SCIENCE AND OUR FOOD SUPPLY

Examining Dietary Supplements

Supplement Facts

Serving Size 1 Gelcap
Servings Per Container 100

	Amount Per Serving	% Daily Value
Vitamin A (as retinyl acetate and 50% as beta-carotene)	900 mcg	100%
Vitamin C (as ascorbic acid)	90 mg	100%
Vitamin D (as cholecalciferol)	20 mcg (800 IU)	100%
Vitamin E (as dl-alpha tocopheryl acetate)	15 mg	100%
Thiamin (as thiamin mononitrate)	1.2 mg	100%
Riboflavin	1.3 mg	100%
Niacin (as niacinamide)	16 mg	100%
Vitamin B_6 (as pyridoxine hydrochloride)	1.7 mg	100%
Folate	400 mcg DFE (240 mcg folic acid)	100%
Vitamin B_{12} (as cyanocobalamin)	2.4 mcg	100%
Biotin	3 mcg	10%
Pantothenic Acid (as calcium pantothenate)	5 mg	100%

Teacher's Guide for High School Classrooms

1st Edition

SCIENCE AND OUR FOOD SUPPLY

Examining **Dietary Supplements**

Dear Teacher,

You may be familiar with the ***Science and Our Food Supply*** curriculum series developed by the U.S. Food and Drug Administration (FDA). It uses food as the springboard to engage students in inquiry-based, exploratory science that fosters awareness and understanding related to food safety, nutrition, and agricultural biotechnology.

FDA has developed a new component to the series: ***Science and Our Food Supply: Examining Dietary Supplements*** —Teacher's Guide for High School Classrooms, 1st edition. This Guide aims to better inform both you and your students about the science and public health impacts related to dietary supplements. Designed to be used separately or in conjunction with your current curriculum, ***Examining Dietary Supplements*** will inform students about a variety of products marketed to them and their potential health impacts.

We are pleased to present you with this science-based curriculum that introduces students to dietary supplement categories, composition, and labeling***. Examining Dietary Supplements*** is designed for use by high school teachers and their students; the emphasis is on an inquiry approach that can be customized to science, health, and related classes. The curriculum aligns with current education standards and supports educators seeking Science, Technology, Engineering, and Mathematics (STEM) activities for their classrooms.

The *Science and Our Food Supply* Team

FDA – an agency of the U.S. Government that is authorized by Congress to inspect, test, approve, and set safety standards for all food, except meat, poultry, processed eggs, and catfish. The agency also ensures that these products are labeled truthfully with the information people need to use them safely and properly.

Curriculum Development Advisors – teachers in the fields of biology, health, agriculture, technology, and related subject areas from across the United States and U.S. territories.

FDA's *Science and Our Food Supply* curriculum series includes:

- *Investigating Food Safety from Farm to Table*
- *Using the Nutrition Facts Label to Make Healthy Food Choices*
- *Exploring Food Agriculture and Biotechnology*
- *Examining Dietary Supplements*

Available online free at www.fda.gov/teachsciencewithfood

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FDA's "Professional Development Program in Food Science" is a summer program designed to train teachers how to use *Science and Our Food Supply* to maximize their students' learning. If you are interested in this program, please visit the program's website at www.teachfoodscience.org.

The web links provided in ***Science and Our Food Supply: Examining Dietary Supplements*** 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. From there, search for topical information.

WELCOME TO

SCIENCE AND OUR FOOD SUPPLY

Examining **Dietary Supplements**

Millions of Americans take dietary supplements, and that number continues to rise. However, dietary supplement labeling can be confusing or misleading. Teens are particularly vulnerable targets for misunderstanding what dietary supplements are and are often unaware of the potential benefits and adverse effects they can have on their bodies. This age group:

- Is becoming more body-conscious as they proceed through puberty and into young adulthood
- May have a strong interest in excelling in sports and/or surpassing the competition to standout on their teams
- Often has discretionary income (According to Pew-Research.org, more than 30% of teens held summer jobs in 2018; 2020 numbers would presumably be greatly skewed due to the closure of business based on social distancing guidelines.)
- Is on the path toward adulthood, making more and more of their own decisions

As dietary supplements attract interest among American teenagers who are struggling with perceived or real weight issues, or striving to enhance their sports performance or overall appearance, it is important that students have the right educational tools to help them understand whether to use a particular dietary supplement. The content and activities in ***Science and Our Food Supply: Examining Dietary Supplements*** are designed to intrigue and stimulate student curiosity and help them to make healthy decisions.

This Guide will help inform you and your students about critical information and develop skills to evaluate dietary supplements.

In-depth information and activities covering:

- The Supplements Facts label
- Limited government oversight of dietary supplements
- Adverse event reporting
- Multivitamins
- Live microbials (commonly referred to as "probiotics")
- Athletic performance enhancement/bodybuilding products
- Dietary supplement advertising
- Caffeine and energy products
- Botanicals

WHY TEACH ABOUT DIETARY SUPPLEMENTS

There is a lot of dietary supplement marketing material available for all age groups. Teens are one vulnerable age group because of their ongoing self-evaluations that revolve around their appearance: they may consider themselves to be too thin, too heavy, or too weak and in their search for self-enhancements, advertisements for "quick fixes" can lead teens toward dietary supplements. These, in turn, may influence them to use or try a product that they know very little about. Internet searches, often the first place teens look for help, can result in sales-oriented product messages with false claims. Many of these products have not been studied for their effects on teens and many can cause harm. *Science and Our Food Supply: Examining Dietary Supplements* can promote greater literacy around this topic for teenagers or people of any age.

Science and Our Food Supply: Examining Dietary Supplements focuses on topic areas that are especially relevant to teens. These common youth-centric themes serve as a springboard for classroom activities and learnings:

- Sports enhancements for performance and focus
- Weight loss/weight gain; miracle diets, e.g., before prom season
- High energy for studying late, etc.
- Vitamins, minerals, and other nutrients for overall health

This curriculum is designed to empower students to evaluate the accuracy and credibility of information they see and hear about dietary supplements, so they can make the best choice for themselves, in consultation with their healthcare providers.

HIGHLIGHTS OF YOUR TEACHER'S GUIDE

What's Inside . . .

Background Information introduces key concepts for each module or activity. This curriculum is written for both teachers and students.

Activities engage students with hands-on exploration.

Student Worksheets are reproducible handouts for students to record their data.

Resources list online references and materials supporting each activity.

Credible Source Guide: Some activities in this Guide ask students to research available information on a specific topic. For these activities, students should use credible information sources. A Credible Source Guide is on page 66.

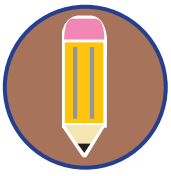
Connections to Curriculum Standards

This curriculum links to national education standards that provide guidance regarding the content that should be taught at particular levels, and what students at each level should be able to do and to understand. **See pages 81-85**.

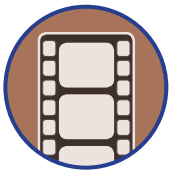
You should carefully examine local and state frameworks and curriculum guides to determine the best method for integrating *Science and Our Food Supply: Examining Dietary Supplements* into the program(s) of your school. Appropriate placement within the scope and sequence of a school's curriculum will optimize the interdisciplinary connections and enhance the ability of a student to learn key concepts related to dietary supplements.

Watch for the following icons . . .

Background Information
Indicates background information



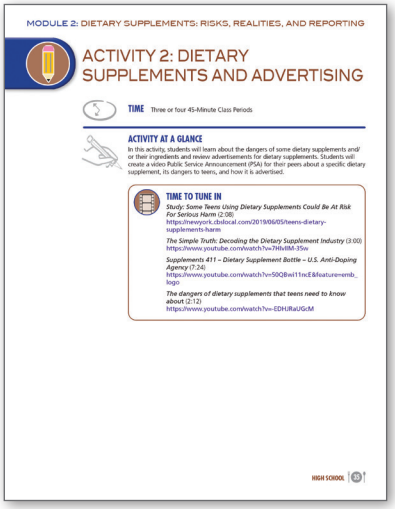
Activity
Indicates an activity



Video
Show or review a video clip. Video URLs and other hyperlinks are shown in purple.

OVERVIEW OF ACTIVITIES

The activities are written in this easy-to-understand format.


MODULE 2: DIETARY SUPPLEMENTS: RISKS, REALITIES, AND REPORTING

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING

TIME Three or four 45-Minute Class Periods

ACTIVITY AT A GLANCE

In this activity, students will learn about the dangers of some dietary supplements and/or their ingredients and review advertisements for dietary supplements. Students will create a video Public Service Announcement (PSA) for their peers about a specific dietary supplement, its dangers to teens, and how it is advertised.

TIME TO TUNE IN

Study: Some Teens Using Dietary Supplements Could Be At Risk For Serious Harm (2:58)
https://newyork.cbslocal.com/2019/06/05/teens-dietary-supplements-harm

The Simple Truth: Decoding the Dietary Supplement Industry (3:00)
https://www.youtube.com/watch?v=7HvtIM-35w

Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency (7:24)
https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

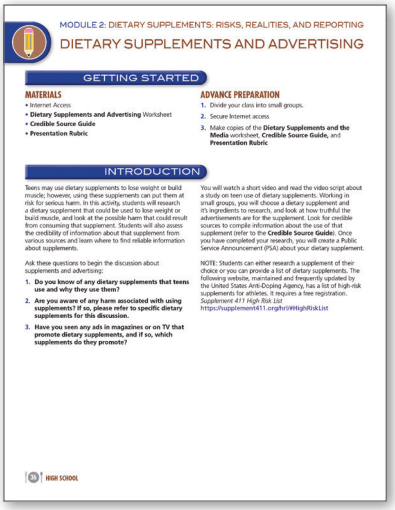
The dangers of dietary supplements that teens need to know about (2:12)
https://www.youtube.com/watch?v=EDHJRaUGcM

HIGH SCHOOL

TIME: The approximate amount of time needed to perform the activity.

ACTIVITY AT A GLANCE: Briefly summarizes the activity.

TIME TO TUNE IN: Shows the URL for an online video related to that activity.


MODULE 2: DIETARY SUPPLEMENTS: RISKS, REALITIES, AND REPORTING

DIETARY SUPPLEMENTS AND ADVERTISING

GETTING STARTED

MATERIALS
- Internet Access
- **Dietary Supplements and Advertising** Worksheet
- **Credible Source Guide**
- **Presentation Rubric**

ADVANCE PREPARATION
1. Divide your class into small groups.
2. Secure Internet access
3. Make copies of the **Dietary Supplements and the Media** worksheet, **Credible Source Guide**, and **Presentation Rubric**

INTRODUCTION

Teens may use dietary supplements to lose weight or build muscle; however, using these supplements can put them at risk for serious harm. In this activity, students will research a dietary supplement that could be used to lose weight or build muscle, and look at the possible harm that could result from consuming that supplement. Students will also assess the credibility of information about that supplement from various sources and learn where to find reliable information about supplements.

Ask these questions to begin the discussion about supplements and advertising:

1. **Do you know of any dietary supplements that teens use and why they use them?**
2. **Are you aware of any harm associated with using supplements? If so, please refer to specific dietary supplements for this discussion.**
3. **Have you seen any ads in magazines or on TV that promote dietary supplements, and if so, which supplements do they promote?**

You will watch a short video and read the video script about a study on teen use of dietary supplements. Working in small groups, you will choose a dietary supplement and it's ingredients to research, and look at how truthful the advertisements are for the supplement. Look for credible sources to compile information about the use of that supplement (refer to the **Credible Source Guide**). Once you have completed your research, you will create a Public Service Announcement (PSA) about your dietary supplement.

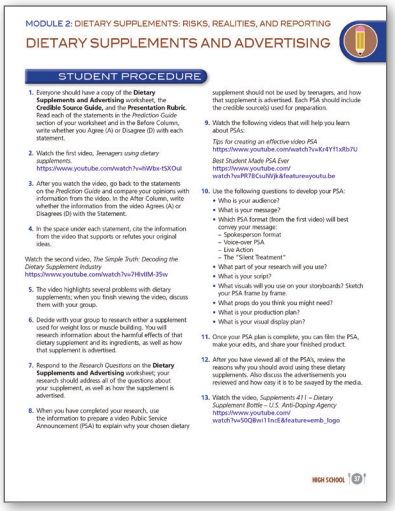
NOTE: Students can either research a supplement of their choice or you can provide a list of dietary supplements. The following website, maintained and frequently updated by the United States Anti-Doping Agency, has a list of high-risk supplements for athletes. It requires a free registration.
Supplement 411 High Risk List
https://supplement411.org/hrl/#HighRiskList

HIGH SCHOOL

MATERIALS: Includes the items needed to perform the activity.

ADVANCE PREPARATION: Indicates what you need to do before conducting the activity.

INTRODUCTION: Provides fun, innovative suggestions for introducing the activity. Where provided, suggested teacher dialogue is indicated by ***boldface italics***.


MODULE 2: DIETARY SUPPLEMENTS: RISKS, REALITIES, AND REPORTING

DIETARY SUPPLEMENTS AND ADVERTISING

STUDENT PROCEDURE

1. Everyone should have a copy of the **Dietary Supplements and Advertising** worksheet, the **Credible Source Guide,** and the **Presentation Rubric**. Read each of the statements in the *Prediction Guide* section of your worksheet and in the Before Column, write whether you Agree (A) or Disagree (D) with each statement.
2. Watch the first video, *Teenagers using dietary supplements*.
https://www.youtube.com/watch?v=hWbx-tSXOuI
3. After you watch the video, go back to the statements on the *Prediction Guide* and compare your opinions with information from the video. In the After Column, write whether the information from the video Agrees (A) or Disagrees (D) with the Statement.
4. In the space under each statement, cite the information from the video that supports or refutes your original ideas.

Watch the second video, *The Simple Truth: Decoding the Dietary Supplement Industry*
https://www.youtube.com/watch?v=7HvtIM-35w

5. The video highlights several problems with dietary supplements; when you finish viewing the video, discuss them with your group.
6. Decide with your group to research either a supplement used for weight loss or muscle building. You will research information about the harmful effects of that dietary supplement and its ingredients, as well as how that supplement is advertised.
7. Respond to the *Research Questions* on the **Dietary Supplements and Advertising** worksheet; your research should address all of the questions about your supplement, as well as how the supplement is advertised.
8. When you have completed your research, use the information to prepare a video Public Service Announcement (PSA) to explain why your chosen dietary supplement should not be used by teenagers, and how that supplement is advertised. Each PSA should include the credible source(s) used for preparation.
9. Watch the following videos that will help you learn about PSAs:

Tips for creating an effective video PSA
https://www.youtube.com/watch?v=Kr4Y11xRb7U

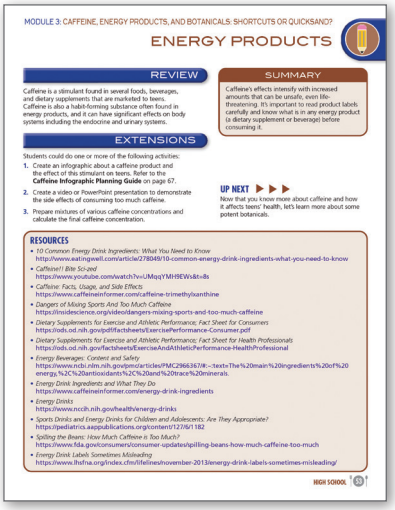
Best Student Made PSA Ever
https://www.youtube.com/watch?v=PKT8CsuNVjk&feature=youtu.be

10. Use the following questions to develop your PSA:
- Who is your audience?
- What is your message?
- Which PSA format (from the first video) will best convey your message:
  - Spokesperson format
  - Voice-over PSA
  - Live Action
  - The "Silent Treatment"
- What part of your research will you use?
- What is your script?
- What visuals will you use on your storyboards? Sketch your PSA frame by frame.
- What props do you think you might need?
- What is your production plan?
- What is your visual display plan?

11. Once your PSA plan is complete, you can film the PSA, make your edits, and share your finished product.
12. After you have viewed all of the PSA's, review the reasons why you should avoid using these dietary supplements. Also discuss the advertisements you reviewed and how easy it is to be swayed by the media.
13. Watch the video, *Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency*
https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

HIGH SCHOOL

STUDENT PROCEDURE: Gives the step-by-step process for the activity.


MODULE 3: CAFFEINE, ENERGY PRODUCTS, AND BOTANICALS: SHORTCUTS OR QUICKSAND?

ENERGY PRODUCTS

REVIEW

Caffeine is a stimulant found in several foods, beverages, and dietary supplements that are marketed to teens. Caffeine is an addictive habit-forming substance often found in energy products, and it can have significant effects on body systems including the endocrine and urinary systems.

SUMMARY

Caffeine's effects intensify with increased amounts that can be unsafe, even life-threatening. It's important to read product labels carefully and know what is in any energy product (a dietary supplement or beverage) before consuming it.

EXTENSIONS

Students could do one or more of the following activities:

1. Create an infographic about a caffeine product and the effect of this stimulant on teens. Refer to the **Caffeine Infographic Planning Guide** on page 67.
2. Create a video or PowerPoint presentation to demonstrate the side effects of consuming too much caffeine.
3. Prepare mixtures of various caffeine concentrations and calculate the final caffeine concentration.

UP NEXT ▶▶▶

Now that you know more about caffeine and how it affects teens' health, let's learn more about some potent botanicals.

RESOURCES
- *10 Common Energy Drink Ingredients: What You Need to Know*
http://www.eatingwell.com/article/3278049/10-common-energy-drink-ingredients-what-you-need-to-know
- *Caffeine! Bite Sci-zed*
https://www.youtube.com/watch?v=UMqqYMH9EWs&t=8s
- *Caffeine: Facts, Usage, and Side Effects*
https://www.caffeineinformer.com/caffeine-trimethylxanthine
- *Dangers of Mixing Sports And Too Much Caffeine*
https://insidescience.org/video/dangers-mixing-sports-and-too-much-caffeine
- *Dietary Supplements for Exercise and Athletic Performance; Fact Sheet for Consumers*
https://ods.od.nih.gov/pdf/factsheets/ExercisePerformance-Consumer.pdf
- *Dietary Supplements for Exercise and Athletic Performance; Fact Sheet for Health Professionals*
https://ods.od.nih.gov/factsheets/ExerciseAndAthleticPerformance-HealthProfessional
- *Energy Beverages: Content and Safety*
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2966367/#:~:text=The%20main%20ingredients%20of%20energy,%2C%20antioxidants%2C%20and%20trace%20minerals.
- *Energy Drink Ingredients and What They Do*
https://www.caffeineinformer.com/energy-drink-ingredients
- *Energy Drinks*
https://www.nccih.nih.gov/health/energy-drinks
- *Sports Drinks and Energy Drinks for Children and Adolescents: Are They Appropriate?*
https://pediatrics.aappublications.org/content/127/6/1182
- *Spilling the Beans: How Much Caffeine is Too Much?*
https://www.fda.gov/consumers/consumer-updates/spilling-beans-how-much-caffeine-too-much
- *Energy Drink Labels Sometimes Misleading*
https://www.lhsfna.org/index.cfm/lifelines/november-2013/energy-drink-labels-sometimes-misleading/

HIGH SCHOOL

REVIEW: Uses interesting questions to guide students through a review of what they learned in the activity.

SUMMARY: Summarizes key concepts learned in the activity.

EXTENSIONS: Suggest activities to help students learn more about the topic.

RESOURCES: Provide references to online resources for the activity or for further study.

UP NEXT: Gives a preview of the next activity.

MODULE 1

INTRODUCTION TO DIETARY SUPPLEMENTS

Definitions, Supplement Facts label, Categories, Claims

For this module, it is recommended that teachers will have taught the following key concepts: the structure and properties of matter; what happens in chemical reactions; the human body is a system of interacting systems; basic human nutrition needs; metric system

BACKGROUND INFORMATION

What is a Dietary Supplement? introduces dietary supplements as a category of products that are heavily marketed to consumers, and which should only be taken with a healthcare provider's advice.

ACTIVITY 1

Product Categories helps teenagers distinguish characteristics of products that they might use.

Time to Tune In

Dietary Supplements: What You Need to Know (1:43)
https://www.youtube.com/watch?v=-tY1Ln9JfVs

Drugs vs. Supplements (1:19)
https://www.webmd.com/vitamins-and-supplements/video/drugs-vs-supplements

The Real Story of Snake Oil (1:44)
https://www.youtube.com/watch?v=LaDsOJATX3A

ACTIVITY 2

Supplements vs. Food helps teens evaluate and compare nutrients that could be obtained through foods or dietary supplements.

Time to Tune In

Understand Changes to Dietary Supplement Labels (2:02)
https://www.youtube.com/watch?v=kLploVqHjBA

Understanding Pre and Probiotics (3:14)
https://www.youtube.com/watch?v=U1p4YMU3vWk

Vitamins and Minerals – Nutrition Fundamentals (6:58)
https://www.youtube.com/watch?v=qgNURQFWNWM

BACKGROUND INFORMATION

What is a Dietary Supplement?

Dietary Supplements: Defined

A dietary supplement is a product that is used to supplement, or *add to*, a person's diet. But a dietary supplement is *not* intended to be a substitute for an actual food or a meal.

To be categorized as a dietary supplement, a product must be able to be "ingested" – in other words, something you can eat or drink. Something that is intended to be injected or applied topically (like to the skin or hair) would *not* be a dietary supplement.

- Vitamins and minerals are common dietary supplements.
- Other dietary supplements include herbs or botanicals and their extracts and constituents, amino acids, live microbials (commonly referred to as "probiotics"), and enzymes.

Dietary supplements come in a variety of forms such as tablets, capsules, softgels, gelcaps, powders, and liquids. They can provide nutritional benefit by helping you meet daily requirements for the nutrients your body needs to function. But it is important to remember that food should be the primary source of nutrients. A healthy diet starts with eating a variety of foods.

Note: Many foods and dietary supplements contain the same components, but a product is classified as a dietary supplement when that component (e.g., vitamin D) is separate from the food (e.g., milk). Foods that are "fortified" with vitamins/minerals are still considered foods, not dietary supplements.

A dietary supplement might include other ingredients, for example, inactive or "filler" ingredients such as silica, which helps the ingredients bind together during manufacturing. These other ingredients are regulated as food additives.

Dietary Supplements: What They Include

Dietary Supplement Categories	*Example of a Specific Dietary Supplement component in each category*	Other Product Classification (not a Dietary Supplement) that might contain the same component	*Example of other product not classified as a dietary supplement*
Vitamins	Vitamin C	Cosmetics	Facial serum containing vitamin C
Minerals	Iron	Drug	Iron injection
Herbs or Botanicals, Extracts and Constituents	Caffeine (from green tea, for example)	Drugs	Over-the-counter (OTC) stimulant drugs
Live microbials ("probiotics")	Lactobacillus acidophilus	Food	Yogurt containing lactobacillus acidophilus
Amino Acids	Lysine	Food	Poultry
Other (such as fish oil, glucosamine, etc.)	Omega 3 fatty acids	Food	Salmon

BACKGROUND INFORMATION

The Dietary Supplement Health and Education Act (DSHEA)

Unlike prescription medications, under DSHEA, FDA does not have the authority to approve dietary supplement products. FDA strives to achieve the right balance between preserving consumers' access to lawful supplements, while still upholding the agency's obligation to protect the public from unsafe and unlawful products.

Connecting the (Historical) Dots to DSHEA

1906 The **Pure Food and Drug Act**, a law a quarter-century in the making, prohibited interstate and foreign commerce in adulterated and misbranded food and drugs. It also positioned the Bureau of Chemistry (predecessor of FDA) as the first federal agency to focus primarily on consumer protection.

1938 The U.S. Congress passed the **Federal Food, Drug, and Cosmetic Act** (FD&C Act) to replace the Food and Drugs Act. This important updated legislation enhanced the consumer protections for food and drugs and broadened the scope of products under FDA's oversight to include medical devices and cosmetics.

1976 The **Vitamins and Minerals Amendments** (led by Sen. William Proxmire of Wisconsin) prohibited FDA from limiting the potency of vitamins and minerals or classifying those that exceeded a specific potency threshold as drugs. It also prevented FDA from limiting any combination of vitamins or minerals or other food ingredients (except in products used for childhood diseases or by pregnant or lactating women).

1994 The **Dietary Supplement Health Education Act** (DSHEA) was signed into law. DSHEA created a new regulatory framework for the safety and labeling of dietary supplements. It defined a **dietary ingredient** as a vitamin, mineral, herb or botanical, amino acid, or a dietary substance used to supplement the diet by increasing total dietary intake (for example, food substances). A dietary ingredient can also be a concentrate, metabolite, constituent, extract, or combination of these ingredients.

