ b. Unsaturated fat? _____

5. Which food tested was highest in:
   a. Saturated fat? _____ b. Unsaturated fat? _____

6. Why is there no %DV for *trans* fat?

7. Look at the Nutrition Facts label. Under which category are saturated and *trans* fat listed? Why are they included in this category?

8. Why is it important to have controls in the grease spot test? Which factors did you control in this test?

9. What determines if a fat is solid or liquid at room temperature?

10. If a fat cannot be directly observed in a particular food, how can you determine if the food contains fat?

11. How would you define "healthy fat"?

12. Which chip dip did you choose, and why did you choose it?

STUDENT WORKSHEET

ACTIVITY 1A: EATING ON THE GO!

Name _____ Date _____ Class/Hour _____

Directions:

1. Determine the personal daily calorie needs and sodium and saturated fat limits for yourself (or someone else) by using the MyPlate Plan calculator.
2. Record the name of a favorite fast food restaurant and the components of a meal that you would like to eat or have eaten there.
3. Use the internet to research your meal and record the appropriate data on your worksheet. [Remember that online menu information will depend upon (1) whether or not the chosen establishment is covered under the menu labeling requirements, and (2) whether a customer can use the online menu to place an order. Additionally, restaurants may provide the information voluntarily.]

a. Personal Daily Calorie Needs: _____

b. Personal Daily Sodium Limit: _____

c. Personal Daily Saturated Fat Limit: _____

d. Name of Restaurant: _____

 Food Name	Total calories	Saturated Fat (g)	*Trans* fat (g)	Sodium (mg)	Total Carbohydrates (g)	Dietary Fiber (g)	Sugars (g)	Protein (g)
Total								

Things to remember for this activity

- The *Dietary Guidelines for Americans*, 2020-2025 recommends consuming less than 10% of calories per day from saturated fats.
- Each gram of protein has 4 calories; each gram of carbohydrates has 4 calories; and each gram of fat has 9 calories.

1. If you eat this meal, how many more calories should you eat for the rest of the day (based on your daily calculated calorie needs)?
2. How many of the calories in this meal are from saturated fat?
3. Considering the personal daily calorie needs you calculated, what is the limit for how many of your calories a day should come from saturated fat?
4. If you eat this meal, how much more saturated fat could you eat today and stay within the recommended limit?
5. How much of your daily sodium limit does this meal have?
6. Based on the data you researched, do you think this is a healthy meal? Justify your response.

STUDENT WORKSHEET
ACTIVITY 1B: EATING ON THE GO!
A HEALTHIER OPTION

Name _____ Date _____ Class/Hour _____

Directions: Use the same favorite restaurant from your Activity 1A worksheet to search for versions to make your meal healthier.

Name of Restaurant _____

 Food Name	Total calories	Saturated Fat (g)	*Trans* fat (g)	Sodium (mg)	Total Carbohydrates (g)	Dietary Fiber (g)	Sugars (g)	Protein (g)
Total								

Things to remember for this activity

- The *Dietary Guidelines for Americans*, 2020-2025 also recommends consuming less than 10% of total calories per day from saturated fats.
- Each gram of protein has 4 calories; each gram of carbohydrates has 4 calories; and each gram of fat has 9 calories.

1. If you eat this meal, how many more calories should you eat for the rest of the day (based on your daily calculated calorie needs)?

2. How many of the calories in this meal are from saturated fat?

3. Considering the personal daily calorie needs you calculated, what is the limit for how many of your calories a day should come from saturated fat?

4. If you eat this meal, how much more saturated fat can you eat today and stay within the recommended limit?

5. How much of your daily sodium limit does this meal have?

6. How did you use the data to determine that this meal is a healthier choice?

STUDENT REVIEW WORKSHEET
EATING ON THE GO!

Name _____ Date _____ Class/Hour _____

1. What is meant by a healthy eating pattern?

2. What information will you be able to find on most restaurant menus that will help you make healthy decisions about the food you order? Why is this information important?

3. Which restaurants are required to meet the menu labeling requirements?

4. In restaurants where the calorie information is on the menu, what additional information should the restaurant have available for the consumer?

5. When you made the choices for your healthier fast food meal, which nutrients played the most important role in making those choices?

6. List at least three tips you would use to order a healthier meal when eating out, and explain why you would use them.

7. Why is it important to know your personal daily calorie needs, and your sodium and saturated fat limits?

STUDENT WORKSHEET

ACTIVITY 2: ✔ YOUR SNACKS!

Name _____ Date _____ Class/Hour _____

Everyone likes to snack! But is your snack healthy for you? Let's find out.

Compare two of your favorite snacks with two school snacks for optimal nutrition. Use the information from the Nutrition Facts label on the packages to complete the tables. Place a ✔ if it meets the criteria as a Smart Snack and **X** if it does not.

List the criteria for a snack to be a Smart Snack:

Nutrient	Snack
Calories	
Total Fat	
Saturated Fat	
Trans Fat	
Sodium	
Sugar	

Your Snack	✔ or X		✔ or X	School Snack
	☐ ☐	Name of Snack	☐ ☐	
	☐ ☐	Serving Size	☐ ☐	
	☐ ☐	Calories	☐ ☐	
	☐ ☐	Total Fat	☐ ☐	
	☐ ☐	Saturated Fat	☐ ☐	
	☐ ☐	*Trans* Fat	☐ ☐	
	☐ ☐	Sodium	☐ ☐	
	☐ ☐	Sugar	☐ ☐	

Your Snack	✔ or X		✔ or X	School Snack
	☐ ☐	Name of Snack	☐ ☐	
	☐ ☐	Serving Size	☐ ☐	
	☐ ☐	Calories	☐ ☐	
	☐ ☐	Total Fat	☐ ☐	
	☐ ☐	Saturated Fat	☐ ☐	
	☐ ☐	*Trans* Fat	☐ ☐	
	☐ ☐	Sodium	☐ ☐	
	☐ ☐	Sugar	☐ ☐	

1. Did your snack meet the criteria for a Smart Snack? _____
2. How do you know? _____
3. How will this make you rethink your snack choices? _____
4. Explain how likely you are to choose a Smart Snack instead of another snack in a grocery store.

