envirohealthlink

Summer Institute

A Professional Development Opportunity
for
Science and Health Teachers
at the Middle Grade Level

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1997 EnviroHealth Link Summer Institute Lesson Plan Binder*
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*NOTE: Lesson plans also available on the Internet at
http://www.mpt.org/learningworks/teachers/ehl/

Unwrapping the Mystery

Overview

Students will use the Internet to gather information about food additives. They will complete a set of guide questions to be answered as they visit one of two Internet sites. They will complete a chart of the most commonly used food additives and their uses. Students will then categorize the food additives according to their uses. They will examine labels to identify the food additives contained in different food products and make subjective statements concerning how effective the additive is at doing its job.

Media Resources

The following Internet sites will be used throughout the lesson. In this lesson, they will be referred to as I and II respectively.

I. International Food Information Council
(http://ificinfo.health.org/brochure/food-add.htm)

II. Food Risks: Perception and Reality
(http://vm.cfsan.fda.gov/~lrd/foodaddi.html)

Learning Objectives

Students will be able to . . .

- define the term food additive
- name five main reasons for using food additives
- categorize food additives by their uses
- analyze food labels

Next

Vocabulary

Food additive: any substance other than basic food stuffs that is present in food because of some aspect of production, processing, packaging, or storage.

Process additive: a food additive that changes the physical characteristics of the food. They include emulsifiers such as vegetable gums and polysorbate used in ice cream to keep the milkfat evenly dispersed; thickeners such as modified food starch used in salad dressings to achieve a more viscous product; anticaking agents such as silicates used in salt to prevent caking in moist weather; and buffers such as calcium carbonate that are added to control acidity and alkalinity.

Materials

- Computer with modem and WWW access
- URLs for each respective site written on the board
- Food labels (at least two for each student)
- Student Worksheets: Background Information Sheet; Guide Questions; Food Additives - What They Do and Where they Are
- Red Delicious apple, one for demonstration

Next

Procedures

1. Gather food labels, or assign students to bring at least two food labels to class. Include labels from snack foods such as chips and Tastycake™ and Snackwell™ products, along with other foods.

2. The night before class, cut a Red Delicious apple in half lengthwise from stem to bottom. Keep the apple halves at room temperature. Place the two halves out of sight of students. (Other foods such as cheese, bananas, and breads can also be used so that students can make comparisons of the effects of various additives on these foods.)

3. Hold up half the apple so that students cannot see the sliced side. Ask students if anyone would like to take a bite of this apple. Ask responders what makes this apple appealing to them.

4. Now turn the apple around so that the sliced side faces them. By this time the apple should be noticeably brown. Ask students if they would take a bite of this apple. Ask responders to explain why they would not eat the fruit.

5. Brainstorm with students to discuss how the food they purchase manages to stay appealing. Write student responses on the board. If student responses do not include food additives or chemicals added to food, suggest these yourself.

6. Write Internet Site I and II addresses on the board. Distribute Student Worksheet: Guide questions. Explain that students will gather the information they need to answer worksheet questions by visiting either site. These sites are mirrors of each other, and contain the same information. Assign half the class to visit one site, and the other half the other site.

   Note: If this is the first time students have used the Internet, you will need to do an introductory lesson on how the Internet operates according to the standards you must meet for your LEA, or use alternative sources for this information.

7. As students complete the guide questions, distribute *Student Worksheet:* Food Additives - What They Do and Where they Are. Direct them to complete the worksheet using the list of the most commonly-used food additives found at the end of each site.

8. Distribute the food labels from various types of foods. Have students examine their label for the various food additives and write the name of the food product next to the additive on their worksheet.

9. Discuss answers to the guide questions and the chart of food additives. Identify and discuss the functions of the largest group of food additives (probably color or flavor enhancers), and the least used food additives based on data from their charts.

Next

Bibliography

Lawrence Hall of Science, Chemicals in Foods: Additives, University of California at Berkeley, Addison-Wesley Publishing Co. 1993

Extensions

1. Tour your school cafeteria to find out what food additives are used in the meals that they serve there.

2. Encourage your students to experiment with brewing rates of other types of apples. Does every apple turn brown at the same rate? Why do they think this happens?

3. Encourage students to keep a personal journal of the food they eat during one day, with a list of additives each food product contains.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

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Unwrapping the Mystery

Background Information Sheet

Information courtesy of the FDA
& The International Food Information Council

FOOD ADDITIVES

Q. What keeps bread mold-free and salad dressings from separating?

Q. What helps cake batters rise reliably during baking and keeps cured meats safe to eat?

Q. What improves the nutritional value of biscuits and pasta, and gives gingerbread its distinctive flavor?

Q. What gives margarine its pleasing yellow color and prevents salt from becoming lumpy in its shaker?

Q. What allows many foods to be available year-round, in great quantity and of the best quality?

ANSWER: *FOOD ADDITIVES*

Food additives play a vital role in today's bountiful and nutritious food supply. They allow our growing urban population to enjoy a variety of safe, wholesome and tasty foods year-round. And, they make possible an array of convenience foods without the inconvenience of daily shopping.

Although salt, baking soda, vanilla and yeast are commonly used in foods today, many people tend to think of any additives added to foods as complex chemical compounds. All food additives are carefully regulated by federal authorities and various international organizations to ensure that foods are safe to eat and are accurately labeled. The purpose of this brochure is to provide helpful background information about food additives, why they are used in foods and how regulations govern their safe use in the food supply.

Why Are Additives Used in Foods?

Additives perform a variety of useful functions in foods that are often taken for granted. Since most people no longer live on farms, additives help keep food wholesome and appealing while en route to markets sometimes thousands of miles away from where it is grown or manufactured. Additives also improve the nutritional value of certain foods and can make them more appealing by improving their taste, texture, consistency or color.

Some additives could be eliminated if we were willing to grow our own food, harvest and grind it, spend many hours cooking and canning, or accept increased risks of food spoilage. But most people today have come to rely on the many technological, aesthetic and convenience benefits that additives provide in food.

Additives are used in foods for five main reasons:

- *To maintain product consistency*. Emulsifiers give products a consistent texture and prevent them from separating. Stabilizers and thickeners give smooth uniform texture. Anticaking agents help substances such as salt to flow freely.
- *To improve or maintain nutritional value*. Vitamins and minerals are added to many common foods such as milk, flour, cereal and margarine to make up for those likely to be lacking in a person's diet or lost in processing. Such fortification and enrichment has helped reduce malnutrition among the U.S. population. All products containing added nutrients must be appropriately labeled.
- *To maintain palatability and wholesomeness*. Preservatives retard product spoilage caused by mold, air, bacteria, fungi or yeast. Bacterial contamination can cause foodborne illness, including life-threatening botulism. Antioxidants are preservatives that prevent fats and oils in baked goods and other foods from becoming rancid or developing an off-flavor. They also prevent cut fresh fruits such as apples from turning brown when exposed to air.
- *To provide leavening or control acidity/ alkalinity*. Leavening agents that release acids when heated can react with baking soda to help cakes, biscuits and other goods to rise during baking. Other additives help modify the acidity and alkalinity of foods for proper flavor, taste and color.
- *To enhance flavor or impart desired color*. Many spices and natural and synthetic flavors enhance the taste of foods. Colors, likewise, enhance the appearance of certain foods to meet consumer expectations. Examples of substances that perform each of these functions are provided in the chart "Common Uses of Additives."

Many substances added to food may seem foreign when listed on the ingredient label, but are actually quite familiar. For example, ascorbic acid is another name for vitamin C; alpha-tocopherol is another name for vitamin E; and beta-carotene is a source of vitamin A. Although there are no easy synonyms for all additives, it is helpful to remember that all food is made up of chemicals. Carbon, hydrogen and other chemical elements provide the basic building blocks of everything in life.

What Is a Food Additive?

In its broadest sense, a food additive is any substance added to food. Legally, the term refers to "any substance the intended use of which results or may reasonably be expected to result -- directly or indirectly -- in its becoming a component or otherwise affecting the characteristics of any food." This definition includes any substance used in the production, processing, treatment, packaging, transportation or storage of food. If a substance is added to a food for a specific purpose in that food, it is referred to as a direct additive. For example, the low-calorie sweetener aspartame, which is used in beverages, puddings, yogurt, chewing gum and other foods, is considered a direct additive. Many direct additives are identified on the ingredient label of foods.

Indirect food additives are those that become part of the food in trace amounts due to its packaging, storage or other handling. For instance, minute amounts of packaging substances may find their way into foods during storage. Food packaging manufacturers must prove to the U.S. Food and Drug Administration (FDA) that all materials coming in contact with food are safe, before they are permitted for use in such a manner.

What Is a Color Additive?

A color additive is any dye, pigment or substance that can impart color when added or applied to a food, drug or cosmetic, or to the human body.

Color additives may be used in foods, drugs, cosmetics and certain medical devices such as contact lenses. Color additives are used in foods for many reasons, including to offset color loss due to storage or processing of foods and to correct natural variations in food color.

Colors permitted for use in foods are classified as certified or exempt from certification. Certified colors are man-made, with each batch being tested by the manufacturer and FDA to ensure that they meet strict specifications for purity. There are nine certified colors approved for use in the United States. One example is FD&C Yellow No. 6, which is used in cereals, bakery goods, snack foods and other foods.

Color additives that are exempt from certification include pigments derived from natural sources such as vegetables, minerals or animals. For example, caramel color is produced commercially by heating sugar and other carbohydrates under strictly controlled conditions for use in sauces, gravies, soft drinks, baked goods and other foods. Colors exempt from certification also must meet certain legal criteria for specifications and purity.

How Are Additives Regulated?

Additives are not always byproducts of 20th century technology or modern know-how. Our ancestors used salt to preserve meats and fish; added herbs and spices to improve the flavor of foods; preserved fruit with sugar; and pickled cucumbers in a vinegar solution.

Over the years, however, improvements have been made in increasing the efficiency and ensuring the safety of all additives. Today food and color additives are more strictly regulated than at any other time in history. The basis of modern food law is the Federal Food, Drug, and Cosmetic (FD&C) Act of 1938, which gives the Food and Drug Administration (FDA) authority over food and food ingredients and defines requirements for truthful labeling of ingredients.

The Food Additives Amendment to the FD&C Act, passed in 1958, requires FDA approval for the use of an additive prior to its inclusion in food. It also requires the manufacturer to prove an additive's safety for the ways it will be used.

The Food Additives Amendment exempted two groups of substances from the food additive regulation process. All substances that FDA or the U.S. Department of Agriculture (USDA) had determined were safe for use in a specific food prior to the 1958 amendment were designated as prior-sanctioned substances. Examples of prior-sanctioned substances are sodium nitrite and potassium nitrite used to preserve luncheon meats.

A second category of substances excluded from the food additive regulation process are generally recognized as safe or GRAS substances. GRAS substances are those whose use is generally recognized by experts as safe, based on their extensive history of use in food before 1958 or based on published scientific evidence. Salt, sugar, spices, vitamins and monosodium glutamate are classified as GRAS substances, along with several hundred other substances. Manufacturers may also request FDA to review the use of a substance to determine if it is GRAS.

Since 1958, FDA and USDA have continued to monitor all prior-sanctioned and GRAS substances in light of new scientific information. If new evidence suggests that a GRAS or prior-sanctioned substance may be unsafe, federal authorities can prohibit its use or require further studies to determine its safety.

In 1960, Congress passed similar legislation governing color additives. The Color Additive Amendments to the FD&C Act require dyes used in foods, drugs, cosmetics and certain medical devices to be approved by FDA prior to their marketing.

In contrast to food additives, colors in use before the legislation were allowed continued use only if they underwent further testing to confirm their safety. Of the original 200 provisionally listed color additives, 90 have been listed as safe and the remainder have either been removed from use by FDA or withdrawn by industry.

Both the Food Additives Amendment and the Color Additive Amendments include a provision which prohibits the approval of an additive if it is found to cause cancer in humans or animals. This clause is often referred to as the Delaney Clause, named for its Congressional sponsor, Rep. James Delaney (D-N.Y.).

Regulations known as Good Manufacturing Practices (GMP) limit the amount of food and color additives used in foods. Manufacturers use only the amount of an additive necessary to achieve the desired effect.

How Are Additives Approved for Use in Foods?

To market a new food or color additive, a manufacturer must first petition FDA for its approval. Approximately 100 new food and color additive petitions are submitted to FDA annually. Most of these petitions are for indirect additives such as packaging materials.