DSHEA enabled FDA to take action against unsafe or otherwise adulterated or misbranded dietary supplements. But unlike the approach taken for drugs, FDA is responsible for demonstrating that a dietary supplement is adulterated prior to taking any enforcement action. Because dietary supplements are under the "umbrella" of foods, FDA's Center for Food Safety and Applied Nutrition (CFSAN) regulates both *finished* dietary supplements and the *individual ingredients* that a supplement might contain. FDA regulates dietary supplements under a different set of regulations than those covering "conventional" foods and drug products.

Responsibility of the Manufacturing Company

Under DSHEA, it is the companies that manufacture or market dietary supplements that are responsible for ensuring that the products they sell are **safe and otherwise lawful.** So unlike FDA's role in regulating prescription drugs, FDA does *not* have the authority to approve dietary supplements or their labeling. In fact, companies can often introduce new dietary supplement products to market without even notifying FDA.

In most cases, FDA's role with a dietary supplement product begins *after* the product enters the marketplace. Specifically, FDA is responsible for taking action against any "adulterated" or "misbranded" dietary supplement. For example, if a product is "adulterated," it might mean that the product contains contaminants or is otherwise unsafe; if a product is "misbranded," it could mean that the labeling is false or misleading. In these cases, FDA can take action to **remove products from the market**.

BACKGROUND INFORMATION

The Nutrients You Need: A Closer Look

Food should always be the **first choice** for getting the nutrients you need. You can learn how much you need from each food group with a personalized MyPlate Plan, based on your age, sex, height, weight, and physical activity level. Beneficial vitamins and minerals can be found in nutrient-dense foods such as fruits, vegetables, and whole grains.

You can refer to the Nutrition Facts label on food packages, which is a helpful tool to evaluate nutrients you are getting from food. The label lists key nutrients in a food and how much a particular food contributes to the recommended amount of that nutrient in the daily diet.

Someone might choose to take a dietary supplement to help reach the daily recommended amount of certain nutrients if they are unable to get them from their diet. For example, someone with lactose intolerance might find it challenging to consume the daily recommended amount of calcium, a key nutrient found in dairy products.

Vitamins and minerals help your body to work properly. **Vitamins** occur naturally in plants and animals and can also be produced synthetically. **Minerals** are inorganic elements that come from the soil and water, and they are absorbed by plants or eaten by people and animals. Your body needs larger amounts of some minerals like calcium. Other minerals are called **trace minerals** because you only need small amounts. Trace minerals include chromium, copper, iodine, iron, selenium, and zinc.

FDA's Vitamins and Minerals charts offer a quick way to track down foods that contain the specific nutrients you may want to add to *your* diet.

Vitamins (cont'd)

VITAMIN	WHAT IT DOES	WHERE IT IS FOUND	DAILY VALUE*
Vitamin C	• Antioxidant • Collagen and connective tissue formation • Immune function • Wound healing	• Fruit (e.g., cantaloupe, citrus fruits, kiwifruit, and strawberries) • Juices (e.g., oranges, grapefruit, and tomato) • Vegetables (e.g., broccoli, Brussels sprouts, peppers, and tomatoes)	90 mg
Vitamin D *Nutrient to get more of*	• Blood pressure regulation • Bone growth • Calcium balance • Hormone production • Immune function • Nervous system function	• Eggs • Fish (e.g., herring, mackerel, salmon, trout, and tuna) • Fish oil and cod liver oil • Fortified dairy products • Fortified margarine • Fortified orange juice • Fortified plant-based beverages (e.g., soy, rice, and almond) • Fortified ready-to-eat cereals • Mushrooms • Pork	20 mcg**
Vitamin E	• Antioxidant • Formation of blood vessels • Immune function	• Fortified cereals and juices • Green vegetables (e.g., spinach and broccoli) • Nuts and seeds • Peanuts and peanut butter • Vegetable oils	15 mg**
Vitamin K	• Blood clotting • Strong bones	• Green vegetables (e.g., broccoli, kale, spinach, turnip greens, collard greens, Swiss chard, mustard greens)	120 mcg

* The Daily Values are reference amounts of nutrients to consume or not to exceed each day.
** Units of measurement have been updated. For more information, visit: https://go.usa.gov/xVvT3.

FDA U.S. FOOD & DRUG ADMINISTRATION
www.fda.gov/nutritioneducation

Interactive Nutrition Facts Label • March 2020
Vitamins and Minerals Chart 4

The National Academies of Sciences, Engineering, and Medicine have created in-depth nutrient charts that offer Recommended Dietary Allowances (RDA) depending on age and life stage. These not only show the amount of nutrients you *do* need, but also "how much is too much."

The nutrient charts are organized by:

1. What You Need
   - For Vitamins
   - For Minerals (Elements)
   - For Water and Macronutrients
2. Upper Limits
   - Tolerable Upper Intake Level for Vitamins
   - Tolerable Upper Intake Level for Minerals (Elements)

There are two types of vitamins.

- **Fat-soluble vitamins** — A, D, E, and K — are dissolved, transported, and stored similar to how fats are used in your body.
- **Water-soluble vitamins** — C and the B-complex vitamins (such as vitamins B6, B12, niacin, riboflavin, and folate) — are generally excreted rapidly by the body and most are not as easily stored.

BACKGROUND INFORMATION

The Dietary Supplement Facts Label: What It Includes

Dietary supplements must be labeled with a **Supplement Facts** label that is specific for the contents in that dietary supplement.

Supplement Facts

1 Serving Size 1 Gelcap
Servings Per Container 100

	Amount Per Serving	% Daily Value
Vitamin A (as retinyl acetate and 50% as beta-carotene)	900 mcg	100%
Vitamin C (as ascorbic acid)	90 mg	100%
Vitamin D (as cholecalciferol)	20 mcg (800 IU)	100%
Vitamin E (as dl-alpha tocopheryl acetate)	15 mg	100%
Thiamin (as thiamin mononitrate)	1.2 mg	100%
2 Riboflavin	1.3 mg	100%
Niacin (as niacinamide)	16 mg	100%
Vitamin B_6 (as pyridoxine hydrochloride)	1.7 mg	100%
Folate	400 mcg DFE (240 mcg folic acid)	100%
Vitamin B_{12} (as cyanocobalamin)	2.4 mcg	100%
Biotin	3 mcg	10%
Pantothenic Acid (as calcium pantothenate)	5 mg	100%

3 Other ingredients: Gelatin, lactose, magnesium stearate, microcrystalline cellulose, FD&C Yellow No. 6, propylene glycol, preservatives (propylparaben and sodium benzoate).

Group 1
Servings
The "Serving Size" and the number of "Servings Per Container." The serving size for dietary supplements that are pills, capsules, tablets, or packets is listed as a quantity (e.g., one capsule), whereas the serving size for dietary supplements that are bulk powders or liquids is listed as a volume (e.g., one teaspoon).

Group 2
Nutrients
List of nutrients in this particular product that are required or permitted on the Supplement Facts label. The actual amount in milligrams or micrograms in addition to the % Daily Value (%DV) are listed. Daily values are reference amounts of nutrients to consume or not to exceed and are used to calculate the %DV, based on a 2,000-calorie/day diet. Not all dietary supplement components have a DV.

Group 3
Other ingredients
List of additional ingredients in descending order by weight. These ingredients can include fillers, preservatives, sweeteners, flavorings, or colors.

DID YOU KNOW?

You Can "Overdo" It with Vitamins or Minerals

While vitamins and minerals are part of a healthy diet, it is possible to take too much of a "good thing." If it is necessary for you to consume them because you can't get enough through the foods you eat, it's important to remember that "more" isn't necessarily better.

Calcium: The body absorbs calcium from food better than from dietary supplements. Too much calcium can increase the risk of heart attack and stroke and cause muscle pain, constipation, abdominal pain and kidney stones. You can also help calcium do its job by getting your calcium from dairy products, avoiding excess salt, and not smoking.

Vitamin D: High levels of vitamin D in the blood can be dangerous. It triggers extra calcium absorption, which in turn can cause the same symptoms as too much calcium.

Vitamin A: The body stores excess vitamin A in fat and does not excrete it. The fact that vitamin A is found in many different supplements means it's easy to get too much. Vitamin A toxicity is caused by too much preformed vitamin A (retinol); signs include headache and skin rashes. Large amounts of beta-carotene and other provitamin A carotenoids are not associated with major adverse effects.

Iron: Iron is a nutrient that supports such functions as growth and development, immunity, and red blood cell formation. But taking high doses of iron supplements (especially on an empty stomach) can cause an upset stomach, constipation, nausea, abdominal pain, vomiting, and fainting. High doses of iron can also decrease zinc absorption; zinc promotes wound healing, immune function, and nervous system function.

Read more in the sources for this information:

- For Calcium, vitamin D and vitamin A: from the Cleveland Clinic
- For Iron: from an NIH factsheet

The **Tolerable Upper Intake Level (UL)** is the term used for the maximum daily intake unlikely to cause adverse health effects.

Always talk to a healthcare professional before starting a vitamin or mineral supplement.

BACKGROUND INFORMATION

What Are Live Microbials?

A live microbial is a single-celled prokaryotic (e.g., bacteria) or eukaryotic (e.g., yeast) microorganism that is intended to be viable or "active" when consumed. Many dietary supplements that are described as "probiotics" contain live microbial ingredients. "Probiotics" are not defined as a regulatory product category under the Federal Food, Drug, and Cosmetic Act (FD&C Act) or the Public Health Service Act (PHSA), and products that may be considered to be "probiotics" may be foods, drugs, and/or biologics under the FD&C Act and/or PHSA, depending on various factors, such as the intended use of the product. "Probiotics" have been defined in other contexts as live microorganisms that, when consumed in adequate amounts of food, provide the host with a health benefit. While there has been a lot of research on live microbials, it's not clear which are helpful and which are not.

Live microbials are present in some fermented foods and available as dietary supplements. They act mainly in the gastrointestinal (GI) tract, where they can affect your gut microbiome. This microbiome is made up of many microorganisms (mostly bacteria) that live primarily in your large intestine. The goal of taking live microbials is that, when you eat or drink enough, they help protect your GI tract from harmful microorganisms, improve your digestion and gut function, and might provide other health benefits as well.

Commonly consumed live microbials include *Lactobacillus, Bifidobacterium, Saccharomyces, Streptococcus, Enterococcus, Escherichia,* and *Bacillus*. Microorganisms are named by their genus and species, and sometimes by their strain. An example is *Lactobacillus rhamnosus* GG. In this example, *Lactobacillus* is the genus, *rhamnosus* is the species, and GG is the strain.

Which foods provide live microbials?

Fermented foods have added microbial cultures. Manufacturers make yogurt, for example, by adding live microorganisms (such as *Lactobacillus* or *Streptococcus*) to milk. But whether the microorganisms provide benefits is inconclusive.

Some fermented foods (such as sourdough bread and most pickles) are processed after fermentation, which kills the microorganisms. Microorganisms that are not alive do not provide the same benefits as living microorganisms and are not considered to be live microbials. Other fermented foods contain microorganisms that have not been studied to the same extent, so whether they have any benefits is not known. Examples of these include apple cider vinegar, cheese, kimchi, kombucha, miso, and sauerkraut.

Some unfermented foods have added microorganisms. These foods include some cereals, juices, milks, nutrition bars, and smoothies. Whether these microorganisms provide benefits is not clear.

What kinds of live microbial dietary supplements are available?

Dietary supplements may contain a wide variety of microorganisms and amounts. The Supplement Facts label on a dietary supplement that contains live microbials lists the total weight of the microorganisms in the product. Many product labels also list the number of colony forming units (CFUs) in a serving. CFUs are a better indicator than total weight of the number of live microorganisms. Examples of CFUs that you might see on a label are 1×10^9 (1 billion) CFUs and 1×10^{10} (10 billion) CFUs.

Supplement Facts

Serving Size 1 capsule
Servings Per Container 60

Ingredient	Amount Per Serving	% Daily Value**
Proprietary Blend of Cultures	180 mg	†
Lactobacillus acidophilus		
Bifidobacterium lactis		
Bifidobacterium longum		
Bifidobacterium bifidum		
Streptococcus thermophilus		

**Percent Daily Value is based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.
† Daily value not established

Other Ingredients: Vegetable cellulose, vegetable magnesium stearate, silica.

BACKGROUND INFORMATION

Dietary Supplement Safety

FDA oversees dietary supplements under a different set of regulations than those covering drug products and "conventional" foods. Under the Food, Drug & Cosmetics Act, manufacturers and distributors of dietary supplements are prohibited from marketing products in interstate commerce that are adulterated or misbranded. They are responsible for evaluating the safety and labeling of their products before marketing to ensure that they meet all the requirements of the FD&C Act and the FDA's regulations. Unlike prescription drugs, dietary supplements are not approved by the government for safety and efficacy. FDA is authorized to take action against any adulterated or misbranded dietary supplement product after it reaches the market.

FDA monitors the compliance of dietary supplement products through a variety of surveillance activities and carefully reviews product complaints and adverse event reports. If FDA determines that a dietary supplement violates the law, the agency takes action, as appropriate. The public can access FDA's resource lists, which are updated with ingredients that are not or do not appear to be lawfully included in products marketed as dietary supplements. Information about ingredients and products that have been the subject of FDA action or advisory statements is shown on these FDA webpages:

- Dietary Supplement Products & Ingredients (https://www.fda.gov/food/dietary-supplements/dietary-supplement-products-ingredients)
- Dietary Supplement Ingredient Advisory List of ingredients under current evaluation (https://www.fda.gov/food/dietary-supplement-products-ingredients/dietary-supplement-ingredient-advisory-list)
- Alerts, Advisories & Safety Information (www.fda.gov/food/recalls-outbreaks-emergencies/alerts-advisories-safety-information)

DID YOU KNOW?

Some Dietary Supplements Have Been Recalled

Some dietary supplements are recalled because of potential – or even proven – harmful effects. Reasons for product recalls include:

- microbiological, heavy metal, or other types of contamination
- absence of a dietary ingredient claimed to be in the product
- the presence of unlabeled allergens or ingredients found in drugs

"Say *What*?" It's All About Claims

It is not uncommon for people to mistakenly think that dietary supplements have been proven to have the same benefits as drugs. Legally, products labeled as dietary supplements that bear claims that the products are intended to treat, prevent, or cure diseases are drugs and subject to all requirements that pertain to drugs. An example would be a dietary supplement label that states, or claims, that the product "treats heart disease." Claims like this render the product a drug and can generally *only* be made after FDA has reviewed and approved the drug.

Dietary supplements *are* permitted to make certain claims that describe how the product might affect either the *structure* or the *function* of the body. These are called structure/function claims, and they describe the role a specific nutrient plays in relation to the human body.

Examples of Structure/Function Claims

Structure and/or function claims can describe the *role* of an ingredient that is intended to affect the normal human body, or the *way* an ingredient acts to maintain such structure or function. For example:

"Calcium builds strong bones." (Structure)

"Fiber maintains bowel regularity." (Function)

These claims can be made if:

- They are truthful and non-misleading
- The manufacturer has proof that the claims are truthful
- The manufacturer notifies FDA of the text of the claim no later than 30 days after marketing the dietary supplement with the claim
- The label includes a disclaimer that says: "This statement has not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease."

FDA has an informative webpage, Consumer Updates – Health Fraud (https://www.fda.gov/consumers/health-fraud-scams/consumer-updates-health-fraud), that reviews all types of health claim fraud, including those for dietary supplements.

BACKGROUND INFORMATION

Claims Terminology: At a Glance

Among the claims that are allowed for dietary supplements are health claims, nutrient content claims, structure/function claims, general well-being claims, and nutrient deficiency disease claims. For all such claims, the manufacturer must have substantiation that the claim is truthful and not misleading.

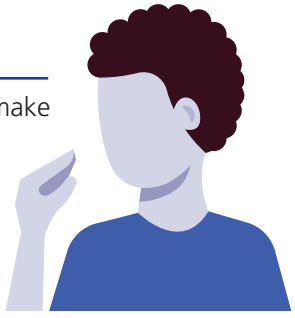
Health claims: Health claims are claims that express or imply the role a food or particular ingredient may have in *reducing the risk of a disease or a health-related condition*. FDA has the authority to review health claims before the product about which the claim is made is marketed.

Nutrient content claims: These are claims that describe the *level* of a nutrient in a food or dietary supplement. For example, this could be terms such as *free, high,* and *low*, or could compare the level of a nutrient in a food to that of another food, using terms such as *more, reduced*, and *lite*. For example, a product could use the claim "high in antioxidant vitamin C" if it contains 20 percent or more of the daily value for vitamin C.

Structure/function claims: These are claims that describe the role of a dietary ingredient intended to affect the normal structure or function of the human body. Structure/function claims may not link the claimed effect of the dietary ingredient to a disease or state of health leading to a disease.

- *General well-being claims:* These are claims that describe general well-being derived from consuming a dietary ingredient.
- *Nutrient deficiency disease claims:* These are claims that describe a benefit related to a nutrient deficiency disease (like vitamin C and scurvy). But interestingly, these are allowed only if they also say how widespread the disease is in the United States.

Silver Poisoning can make a person turn blue!



Think Before You Decide

The potential impact that a dietary supplement can have on overall health, and the fact that dietary supplements are released into the marketplace without FDA approval, underscores the need to **thoroughly research** any dietary supplement you might consider taking.

FDA and the National Institutes of Health offer these tips for consideration:

1. **Consider your overall diet.** Remember: dietary supplements are intended to *supplement* the diet when needed, but not to *replace* a healthy and balanced diet. While you need enough nutrients, too much of some nutrients can cause problems.
2. **Talk to your healthcare provider** before deciding to purchase or use a dietary supplement. Be mindful that some supplements may interact with medicines or other supplements. Also, do not use dietary supplements in place of prescription medications. Many supplements contain active ingredients that have strong biological effects; if you have certain health conditions, using them could place your health at risk.
3. **Be aware that some dietary ingredients can be toxic in certain circumstances.** Some ingredients and products can be harmful when consumed in high amounts, when taken for a long time, or when used in combination with certain other drugs, dietary supplements, or foods.
4. **Investigate potential dietary supplement(s) + drug interactions** including prescription and over-the-counter (OTC) medicines. For example, certain supplements can be problematic when used with blood thinners or can lessen the effectiveness of prescription medicine. So, be sure to check out potential interactions of any dietary supplement with the prescription or OTC drugs *you* are taking.

DID YOU KNOW?

Combining Dietary Supplements with Drugs Can Cause Problems

Rx

- Vitamin E and ginkgo biloba are dietary supplements that can thin the blood. If they are combined with Coumadin (a prescription medicine) or aspirin (OTC drug), they can increase the potential for internal bleeding.
- St. John's Wort may reduce the effectiveness of prescription drugs for heart disease, depression, seizures, HIV, certain cancers, or oral contraceptives.

BACKGROUND INFORMATION

5. **Know the health implications in certain situations**, like before a surgical procedure or platelet donation.
   - **If you are planning elective surgery**: Be aware that some dietary supplements can interact in a harmful way with medications you need to take before, after, or during surgery. Your healthcare professional may ask you to stop taking dietary supplements 2-3 weeks before the procedure to avoid potentially dangerous changes in heart rate, blood pressure, or bleeding risk.
   - **If you plan to donate platelets**: You must not take a blood-thinning supplement, such as vitamin E, (or aspirin) for at least 48 hours preceding platelet donation.
6. **Most important of all, be "skeptical"!** Be aware that if claims on the label (or in the marketing materials/website) of a dietary supplement *sound* too good to be true—they probably are. Safety is the most important thing—so always do your research and be sure to consult your healthcare provider before deciding to purchase or use any dietary supplement.

DID YOU KNOW?

Dietary supplement advertising, including ads broadcast on radio and television, falls under the jurisdiction of the Federal Trade Commission (FTC). FDA and FTC work together to regulate dietary supplement marketing.

"Natural"?

Do not assume that the term "natural" ensures wholesomeness, or that these food-like substances necessarily have milder effects, than drugs. The term "natural" on labels is not well defined and is sometimes used ambiguously to imply unsubstantiated benefits or safety. For example, many weight-loss products claim to be "natural" or "herbal," but this doesn't necessarily make them safe. Their ingredients may interact with drugs or may be dangerous for people with certain medical conditions.

Common Sense Tip: If it sounds too good to be true, it probably is! FDA says that consumers should be suspicious of product claims such as "works better than [a prescription drug]," "totally safe," or has "no side effects."

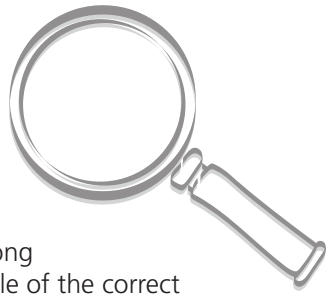
Research Matters!

When considering whether to take a dietary supplement, it's absolutely critical to do your research. FDA recommends using noncommercial sites instead of depending on information from sellers, which *could* contain "marketing spin" versus scientific fact.

Credible sites could include:

- FDA Dietary Supplements: https://www.fda.gov/food/dietary-supplements
- NIH Office of Dietary Supplements: https://ods.od.nih.gov/HealthInformation/DS_WhatYouNeedToKnow.aspx/
- NIH Dietary Supplement Label Database: https://dsld.od.nih.gov/dsld/
- USDA National Agricultural Library - Dietary Supplements: https://www.nal.usda.gov/topics/dietary-supplements
- USDA's Dietary Supplement Ingredient Database: https://dietarysupplementdatabase.usda.nih.gov/

Quality



FDA has established good manufacturing practices (GMPs) that companies must follow to help ensure the identity, purity, strength, and composition of their dietary supplements. These GMPs can prevent adding the wrong ingredient (or too much or too little of the correct ingredient) and reduce the chance of contamination or improper packaging and labeling of a product. FDA also periodically inspects facilities that manufacture supplements.

Several independent organizations offer quality testing and allow products that pass these tests to display a seal of quality assurance that indicates the product was properly manufactured, contains the ingredients listed on the label, and does not contain harmful levels of contaminants. These seals do not guarantee that a product is safe or effective. Organizations* that offer quality testing include:

- ConsumerLab.com
- NSF International
- U.S. Pharmacopeia (USP)

** Listing a specific company, organization, or service does not represent an endorsement by FDA.*

ACTIVITY 1: PRODUCT CATEGORIES

TIME One 45-Minute Class Period

ACTIVITY AT A GLANCE

In this activity, students will learn to identify products that are dietary supplements, as opposed to foods, drugs, or cosmetics.

TIME TO TUNE IN

Dietary Supplements: What You Need to Know (1:43)
https://www.youtube.com/watch?v=-tY1Ln9JfVs

Drugs vs. Supplements (1:19)
https://www.webmd.com/vitamins-and-supplements/video/drugs-vs-supplements

The Real Story of Snake Oil (1:44)
https://www.youtube.com/watch?v=LaDsOJATX3A

GETTING STARTED

MATERIALS

- **Product Category** cards
- **Product Category** worksheet

ADVANCE PREPARATION

- Students can work individually or in groups.
- Make a **Product Category** card set for each student or group.
- Make a copy of the **Product Category** worksheet for each student or group.
- Confirm student access to the online student worksheet if teaching in an online setting.

INTRODUCTION

Explain that dietary supplements are meant to *supplement* the diet and must be *ingested* (taken orally). Discuss a few examples, such as multivitamins.

Ask why people might take dietary supplements, e.g., for possible health benefits or for a desired benefit to their appearance. Point out that cosmetics are often used to enhance appearance, but they are not ingested.

Explain that dietary supplements are not approved for safety prior to sales to consumers, but that a reporting system exists for people to report adverse reactions to specific dietary supplements.

PRODUCT CATEGORIES

STUDENT PROCEDURE

1. Work alone or in pairs.
2. Examine each **Product Card** and decide which category each one belongs to: food, drug, cosmetic, or dietary supplement.
3. Complete the **Product Category** student worksheet.
4. Watch these three videos that provide an overview about what dietary supplements are and also explain how to understand the Supplement Label.

   Dietary Supplements: What You Need to Know (1:43)
   https://www.youtube.com/watch?v=-tY1Ln9JfVs

   Drugs vs. Supplements (1:19)
   https://www.webmd.com/vitamins-and-supplements/video/drugs-vs-supplements

   The Real Story of Snake Oil (1:44)
   https://www.youtube.com/watch?v=LaDsOJATX3A
5. Read FDA's Fact Sheet: Cosmetics Facts
   https://www.fda.gov/media/93074/download
6. Review the answers on your worksheet. Based on the information learned from the videos and the Cosmetics Fact Sheet, check if your initial choices are correct, and if necessary, move items into their correct categories.
7. As a class, discuss the differences among the product categories.