_____

STUDENT REVIEW WORKSHEET
✔ YOUR SNACKS

Name _____ Date _____ Class/Hour _____

1. What nutrient information must be shown on snacks sold in some vending machines? How would this information influence the snack you purchase from this vending machine?

2. What is a **Smart Snack**? How is this snack different from ones not sold in schools?

3. Do you think that snacks sold in schools should be healthier than those sold in the supermarket? Please provide your reasons.

4. An "anytime" snack has been defined as a snack that is nutrient dense. Which of the snacks you reviewed for this activity would belong to this group? What information did you use to put the snack(s) in this group?

5. A "sometimes" snack has been defined as a snack high in empty calories, saturated fats, added sugars, or sodium and are foods that should be limited. Which of the snacks you reviewed for this activity would belong to this group? What information did you use to put the snack(s) in this group?

STUDENT WORKSHEET

MAKING A NEW APPLE CULTIVAR

PART A: *APPLE - HOW DOES IT GROW?*

WWW.YOUTUBE.COM/WATCH?V=UWLMEH1HIBW

Name _____ Date _____ Class/Hour _____

1. What is meant by the statement "Each apple seed is genetically unique?"

2. Explain how grafting is used to propagate new apple trees.

3. Explain the importance of pollinators in the production of the apple crop.

4. Describe some methods that apple growers use to control pests?

5. If apples are only harvested in the late summer and fall, how are they available to consumers all year round?

6. How does the United States compare to other countries in the amount of apples produced?

STUDENT WORKSHEET
MAKING A NEW APPLE CULTIVAR
PART B: APPLE BREEDING

Name _____ Date _____ Class/Hour _____

You will carry out a simulated, apple breeding activity, similar to the process of crossbreeding, to create your own new apple cultivar. You will do this simulation by choosing the two "parents" from the apple variety cards provided and simulate the crossbreeding of those parents by flipping a coin. The purpose of this activity is to replicate how long it takes to produce new apple cultivars.

1. Review the Apple Cultivar Cards.
2. Choose the parent apple cultivars – "mother" and "father" – that have the traits (color, size, shape, flavor, and resistance) that you want for your new apple cultivar. You will crossbreed these parents to produce your new apple cultivar. Write the names of your two parent cultivars on the lines below. Your mother cultivar will be represented by heads on your coin; your father cultivar will be represented by tails. At least one of your parents must have the trait you want to have in your new apple cultivar.

   Mother apple cultivar – heads _____

   Father apple cultivar – tails _____

3. List the five traits, including one resistance trait, you want for your new apple cultivar.

Desired traits of your new apple cultivar	
Fruit color	
Fruit size	
Fruit shape	
Flavor	
Choose 1 resistance trait and cross-out the others	
Browning	
Scab	
Mildew	
Fire blight	
Cedar Apple Rust	

4. You will flip a coin to determine if the trait is inherited from the mother apple or the father apple. If the coin is heads, the apple inherits the trait from the mother; if the coin is tails, the apple inherits the trait from the father (this is a very simplified model for inheritance). Count the number of flips for **each** trait until you get the desired trait. Record that data in the table below. Complete the selection of each trait before you start the next one.

New Apple Cultivar Trait	Mother	Father	Number of flips to get desired trait
Fruit color:			
Fruit size:			
Fruit shape:			
Flavor:			
Resistance to:			
Total number of coin flips to get all of the desired traits			

Report:

1. How many times (coin flips) did it take for you to get all the traits you want in your apple? _____
2. If it takes up to 5 years for a tree to mature enough to produce an apple, how many years would this process have taken you to produce your new cultivar? (Multiply the number of times (flips) it took you to replicate the variety, times 5 years.) _____
3. You can now patent and name your new apple. What will you call it? _____
4. Why did you pick the name? _____

5. Draw a picture of your new apple cultivar below:

Red Delicious Apple

Fruit color ..... Bright red speckled with white spots
Fruit size ..... Medium
Fruit shape ..... Heart-shaped
Flavor ..... Mildly sweet
Crispness ..... Light crispness
Juiciness ..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Susceptible
Mildew ..... Moderately resistant
Fire blight ..... Resistant
Cedar Apple Rust ..... Very resistant

Gala Apple

Fruit color ..... Pink/orange stripes with yellow undertones
Fruit size ..... Medium to large
Fruit shape ..... Short-round-conical
Flavor ..... Very sweet and mild
Crispness ..... Not very crisp, but firm
Juiciness ..... Juicy
Resistant to browning .... Yes

Resistance to disease

Scab ..... Very susceptible
Mildew ..... Some susceptibility
Fire blight ..... Some susceptibility
Cedar Apple Rust ..... Some susceptibility

Granny Smith Apple

Fruit color ..... Bright green may be speckled with white spots
Fruit size ..... Medium to large
Fruit shape ..... Round
Flavor ..... Very tart
Crispness ..... Crispy
Juiciness ..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Susceptible
Mildew ..... Very susceptible
Fire blight ..... Very susceptible
Cedar Apple Rust ..... Resistant

Jonathan Apple

Fruit color ..... Red/yellow stripes, blushed with yellow to green undertones
Fruit size ..... Medium to large
Fruit shape ..... Short-round-conical
Flavor ..... Sweet and tart
Crispness ..... Crispy
Juiciness ..... Very juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Susceptible
Mildew ..... Very susceptible
Fire blight ..... Very susceptible
Cedar Apple Rust ..... Susceptible