A food or color additive petition must provide convincing evidence that the proposed additive performs as it is intended. Animal studies using large doses of the additive for long periods are often necessary to show that the substance would not cause harmful effects at expected levels of human consumption. Studies of the additive in humans also may be submitted to FDA.

In deciding whether an additive should be approved, the agency considers the composition and properties of the substance, the amount likely to be consumed, its probable long-term effects and various safety factors. Absolute safety of any substance can never be proven. Therefore, FDA must determine if the additive is safe under the proposed conditions of use, based on the best scientific knowledge available.

If an additive is approved, FDA issues regulations that may include the types of foods in which it can be used, the maximum amounts to be used, and how it should be identified on food labels. Additives proposed for use in meat and poultry products also must receive specific authorization by USDA. Federal officials then carefully monitor the extent of Americans' consumption of the new additive and results of any new research on its safety to assure its use continues to be within safe limits.

In addition, FDA operates an Adverse Reaction Monitoring System (ARMS) to help serve as an ongoing safety check of all additives. The system monitors and investigates all complaints by individuals or their physicians that are believed to be related to specific foods; food and color additives; or vitamin and mineral supplements. The ARMS computerized database helps officials decide whether reported adverse reactions represent a real public health hazard associated with food, so that appropriate action can be taken.

Summary

Additives have been used for many years to preserve, flavor, blend, thicken and color foods, and have played an important role in reducing serious nutritional deficiencies among Americans. Additives help assure the availability of wholesome, appetizing and affordable foods that meet consumer demands from season to season. Today, food and color additives are more strictly regulated than at any time in history. Federal regulations require evidence that each substance is safe at its intended level of use before it may be added to foods. All additives are subject to ongoing safety review as scientific understanding and methods of testing continue to improve.

Additional Information About Additives

Q. *What is the difference between "natural" and "artificial" additives?*
A. Some additives are manufactured from natural sources such as soybeans and corn, which provide lecithin to maintain product consistency, or beets, which provide beet powder used as food coloring. Other useful additives are not found in nature and must be man-made. Artificial additives can be produced more economically, with greater purity and more consistent quality than some of their natural counterparts. Whether an additive is natural or artificial has no bearing on its safety.

Q. *Is a natural additive safer because it is chemical-free?*
A. No. All foods, whether picked from your garden or your supermarket shelf, are made up of chemicals. For example, the vitamin C or ascorbic acid found in an orange is identical to that produced in a laboratory. Indeed, all things in the world consist of the chemical building blocks of carbon, hydrogen, nitrogen, oxygen and other elements. These elements are combined in various ways to produce starches, proteins, fats, water and vitamins found in foods.

Q. *Are sulfites safe?*
A. Sulfiting agents are sometimes used to preserve the color of foods such as dried fruits and vegetables, and to inhibit the growth of microorganisms in fermented foods such as wine. They are also sometimes used in baked goods, condiments, snack foods and other products. Sulfites are safe for most people. A small segment of the population, however, has been found to develop shortness of breath or fatal shock shortly after exposure to these preservatives. Sulfites are capable of producing severe asthma attacks in sulfite-sensitive asthmatics. For that reason, in 1986 the Food and Drug Administration (FDA) banned the use of sulfites on fresh fruits and vegetables (except potatoes) intended to be sold or served raw to consumers. Sulfites added to all packaged and processed foods must be listed on the product label.

Q. *Does FD&C Yellow No. 5 cause adverse reactions?*
A. FD&C Yellow No. 5, or tartrazine, is used to color beverages, dessert powders, candy, ice cream, custards and other foods. The color additive may cause hives in fewer than one out of 10,000 people. By law, whenever the color is added to food or taken internally, it must be listed on the label. This allows the small portion of people who may be sensitive to FD&C Yellow No. 5 to avoid it.

Q. *Does the low-calorie sweetener aspartame cause adverse reactions?*
A. In carefully controlled clinical studies, aspartame has not been shown to cause allergic reactions in adults or children. In addition, consumer complaints of possible adverse reactions have been monitored for more than 10 years by the FDA. Experts in food safety have concluded there is no convincing evidence of a cause and effect relationship between aspartame and the various sensitivities reported. Whenever aspartame is added to foods, it is listed on the product label. Individuals who have concerns about possible adverse reactions to aspartame or other substances should contact their physicians.

Q. *Do additives cause childhood hyperactivity?*
A. No. Although this theory was popularized in the 1970's, well-controlled studies conducted since that time have produced no evidence that food additives cause hyperactivity or learning disabilities in children. A Consensus Development Panel of the National Institutes of Health concluded in 1982 that there was no scientific evidence to support the claim that additives or colorings cause hyperactivity.

Q. *Why are decisions sometimes changed about the safety of food ingredients?*
A. Since absolute safety of any substance can never be proven, decisions about the safety of food ingredients are made on the best scientific evidence available. Scientific knowledge is constantly evolving. Therefore, federal officials often review earlier decisions to assure that the safety assessment of a food substance remains up-to-date. Any change made in previous clearances should be recognized as an assurance that the latest and best scientific knowledge is being applied to enhance the safety of the food supply.

Q. *What are some other food additives that may be used in the future?*
A. Among other petitions, FDA is carefully evaluating requests to use ingredients that would replace either sugar or fat in food. In 1990, FDA confirmed the GRAS status of Simplesse ®, a fat replacement made from milk or egg white protein, for use in frozen desserts. The agency also is evaluating a food additive petition for olestra, which would partially replace the fat in oils and shortenings.

Q. *What is the role of modern technology in producing food additives?*
A. Many new techniques are being researched that will allow the production of additives in ways not previously possible. One approach, known as biotechnology, uses simple organisms to produce additives that are the same as food components found in nature. In 1990, FDA approved the first bioengineered enzyme, rennin, which traditionally has been extracted from calves' stomachs for use in making cheese.

Common Uses of Additives

Impart/Maintain Desired Consistency
Alginates, Lecithin, Mono- & Diglycerides, Methyl Cellulose, Carrageenan, Glycerine, Pectin, Guar Gum, Sodium Aluminosilicate
Foods Where Likely Used
Baked Goods, Cake Mixes, Salad Dressings, Ice Cream, Process Cheese, Coconut, Table Salt

Impart/Maintain Nutritive Value
Vitamins A and D, Thiamine, Niacin, Riboflavin, Pyridoxine, Folic Acid, Ascorbic Acid, Calcium Carbonate, Zinc Oxide, Iron
Foods Where Likely Used
Flour, Bread, Biscuits, Breakfast Cereals, Pasta, Margarine, Milk, Iodized Salt, Gelatin Desserts

Maintain Palatability and Wholesomeness
Propionic Acid and its Salts, Ascorbic Acid, Butylated Hydroxyanisole (BHA), Butylated Hydroxytoluene (BHT), Benzoates, Sodium Nitrite, Citric Acid
Foods Where Likely Used
Bread, Cheese, Crackers, Frozen and Dried Fruit, Margarine, Lard, Potato Chips, Cake Mixes, Meat

Produce Light Texture; Control Acidity/Alkalinity
Yeast, Sodium Bicarbonate, Citric Acid, Fumaric Acid, Phosphoric Acid, Lactic Acid, Tartrates
Foods Where Likely Used
Cakes, Cookies, Quick Breads, Crackers, Butter, Soft Drinks

Enhance Flavor or Impart Desired Color

Cloves, Ginger, Fructose, Aspartame, Saccharin, FD&C Red No. 40, Monosodium Glutamate, Caramel, Annatto, Limonene, Turmeric

Foods Where Likely Used

Spice Cake, Gingerbread, Soft Drinks, Yogurt, Soup, Confections, Baked Goods, Cheeses, Jams, Gum

Name _____ Date _____

Internet Site Address Visited _____

Guide Questions

Directions: You will find the information you need to answer these questions on the Internet site you will visit. Write your responses on the back of this page; you can use additional paper if needed.

- What are food additives?
- List five reasons food additives are used.
- Additives have been used for many centuries. Name three additives that our ancestors used. Explain how each one was used.
- What is the Federal Food, Drug, and Cosmetic Act of 1938? How was this act amended in 1958?
- What federal organization is in charge of regulating what can be added to food?
- What do the letters GRAS stand for? How are GRAS substances different from other food additives? Give five examples of a GRAS.
- List the steps necessary for a new food or color additive to be approved.
- Explain the difference between a "direct" additive and an "indirect" additive.
- What is an erythorbate?
- Some people are sensitive to different food or color additives. How can they avoid eating products that will cause them to have an allergic reaction?
- Why are color additives used in some products? Why is caramel color exempt from certification?

Name _____ **Date** _____

Internet Site Address Visited _____

Food Additives:
What They Do and Where They Are

Directions: Additives can be grouped according to the purpose for which they are used: 1) they can enhance the product's flavor or color; 2) they can enhance the product's nutritional content; 3) they can preserve a product or keep it from spoiling; and 4) they can change the product's physical characteristics (these are called process additives, and include substances like thickeners and buffers).

At the end of the web site you are visiting, you will find a list of common additives. Place them in the chart below based on their purpose. Then analyze your food labels. Write the name of the food product next to the additive it contains.

Color/Flavor Enhancers	Food Product(s)
Nutrition Enhancers	Food Product(s)
Preservatives	Food Product(s)
Process Additives	Food Product(s)

What's in What We Eat?

Overview

The students will use the World Wide Web to research the scientific role food additives play in foods. They will search to discover many common additives used today in the foods they eat. They will demonstrate their understanding by creating a multimedia project to present their findings.

Media Resources

Backgrounder on Food Additives:
http://vm.cfsan.fda.gov/~lrd/foodaddi.txt.
Useful background and general information about food additives and the roles they play in the foods we eat every day.

Food Additives & Processing Aides
http://ifse.tamu.edu/CKNOWLEDGE/FoodAdditives.html

Food Additives--International Food Information:Council
http://ificinfo.health.org/index9.htm.
This site is set up in a question and answer format. The questions are real-world questions about the foods we eat every day. The answers to the questions contain information about food additives and the role they play in the foods we eat.

Learning Objectives

Students will be able to . . .

- use the World Wide Web for research.
- identify natural and chemical compounds that are added to food
- use multimedia software to demonstrate their understanding
- identify five functions which natural and chemical compounds play in food

Next

Vocabulary

Additive: a substance added to another to produce a desired effect (i.e., preservatives in food)
Sulfites: dangerous acidic salts
Preservative: a substance added to food to keep it from spoiling
Pesticide: any chemical used for killing insects, weeds, etc.
MSG: monosodium glutamate

Materials

- Computer with modem and WWW connection
- Student Worksheets:
  Web Activity; Assessment; Action Plan
- Multimedia software (i.e., Power Point, Hyperstudio, ClarisWorks 4.0)

Next

Procedures

1. Direct students to complete the *Student Worksheet* - Web Activity to find the information required to complete the assessment activity. If an Internet connection is available, they can point the browser to one of the sites listed in the Media Resources section and start their research from that point. If an Internet connection is not available, then the teacher can print copies of the sites listed and have the students complete their research using resource packets instead.

2. When the students complete their research they can begin working on their multimedia presentation. Many different software applications lend themselves well to this project, but success depends on the planning that goes into the project.

   Have the students use the *Student Worksheet* - Assessment to help them plan their project.

3. Explain to students that the goal of this project is to present the facts an observer would need to develop his or her own opinion. Review with students the procedures they should follow to construct their presentation. The sequence for the cards they will create is listed on the *Student Worksheet* - Assessment. It is based on the work students complete during their web site visit.

4. Carefully review the requirements for content on cards 1, 7, and 8.

   CARD 1 - The students will use this card to introduce the viewer to their presentation. It should include relevant graphics, a catchy title, and their name.
   CARD 7 - This card should be a summary of the project and provide a creative way to bring closure to the previous cards.
   CARD 8 - This card should offer a space where the viewer can enter their opinion or offer a question related to the project to which the reader can respond.

5. To be successful, the students should first complete a storyboard containing sketches of their ideas for the presentation. This could be considered a prewriting exercise and will save valuable time when they construct their presentations on the computer. An explanation of how to construct a storyboard is included on the Assessment worksheet.

Next

Name _____ Date _____

Internet Site Address Visited _____

Web Activity

Objectives:

- At the end of this lesson you should be able to...
  use the Internet for research
- identify natural and chemical compounds that are added to food
- identify five functions natural and chemical compounds play in food

Directions:

Today, you will use the Internet to search for information related to food additives. After answering the questions below using the information you find, you will create a multimedia project which demonstrates your understanding of the material. Your project will be an interactive brochure that informs poeple about the additives that are present in the food they eat every day.

