Why do a unit on skin?

It's current. Rising skin cancer rates have triggered a recent boom in skin research and related fields of science and medicine. More people are overexposing themselves to the sun. A declining ozone layer may be contributing to the problem.

Exciting. Expect more therapies and discoveries. Also expect that your students may be responsible for these advances. New career opportunities in skin research include a rising field called photobiology (the effects of light on living organisms).

Relevant. We all have skin; we all use laboratory-tested skin products every day. Four out of five students suffer from acne. Rapid advances in research have produced new treatments for many skin conditions.

CURE
Connecticut United for Research Excellence, Inc.
Connecticut’s BioScience Cluster

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# Curriculum Chart: Sun And Skin

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## Classroom Resources

- **National Cancer Institute**, What You Need to Know About Melanoma (1992); NIH Publication No. 93-1563.
- **National Cancer Institute**, What You Need to Know About Skin Cancer (1992); NIH Publication No. 92-1564.

## The Skin Cancer Foundation. It’s Never Too Early to Stop Skin Cancer (1985).

- **Van Cleave, Janice.** *Biology for Every Kid, John Wiley & Sons; 1990.

For free information about preventing skin cancer, acne, and other skin diseases, contact: The American Academy of Dermatology, 930 N. Meacham Rd., P.O. Box 4014, Schaumburg, IL 60173-4014; (847) 330-0230.

## Bibliography


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What's New in Skin Research

Increasingly, researchers are studying how skin acts to maintain our health and well-being. Their focus is health promotion and disease prevention:

- Discoveries by photobiologists (scientists who study the effects of light on cells) are leading to treatments for many skin diseases.
- Research is also aimed at developing better products to protect skin—acne creams and sunscreens, for example.
- Researchers are learning more about how nociceptors (NOH sis sep tors), pain processing cells in the skin, receive and transmit signals to the spinal cord and brain. This knowledge may lead to new therapies to reduce chronic pain.
- Researchers are trying to identify genes and proteins that regulate the growth of both healthy and abnormal melanocytes (cells that make the skin pigment melanin). This knowledge may lead to new therapies to prevent or stop melanoma, a type of skin cancer.

Healthy Skin Today

(page 1 of BioRAP): Discuss the concept: skin is a mirror of your health. What messages does skin "reflect"? Can your skin tell you if a person is hot or cold (goosebumps)? Tired (bags under eyes) or wide awake? Healthy or ill? Embarrassed? An outdoor or indoor person? What else?

What does "healthy" skin look like? Is a tan healthy or unhealthy? Why? How many students have had a sunburn? What does it feel like? (Note: Dark-skinned people burn, but not as easily or noticeably as light-skinned people.)

After reading the "Healthy Skin" article, discuss how and why skin can become unhealthy. Which people are more prone to skin cancer? (Unprotected sun bathers, light-skinned people, or those who live where the ozone layer is thinning). Why is some skin darker than others? What makes people tan? What causes acne?

Your Skin (page 4 of BioRAP): Skin is the body's largest and heaviest organ. Ask: Why do we need it? What does it do for us? How does your skin fight infection? What products do people put on skin and why? (Hand lotions, sunscreens, make-up, ointment for wounds, etc.) Which products protect skin? What's in them? Have students bring in skin products, research and discuss the ingredients. (See Lesson 2: UV Rays and Ozone.)

Learning Objectives

- Observe skin to understand its structure and function
- Identify health hazards and diseases of skin
- Discuss prevention and treatment of these diseases, including biological research that results in new skin care products
Skin Sleuth: Have students closely examine their skin with a magnifying glass to learn more about its structure and function. Identify and draw: wrinkles, lines, hair, mole, freckle, birthmark, blackheads, pimples (infected by bacteria), scar, callus, wart, rash, goosebumps, cut, scratch, burn, scab, bruise, and so on.

Ask: Where is skin thicker? (Back, soles of feet, palm of hand.) Soft and flexible? (Eyelids, between fingers.) Students can check for oil (a substance called sebum) by wiping tissues on the forehead, forearm, etc., or dropping water on skin to see if oil keeps it from penetrating. Why is skin oily? (To form a waterproof seal.)

Skin Prints: Making fingerprint-like rubbings of skin parts can reveal a lot about how we use our skin. Assign students to work in teams of two. Distribute clear tape, pencils, and paper towels for clean-up. (You may substitute an ink pad for pencil rubbings, but it takes a little practice to get un-smudged prints.)

Discuss the “Think About It” questions. (See below.) Have students make various skin prints. First, compare differences in prints by group. Do any two palm prints look alike? (Each person’s skin pattern is unique.) Then discuss common elements. What do all the elbow prints have in common, for example?

The skin pattern indicates how much, how far, and in what direction skin is folded or stretched. Skin stretched in many directions (elbow, knee) looks mottled with little crosses in it. Palms have deep creases where the skin folds. Skin that doesn’t stretch much (forearm, back of hand) has tiny lines and is smoother. Compare hair on the skin prints. Does hair grow everywhere? (The palm has no hair; the forearm has plenty, for example.) Which prints show large pores (the nose, for example)? Why are knuckles so wrinkled? Why are elbows rough? Based on their observations, would students be able to identify the origin of a skin print just by looking at it? How?