Opal Apple

Fruit color ..... Bright lemon yellow
Fruit size ..... Medium to large
Fruit shape ..... Round
Flavor ..... Sweet and tangy
Crispness ..... Crisp
Juiciness ..... Juicy
Resistant to browning .... Yes

Resistance to disease

Scab ..... Some resistance
Mildew ..... Some resistance
Fire blight ..... N/A
Cedar Apple Rust ..... N/A

Baldwin Apple

Fruit color ..... Bright red green with red stripes, may be speckled with small dots
Fruit size ..... Large to extra large
Fruit shape ..... Flat and round
Flavor ..... Sweet and tart
Crispness ..... Not very crisp, but firm
Juiciness ..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Susceptible
Mildew ..... Very susceptible
Fire blight ..... Susceptible
Cedar Apple Rust ..... Very resistant

Macintosh Apple*

Fruit color ..... Dark red and green and speckled with white dots
Fruit size ..... Small to medium
Fruit shape..... Flat and round
Flavor..... Sweet and tart
Crispness ..... Crisp
Juiciness..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Very susceptible
Mildew ..... Moderately resistant
Fire blight ..... Susceptible
Cedar Apple Rust..... Very resistant

**also called McIntosh*

Enterprise Apple

Fruit color ..... Red speckled with white dots
Fruit size ..... Medium to large
Fruit shape..... Flat and round
Crispness ..... Not very crisp
Flavor..... Very tart
Juiciness..... Very juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Very resistant
Mildew ..... Susceptible
Fire blight ..... Resistant
Cedar Apple Rust..... Resistant

Golden Delicious Apple

Fruit color ..... Yellow gold and speckled with small spots
Fruit size ..... Small to medium
Fruit shape..... Oblong or conical
Flavor..... Sweet and tart with a taste of honey
Crispness ..... Crispy
Juiciness..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Susceptible
Mildew ..... Very susceptible
Fire blight ..... Susceptible
Cedar Apple Rust..... Susceptible

Honeycrisp Apple

Fruit color ..... Light green/yellow background covered with red orange flush and speckled with dark spots
Fruit size ..... Medium to large
Fruit shape..... Short-round-conical
Crispness ..... Very crisp
Flavor..... Medium sweet
Juiciness..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Moderately resistant
Mildew ..... Susceptible
Fire blight ..... Resistant
Cedar Apple Rust..... Susceptible

Keepsake Apple

Fruit color ..... Mostly red with orange or green blush
Fruit size ..... Small
Fruit shape..... Irregular shaped-short-round
Flavor..... Sweet and spicy
Crispness ..... Very crisp
Juiciness..... Juicy
Resistant to browning .... No

Resistance to disease

Scab ..... Very susceptible
Mildew ..... Very susceptible
Fire blight ..... Moderately resistant
Cedar Apple Rust..... Moderately resistant

Cosmic Crisp® Apple

Fruit color ..... Red speckled with small yellow star shaped dots
Fruit size ..... Medium to large
Fruit shape..... Round
Crispness ..... Very crisp
Flavor..... Sweet and tart
Juiciness..... Very juicy
Resistant to browning .... Yes

Resistance to disease

Scab ..... Not available
Mildew ..... Moderately susceptible
Fire blight ..... Moderately susceptible
Cedar Apple Rust..... Not available

APPLE VARIETY CARDS

STUDENT WORKSHEET

STRAWBERRY DNA EXTRACTION

STRAWBERRY DNA EXTRACTION LAB EXPLANATION - WWW.YOUTUBE.COM/WATCH?V=VNJWNIJKTZK

Name _____ Date _____ Class/Hour _____

1. What is DNA?

2. Where in the cell is the DNA found?

3. What does the word *extraction* mean?

4. How do you think you could extract the DNA from cells?

5. Does your food contain DNA, and if so, where would that DNA be found?

6. Each step in the extraction process aids in isolating DNA from the other cellular materials. Explain why each step was necessary and put the DNA extraction procedure into context by answering the following questions:

Why did you have to mash the strawberries?

What was the purpose of the salt in the DNA extracting solution?

What was the purpose of the liquid detergent in the DNA extracting solution?

Explain what happened when you added the alcohol to the strawberry extract.

What did the extracted DNA look like?

7. Why is it useful for scientists to be able to extract DNA from fruits and vegetables? List at least two reasons.

8. If you could extract the DNA from any fruit or vegetable, which one would you choose and why would you want to study its DNA?

STUDENT WORKSHEET

GENETIC ENGINEERING

Name _____ Date _____ Class/Hour _____

After you have matched the Crop Problem and Possible Solution cards, complete the chart below by writing a brief description of each problem and solution in your own words.

Crop Problems and Possible GE Solutions

Crop	Problem	Possible Solution
Alfalfa		
Alfalfa		
Apple		
Canola		
Field Corn		
Field Corn		
Field Corn		
Cotton		
Papaya		
Potato		
Potato		
Potato		
Potato		
Potato		
Rice		
Soybean		
Soybean		
Sugar Beet		
Summer Squash		

Alfalfa Problem 1

Alfalfa is a very nutritious, perennial legume that contains high concentrations of several vitamins needed by dairy cattle. Weed infestations in alfalfa fields cause many problems for farmers: reduced crop yield, reduced crop quality, and more severe insect infestations. Alfalfa farmers use crop rotation, herbicides, and other practices to try to control weed infestation.