REVIEW

What are some examples of dietary supplements?
Dietary supplements can be vitamins, minerals, live microbials (commonly referred to as "probiotics"), herbs, botanicals, extracts, fish oil, amino acids, or enzymes.

How do dietary supplements differ from drugs? From foods? From cosmetics?
Dietary supplements are taken **in addition to** food, to supplement the diet, and they must be taken orally (not applied topically). In contrast, drugs are Intended to, among other things, treat or prevent disease.

EXTENSIONS

Students could do one or more of the following activities:

1. Design a poster (for display in class or online) to inform other high school students about different categories of dietary supplements.
2. Create a game for middle school students that will teach them how to recognize what a dietary supplement is.
3. Design a similar card activity using a different set of items with properties similar to those in the original set.

SUMMARY

Dietary supplements should not replace eating healthy food. You should always talk with your healthcare provider before you consider taking a dietary supplement.

UP NEXT ▶ ▶ ▶

Now that you can identify a dietary supplement, let's take a closer look at the label that informs people about what is in dietary supplements.

RESOURCES

U.S. Pharmacopeia
https://qualitymatters.usp.org/index.php/topics/dietary-supplements

Dietary Supplement Practicum (5 of 21): Drugs vs. Foods vs. Dietary Supplements
https://www.youtube.com/watch?v=3EtmTEHZi0Y

Dietary Supplements: A Framework for Evaluating Safety
https://www.ncbi.nlm.nih.gov/books/NBK216048

STUDENT WORKSHEET

ACTIVITY 1: PRODUCT CATEGORIES

Name _____ Date _____ Class/Hour _____

Consider each product below and complete the chart. Some products could be in more than one category.

Product	Food, Drug, Cosmetic, Dietary Supplement, or multiple possible categories?	What evidence did you use to decide on this category?	Safety evaluated before or after sales?
 Orange-flavored lip balm			
 Daily multivitamin			
 Whitening toothpaste that helps prevent cavities			
 Biotin pills (100 micrograms each)			
 Energy Drink			
 Whey protein powder			
 Coconut-scented shampoo			
 Vitamin E oil			
 Sleep aid liquid (OTC)			
 Caffeine lozenges			
 Yogurt			
 Weight loss pill			

WEIGHT LOSS PILL

VITAMIN E OIL

TOOTHPASTE

SLEEP AID

PROTEIN POWDER

LIP BALM

MULTIVITAMIN

ENERGY DRINK

SHAMPOO

CAFFEINE LOZENGES

YOGURT

BIOTIN

ACTIVITY 2: SUPPLEMENTS VS. FOOD

TIME One 45-Minute Class Period

ACTIVITY AT A GLANCE

Students will examine a Supplement Facts label for a product containing a multivitamin, or fish oil. They will choose one component shown on the label, and identify food sources to achieve the same daily intake amount.

TIME TO TUNE IN

Understand Changes to Dietary Supplement Labels (2:02)
https://www.youtube.com/watch?v=kLploVqHjBA

Understanding Pre and Probiotics (3:14)
https://www.youtube.com/watch?v=U1p4YMU3vWk

Vitamins and Minerals – Nutrition Fundamentals (6:58)
https://www.youtube.com/watch?v=qgNURQFWNWM

GETTING STARTED

MATERIALS

- Sample **Supplement Facts** label
- **Supplement Facts Label** student worksheet
- Credible Source Guide

ADVANCE PREPARATION

- Students can work individually or in groups.
- Make a copy of the **Supplement Facts Label** student worksheet for each student.
- Confirm internet access for online teaching.

INTRODUCTION

A balanced diet typically offers all the nutrients people need. If you are considering taking a dietary supplement, how do you think your overall nutrient intake might differ if you consumed the same nutrients through the foods you eat and the beverages you drink?

SUPPLEMENTS VS. FOOD

STUDENT PROCEDURE

1. Watch these three videos:

   Understand Changes to Dietary Supplement Labels (2:02)
   https://www.youtube.com/watch?v=kLploVqHjBA

   Understanding Pre and Probiotics (3:14)
   https://www.youtube.com/watch?v=U1p4YMU3vWk

   Vitamins and Minerals – Nutrition Fundamentals (6:58)
   https://www.youtube.com/watch?v=qgNURQFWNWM

2. Review the instructions on the Supplement Facts Label worksheet and choose a Supplement Facts label to examine. You can use the one provided or choose a different one from the references on the worksheet, from a supplement bottle from home, or from the NIH Dietary Supplement Label Database: https://dsld.od.nih.gov

3. If you choose a different label, make a copy/photo of the label to add to the worksheet.

4. Complete the **Supplement Facts Label** student worksheet.
   - Select one component in the dietary supplement to study further.
   - List the dietary supplement component category (e.g., vitamins, minerals).
   - How much of that component is in one dose/serving of the supplement?
   - Is this component water soluble?
   - Identify foods and/or beverages that could be consumed to match the same quantity of your chosen dietary supplement component. Using the Nutrition Facts label (or online nutrition data) to list each food and/or beverage and the amount of this component per serving.
   - What are some of the other nutrients (e.g., dietary fiber) provided by consuming the food choices that are not in the dietary supplement?

5. When you have completed your worksheet, discuss your answers with the whole class.

REVIEW

What is included on a Supplement Facts label?
This label includes the serving size, servings per container, the amount per serving for many components, and the % Daily Value for some components. The label also lists Other Ingredients such as fillers and preservatives in the supplement.

Why is a Daily Value shown for some dietary supplement components and not shown for others?
Not all nutrients or dietary supplement components have an established Daily Value. For example, omega-3 fatty acids found in fish oil supplements do not have a Daily Value.

EXTENSIONS

Students could do one or more of the following activities:

1. Make a poster showing how to read parts of a Supplement Facts label.
2. Identify five nutrients to get more of and create a daily menu that fulfills this goal.

SUMMARY

The same nutrients that are in dietary supplements are also available in foods and beverages. Foods and beverages also usually provide additional nutrients and health benefits not found in dietary supplements.

RESOURCES

How to Read a Supplement Label
https://qualitymatters.usp.org/how-read-supplement-label

Osmosis.org: Prebiotics & Probiotics
https://www.youtube.com/watch?v=0z47wLZ4-O4

Probiotic Product Labels
https://isappscience.org/for-consumers/probiotic-product-labels/

How to Evaluate Health Information on the Internet: Questions and Answers
https://ods.od.nih.gov/HealthInformation/How_To_Evaluate_Health_Information_on_the_Internet_Questions_and_Answers.aspx

UP NEXT ▶ ▶ ▶

Now that you are more familiar with Supplement Facts labels, let's take a closer look at some more dietary supplements issues that might be helpful to know about.

STUDENT WORKSHEET

ACTIVITY 2: SUPPLEMENT FACTS LABEL

Name _____ Date _____ Class/Hour _____

Use the Supplement Facts label to the right or choose another one that includes multivitamins, live microbials (commonly referred to as "probiotics"), or fish oil. You could use a label from a dietary supplement found in your home, find one online, or choose one from the NIH Dietary Supplement Label Database: https://dsld.od.nih.gov.

Supplement Facts

Serving Size 1 Gelcap
Servings Per Container 100

	Amount Per Serving	% Daily Value
Vitamin A (as retinyl acetate and 50% as beta-carotene)	900 mcg	100%
Vitamin C (as ascorbic acid)	90 mg	100%
Vitamin D (as cholecalciferol)	20 mcg (800 IU)	100%
Vitamin E (as dl-alpha tocopheryl acetate)	15 mg	100%
Thiamin (as thiamin mononitrate)	1.2 mg	100%
Riboflavin	1.3 mg	100%
Niacin (as niacinamide)	16 mg	100%
Vitamin B_6 (as pyridoxine hydrochloride)	1.7 mg	100%
Folate	400 mcg DFE (240 mcg folic acid)	100%
Vitamin B_{12} (as cyanocobalamin)	2.4 mcg	100%
Biotin	3 mcg	10%
Pantothenic Acid (as calcium pantothenate)	5 mg	100%

Other ingredients: Gelatin, lactose, magnesium stearate, microcrystalline cellulose, FD&C Yellow No. 6, propylene glycol, preservatives (propylparaben and sodium benzoate).

Choose one of the key components, such as a specific vitamin or mineral listed on the label of your chosen supplement, to research and answer the following questions about that component:

1. Identify your chosen supplement _____
2. Which component of that supplement will you research?

   _____
3. How much of that component is in one dose/serving?

   _____
4. Is this component water soluble? _____
5. Complete the first line of the chart below with information about your component.
6. Research your chosen component to learn about foods/beverages that contain that component; list at least 3 different foods/beverages that contain your chosen component on the chart below.

Use the Nutrition Facts label (or online nutrition data, such as this database https://fdc.nal.usda.gov/index.html) to research each food and/or beverage to complete the chart below. Your completed chart will help you identify food sources that could provide you with the same daily intake amount.

Dietary supplement versus food/beverage consumption			
Dietary Supplement Component	**Amount per serving**	**Number of servings/day**	**Daily total amount consumed**
Food or beverage	**Nutrient amount per serving**	**Number of servings consumed**	**Total amount consumed**
Could you get enough of this component in foods you would eat?			

Choose one of the foods or beverages in column 1, and list some of the other nutrients (e.g., protein) that are found in that food that are **not** in the dietary supplement?

-

MODULE 2 DIETARY SUPPLEMENTS: RISKS, REALITIES, AND REPORTING

Healthy Skepticism about Work-Out and Weight Loss Dietary Supplements, Awareness of Misleading Product Labeling, and Paying Attention to Adverse Reactions

The content in this module recommends that teachers will have already taught students the following underlying key concepts: homeostasis, human body systems and their interconnectedness, and critical skills to evaluate marketing labels.

BACKGROUND INFORMATION

"Too Good to be True?" shows teens that dietary supplements marketed as bodybuilding (or muscle-building) and weight loss products can contain unsafe or undeclared ingredients in uncertain quantities. It also guides them to talk with their healthcare providers and report adverse reactions they experience with these products.

ACTIVITY 1

Banned from Sports helps students understand that the United States Anti-Doping Agency (USADA) prohibits competing athletes from using certain ingredients that may be in dietary supplements.

Time to Tune In
Athlete Voices - Abby Raymond (3:31)
https://www.youtube.com/watch?v=d9tVERZHsBY

ACTIVITY 2

Dietary Supplements and Advertising teaches teens to critically evaluate some of the deceptive and misleading advertising used to promote many dietary supplements to them.

Time to Tune In
Teenagers using dietary supplements (1:00)
https://www.youtube.com/watch?v=hWbx-tSXOuI

The Simple Truth: Decoding the Dietary Supplement Industry (3:00)
https://www.youtube.com/watch?v=7HIvIIM-35w

Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency (7:24)
https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

BACKGROUND INFORMATION

"Too Good to be True?"

When Dietary Supplements Pose Potential Health Risks

As you learned in Module 1, dietary supplements can serve as a *secondary source* of nutrients. They can help you meet the daily requirements of certain nutrients that your body needs, but remember that a healthy and balanced diet should always be the *primary source* of those vitamins and minerals that your body needs to function.

Although some dietary supplements can be beneficial to health, taking certain supplements can also involve health risks. The U.S. Centers for Disease Control and Prevention (CDC) has estimated that 23,000 emergency room visits each year are attributed to dietary supplement use. (New England Journal of Medicine) Examples of types of potentially risky dietary supplements are **muscle-building/ bodybuilding** products and **weight loss** products.

Previous Points to Remember

- Dietary supplements are *not* subject to the same requirements as drugs; FDA does not have the authority to approve dietary supplements or their labeling.
- Dietary supplements should *never* be used in place of prescription medications.

What's on the Label? – Common Ingredients in Muscle-Building or Weight Loss Products

Dietary supplements marketed as **muscle-building or exercise-enhancing** can contain a variety of ingredients. These might include:

- Vitamins and minerals
- Protein
- Amino acids
- Herbs
- Caffeine

Dietary supplements marketed for **weight loss** can contain ingredients that are different from those found in bodybuilding products. In fact, many supplements can contain dozens of ingredients—even as many as 90 ingredients or more. Common ingredients in these supplements include:

- Botanicals (herbs and other plant components)
- Dietary fiber
- Caffeine
- Minerals

Depending on the product, the ingredients will be listed in different amounts and combinations. If you are considering a specific supplement, be sure to check the Supplement Facts label and ingredient list.

The National Institutes of Health (NIH) provides lists of common ingredients found in bodybuilding and weight loss products, along with detailed information about each ingredient. These are great resources to use as you examine the label of any dietary supplement you might be considering. It's important to do your research.

NIH Dietary Supplements for Exercise and Athletic Performance (https://ods.od.nih.gov/factsheets/ExerciseAndAthleticPerformance-Consumer/)

NIH Dietary Supplements for Weight Loss (https://ods.od.nih.gov/factsheets/WeightLoss-HealthProfessional/)

Sample Performance Supplement Label

Supplement Facts

Serving Size 2 capsules
Servings Per Container 60

Ingredient	Amount Per Serving	% Daily Value
Creatine Monohydrate	1500 mg	*

*Daily value not established

Other Ingredients: Gelatin, magnesium stearate, silicon dioxide.

BACKGROUND INFORMATION

DID YOU KNOW?

Companies that make supplements are responsible for ensuring the quality and safety of their products. But this doesn't always happen—and some products marketed as supplements may contain drug ingredients or ingredients not listed on the label. Sometimes, the amount of an ingredient listed on the label is not how much is actually in the product.

Be Aware of Hidden (and Dangerous) Ingredients

You could unknowingly take products that are marketed as dietary supplements but that actually include prescription drug ingredients, controlled substances, or untested and unstudied pharmaceutically active ingredients. These deceptive products can harm you!

Hidden ingredients in bodybuilding and weight loss products are a difficult challenge. FDA actively works to identify and remove from the market over-the-counter products, frequently represented as dietary supplements, that contain **undeclared ingredients** that could be harmful.

Updated public notifications about specific bodybuilding and weight loss products that have been found to be tainted are posted on FDA's website. These are important sources for anyone considering either of these types of supplements.

Tainted Bodybuilding Products and Ingredients

Tainted Weight Loss Products and Ingredients

DID YOU KNOW?

FDA Says Some Illegal Products Marketed as Dietary Supplements *May* Contain Hidden Drugs

Potentially harmful active pharmaceuticals (drugs) continue to be identified in over-the-counter products marketed as dietary supplements.

From 2007 through 2016, FDA studies showed that unapproved *drug* ingredients were identified in 776 products. These products were tainted with drugs, and yet many were marketed as dietary supplements or even foods. What's more, 157 of the tainted products (20.2%) contained *more than one* undeclared ingredient.

These products were commonly marketed for weight loss, muscle building, etc. and often marketed as products that provide an immediate or prescription drug-like effect.

Risk Outweighs Reward: An Inside Look at Bodybuilding Products

Bodybuilding products are typically marketed as pills, powders, energy bars, or drinks. In a society where sports achievements are often idolized, it's understandable that some athletes may look for a "shortcut" to build muscles and increase strength. "Bodybuilding" products include "pre-workout," "workout," and "recovery" products.

It is not uncommon for bodybuilding products sold online or in retail stores to be labeled as dietary supplements. Some may even make safety claims, such as stating that they don't cause liver damage. But FDA has cautioned that bodybuilding products can contain steroids or steroid-like substances. These ingredients are associated with potentially serious health risks, including life-threatening liver injury.

Many bodybuilding products are not dietary supplements at all. They are illegally marketed, unapproved drugs that have not been reviewed for safety, effectiveness, or quality.

That means consumers are unknowingly at risk of ingesting dangerous ingredients from products that promote "miraculous" results or make empty promises.

HEALTH ALERT: It is especially difficult to know whether sports supplements are safe because it's unusual to have long-term studies that focus on teens. Products marketed as sports supplements also may contain harmful drugs or additives that are *not listed on the label.*

That's why it is *critical* to talk to your healthcare provider if you're considering taking a sports supplement.

BACKGROUND INFORMATION

What is a Steroid?

The term "steroid" refers to a type of compound that has a specific molecular structure. Generally speaking, steroids mimic hormones that are produced by glands in the human body. But there are different *types* of steroids. Some are used to treat health problems—but others can be dangerous.

Corticosteroids: These are common steroids that are taken—usually for a short time—for a variety of health issues. Corticosteroids are similar to the hormones that your adrenal glands make to fight stress associated with illnesses and injuries. They also reduce inflammation and affect the immune system. Corticosteroids are a class of drugs and are often prescribed by a healthcare provider for the treatment of:

- Arthritis
- Asthma
- Autoimmune diseases such as lupus and multiple sclerosis
- Skin conditions such as eczema and rashes
- Some kinds of cancer

Because they are strong medicines, they can cause side effects such as weakened bones. That's why people usually take them for as short a time as possible, and it's important to always follow the instructions from healthcare providers.

Anabolic steroids: These steroids can have **harmful effects**. They mimic the actions of the male sex hormone, *testosterone*: they promote the growth of cells, especially in muscle, and maintain or increase male physical characteristics. Anabolic steroids are a class of drugs that are considered controlled substances, subject to very strict regulations, and only legally available with a doctor's prescription.

In the medical community, anabolic steroids are also known as anabolic-androgenic steroids (AAS). These synthetically produced substances replicate naturally occurring testosterone; "anabolic" means muscle-building, and "androgenic" indicates increased male sexual characteristics.

Sources: Medline steroid information and Mayo Clinic steroid information

To learn more about bodybuilding products and FDA's warnings about them, visit: https://www.fda.gov/consumers/consumer-updates/caution-bodybuilding-products-can-be-risky

Steroid- Related Risk Prevention Efforts

1990 Congress passed the **Anabolic Steroid Act of 1990**, amending the Controlled Substances Act to provide criminal penalties relating to the use of anabolic steroids and including more than 24 substances under the definition of anabolic steroid.

2004 The **Anabolic Steroid Control Act of 2004** banned over-the-counter steroid precursors (substances the human body can convert into steroids), increased penalties for making, selling, or possessing them, and funded preventive education to children. The Anabolic Steroid Control Act largely gave the Drug Enforcement Administration (DEA) authority to schedule steroids into drug categories.

2016 FDA approves new changes to testosterone labeling regarding the risks associated with abuse and dependence of testosterone and other anabolic androgenic steroids (AAS) https://www.fda.gov/drugs/drug-safety-and-availability/fda-approves-new-changes-testosterone-labeling-regarding-risks-associated-abuse-and-dependence

DID YOU KNOW?

The U.S. Drug Enforcement Agency (DEA) oversees controlled substances. Drugs are placed on this list based upon the substance's medical use, potential for abuse, and safety or dependence liability. Learn more here: https://www.dea.gov/controlled-substances-act

BACKGROUND INFORMATION

Anabolic Steroids: Under the Microscope

As tempting as a "quick fix" to increase muscle size might sound, there are *frightening* risks in using anabolic steroids. For many years, public health experts have warned about the potentially dangerous effects of these drugs, *especially* among teens. According to the American Medical Association (AMA), anabolic steroids are considered toxic (poisonous).

According to AMA, risks include:

- Hair loss
- Severe acne
- Liver injury
- Blood clots in the lungs or veins
- Heart attack and stroke
- Seizures
- Anxiety, fear, depression, and mood changes
- Irritability and "steroid rage" (sudden random outbreaks of anger)
- Reduced mature height
- Injury to ligaments, bone, and cartilage that hasn't grown as quickly as muscles
- Altered function of the ovaries in young women—even after discontinued use
- Kidney damage
- Sudden death

Enhance Your Athleticism the Healthy Way: Four Proven Steps

- Get plenty of sleep.
- Eat a healthy diet. Consult a physician or dietitian if you feel that you need advice.
- Use a safe training plan. Ask a coach or fitness instructor for guidance.
- Avoid alcohol and tobacco/nicotine products.

Examples of Common Sports Supplement Ingredients

Amino acids help build muscle. Examples include glutathione, cysteine, arginine, leucine, glutamine, and citrulline. Despite their typical packaging claims, such as "greater endurance" and "reduced soreness," most studies do not show benefits of taking amino acid supplements. They can cause side effects and have not been studied to determine safety for use by teens.

Creatine in the body helps make energy for muscle contractions. While it can help athletes have short bursts of intense exercise with short recovery times, studies have rarely explored whether it can be safely used by teens. Research shows that it can harm the kidneys, so doctors typically do not recommend it for those under 18. Side effects include:

- weight gain
- joint stiffness
- muscle cramping
- nausea
- headaches

DID YOU KNOW?

The American Academy of Pediatrics advises against using creatine. But a related study* has shown that health food store employees frequently recommend creatine and testosterone "boosters" to male high school athletes when they visit their stores as customers. Don't rely on a store clerk for advice about supplements – instead, rely on your doctor's advice.

* *Dietary Supplements and Young Teens: Misinformation and Access Provided by Retailers* https://pediatrics.aappublications.org/content/139/2/e20161257

Protein supplements are typically made of the proteins *casein* and *whey*. They are usually marketed as powders that can be mixed with water, milk, milk substitute, or other liquid. But while protein supplement labels often claim the product(s) will build muscles, the reality is that most people get all the protein they need by eating a balanced diet.

A protein supplement may help someone who doesn't get enough protein in their diet; for example, if they are vegan, recovering from an injury, or experiencing a rapid growth period. While they usually don't cause serious side effects, high doses can cause:

- thirst
- bloating
- cramps
- diarrhea
- lack of appetite
- tiredness

As with other nutrients, the best choice is to get protein from eating nutrient-dense foods such as eggs.

BACKGROUND INFORMATION

DID YOU KNOW?

Another common ingredient in bodybuilding or weight loss supplements is caffeine.

Stay tuned for Module 3!

Always read the label to see what ingredients are listed in the supplement you are considering. Then do your research! The U.S. Department of Agriculture's (USDA) list of Dietary Supplements for Athletes includes a list of Dietary Supplements for Exercise and Athletic Performance that can help: https://www.nutrition.gov/topics/dietary-supplements/dietary-supplements-athletes. The National Institutes of Health, Office of Dietary Supplements, also provides many fact sheets for dietary supplements that are listed alphabetically, including fact sheets on dietary supplements for exercise & athletic performance and dietary supplements for weight loss: https://ods.od.nih.gov/factsheets/list-all.

Fad Diets: *Not* a Miracle Cure

Weight loss/weight control supplements can have serious adverse effects on teens and young adults.

In 2019, FDA conducted a study based upon 10+ years of adverse event reports (just under 1,000 reports) for weight loss supplements for people up to age 25. Severe medical events listed in these reports included death, disability, life-threatening events, hospitalization, emergency room visits, and/or required intervention to prevent permanent disability. It was found that these supplements were associated with almost three times the risk for severe symptoms than vitamin supplements. Source: Journal of Adolescent Health (report abstract: https://www.jahonline.org/article/S1054-139X(19)30163-6/fulltext)

Why People "Diet"

There are different reasons people choose to monitor their diet. Maybe they are at an unhealthy weight according to CDC guidelines and are monitoring their nutrient intake and activity. Maybe they just think they'd look and feel better. Or maybe they participate in sports and want to be in top condition. Whatever the reason, sometimes people consider trying dietary supplements that promise quick and "miraculous" results. But, just as with other dietary supplement claims, do they sound too good to be true?

It is important to remember that people need calories to keep their bodies running well. That's why a diet without a variety of nutrient-dense foods can be harmful. It's also why diets that promote cutting out certain nutrient groups (like carbohydrates) or eating only limited foods (like cabbage soup or grapefruit) are a bad idea, and are sometimes dangerous. These scenarios would make it extremely hard—if not impossible—to get the vitamins, minerals, and other nutrients your body needs.

Don't Let Dietary Habits Become Dangerous

Sometimes, bad situations can affect eating—examples could be a stressful homelife or difficulty at school. This can sometimes lead to eating disorders like anorexia (eating too little), bulimia (vomiting after eating), or binging (feeling an inability to stop eating). These conditions are unhealthy and dangerous.

Warning signs that your food habits may have become dangerous are:

- Thinking about food all the time—or having a fear of food
- Restricting activities or avoiding family and friends because of food or need to exercise
- Wearing baggy clothes as a way to hide thinness
- Vomiting after meals or using laxatives
- Feeling weak, lightheaded, or dizzy from not eating
- Taking dietary supplements that promise weight loss
- Continuing to diet, even if you are at a healthy weight. CDC offers excellent information for assessing your healthy weight: https://www.cdc.gov/healthyweight/assessing/index.html
- Eating in secret or feeling out of control when you eat

If you or a friend are experiencing any of these eating issues, talk to a trusted adult or your healthcare professional.