Making Skin Prints

Skin prints are like fingerprints. They show the pattern of skin on your wrist, elbow, and other body parts. In this experiment, you’ll make and compare skin prints from different parts of your body. Then you’ll compare your skin prints to those of your classmates.

ROUND IT UP

blank paper  pencil  clear tape  soap and water

THINK ABOUT IT

Does all of your skin look alike? If not, how and why does it differ?

Acne Everywhere: Students may be embarrassed by acne, but as the Healthy Skin article in BioRAP points out, 80% of young people are afflicted to varying degrees. Have students conduct a survey to find out how many students believe certain foods cause acne (they don’t). How could students debunk this myth scientifically? (For more on acne treatments, see Lesson 3: In the Lab.)

Elephant Hide/Rabbit Pelt: Have the students brainstorm about animals with skin that is very different from human skin (elephants, amphibians, sharks, dolphins, etc.). How is the skin of animals adapted to their particular environment? Have students design a make-believe animal. It may have scales, plates, fur, feathers, coarse and thick skin, etc. Where does the make-believe animal live, and how does its skin adaptations allow it to live there? (For example, armor protects from predators, fur protects from cold, color can camouflage.)

DO IT

1. Rub a pencil back and forth on paper. The pencil emudge should be about the size of your palm.
2. Rub the inside of your wrist in the emudge until it’s black.
3. Lay a piece of tape over your wrist. Then gently lift the tape; it will have a print of your skin.
4. Tape your skin print onto a piece of paper and label it “wrist.”
5. Make prints of your elbow or knee, top of your forearm, knuckles, and nose. Then clean your skin with soap and water.

REVIEW IT

On a separate paper, describe each print in detail. Pretend you’re talking over the phone to someone who can’t see the print. Identify pores, hairs, moles, or other skin features. What else makes each skin print unique?

Form a hypothesis to explain why different parts of the skin have different patterns of lines and wrinkles.
FACT SHEET

More than Skin-Deep

"It's only skin-deep" is a saying that belies a wealth of scientific truth. Human skin, only a few millimeters thick, contains a universe of highly specialized cells—about 20 million per square inch of skin. These cells act to maintain the health and well-being of the entire body. The story of human skin is told in two layers: epidermis (the upper layer that’s as thin as a sheet of paper) and the dermis (the underlying layer that ranges from 15 to 40 sheets thick).

Ask students to name things that are inside skin. Hair is easy; you can see it from the outside. What else is there and how do you know? What evidence of skin parts can you see, feel, smell, or infer? Have students draw a cross section of the dermis and label the parts. Make an overhead transparency of the "Parts of the Skin" reproducible on page 4. Discuss the parts and have students revise their drawings.

The Epidermis

The epidermis consists primarily of cells called keratinocytes (care uh TIN oh sites) because they contain the protein keratin (CARE uh tin). Keratinocytes form at the bottom layer of the epidermis. Over a period of about 30 days, they push their way to the outer epidermal layer. As young keratinocytes migrate to the skin's surface, they displace their older, dying counterparts, which flake off or are brushed or washed away. In this way, humans literally shed their skin. Most people lose a layer of keratinocytes every month or so.

The skin's pigment-forming cells, the melanocytes (mell AN OH sites), are at the base of the epidermis. They contain melanin, the protein that determines skin color. In general, the more melanin, the darker the skin. But whether a person's skin is light or dark depends on various factors, in particular inherited genes that direct the quantity and quality of melanin production.

Overexposure to both types of ultraviolet light (UVA and UVB) stimulates melanocytes to produce extra melanin, creating a tan. Scientists believe excessive sun exposure, along with genetics, may play a role in the type of skin cancer known as melanoma, where the melanocytes become cancerous and produce a tumor. If the melanoma tumor spreads to vital organs, such as the heart, lung, brain, or liver, death can result. (See Lesson 4: Skin Diseases for more on skin cancer.)

Functions of the Skin

A basic purpose of skin is to provide a waterproof, protective covering for the body's complex internal environment. The skin also plays key roles in helping to maintain the circulatory and nervous systems.

Because it contains thousands of small blood vessels, or capillaries, the skin helps transport blood throughout the body. In addition to providing oxygen and nutrients to cells within skin layers, the skin's blood vessels aid in regulating body temperature. By expanding on a hot day, skin capillaries help the body to shed internal heat. On a cold day, constricting capillaries help the body to retain heat.

Nerve cells in the skin from the body's first contact with the outer world. At the moment of birth, an infant's first experiences of the physical world are perceived through the sense of touch. Though nerve cells, the skin receives and transmits signals for touch, pain, and change of temperature.

UV rays from the sun stimulate a biochemical process that converts a body chemical in the skin to vitamin D. Vitamin D helps the body absorb calcium.