Use your browser to connect with one of the site addresses listed below.

Backgrounder on Food Additives

http://www.social.com/health/ific/food_additives/bak-fadd.html
Useful background general information about food additives and the part they play in foods we eat everyday.

Food Additives: International Food Information Concil

http://ificino.health.org/brochure/food-add.html
This site contains questions most people ask about the basics of food additives, along with easy-to-understand answers.

Questions

1. List five common reasons food additives are used.

.

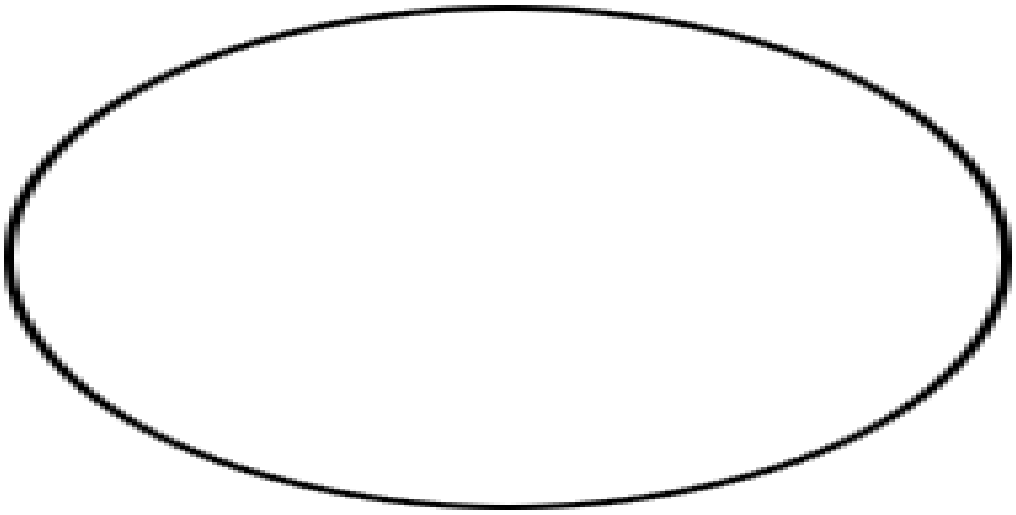
_____

_____

_____

_____

2. What are the similarities and differences between "natural" and "artificial" additives?



3. List five specific food additives and how they affect food products.

Food Additive	How it affects food products

4. How are food additives regulated?

5. Are pesticides considered food additives? Explain.

6. In your opinion and in light of what you found out at these web sites, do you think natural and artificial additives are helpful? Explain and support your response with facts from your research.

Name _____ **Date** _____

What's in What We Eat?

Objective:

At the end of this lesson, you should be able to summarize your Internet research into a multimedia presentation.

Directions:

In the first activity in this lesson, you used the Internet to research information about food additives and how they affect the food we eat. Your goal in this activity is to organize the information you have collected into a presentation that makes the observer aware of the role of additives in our food. Your presentation should contain only facts; please do not include any personal observations or opinions. People who watch your presentation should be able to decide for themselves which food additives they would avoid.

Each box below represents a card in your multimedia presentation. Your presentation must contain these eight cards. You may add other cards if they are related to the topic.

Card 1	Card 2	Card 3	Card 4
Title/Project Overview	5 Common Uses of Food Additives	Differences Between Natural and Artificial	Different Kinds of Additives

Card 5	Card 6	Card 7	Card 8
How are Additives Regulated?	Are Pesticides Considered Additives?	Conclusions (Not Opinions)	Viewers Can Write Their Own Opinions

Before you begin work on the computer, list ideas and create a storyboard for your project. Your storyboard should be based on the cards above, but should also include specific information you found during your research. to create a storyboard, fold a piece of paper into four equal sections. Each section represents one card in your presentation stack. Use the sections to compose a rough sketch of what your card will look like. Include as many pages as you need to make your presentation clear and logical to viewers.

Name _____ Date _____

Action Plan

Directions:
Use this chart to complete a survey of food additives found in similar food items in both a regular grocery store and a natural food store that sells organic products.

1. List ten common food items your family eats:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

2. Complete the chart. After you complete the chart, write a report that summarizes what you found out.

R = Regular Grocery Store, N = Natural Food Store

Food Item	**Ingredients**		**Variety**		**Price**	
	R	N	R	N	R	N

Browning Not Allowed!

Overview

This activity is a laboratory exercise during which students investigate the effectiveness of selected natural (such as citric and ascorbic acids and lemon juice), and synthetic substances (such as sodium benzoate) on the rate of apple browning.

Media Resources

Teacher Background site:
Food Additives and Processing Aids
(http://ifse.tamu.edu/CKNOWLEDGE/FoodAdditives.html)

Learning Objectives

Students will be able to . . .

- investigate the effectiveness of various preservation methods of slowing the browning process
- determine which preservation methods are the most effective
- determine which methods are the least effective
- demonstrate prior knowledge by identifying food additives that are used for color retention

Next

Vocabulary

Browning: a chemical reaction that takes place when molecules in the apple or other fruit combine with molecules of oxygen in the air. This is an oxidation reaction.
Erythorbate: a food ingredient that inhibits the change of flavor and color in food when it is exposed to air

Materials

For the teacher:

- Two - three Red Delicious apples: one cut the day before the lab occurs; and one for use by students, cut into slices (if working with a large class, you may need more than one apple)
- Plastic knife
- Bag of dried apples preserved with sulfur dioxide
- Bag of dried apples preserved without sulfur dioxide
- 10% solutions of ascorbic acid (or substitute Vitamin C tablets dissolved in distilled water) and citrus acid; lemon juice; vegetable oil

For each student:

- Safety goggles
- Copy of *Student Worksheet*: Data Table

For each group of four students:

- Six 15 X 100 mm test tubes
- Plastic knife
- Paper towels
- Apple slice(s)
- One 30 mL dropper bottle of 10% ascorbic acid solution
- One 30 mL dropper bottle of 10% citric acid solution
- One 30 mL dropper bottle of lemon juice
- One 30 mL dropper of vegetable oil
- Plastic wrap, 10 cm X 10 cm

For optional solution (per class):

- Four 30 mL dropper bottles of 10% sodium benzoate solution
- Four 30 mL dropper bottles of sodium carbonate solution
- Salt
- Sugar
- Water

Next

Procedures

1. Cut one Red Delicious apple in half. Place one half in cold storage (refrigerator or ice chest). Leave the other half at room temperature.

2. Divide the class into lab teams of four students each.

3. Hold up the apple kept at room temperature. Explain to students that apple browning is a chemical change that occurs when molecules in the apple combine with molecules of oxygen in the air. Ask students which group of food additives prevent color change. (Preservatives) Brainstorm to discover why this kind of food additive is useful.

4. Have students suggest ways to prevent or slow apple browning. Do they recall any food additives from their Internet research that are useful in slowing the browning process? If students suggest refrigeration, show them the browned apple that you have kept refrigerated. If they do not mention substances such as ascorbic and citrus acids, lemon juice, and vegetable oil, remind them about these substances.

5. Tell students their lab teams will investigate to analyze the effectiveness of preservatives in slowing the rate of browning in apples.

6. Have students develop a data sheet in which to record what happens during the experiment. In chart form, columns should read "Test Tube #," "Substance Tested," "Appearance at Start of Experiment," "After 10 Minutes," etc. Rows should be numbered.

   If sufficient computers are available and students know how to use a database, you can have each group set up a database on which to record their group's data. They will need two columns: one for the substances tested, and the other for the appearance of the apple at ten minute intervals beginning with zero minutes and ending with thirty minutes.

7. Distribute all laboratory materials to student teams. Remind students about the rules for safe laboratory behavior.

8. Direct students to place the apple slice on the paper towel and use the plastic knife to cut the apple slice into six equally-sized pieces. They should also remove the peel from each apple piece. Explain that plastic knives will bruise the apple, causing it to brown at a faster rate than if it were cut with a metal knife.

9. Students should place one piece of apple into one of the test tubes to use as a control. They should set this test tube aside and not add anything to it. As they do this, prompt students to remember the purpose for having a control in an experiment. Direct them to wrap another piece of apple in the plastic wrap, seal it tightly, and set it aside.

10. Direct students to place one of each of the remaining four pieces of apple into one of the remaining test tubes. They should record the appearance of all apple pieces in the data table entry in the first column at zero minutes.

11. Direct students to add ten drops of each solution (ascorbic acid, citric acid, lemon juice, and vegetable oil) to separate test tubes. They should place the solutions directly on the flesh of the apple and allow excess solution to flow off the sides.

12. Students should observe the appearance of each apple piece at ten, twenty, and thirty minutes into the experiment; they should record their observations on the data table. They should then compare the appearance of the apple slices in solution and in plastic wrap to that of the control piece.

13. After they have recorded their data, each group should compare their results with those of another group. Ask students, "Were the substances equally effective at slowing the rate of browning for all the apple pieces?" Have them identify which substances were the most effective and which were the least effective at slowing the rate of browning.

14. Tell students to remove the apple slices from the test tubes and examine them carefully. Ask students to explain if and how the physical characteristics of the apple pieces have changed.

15. Show students the bag of dried apples treated with sodium dioxide and have them compare these apples with the dried apples that were not treated with sodium dioxide, and with the apple pieces they tested. Discuss the similarities and differences. Ask them, "Do you think any of the substances used in the testing will provide long term color retention for your apple?" You could test their hypotheses by setting up an example of the experiment for the class to observe the next day.

Bibliography

Hill, John and Kolb, Doris, *Chemistry for Changing Times*, Prentice Hall 1995

Extension

1. Add an optional fifth substance to the experiment. This could be a 10% sugar or salt solution, sodium benzoate, or sodium carbonate.
2. Students might want to investigate the minimum concentration of ascorbic and citric acids, lemon juice, and vegetable oil needed to slow the browning process.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Linda McClelland and S. Dean Curtis

Name _____ Date _____

Data Table

Directions:

Use this chart to record the observations from your experiment.

Time you began experiment: _____

Appearance of Apple...					
Test Tube #	Substance tested	at start of experiment	at 10 minutes	at 20 minutes	at 30 minutes
1	Control				
2	Wrapped				
3	Lemon Juice				
4	Ascorbic acid				
5	Citric acid				
6	Vegetable oil				

To Change or Not to Change

Overview

This experiment will allow students to observe how buffers work to resist pH changes when acids and bases are added to a solution.

Teacher Background

Country Time™ drink mixes, certain types of aspirin products, and human blood all have something in common: each of these items contains a buffer. In chemical terms, a buffer is a solution that maintains a relatively stable pH when moderate amounts of acids or bases are added to it. This pH stability is critical in the human body, where the pH of blood must be between 7.35 and 7.45. It is valuable in a powdered drink mix because the flavor of the drink will be similar despite the pH of the drinking water used to make it.

A buffer consists of a weak acid and the salt for that acid or a weak base and its salt. In human blood, the buffer is composed of carbonic acid and a bicarbonate ion; carbonic acid can neutralize small amounts of a base; bicarbonate can neutralize small amounts of acids. In this way, a buffer can neutralize an acid and a base since the amounts of the acid and base are small.

Media Resources

Teacher Background site:

Food Risks: Perception vs. Reality
(http://vm.cfsan.fda.gov/~lrd/foodaddi.txt)

Food Additives & Processing Aides (http://ifse.tamu.edu/CKNOWLEDGE/FoodAdditives.html)

Learning Objectives

Students will be able to . . .

- use wide range pH paper to compare the effectiveness of the buffers baking soda and buffered aspirin
- determine which buffer is more effective

Next

Vocabulary

Buffer: a chemical compound that reacts with either an acid or a base to keep the pH of a solution essentially constant.
pH: H stands for hydrogen and p for power; thus it is the power of hydrogen or more specifically, the hydronium ion
Scale: a convenient scale proposed in 1909 by S. Sorensen. It extends from 0 to 14, with 7 being the neutral point on the scale. Values below 7 become increasingly acidic and those above 7 increasingly basic. Thus pH 6 is only very slightly acidic, whereas pH 12 is strongly basic.