To maintain a healthy weight, the Nutrition Facts label can be your go-to guide. Remember to check out *Science and Our Food Supply: Using the Nutrition Facts Label to Make Healthy Food Choices* for tips that ensure a balanced and nutrient-rich diet.

Adapted from The Deal With Diets

BACKGROUND INFORMATION

Instead of considering a quick fix, try these ideas:

- Choose healthy meals and snacks. (Check out *Science and Our Food Supply: Using Nutrition Facts Label to Make Healthy Food Choices* for guidance https://www.fda.gov/media/109430/download.)
- Aim to eat more fruits, veggies, and whole grains, and drink water instead of sugary beverages like sports drinks or sodas.
- Cut back on meats high in fat (like burgers and hot dogs), fried foods, sweets, and other junk food.
- Get regular exercise. It helps you maintain a healthy weight, promotes normal growth, and can help you feel great! (CDC has a great online resource for exercise and activity inspiration. Check out Active People, Healthy Nation for ideas.)

DID YOU KNOW?

Everyone needs fat in their diet for their body to function properly. About 35% of your total calories should come from fat.

Dietary Supplement Recalls: At a Glance

- FDA can take action to remove products from the market, but the agency must first establish that such products are "adulterated" (tainted or unsafe) or "misbranded" (labeling is false or misleading).
- While FDA can issue a *mandatory* recall for a dietary supplement, manufacturers usually *voluntarily* recall products of concern.
- Dietary supplements comprise only a small portion of total FDA recalls: just 2% of more than 800 recalls initiated in 2019 involved dietary supplement products.

Alerting FDA: When and How to Report a Dietary Supplement

As you learned in Module 1, dietary supplements usually are not reviewed by FDA before they are sold to the public. That's why it's important for everyone—consumers, healthcare professionals, and industry members—to report issues, called "adverse events," to FDA. Adverse events include reactions/symptoms or illnesses you might experience after taking a dietary supplement. The reports help the Agency to take action to protect the public from unsafe products.

Recognizing Serious Reactions or Illnesses

Adverse events from taking dietary supplements can range from itching, fatigue, and diarrhea, to severe joint/muscle pain, heart palpitations, and hospitalization.

- Itching, rash, hives, throat/lip/tongue swelling, wheezing
- Low blood pressure, fainting, chest pain, shortness of breath, palpitations, irregular heartbeat
- Severe, persistent nausea, vomiting, diarrhea, or abdominal pain
- Fatigue or appetite loss
- Yellowing skin/eyes
- Severe joint/muscle pain
- Marked mood (irritability, anxiety), cognitive, or behavioral changes, thoughts of suicide
- Difficulty urinating, decreased urination, blood in urine, or dark urine
- Blood in stool, vomit, or sputum
- Abnormal bleeding from nose or gums
- Slurred speech, one-sided weakness of face, arm, leg, vision (these are signs of stroke)
- Visit to emergency room or hospitalization

Contact your healthcare provider if you have any of these adverse reactions.

BACKGROUND INFORMATION

When to Report

If you think that a dietary supplement may have caused one of these serious reactions or illnesses, **stop using the product immediately** and contact your healthcare provider. Then fill out a safety report through the Safety Reporting Portal to submit your complaint to FDA.

Here's how:

- Go to the Department of Health and Human Services **Safety Reporting Portal** (https://www.safetyreporting.hhs.gov/SRP2/en/Home.aspx?sid=6ee28a3a-aa2f-4480-92c4-b7ea22b91a81).
- After logging in or choosing to report as a guest, select the option "Start a new report" and choose "Dietary Supplement Report (voluntary)"
- Include as much detail as you can. Complete reports are the most helpful, but even a small amount of information can help FDA to identify potentially dangerous products.

Before You Start

Check out the FAQ (Frequently Asked Questions) page on the Safety Reporting Portal; you will learn about how to use the portal, how to complete and submit a report, what happens to the report, answers to technical questions, and so much more.

FDA can help if you have any problems reporting a dietary supplement.

- If you need technical support to complete your report, contact SRPSupport@fda.hhs.gov
- If you have questions that weren't addressed on the FAQ, contact DSRSupport@fda.hhs.gov

FDA Offers Information on Specific Dietary Supplement Ingredients

The two helpful resources below provide in-depth information about dietary supplement products, ingredients, and other supplements. You can compare these resources to the labels of dietary supplements you are investigating.

1. FDA Dietary Supplement Products and Ingredients: Lists selected products that FDA has determined are **unsafe or misleading.**
2. FDA Dietary Supplement Ingredient Advisory List: Lists products that FDA is **currently evaluating**.

Products and Ingredients List

As you have learned, FDA can take action to remove products from the market if they find them to be adulterated (the product is unsafe) or misbranded (the labeling is false or misleading). As of 2021, the following ingredients have been the subject of FDA action and/or statements:

- Acacia rigidula
- BMPEA
- Cesium Chloride
- DMAA
- DMBA
- DMHA
- Methylsynephrine
- Phenibut
- Picamilon
- Pure Powdered Caffeine
- Tianeptine

Ingredient Advisory List

This list includes ingredients that do not appear to be lawfully included in dietary supplements. It's important to be aware of this list and compare it to the labels of dietary supplements you are investigating. If an ingredient is on this list, it doesn't necessarily mean that it is NOT safe; it means FDA is taking steps to further evaluate the ingredient. The list includes synonyms for the named ingredients, to help you recognize them on the label.

As of 2021, these are the ingredients on the list:

- 1,4-DMAA
- 5-Alpha-Hydroxy-Laxogenin
- Andarine
- Bismuth nitrate
- Higenamine
- Hordenine
- N-Methyltyramine
- Octopamine
- Sodium tetrachloroaurate
- Sulbutiamine

BACKGROUND INFORMATION

FDA On the Job: Reviewing "Adverse Event" Reports for Bodybuilding Products

FDA tracks and reviews adverse event reports submitted by physicians and consumers. This includes reports made about anabolic steroids between July 2009 and December 2016. For example, during this time, 35 reports showed evidence of serious liver injury. FDA followed up on these reports and, where applicable, notified companies of violative products and advised consumers to immediately stop using over-the-counter body-building products labeled or promoted to contain steroid and steroid-like substances due to the risk of serious liver injury and other adverse health consequences.

By studying these reports, FDA learned that bodybuilding products are often promoted as "hormone products" and/or as "alternatives to anabolic steroids" to increase muscle mass and strength. In fact, while many of these products make claims about their ability to enhance or diminish androgen, estrogen, progestin-like effects in the body, they actually contain anabolic steroids or steroid-like substances (for example, synthetic hormones related to testosterone).

Case Study—DMAA: A Dangerous Ingredient

In 2013, FDA began its efforts to ensure that dietary supplements containing a stimulant called **dimethylamylamine (DMAA)** were no longer distributed or available for sale to consumers in the marketplace. This action was taken after FDA received **86 reports of illnesses and death, including heart problems and nervous system or psychiatric disorders,** associated with supplements containing DMAA.

FDA warned consumers that DMAA can pose cardiovascular risks ranging from high blood pressure to heart attacks.

Even though FDA stated publicly that DMAA is not allowed in dietary supplements, four years later, FDA was still finding dietary supplements containing DMAA in the marketplace. This does not mean FDA has changed its position on DMAA.

Remember: FDA's authority for dietary supplements is all post-market – FDA does not approve dietary supplement products before they are marketed.

To learn more about hormones, see TeensHealth's explanation of the *Endocrine System* https://teenshealth.org/en/teens/endocrine.html?ref=search.

What to Do If You've Taken a Bodybuilding Product

If you're taking any bodybuilding products that claim to contain steroids or steroid-like substances, FDA recommends that you **stop taking them immediately** because of the potentially serious health risks associated with using them.

In addition, talk to a health care professional about any bodybuilding products and/or ingredients you have taken or are planning to take. Let them know if you are experiencing *any* of these symptoms: nausea, weakness or fatigue, fever, abdominal pain, chest pain, shortness of breath, jaundice (yellowing of the skin or whites of the eyes), or brown or discolored urine. It's important!

DO YOUR RESEARCH!

The most important thing to do when exploring or considering using a dietary supplement is to **not** assume that marketing claims, ads, etc., are accurate. If claims sound too good to be true, they probably are. You should be cautious of product claims such as "works better than [a prescription drug]," "totally safe," or has "no side effects."

Do your own research. When you research specific supplements and their ingredients, **always use credible and impartial sources**—not product websites. Credible sources include:

- Government health sites like FDA, USDA, CDC, NIH, and Medline
- Medical organizations like AMA and American Academy of Pediatrics (AAP)
- Reputable medical/hospital sources like the Mayo Clinic, Cleveland Clinic, and the New England Journal of Medicine

Always remember to talk to your doctor, pharmacist, or other healthcare professional before deciding to purchase or use a dietary supplement.

ACTIVITY 1: BANNED FROM SPORTS

TIME Three or four 45-Minute Class Periods

ACTIVITY AT A GLANCE

Students will learn that dietary supplements can include ingredients that are prohibited in sports and about resources that are available to answer their questions about dietary supplements and their ingredients.

TIME TO TUNE IN

Athlete Voices - Abby Raymond (3:31)
https://www.youtube.com/watch?v=d9tVERZHsBY

GETTING STARTED

MATERIALS

- Internet access
- **Banned from Sports** worksheet
- **Credible Source Guide**
- **Presentation Rubric**

ADVANCE PREPARATION

1. Divide the class into small groups.
2. Make copies of the **Banned from Sports** worksheet, **Credible Source Guide** and the **Presentation Rubric** for each group.

INTRODUCTION

Students who participate in sports may use dietary supplements for a variety of reasons that include helping them to perform better. Sometimes the supplements may contain a prohibited ingredient that can cause the athlete to be suspended or banned from a sport for a period of time. What are some of these ingredients and how can a student athlete limit the risk of consuming them? If students have a question about a dietary supplement and/or its ingredients, where can they get reliable information about that?

Discuss the reasons a student might be suspended or banned from participating in a particular sport, and why sometimes the suspension or ban from a sport also can apply to anyone involved with the team, including the student manager. (Students can refer to their school's *Athlete's Code of Conduct,* usually found in the Student Handbook.) The United States Anti-Doping Agency (USADA) monitors athletic competitions and provides information about banned ingredients.

Sometimes students consume dietary supplements that they believe are safe, but may contain ingredients that are prohibited and may be harmful to their health. Sometimes these ingredients are not listed on the product label. Students will research prohibited ingredients in dietary supplements that can result in a student's suspension or ban from a sport.

BANNED FROM SPORTS

STUDENT PROCEDURE

Day 1

1. Watch the video – *Athlete Voices - Abby Raymond* (3:31) https://www.youtube.com/watch?v=d9tVERZHsBY and then discuss these questions with your group:

   What was the banned substance in Abby's supplement? Why did Abby think the supplement was safe to take? Have you heard of other instances when people were suspended or banned from a sport? What was the reason for that suspension or ban?

   What are some of the substances that can cause issues for athletes? How do athletes access these substances?

   There are other substances found in supplements that are not drugs and are prohibited for athletes. What kind of ingredients might be prohibited for athletes and why do you think they are prohibited?

2. Choose and research one of the following ingredients about which FDA has expressed concerns: 1,4-DMAA; Andarine; BMPEA; DMBA; DMHA; Higenamine; Hordenine; Methylsynephrine; N-Methyltyramine; Octopamine; Picamilon. (Sources: *Supplement 411 High Risk List* https://supplement411.org/hrl/#HighRiskList; *Dietary Supplement Ingredient Advisory List* https://www.fda.gov/food/dietary-supplement-products-ingredients/dietary-supplement-ingredient-advisory-list#collapseDMAA; *Dietary Supplement Products & ingredients* https://www.fda.gov/food/dietary-supplements/dietary-supplement-products-ingredients.)

   Use credible sources to research your selected ingredient and respond to the questions on the **Banned from Sports** worksheet.

Day 2

1. When you finish your research, plan how your group can creatively present your findings to the class. Ideas for your presentations include a news broadcast; foldable book; poster; infographic; blog entry; video; animated slide show.

2. Each group should also prepare a simple Fact Sheet about the prohibited substance and distribute it to the other groups before they make their presentation.

Day 3

1. Each group should distribute their Substance Fact Sheet to the class before they present their research project; allow time for everyone to quickly review it.

2. After each group makes its presentation, review their Substance Fact sheet again and add any additional information from their presentation that isn't on the sheet.

3. What sources did the group use for its information?

REVIEW

Some dietary supplements are risky for athletes. They could contain ingredients that lead to health problems or ban the athlete from his or her sport.

SUMMARY

It is especially difficult to know whether sports supplements are safe because it's unusual to have long-term studies that focus on teens. Sports supplements also may contain harmful drugs or additives that are *not listed on the label*.

EXTENSIONS

Students could do one or more of the following activities:

1. Create a warning label for prohibited substances in a specific dietary supplement.
2. Research United States athletes who were banned from a sport and the impact this had on their careers (ex: Jessica Hardy).

UP NEXT

Now that you've learned about some prohibited ingredients, let's take a closer look at some dietary supplement advertising.

BANNED FROM SPORTS

RESOURCES

- *Athletes and Supplements: Prevalence and Perspectives*
  https://journals.humankinetics.com/view/journals/ijsnem/28/2/article-p126.xml
- *Dietary Supplement Fact Sheets*
  https://ods.od.nih.gov/factsheets/list-all
- *Dietary Supplements for Exercise and Athletic Performance Fact Sheet*
  https://ods.od.nih.gov/factsheets/ExerciseAndAthleticPerformance-HealthProfessional/
- *Dietary Supplement Ingredient Advisory List*
  https://www.fda.gov/food/dietary-supplement-products-ingredients/dietary-supplement-ingredient-advisory-list
- *Dietary Supplement Product & Ingredients*
  https://www.fda.gov/food/dietary-supplements/dietary-supplement-products-ingredients
- *FAQs and Ask the Expert*
  https://www.usada.org/athletes/substances/supplement-411/supplement-411-faqs
- *For Swimmer, Ban Ends, but Burden Could Last*
  https://www.nytimes.com/2010/08/08/sports/08hardy.html
- *Medication Health Fraud*
  https://www.fda.gov/drugs/buying-using-medicine-safely/medication-health-fraud
- *Request Denied in Clemson Ostarine Case*
  https://wach.com/sports/solid-orange/clemson-tailgate/request-denied-in-clemson-ostarine-case
- *Supplement 411 High Risk List*
  https://supplement411.org/hrl/#HighRiskList
  (note that this link requires a user name & password)
- *Supplement 411*
  Supplement 411 | U.S. Anti-Doping Agency (USADA)
- *The WADA Prohibited List in Action*
  https://www.globaldro.com/US/search
- *Tips for Dietary Supplement Users*
  https://www.fda.gov/food/information-consumers-using-dietary-supplements/tips-dietary-supplement-users

STUDENT WORKSHEET

ACTIVITY 1: BANNED FROM SPORTS

Name _____ Date _____ Class/Hour _____

1. Watch the video – *Athlete Voices - Abby Raymond*
   https://www.youtube.com/watch?v=d9tVERZHsBY

2. Write your responses to the following questions and then discuss with your group:

   a. What was the banned substance in Abby's supplement?

   _____

   b. Why did Abby think the supplement was safe to take?

   _

   _

   c. Have you heard of other instances when athletes were suspended or banned from a sport? What was the reason for that suspension or ban?

   _

   _____

   d. What are some of the substances that can lead to issues for athletes?

   _

   _

   e. How do athletes access the substances?

   _

   _____

   f. There are other substances found in supplements that are not drugs and are prohibited for athletes. What kind of ingredients might be prohibited for athletes and why do you think they are prohibited?

   _

   _

3. Select one of the following ingredients to research: 1,4-DMAA, Andarine, BMPEA, DMBA, DMHA, Higenamine, Hordenine, Methylsynephrine, N-Methyltyramine, Octopamine, Ostarine, Picamilon. Use your research to answer the following questions as succinctly as possible.
   Teacher Note: Information on these websites can be used to evaluate student answers:
   https://www.fda.gov/food/dietary-supplements/dietary-supplement-products-ingredients &
   https://www.fda.gov/food/dietary-supplement-products-ingredients/dietary-supplement-ingredient-advisory-list

   a. What are the different names by which the ingredient is known?

   _

   _____

   b. In what kind of dietary supplement(s) product has the ingredient been found?

   _

   _

continued on next page

STUDENT WORKSHEET

ACTIVITY 1: BANNED FROM SPORTS (CONTINUED)

c. Is this ingredient normally found in a dietary supplement or is it possible that it was mistakenly added?

d. Is the ingredient legal in the United States?

e. What is the reported effect this ingredient will have on the body?

f. Have any studies been conducted about this ingredient and, if so, by whom/which organization?

g. What are the side effects of this ingredient?

h. What promises, if any, does the company marketing the ingredient offer?

i. Has the FDA issued any warning letters about this ingredient and if so, what was the warning and was there a follow-up action from the company?

j. Has the supplement that contains this ingredient been endorsed by anyone and, if so, by whom?

k. How could the *Supplement Guide: Reducing Supplement Risk* help you to make decisions about using banned substances? https://www.usada.org/wp-content/uploads/supplement-guide.pdf

4. When you have completed your research, create a presentation about your supplement ingredient. The presentation might be a news broadcast, foldable book, poster, infographic, blog entry, video, or animated slide show.

5. Prepare a brief Fact Sheet about your supplement ingredient for distribution to the class before your presentation.

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING

TIME Three or four 45-Minute Class Periods

ACTIVITY AT A GLANCE

In this activity, students will learn about the dangers of some dietary supplements and/or their ingredients and review advertisements for dietary supplements. Students will create a video Public Service Announcement (PSA) for their peers about a specific dietary supplement, its dangers to teens, and how it is advertised.

TIME TO TUNE IN

Teenagers using dietary supplements (1:00)
https://www.youtube.com/watch?v=hWbx-tSXOuI

The Simple Truth: Decoding the Dietary Supplement Industry (3:00)
https://www.youtube.com/watch?v=7HIvIIM-35w

Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency (7:24)
https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

DIETARY SUPPLEMENTS AND ADVERTISING

GETTING STARTED

MATERIALS

- Internet Access
- **Dietary Supplements and Advertising** Worksheet
- **Credible Source Guide**
- **Presentation Rubric**

ADVANCE PREPARATION

1. Divide your class into small groups.
2. Secure Internet access
3. Make copies of the **Dietary Supplements and the Media** worksheet, **Credible Source Guide,** and **Presentation Rubric**

INTRODUCTION

Teens may use dietary supplements to lose weight or build muscle; however, using these supplements can put them at risk for serious harm. In this activity, students will research a dietary supplement that could be used to lose weight or build muscle, and look at the possible harm that could result from consuming that supplement. Students will also assess the credibility of information about that supplement from various sources and learn where to find reliable information about supplements.

Ask these questions to begin the discussion about supplements and advertising:

1. **Do you know of any dietary supplements that teens use and why they use them?**
2. **Are you aware of any harm associated with using supplements? If so, please refer to specific dietary supplements for this discussion.**
3. **Have you seen any ads in magazines or on TV that promote dietary supplements, and if so, which supplements do they promote?**

You will watch a short video and read the video script about a study on teen use of dietary supplements. Working in small groups, you will choose a dietary supplement and its ingredients to research, and look at how truthful the advertisements are for the supplement. Look for credible sources to compile information about the use of that supplement (refer to the **Credible Source Guide**). Once you have completed your research, you will create a Public Service Announcement (PSA) about your dietary supplement.

NOTE: Students can either research a supplement of their choice or you can provide a list of dietary supplements. The following website, maintained and frequently updated by the United States Anti-Doping Agency, has a list of high-risk supplements for athletes. It requires a free registration.
Supplement 411 High Risk List
https://supplement411.org/hrl/#HighRiskList

DIETARY SUPPLEMENTS AND ADVERTISING

STUDENT PROCEDURE

1. Everyone should have a copy of the **Dietary Supplements and Advertising** worksheet, the **Credible Source Guide,** and the **Presentation Rubric**. Read each of the statements in the *Prediction Guide* section of your worksheet and in the Before Column, write whether you Agree (A) or Disagree (D) with each statement.

2. Watch the first video, *Teenagers using dietary supplements.*
https://www.youtube.com/watch?v=hWbx-tSXOuI

3. After you watch the video, go back to the statements on the *Prediction Guide* and compare your opinions with information from the video. In the After Column, write whether the information from the video Agrees (A) or Disagrees (D) with the Statement.

4. In the space under each statement, cite the information from the video that supports or refutes your original ideas.

Watch the second video, *The Simple Truth: Decoding the Dietary Supplement Industry*
https://www.youtube.com/watch?v=7HIvIIM-35w

5. The video highlights several problems with dietary supplements; when you finish viewing the video, discuss them with your group.

6. Decide with your group to research either a supplement used for weight loss or muscle building. You will research information about the harmful effects of that dietary supplement and its ingredients, as well as how that supplement is advertised.

7. Respond to the *Research Questions* on the **Dietary Supplements and Advertising** worksheet; your research should address all of the questions about your supplement, as well as how the supplement is advertised.

8. When you have completed your research, use the information to prepare a video Public Service Announcement (PSA) to explain why your chosen dietary supplement should not be used by teenagers, and how that supplement is advertised. Each PSA should include the credible source(s) used for preparation.

9. Watch the following videos that will help you learn about PSAs:

   Tips for creating an effective video PSA
   https://www.youtube.com/watch?v=Kr4Yf1xRb7U

   Best Student Made PSA Ever
   https://www.youtube.com/watch?v=PR7BCsuIWjk&feature=youtu.be

10. Use the following questions to develop your PSA:
    - Who is your audience?
    - What is your message?
    - Which PSA format (from the first video) will best convey your message:
      – Spokesperson format
      – Voice-over PSA
      – Live Action
      – The "Silent Treatment"
    - What part of your research will you use?
    - What is your script?
    - What visuals will you use on your storyboards? Sketch your PSA frame by frame.
    - What props do you think you might need?
    - What is your production plan?
    - What is your visual display plan?

11. Once your PSA plan is complete, you can film the PSA, make your edits, and share your finished product.

12. After you have viewed all of the PSA's, review the reasons why you should avoid using these dietary supplements. Also discuss the advertisements you reviewed and how easy it is to be swayed by the media.

13. Watch the video, *Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency*
    https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

DIETARY SUPPLEMENTS AND ADVERTISING

REVIEW

Dietary supplement product labeling can sometimes be misleading or deceptive to get consumers to buy the products. Consumers need to think carefully, research, and logically assess dietary supplement label information before buying a product.

When you research specific supplements and their ingredients, ***always use credible and impartial sources—not product websites.*** Credible sources include:

- Government health sites like FDA, USDA, CDC, NIH, and Medline
- Medical organizations like AMA and American Academy of Pediatrics (AAP)
- Reputable sources like the Mayo Clinic, Cleveland Clinic, and the New England Journal of Medicine

Always talk to your doctor, pharmacist, or other healthcare professional before deciding to purchase or use a dietary supplement.

EXTENSIONS

Students could do one or more of the following activities:

1. Make a written PSA (instead of a video PSA) about dietary supplements, their ingredients, and advertising.
2. Write a letter of advice to a teenager who has requested information on whether or not to use a dietary supplement.
3. Research how to report a manufacturer of a dietary supplement to the FDA for an advertised claim that wasn't true.
4. Make a list of reliable sources for information about using dietary supplements.

SUMMARY

Always read the label to see what ingredients are listed in the supplement you're considering taking. Then do your research! Without realizing it, consumers can ingest dangerous ingredients from products that promote "miraculous" results or make empty promises.

UP NEXT

Now that you know more about dietary supplement marketing, let's learn more about other dietary supplements, particularly those classified as stimulants.