Possible Solution

Removing weeds by physical methods such as tilling can be time-consuming and expensive, so farmers often spray herbicides to destroy weeds. However, a farmer can only spray herbicides on a crop if it is tolerant to the herbicide. Scientists have genetically engineered crop plants to be tolerant to certain herbicides. Use of herbicide-tolerant crops could help prevent environmental damage because they require less tilling. Farmers use less fuel because fewer passes are made through the field to till. Less tilling can lead to reduced soil erosion.

Alfalfa Problem 2

Alfalfa is a very nutritious, perennial legume that provides food for dairy cattle. Alfalfa plant stems contain lignin, which is important because it provides strength for upright growth. The amount of lignin in the stems increases as the plants mature (grow). Since lignin is mostly indigestible by cows, this means that the quality of the alfalfa as a food decreases the longer the farmer waits to harvest it. The farmers have limited time during the growing season to harvest the alfalfa.

Possible Solution

Scientists have identified several genes that control the ability of the plant to produce certain lignin building blocks. Genetic engineering has been used to suppress these genes, which causes a slower rate of lignin production in the plant but does not affect the strength of the plant's stem. The reduced-lignin plant gives the farmer greater flexibility to decide when to harvest his crop to achieve high yields and good food quality. This results in better food efficiency and less manure production.

Apple Problem

Apples are a very important crop in the United States, the second largest producer of apples in the world. Biting and/or slicing into an apple damages the apple cells, and this causes a chemical reaction that turns the apple brown. The brown color is unappetizing to consumers who often throw the apples away rather than eating them. This results in wasted food.

Possible Solution

Researchers have discovered that by inserting extra pieces of several genes into a plant, they can turn off expression of the enzymes that make them turn brown and prevent browning.

Canola Problem

The canola plant is cultivated for its seeds. The seeds are processed into high quality, edible oil that is used in many foods, and into high protein meal, which is desirable food for livestock, poultry and fish.

Weeds that grow among the canola plants compete for space, nutrients, and sunlight and ultimately can lead to significant crop yield losses and contaminate bulk seed at harvest. Weed control through herbicide application during the growing season improves the quantity and quality of the grain produced.

Possible Solution

Removing weeds by physical methods such as tilling can be time-consuming and expensive, so farmers often spray herbicides to destroy weeds. However, a farmer can only spray herbicides on his or her crop if it is tolerant to the herbicide. Scientists have genetically engineered crop plants to be tolerant to certain herbicides. Use of herbicide-tolerant crops could help prevent environmental damage because they require less tilling. Farmers use less fuel because fewer passes are made through the field to till. Less tilling can lead to reduced soil erosion.

Field Corn Problem 1

Corn is the premium food for cows, pigs, and chickens. Field corn is also used in the production of ethanol, an additive in gasoline, and a small portion is processed for use as corn cereal, corn starch, corn oil, and corn syrup for human consumption.

The corn borer, a moth that lays eggs on corn plants, is a serious pest. When the eggs hatch, the larva that looks like a small worm eats the corn plants and can cause millions of dollars of damage to the corn field.

Possible Solution

To make plants resistant to damage by insect pests, scientists have taken genes from the bacteria *Bacillus thuringiensis* (Bt) and inserted these into the plant. The genes make proteins that are toxic to the insect pests that eat the plants. Bt toxins are desirable pest control agents because they are non-toxic to humans, animals, or most other insects, but are highly effective against specific groups of pest insects. When ingested, Bt toxins act as gut poisons for the pest, causing susceptible insects to stop feeding and eventually die.

Field Corn Problem 2

Corn is the premium food for cows, pigs, and chickens. Field corn is also used in the production of ethanol, an additive in gasoline, and a small portion is processed for use as corn cereal, corn starch, corn oil, and corn syrup for human consumption.

Weed control is one of corn farmer's greatest challenges, because poorly controlled weeds drastically reduce crop yield and quality. Herbicides help increase yield, so they are an important part of commercial food production.

Possible Solution

Removing weeds by physical methods such as tilling can be time-consuming and expensive, so farmers often spray herbicides to destroy weeds. However, a farmer can only spray herbicides on a crop if it is tolerant to the herbicide. Scientists have genetically engineered crop plants to be tolerant to certain herbicides. Use of herbicide-tolerant crops could help prevent environmental damage because they require less tilling. Farmers use less fuel because fewer passes are made through the field to till. Less tilling can lead to reduced soil erosion.

Field Corn Problem 3

Corn is the premium food for cows, pigs, and chickens. Field corn is also used in the production of ethanol, an additive in gasoline, and a small portion is processed for use as corn cereal, corn starch, corn oil, and corn syrup for human consumption.

In some corn-growing regions of the United States, farmers can experience water shortages, sometimes caused by drought. Climate models suggest that drought will become more frequent in North America if the planet continues to heat up. Water will become increasingly precious. Plants under drought stress grow slower and may not survive. Droughts can lead to significant crop yield losses for farmers.

Possible Solution

Scientists have developed a plant variety that carries a gene from the soil bacterium *Bacillus subtilis.* This gene makes a protein that helps reduce the damaging effects of drought by enabling the plant to preserve normal growth functions even when water is limited.

Cotton Problem

Cotton is one of the most important crops grown in the United States. The major use of the cotton fiber is in the textile industry. The oil from the seeds is used in cooking and in making soaps. The seeds may also be used as food for livestock.

The cotton bollworm is an insect larva that feeds on parts of the cotton plant. Major harvest damage from bollworm infestations results in huge losses to farmers as well as industry, and leads to waste of precious resources like soil, water, and labor.

Possible Solution

To make plants resistant to damage by insect pests, scientists have taken genes from the bacteria *Bacillus thuringiensis* (Bt) and inserted these into the plant. The genes make proteins that are toxic to the insect pests that eat the plants. Bt toxins are desirable pest control agents because they are non-toxic to humans, animals, or most other insects, but are highly effective against specific groups of pest insects. When ingested, Bt toxins act as gut poisons for the pest, causing susceptible insects to stop feeding and eventually die.