Materials

- 0.1M Hydrochloric acid (HCl)
- 0.1M Sodium hydroxide (NaOH)
- 1 L of saturated Buffered aspirin solution
- 2- 10 mL graduated cylinders
- 1 L of 1M Baking soda solution
- 1- 100mL beaker
- Several strips of inch-long wide range pH paper, inch long
- A clear plastic cup (150 mL volume)
- Eye Dropper
- Phenolpthalein solution (10%)
- Paper towels
- Graph paper, one sheet per student
- *Student Worksheets:*
  - Data Chart
  - Laboratory Report Format
- Safety goggles for each student

For Extension

Country Time™ lemonade flavor or similar powdered drink mix

Next

Procedures

1. Caution students to wear safety goggles at all times during the experiment.

2. Give each pair of students a beaker or plastic cup containing 30 mL of 1.0 M solution of baking soda. Instruct students to add 4-5 drops of phenolpthalein solution to the baking soda. Then have students measure 10 mL of NaOH in a clean cylinder.

3. Have students start the titration and take an initial pH reading of the buffer solution using the pH paper. Have them record the color and the corresponding pH value of the buffer solution in the *Student Worksheet:* Data Chart. Tell them to place the used pH paper strip in the paper towel to be disposed of at the end of the lab.

4. Give each group of students a dropper to add the NaOH solution to the baking soda solution in the beaker in increments of 1.0 mL. Tell them to swirl the beaker GENTLY. They should then take a pH reading using a clean strip of pH paper by placing one drop of the solution on the pH paper strip, recording the color of the paper and its pH value in the data chart, and then discarding the pH strip.

5. Students will continue to repeat the above procedure each time after adding 0.1 mL of NaOH to the baking soda. Additional NaOH will come from you, so you may want to designate someone at each group to be the materials handler

6. After students have added a total of 10 mL of NaOH (the entire contents of the cylinder), decrease the amount of NaOH added to the baking soda from 1.0 mL to 0.5 mL. Have students continue to add 0.5 mL of NaOH until they observe a large change (either up or down) in the pH reading. This is the point where the buffer has failed. Students should take a few more readings beyond this point to develop a curve.

7. Students should plot the curve on graph paper, using an x-y axis. Ask students to identify the variables in the experiment, and identify which variable goes on the y-axis (pH values) and which goes on the x-axis (volume of NaOH used).

8. Give each group 30 mL of baking soda in a clean beaker, add 4-5 drops of indicator solution and have students test again using HCl.

9. Measure 30 mL of saturated buffered aspirin solution into a clean beaker for each group. Add 4-5 drops of indicator solution to the aspirin solution in the beaker. Repeat the above tests beginning with 10 mL of NaOH added to the solution in 1.0 mL increments. Then test a second sample of 30 mL of buffered aspirin/ indicator solution with 10 mL of HCl repeating the same steps.

10. Distribute *Student Worksheet:* Laboratory Report Format and direct students to follow this format in preparing a report on their experiment.

11. If you feel your students can work independently, consider assigning students to work in pairs within their lab group. One pair would complete work using baking soda; the other pair, the buffered aspirin. This would save time and allow students within a lab group to compare the effectiveness of both substances as buffers.

12. Discuss these questions with your students to help them analyze their work:

    Why are buffers used?

    How effective was the baking soda as a buffer compared with the saturated buffered aspirin solution sample? Cite evidence from your data and graph to explain your answer.

    What other mixtures could work as buffers?

    How do you think high acid foods are buffered?

Bibliography

Hill, John and Kolb, Doris, *Chemistry for Changing Times*, Prentice Hall 1995

Extension

Obtain 30 mL of Country Time™ lemonade flavored drink mix and test it beginning with 10 mL of NaOH. Then test a second 30 mL sample with 10 mL HCl. Describe the effectiveness of the Country Time™ lemonade sample as a buffer. Read the label and list the buffers in Country Time™ lemonade mix. Add an optional fifth substance to the experiment. This could be a 10% sugar or salt solution, sodium benzoate, or sodium carbonate.

Environhealth Link Master Teacher Team:

Linda McClelland and S. Dean Curtis

Data Chart

Directions:
Use this chart to record the observations from your experiment.

Substance Tested	**Volume of NaOH in mL**	**Color of pH paper**	**pH of Solution**
Baking soda			
	Volume of HCl in mL	**Color of pH paper**	**pH of Solution**
Buffered Aspirin Solution	**Volume of NaOH in mL**	**Color of pH paper**	**pH of Solution**
	Volume of HCl in mL	**Color of pH paper**	**pH of Solution**

Name _____ Date _____

Laboratory Report Format

Directions:

You can use this format to complete a report on your experiment.

Title of Laboratory Report:_____

Recall and Explain: Briefly recall what you physically did in the lab. Report each step thoroughly, but do not give too many details. Explain what you wanted to learn by conducting this experiment. Do not use personal pronouns. You should write this part of your report as a paragraph containing 5-8 sentences.

Results: State what your charts, graphs, and diagrams show about the data you collected from the lab. Use some of the collected data as examples in the report. What is your data saying? How certain are you of your investigative results? Is there a better way to do this lab investigation? Again, do not use personal pronouns. Since this is the body of your lab report, this part should contain at least two paragraphs with 5-8 sentences in each paragraph.

Uncertainties: Describe the sources of errors that may or do exist. Explain why you think these errors exist. Be specific in your explanation and justify your statements. Should the investigation be done again? How do you account for an explanation that is different from yours? Do not use personal pronouns. You should write this part of your report as a paragraph with 5-8 sentences.

Conclusion: What have you learned from doing this laboratory investigation? How will it be useful to you now and in the future?

Cancer and the Food Additive Connection

Overview

Students will use the knowledge they learned from previous activities on food additives to find out how they can reduce their risk for cancer. They will visit a web site to complete research on the prevention of cancer. They will complete a circle graph showing percentages of cancers caused by various agents. They will take an in-depth look at one preventable cancer. Finally, they will synthesize their research to present a poster or sign that explains one guideline people should follow to prevent cancer.

Teacher Background

An overview of some basic information about cancer and the role food additives may play in its formation is included in this lesson. You can use this as a basis for your class presentation or distribute it to students to prepare them for a class discussion on this subject.

Media Resources

For student research:
Cancer Research Foundation of America
(http://www.preventcancer.org/)

Teacher Background sites:
Mayo Clinic's Health Oasis
(http://www.mayo.ivi.com/)

University of Pennsylvania OncoLink
(http://cancer.med.upenn.edu/)

American Cancer Society
(http://www.cancer.org/)

Next

Learning Objectives

Students will be able to . . .

- explain the relationship between positive health behaviors and the prevention of cancer
- recognize that positive health practices and appropriate health care can prevent some cancers

Vocabulary

Cancer: rapidly dividing; uncontrolled growth of cells
Carcinogen: another substance that causes cancer
GRAS list: a list of food additives that have been used for many years without apparent harmful effects. The letters stand for "generally recognized as safe."

Materials

- Computer with modem and Internet access
- Overhead projector and screen
- Transparencies:
  1. Normal Animal Cell Division: Visit
     - http://www.geocities.com/Athens/Olympus/5297/mitosis.html
     - http://www.geocities.com/Athens/Olympus/5297/cell.html

  2. Cancer Cell
  3. The Warning Signs of Cancer
- Construction paper and markers
- *Student Worksheet Package:*
  :- Cancer and the Food Additive Connection - Preventing Cancer
  :- Cancer and the Food Additive Connection - Background Information
- Protractors

Next

Procedures

1. Prepare transparencies of a typical cell, an abnormal cell the effects of cancer, and a list of the seven warning signs of cancer.

2. Students will recognize the word *cancer* and may be able to relate to the disease through personal experience. It is helpful to provide background information on cancer, its causes, and prevention to help students touched by the disease to keep things in perspective. Use *Student Worksheet: Background Information* to help you prepare an introductory lesson focused on these issues, using the transparencies you have created. Alternately, the *Background Information* sheet may be duplicated and distributed for students to use in preparation for a class discussion.

3. Preview the web site to be used for class research. Pay particular attention to two links on the home page: "Reduce Your Risks" and "Six Preventable Cancers." The "Reduce Your Risk" link provides information explaining how people can generally reduce their risk of having certain cancers. On the "Six Preventable Cancers" links, information is given on each of these cancers and how they can be prevented.

4. Discuss with students some of the background information about cancer and food additives. Using a computer, review with students the parts of the animal cell and cell division. Show students the cancer cell and discuss the two types of cell division. If a computer is not available, provide photocopies of healthy and abnormal cells from a textbook or medical resource.

5. Tell them that they will visit a web site on which they will find additional information about the relationship between diet and the development of cancer and learn about the six types of cancers that are preventable and what they can do to protect themselves.

6. Distribute *Student Worksheet Package:* Preventing Cancer, and review it with students. Write the Internet address they will visit on the board. Tell students the information they will need to find can be found at the "Reduce Your Risks" and "Six Preventable Cancers" links. Direct students to complete their worksheet package based on the information they find.

7. While students are working, distribute protractors for student use in completing circle graphs. Students may also need to use calculators.

8. Have students present their signs or posters of the guideline they selected to the class. Have students in the class determine which guideline the sign or poster represents. Be sure that all guidelines are represented. To accomplish this you may want to assign guidelines to specific students or have groups of students work together to construct one sign or poster for an assigned guideline.

Bibliography

Korchen, Florence G., *Science in the Marketplace*,Tiger Publications, Inc. 1995

Extension

Develop a one day meal plan (breakfast, lunch, and dinner, including snacks) for a family of five with three children, ages three, seven, and thirteen years, and two adults. Use the food suggestions from the guidelines and from your research that can reduce the risk of developing cancer.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Linda McClelland and S. Dean Curtis

Name _____ Date _____

Background Information

Cancer is the uncontrolled growth of harmful cells in the body that multiply and attack healthy cells. Cancer is a leading cause of death in the United States for people of all age groups, and kills more children between the ages of one and fourteen than any other disease. There are many probable causes of cancer. Some kinds of cancer have a genetic link; a person may inherit a gene for a certain type of cancer from parents. Some cancers are related to the substances to which a person has been exposed. A substance that causes cancer is called a carcinogen. Some food additives have proven to be cancer-causing agents, or carcinogens. One of those agents is nitrite.

The use of nitrites such as sodium nitrite has a history that goes back to medieval times when travelers on land and sea noted that meats treated with nitrite compounds remained edible for long periods. In modern times, nitrites were added to the food to maintain the pink color of smoked hams, hot dogs, and bologna.

Later it was discovered that nitrites were very affective as inhibitors of Clostridium botulinum, the bacterium that produces botulism poisoning. However, in the presence of stomach acid, nitrites are changed to nitrous acid. When nitrous acid reacts with amines, they form nitroso compounds. Nitroso compounds are among the most potent carcinogens known. By eating foods containing nitrites, we may be giving our stomachs the raw materials for cancer.

The FDA has approved the use of sodium hypophosphine as a substitute for nitrite because of this. However, the incidence of stomach cancer is declining in the United States. Scientists know that ascorbic acid inhibits the reaction between nitrous acid and amines to form nitroso compounds (vitamin C). Perhaps this is what is happening in our stomachs.

Another food additive, synthetic food colors, was on the GRAS List usually without the same rigors of testing other food additives underwent. This is because these products had been used for many years without any side effects. However, in 1950, when a candy manufacturer used too much Orange dye #1 to emulate the color of pumpkins in their Halloween candy, it caused severe gastrointestinal problems in a number of children.

The FDA eventually banned the use of this dye because of this. This incident also prompted the FDA to begin retesting items that had been on the GRAS list for decades. In 1953, the yellow dye #s 3 & 4 were found to contain small amounts of a carcinogen that reacted with acids in the stomach to produce more carcinogens. Further testing confirmed this carcinogen induced cancer of the bladder in lab animals. Both dyes were removed from the GRAS List. In 1976 red dye #2 was also removed after it was shown to cause cancer in lab animals. To this date the FDA has identified 14,000 substances suspected of causing cancer.

Other probable causes of cancer are related to the health habits of people. People who smoke increase their risk of developing cancers of the lung, mouth, and throat. People who sunbathe expose their skin to the ultraviolet rays of the sun, increasing their risk of developing skin cancer.

Name _____ Date _____

Preventing Cancer

Recall:
You have done research using the Internet and completed labs focused on food additives and their functions. All food additives are categorized based on their function. List the four basic groups of food additives and briefly describe their function(s).

During your investigations, you found out that, to be approved by the FDA as safe for its intended use, a food additive must be tested thoroughly. These tests involve experimental evidence collected from feeding studies and other tests. You have also discovered that some food additives that used to be considered as safe have actually been found to be harmful because they contain carcinogens, or cancer-causing agents.

Research:

You should know that some carcinogens occur naturally in some food. For example, a charbroiled steak contains a carcinogen that is also found in cigarette smoke and automobile exhaust fumes. The spices cinnamon and nutmeg contain safrole, which is also a carcinogen. Because of this, the FDA banned safrole as a flavoring for root beer. Probably the most potent carcinogens are called aflatoxins. They are produced by molds growing on stored peanuts and grains.