DIETARY SUPPLEMENTS AND ADVERTISING

RESOURCES

- *15 Supplement Ingredients to Always Avoid*
  https://www.consumerreports.org/vitamins-supplements/15-supplement-ingredients-to-always-avoid
- *Best Student Made PSA Ever* (0:55)
  https://www.youtube.com/watch?v=PR7BCsuIWjk&feature=youtu.be
- *Dietary Supplements and Young Teens: Misinformation and Access Provided by Retailers*
  https://pediatrics.aappublications.org/content/139/2/e20161257
- *Dietary Supplement Fact Sheets*
  https://ods.od.nih.gov/factsheets/list-all
- *Dietary Supplements for Athletes*
  https://www.nutrition.gov/topics/dietary-supplements/dietary-supplements-athletes
- *Dietary Supplements for Exercise and Athletic Performance; Fact Sheet for Consumers*
  https://ods.od.nih.gov/pdf/factsheets/ExercisePerformance-Consumer.pdf
- *Dietary Supplements for Exercise and Athletic Performance*; Fact Sheet for Health Professionals
  https://ods.od.nih.gov/factsheets/ExerciseAndAthleticPerformance-HealthProfessional
- *Dietary Supplements for Weight Loss; Fact Sheet for Consumers*
  https://ods.od.nih.gov/pdf/factsheets/WeightLoss-Consumer.pdf
- *Dietary Supplements for Weight Loss; Fact Sheet for Health Professionals*
  https://ods.od.nih.gov/factsheets/WeightLoss-HealthProfessional
- *Dangerous Ingredients Found in Dietary Supplements* (3:06)
  https://www.youtube.com/watch?v=cJlT5Sdr-YQ
- *Sports Supplements*
  https://kidshealth.org/en/teens/sports-supplements.html
- *Teenagers using dietary supplements* (1:00)
  https://www.youtube.com/watch?v=hWbx-tSXOuI
- *The Simple Truth: Decoding the Dietary Supplement Industry* (3:00)
  https://www.youtube.com/watch?v=7HIvIIM-35w
- *Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency* (7:24)
  https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo
- *Tips for creating an effective video PSA* (5:20)
  https://www.youtube.com/watch?v=Kr4Yf1xRb7U

STUDENT WORKSHEET

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING

Name _____ Date _____ Class/Hour _____

1. Read each of the statements below and write A (Agree) or D (Disagree) in the Before Column.

2. Watch the video, *Teenagers using dietary supplements:* https://www.youtube.com/watch?v=hWbx-tSXOuI

3. Review the Statements on the Prediction Guide and compare your opinions with information provided in the video.

4. In the After column, write whether the information from the video Agrees (A) or Disagrees (d) with the statement.

5. In the space under each Statement, cite the information from the video that supports or refutes your original opinion.

Prediction Guide

Before	STATEMENT	After
	Dietary supplements can cause serious harm or even death.	
	It is ok to combine dietary supplements with prescription medications without consulting a doctor.	
	Dietary supplements sold for weight loss, muscle building or to increase energy are no more risky than vitamin supplements.	
	Dietary supplements may cause harm because they may contain dangerous, unlabeled ingredients.	

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STUDENT WORKSHEET

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING (CONTINUED)

To prepare for the next part of this activity, watch *The Simple Truth: Decoding the Dietary Supplement Industry* (3:00)
https://www.youtube.com/watch?v=7HIvIIM-35w

What is the name of the dietary supplement you will research? _____

Research Questions: As you answer these questions, cite the source for each response. (Refer to the Credible Source Guide.)

1. About the Dietary Supplement and Its Ingredients

a. What are the ingredients in your supplement?

b. Why would someone use this supplement?

c. What scientific evidence, if any, is there to support this use?

d. What are the active ingredients in the supplement?

e. What are the short-term and long-term effects of using this dietary supplement?

f. What harmful ingredients, if any, are found in the supplement and why are they harmful?

g. In which types of stores could you find this supplement? (ex: grocery)

continued on next page

STUDENT WORKSHEET

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING (CONTINUED)

h. How safe is the use of this dietary supplement for high school students?

i. Who might use this supplement?

2. About the Advertisement(s) for the Dietary Supplement and/or Its Ingredients

a. Does the supplement promise a quick fix or does it sound too good to be true?

b. Does the supplement promote any unhealthy habits?

c. Is there a slogan that is used to promote this supplement?

d. If so, what is it, and who is the target audience?

e. How truthful is the slogan?

f. Does the advertisement provide information based on a personal story or testimonial rather than on facts?

3. If you want to find truthful information about this supplement, where would you look?

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STUDENT WORKSHEET

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING (CONTINUED)

PSA Planning

Watch these videos to help you create your PSA.

Tips for creating an effective video PSA (5:20)
https://www.youtube.com/watch?v=Kr4Yf1xRb7U

Best Student Made PSA Ever (0:55)
https://www.youtube.com/watch?v=PR7BCsuIWjk&feature=youtu.be

Write down the tips you will use from the videos as you create your PSA.

Keep these questions in mind as you plan your PSA:

- Who is your audience?
- What is your message?
- Which PSA format (from the first video) will best convey your message:
  - Spokesperson format
  - Voice-over PSA
  - Live Action
  - The "Silent Treatment"
- What part of your research will you use?
- What is your script?
- What visuals will you use on your storyboards? Sketch your PSA frame by frame.
- What props do you think you might need?
- What is your production plan?
- What is your visual display plan?

Once your PSA plan is complete you can begin filming. A strong plan, with a tightly edited script, will result in a good PSA. Your PSA might require several edits and/or "takes" until you are ready to share it with your class.

As a final wrap-up, view this video:

Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency (7:24)
https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

MODULE 3 CAFFEINE, ENERGY PRODUCTS, AND BOTANICALS: SHORTCUTS OR QUICKSAND?

"Look before you leap" to avoid significant risks before consuming certain energy products and botanicals!

For this module, it is recommended that teachers will have already taught students the following underlying key concepts: homeostasis; distinction between food, drugs, and dietary supplements; human body systems and their interconnectedness.

BACKGROUND INFORMATION: PART 1

Stimulants as Dietary Supplements focuses on caffeine, which is a widely available component in many foods, drugs, and dietary supplements. While many dietary supplements can contain caffeine, those marketed as "energy products" are a major source and some can contain very risky amounts.

ACTIVITY 1

Energy Products introduces students to the effects of caffeine on human health.

Time to Tune In

Are Energy Drinks Really That Bad (4:06)
https://www.youtube.com/watch?v=5l0cjsZS-eM

How Does Caffeine Keep Us Awake? (5:14)
https://www.youtube.com/watch?v=foLf5Bi9qXs

BACKGROUND INFORMATION: PART 2

Understanding Herbals and Botanicals provides a brief overview of some additional plant-based products.

ACTIVITY 2

Extreme Botanicals - Natural Does Not Always Mean Safe exposes students to several botanicals and their potentially toxic effects at varying doses.

Time to Tune In

Dangerous ingredients found in dietary supplements (3:06)
https://www.youtube.com/watch?v=cJlT5Sdr-YQ

15 Supplement Ingredients to Always Avoid (1:35)
https://www.consumerreports.org/vitamins-supplements/15-supplement-ingredients-to-always-avoid/

Black Raspberry Supplements Put to the Test (4:04)
https://nutritionfacts.org/video/black-raspberry-supplements-put-to-the-test/

BACKGROUND INFORMATION

PART 1
Stimulants as Dietary Supplements

Module 2 introduced important information about bodybuilding and weight loss products, many of which can contain dangerous dietary ingredients or make fraudulent claims about their effects. In Module 3, we will look at another type of dietary ingredient that is commonly found in some dietary supplements: **stimulants**. The most common example of a stimulant is caffeine.

As you learned in the earlier modules of this curriculum, dietary supplements are a broad category that extends beyond vitamins or other products that are only marketed in traditional "pill" form. While caffeine can be found in certain food and drug products, ingredients with caffeine can also be found in dietary supplements.

Caffeine Versus "Energy"

Caffeine is a stimulant that is often listed as an ingredient in many "energy" products. However, our body's main source of energy is glucose (sugar), which our cells convert to adenosine triphosphate (ATP) for real energy, through a process called cellular respiration. To determine how much energy a product can give our cells, we first need to determine how many grams of glucose it provides and convert that amount to kilocalories.

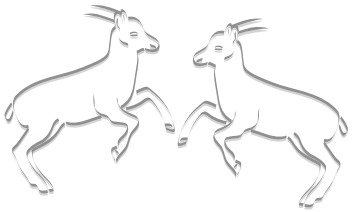
Previous Points to Remember

- Dietary supplements are *not* subject to the same requirements as drugs; FDA does not have the authority to approve dietary supplements or their labeling.
- If a dietary supplement sounds too good to be true, it probably is. ALWAYS do your research and talk to a healthcare professional before taking any dietary supplement.
- *Refer to **Module 2** for more information on stimulants such as DMAA.*

Caffeine: Coffee and Beyond

Caffeine stimulates the central nervous system, causing increased alertness. It can provide a temporary energy boost and elevate mood. Even though scientists at FDA believe that foods containing caffeine, like coffee and tea, *can* be part of a healthy diet for most people, the experts caution that factors like body weight, medications, and potential sensitivity to caffeine can greatly impact its effect. In fact, too much caffeine may pose a danger to your health.

An Ethiopian Legend about the Origin of Coffee



Coffee grown worldwide can trace its heritage back centuries to the ancient coffee forests on the Ethiopian plateau. There, legend says the goat herder Kaldi first discovered the potential of these beloved beans.

The story goes that Kaldi discovered coffee after he noticed that after eating the berries from a certain tree, his goats became so energetic that they did not want to sleep at night. Kaldi reported his findings to the abbot of the local monastery, who made a drink with the berries and found that it kept him alert through the long hours of evening prayer. The abbot shared his discovery with the other monks at the monastery, and knowledge of the energizing berries began to spread.

As word moved east and coffee reached the Arabian peninsula, it began a journey which would bring these beans across the globe. (Source: National Coffee Association https://www.ncausa.org/About-Coffee/History-of-Coffee)

Caffeine Quantities

Many dietary supplements that contain caffeine provide information on the label about *how much* caffeine they contain. But some don't list the amount (e.g., if caffeine is part of a blend or the ingredient is "caffeine-containing" like green tea extract), which can make it hard to gauge the effect the caffeine could have on you, since the amount in the product is unknown.

BACKGROUND INFORMATION

There are online databases that provide *estimates* of caffeine content of certain foods and beverages such as coffee and tea. But the actual amount of caffeine can vary depending on how and where the coffee beans or tea leaves were grown/processed and how the product is prepared.

Caffeine-Containing Products At a Glance

Caffeine is found in more than just coffee; it can be found in:

- Tea
- Soft drinks
- Energy drinks
- Food (like chocolate)

- OTC medications (like some headache remedies)
- Caffeine "pills"

Teenshealth.org has a list of common products that contain caffeine. You can find it here (https://teenshealth.org/en/teens/caffeine.html?view=ptr&WT.ac=t-ptr).

Caffeine Content in Beverages

- 12-ounce can of a caffeinated soft drink = 30 to 60 mg of caffeine
- 8-ounce cup of green or black tea = 30 to 50 mg of caffeine
- 8-ounce cup of coffee = 80 to 100 mg of caffeine
- 8-ounce energy drink = 40 to 250 mg of caffeine

Decaf* Versus Caffeine Free

- "Decaf" coffees and teas have less caffeine than their regular counterparts, **but they still contain some caffeine**. These items are made by taking a caffeinated substance and *removing* most of the caffeine, e.g., decaf coffee typically has between 2 and 15 mg of caffeine in an 8-ounce cup.
- Caffeine-free beverages, like some herbal teas, **never had any caffeine to begin with**, so there is nothing to "remove."

*Decaf is a term commonly used in place of decaffeinated.

Caffeine-Containing Ingredients

Ingredient	Synonyms
Yerba Mate	Mate, Ilex paraugariensis
Guarana*	Paullinia cupana
Kola nut	Cola seeds, Cola nitride
Cocoa	Cacao, Theobroma cacao
Coffee beans	Coffee
Green tea	Camellia sinensis, Theo sinensis, Camellia
Black tea	

*Guarana is a fruit-bearing plant that grows in the Amazon rainforest and is abundant in Brazil. Guarana seeds are about the size of coffee beans and contain twice the caffeine of coffee. The seeds are ground into powder, which is used to flavor syrups and added to soft drinks. Guarana is sometimes referred to as guarana paste/gum or Brazilian cocoa.

Caffeine for Kids is Not Recommended

According to FDA, up to 400 milligrams of caffeine per day (about four or five cups of coffee) is usually safe for adults, although how it affects individuals varies a lot. However, FDA has *not* recommended a safe level of caffeine for children. The American Academy of Pediatrics (AAP) discourages the consumption of caffeine and other stimulants by children and adolescents whenever possible.

AAP recommends a maximum daily caffeine intake of 100 mg for adolescents ages 12 to 18, which means only one cup of coffee, one to two cups of tea, or two to three cans of soda. However, many sodas contain **empty calories** and are not nutritious beverages. (Check out *Science and Our Food Supply: Using the Nutrition Facts Label to Make Healthy Food Choices* for guidance.)

Caffeine and Sleep

Consuming caffeine during the day can interfere with your sleep; getting enough sleep is key to good health, especially during the teen years. AAP recommends that teenagers 13 to 18 years of age should sleep 8 to 10 hours per 24 hours on a regular basis to promote optimal health.

BACKGROUND INFORMATION

Because caffeine is a stimulant, it may cause you to be more alert and awake, but it is not a *substitute* for sleep. Typically, it can take 4 to 6 hours for your body to metabolize half of what you consumed. This means that just one cup of coffee at dinner may keep you awake at bedtime.

Even small amounts of sleep loss can add up and affect your daytime alertness and performance. This can become a cycle, because if you are tired and drink caffeinated beverages to help you stay awake during the day, caffeine can keep you from falling asleep at night, which shortens the length of time you sleep.

Common Symptoms of Too Much Caffeine

In addition to insomnia or poor sleep, over-consuming caffeine can also cause:

- Jitters
- Anxiousness
- Fast heart rate
- Upset stomach
- Nausea
- Headache
- Dysphoria (a feeling of unhappiness)

Other Effects of Caffeine*

As with any other dietary supplement, it's important to always inform your healthcare provider if you are consuming caffeine. That's because it can have many effects on the body—and some can be serious. For example:

- Caffeine is a mild diuretic. It increases urine output by inhibiting the release of antidiuretic hormone (ADH) from the anterior pituitary. ADH targets the kidneys and causes them to reabsorb more water back into the bloodstream. Less ADH, therefore, causes higher urine output which can lead to dehydration. That's why it should be avoided in hot weather or during exercise.
- Caffeine can cause the body to lose calcium, which can impact bone density and even lead to bone loss over time.
- Caffeine can aggravate certain heart problems.
- Caffeine can interact with some medicines or supplements.
- Caffeine can increase stress/anxiety and can make migraines worse (even though some headache medicines include caffeine).

*Adapted from: Teenshealth.org (Nemours) https://teenshealth.org/en/teens/caffeine.html?view=ptr&WT.ac=t-ptr

When Caffeine Becomes Dangerous

There are situations when caffeine's effects can cause potentially serious health effects. FDA says toxic effects, like seizures, can occur with rapid consumption of caffeine (around 1,200 milligrams) or just 0.1 tablespoon of pure caffeine.

According to FDA, **pure and highly concentrated caffeine products** are a real public health issue. In recent years, dietary supplements consisting of pure or highly concentrated caffeine in powder and liquid forms have emerged on the market. These products are often sold in bulk packaging with up to *thousands of servings* per container. This means that the consumer is responsible for measuring out a safe serving from what could actually be a toxic—or even lethal—amount of bulk product.

Safe quantities of these products can be difficult or nearly impossible to measure accurately with common kitchen measuring tools.

- Just one teaspoon of pure powdered caffeine can contain the same amount of caffeine as 40-50 cups of coffee (based on 80-100 mg /cup).
- Pure caffeine also comes in liquid form: a ½ cup of a highly concentrated liquid caffeine product has the same amount of caffeine as 20+ cups of coffee.

Products with highly concentrated caffeine contain toxic amounts that can have serious health consequences and have led to at least two deaths in the United States. The risk of caffeine overdose increases as the concentration of caffeine in the product increases. That means that even tiny amounts of a highly concentrated caffeine product could lead to dangerous effects more quickly than a food or drink containing caffeine.

BACKGROUND INFORMATION

Symptoms of caffeine toxicity (poisoning) can include:

- Vomiting
- Diarrhea
- Stupor and disorientation
- Rapid or dangerously erratic heartbeat
- Seizures
- Death

Pre-existing conditions can intensify the effects of caffeine and make these products even more dangerous.

FDA's Role in Regulating Concentrated Caffeine

FDA aggressively monitors the marketplace for dangerous products, including dietary supplements consisting of pure and highly concentrated caffeine, and will continue to take action as appropriate.

If violations are found, FDA can pursue enforcement action, such as seizure of the product or an injunction to prevent the firm from continuing to manufacture or market the product.

Energy Products With More than Just Caffeine

Caffeine is a common ingredient in energy products. But these products also include other ingredients, such as vitamins and minerals. If you eat a balanced diet of nutrient-dense foods, you will consume the vitamins and minerals your body needs to thrive. But if you think you may be lacking in certain nutrients, talk to your doctor before you decide to take energy products or vitamin or mineral supplements.

For energy products that claim to include various beneficial vitamins and minerals, read the Supplement Facts label and do your research. Be familiar with vitamins and minerals and their role in the human body. Vitamins and minerals boost the immune system, support normal growth and development, and help cells and organs do their jobs. In other words, vitamins and minerals help your body to work properly. However, most vitamins and minerals also have a tolerable upper intake level, which is an amount that you should not exceed each day.

Energy and Performance Supplements: Claims and Potential Effects

If you get regular exercise or play sports, you are likely aware that a healthy diet and plenty of fluids are important. But it's not unusual to wonder whether dietary supplements that claim to boost energy or enhance sports performance might help you work harder or give you a competitive edge.

According to the National Institutes of Health (NIH), products that are marketed as improving exercise and athletic performance are sometimes called "ergogenic aids." They might claim to improve strength or endurance, help you achieve a performance goal more quickly, or increase your ability to undertake more intense training. They might also claim to help prepare your body for exercise, reduce the chance of injury during training, or assist with recovery after exercise.

As with any claim that sounds like it might offer a "short cut" to replace healthier choices, it's important that you do adequate research and talk to a healthcare professional before taking *any* of these products. In fact, energy/sports supplements can have a number of adverse effects.

This is especially true with products that contain high levels of caffeine and sugar along with other ingredients. They can cause a variety of reactions, such as:

- Headache
- Nausea
- Jitters/nervousness
- Skin reactions
- Trouble concentrating
- Insomnia
- Constipation
- Frequent urination

Remember: If you're thinking about taking an energy/performance supplement, talk to your healthcare provider first. **This advice is especially important for teens.**

BACKGROUND INFORMATION

Energy/Performance Supplements: A Key Concern

Dietary supplements marketed as energy/performance supplements can contain many ingredients such as vitamins and minerals, protein, amino acids, and herbs, and the amounts of these ingredients in the products can vary.

According to NIH, a key concern is that ingredients can work differently when they're combined, and many *ingredient combinations* have not been studied to see whether they really work and are safe.

And in the limited situations in which studies on performance supplement ingredients and ingredient-combinations are conducted, they are typically focused on young healthy men — not on women or teenagers. As with other dietary supplements, FDA does not test or approve performance supplements before they are sold.

DID YOU KNOW?

Some energy products have been linked to an increase in emergency room visits and deaths. The American Heart Association studied the impact of energy drinks on young healthy volunteers and found that energy drinks significantly impact heart rate and raise blood pressure.

Focus on Liquid Caffeine Products

Caffeine is sold in various liquid products, including drops, "shots," and drinks. Due to their smaller volume, caffeine drops and shots are more highly concentrated forms of liquid caffeine. A good general guideline is that energy drinks are often marketed as foods, while energy shots are often dietary supplements (with some exceptions for both).

A Variety of Caffeine Products:

- **Highly Concentrated Liquid Caffeine Products** are very potent and can cause serious health effects, including rapid or dangerously erratic heartbeat, seizures, and death. A half cup of a highly concentrated liquid caffeine product contains the equivalent of more than 20 cups of coffee. Read more about **Pure and Highly Concentrated Caffeine** (https://www.fda.gov/food/dietary-supplement-products-ingredients/pure-and-highly-concentrated-caffeine).
- **Energy Drinks** often claim to provide boosts in energy and nutrition and enhanced athletic performance. Most contain sugar and caffeine; some are highly caffeinated and contain as much caffeine as in 1 to 3 cups of coffee.
- **Caffeine Drops and Energy Shots** provide more caffeine in smaller volumes compared to energy drinks. Caffeine drops are typically added to another liquid that dilutes the resulting caffeine concentration.
- **Vitamin Waters** are also known as "fitness waters" or "enhanced waters," and are available in many flavors. They include various combinations of supplemental vitamins and minerals, sugar, artificial sweeteners, caffeine, and/or or herbal ingredients. Some vitamin waters include caffeine and sugar, and some do not.

Typically, energy drinks have added ingredients that say they "do" something extra such as increase energy and alertness, boost nutrition, or even enhance athletic performance. They usually contain carbohydrates (sugar), as well as electrolytes like sodium and potassium, which the body loses through perspiration (sweat).

Energy drinks are not the same as **sports drinks!**

- **Sports drinks** (example: Gatorade®) help you stay hydrated during exercise and provide carbohydrates, in the form of sugar, and electrolytes that may be lost through perspiration.
- **Energy drinks** may contain caffeine. The caffeine in energy drinks acts as a diuretic and promotes dehydration, so experts advise that they should *not* be consumed during exercise.

Overall, the best source of hydration/rehydration is plain water.

As with any dietary supplement, when FDA finds an unsafe performance supplement it can remove it from the market or ask the manufacturer to recall the product. Of course, FDA can also take action on companies that are unlawfully marketing their products as drugs.

Only adults should consider using any sort of performance supplements. The American Academy of Pediatrics states that performance supplements don't improve the abilities of teenage athletes beyond those that are a result of proper nutrition and training.

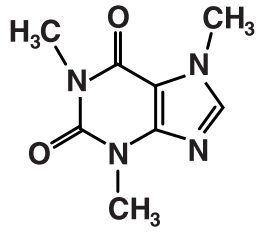
BACKGROUND INFORMATION

Energy and Performance Supplements Can Interact with Medications

Like all dietary supplements, performance supplements can have negative effects. Dietary supplements marketed for energy/performance can be especially problematic when mixed with prescription medicine or used before and after medical procedures. These are examples of some supplements and the negative reactions that can occur from their use:

- Ginseng can reduce the effects of **blood-thinning medication**.
- Some **antidepressant drugs** should not be combined with certain substances commonly marketed as dietary supplements, such as gingko (often taken for depression or asthma), St. John's Wort (often taken for skin care, depression), and ginseng (included in many energy products).
- Supplements may interfere with some **blood tests** and they may also interfere with other **laboratory tests**. For example: biotin can significantly interfere with certain lab tests and cause incorrect test results that may leave health issues undetected.
- **Caffeine**
  - It can interact with **ephedrine (used in decongestants)**. Caffeine mixed with ephedrine might increase your risk of high blood pressure, heart attack, stroke, or seizure.
  - **Bronchial/asthma medication** (theophylline) has caffeine-like effects, so taking it with caffeine might increase adverse effects such as nausea and heart palpitations.
  - **Echinacea, which is often taken to prevent colds**, is an herbal supplement that may increase the concentration of caffeine in your blood and may increase caffeine's unpleasant effects.
- Some dietary supplements such as garlic, ginger, or ginseng can cause problems if they are taken before a **medical procedure or surgery**. Risks can include an increased chance of bleeding, increased heart rate, or prolonged effects of anesthesia.

Structure of Caffeine



The American Academy of Family Physicians has a handy chart (https://www.aafp.org/afp/2008/0101/p73.html#:~:text=Herbal%20and%20Dietary%20Supplement–Drug%20Interactions%20%20%20,or%20bl%20...%20%2015%20more%20rows%20) that shows which dietary supplements are known to interfere with various drugs.

ACTIVITY 1: ENERGY PRODUCTS

TIME Two 45-Minute Class Periods

ACTIVITY AT A GLANCE

This lesson focuses on caffeine products and how they can have a negative impact on health. Students will learn about the various ingredients in caffeine-containing liquids, including supplements, and the effects they can have on teenagers' health. They will learn about a caffeine product and the effects of this stimulant on teens.

TIME TO TUNE IN

Are Energy Drinks Really That Bad (4:06)
https://www.youtube.com/watch?v=5l0cjsZS-eM

How Does Caffeine Keep Us Awake? (5:14)
https://www.youtube.com/watch?v=foLf5Bi9qXs

GETTING STARTED

MATERIALS

- Empty containers and/or labels from caffeine-containing liquid products (e.g., energy drinks, flavored caffeine drops)
- **How Does Caffeine Keep Us Awake** worksheet
- Printed copies of **Caffeine and ADH** activity booklet
- Scissors, tape, and/or stapler
- Internet access

ADVANCE PREPARATION

1. Divide the class into small groups.
2. Collect empty containers and/or labels from caffeine-containing liquid products (e.g., energy drinks).
3. Make copies of the **How Does Caffeine Keep Us Awake** worksheet and the **Caffeine and ADH** activity booklet.