Papaya Problem

The papaya is a tropical fruit with a pear shape, sweet taste, and soft texture.

One of the problems with growing papaya is susceptibility to a disease called the papaya ring spot virus. This virus deforms the fruit of young plants and can also prevent the plant from producing fruit. The virus is spread by insects and cannot be contained. Papaya production in Hawaii was cut in half because of this virus.

Possible Solution

Scientists have transferred a virus gene into plants. This acts like a vaccine that makes the plant resistant to that specific virus.

Potato Problem 1

The potato is the leading vegetable crop in the United States. Potatoes are sold fresh and as processed products such as French fries and chips. Raw by-products of potato processing, as well as some potato protein, are used as food for farm animals.

Potatoes can be bruised by impact during harvesting and storage, which results in black spots in the potato. Consumers will not purchase discolored potatoes and those are thrown away. This results in food waste.

Possible Solution

Researchers have discovered that by inserting a piece of a certain wild plant gene, they can turn off the expression of the enzyme in a plant involved in bruising. This prevents discoloration from bruising.

Potato Problem 2

The potato is the leading vegetable crop in the United States. Potatoes are sold fresh and as processed products such as French fries and chips. Raw by-products of potato processing, as well as some potato protein, are used as food for farm animals.

During storage, the starch in the potato can turn into sugar and can negatively affect the color and taste of fried potato products. If sugar formation during storage could be prevented, the French fries and chips made from the stored potato would have a more consistent golden color and a better taste and texture.

Possible Solution

Researchers have discovered that by inserting pieces of certain genes from a plant, they can turn off expression of the enzymes that change starch into sugars. This prevents production of the sugars responsible for undesirable color and taste.

Potato Problem 3

The potato is the leading vegetable crop in the United States. Potatoes are sold fresh and as processed products such as French fries and chips. Raw by-products of potato processing, as well as some potato protein, are used as food for farm animals.

Asparagine is a chemical found in potatoes that causes the potato, when cooked at high temperatures, to produce another chemical called acrylamide. Reducing acrylamide levels in foods may mitigate potential human health risks from exposure to acrylamide. If the amount of asparagine in the potato is reduced, then the amount of acrylamide produced can be reduced.

Possible Solution

Researchers have discovered that by inserting a piece of a certain plant gene, they can turn off expression of the enzyme in plants that makes asparagine and prevent asparagine production.

Potato Problem 4

The potato is the leading vegetable crop in the United States. Potatoes are sold fresh and as processed products such as French fries and chips. Raw by-products of potato processing, as well as some potato protein, are used as food for farm animals.

Late blight, also called potato blight, is the disease that caused the Irish potato famine in the 1840's. This disease rotted the entire potato crop and led to the death of about a million people in Ireland. Late blight disease is still a major problem for potato farmers, especially in regions that receive a great deal of rainfall. Fungicides have been used for decades to prevent the blight disease, which is caused by a fungus-like organism.

Possible Solution

Scientists have developed crops that are resistant to certain fungal diseases by inserting a gene from a wild relative that is resistant to the disease. This acts like a vaccine that makes the crop plant resistant to that specific disease. This new genetically engineered crop is more resistant to the damage caused by the fungus-like organism, so the farmer doesn't need to apply as much fungicide to keep the plants healthy.

Potato Problem 5

The potato is the leading vegetable crop in the United States. Potatoes are sold fresh and as processed products such as French fries and chips. Raw by-products of potato processing, as well as some potato protein, are used as food for farm animals.

Colorado potato beetle larvae are slug-like animals with a soft shell. Larvae eat foliage as they grow; this is the most destructive stage, but the adult beetle can also eat the plant foliage and destroy the potato plant. Methods used to try to control this insect include: crop rotation, beneficial insects, systemic insecticides, foliar insecticides, and Bt products.

Possible Solution

To make plants resistant to damage by insect pests, scientists have taken genes from the bacteria *Bacillus thuringiensis* (Bt) and inserted these into the plant. The genes make proteins that are toxic to the insect pests that eat the plants. Bt toxins are desirable pest control agents because they are non-toxic to humans, animals, or most other insects, but are highly effective against specific groups of pest insects. When ingested, Bt toxins act as gut poisons for the pest, causing susceptible insects to stop feeding and eventually die.

Rice Problem

Rice is grown in more than 100 countries around the world. It is consumed as a staple food in several south and southeast Asian countries where many people suffer from a lack of vitamin A in their diets. Vitamin A deficiency is the leading cause of preventable blindness in children and long-term vitamin A deficiency increases the risk of infections and death. Although the carbohydrates in rice make it a good source of energy, rice has very little vitamin A. Since the populations that are vitamin A deficient are the same ones that use rice as a staple food, improving the nutritional quality of rice could improve their health.

Possible Solution

Scientists inserted two genes – one from a plant and one from bacteria – into a plant to enable it to produce beta-carotene in the crop grains. The grain is 'golden' in color and can be eaten as a source of dietary beta-carotene. The human body can convert the beta-carotene we eat into vitamin A. This grain with beta-carotene has the potential to improve the health of populations that do not currently get enough vitamin A or beta-carotene in their diet.

Soybean Problem 1

Soybeans are protein-rich, edible legumes that are used mainly as livestock food, but they are also used to produce many food ingredients such as tofu, soy beverages, soybean oil, and soy lecithin, which is used in chocolate and ice cream for a smoother texture. Weed growth alongside the crop is a recurring problem for farmers, who use a lot of time and materials to control the weeds.