There is no way of keeping all aflatoxins out of our food, so the FDA has said that food products can only contain 20 parts per billion (ppb) of aflatoxins. Preservatives such as sodium and calcium propionate can retard the growth of these molds. But, given all that, what can we do to maintain our health?

As you visit a web site and complete this package of information, you will begin to see the relationship between diet and the development of cancer. You will also learn about the six types of cancer that are generally considered preventable, and look at some guidelines for preventing cancer.

1. Name of the group who established this web site:

2. The purpose of this web site is:

3. According to the experts, there is a relationship between diet and the development of different types of cancer. What type of diet do the experts suggest cause cancer?

4. Give the percentages of cancers that are attributed to:
   Diet _____% smoking and alcohol _____% other causes _____%

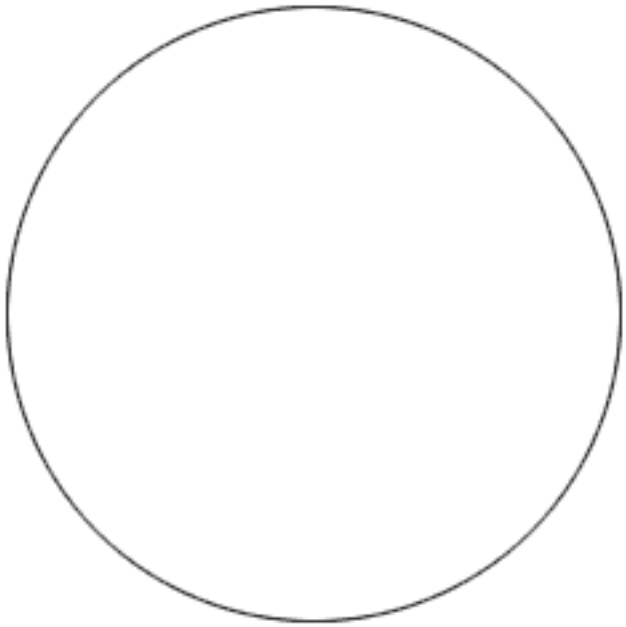
5. Using a protractor and your math skills, represent the percentages in a circle graph. Show all of your calculations.

6. Explain how you calculated the number of degrees each percentage would represent in the circle graph.

7. Name the cancers that are believed to be preventable.

8. What percentage of cancers can be prevented?

9. Using a protrator and your math skills, represent the percentages in a circle graph. Show all of your calculations in the space below.



Going In Depth

Choose one of the preventable cancers and complete the following:

1. What do the experts suggest is your best course of action to prevent this type of cancer?
2. Describe the significance of early detection and treatment of this type of cancer.
3. What are the risk factors for producing this type of cancer?
4. List the symptoms a person should look for in this type of cancer.
5. How many people get this type of cancer in the United States?
6. What percentage of these people die of this type of cancer?

Action

Through many years of extensive research, guidelines have been developed that people can follow to reduce their risk of developing cancer. Read the list of guidelines. Choose one guideline and design a sign or poster that corresponds to the message of the guideline. Be creative, but make sure that observers can determine the guideline that corresponds to the sign or poster you have constructed. When you are ready, obtain construction paper and markers to make the actual sign or poster. All work must be done neatly for presentation to the class.

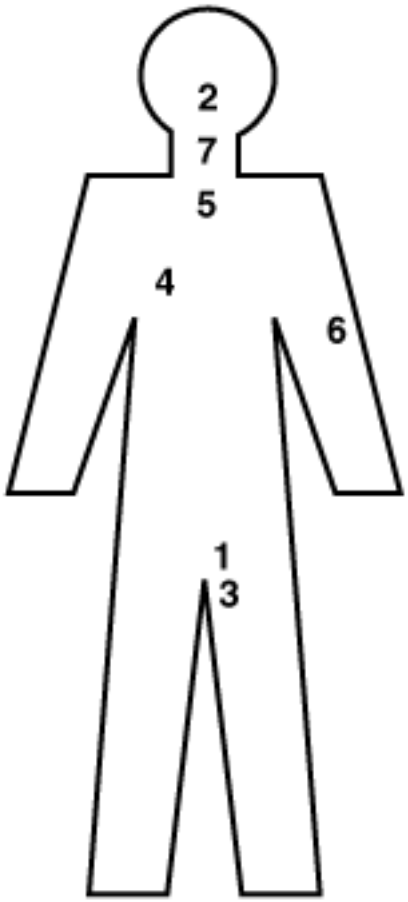
Name _____ **Date** _____

Seven Warning Signals

Cancer's Warning Signals!

1. Change in bowel or bladder habits.
2. A sore that does not heal.
3. Unusual bleeding or discharge.
4. Thickening or lump in breast or elsewhere.
5. Indigestion, or lump in breast or elsewhere.
6. Indigestion, or difficulty in swallowing.
7. Obvious change in wart or mole.
8. Nagging cough or hoarseness

If you have a warning signal, see your doctor.



Would You Like Pesty Sides with That?

Overview

The students will use the World Wide Web to examine different myths associated with the effects pesticides have over a long period of exposure. The students will demonstrate their understanding of the material by making a short video that informs the viewer about the dangers posed by pesticides.

Media Resources

Pesticide Industry Propaganda
(http://www.ewg.org/pub/home/ reports/Myths/Industry_Myths.html)

On this web page you will find links to pages related to eight myths portrayed in pesticide industry propaganda. You can follow other links on this page to find information about pesticides and childhood cancer and the health risks faced by farmers who have daily contact with high doses of harmful pesticides.

Learning Objectives

Students will be able to . . .

- explain the long-term dangers pesticides have on health
- identify and explain the myths that surround the use of pesticides
- use the Internet to search for answers to health-related questions

Next

Vocabulary

Carcinogen: any substance that produces cancer
Cancer: any of the various diseases characterized by the uncontrolled growth of cells that disrupt normal body, muscle, etc. function.
Pesticide: any chemical used for killing insects, weeds, etc.
Myth: any fictitious story or unscientific theory, account or belief.
Propaganda: widespread dissemination of a particular belief or idea by various media.

Materials

- Computer with modem and Internet access
- *Student Worksheets:*
  - Background Information Sheet
  - Pesticides and Health
  - Storyboard Organizer
- Video camera, batteries, and cassettes

Next

Procedures

1. Start the class with a discussion of propaganda and the different kinds of propaganda of which your students may be targets. List these on the board. If the students identify propaganda from companies producing products such as cigarettes and alcohol, be sure to mention them in your discussion.

2. Distribute *Student Worksheet:* Pesticides and Health. Have students read the quote it contains to themselves and then aloud as a class. Discuss the quote and then have the students answer the three worksheet questions independently.

3. Go over the questions as a class to ensure that students have absorbed this information.

4. Review the entire assignment with the students. Make sure it is clear that the end result of this project will be an informational video and that retrieving accurate facts and data is essential to make the video a success. Discuss the fact that they do not want to be guilty of misstating the issues as some companies have been accused of doing.

5. Group students into video production teams. Team members will individually visit the Pesticide Industry Propaganda web page to take notes on three separate myths. This will assure that the group will have reviewed the entire list.

6. Once the research is done, students are ready to plan their video. Have them use the storyboard sheets to get a general idea of the flow of their video. Storyboards should contain a succession of quick sketches, showing the images the video will contain, in the order in which they will occur. Students should use their storyboards to write the script for their video. Since the video is already planned, each student can work on a different part of the script at the same time.

7. Have the students choose ways that they can use their video in the community to inform people about the dangers of pesticides in foods. One possibility is to approach a local natural food store and ask their permission to set up a small table and show the video during the weekend. The main idea is to get the students thinking critically of strategies for dissemination of the information they have put together.

Extension

The students could use the research they have done to make brochures and fliers that highlight the most important findings of their research. They could distribute these throughout the school and in the community.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

S. Dean Curtis and Linda McClelland

Next

Would You Like Pesty Sides with That?

Pesticide Industry Propaganda and The Real Stories Behind

Information Courtesy of the Environmental Working Group

Myth #1: Animal tests of pesticides don't predict human cancer risks because the high doses fed to animals are irrelevant to the low doses consumed by humans.

What's the real story behind Myth #1?

Animal test of pesticides don't predict human cancer and other health risks because animal studies are the public's first line of defense against toxic substances. Major public health disasters have been avoided or minimized, because regulators acted on the basis of animal studies. For example, DDT was banned due to problems first identified in animal tests.

As plainly stated by Dr. David Rall, former director of the National Institute of Environmental Health Sciences, "Animal studies must serve as a primary tool of prevention. Epidemiology studies, while valuable, often provide information 25 years too late."

In other cases regulators ignored the results of animal studies, causing great human suffering. Workers were not protected from asbestos until after lung cancer cases in workers were linked directly to occupational exposure to the substance. Evidence that asbestos caused cancer in animals was suppressed by the manufacturer for at least 15 years. Animal evidence was also ignored with the fertility drug DES, which was not banned until the daughters of women who took it developed a rare vaginal cancer. High dose animal testing is used by every public health agency around the world, from EPA to European bureaus to the World Health Organization-- and even by industry when it likes the results (for example when these studies prove the safety of drugs, cosmetics, or other pesticides).

Animal studies accurately predict risk for humans. Extrapolating from mice to men is logical because rodents and humans are remarkably similar genetically (Rall et al. 1987). It is not surprising, therefore, that all known human carcinogens have also been shown to cause cancer in experimental animals. Most scientists agree that it is prudent to assume the reverse is also true and that chemicals clearly causing cancer in animals present human risks (NRC 1993a). The same is true for chemicals that cause birth defects in humans; they all cause birth defects in animal studies (Kimmel et al. 1992). In fact, current animal testing protocols, particularly for cancer and subtle multigenerational effects, underestimate human risk (NRC 1993a). People are exposed to pesticides from conception through death. In contrast, animals are exposed typically beginning at 8 weeks (roughly equivalent to 5 years of age in the human), and ending at two years (roughly equivalent to age 65 in the human). One study designed to better understand this shortcoming found that rats fed the carcinogens N-nitrosodiethylamine (NDEA) or N-nitrosodimethylamine (NDMA) for two and one-half years had seven times the cancer incidence compared with rats fed NDEA or NDMA the standard two years required by the EPA (Peto et al. 1991).

A substantial body of evidence points to dramatically increased cancer rates when experimental animals are dosed in the womb and as neonates. A major study of 1,040 animals found a six-fold increase in cancer incidence when exposure began at three weeks, as compared to 20 weeks of life (Gray et al. 1991). Another review of animal studies on 22 chemicals found that more cancers were produced, and were produced earlier in life, when animals were exposed from conception and during weaning (McConnell 1992).

Most chemicals do not cause cancer, even when tested at very high doses. To discredit animal tests of pesticides, industry fixates on the Maximum Tolerated Dose (MTD) (the highest dose that can be fed to an animal without causing tissue damage), claiming that virtually "everything causes cancer" at such a high level. But in fact most chemicals are not carcinogenic even when tested using maximum tolerated doses; of the hundreds of chemicals tested by the National Cancer Institute and the National Toxicology Program, 68% proved carcinogenic when selected for testing because of their suspected cancer-causing potential. When chemicals were tested on the basis of potential high human exposure, only 22% caused cancer in high-dose tests, suggesting that about one-fifth of all environmental pollutants may cause cancer in high-dose animal tests (Rall 1994, Fung, et al. 1993). Most chemicals that cause cancer at high doses also cause cancer at low doses. A review by the National Toxicology Program found that only 6% of all chemicals analyzed caused cancer at the high dose only (Rall 1994). While several alternative theories have been advanced, mainstream scientists still agree that there is no dose of a carcinogen that does not increase the risk of cancer (Portier et al. 1994). This is particularly true in the current environment where people are exposed to scores of carcinogens each day, each one adding to the cancer risk of the other.

Several important animal studies have tried and failed to identify a so-called "threshold", or safe dose. Recently, using extremely low doses on over 4,000 rats, researchers were unable to find a dose of N-nitrosodiethylamine or N-nitrosodimethylamine that did not significantly increase cancer rates (Peto et al. 1991).

Industry further complains that the government overreacts to reports of rodent tumors and tries to ban any chemical so implicated. In fact, the opposite is true. According to the Office of Technology Assessment, most rodent carcinogens are not regulated and few are banned (OTA 1987). Of the more than 90 pesticides found to cause cancer in animal studies, the vast majority continue to be used on food crops.(See Note 1)

Myth #2: The amount of pesticide residues in food and water is so small as to pose no health risks -- expressed as "You have to eat 340 oranges a day to get the dose causing health problems in animal tests."