The skin is also a major contributor to the body's immune system. In addition to being the first line of defense in keeping out bacteria, viruses, and other organisms that invade the body, the skin is home to enormous quantities of T-lymphocytes, or T-cells. T-cells attack and destroy bacteria, fungi, viruses, parasites, toxins, and cancerous cells that can cause disease.
PARTS OF THE SKIN

DEMET

Subcutaneous tissue (connects to muscles and bones)

Nerve

Hair follicle

Sweat gland

Melanocytes (contain melanin pigment)

Vascular network (blood vessels)

Old keratinocyte

Young keratinocyte

Epidermis (upper layer)

Gland
What’s New in UV and Ozone Research

- In the past decade, clinical and epidemiologic data have demolished the myth that a tan is a sign of good health. A tan — like a sunburn — indicates overexposure to UV rays, which can lead to skin cancer and premature aging.

- In 1995, the United Nations World Meteorological Organization said that the ozone hole covers 3.86 million miles over Antarctica, an area about the size of Europe.

- Recent research has shown that ultraviolet A (UVA) radiation, once thought to be harmless, may be even more harmful than ultraviolet B (UVB) light. Many newer sunscreens absorb and filter both types of UV rays.

- Researchers are examining suspicious correlations between the diminished ozone layer and rising skin cancer rates. For example, epidemic increases in skin cancer rates are occurring at far northern and far southern latitudes, where ozone depletion is greatest.

Read, Think, and Discuss

Sure in the Sun (page 2 of BioRAP): Before students read the cartoon, find out how many have misconceptions about sun protection. Ask: Do dark-skinned people get sunburns? Does a sunscreen allow you to safely sunbathe all day? What’s the difference between a sunblock and a sunscreen? Can you get a sunburn while swimming? While in the shade? (Yes, if UV rays reflect off sand and water.) With each of the above questions, ask the students to explain why they answered as they did. After reading the cartoon, explore other common misconceptions. Can you get a sunburn when it’s cold out? (Yes; UV rays bombard the surface no matter what the temperature.) In winter? (Yes; 80 percent of UV rays reflect off snow. Skiers often wear sunblock for this reason.)

Protect Yourself (page 5 of BioRAP): We all need sunlight; it is essential to life. The problem is overexposure. Sunburn is especially harmful. Ask: what time of day, season, location, and skin type would present the greatest risk? Sunscreens do not offer total protection. Ask: How might inappropriate use of sunscreens lead to more skin damage? (People may get a false sense of security and stay out too long.)

What’s in a Label? (page 8 of BioRAP): What SPF number would students use? Why? Create math problems in which students calculate how much longer various SPF sunscreens allow them to stay in the sun. For example, suppose you normally burn after 10 minutes in the sun. An SPF 15 sunscreen allows you to sunbathe for 10 x 15 minutes, or 150 minutes (2.5 hours), before burning.
In the News: Ask students to clip newspaper and magazine articles about ozone research over several weeks or months. Discuss the progress of research and regulation. What questions do scientists hope to answer?

Stopping the Sun's Rays: UV rays can penetrate skin cells below surface, without your knowing it. Set up a simple demonstration to observe the damaging effects of sunlight. Cut designs out of paper and clip them to sheets of dark-colored construction paper. Set the sheets in sunny locations: on a windowsill, outdoors in full light, beneath waxed paper (or other materials), and so on. After a few days, lift the designs. Compare the sun's damage to the construction paper with undamaged paper. Did windows filter the sun's rays? How about other materials? Did anything block the rays completely?

Skin Survey: Pass out the "Skin Survey" reproducible. Explain that the six skin types depend on how much melanin (a dark brown pigment) is present. Lighter-skinned people have less melanin, and so burn more easily. Have students take the skin survey home. Since many families have more than one skin type, have students fill out the form for each family member and bring to class. Analyze the results in class. Which skin type is most common in your classroom? How many hours per week does the average student spend in the sun? How many use sunscreens? Sunblocks? Which students have a higher risk for sunburn and skin cancer? (Those with fair skin who spend a lot of time in the sun, unprotected.)

Using the information from the Fact Sheet, discuss how our knowledge of the ozone hole is very recent. There is still much we do not know. But while scientists are searching for answers, international cooperation between nations holds out hope for controlling emissions. Ask students how nations cooperate on other issues (the United Nations, atomic test ban treaties, fishing treaties, etc.).

About Albinos: Ask students to research albinism (AL-bin-izm) to find the cause (genetic), symptoms (white skin and hair, eye intolerance to light) and complications (skin cancer, vision problems). Albinos have no melanin in their skin, hair and eyes. Although rare, it occurs in all races. The prevalence of albinism is low in the U.S. with less than five people per 100,000 affected.

Message in a Bottle: What words, messages, and images do companies use to "sell" their sun lotion products? Have students design and draw a new and improved bottle, including a label, for a sun lotion product. The goal is to clearly state what the product does while convincing a consumer to buy it.