Possible Solution

Removing weeds by physical methods such as tilling can be time-consuming and expensive, so farmers often spray herbicides to destroy weeds. However, a farmer can only spray herbicides on a crop if it is tolerant to the herbicide. Scientists have genetically engineered crop plants to be tolerant to certain herbicides. Use of herbicide-tolerant crops could help prevent environmental damage because the crops require less tilling. Farmers use less fuel because fewer passes are made through the field to till. Less tilling can lead to reduced soil erosion.

Soybean Problem 2

Soybeans are protein-rich, edible legumes that are used mainly as livestock food, but they are also used to produce many food ingredients such as soybean oil. Soybean oil contains a type of fat – polyunsaturated fat – which makes the oil less stable, resulting in a disagreeable taste and a shorter shelf-life. To increase soybean oil stability, manufacturers use a process called hydrogenation to decrease the levels of the unstable fats. Partial hydrogenation of soybean oil makes the oil more stable when used in food, but the process also produces *trans* fat. *Trans* fat has been linked to heart disease.

Possible Solution

Scientists can use genome editing to remove, or delete, genes in the plant that are involved in the production of the polyunsaturated fat. Instead of making polyunsaturated fat, these plants accumulate more of a monounsaturated fat called oleic acid. Oils with a higher level of oleic acid are more stable, require less processing, and may be useful as an alternative for unhealthy *trans* fat-containing oils in processed food.

Sugar Beet Problem

The sugar beet is a plant that is grown for its sugar content. Part of the plant is also used for animal food.

Sugar beets are labor-intensive to grow and require constant care. Sugar beet farmers consider weeds to be their major problem, and they spend a lot of time, effort, and resources trying to control the weeds. Because sugar beets grow over two seasons, there are many different weeds that affect the crop, so farmers must plan carefully, deciding which weeds to treat and when.

Possible Solution

Removing weeds by physical methods such as tilling can be time-consuming and expensive, so farmers often spray herbicides to destroy weeds. However, a farmer can only spray herbicides on a crop if it is tolerant to the herbicide. Scientists have genetically engineered crop plants to be tolerant to certain herbicides. Use of herbicide-tolerant crops could help prevent environmental damage because the crops require less tilling. Farmers use less fuel because fewer passes are made through the field to till. Less tilling can lead to reduced soil erosion.

Summer Squash Problem

Summer squash is a very common vegetable that is subject to infection from four different viruses. Infections result in stunted, discolored plants and some plants may have spots and an irregular shape. While these vegetables are safe to eat, their appearance deters consumers from purchasing them. The viruses routinely reduce crop yields by 20–80%, depending on the production season and growing region. Farmers use large amounts of insecticides to control the spread of the viruses because insects carry the viruses from plant to plant.

Possible Solution

Scientists have transferred virus genes into plants. This acts like a vaccine that makes the plant resistant to that specific virus. If the plants are resistant to viral infection, the plants will be healthier and the farmer might use less insecticide to control the insects that spread the virus.

STUDENT WORKSHEET

ACTIVITY 1: AGRICULTURAL PESTS

Name | Date | Class/Hour

Write your working definition for agricultural pests here:

DATA TABLE		
Name and Kind of Organism	**Pest or Beneficial**	**Action**

List the pests that affect the plants shown in the video, *The Amazing Way Plants Defend Themselves*
https://ed.ted.com/lessons/the-amazing-ways-plants-defend-themselves-valentin-hammoudi

List the pests that affect agricultural crops shown in the video, *Do We Really Need Pesticides*?
https://ed.ted.com/lessons/do-we-really-need-pesticides-fernan-perez-galvez#review

Final working definition for agricultural pests:

STUDENT WORKSHEET

ACTIVITY 2: PEST MANAGEMENT RESEARCH PROJECT

Group Members _____ Pest _____

Use the tables below to collect data for your poster.

PEST		
Description of Pest	**Native/Non-Native (Where it came from and how it got here)**	**Life Cycle Most Dangerous to Crop**
Crop(s) Affected	**Damage to Crop**	**Number of Individual Pests Present to Significantly Harm Crop**

PEST MANAGEMENT OPTIONS			
Management Method	**Environmental Impact**	**Effectiveness**	**Data Source(s)**

continued on next page

STUDENT WORKSHEET

ACTIVITY 2: PEST MANAGEMENT RESEARCH PROJECT (CONTINUED)

Best possible management solution(s).

Note any data you find about the environmental impact of the best management solution(s), using **+** for positive impact, **—** for negative impact and **0** for no impact.

Air Quality		Pollinators		Human Health	
Biodiversity		Wildlife		Surface Water	
Groundwater		Soil Fauna		Irrigation	
CO_2 Emissions		Estuaries		Fossil Fuels	
Waste		Methane Emissions		Desertification	
Sustainability		Government Policy		Flora	

STUDENT WORKSHEET

ACTIVITY 3: CITRUS GREENING DISEASE

Name _____ Date _____ Class/Hour _____

Answer the following questions as you watch these two videos:
Bitter Fruit - Citrus Greening Disease Threatens Florida Industry www.youtube.com/watch?v=T5nqVmliUaM and *Citrus Greening Disease* www.youtube.com/watch?v=G_1sobDdtiM.

1. What is citrus greening disease and what are its symptoms?
2. What is the name of the bacterium that causes the disease?
3. How does the disease spread in a citrus grove?
4. How widespread is this disease in the United States?
5. Which groups of people are impacted by citrus greening disease?
6. What is the research objective of the scientists' work in the video?
7. What is the hypothesis for their research?
8. What happens to the bacterium in the body of a psyllid that enables it to be transmitted from one citrus tree to another?
9. List the 4 steps in the Detached Leaf Transmission Assay.
10. How do the scientists detect the bacteria in the infected leaves and why do they use this method?
11. What did the scientists learn through their research?
12. What do the scientists hope to eventually be able to do with their information?
13. Why do you think this research is important?
14. If you could use Genetic Engineering to create a way to control HLB, what would you design, and which pest control method would it use?