What's the real story behind Myth #2?

In fact, some children are very likely being sickened each day by pesticides in food. A five-year, consensus National Academy of Sciences study found that "...for some children, exposures [to just five pesticides on eight foods] could be sufficiently high to produce symptoms of acute organophosphate pesticide poisoning" (NRC 1993a). This conclusion is based on a sophisticated probability analysis of actual exposures to pesticides in the food supply. The same analysis showed that 50,000 two-year-olds exceed federal safety margins for organophosphate insecticides each day, and that about 1,500 two-year-olds exceed these safety margins by a factor of ten (NRC 1993a).

If American children did eat 340 oranges, some huge percentage--30, 50, 70 percent, depending on the pesticide--would suffer health consequences (cancer, nerve damage, weakening of the immune system, or disruption of normal hormone function). If this were the case, we would have a public health crisis of unimaginable dimensions.

On the other hand, children are simultaneously exposed to many different pesticides from many sources--in water, food, and around the home. The U.S. Department of Agriculture found eight pesticides on individual samples of apples, seven on peaches, and six on grapes that were washed and prepared for normal consumption (USDA 1994). The FDA reported 103 pesticides on just 22 fruits and vegetables over a two-year period, and 67 pesticides and metabolites were found in Midwestern drinking water sources from 1987 to 1994 (Wiles et al. 1994).

Current regulations do not account for these multiple exposures, nor do they provide specific protection for infants and young children. The young remain unprotected in spite of a five-year, consensus National Academy of Sciences study that called for sweeping regulatory and scientific changes to protect infants and children from pesticides in food, water, and the home environment (NRC 1993a).

Myth #3: We're winning the war against cancer. Cancer rates are declining.

What's the real story behind Myth #3?

Cancer incidence in the American population has skyrocketed--up 48% from 1950 through 1990, according to National Cancer Institute statistics. These statistics are adjusted for an aging population and exclude lung and stomach cancers where the causes are generally well-understood. (See Note 2).

Those who say cancer rates are decreasing focus on cancer death rates because the cancer death rate overall is stable, despite increasing incidence. While cancer kills the same percentage of people that it always has, far more people are getting the disease. See Table 1.

Framing the debate in terms of death rates is particularly cold-hearted toward children. It intentionally obscures the fact that a greater percentage of children get cancer than ever before in our history. The incidence of childhood brain cancer and childhood leukemia has increased 33 percent since 1973 (Ries et al. 1993). Cancer kills more children under the age of 14 than any other disease.

Focusing on childhood death rates further minimizes the pain and suffering of these children, the higher incidence of subsequent cancers that these people face as adults, and the costs of maintaining a growing number of childhood cancer wards.

Since 1950, cancer rates for the general population (excluding lung and stomach cancer) have risen at a rate of about 1.2 percent per year, with extraordinary increases in certain cancers, including cancers of male and female sexual organs, notably the breast (up 52%), prostate (up 134%), and testis (up 125%) (Miller et al. 1993).

Other organs exhibiting huge cancer increases during the past 40 years -- which are also shown in lab tests to be prone to tumors from carcinogenic chemicals--are the kidney (up 116%), liver (up 88%), brain (up 74%), and thyroid (up 102%), as well as non-Hodgkin's lymphomas (up 172%) and multiple myelomas (up 183%) (Miller et al. 1993). Farmers, otherwise healthier than the average population, have elevated rates of several types of cancer that are associated with chemical exposure (see farmer reference, Appendix 2). Although some of these higher cancer rates could be due to better detection, detection alone does not account for such enormous increases (Miller et al. 1993).

Myth #4: Nobody has ever been hurt by exposure to pesticides at the low doses found in food and water.

What's the real story behind Myth #4?

The landmark 1993 National Academy of Sciences study of children and pesticides concluded exactly the opposite when it found, based on an examination of actual residues in actual diets, that some children are exposed to so many organophosphate pesticides in food each day that they could experience "acute organophosphate insecticide poisoning" (NRC 1993a).

Mainstream scientists agree that real world exposure to cancer-causing chemicals presents real risks (Portier et al. 1994), particularly in the modern, polluted environment where people are routinely exposed to complex mixtures of cancer-causing chemicals. Between 30,000 and 60,000 people each year die from exposure to cancer-causing environmental pollutants.

At least 20 additional epidemiology studies in the peer-reviewed literature document a relationship between exposure to pesticides and increased risk of cancer in children (see children's references, Appendix 1). Children are generally more susceptible to the toxic effects of these chemicals than adults, and current animal tests and regulations do not protect children (NRC 1993a, WHO 1986).

Children are routinely exposed to hundreds of pesticides in food, as well as contaminants in air and water. The combined toxicity of these chemicals is not known, nor is it being studied. Meanwhile, the incidence rate of childhood cancers, particularly brain cancer and childhood leukemia, continues to rise (Ries, et al. 1993).

Researchers at the National Cancer Institute have found that farmers have elevated rates of several types of cancer that are associated with chemical exposure, including pesticides (see farmer references, Appendix 2).

Other effects, such as disruption of the endocrine system, have been shown to occur in animals at extremely low doses (Gray 1992). Scientists agree that there is a biologically plausible relationship between many chlorinated chemicals in the environment, including pesticides, and endocrine-related effects, such as declining sperm counts and rising rates of testicular and breast cancer that are widely reported in the industrialized world (Auger et al. 1995, Abell et al. 1994, Sharp and Skakkebaek 1993, Carlsen et al. 1992, Schrader 1988).

Myth #5: Natural carcinogens in food are more dangerous than pesticides.

What's the real story behind Myth #5?

This is an extremist view, not supported by replicated peer-reviewed studies and not accepted by the scientific or regulatory community. The principal proponent of this view is Dr. Bruce Ames, a prominent Berkeley biochemist. Many scientists have detailed the flaws in the Ames theory.

First, Ames brands many natural substances as carcinogens on the basis of flimsy or equivocal evidence, such as causing tumors only from a high dose, precisely the argument he rejects when applied to man-made carcinogens (NRC 1993a, Perrera et al. 1988).

Second, some of the natural carcinogens cited by Ames are not carcinogens at all. One of his top three alleged natural carcinogens, d-limonene, is not considered carcinogenic by any credible regulatory or international scientific agency (Huff 1993, EPA 1994b).

Third, Ames looks at only a handful of pesticides in the food supply, dramatically understating the total load of cancer-causing pesticides in food and water. Dr. Frederica Perrera and colleagues constructed a more representative, but still incomplete, list of man-made carcinogens and found exposure to these compounds to be about equal to that of natural carcinogens cited by Ames. (Perrera et al. 1988).

Fourth, Ames incorrectly inflates exposure to natural carcinogens. For example, he assumes that everyone in the United States drinks a cup of comfrey tea each day when illustrating the danger of natural carcinogens, but uses far smaller average food consumption estimates for the entire U.S. population when calculating the dangers of DDT in the diet.

Fifth, Ames does not consider that children may get far higher doses of synthetic or natural carcinogens than adults, based on their unique eating habits.

Sixth, Ames ignores the fact that the risks from some man-made carcinogens are low precisely because these carcinogens have been regulated. The issue of natural vs. man-made carcinogens is one of ethics and common sense. Just because natural sources of cancer risk exist, it doesn't follow that we should add more synthetic carcinogens to the food, air, and water supply.

Americans want avoidable cancer risks reduced, whether they are from naturally occurring aflatoxins or man-made pesticides.

Myth #6: Alar on apples was a "scare," reflecting environmentalists' use of emotion and scare tactics, not sound science.

What's the real story behind Myth #6?

The EPA's initial decision to ban Alar has been reaffirmed by subsequent industry-sponsored animal tests, which led the agency to quietly ban the chemical for all food uses in 1992. The unavoidable breakdown product of Alar, (asymmetrical dimethyl hydrazine, UDMH) routinely found in apple juice and apple sauce, has been classified by the EPA as a probable human carcinogen, and at the time it was discontinued for use on apples in 1989 it was the most potent carcinogenic pesticide allowed in the U.S. food supply.

Meanwhile, apple production, sales, and profits have soared since Alar was banned for use on apples. Since 1989, apple industry revenues have increased by nearly 50 percent, and production has increased by nearly 10 percent (USDA 1993a). Per capita consumption of apple products has remained steady since Alar was removed from the market (USDA 1993b).

At the time of the Alar report on 60 Minutes, two states (Massachusetts and New York) had already banned the chemical, and the American Academy of Pediatrics had urged such a ban at the federal level. A subsequent lawsuit brought by apple growers against CBS and 60 Minutes was dismissed, with the judge noting "that governmental methodology fails to take into consideration the distinct hazards faced by preschoolers. The government is in grievous error when allowable exposures are calculated...without regard for the age at which exposure occurs."

In 1993, the National Academy of Sciences confirmed the central message of the Alar case, which is that infants and young children need greater protection from pesticides. Finding that federal calculations for allowable levels of pesticides do not account for increased childhood consumption of fruit, for children's lower body weight, or for their heightened sensitivity, NAS called for an overhaul of regulatory procedures specifically to protect kids (NRC 1993a).

Myth #7: Restricting the use of pesticides will cause food shortages and raise the price of food.

What's the real story behind Myth #7?

Experience shows that this claim is totally false. Since 1985, the EPA has banned various uses of 12 pesticides on more than 200 crops. The cancellation of these pesticide uses had absolutely no effect on the price or availability of any food anywhere in the United States (Elderkin 1995).

The reason is that there are plenty of available alternative pesticides and pest control techniques for farmers of every crop in the United States (NRC 1989, NRC 1993b). Perhaps the best example is that of Alar (see Myth #6), which caused a tremendous uproar from apple growers when it was removed from the market. Yet after Alar sales were halted by the manufacturer, apple yields, sales and profits went up, while consumer prices remained steady (USDA 1993a, USDA 1993b, Elderkin 1995).

Many pesticides that are widely used here are banned for health and environmental reasons in other countries. One example is atrazine--the most heavily used pesticide in the U.S.--which is banned in many European nations. Another is alachlor, a heavily used corn and soybean herbicide that is banned in Canada.

Indonesia, a tropical country with extreme pest pressure, has gone so far as to ban whole categories of pesticides used in the United States, in a successful effort to contain surging pest resistance to pesticides and to promote integrated pest control measures.

In fact, pesticides are increasingly ineffective. American farmers used 33 times more pesticides in 1990 than they did in 1945, yet crops losses from pests during that time increased from 31 to 37 percent (Pimentel et al. 1992). The reason for this is genetic pest resistance to the growing chemical assault.

Myth #8: Pesticides cost money, so farmers currently use as few pesticides as possible.

What's the real story behind Myth #8?

Two consecutive National Academy of Sciences studies--Alternative Agriculture, and Soil and Water Quality: An Agenda for Agriculture--have concluded the opposite, that farmers currently have no compelling economic incentive to reduce pesticide use. At the same time, these two studies showed that major reductions in current pesticide use levels are possible with available off-the-shelf pest control methods (NRC 1989a, NRC 1993b).

Farmers maintain unnecessarily high levels of pesticide use because pesticides are weakly regulated, because farmers pay none of the costs to remedy the pollution caused by pesticides, and because pesticides account for a relatively small percentage of overall production costs and per-acre crop value.

The average value of an acre of Florida tomatoes is about $14,000, while the average cost per acre for pesticides is about $750, or about 5 percent of the crop's value. Reducing pesticide costs by 20 percent, or $150, for example, provides virtually no potential economic reward compared with the perceived risk of change and the cash value of the crop.

In corn and soybean crops, pesticide use is less intensive and an even smaller percentage of production costs or crop value. The value of an average acre of corn is $322 (assuming $2.80 per bushel for corn, including subsidies and 115 bushel yield). The cost of using cancer-causing herbicides that pollute the drinking water of at least 11 million people in the Corn Belt is about $5.00 per acre, or only about 1.7 percent of the value of the crop.

There is little economic incentive to reduce use when the profits on the line are so relatively great, and when farmers pay none of the costs associated with the pollution caused by pesticide use.

Name _____ Date _____

Pesticides and Health

Objectives:

At the end of this lesson plan, you should be able to . . .