Using the historical information they gathered, have the students write a short essay on what were the attitudes of their parents, grandparents or guardians toward tanning and sun protection when they were adolescents. How have attitudes changed?
UV Rays and the Endangered Ozone

Dangerous solar rays come from the ultraviolet end of the sunlight spectrum (invisible light just beyond the visible violet band). There are three kinds of UV radiation: A, B, and C. UV C rays are too weak to penetrate Earth’s atmosphere. UVB rays represent less than one percent of the sun’s energy that reaches the surface. They are most prevalent in summer, are more energetic than UVA rays and can cause sunburn much faster. Researchers have learned that UVB rays are a major cause of skin cancer.

People once thought that UVA rays were harmless. Some sunscreen products absorb only UVB rays, allowing UVA rays to filter through for a “saf e” tan. Recent research has shown that UVA rays may be more harmful than UVB rays. They are 100 to 1,000 times more abundant, depending on the season. While UVB light only reaches the epidermis (outer layer of skin), UVA penetrates to the dermis (inner layer), where it can damage blood vessels, elastin (cells that make up the skin’s physical support system), and DNA.

Sunscreen Labels

Thanks to increased understanding of UV rays, consumers can select from a range of sunscreens. After discussing “What’s in a Label” article (page 8 of BioRAF) examine real sunscreen labels.

Active Ingredients: Until recently, the most common active ingredient was PABA (para- amino benzoic acid), but it can cause allergic reactions. There are several active ingredients with fewer reported allergic reactions. Certain products afford some blockage of portions of the UVA spectrum and may be labeled “broad spectrum.”

Water Resistance/Water-Proof: Some products are formulated to be water-resistant or water-proof. This is indicated on the label.

Sunblocks: A sunscreen absorbs and filters UV rays; a sunblock stops all the sun’s light. Sunblocks contain titanium dioxide, magnesium oxide, or zinc oxide.

Sun Protection Factor (SPF) Numbers: No matter what your skin type, most dermatologists recommend an SPF of 15 or higher. Regular use in the first 18 years of life could reduce the incidence of skin cancer. No broad spectrum sunscreen, no matter how high its SPF, filters the full spectrum of UVA rays. You can sit in the sun all day wearing certain sunscreens and not get a sunburn, but you will still be exposed to highly damaging UVA rays. Even with a sunscreen, never expose your skin for protracted periods.

The Ozone Layer

In December 1992, an aging weather satellite recorded the lowest global ozone levels in the lower stratosphere—the ozone layer—in 14 years of collecting data. The 14 percent drop from the previous year seemed too large and abrupt. Perhaps the satellite was failing, scientists surmised. But further measurements confirmed the data. One factor was the eruption of Mount Pinatubo in the Philippines in 1991, which disgorged approximately 50 metric tons of sulfur dioxide into the stratosphere.

Both chemical reactions and the wind play major roles in the diminishing ozone layer. Undisturbed, this layer acts as a kind of celestial balloon, 12 to 15 miles above our heads. Three forms of oxygen perform a minuet: ozone (O3), with three linked oxygen atoms, normal oxygen (O2), and single oxygen atoms (O). Normal and single oxygen atoms combine to form ozone, a virtuoso in absorbing UV light. Because of the solar energy it has absorbed, ozone breaks up into normal and single oxygen atoms. Earth’s protective ozone layer has maintained this oxygen minuet over the millennia.

In the last few decades, artificial chemicals called chlorofluorocarbons (CFCs) hit the stratospheric “dance floor” like a rowdy gang crashing a party. CFCs serve as a main component of dry cleaning and refrigerating chemicals; they are also byproducts of manufacturing processes and nitrogen fertilizers. CFCs disperse in the lower atmosphere where they linger for years before migrating to the stratosphere. There, CFCs and other chlorine compounds combine with the oxygen types, depleting the amount of ozone.

In 1995, the United Nations World Meteorological Organization said that the ozone hole covers 3.86 million square miles over Antarctica, an area about the size of Europe. Depletion of the ozone layer means more UV light reaches Earth’s surface, where it can damage DNA in humans and animals.

Slowing the Decline: Several International Conventions on the Protection of the ozone layer have produced agreements by 93 nations to phase out CFCs. Even so, their presence in the atmosphere is expected to double in the next few decades. This is because the agreements allow countries to produce CFCs for a time in order to soften the blow to the world economy. Plus, CFCs released in the 1980s will linger for years. Yet, it is hoped that the ozone layer will recover completely by the year 2060.
SKIN SURVEY

Male or Female: _____
Grade: _____

Read the descriptions for all six skin types. Circle the one that most matches you. Then answer the rest of the survey questions as accurately as you can.

WHAT'S YOUR SKIN TYPE?

1. Very fair skin; red or blond hair; freckles; always burns; never tans
2. Usually fair skin; burns easily; minimal tan
3. Fair skin; sometimes burns; gradual tan
4. Usually white or light brown skin; minimum burning; always tans
5. Brown skin; seldom burns; always tans
6. Dark brown or black skin; tans darkly; burns only with severe exposure

In the last month, about how many hours per week were you in the sun?

0 to 5
6 to 10
11 to 15
16 to 20
more than 20

When you are out in the sun, about how often do you use a sunscreen?

Never
Sometimes
Often
Always

Who has had sunburn in your family? What were the conditions (time of year, time of day, length of exposure, etc.)?