INTRODUCTION

Although caffeinated products are often marketed as providing energy, it's important to remember that our energy source for cells, especially in the brain, is sugar and not caffeine. It is not unusual to see teens drinking these products that were formulated for adults, although they may be harmful to their health. This activity will make students aware of the ingredients in these liquids, especially caffeine, and how harmful caffeine is for teens.

Students will research caffeine in energy products and learn how stimulants can affect the brain and other body functions.

There is a difference between sports drinks and energy drinks:

A **sports drink** is a beverage designed or marketed for consumption in conjunction with sporting activity or strenuous exercise; it typically contains electrolytes such as sodium, potassium, and chloride, and a high percentage of sugar to restore energy.

An **energy drink** is any of various types of beverages that manufacturers claim to be a source of energy or to provide energy, especially one containing a high percentage of sugar and caffeine or another stimulant.

ENERGY PRODUCTS

STUDENT PROCEDURE

Imagine that you have a friend who wants to buy some energy drinks to consume before soccer practice "to give him more energy." What advice will you give your friend?

To provide the best advice, you need to learn about the effects of caffeine on the human body.

PART A

1. Watch the video *How Does Caffeine Keep Us Awake*? and then discuss the video questions on the worksheet. https://www.youtube.com/watch?v=foLf5Bi9qXs

   As you watched and discussed the video, you learned that caffeine affects your nervous system by blocking the adenosine receptors. But that is not the only body system that is affected.

   Caffeine also effects the **endocrine** and **urinary systems**. You might recall that endocrine organs release **hormones**, or chemical messengers, to help us maintain homeostasis. The **hypothalamus** is the endocrine organ that helps to connect the nervous system and endocrine system. An example of this is when water levels in the body are low, receptors in the hypothalamus, known as **osmoreceptors**, sense this change by recognizing higher levels of dissolved ions, like sodium (Na+), in the blood. Two actions then occur:

   a. First the hypothalamus signals thirst, causing you to drink fluids, if possible.

   b. Second, the hypothalamus signals the **pituitary** gland to release a hormone called **antidiuretic hormone**, or **ADH**, into the bloodstream. All hormones have target organs with receptors.

   ADH targets the kidney, where it causes **aquaporins** (water channels) to form in the collecting ducts, which allow more water to be reabsorbed back into the bloodstream instead of becoming urine. In this way, ADH helps prevent dehydration.

   However, *caffeine interferes with this process*. When caffeine is in the blood, it inhibits, or slows, the release of ADH. This results in fewer aquaporins and less water being reabsorbed into the blood, so more urine is created. That is why when someone drinks a large caffeinated beverage or an energy drink, they may still feel thirsty and have to urinate frequently. Caffeine can have an effect on many body systems, and the way that it interacts with the endocrine and urinary systems can lead to dehydration.

2. Follow the instructions to complete the **Caffeine and ADH** activity booklet; you can do this individually or as a group.

PART B

1. Watch the video: *Are Energy Drinks Really That Bad?* (4:06) https://www.youtube.com/watch?v=5l0cjsZS-eM
   - Take notes as the video discusses products other than caffeine found in energy drinks.
   - Compare your notes with your group.

2. Look at the sample containers and labels and focus on just one ingredient – caffeine.
   - Is information about caffeine displayed on the label?
   - If so, how clearly is that ingredient listed?
   - In addition to caffeine, are there other ingredients listed that could contribute to the amount of caffeine in the drink or have similar effects as caffeine?
   - Discuss the other ingredients that may contain caffeine or may produce effects similar to caffeine. Why should you be concerned about caffeine and the quantity in a beverage?

3. In a well-crafted paragraph, explain to your friend why consuming supplements with caffeine or caffeine-containing botanicals is not a healthy choice. Be sure to mention and explain the body systems that are affected.

ENERGY PRODUCTS

REVIEW

Caffeine is a stimulant found in several foods, beverages, and dietary supplements that are marketed to teens. Caffeine is also a habit-forming substance often found in energy products, and it can have significant effects on body systems including the endocrine and urinary systems.

SUMMARY

Caffeine's effects intensify with increased amounts that can be unsafe, even life-threatening. It's important to read product labels carefully and know what is in any energy product (a dietary supplement or beverage) before consuming it.

EXTENSIONS

Students could do one or more of the following activities:

1. Create an infographic about a caffeine product and the effect of this stimulant on teens. Refer to the **Caffeine Infographic Planning Guide** on page 67.
2. Create a video or PowerPoint presentation to demonstrate the side effects of consuming too much caffeine.
3. Prepare mixtures of various caffeine concentrations and calculate the final caffeine concentration.

UP NEXT

Now that you know more about caffeine and how it affects teens' health, let's learn more about some potent botanicals.

RESOURCES

- *10 Common Energy Drink Ingredients: What You Need to Know*
  http://www.eatingwell.com/article/278049/10-common-energy-drink-ingredients-what-you-need-to-know
- *Caffeine!! Bite Sci-zed*
  https://www.youtube.com/watch?v=UMqqYMH9EWs&t=8s
- *Caffeine: Facts, Usage, and Side Effects*
  https://www.caffeineinformer.com/caffeine-trimethylxanthine
- *Dangers of Mixing Sports And Too Much Caffeine*
  https://insidescience.org/video/dangers-mixing-sports-and-too-much-caffeine
- *Dietary Supplements for Exercise and Athletic Performance; Fact Sheet for Consumers*
  https://ods.od.nih.gov/pdf/factsheets/ExercisePerformance-Consumer.pdf
- *Dietary Supplements for Exercise and Athletic Performance; Fact Sheet for Health Professionals*
  https://ods.od.nih.gov/factsheets/ExerciseAndAthleticPerformance-HealthProfessional
- *Energy Beverages: Content and Safety*
  https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2966367/
- *Energy Drink Ingredients and What They Do*
  https://www.caffeineinformer.com/energy-drink-ingredients
- *Energy Drinks*
  https://www.nccih.nih.gov/health/energy-drinks
- *Sports Drinks and Energy Drinks for Children and Adolescents: Are They Appropriate?*
  https://pediatrics.aappublications.org/content/127/6/1182
- *Spilling the Beans: How Much Caffeine is Too Much?*
  https://www.fda.gov/consumers/consumer-updates/spilling-beans-how-much-caffeine-too-much
- *Energy Drink Labels Sometimes Misleading*
  https://www.lhsfna.org/index.cfm/lifelines/november-2013/energy-drink-labels-sometimes-misleading/

STUDENT WORKSHEET

ACTIVITY 1: ENERGY PRODUCTS

Name _____ Date _____ Class/Hour _____

HOW DOES CAFFEINE KEEP US AWAKE?

Complete this worksheet after you view the video: *How Does Caffeine Keep Us Awake?*
https://www.youtube.com/watch?v=foLf5Bi9qXs

1. How does caffeine work in your brain to keep you awake?

2. What are your dopamine receptors and what effect does caffeine have on them?

3. What long term effects might caffeine have on your body?

4. How does your body adapt to the constant consumption of caffeine?

5. What happens to your body if you suddenly stop consuming caffeine?

6. What beneficial effects, if any, does caffeine have on the body?

7. What are some possible negative effects/risks of caffeine?

CAFFEINE AND ADH ACTIVITY BOOKLET

Printing and Folding Directions

1. Print each page.
2. Cut out each of the Tables (1, 2, & 3).
3. Fold each table in half so that the blank side for the pictures meets the text side.
4. Tape, glue, or staple the back of the text side of Table 2 to the back of the blank side of Table 1.
5. Tape, glue, or staple the back of the text side of Table 3 to the back of the blank side of Table 2.
6. Cut out the reflection questions and tape or glue them to the back of your booklet.
7. Cut out the pictures individually, match them with the corresponding text, and tape or glue them into the correct locations to illustrate the explanation.
8. On the front cover of your booklet, write a meaningful title that explains the content and add your name.
9. Answer the reflection questions.

Reflection Questions

1. What releases ADH? _____
2. What does ADH target? _____
3. What effect does ADH have on the amount of water reabsorbed into the blood? _____
4. What effect does ADH have on the amount of urine produced? _____
5. What effect does caffeine have on the amount of ADH released? _____
6. What effect does caffeine end up having on the amount of water reabsorbed into the blood? _____
7. What effect does caffeine end up having on the amount of urine produced? _____

1.

When the body is dehydrated, the **osmoreceptors** in the **hypothalamus** detect low water levels by recognizing high solute concentrations.

The hypothalamus signals thirst.

The hypothalamus stimulates the **pituitary gland** to release a hormone called **ADH (antidiuretic hormone)**.

2.

ADH targets the **kidneys.**

ADH causes **aquaporins** to form in the collecting ducts which allows more water to be reabsorbed in the blood stream.

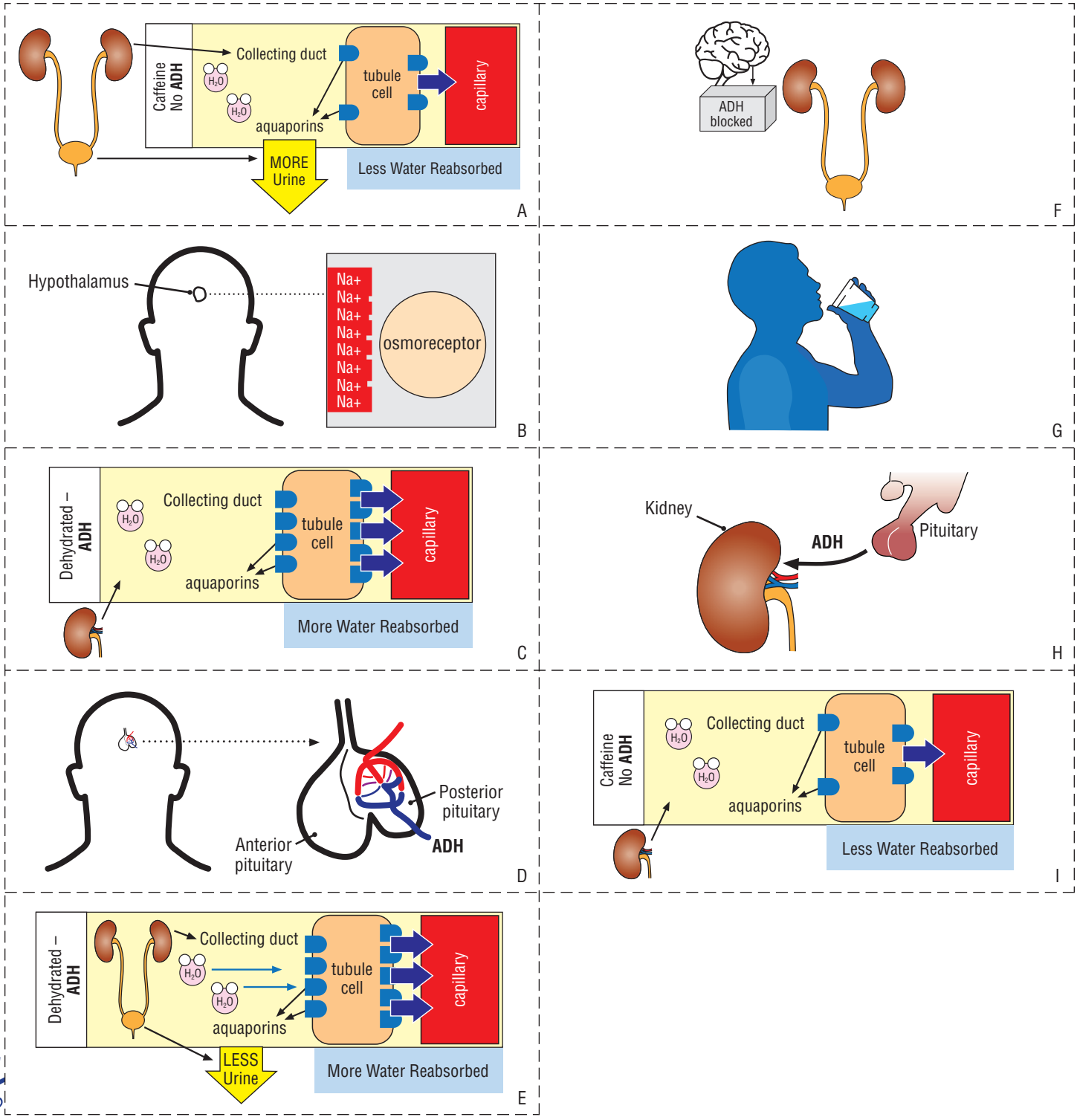
As a result, ADH causes less urine to be produced.

3.

Caffeine inhibits the release of ADH by the pituitary.

Lack of ADH results in fewer aquaporins in the collecting ducts and less water is reabsorbed into the bloodstream.

Caffeine results in increased urine production and dehydration.


Caffeine
No ADH
Collecting duct
H_2O
H_2O
aquaporins
tubule cell
capillary
MORE Urine
Less Water Reabsorbed
A
ADH blocked
F
Hypothalamus
Na+
Na+
Na+
Na+
Na+
Na+
Na+
Na+
osmoreceptor
B
G
Dehydrated – ADH
Collecting duct
H_2O
H_2O
tubule cell
capillary
aquaporins
More Water Reabsorbed
C
Kidney
ADH
Pituitary
H
Posterior pituitary
Anterior pituitary
ADH
D
Caffeine
No ADH
Collecting duct
H_2O
H_2O
tubule cell
capillary
aquaporins
Less Water Reabsorbed
I
Dehydrated – ADH
Collecting duct
H_2O
H_2O
tubule cell
capillary
aquaporins
LESS Urine
More Water Reabsorbed
E

BACKGROUND INFORMATION

PART 2
Understanding Herbals and Botanicals

Many dietary supplements include herbals and other botanicals.

- A botanical is the broader term for any plant or plant part.
- Herbs are a special "subset" of botanicals that includes those used for flavoring or for specific health benefits.

Products made from botanicals that are used to maintain or improve health are sometimes called herbal products, botanical products, or phytomedicines. In dietary supplements, the terms "herbal" and "botanical" are often used interchangeably.

DID YOU KNOW?

Botanicals are sold as both fresh and dried plant materials. For example, ginger can be sold as fresh ginger root, dried for use as a spice, in tea bags, or even in liquid form.

Botanicals can be prepared in many ways.

- *Tea* is made by adding boiling water to fresh or dried botanicals and steeping them.
- *Concentrates* can be made by adding roots, bark, and berries to water, which is then boiled and simmered at lower heat.
- A *tincture* is made when a botanical is soaked in a solution of alcohol and water.
- An *extract* is made when the botanical is soaked in a specific liquid, such as water or alcohol, to remove the desired constituents; the extract can then be used in its current state or evaporated to make a dry extract.

Botanical Supplements: A Closer Look

Just because a product is labeled as "natural" doesn't mean it is safe or beneficial. The safety of a botanical depends on many things:

- Chemical makeup
- How it works in the body
- How it is prepared
- The amount used in the product

Botanical effects range from mild to powerful.

- A botanical with mild action, like chamomile or peppermint tea, might have subtle effects, such as helping with digestion. In fact, mild botanicals might be taken for weeks or months before you would see their full effect.
- But there are also powerful botanicals that produce fast results. For example, green tea and yohimbe can have strong and immediate stimulant effects.

You might have heard the phrase: "The dose makes the poison." This means that some chemical compounds might be relatively safe or beneficial in small amounts, but they can be highly toxic if taken at, or over, a certain quantity. Even very small amounts of certain botanicals could be deadly. You should always know the source and amount of any dietary supplement (store-bought or shared by a friend or relative) you might take.

Most people have heard of Socrates, a famous ancient Greek philosopher; you also might have heard that he died by drinking hemlock tea. Hemlock is a small flower that grows in most U.S. states, and it looks similar to a plant that gardeners grow for homemade tea. Protect your health and be savvy about what you consume.

The form of a botanical preparation also plays an important role in its safety. For example, the same ingredient that is safe in peppermint tea can be toxic as peppermint oil if it is used incorrectly. Peppermint tea is generally considered safe, but peppermint oil is a potent liquid that can interfere with how your body digests vitamins, minerals, and medicines; very high doses can be toxic, and can even cause

BACKGROUND INFORMATION

kidney failure. Some other botanicals that are known to be poisonous are belladonna, poison oak, and oleander.

Always do your research and talk with your healthcare provider about any botanical (or other dietary supplements) that you are thinking about using.

NIH's Dietary Supplement Fact Sheets (https://ods.od.nih.gov/factsheets/list-all/) also include details on botanical and herbal ingredients.

Can Botanicals and Other Dietary Supplements Be Helpful?

Some dietary supplements can be good for your health, while others aren't as effective. The amount of scientific evidence on dietary supplements varies widely, with a lot of information on some and very little on others. Studies have found that some dietary supplements may have some benefit, such as melatonin for jet lag. However, studies of some supplements haven't supported claims made about them. For example, in several studies, echinacea didn't help cure colds and *Ginkgo biloba* didn't prevent memory loss or cognitive decline in studies of people with dementia.

Research on a dietary supplement is often conflicting, such as whether calcium supplements do or do not help reduce blood pressure. Most research shows that taking multivitamins doesn't result in living longer, slowing cognitive decline, or lowering the chance of getting cancer, heart disease, or diabetes. If you're considering using a dietary supplement, it's also important to know that supplements you buy from stores or online may differ in important ways from products that are tested in research studies.

Know What You Order – A Note About Retail Items

It's always smart to know what's in the food or beverages you order when you're eating out at restaurants, coffee bars, and smoothie bars, and ordering online products! Just like someone who is allergic to peanuts wants to avoid food with peanut butter, know what is "added" to shakes or other products you order. Some menu selections could include added botanical powders or syrups, and even extra caffeine.

ACTIVITY 2: EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE

TIME Two 45-Minute Class Periods

ACTIVITY AT A GLANCE

This lesson will address botanical substances that are known toxins. Students will learn about several toxic botanicals and complete a chromatography lab to compare the contents of two brands of the same botanical supplement. They will research a toxic botanical to create a warning poster or fact sheet to educate other teens about the substance.

TIME TO TUNE IN

Dangerous ingredients found in dietary supplements (3:06)
https://www.youtube.com/watch?v=cJlT5Sdr-YQ

15 Supplement Ingredients to Always Avoid (1:35)
https://www.consumerreports.org/vitamins-supplements/15-supplement-ingredients-to-always-avoid/

Black Raspberry Supplements Put to the Test (4:04)
https://nutritionfacts.org/video/black-raspberry-supplements-put-to-the-test/

GCSE Chemistry - Paper Chromatography #48 (6:32)
www.youtube.com/watch?v=TdJ57SQ6GAQ&list=RDCMUCaGEe4KXZrjou9kQx6ezG2w

GETTING STARTED

Activity 2 is comprised of two components:
PART A: Chromatography Lab and **PART B: Toxin Research & Presentation**
Materials and procedures will be listed below each component.

EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE

INTRODUCTION

Many dietary supplements include herbals and other botanicals. Botanical is the broader term for any plant or plant part. Herbs are a special "subset" of botanicals that includes those used for flavoring or for specific health benefits.

Products made from botanicals that are used to maintain or improve health are sometimes called herbal products, botanical products, or phytomedicines. In dietary supplements, the terms "herbal" and "botanical" are often used interchangeably.

Just because a product is labeled as "natural" doesn't mean it is safe or beneficial. The safety of a botanical depends on many things, including its chemical makeup and the amount used in the product.

Botanical effects range from mild to powerful. You might have heard the phrase: "The dose makes the poison." This means that some chemical compounds might be relatively safe or beneficial in small amounts, but they can be highly toxic if taken at or over a certain quantity. Even very small amounts of certain botanicals could be deadly. You should always know the source and amount of any dietary supplement (store-bought or shared by a friend or relative).

Some botanicals are known to be poisonous, so you should always talk with your healthcare provider about any botanical (or other dietary supplements) that you are thinking about using. Many botanicals also cause adverse reactions when mixed with over-the-counter and prescription drugs.

PART A: CHROMATOGRAPHY LAB

Divide the class into small groups for this lab

MATERIALS

For each group:

- 1 piece of filter paper
- 2 brands of the same botanical supplement: Echinacea or Elderberry
- 1 capsule of each of those supplements (see Advance Preparation notes below)
- Electronic Balance
- Weigh Paper
- One 250-mL beaker
- Two 50-mL beaker
- Two 1-mL plastic pipettes
- Plastic Ruler (cm)
- 2 mL of Hexane
- Water
- Safety goggles (for each student)
- Gloves (for each student)

ADVANCE PREPARATION

1. Find two brands of the same botanical extract supplement in capsule form with an identical ingredient list of either Elderberry extract or Echinacea extract (as the same concentration). Conceal the brand names and label one "A" and the other "B".

2. Prepare the materials for each lab station and make copies of the lab procedures for each group.

EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE

INTRODUCTION

In this experiment you will be using **chromatography** to compare two brands of the same botanical supplement. Chromatography is a technique used to physically separate **mixtures** into individual components. Chromatography is commonly used in laboratories as a method to identify unknown components in mixtures.

There are several types of chromatography, but they all rely on two phases: a **mobile phase**, in which an **eluent** (like a liquid or gas) is forced through a **stationary phase** (usually a solid or semi-solid). Since some components of the mixture are more attracted to the stationary phase while others are more attracted to the eluent, the components can separate.

In this experiment, you will not know if each component of the botanical supplement is a mixture or a pure substance, but you will be able to compare two different samples of a botanical extract supplement. Using chromatography, the components in a sample will migrate along the filter paper at different rates, so that they spread out and separate from each other. Mixtures containing the same ingredients will likely have compounds that travel the exact same distances. The component traveling process is called **elution**. If the two samples contain identical ingredients, the chromatography results should be the same.

Safety Note: You will be using a solvent called **hexane, which is flammable**. You must wear goggles and gloves during this experiment.

Hexane is flammable. Use caution.

STUDENT PROCEDURE

1. Watch these videos:

Dangerous ingredients found in dietary supplements
https://www.youtube.com/watch?v=cJlT5Sdr-YQ

15 Supplement Ingredients to Always Avoid
https://www.consumerreports.org/vitamins-supplements/15-supplement-ingredients-to-always-avoid/

Black Raspberry Supplements Put to the Test
https://nutritionfacts.org/video/black-raspberry-supplements-put-to-the-test/

GCSE Chemistry - Paper Chromatography #48
http://www.youtube.com/watch?v=TdJ57SQ6GAQ&list=RDCMUCaGEe4KXZrjou9kQx6ezG2w

2. Procedures to set-up the lab

a. Filter paper: if filter paper is circular, cut edges to make a rectangle. Draw a line 1 cm from the top (shorter end) of the filter paper.

b. As your instructor gives you the botanical supplement capsules, place one capsule on a paper labeled A and the other on a paper labeled B so that you do not mix them up.

c. Label one of your 50-mL beakers A and the other B.

d. Pour water into your 250-mL beaker so that the water is 1 cm in depth.

e. Place weigh paper on your balance and zero it out.

f. Open capsule A and pour the contents onto the weigh paper until it reads 0.4 grams.

g. Add the contents into the 50-mL beaker labeled A.

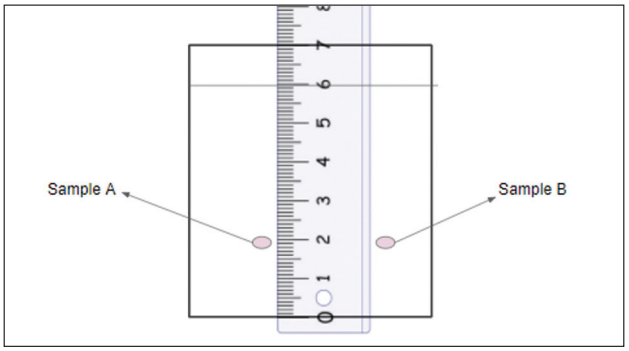
h. Repeat the same process with capsule B and add the contents into the beaker labeled B.

i. Carefully measure 1 mL of Hexane using a 1-mL pipette and add to beaker A. Stir and pipette up and down to dissolve the capsule contents.

j. Carefully measure 1 mL of Hexane using a NEW 1-mL pipette tip and add to beaker B. Stir and pipette up and down to dissolve the capsule contents.