- identify myths in the media regarding the harmful effects of pesticides in food
- describe the relationship between pesticide exposure and cancer

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Directions:

In the lesson you will use the information from the web site Pesticide Industry Propaganda to learn about myths that are presented by many types of media regarding the use and harmful effects of pesticides used in producing food. This web site is located at **http://www.ewg.org/pub/home/reports/Myths/Industry_ Myths.html**

"The chemical and food industries care about the bottom line, even if that means fostering myths and distorting science to convince the public and policy makers not to regulate pesticides."
Pesticide Industry Propaganda web site

Questions: Answer these questions about the quotation above.

1. What does the term "bottom line" refer to?
2. How can someone "distort science" to convince people of something?
3. Why would pesticide companies not want to have pesticides regulated?

Directions:

Use your Internet browser to dial the Pesticide Industry Propaganda web site. On the first, or home, page of this site you will find information about eight different myths associated with the pesticide industry. Read all of the myths. Then select three myths as the focus for your research. Record your notes for each myth in the spaces below.

Myth # ___
Write the myth in your own words:

Write three facts from your reading that show why the myth is not true.

Myth # ___
Write the myth in your own words:

Write three facts from your reading that show why the myth is not true.

Myth # ___
Write the myth in your own words:

Write three facts from your reading that show why the myth is not true.

Action:

In order to better inform the public about these issues, you will work with your team members to create a 2 - 5 minute video that tells the real story behind five of the myths you have studied. Follow the steps below to help you prepare to record your video:

[ ] Storyboard: A storyboard is like a map of what your video will look like. You can use as many copies of the storyboard organization sheet as you need to tell a convincing story. Draw quick sketches of what the audience will see.

[ ] Script: Use the storyboard pictures to help you write a script that will take between 2 and 5 minutes to perform. As you write, keep a list of all the things you will need for the actors, and what kind of scenery you need. Keep things as simple as possible.

[ ] Talent Search: Seek out people you think will be best able to play out the story you wrote in your script. Try to use people in your own group or class.

[ ] Rehearsal: Make sure you have practiced many times before you begin taping. This will help you troubleshoot any problems you might have in getting your production finished.

[ ] Final Production: Shoot the video!

Name _____ Date _____

Pesticides and Health -- Storyboard

Can You Find It?

Overview

Students will investigate subsurface contamination of our water supply from USTs and other sources, and consider the issues involved in prevention as well as clean up of existing contamination. This activity is interdisciplinary in nature and involves the use of critical thinking and analysis to solve a problem.

Teacher Background

Ground water is the water that lies beneath the earth's surface. It is currently estimated that 25% of the available ground water in the United States is contaminated. Common pollutants include gasoline, heating oil, wastes from septic tanks and various toxic chemicals stored in underground storage tanks (USTs). The Environmental Protection Agency (EPA) regulates 30% of the known USTs. The remaining 70% are found on private property, usually hold less than 1,000 gallons of material and are a major source of ground water pollution.

One out of four Americans lives within four miles of a Superfund hazardous waste site. There are Superfund sites and many other hazardous waste sites in every state. In addition, the possibility of further contamination remains as communities continue to generate hazardous wastes.

The Federal Superfund Program, administered by the EPA, investigates and cleans up hazardous waste sites throughout the United States. Part of this program is devoted to informing the public and involving them in the process of cleaning up hazardous waste sites. Questions concerning the Superfund Program can be answered by contacting Nancy L. Cronin of Superfund's Community Involvement and Outreach Center at 703-603-9097.

Next

Media Resources

For student research:

A Citizen's Guide to EPA's Superfund Program
(http://www.epa.gov/reg3hwmd/super/sfguide)
An understandable explanation of the Superfund and how it works.

Common Chemicals found at Superfund Sites
(http://www.epa.gov/superfund/resources/chemicals.htm)

Region 3 Superfund Sites
(http://www.epa.gov/reg3hwmd/super/npllist.htm)

For teacher background:

Environmental Protection Agency
(http://www.epa.gov/epahome/browse.htm)
You can move from this home page to a variety of links focused on our water supply, water pollution and other environmental issues.

EnviroMysteries video, Earth Watch segment 3, Maryland Public Television, 1996.

Learning Objectives

Students will be able to . . .

- appreciate how difficult studying subsurface contaminants is
- understand the potential threat of USTs to our water supply
- identify various ground water pollutants
- identify primary drinking water standards for the ground water pollutants.

Next

Vocabulary

Contamination: the introduction of harmful or hazardous matter into the environment.
Hazardous Substance: a broad term that includes all substances that can be harmful to people or the environment; toxic substances, hazardous materials and other similar terms are subsets of hazardous substances.
Underground Storage Tanks (USTs): an underground tank storing hazardous substances or petroleum products.
Superfund waste site: areas containing buried, abandoned, accidentally spilled, or illegally dumped hazardous substances from the past, primarily from business and industry.
Subsurface: found below the surface.

Materials

For class:

- Computer with modem and Internet access
- VCR and monitor
- An aquarium or terrarium filled with sand, in which a balloon filled with colored water is buried so that it is not visible
- Copy(ies) of Chemical Card Sheet

For each student:

- Copy of *Student Worksheets:*
  What is the EPA Superfund?
  Pollution from Chemicals
  Graph Sheet
  Exploring Maryland's Superfund Sites
  Summing it Up

For each group of 3 - 5 students:

- Metric ruler
- Masking tape
- Plastic shoe box
- Sand
- Toothpicks
- Paper clips
- String
- An oddly shaped object (such as an apple or a stapler)

Next

Procedures

1. Duplicate copies of worksheets.

2. Set up the demonstration aquarium or terrarium before class.

3. Instruct the students to locate the "contaminated underground storage tank" buried in the sand. Students should insert sharp toothpicks into the sand to detect the location of the tank, which should burst the balloon. This introduces the class to one of the major problems people encounter when dealing with subsurface contaminants, leaking storage tanks.

4. Give a brief overview of the Superfund based on information in the Teacher Background section. Then, direct students to use their Internet browser to find the information they need to complete the worksheet on Superfund programs. This information is located at The Citizen's Guide to the EPA Superfund Program (http://www.epa.gov/reg3hwmd/super/sfguide.htm).

5. Explain that the EPA is particularly vigilant in managing these sites because the chemicals they contain are potentially hazardous to our water supply. Give each student a copy of the *Student Worksheet:* Pollution from Chemicals. Direct them to use their Internet browser to go to this site: http://www.epa.gov/docs/oerrpage/superfnd/web/oerr/atsdr/index.htm and explore the links on this page to find out more about these chemicals: cadmium, arsenic, benzene, acetone, carbon tetrachloride, chlordane, mercury, DDT/DDE/DDD, lead, aldrin, 2-butanone, chromium, toluene, vinyl chloride, nickel, tetrachloroethylene.

6. If time permits a second Internet experience, distribute the Student Worksheet: Exploring Maryland's Superfund Sites, and encourage students to explore these sites to complete their worksheet. This information is located at http://www. epa.gov/reg3hwmd/super/npllist.htm. You could also assign half the class to investigate these sites while the other half completes the research on the chemicals themselves as described in #5.

7. Divide students into teams of 3 - 5 members. Give each a plastic shoe box filled with sand in which you have buried an object such as a banana or stapler. The shoe box serves as a simulated Superfund site. Also distribute graph paper and other supplies they will use.

8. Students should section off the container into small quadrants (approximately 2.5 cm X 2.5 cm) using string and masking tape.

9. Give students a straightened paper clip and tell them to use it to find and identify the UST. Remind them to poke carefully, as each poke could "puncture" their tank. Each probe simulates the sinking of a monitoring well like those used at Superfund sites. Students should sink a minimum of five wells per grid.

10. Students should plot their trial pokes on the graph paper, creating a surface map of their area showing the location of the UST.

11. Students should recover buried objects at the completion of the activity, and check the plotted surface map to see how closely the two resemble each other.

12. While still in their small groups, students should discuss the answers to the following questions:
    What difficulties were encountered in your attempt to locate the USTs?
    What kinds of technology could be used to help locate USTs?

Extension

The following can be used as extension activities to reinforce the concepts and objectives of the lesson. These documents are included in *Drinking Water Activities for Teachers and Students*, U.S. EPA Office of Water, January 1995.

"Resource Management - Protecting Your Drinking Water"
"Tracking Pollution - A Hazardous Whodunit"

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Howard Schindler and Jennie Discepolo

Next

Name _____ Date _____

What is the EPA Superfund?

Directions:

Use your Internet browser to visit this site:
A Citizen's Guide to the EPA Superfund Program (http://www.epa.gov/reg3hwmd/super/sfguide.htm).
Use the information you find there to answer these questions.

1. In addition to Underground Storage Tanks, what are some other common hazardous waste sites?
2. What is the Superfund Program?
3. What is the ultimate goal of the Superfund Program?
4. How are Superfund sites discovered?
5. How does the Superfund work in an emergency such as a chemical spill?
6. What is the TAG program? How does it work?
7. What are the six steps involved in a long-term Superfund cleanup?
8. What pays for a Superfund cleanup?

Chemical Cadmium **card**	**Chemical** Arsenic **card**
Chemical Benzene **card**	**Chemical** Acetone **card**
Chemical Carbon Tetrachloride **card**	**Chemical** Chlordane **card**
Chemical Mercury **card**	**Chemical** DDT.DDE.DDD **card**
Chemical Lead **card**	**Chemical** Aldrin **card**
Chemical 2-Butanone **card**	**Chemical** Chromium **card**
Chemical Toluene **card**	**Chemical** Vinyl Chloride **card**
Chemical Nickel **card**	**Chemical** Tetrachloroethylene **card**

Name _____ Date _____

Pollution from Chemicals

Directions:

Use your Internet browser to visit this site:
Common Chemicals Found at Superfund Sites
(http://www.epa.gov/superfund/resources/chemicals.htm)
Follow the links there to find information about your chemical.

Chemical Name:

- What is it?
- How is it used?
- Why is it being regulated?
- What are the health effects of this chemical?
- What happens when this chemical is released into the environment?
- How can this chemical be removed from my water supply?

Name _____ Date _____

Exploring Maryland's Superfund Sites

Directions:

Use your Internet browser to visit this site, which lists Superfund sites in Maryland:
Superfund Site: Maryland
(http://www.epa.gov/reg3hwmd/super/md.htm)
Click on a link to one of the sites. Use the information you find there to fill in this chart.

Site Name:

- What waste products are located at the site?
- What threats and contaminants are located at the site?
- What is being done to treat the site immediately?
- What will be done to make the entire site safe?
- What progress has been made so far?

Summing It Up

Directions:

Answer these questions in complete sentences.

1. Name three chemical contaminants that can make their way into our water supply.

2. Many USTs contain petroleum products such as gasoline and heating oil. As they age, the USTs begin to leak, and the materials stored in them become part of the ground water supply. What kind of regulations should the government adapt to make sure new USTs don't have this problem?

3. Describe a demonstration experiment that you might use to show people about the effects of chemicals that leak from USTs and other sources?

4. If you could ban the production of one of the chemicals your class investigated, what would it be? Why would you want it banned?

Water by The Number
Grades 5 - 8

Overview

The intent of this lesson is to develop and enhance student understanding of the nature of water as a chemical substance and the finiteness of our water supply. In this lesson, students will use the knowledge they gain from visiting a site on the Internet to construct a mathematical board game focused on water facts. They will also use this knowledge to involve another class in the game through E-mail.

Teacher Background

Water is necessary to all living things. Earth is unique in our solar system, having about 70% of its surface area covered with water. Of this water, only about 3% is potable (fit for human drinking). Of this three percent, almost two-thirds is frozen in glaciers and sea ice, leaving approximately one percent of Earth's water available for use by living organisms including humans. This amount of available drinkable water is further reduced by the introduction of pollutants to our water cycle. Clean water is not a limitless resource.

Media Resources

For student research:
Facts about Water
(http://www.epa.gov/OW/facts-quotes/facts.html)
This EPA site contains a number of facts about this precious resource.

For Teacher Background:
Environmental Protection Agency
(http://www.epa.gov/epahome/browse.htm)
By following the links on this page, you can take a look at a number of subjects related to this lesson.