Ask a parent, guardian or grandparent how much they were in the sun when they were adolescents. How did they dress? Did they use any protection? Did they have any sunscreens? When did they first learn about ozone? (Use extra paper if necessary)
A field called photobiology has grown considerably in the last two decades. More than 1,000 scientists in the U.S. are photobiologists, experts in the effects of light on cells, particularly skin cells, plant cells, bacteria, fungi, and viruses.

Over the past two decades, researchers have developed many new methods for treating acne; antibiotics to treat bacterial skin infections; creams and topical medications containing a vitamin A–like chemical that helps dry out pimples; natural vitamin A, sometimes with zinc, to treat acne.

Dermatologists and photobiologists are using phototherapy to treat psoriasis, a painful condition in which keratinocytes (skin cells) proliferate rapidly without shedding fast enough, creating thick, scaly skin.

Today's Research Lab (page 3 of BioRAP): Ask students to think about their morning routines. They rise from sheets washed in laundry detergent. They use soap, shampoo, and hair conditioner. They brush their teeth with toothpaste and apply deodorant. Before any of these products were sold, manufacturers had to prove they were safe and effective (did what they were advertised to do). Most everyday products, or at least the ingredients in them, were tested on animals to make sure they are not toxic to humans.

Review the four scientific steps in the article. Then ask: Why did Dr. Freeman repeat step 1, called an in vitro (“in glass”) experiment? (Replicating results minimizes error.) Why not just stop there? Why do more tests? (The first experiment didn’t prove the ingredient was safe to humans.) The article focuses on the principal scientist, a fictional character. Why does she consult with other careful scientific scrutiny of the data. Also, researchers must often call on many areas of expertise.)

What if the experimental rats had shown irritation? (Ingredient 1 would have been deemed unsafe. Scientists might alter the experimental formula of the medication, or even rule out human trials altogether, stopping the research at this stage.)

After safe animal experiments, scientists test the product on volunteers in human clinical trials. Would students volunteer? Why or why not? Do they believe the product is safe at this point? Ask students to identify variables (factors that may affect the outcome). (Amount of material applied, how applied, amount of acne the subject has, the placebo effect, and so on.) How can scientists control these variables? For example, both experimental and control groups applied cream the same way; once in the morning and once at night, after washing their faces with a mild soap.
Following the scientific method, how would students prove which ingredient (flour, sugar, egg, milk, baking powder) makes muffins lighter and fluffier?

Career Rap (page 4 of BioRAP): Brainstorm subjects that a photobiologist might investigate. Start by listing types of light (UV, visible, lasers) and effects of light on organisms (tan and sunburn, sets the biological clock, allows eyes to see, and so on). Have students research advances in photobiology:
- How light interacts with the human eye to produce vision.
- How light affects the molecules of plant and animal cells.
- How lasers can treat disease—closing ruptured blood vessels in the skin and eliminating some types of skin cancers, for example.

Product Safety and Animal Testing (page 5 of BioRAP): Ask students what might occur if companies were allowed to sell products or medications that have never been tested for safety? If a small child accidentally drank an untested shampoo with a new herbal ingredient, how would a doctor determine the severity of the incident? Is the child's life in danger, or will there be no ill effects? What is the most appropriate treatment? What do the words replace, reduce, and refine mean?

Though much has been done to reduce the number of animals used in product safety testing and research (the number of animals used has gone down by more than 40 percent in the last 20 years), their use helps insure that medications and consumer products are safe and effective. (See the Fact Sheet for more information.)

Investigate! Investigate! Investigate!

Double Touch: This reproducible is a scientific experiment on skin sensitivity. The goal is to use the scientific method to support or disprove a hypothesis by collecting data and making observations. If results vary, great! Use the discrepancies to discuss the importance of controlling variables. Also, replicating the experiment and collecting a large body of data (the whole class instead of one student) helps to minimize error. Fingertips, lips, and other body parts used to collect sensory data generally have more touch-sensitive nerve endings.

Hands-on Photobiology: While the harmful effects of excessive sun exposure have been well documented, we all know that sunlight is vital to life. Our existence—and our quality of life—is dependent upon the sun. Have students design a controlled experiment—the effects of sunlight on plants, for example. Begin by brainstorming interesting scientific questions: How are some plants adapted to living in the shade? How are others adapted to desert sun? Why do some plants prefer shade and others sunlight? Does more sunlight make tomato plants produce more tomatoes? Do some plants have a greater threshold for surviving too little or too much sun?

Seeing is Believing: Demonstrate bias, an unintentional desire to make an experiment turn out a certain way. Tell students that many people believe eggs stand on end only during the equinox (a common myth that's easily debunked). Pass out eggs on a non-equinox day and see what happens. Bias may preclude many students from standing them on end. After you debunk the myth, do more students succeed?

In all experiments, especially those involving human subjects, experimenters and subjects show bias. For instance, subjects may have a medical condition that the test product could improve or cure, and so may be desperate for success. They may show temporary improvement even though they are given an inert substance, or placebo, with no medicinal effect; hence, the name for this syndrome, the placebo effect.