CITRUS GREENING MANAGEMENT PROGRAMS DATA TABLE

Manage-ment Program	Management Description	Effectiveness of Treatment	Environmental Impact	Part of Tree Treated	Where Used and Frequency

STUDENT WORKSHEET

MALNUTRITION REPORT

Name _____ Date _____ Class/Hour _____

Refer to the Hunger Map and review which countries have the highest percentages of malnourishment (over 35% of the population). Select one of these countries to research and answer the following questions. Be sure to refer to the Credible Source Guide as you do your research. 2019 - Hunger Map (World Food Programme) **https://docs.wfp.org/api/documents/WFP-0000108355/download/?_ga=2.160307259.785805201.1573072332-1794787673.1573072332** (updated annually)

1. How do you know that the Hunger Map **(provided)** is a credible source?

2. Which countries exhibit undernourishment for greater than 35% of their population?

3. Choose one of those countries for your report on malnutrition. Which country did you choose? Why?

4. Sketch the shape of the country you chose and identify on which continent this country is located.

5. Describe the country's climate.

6. Complete the chart below using the **Credible Source Guide**.

Question	Answer(s) From Your Research	Citation: Title/Website Address
a. Identify one nutrient that this country struggles to provide its population.		
b. What percentage of the population suffers from malnourishment?		
c. What crops are grown in this country?		
d. Which foods are considered the staples in this country (rice, beans, cassava)?		
e. What are the reported causes of malnourishment in this country (environmental, economic, etc.)?		

continued on next page

STUDENT WORKSHEET

MALNUTRITION REPORT (CONTINUED)

Based on what you learned about the causes and effects of malnutrition in this country, what do you think can be done to help improve health here? In the chart below, identify three crops that could be nutritionally enhanced (by selective breeding or genetic engineering), grown, marketed, and distributed to the inhabitants of this country. *Confirm that the crop can grow in this country's climate and conditions.*

Nutrient-enhanced crop that could be grown in this country	Website Address/Citation

A challenge that farmers and scientists encounter after creating a nutrient-enhanced crop is whether other farmers will grow the food and people will incorporate it into their diet. Outline your plan to get one of the crops from your list into the country's cultivation system for widespread consumption. Create a five-step plan and explain each step.

Step	What you will do?	Why you will do it?
1		
2		
3		
4		
5		

STUDENT WORKSHEET

ARE THERE INGREDIENTS FROM GE PLANTS IN MY FOOD?

Name _____ Date _____ Class/Hour _____

Look at each **Food Label** card (pages 45-46) and think about the ingredients in that item. If there isn't a label, research the food or beverage to find out what ingredients it might contain. After you have determined which group the food belongs to (GE/possible GE or Non-GE), put a check mark in that box below and list the reason(s) for that choice.

Food Card item	Marketing label, e.g., organic	Food or ingredients that may come from GE crops	GE or Possibly GE	Food or ingredients with no corresponding GE counterpart	Non-GE
Arctic Apple			☐		☐
Cinnamon Crunch Cereal			☐		☐
Clementines			☐		☐
Coffee			☐		☐
Cosmic Crisp Apple			☐		☐
Cottage Cheese			☐		☐
Cream Filled Cookies			☐		☐
Cut Green Beans			☐		☐
Graham Crackers			☐		☐
Granola Bars			☐		☐
Honey Nut Oat Cereal			☐		☐
Margarine			☐		☐
Orange Juice			☐		☐
Pita Bread			☐		☐
Rainbow Papaya			☐		☐
Seedless Watermelon			☐		☐
Sour Cream			☐		☐
Table Salt			☐		☐
Tea			☐		☐
Wheat Bread			☐		☐

HONEY NUT OAT CEREAL

INGREDIENTS:

(Whole Grain Oats, Sugar, Oat Bran, Modified Corn Starch, Honey, Brown Sugar Syrup, Salt, Ground Almonds, Calcium Carbonate, Trisodium Phosphate, Wheat Flour, Vitamin E, Zinc, Iron, Vitamin C, Niacinamide, Vitamin B6, Vitamin B2, Vitamin B1, Vitamin A Palmitate, Folic Acid, Vitamin B12, Vitamin D)

CREAM FILLED COOKIES

INGREDIENTS:

Sugar, Unbleached Enriched Flour (Wheat Flour, Niacin, Reduced Iron, Thiamine Mononitrate {Vitamin B1}, Riboflavin {Vitamin B2}, Folic Acid), Palm, And/Or Canola Oil, High Fructose Corn Syrup, Cornstarch, Salt, Baking Soda, Soy Lecithin, Naturally And Artificial Flavor

COSMIC CRISP APPLE

ARCTIC APPLE

SEEDLESS WATERMELON

RAINBOW PAPAYA

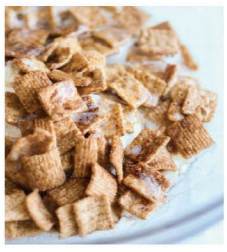
GRANOLA BARS

INGREDIENTS:

Rolled Oats, Brown Sugar, Rice Flour, Rolled Wheat, Soybean Oil, Whole Wheat Flour, Soy Protein, Dried Coconut

CLEMENTINES

CINNAMON CRUNCH CEREAL



INGREDIENTS:

Whole Grain Wheat, Sugar, Rice Flour, Canola Oil, Fructose, Maltodextrin, Dextrose, Salt, Cinnamon, Trisodium Phosphate, Soy Lecithin, Caramel Color. BHT Added to Preserve Freshness.