3. Procedures to run the chromatography experiment

a. Use your plastic ruler to measure from the bottom of the filter paper to the 2 cm mark. Leave the ruler on the paper and add one drop from beaker A on the left side of the ruler at the 2cm mark and one drop from beaker B on the right side of the ruler at the 2 cm mark.



EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE

b. Carefully lift the filter paper and place it in the 250-mL beaker that contains the water. Lean it up against the edge of the beaker.

c. Wait about 10 minutes for the solvent (water) to reach the line at the top of the filter paper.

d. Remove the filter paper from the beaker and put it on your lab table. Measure 2 cm from the bottom again and put a dot where you placed the drops, so that you can measure the migration.

e. Some of the contents of the capsules should have migrated up the filter paper as color. Measure from the 2 cm mark to the top of the migration.

f. Note the color(s) that are present in each migration. Record your measurements and observations in the data table.

DATA		
	Capsule A	**Capsule B**
Measured migration in cm *(measure to the nearest tenth cm or one decimal place.)*		
Observations		

If the ingredients in the capsules were the same, you would expect that the results of your chromatography experiment would be the same for both samples. If the results are not as expected, that could mean that the purity of the contents is not identical for the two brands.

4. Reflection:

Explain what your results could mean. If your experimental results demonstrated that the two brands are not the same, what could account for those results?

Would you recommend further testing of these supplements to verify purity? Explain why or why not.

EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE

PART B: TOXIN RESEARCH & PRESENTATION

MATERIALS

- Pictures of potentially toxic botanicals
- **Credible Source Guide**
- **Presentation Rubric**
- Poster paper and markers
- Internet access

ADVANCE PREPARATION

1. Collect empty containers and/or labels from dietary supplements containing potentially highly-toxic botanical ingredients.
2. Make copies of the **Credible Source Guide** and the **Presentation Rubric**.
3. Gather the materials the students will need to create their poster or fact sheet.

STUDENT PROCEDURE

1. Select one of these botanicals to research:
   Aconite (*Aconitum napellus*)
   Belladonna (*Atropa belladonna*)
   Bitter Orange (*Citrus aurantium*)
   Borage (*Borago officinalis*)
   Calamus (*Acorus calamus*)
   Chan Su (*Venenum Bufonis)*
   Chaparral (*Larrea indentata*)
   Coltsfoot (*Tussilago farfara*)
   Comfrey (*Symphytum officinale*)
   Country Mallow (*Sida cordifolia)*
   Ephedra; Ma-huang (*Ephedra sinica*)
   Germander (*Teucrium chamaedrys*)
   Kava (*Piper methysticum*)
   Life root (*Senecio aureus L.*)
   Lily of the valley (*Convallaria majalis*)
   Lobelia (*Lobelia)*
   Oleander (*Nerium oleander*)
   Pennyroyal (*Mentha pulegium*) oil
   Peppermint oil (*Mentha x piperita*)
   Poison oak (*Toxicodendron diversilobum*)
   Sassafras (*Sassafras albidum*)
   St. John's Wort (*Hypericum perforatum*)
   Water hemlock (*Cicuta douglasii*)

2. Refer to the **Credible Source Guide** as you research these questions:
   a. Where in the world does the botanical grow? (List countries and U.S. states)
   b. Is this botanical known by any other name? If any, list them.
   c. What is the intended use of this botanical? (e.g., yard decoration, tea, topical, supplement, other)?
   d. Is it sold as an ingredient in any dietary supplements?
   e. What are the marketed benefits (if any) of this ingredient?
   f. Are you aware of a story in history or in the news about someone had a severe toxic reaction to this botanical substance?
   g. What is the toxic compound in the botanical? What part of the plant does it come from?
   h. Does it interfere with any medication (prescription or over the counter) Describe the interference?
   i. What is the toxic dose for this compound/ botanical?
   j. What factors influence the toxic dose (e.g., body weight, other medical conditions)?
   k. Which human body systems does it affect? What are the signs of toxicity? (e.g., skin irritation, nausea, organ failure, death)
   l. Is there an antidote or treatment to reverse the toxic effects of this botanical?

3. Present your botanical ingredient research as a poster or fact sheet that will inform and warn your classmates about potential toxicity related to this botanical. Refer to the **Presentation Rubric** as a guide.
   - Include a drawing or image of the plant.
   - Include a graph, chart, or table to depict the affect of varying doses of the botanical product.

4. Share your poster or fact sheet with your classmates.

EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE

REVIEW

Botanicals are found in several dietary supplements that are marketed to teens. Several can be toxic at or above a certain dose. They can cause serious health effects, including nausea, increased heart rate, nervous system impairment, liver or kidney damage, or death.

SUMMARY

Botanical effects intensify with increased amounts that can be unsafe, even life-threatening. It's important to read product labels carefully and know what is in a dietary supplement before consuming it. Protect your health and be savvy about what you consume.

EXTENSIONS

Students could do one or more of the following activities:

1. Design a botanical warning label for a product.
2. Create a video to demonstrate the side effects of consuming too much of a certain botanical.
3. Create an art project that illustrates how to recognize domestic plants/botanicals that can be toxic to humans.

RESOURCES

- *Botanical Dietary Supplements - Background Information*
  https://ods.od.nih.gov/factsheets/BotanicalBackground-Consumer
- *Herbs At A Glance*
  https://www.nccih.nih.gov/health/herbsataglance
- *Toxicity of Herbs, Vitamins, and Supplements*
  https://pubmed.ncbi.nlm.nih.gov/32147004/
- *Toxic herbals and plants in the United States*
  https://www.sciencedirect.com/science/article/pii/B9780128158463000193
- *Safe and Poisonous Garden Plants/Herbal Medicines*
  https://ucanr.edu/sites/poisonous_safe_plants/Herbal_Medicines_18/
- *5 Risky Herbal Supplements*
  https://www.webmd.com/vitamins-and-supplements/features/risky-herbal-supplements
- *12 Dangerous Supplements*
  https://www.cbsnews.com/pictures/12-dangerous-supplements/
- *9 Poisonous Plants You Might Have Around Your House*
  https://www.youtube.com/watch?v=p71KQM1hc30
- *Toxic Plants, Fungi and Herbal Supplements*
  https://www.youtube.com/watch?v=8Ofp6TNC_5c
- *Herbal Supplement Study – Mayo Clinic*
  https://www.youtube.com/watch?v=y6_-dtVCCKs
- *Natural Doesn't Necessarily Mean Safer, or Better*
  https://www.nccih.nih.gov/health/know-science/natural-doesnt-mean-better
- *CVS launches dietary supplement testing program*
  https://cen.acs.org/safety/consumer-safety/CVS-launches-dietary-supplement-testing/97/web/2019/06

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 https://uknowit.uwgb.edu/page.php?id=30276

PRESENTATION 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.

CAFFEINE INFOGRAPHIC PLANNING GUIDE

(for optional Extension activity 1 on page 53)

Review these infographics about energy products and caffeine before you begin to create your own infographic. Refer to the **Presentation Rubric** to see how these examples meet the requirements for a good infographic.

Health Effects of Caffeine
https://visual.ly/community/Infographics/health/health-effects-caffeine-0

The Facts on Caffeine
https://foodinsight.org/the-facts-on-caffeine-infographic

Energy Drinks, the Dangerous Downside – Infographic
https://graphicspedia.net/effects-of-energy-drinks-infographic

Discuss the following questions within your group:

- What makes the infographics interesting – the content, the design, or both?
- How was the information arranged and presented? Were there sections, titles, and/or graphs?
- How are fonts, color, and graphics used?
- Did the design contribute to how you felt about the information?
- What did you like about the infographics?
- What would you change in the infographic to make it better?

Consider how you might respond to/address these questions on your infographic:

- What are energy products?
- What ingredients are found in liquid energy products and what effects do they have on your body?
- How are energy products regulated?
- How does the amount of caffeine in an energy drink compare with the amount in other caffeinated beverages?
- What health benefits, if any, are there from consuming caffeine?
- What are the side effects from drinking energy drinks?
- Why are energy drinks harmful for teens?

When you have completed your research, consider these questions as you design your infographic:

- What is your goal?
- Who is your audience?
- What information is essential? What information is not?
- What colors and layout will work best?
- What is the best way to have the information flow?
- Have you streamlined your information?

Optional: You can display the completed infographics in the classroom. Create a gallery walk and use sticky notes to comment on the best features of each infographic. After the gallery walk, review the comments and score the infographics, using the **Presentation Rubric**.

INDEX AND GLOSSARY

For the purposes of this curriculum, these terms are defined as follows.

Many of the terms below are clearly defined within the curriculum text and are listed in the index below with the page number where the definition can be found. Some additional terms that are not defined in the text and that might not be familiar to your students are defined below.

INDEX

GLOSSARY

Term	Page
ADH (Anti-diuretic hormone) – A hormone that is released by the pituitary gland and targets the kidneys, causing them to reabsorb more water back into the blood.	47, 52
Amino Acids – Building blocks of proteins. When proteins are digested, they are broken down into amino acids. The body then uses those amino acids to build new proteins.	25
Aquaporins – Pores in the membrane of cells that allow water to flow. Often referred to as water channels.	52
Chromatography – A laboratory technique for the separation of a mixture into its individual components.	62
Component – A smaller, individual part of a larger entity, such as the individual particles that make up a solution.	60
Eluent – A substance that separates and moves components of a mixture in chromatography. In liquid chromatography, the eluent is the liquid, whereas in gas chromatography, gas is the eluent.	62

Term	Page
Elution – Separation of one material from another, usually using a solvent.	62
Enzyme – A substance that acts as a catalyst in a chemical reaction. The enzyme regulates the rate at which the chemical reaction occurs without itself being altered during the reaction.	6, 15
GI Tract – Gastrointestinal Tract – Part of the digestive system. It is made up of the organs through which food and liquids travel when they are swallowed, digested, absorbed, and leave the body as feces. GI tract organs include the mouth, pharynx, esophagus, stomach, small intestine, large intestine, rectum, and anus.	10
Heart Palpitations – Sensations that the heart is racing, pounding, fluttering, or skipping a beat.	17, 50
Mobile Phase – The liquid or gas that moves materials to be separated through a chromatography system.	62

Term	Page
Nutrients – Nutrients are substances in food that contribute to growth and health. Nutrients provide energy, cell-building and structural materials, and agents that regulate body chemistry.	6, 8, 9
Nutrient-Dense – Nutrient Dense foods and beverages contain vitamins, minerals, dietary fiber, and other substances that may have positive health effects, while contributing relatively few calories. Examples include fruits, vegetables, whole grains, seafood, beans and peas, unsalted nuts and seeds, fat-free and low-fat milk and milk products, and lean meats and poultry.	8, 25, 26
Osmoreceptors – Cells in the hypothalamus that detect the concentration of solutes in the blood, indicating the state of hydration.	52
Stationary Phase – The phase in chromatography that does not move. In paper chromatography, the paper is the stationary phase.	62

STUDENT WORKSHEET ANSWERS

ACTIVITY 1: PRODUCT CATEGORIES

Name _____ Date _____ Class/Hour _____

Consider each product below and complete the chart. Some products could be in more than one category.

Product	Food, Drug, Cosmetic, Dietary Supplement, or multiple possible categories?	What evidence did you use to decide on this category?	Safety evaluated before or after sales?
 Orange-flavored lip balm	Cosmetic	Enhances appearance, applied topically	After sales
 Daily multivitamin	Dietary Supplement	Ingested; has dietary ingredients	After sales
 Whitening toothpaste that helps prevent cavities	Cosmetic OTC drug	Enhances appearance, claims to "prevent cavities"	After sales Before sales
 Biotin pills (100 micrograms each)	Dietary Supplement	Ingested; has dietary ingredients	After sales
 Energy Drink	Food (beverage) or Dietary Supplement	Ingested; has dietary ingredients	After sales
 Whey protein powder	Food or Dietary Supplement	Ingested; has dietary ingredients	After sales
 Coconut-scented shampoo	Cosmetic	Enhances appearance, applied topically	After sales
 Vitamin E oil	Cosmetic or Dietary Supplement	Enhances appearance; placed on skin Ingested; some products may be taken orally (has dietary ingredients)	After sales
 Sleep aid liquid (OTC)	Over the Counter (OTC) drug	Ingested	Before sales
 Caffeine lozenges	Food or Dietary supplement or OTC Drug	Ingested; has dietary ingredients Cough lozenges are OTC drugs, and some can contain caffeine.	After sales Before sales (OTC drugs)
 Yogurt	Food	Ingested	After sales
 Weight loss pill	Drug or Dietary Supplement	Ingested; has dietary ingredients Some drug products require a prescription	Before sales (drugs) After sales

STUDENT WORKSHEET ANSWERS

ACTIVITY 2: SUPPLEMENT FACTS LABEL

Name _____ Date _____ Class/Hour _____

Use the Supplement Facts label to the right or choose another one that includes multivitamins, live microbials (commonly referred to as "probiotics"), or fish oil. You could use a label from a dietary supplement found in your home, find one online, or choose one from the NIH Dietary Supplement Label Database: https://dsld.od.nih.gov.

Supplement Facts

Serving Size 1 Gelcap
Servings Per Container 100

	Amount Per Serving	% Daily Value
Vitamin A (as retinyl acetate and 50% as beta-carotene)	900 mcg	100%
Vitamin C (as ascorbic acid)	90 mg	100%
Vitamin D (as cholecalciferol)	20 mcg (800 IU)	100%
Vitamin E (as dl-alpha tocopheryl acetate)	15 mg	100%
Thiamin (as thiamin mononitrate)	1.2 mg	100%
Riboflavin	1.3 mg	100%
Niacin (as niacinamide)	16 mg	100%
Vitamin B_6 (as pyridoxine hydrochloride)	1.7 mg	100%
Folate	400 mcg DFE (240 mcg folic acid)	100%
Vitamin B_{12} (as cyanocobalamin)	2.4 mcg	100%
Biotin	3 mcg	10%
Pantothenic Acid (as calcium pantothenate)	5 mg	100%

Other ingredients: Gelatin, lactose, magnesium stearate, microcrystalline cellulose, FD&C Yellow No. 6, propylene glycol, preservatives (propylparaben and sodium benzoate).

Choose one of the key components, such as a specific vitamin or mineral listed on the label of your chosen supplement, to research and answer the following questions about that component:

1. Identify your chosen supplement Multivitamin - 1 Gelcap
2. Which component of that supplement will you research?
   Vitamin D
3. How much of that component is in one dose/serving?
   20 mcg
4. Is this component water soluble? No
5. Complete the first line of the chart below with information about your component.
6. Research your chosen component to learn about foods/beverages that contain that component; list at least 3 different foods/beverages that contain your chosen component on the chart below.

Use the Nutrition Facts label (or online nutrition data, such as this database https://fdc.nal.usda.gov/index.html) to research each food and/or beverage to complete the chart below. Your completed chart will help you identify food sources that could provide you with the same daily intake amount.

Dietary supplement versus food/beverage consumption

Dietary Supplement Component	Amount per serving	Number of servings/day	Daily total amount consumed
Vitamin D	20 mcg	1	20 mcg
Food or beverage	**Nutrient amount per serving**	**Number of servings consumed**	**Total amount consumed**
Milk - 1 cup	2.5 mcg	2	5 mcg
Wild caught salmon (3.5 ounce filet)	24.7 mcg	1	24.7 mcg
Canned light tuna - 3.5 oz.	6.7 mcg	1	6.7 mcg
Could you get enough of this component in foods you would eat?			

Choose one of the foods or beverages in column 1, and list some of the other nutrients (e.g., protein) that are found in that food that are **not** in the dietary supplement?

Milk also contains calcium, protein, phosphorus, and fat.

STUDENT WORKSHEET ANSWERS

ACTIVITY 1: BANNED FROM SPORTS

Name _____ Date _____ Class/Hour _____

1. Watch the video – *Athlete Voices - Abby Raymond*
https://www.youtube.com/watch?v=d9tVERZHsBY

2. Write your responses to the following questions and then discuss with your group:

   a. What was the banned substance in Abby's supplement?
   Ostarine

   b. Why did Abby think the supplement was safe to take?
   She trusted the supplier, who was a family friend. The supplier had assured her that she had nothing to worry about.

   c. Have you heard of other instances when athletes were suspended or banned from a sport? What was the reason for that suspension or ban?
   In 1988, an Olympic sprinter was stripped of his gold medal when he tested positive for a steroid (stanozolol).
   NFL and MLB players have also been suspended for testing positive for performance-enhancing drugs (PEDs).

   d. What are some of the substances that can lead to issues for athletes?
   Certain substances that can lead to issues include performance-enhancing drugs, such as anabolic steroids, human growth hormone, some stimulants, and antidiuretics. Substances that are chemically similar to the exact banned substances can also generate problems.

   e. How do athletes access the substances?
   Athletes can obtain products containing these substances from companies that advertise in magazines and online, and promise that their product provides results, without stating that it may contain banned substances.

   f. There are other substances found in supplements that are not drugs and are prohibited for athletes. What kind of ingredients might be prohibited for athletes and why do you think they are prohibited?
   Substances that may be prohibited include stimulants and growth factors. These substances are likely prohibited because they give the athletes an unnatural advantage and may harm their health.

3. Select one of the following ingredients to research: 1,4-DMAA, Andarine, BMPEA, DMBA, DMHA, Higenamine, Hordenine, Methylsynephrine, N-Methyltyramine, Octopamine, Ostarine, Picamilon. Use your research to answer the following questions as succinctly as possible.
Teacher Note: Information on these websites can be used to evaluate student answers:
https://www.fda.gov/food/dietary-supplements/dietary-supplement-products-ingredients &
https://www.fda.gov/food/dietary-supplements/dietary-supplement-products-ingredients/dietary-supplement-ingredient-advisory-list

   a. What are the different names by which the ingredient is known?
   Sample answer 1: Ostarine is also known as MK-2866, enobasarm, GTx-024.
   Sample answer 2: Hordenine is also known as anhaline, *N,N*-Dimethyltyramine, peyocactin.

   b. In what kind of dietary supplement(s) product has the ingredient been found?
   Sample answer 1: Ostarine may be found in products marketed as bodybuilding supplements.
   Sample answer 2: Hordenine is found in athletic performance and weight loss supplements.

continued on next page

STUDENT WORKSHEET ANSWERS

ACTIVITY 1: BANNED FROM SPORTS (CONTINUED)

c. Is this ingredient normally found in a dietary supplement or is it possible that it was mistakenly added?

Sample answer 1: Ostarine may be added intentionally to the products marketed as supplements by some companies. It might also be added when products are prepared on improperly cleaned equipment.
Sample answer 2: Hordenine has been intentionally added to dietary supplements.

d. Is the ingredient legal in the United States?

Sample answer 1: Not for use in dietary supplements. Ostarine has been subject to clinical investigations as a new drug, and products containing ostarine are not dietary supplements.
Sample answer 2: Hordenine is on FDA's Dietary Supplement Ingredient Advisory List. As such, hordenine does not appear to be a lawful ingredient in dietary supplement.

e. What is the reported effect this ingredient will have on the body?

Sample answer 1: Enhanced muscle growth, liver damage
Sample answer 2: Hordenine is reported to be used for weight loss and improved athletic performance. Hordenine has also been advertised as increasing immunity to infectious diseases.

f. Have any studies been conducted about this ingredient and, if so, by whom/which organization?

Sample answer 1: One study was conducted by scientists at Universities in Germany studying the effectiveness of ostarine in increasing muscle mass and physical function. **https://www.frontiersin.org/articles/10.3389/fendo.2020.556581/full**
Sample answer 2: There is no good evidence that shows hordenine is effective for losing weight, improving athletic performance, or increasing immunity to infectious diseases.

g. What are the side effects of this ingredient?

Sample answer 1: Liver damage, constipation, diarrhea, headache, nausea, fever, heart attack, stroke
Sample answer 2: The side effects from using hordenine could be increased heart rate, high blood pressure, and increased risk of kidney stones.

h. What promises, if any, does the company marketing the ingredient offer?

Sample answer 1: One of the marketing promises is an increase in muscle mass.
Sample answer 2: A dietary supplement containing hordenine has been marketed as increasing your immunity to infectious diseases.

i. Has the FDA issued any warning letters about this ingredient and if so, what was the warning and was there a follow-up action from the company?

Sample answer 1: The FDA has issued several warning letters to manufacturers of products marketed as dietary supplements that contain ostarine, ordering them to stop manufacturing the supplement. In one instance the manufacturer was sentenced to jail. **https://www.justice.gov/opa/pr/owner-sport-supplement-company-sentenced-unlawful-distribution-steroid-drugs**
Sample answer 2: FDA issued a warning letter to a company manufacturing a dietary supplement containing hordenine to recall the supplement. Subsequently, FDA went to court and filed a consent decree of permanent injunction against the company for violating federal law by distributing products containing hordenine HCl and vitamin D as preventions or treatments for COVID-19.

j. Has the supplement that contains this ingredient been endorsed by anyone and, if so, by whom?

Sample answer 1: Ostarine is banned by USADA. Products marketed as dietary supplements containing ostarine have not been endorsed by anyone.
Sample answer 2: A supplement containing hordenine was endorsed by a 'Top Doctor' who believed it could help the current pandemic. The supplement was removed from the market.

k. How could the *Supplement Guide: Reducing Supplement Risk* help you to make decisions about using banned substances? **https://www.usada.org/wp-content/uploads/supplement-guide.pdf**

It lists substances that should be avoided. The guide also includes information about how to choose healthy foods with ingredients that can help performance.

4. When you have completed your research, create a presentation about your supplement ingredient. The presentation might be a news broadcast, foldable book, poster, infographic, blog entry, video, or animated slide show.

5. Prepare a brief Fact Sheet about your supplement ingredient for distribution to the class before your presentation.

STUDENT WORKSHEET ANSWERS

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING

Name _____ Date _____ Class/Hour _____

1. Read each of the statements below and write A (Agree) or D (Disagree) in the Before Column.

2. Watch the video, *Teenagers using dietary supplements:* https://www.youtube.com/watch?v=hWbx-tSXOuI

3. Review the Statements on the Prediction Guide and compare your opinions with information provided in the video.

4. In the After column, write whether the information from the video Agrees (A) or Disagrees (d) with the statement.

5. In the space under each Statement, cite the information from the video that supports or refutes your original opinion.

Prediction Guide

Before	STATEMENT	After
	Dietary supplements can cause serious harm or even death. A study released said that teenagers using dietary supplements to lose or gain weight can be putting themselves in serious harm or risk. The news story cited a study that said teenagers who use dietary supplements to lose or gain weight can put themselves at risk for serious harm and even death.	Agree.
	It is ok to combine dietary supplements with prescription medications without consulting a doctor. Combining dietary supplements with prescription drugs can be harmful.	Disagree.
	Dietary supplements sold for weight loss, muscle building or to increase energy are no more risky than vitamin supplements. The report cited that dietary supplements, not vitamins, were responsible for the majority of unhealthy incidents.	Disagree.
	Dietary supplements may cause harm because they may contain dangerous, unlabeled ingredients. Dietary supplements can contain ingredients not listed on the label.	Agree.

continued on next page

STUDENT WORKSHEET ANSWERS

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING (CONTINUED)

To prepare for the next part of this activity, watch *The Simple Truth: Decoding the Dietary Supplement Industry* (3:00)
https://www.youtube.com/watch?v=7HIvIIM-35w

What is the name of the dietary supplement you will research? Beta-alanine

Research Questions: As you answer these questions, cite the source for each response. (Refer to the Credible Source Guide.)

1. About the Dietary Supplement and Its Ingredients

a. What are the ingredients in your supplement?
Beta-alanine is usually the only ingredient in this supplement.

b. Why would someone use this supplement?
Someone might use this supplement in hopes of lowering lactic acid build up and increasing athletic performance and endurance.

c. What scientific evidence, if any, is there to support this use?
Some studies have shown small increases in athletic performance in events like swimming.

d. What are the active ingredients in the supplement?
Beta-alanine, which is an amino acid found in foods, is the active ingredient.

e. What are the short-term and long-term effects of using this dietary supplement?
Taking 800 mg of Beta-alanine can cause a tingling sensation called paresthesia. The effects of long-term use are unknown.

f. What harmful ingredients, if any, are found in the supplement and why are they harmful?
Beta-alanine is the only ingredient. It may interact with some heart medications and drugs for erectile dysfunction. Safety for children has not been established. https://www.webmd.com/vitamins-and-supplements/beta-alanine-uses-and-risks

g. In which types of stores could you find this supplement? (ex: grocery)
This product can be purchased at superstores and nutritional supplement shops.

continued on next page

STUDENT WORKSHEET ANSWERS

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING (CONTINUED)

h. How safe is the use of this dietary supplement for high school students?