In blind studies, subjects don't know whether they're in the experimental or control group, so everyone believes he or she may be receiving the experimental treatment.

Afterward, researchers can measure the extent of the placebo effect, if any, in the control subjects. Ideally, researchers conduct a double-blind study. Neither the experimenters nor the subjects know who is part of the experimental or control group.

Label Hunt: While the FDA regulates products, labeling practices are not always standardized. For example, there is no universal definition for the labels "hypoallergenic," "not tested on animals," or "cruelty free." Many products labeled "cruelty free" were allowed by government regulators because other companies did animal tests on the same or a nearly identical product or ingredient. Ask students to conduct a drug store search for these and other product labels. What are the ingredients in the products? Are they the same ingredients that are in competing brands?
FACT SHEET

PROTECTING THE CONSUMER

Adolescence. It’s when we feel uncertain about ourselves and self-conscious about our appearance. It’s no surprise that teenagers spend millions of dollars on products that promise to control acne, make hair shine, or help skin tan.

Who ensures that these products perform safely, as promised? The Federal Food and Drug Administration (FDA) works in cooperation with manufacturers of skin-care products and others. It divides products into prescription drugs and over-the-counter (OTC) products. Manufacturers must prove that both types are: 1) safe, (they don’t harm the consumer); and 2) effective (they do what the makers say they do).

Prescription drugs require pre-market approval by the FDA after years of tests for safety and effectiveness. OTC drug products (which include acne products and sunscreens) also require FDA approval; manufacturers must have on file proof of safety and effectiveness. (Cosmetic products do not require pre-market FDA approval; however, many of their ingredients undergo a review by an independent authority.) The data submitted to the FDA is reviewed by a panel of experts and the findings are published in an article called a monograph.

Laboratory Animals

Animal tests can help determine whether people can be harmed by cleaning products or cosmetics at home, by chemicals at our jobs, or by the pesticides sprayed on our lawns. For example, a pesticide known as 2-AAF, or 2-acetylaminofluorene, was a promising chemical for reducing crop losses. But animal studies showed it might cause cancer, and the EPA never approved it. Animal studies help protect people, other animals, and the environment. Still, scientists are working on ways to reduce the need for research animals. In scientific circles, these methods are called the “three Rs”:

**Replace:** As in vitro (“in glass”) testing and computer modeling improves, scientists increasingly use these methods to replace animal testing. For instance, scientists often use Salmonella bacteria to test substances that can cause genetic damage. Powerful computers chemically analyze and model the effects of a substance based on its molecular structure. These alternatives can be faster and less expensive than animal tests. At present, however, we still need to test many substances for toxicity on living animals.

**Reduce:** Years ago, a toxicity test for substances was called LD₅₀ (Lethal Dose₅₀). Groups of animals received a different dose of a compound to determine at what level it routinely killed 50% of the test population. Today, new methods mean as few as six to 10 animals receive fewer doses (often non-lethal) of the chemical. Thus, the same information is obtained from far fewer animals.

**Refine:** Federal regulations limit the extent and intensity of pain in animal research and allow it only when no other research methods are possible. Federal studies show that animals are either free from pain or treated with painkillers in 94 percent of laboratory animal tests. Motivated not only by regulations but by the desire to treat animals humanely, scientists alter procedures to minimize the discomfort felt by animals. Painkillers are not used only when their use would interfere with the research results, for example, when painkillers themselves are the object of study.

Scientists continue to develop alternatives. Writes Alan M. Goldberg, director of the Johns Hopkins Center for Alternatives to Animal Testing: “At this stage in the alternatives debate, most toxicologists are willing to accept the fact that in vitro and other alternatives are a fruitful avenue for research and that at some point in the future they may replace many whole-animal methods in toxicity testing ... It is not possible to predict what scientific information will be produced over the next decade and what its effect on the feasibility and timing of replacement methodologies will be.”

Acne

For many teenagers perhaps the gravest skin hazard from a social point of view is acne: whiteheads, blackheads, pimples, or boll-like lesions or cysts that appear on the face, neck, shoulders, or back. Without proper treatment, severe acne can leave lifelong physical and emotional scars. Acne usually occurs when the male or female body produces higher levels of the male hormone testosterone, which stimulates the skin’s sebaceous glands to produce excessive sebum, an oily substance which can clog pores and trap bacteria. (See Lesson 1: Healthy Skin.) Fortunately, most cases of acne taper off during the onset of adulthood.

Dermatologists caution that certain cosmetics and sports equipment such as helmets with chin straps may aggravate acne. Long exposure to the sun and fluctuating hormone levels before or during menstruation may also intensify acne. While dirt does not cause acne, proper cleansing at least twice daily will reduce minor cases by clearing away excess sebum. More severe cases may need a doctor’s attention.
Is skin equally sensitive on all parts of the body? For example, is the forearm more or less sensitive than the fingertips? Use the scientific method to find out.