GRAHAM CRACKERS

INGREDIENTS:

Unbleached Enriched Flour (Wheat Flour, Niacin, Reduced Iron, Thiamine Mononitrate {Vitamin B1}, Riboflavin {Vitamin B2}, Folic Acid), Graham Flour (Whole Grain Wheat Flour), Sugar, Soybean and/or Canola Oil, Honey, Leavening (Baking Soda and/or Calcium Phosphate), Salt, Soy Lecithin, Artificial Flavor.

TABLE SALT

INGREDIENTS:
Salt, Calcium Silicate (an anticaking agent), Dextrose, Potassium Iodine

CUT GREEN BEANS

INGREDIENTS:
Organic Green Beans, Water, Sea Salt

PITA BREAD

INGREDIENTS:
Unbleached Enriched Flour (Wheat Flour Niacin Iron Thiamin Mono-Nitrate Riboflavin Folic Acid) Water Yeast Salt Dough Conditioners (Wheat Flour Mono-Diglycerides Calcium Sulfate Corn Starch Guar Gum Calcium Carbonate Soy Oil Salt Ascorbic Acid Ada Ammonium Sulfate Enzymes Sodium Meta Bisulfate Potassium Iodate) Preservatives Less Than 1% Calcium Propionate Potassium Sorbate.

WHEAT BREAD

INGREDIENTS:
Whole Wheat Flour, Water, Sugar, Wheat Gluten, Raisin Juice Concentrate, Wheat, Bran, Yeast, Molasses, Soybean Oil, Salt, Preservatives (Calcium Propionate, Sorbic Acid), Monoglycerides, DATEM, Calcium Sulfate, Grain Vinegar, Soy Lecithin, Soy, Whey (Milk)

COFFEE

INGREDIENTS:
Ground Coffee Beans

MARGARINE

INGREDIENTS:
Oil Blend (Canola, Palm, Fish, Flaxseed, And Olive Oils), Water, Contains Less Than 2% Of, Salt, Pea Protein, Natural And Artificial Flavors, Sunflower Lecithin, Vitamin A Palmitate, Beta-Carotene (Color), Vitamin D, Monoglycerides Of Vegetable Fatty Acids (Emulsifier); And Potassium Sorbate, Lactic Acid, TBHQ, Calcium Disodium EDTA (To Protect Freshness).

ORANGE JUICE

INGREDIENTS:
Water, Concentrated Orange Juice

COTTAGE CHEESE

INGREDIENTS:
Organic Cultured Pasteurized Skim Milk, Organic Pasteurized Cream, Organic Nonfat Milk, Salt, Citric Acid, Organic Guar Gum, Organic Locust Bean Gum, Acidophilus and Bifidus Cultures.

SOUR CREAM

INGREDIENTS:
Cultured Pasteurized Cream and Fat Free Milk, Enzymes

TEA

INGREDIENTS:
Green Tea

POSTER/INFOGRAPHIC RUBRIC

CATEGORIES	4	3	2	1
Required Elements	All required elements and additional information are included.	All required elements are included.	All but 1 of the required elements are included.	Several required elements were missing.
Labels	All items of importance are clearly labeled.	Almost all items of importance are clearly labeled.	Many items of importance are clearly labeled.	Labels are too small to view or no important items were labeled.
Graphics - Relevance	All graphics are related to the topic and make it easier to understand.	All graphics are related to the topic and most make it easier to understand.	All graphics relate to the topic.	Graphics do not relate to the topic.
Attractiveness	The presentation is exceptionally attractive in terms of design, layout, and neatness.	The presentation is attractive in terms of design, layout, and neatness.	The presentation is attractive but it may be a bit messy.	The presentation is poorly designed and not attractive.
Grammar	There are no grammatical/mechanical mistakes.	There are 1-2 grammatical/mechanical mistakes.	There are 3-4 grammatical/mechanical mistakes.	There are more than 4 grammatical/mechanical mistakes.

CREDIBLE SOURCE GUIDE

The internet is such an extensive source of information that it can be challenging to find credible information. A credible source is one that is balanced and is written with factual evidence. Credible sources can vary with the audience, topic, and discipline. To determine if a source can be trusted, consider the following characteristic of a credible source:

Author	Information that includes an author or additional contact information can be a good indicator of credible work. An author who is willing to identify him/herself as the writer validates this site or work. The author's credibility can also be verified through searches for their background as well as for additional articles by the author.
Date	The date of research information shows whether the information is recent. The validity of older information can be confirmed by considering whether more recent information supports it.
Sources	The information found on websites or articles should have citations, i.e., list sources of the information included in the article.
Domain	Many domains (ex: .com, .org, and .net) can be purchased and used by any person or group. The domain .edu is used by higher education schools, colleges and universities; the .gov domain is reserved for government websites. Information found on the .edu and .gov domains usually host credible information, but sometimes students are given a .edu address for their personal use by universities — be careful when citing). The .org domain is usually used by non-profit organizations that may host articles or information that supports a specific perspective and is not solely educational information.
Site Design	Often, a well-designed site can indicate reliable information (however, this is very subjective). A well-designed site or article helps make information more easily accessible.
Writing Style	Poor spelling and grammar indicate that the site or article may not be credible. Credible sites carefully review writing style and grammar to ensure that information is clear, concise, and accessible to its audience.

There are always exceptions to any rule; sometimes there are credible sites and articles that don't conform to these six categories. If you are unsure that the site you are using is credible, crosscheck the information with other sources that are known to be credible, such as an encyclopedia or another reliable source about the subject.

Adapted from UWGB: **https://web.archive.org/web/20210614193138/https://uknowit.uwgb.edu/page.php?id=30276**

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