According to the NIH, studies show that using Beta-alanine for 2-4 weeks period at the recommended dose is safe for healthy individuals. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4501114/

i. Who might use this supplement?

Athletes who experience neuromuscular fatigue may be interested in using the supplement.

2. About the Advertisement(s) for the Dietary Supplement and/or Its Ingredients

a. Does the supplement promise a quick fix or does it sound too good to be true?

The supplement promises that the user will be able to exercise harder and longer with less muscle fatigue.

b. Does the supplement promote any unhealthy habits?

The advertising warns that pregnant women should not use it and states that users should consult their physician if they have any adverse reactions. It doesn't seem to promote any unhealthy habits.

c. Is there a slogan that is used to promote this supplement?

Yes. It promises to "Support Lean Muscle Gain".

d. If so, what is it, and who is the target audience?

The target audience seems to be people who want to add muscle quickly and avoid muscle fatigue during exercise.

e. How truthful is the slogan?

The use of the term "lean" in the slogan makes one wonder what "non-lean" muscle would be. Research seems to point to the fact that it can reduce muscle fatigue, but there is no research that supports this slogan directly.

f. Does the advertisement provide information based on a personal story or testimonial rather than on facts?

There were no personal stories shared in the advertisements.

3. If you want to find truthful information about this supplement, where would you look?

To find truthful information, one should seek research studies published in peer review journals, or information found on .gov websites such as FDA or NIH.

continued on next page

STUDENT WORKSHEET ANSWERS

ACTIVITY 2: DIETARY SUPPLEMENTS AND ADVERTISING (CONTINUED)

PSA Planning

Watch these videos to help you create your PSA.

Tips for creating an effective video PSA (5:20)
https://www.youtube.com/watch?v=Kr4Yf1xRb7U

Best Student Made PSA Ever (0:55)
https://www.youtube.com/watch?v=PR7BCsuIWjk&feature=youtu.be

Write down the tips you will use from the videos as you create your PSA.

- Include the 5 W's - Who, What, Where, When and Why.
- Gather facts and information and write a script.

Keep these questions in mind as you plan your PSA:

- Who is your audience?
- What is your message?
- Which PSA format (from the first video) will best convey your message:
  - Spokesperson format
  - Voice-over PSA
  - Live Action
  - The "Silent Treatment"
- What part of your research will you use?
- What is your script?
- What visuals will you use on your storyboards? Sketch your PSA frame by frame.
- What props do you think you might need?
- What is your production plan?
- What is your visual display plan?

Once your PSA plan is complete you can begin filming. A strong plan, with a tightly edited script, will result in a good PSA. Your PSA might require several edits and/or "takes" until you are ready to share it with your class.

As a final wrap-up, view this video:

Supplements 411 – Dietary Supplement Bottle – U.S. Anti-Doping Agency (7:24)
https://www.youtube.com/watch?v=50QBwi11ncE&feature=emb_logo

STUDENT WORKSHEET ANSWERS

ACTIVITY 1: ENERGY PRODUCTS

Name _____ Date _____ Class/Hour _____

HOW DOES CAFFEINE KEEP US AWAKE?

Complete this worksheet after you view the video: *How Does Caffeine Keep Us Awake?*
https://www.youtube.com/watch?v=foLf5Bi9qXs

1. How does caffeine work in your brain to keep you awake?

Caffeine blocks a sleep inducing molecule, adenosine. Caffeine is an adenosine receptor antagonist. Because it can block adenosine receptors, it blocks the molecules that slow the neurons down and cause us to feel sleepy.

2. What are your dopamine receptors and what effect does caffeine have on them?

Dopamine receptors are the location in the neuron where dopamine, a mood boosting neurotransmitter, docks. Adenosine makes it difficult for dopamine to fit into its receptor, but when caffeine takes the place of adenosine, dopamine is allowed to fit into its receptor.

3. What long term effects might caffeine have on your body?

The way that caffeine interacts with the adenosine and dopamine receptors may help to reduce the risk of diseases such as Parkinson's disease, Alzheimer's disease and certain cancers.

4. How does your body adapt to the constant consumption of caffeine?

When the body is met with a constant consumption of caffeine, it adapts by creating more adenosine receptors, so that adenosine's function in the nervous system continues.

5. What happens to your body if you suddenly stop consuming caffeine?

A sudden stop in caffeine consumption means that those extra adenosine receptors have no caffeine to block them, and side effects such as headache, fatigue and depression may result from the extra adenosine action.

6. What beneficial effects, if any, does caffeine have on the body?

It may help to reduce the risk of some diseases, as mentioned above, as well as make you feel alert, focused, happy, or energetic.

7. What are some possible negative effects/risks of caffeine?

Caffeine can cause raised heart rate and blood pressure, increased urination, diarrhea, insomnia, and anxiety.

CAFFEINE AND ADH ACTIVITY BOOKLET ANSWERS

Printing and Folding Directions

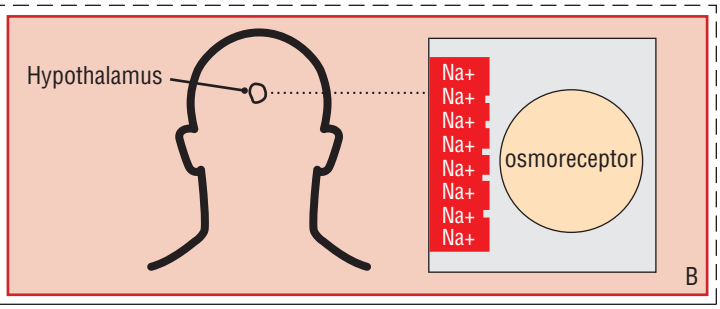
1. Print each page.
2. Cut out each of the Tables (1, 2, & 3).
3. Fold each table in half so that the blank side for the pictures meets the text side.
4. Tape, glue, or staple the back of the text side of Table 2 to the back of the blank side of Table 1.
5. Tape, glue, or staple the back of the text side of Table 3 to the back of the blank side of Table 2.
6. Cut out the reflection questions and tape or glue them to the back of your booklet.
7. Cut out the pictures individually, match them with the corresponding text, and tape or glue them into the correct locations to illustrate the explanation.
8. On the front cover of your booklet, write a meaningful title that explains the content and add your name.
9. Answer the reflection questions.

Reflection Questions

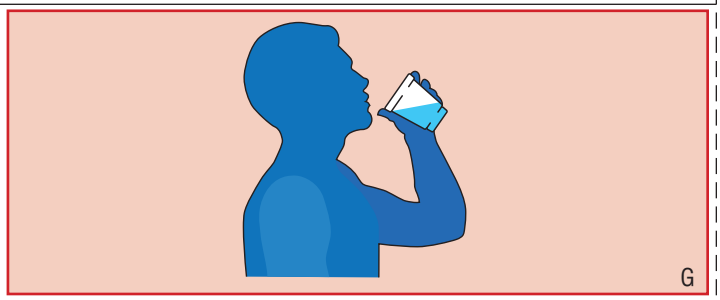
1. What releases ADH? ADH is released by the pituitary gland.
2. What does ADH target? The target organs of ADH are the kidneys.
3. What effect does ADH have on the amount of water reabsorbed into the blood? ADH causes more water to be reabsorbed into the blood.
4. What effect does ADH have on the amount of urine produced? ADH causes less urine to be produced.
5. What effect does caffeine have on the amount of ADH released? Caffeine inhibits the release of ADH.
6. What effect does caffeine end up having on the amount of water reabsorbed into the blood? Because caffeine inhibits ADH, less water is reabsorbed into the blood.
7. What effect does caffeine end up having on the amount of urine produced? Caffeine causes more urine production.

1.

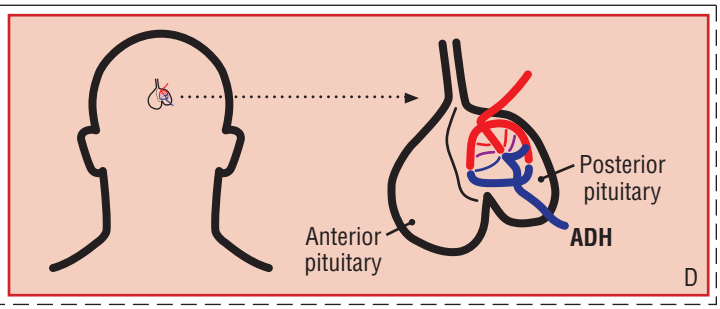
When the body is dehydrated, the **osmoreceptors** in the **hypothalamus** detect low water levels by recognizing high solute concentrations.



The hypothalamus signals thirst.



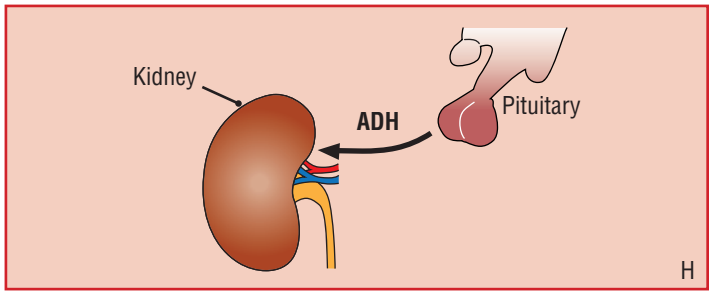
The hypothalamus stimulates the **pituitary gland** to release a hormone called **ADH (antidiuretic hormone)**.



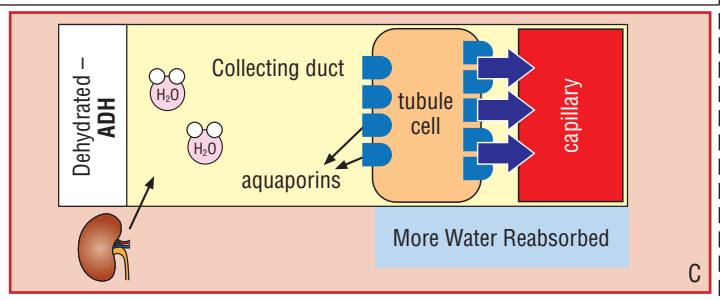
CAFFEINE AND ADH ACTIVITY BOOKLET ANSWERS

2.

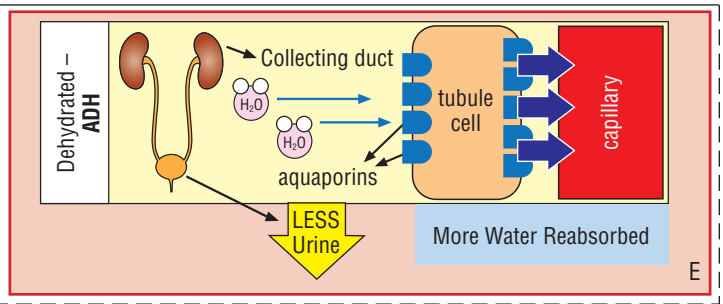
ADH targets the **kidneys.**



ADH causes **aquaporins** to form in the collecting ducts which allows more water to be reabsorbed in the blood stream.

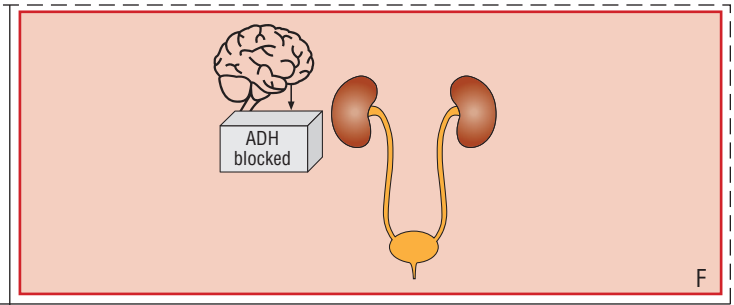


As a result, ADH causes less urine to be produced.

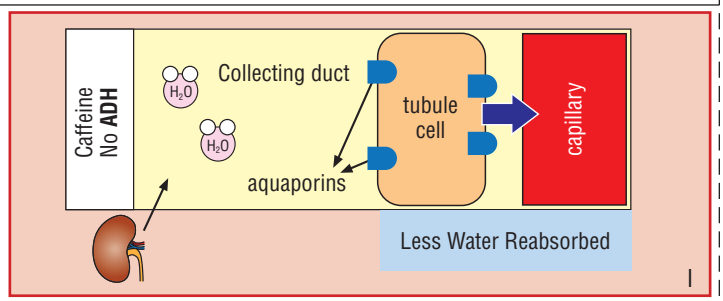


3.

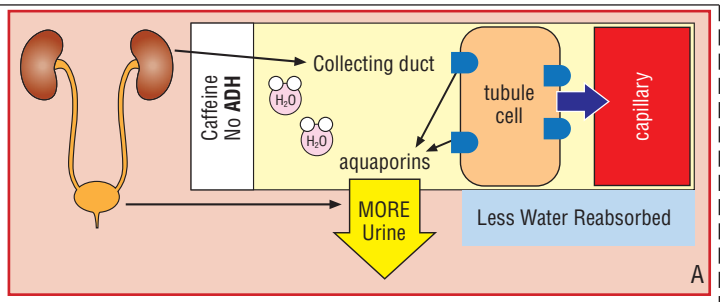
Caffeine inhibits the release of ADH by the pituitary.



Lack of ADH results in fewer aquaporins in the collecting ducts and less water is reabsorbed into the bloodstream.



Caffeine results in increased urine production and dehydration.



EXTREME BOTANICALS - NATURAL DOES NOT ALWAYS MEAN SAFE ANSWERS

b. Carefully lift the filter paper and place it in the 250-mL beaker that contains the water. Lean it up against the edge of the beaker.

c. Wait about 10 minutes for the solvent (water) to reach the line at the top of the filter paper.

d. Remove the filter paper from the beaker and put it on your lab table. Measure 2 cm from the bottom again and put a dot where you placed the drops, so that you can measure the migration.

e. Some of the contents of the capsules should have migrated up the filter paper as color. Measure from the 2 cm mark to the top of the migration.

f. Note the color(s) that are present in each migration. Record your measurements and observations in the data table.

DATA		
	Capsule A	**Capsule B**
Measured migration in cm *(measure to the nearest tenth cm or one decimal place.)*		
Observations		

If the ingredients in the capsules were the same, you would expect that the results of your chromatography experiment would be the same for both samples. If the results are not as expected, that could mean that the purity of the contents is not identical for the two brands.

4. Reflection:

Explain what your results could mean. If your experimental results demonstrated that the two brands are not the same, what could account for those results?

If the ingredient list is the same but the experimental results differ, this could indicate that they actually do not contain the same ingredients or that there are ingredients not listed on the label.

Would you recommend further testing of these supplements to verify purity? Explain why or why not.

If the experimental results differ, I would recommend further testing for purity.

If the experimental results were the same, I would not recommend further testing for purity.

SCIENCE AND OUR FOOD SUPPLY

Examining **Dietary Supplements**

Education Standards by Activity						
	Product Categories	**Supplements vs. Food**	**Banned From Sports**	**Dietary Supplements and Advertising**	**Energy Products**	**Extreme Botanicals**
NGSS - Physical Science: Structure & Properties of Matter	✔	✔	✔	✔	✔	✔
NGSS - Life Science: Structure & Function	✔	✔	✔	✔	✔	✔
NGSS - Life Science: Matter & Energy in Organisms & Ecosystems	✔	✔	✔	✔	✔	✔
NGSS - Life Science: Inheritance & Variation of Traits	✔	✔	✔	✔	✔	✔
NGSS - Engineering: Engineering Design			✔	✔	✔	✔
AL - Food, Health & Lifestyle	✔	✔	✔	✔	✔	✔
NSFCSE 3.0 - Career, Community & Family Connections	✔	✔	✔	✔	✔	✔
NSFCSE 3.0 - Consumer & Family Resources	✔	✔	✔	✔	✔	✔
NSFCSE 3.0 - Consumer Services	✔	✔	✔	✔	✔	✔
NSFCSE 3.0 - Food Production & Services	✔	✔	✔	✔	✔	✔
NSFCSE 3.0 - Food Science, Dietetics, & Nutrition	✔	✔	✔	✔	✔	✔
NSFCSE 3.0 - Nutrition & Wellness	✔	✔	✔	✔	✔	✔
NHES (2)	✔	✔	✔	✔	✔	✔
NHES (3)	✔	✔	✔	✔	✔	✔
CCSS - ELA-Literacy	✔	✔	✔	✔	✔	✔

See next pages for full standards: NGSS, AL, NSFCSE, National Health Education Standards, and Common Core ELA/Literacy ▶

EDUCATION STANDARDS

Science and Our Food Supply: Examining Dietary Supplements aligns with the following current education standards:

NGSS – Next Generation Science Standards Arranged by Topic

Physical Science

Structure & Properties of Matter

- HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Life Science

Structure & Function

- HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Matter & Energy in Organisms & Ecosystems

- HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Inheritance & Variation of Traits

- HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Engineering Design

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

National Agricultural Literacy Outcomes (AL)[1]

Food, Health & Lifestyle

- T3.9-12.a Accurately read labels on processed food to determine nutrition content.
- T3.9-12.b Compare the changes in nutritional needs of humans over their lifetimes.
- T3.9-12.e Explain food labeling terminology related to marketing and how it affects consumer choices (e.g., natural, free-range, certified organic, conventional, cage-free, zero trans-fat, sugar-free, reduced calorie).
- T3.9-12.g Identify how various foods can contribute to a healthy diet.

Family & Consumer Science National Standards 3.0

1.0 Career, Community & Family Connections

- 1.1.1 Summarize local and global policies, issues, and trends in workplace, community, and family dynamics that affect individuals and families.
- 1.1.2 Analyze the effects of social, economic, and technological changes on work and family dynamics.

[1] Spielmaker, D. M., & Leising, J. G. (2013). National agricultural literacy outcomes. Logan, UT: Utah State University, School of Applied Sciences & Technology. Retrieved from http://agclassroom.org/teacher/matrix

CONTINUED ▶ ▶ ▶

- 1.1.5 Determine goals for life-long learning and leisure opportunities for all family members.
- 1.2.7 Analyze factors that contribute to maintaining safe and healthy school, work and community environments.
- 1.3.5 Analyze the effects of federal, state, and local public policies, agencies, and institutions on the family.
- 1.3.6 Identify ways individuals and families can influence change in policies, agencies, and institutions that affect individuals and families.

2.0 Consumer & Family Resources

- 2.1.2 Analyze how individuals and families make choices to satisfy needs and wants.
- 2.3.1 Analyze state and federal policies and laws providing consumer protection.
- 2.4.2 Analyze how media and technological advances influence family and consumer decisions.

3.0 Consumer Services

- 3.2.5 Apply strategies to reduce the risk of consumer fraud.
- 3.2.6 Analyze the role of media in consumer advocacy.
- 3.2.8 Analyze the use of educational and promotional materials in consumer advocacy.
- 3.5.6 Evaluate the labeling, packaging, and support materials of consumer goods.

8.0 Food Production & Services

- 8.2.5 Practice standard personal hygiene and wellness procedures.

9.0 Food Science, Dietetics, & Nutrition

- 9.1.1 Explain the roles and functions of individuals engaged in food science, food technology, dietetics, and nutrition careers.
- 9.2.5 Demonstrate practices and procedures that assure personal and workplace health and hygiene.
- 9.3.1 Analyze nutrient requirements across the life span addressing the diversity of people, culture, and religions.
- 9.3.2 Analyze nutritional data.
- 9.3.4 Assess the influence of socioeconomic and psychological factors on food and nutrition and behavior.
- 9.3.6 Critique the selection of foods to promote a healthy lifestyle.
- 9.4.1 Analyze nutritional needs of individuals.
- 9.4.2 Use nutritional information to support care planning.
- 9.4.5 Design instruction on nutrition to promote wellness and disease prevention.
- 9.7.1 Explain the properties of elements, compounds, and mixtures in foods and food products.
- 9.7.5 Relate the composition of lipids and proteins to their functions in foods and their impact on food preparation and nutrition.

14.0 Nutrition & Wellness

- 14.1.1 Explain physical, emotional, social, psychological, cultural, and spiritual components of individual and family wellness.
- 14.1.2 Investigate the effects of psychological, cultural, and social influences on food choices and other nutrition practices.
- 14.1.3 Investigate the governmental, economic, and technological influences on food choices and practices.
- 14.1.4 Analyze the effects of global, regional, and local events and conditions on food choices and practices.
- 14.1.5 Analyze legislation and regulations related to nutrition and wellness.
- 14.2.1 Evaluate the effect of nutrition on health, wellness and performance.
- 14.2.2 Analyze the relationship of nutrition and wellness to individual and family health throughout the life span.
- 14.2.3 Analyze the effects of food and diet fads, food addictions, and eating disorders on wellness.
- 14.2.4 Analyze sources of food and nutrition information, including food labels, related to health and wellness.

CONTINUED ▶ ▶ ▶

- 14.3.2 Design strategies that address the health and nutritional recommendations for individuals and families, including those with special needs.
- 14.3.4 Evaluate policies and practices that impact food security, sustainability, food integrity, and nutrition and wellness of individuals and families.
- 14.4.4 Investigate federal, state, and local inspection and labeling systems that protect the health of individuals and the public.

National Health Education Standards

(2) Analyze the influence of family, peers, culture, media, technology, and other factors on health behaviors.

- 2.12.2 Analyze how the culture supports and challenges health beliefs, practices, and behaviors.
- 2.12.5 Evaluate the effect of media on personal and family health.
- 2.12.6 Evaluate the impact of technology on personal, family, and community health.
- 2.12.10 Analyze how public health policies and government regulations can influence health promotion and disease prevention.

(3) Demonstrate the ability to access valid information, products and services to enhance health.

- 3.12.1 Evaluate the validity of health information, products, and services.

Common Core State Standards, ELA-Literacy

- RL.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- RI 9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- RI.9-10.5 Analyze in detail how an author's ideas or claims are developed and refined by particular sentences, paragraphs, or larger portions of a text (e.g., a section or chapter).
- RI.9-10.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.
- W.9-10.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
- W.9-10.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
- W.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- W.9-10.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- W.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- W.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- W.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- W.9-10.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
- W.9-10.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

CONTINUED ▶ ▶ ▶

- SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 9–10 topics, texts, and issues,* building on others' ideas and expressing their own clearly and persuasively.
- SL.9-10.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
- SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
- L.9-10.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- L.9-10.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
- L.9-10.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
- RH.9-10.1 Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
- RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*.
- RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms.
- RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
- WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

***Science and Our Food Supply: Examining Dietary Supplements* was brought to you by…**

U.S. FOOD & DRUG ADMINISTRATION

Center for Food Safety and Applied Nutrition
College Park, MD

Subject Matter Experts

FDA

Center for Food Safety and Applied Nutrition
- ***Office of Analytics and Outreach***
- ***Office of Dietary Supplement Programs***
- ***Office of Food Additive Safety***
- ***Office of Nutrition and Food Labeling***

NIH

Office of Dietary Supplements

Curriculum Development Experts

Vernon Callwood, Ed.S.
Secondary Teacher
Charlotte Amalie High School
St. Thomas, U.S. Virgin Islands

Mimi Cooper, M.Ed.
Lead SOFS Advisor
Educational Consultant
St. Augustine, FL

Susan Hartley, B.S.
Biomedical Sciences Teacher
Hinkley High School
Aurora, CO

Laurie Hayes, B.A.
Biomedicine Instructor
The Center for Advanced Research and Technology (CART)
Clovis, CA

Isabelle Howes, M.L.S.
National Training Coordinator for FDA School-Based Food Safety & Nutrition Education Programs
Graduate School USA
Washington, D.C.

Elena Stowell, M.S. NBCT AYA Biology
Biology & Earth Systems; College in the High School Biology Teacher
High School SOFS Advisor
Kentwood High School
Kent, WA

Henie Parillon, Ed.S.
Supervisor of Science, K-12
Orange Public Schools
Orange, NJ

Leah Akins Rehberg, M.Ed.
Family and Consumer Science Teacher
Swainsboro Middle School
Swainsboro, GA

Peter Sykora, B.S.
Science Instructor K-12
Middle Level SOFS Advisor
Langdon Area High School
Langdon, ND

Jodi Songer Riedel, M.S. NBCT
Agricultural Education Teacher, FFA Advisor
Wakefield High School
Raleigh, NC

Leanne H Thele, M.A.
Science Instructor, SNHS Sponsor, Science Fair Coordinator
Jackson Senior High School
Jackson, MO

Keshia D. Williams, Ed.S. NBCT
Life Science Specialist (9-12)
Alabama State Department of Education
Montgomery, AL

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