**Observation.** Observe the skin on arms and fingertips without touching it.

**Hypothesis.** Write a hypothesis about skin sensitivity based on the observation.

**Experiment.** Make a Touch-o-Meter by taping together two dull-pointed pencils as shown. Be sure the pencil tips are even.

Look away while your partner gently touches your forearm with the Touch-o-Meter, making sure both points touch at the same time. How many points can you feel? Record your data below. Then test the other areas listed.

<table>
<thead>
<tr>
<th>Body Part</th>
<th>Pencil Points Felt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forearm</td>
<td>0 1 2</td>
</tr>
<tr>
<td>Fingertips</td>
<td>0 1 2</td>
</tr>
<tr>
<td>Shoulder</td>
<td>0 1 2</td>
</tr>
<tr>
<td>Back</td>
<td>0 1 2</td>
</tr>
<tr>
<td>Other</td>
<td>0 1 2</td>
</tr>
</tbody>
</table>

Switch places with your partner and repeat the experiment.

**Conclusion.** Compare your data with other students'. Not all data may agree. What might be some reasons? What variables (factors) affect the outcome of the experiment?

What conclusion can you draw about your hypothesis?
Epidemiologists (scientists who study diseases in large populations) report that skin cancer has hit record levels.

- Worldwide, from the early 1960s through 1982, cases of melanoma (the deadliest skin cancer) increased an average of 3 to 7 percent per year in white populations.

- In the U.S. since 1973, melanoma incidence has increased 4 percent per year. Cases in whites rose 10 times faster than in blacks. In 1995, approximately 34,000 Americans developed melanoma; approximately 7,200 reportedly died of it.

- Although according to the American Cancer Society, melanoma incidence increases for those living near the equator, in regions of New Zealand, Australia, and Scotland, melanoma rates more than doubled over the past eight years.

**Read, Think, and Discuss**

**Melanoma (page 5 of BioRAP):**

The article mentions that cancer rates of young people, especially women, have risen the fastest. Discuss possible explanations. For example, young women spend more time in the sun without proper skin protection. Do girls sunbathe more often than boys in your school? (See the "Skin Survey" reproducible on page 8 of Teacher's Guide.) If so, why?

Compare melanoma to a computer virus. For example, the DNA in skin cells is like a computer program that tells cells what to do. Like a computer virus, melanoma corrupts the DNA by changing this "program." The skin cells unwittingly carry out the corrupted program, divide, and spread, just as a computer virus gradually spreads through a system. What's the treatment? In time, an unchecked, corrupted "program" can be deadly—to a human or to a computer. The only remedy is to kill (or erase) all the infected cells (or program codes). Generally, this is done by surgery and/or radiation therapy.

**Learning Objectives**

- Identify and describe causes and symptoms of three types of skin cancer
- Discuss possible factors leading to a rise in skin cancer rates on a world map; discuss possible reasons for geographical differences
- Identify symptoms of common animal skin diseases
Facts Around The World (page 7 of BioRAP): Before reading the article, ask students to predict where in the world melanoma rates are climbing fastest. Prompt them to give logical reasons for their predictions. Students may think of the equator, where the sun shines strongly all year round. According to the American Cancer Society, incidence increases for those living near the equator. However, epidemic increases are occurring at far northern and far southern latitudes where ozone depletion is most pronounced. Scientific research has not determined the precise relationship, if any, that the thinning ozone layer has to increased skin cancer incidence. While the issue remains controversial, scientists are working to examine suspicious correlations.

Investigate! Investigate! Investigate!

Mole Hunt: Have students locate, count, and describe differences in moles on their skin. Is there a pattern to where moles appear? For example, are more moles on the top or bottom of the forearm? What is the range of tones and sizes in moles? Do they appear more often in light-skinned or dark-skinned people, or about the same amount? Make a class graph of the number of moles on both arms; categorize the data by skin type to see if there’s a correlation. (See the reproducible).

Spread the Word: Why do some people ignore safety measures to protect themselves from cancer? Review the “Save Your Skin” reproducible. What might convince frequent sunbathers to change their habits? One of the biggest risk factors for skin cancer is overexposure to the sun during childhood. Discuss movies and TV shows that encourage sun-tanning among teenagers.

Challenge students to create an anti-skin cancer message for teenagers using their choice of creative medium: stories, music, posters, videos, speeches, and so on. After students have presented their messages, discuss which ones are most effective and why.

Animal Skin Problems

The “In Fact” column on page 7 of BioRAP discusses several common skin diseases of pets. While Mother Nature spared most animals the pain of a sunburn, pets and farm animals suffer allergic skin diseases and assaults by parasites, including mites, ticks, fleas, and fungi. Veterinary, medical and biological research has led to effective treatments for many of these diseases.

Mange: Many dogs come down with sarcoptic mange, commonly known as the mange. It is caused by a scabies mite. This skin problem is transmittable to humans, causing a bad rash. A topical spray or ointment can eliminate the pest in both people and dogs.

Allergic Skin Disease: Dogs are allergic to many of the same things that people are, including dust and pollen. Veterinarians can often determine the source of the allergies and desensitize the animal through allergy shots.

Ringworm: Cats can pass ringworm, a fungus, on to humans. Look for a crusty, circular lesion on the animal’s face. A topical antifungal cream usually wipes out this pesky invader, but sometimes treatment is prolonged.
The Most Common Cancer

The American Academy of Dermatology (AAD) estimates that skin cancer will strike one of every six Americans during their lives. Although this issue of BiCARE concentrates on melanoma, other skin cancers are more common and less dangerous, including basal (BAY-su) cell carcinoma and squamous (SKWAY-mus) cell carcinoma. A carcinoma is a cancer that develops in the tissue forming the lining or covering of an organ. In this case the epidermis.) More Americans are now expected to develop non-melanoma skin cancers than all other cancers combined.

A full-body skin exam by a physician or nurse is the best way to detect skin cancer. A careful self-exam can also reveal telltale signs. Report new skin growths or changes in existing moles to a doctor immediately. Early detection can lead to cure of at least 90% of all skin cancers. Depending on the type of skin cancer, therapies include: surgery (including cryosurgery in which the cancerous growth is frozen and destroyed with liquid nitrogen) and radiation therapy.

Basal Cell Carcinoma

Basal cell carcinoma is the most commonly diagnosed cancer among Caucasians in the U.S. The disease most often appears first on the head or neck, but rarely spreads to vital organs. For this reason, well under 1% of patients die from the disease. Unchecked, basal cell carcinoma can cause the loss of an eye, ear, or nose.

Symptoms of basal cell carcinoma can mimic those of other skin conditions such as psoriasis or eczema. Here are the five main warning signs:

• A persistent small, raised, translucent bump colored pink, red, white, tan, brown, or black;
• A small, open, red sore that lasts three weeks or more—sometimes this sore will bleed, ooze, or crust over;
• Small patches of red skin on the chest, shoulders, arms, or legs that do not change or improve;
• A small, red, rolled-edged crater with or without evident capillaries;
• A small, shiny, yellow or white scar for which there is no history of injury.

The main warning sign is a small, raised, or scaly bump that is red or pink and has sores in the center. These bumps tend to appear first in exposed areas: the head, neck, shoulders, or arms.

Melanoma

Melanoma cells can spread to vital organs and kill. Fortunately, this potential killer is among the easiest cancers to cure if detected in its early stages. According to the A.A.D., these are the main warning signs:

• Abnormal moles that rapidly change size, shape, or color.
• Moles in this category may itch, hurt, or bleed.
• Other characteristics of these moles include irregular shape, non-circular shape, change in color to black or dark brown, and having a size larger than a pencil eraser.

Remember the “A-B-C-D” rule for identifying melanoma: a mole may be cancerous depending on its asymmetry, border irregularity, color, or diameter. Only surgical biopsy can produce a definite diagnosis.

Risk factors for melanoma are the same as those for basal cell carcinoma, but also include the presence of many moles, a family history of the disease, and many blistering sunburns during childhood.

Squamous Cell Carcinoma

Another common form of non-melanoma skin cancer affects squamous cells, which help to form the skin’s outer layer. According to the American Cancer Society, there are over 500,000 cases a year of highly curable basal cell or squamous cell cancers. Although life-threatening because it can spread to vital organs, squamous cell cancer is curable by surgery if detected early.
SAVE YOUR SKIN

10 Ways to Prevent Skin Cancer and Premature Wrinkling

1. Avoid the sun from 10 a.m. to 2 p.m. (11 a.m. to 3 p.m. Daylight Savings Time), the most intense part of the day.

2. Wear a broad hat and clothing that blocks the sun's rays. Wet shirts and many lightweight clothes allow dangerous rays to pass through.

3. Wear sunglasses that filter ultraviolet (UV) light.

4. Use a sunscreen with an SPF (sun protection factor) of at least 15. Apply 30 minutes before going out, even on cloudy days. Reapply every two hours, especially after swimming or perspiring.

5. Overexposure to sun in cold-weather months also poses a risk for skin cancer. Wear sunblocks and sunglasses when outdoors for long periods at any time of the year.

6. Keep infants out of the sun. Babies less than six months old should never wear sunscreens; their bodies can't metabolize the chemicals.

7. Apply sunscreens liberally to children over the age of six months.

8. Be aware that dark-skinned people are not immune to skin cancer. Dark skin produces more melanin (the pigment that gives skin its color), and so offers more protection, but it can still burn.

9. Do not use tanning booths. Because of high levels of UV rays, cataracts and other eye injuries may occur when users don't wear goggles. People taking certain antibiotics, tranquilizers, diabetic medications, or antihypertensive drugs may burn severely after even brief exposure. In some states, tanning booth users under 18 must have parental consent.

10. Be aware that self-tanning lotions provide a tan without UV exposure, but don’t protect against sunburn or premature wrinkling. Self-tanning lotions contain a safe, colorless dye known as DHA (dihydroxyacetone), which produces a light brown "stain." They don't block or filter UV rays, however.

PARENTS BEWARE:
Because you are more likely to develop early warning signs of skin cancers than your children, we have encouraged students to share with you this important information.