For E-mail game:
The Academy E-Pals
(http://ofcn.org/cyber.serv/academy/epals/)
The Organization for Community Networks in Ohio maintains this data base of classes looking for E-pals

EnviroMysteries *Video, "Water + ? = Trouble!* Maryland Public Television, 1996

Next

Learning Objectives

Students will be able to:

- give three facts about the physical nature of water
- characterize water consumption in the United States by giving three examples of usage
- use their knowledge to design and play a board game, based on mathematics, about water and water usage

Vocabulary

Hydrologic cycle: the process through which water travels through our environment, as precipitation that evaporates and condenses in a never-ending cycle
Water supply: the amount of potable water existing in our environment

Materials

For the class:

- Computer with modem and Internet access
- VCR and monitor

For each student:

- Copy of Student worksheet: Rules of the Game
- Copy of Student Worksheet: Water Q&A
- Copy of Student Worksheet: Facts about Water
- Copy of Game Piece Sheet
- Calculator
- Scissors

Next

Procedure

1. Duplicate copies of worksheets; game piece sheet should be duplicated on heavier stock paper.

2. Use the *EnviroMysteries* video to introduce students to the nature of water, our reliance on this resource, and how our usage impacts the potential water supply.

3. Give students a copy of Student Worksheet: Water Q&A. Direct students to access the site listed on the worksheet to find information that will help them answer these questions. If you do not have access to the Internet, you can give students a copy of the Student Worksheet: Fact About Water, which is a copy of the information students will find at this site. This worksheet will also be helpful for students as they design their game.

4. Distribute copies of the Student Worksheet: Rules of the Game and Game Piece Sheet. Tell students that they will construct a game based on the water facts that they found on the Internet. Review the rules of the game.

5. Collect game pieces and play the game as a class or in small groups.

6. Use the Internet to dial in the The Academy E-Pals School listing. Find a class or classes on the list that would like to participate in the game your students designed. Students could post a series of questions they have developed, ask for responses within a week, collect answers, and post correct answers and school scores.

EnviroHealth Link Master Teacher Team

Howard Schindler and Jennie Discepolo

Name _____ Date _____

Water Q&A

Directions:
Use your Internet browser to visit this site:
http://www.epa.gov/OW/facts-quotes/facts.html
Use the information you find there to answer these questions:

1. Water is the only natural substance that is found in three forms. Name these forms and tell where you might find them.
   a.
   b.
   c.

2. Why is it possible to drink water that was part of the dinosaur age?

3. Most of Earth's water contains salt. What percent of Earth's water is fresh or drinkable water? Where can you find fresh water?

4. Why do people need to drink water?

5. How much water do you need to drink each day to maintain good health?

6. Seventy-four percent of the water we use each day is used in the bathroom. How much water does it take to ...
   run the water until it's cold?
   take a tub bath?
   take a shower?
   flush the toilet?

7. How is most of the water available in this country used?

8. Give three examples of other water facts you find the most interesting.

Name _____ Date _____

Facts about Water

Background Sheet

Information courtesy of the Environmental Protection Agency

- The most common substance found on earth is water. Water is the only substance found naturally in three forms: solid, liquid, and gas.
- The amount of water is constant and recycled throughout time; actually, it is possible to drink water that was part of the dinosaur era.
- Eighty percent of the earth's surface is water.
- Ninety-seven percent of the earth's water is saltwater in oceans and seas. Of the 3% percent that is freshwater, only 1% percent is available for drinking -- the remaining 2% is frozen in the polar ice caps.
- Water serves as nature's thermometer, helping to regulate the earth's temperature.
- Water freezes at 32 degrees Fahrenheit, O degrees Celsius.
- Water boils at 212 degrees Fahrenheit, 100 degrees Celsius.
- Once evaporated, a water molecule spends ten days in the air.
- Forty trillion gallons of water a day are carried in the atmosphere across the United States.
- An acre of corn gives off 4,000 gallons of water per day in evaporation.
- Forty percent of the atmosphere's moisture falls as precipitation each day.
- It would take 1.1 trillion gallons of water to cover one square mile with one foot of water.
- One gallon of water weighs 8.34 pounds; one cubic foot contains 7.84 gallons of water.
- People need about 2.5 quarts of water a day (from drinking or eating) to maintain good health. A person can live without water for approximately one week, depending upon the conditions.
- While usage varies from community to community and person to person, on average, Americans use 183 gallons of water a day for cooking, washing, flushing, and watering purposes. The average family turns on the tap between 70 and 100 times daily.
- About 74% of home water usage is in the bathroom, about 21% is for laundry and cleaning, and about 5% is in the kitchen.
- A clothes washer uses about 50 gallons of water (the permanent press cycle uses an additional 15 gallons).
- It takes 12 to 20 gallons of water to run an automatic dishwasher for one cycle.
- About 2 gallons of water go down the drain when the kitchen faucet is run until the water's cold.
- About 2 gallons of water are used to brush our teeth.
- Flushing a toilet requires 2 to 7 gallons of water.
- A 10 minute shower can take 25 - 50 gallons of water. High flow shower heads spew water out at 6 - 10 gallons a minute. Low flow shower heads can cut the rate in half without reducing pressure.
- About 25 - 50 gallons are needed for a tub bath.
- A typical garden hose can deliver 50 gallons of water in just 5 minutes.
- It takes about four times the amount of water to produce food and fiber than all other uses of water combined.
- About 4,000 gallons of water are needed to grow one bushel of corn, 11,000 gallons to grow one bushel of wheat, and about 135,000 gallons to grow one ton of alfalfa.
- It takes about 1,000 gallons of water to grow the wheat to make a two pound loaf of bread, and about 120 gallons to produce one egg.
- About 1,400 gallons of water are used to produce a meal of a quarter- pound hamburger, an order of fries and a soft drink.

- About 48,000 gallons are needed to produce the typical American Thanksgiving dinner for eight people.
- About 1,800 gallons of water are needed to produce the cotton in a pair jeans, and 400 gallons to produce the cotton in a shirt.
- It takes 39,000 gallons of water to produce the average domestic auto, including tires.
- Producing an average-size Sunday newspaper requires about 150 gallons of water.
- Water makes up almost two-thirds of the human body, and seventy percent of the brain.
- Four hundred gallons of water are recycled through our kidneys each day.
- Water makes up 80% of an earthworm, 70% of a chicken, and 70% of an elephant
- Water makes up 90% of a tomato, 80% of pineapples and corn, and 70% of a tree.
- About 60,000 public water systems across the United States process 34 billion gallons of water per day for home and commercial use. Eighty-five percent of the population is served by these facilities. The remaining 15 percent rely on 13 million priva te
- It can take up to 45 minutes for a water supplier to produce one glass of drinking water.
- You can refill an 8 oz. glass of water approximately 15,000 times for the same cost as a six pack of soda pop. And, water has no sugar or caffeine.
- An average of 800,000 water wells are drilled each year in the United States. That's tapping into our underground water supplies at approximately 100 times each hour for domestic, farming, and commercial needs.
- The United States and Canada have about one million miles of pipelines and aqueducts -- enough to circle the planet 40 times.

Name _____ Date _____

Rules of The Game

Directions:

Use the information about water that you discovered on the Internet to design a game called "Water by the Numbers." You might have noticed that many of the facts you read contained numbers. The questions for your game should be based on these mathematical facts.

These are some examples of questions that might be good for your game:
• It's 5° below zero. About how many degrees would the temperature have to rise before water would melt? (*answer: 37 degrees*)
• If Earth's atmosphere carries 40 trillion gallons of water a day, and each gallon of water weighs about 8 pounds, how much does the water in our atmosphere weigh? (*answer: 32 trillion gallons*)

You should develop ten questions like these for your game.

Next, use your calculator to determine a correct answer for each question.

Write one question and 3 possible answers on each game piece card. One answer should be the correct answer. Cut the cards apart.

Playing the Game:

Your teacher will collect all the cards, and divide your class into groups to play the game. Each group should have a calculator. Decide on a time limit for each game and the amount of points for a correct answer.

The teacher will read the questions, and select someone to keep score.

If you know the answer to a question as it is read, raise your hand. You might not need to use a calculator to find an answer if you estimate and round numbers to find an approximate answer.

QUESTION: POSSIBLE ANSWER: 1. 2. 3.	QUESTION: POSSIBLE ANSWER: 1. 2. 3.
QUESTION: POSSIBLE ANSWER: 1. 2. 3.	QUESTION: POSSIBLE ANSWER: 1. 2. 3.
QUESTION: POSSIBLE ANSWER: 1. 2. 3.	QUESTION: POSSIBLE ANSWER: 1. 2. 3.
QUESTION: POSSIBLE ANSWER: 1. 2. 3.	QUESTION: POSSIBLE ANSWER: 1. 2. 3.
QUESTION: POSSIBLE ANSWER: 1. 2. 3.	QUESTION: POSSIBLE ANSWER: 1. 2. 3.

Water: Here Today, Where Tomorrow?

Overview

This lesson will provide better understanding of the relationship between water pollution and human health. Students will first use the Internet to explore the water cycle and water treatment processes. The concrete activities that follow (tasting, smelling and observing water) are intended to be launch points for students to acquire a background in the study of water quality. Through these activities, students will learn where their water supply comes from, where it goes, what is in it, and how problems with water are being addressed.

Note to Teachers: Even the most challenged learners can understand environmental concerns. Providing them with a background of information and an opportunity to use the information actively, they will begin to feel a stewardship for the world. Using activities that develop stewardship will hopefully become a basis for action and decisions in their future lives.

Media Resources

For student research:
The Environmental Protection Agency, Office of Water Kids Page
(http://www.epa.gov/OGWDW/kids)
Students will use this page as a spring board to look at the water cycle, explore how water is treated to remove impurities, and look at ways their activities affect the water supply. They can also follow links here to look at the Blue Thumb Project to conserve and protect our drinking water

For teacher background:
The Blue Thumb Basic Brochure
(http://www.awwa.org/bluethum.htm)
An introduction to the basics of preserving and protecting our water supply

Build your own Aquifer
(http://www.epa.gov/OGWDW/kids/ aquifer.html)
Background information on aquifers and complete directions on how to involve students in creating a model aquifer to see why these underground sources are so important to our water supply.

Water Filtration
(http://www.epa.gov/OGWDW/kids/filter.html)
Background information on water treatment is linked with complete directions on an experiment where students design a water filtration system.

Learning Objectives

Students will be able to . . .

- identify their water source, where used water goes, how it is disposed and purified
- describe how a waste water treatment works
- develop, practice and evaluate conservation practices
- recognize problem areas of waste and pollution

Vocabulary

Water sources: rivers, streams, rain, etc.
Treatment: act or process of treating
Hazardous: full of risk
Filtration: process of straining substances from a liquid
Contaminate: making impure by contact; to pollute
Pesticide: substance used to kill pests
Adapt: change in order to survive
Solution: process of dissolving
Suspension: mixture in which small particles remain suspended without dissolving
Coagulant: substance producing a change from a liquid to a thickened mass Disinfectant: a chemical solution, heat, or any agent used to destroy or inhibit the growth of disease germs

Materials

For the class:

- Computer with modem and Internet access
- 20 quart jars with secure lids
- 1/2 kg household salt
- 1 bucket each: sand, clay, gravel
- Odoriferous substances for Hands-On Exploration (vinegar, vanilla extract, perfume, lemon extract)
- Plastic cups filled with water
- Schematic Sketch of waste water flow from home to septic or sewage treatment

For each group:

- Garbage bags
- Clip boards
- Newsprint, markers, pencils, paper for brainstorming
- 5 clear cups/ containers
- 5 clear liquids for tasting activity (sugar water, white vinegar, salt water, water and citric acid, tap water)
- *Student Worksheet*: Background Information

For each student:

- Disposable gloves
- Drawing paper & supplies
- Cotton swabs
- Journals to record observations

Next

Procedures

1. To help students understand that clear water isn't necessarily free of pollutants, add an odoriferous liquid to separate cups of water. To complete the taste test, have students use cotton swabs to taste a sample from each cup. (Dispose of swabs after each taste) Students should record what they think they are tasting in their observation journals. When students have tasted all the liquids, discuss the concept that not all pollutants can be seen.

   (Note: If you have a local creek or stream, this is a good jumping-off point to discuss the problems it may have.)

2. Direct student teams to use the Internet browser to look at the two EPA pages containing animations of the water cycle (http://www.epa.gov/OGWDW/kids/cycle.html) and an interactive look at water treatment processes (http://www.epa.gov/OGWDW/kids/treat.html). If you do not have access to the Internet, consider using one of these activities to follow up the taste test:

   Amazing Water Activity:

   Students will study the water supply to their home or school and draw a map from the source (river, well, reservoir) to the nearest faucet or bathroom. They could adapt the maps to make a maze for the drop of water from its source to the nearest faucet, and then exchange them with a partner to try.

   A Few Words About Gluppity Gulp

   Discuss schematic of where wastewater goes when it leaves your home. Visit the site of a septic system or sewage treatment plant. Describe how the system works, and sketch the major parts of the system.

3. Direct student teams to visit the Internet site http://www.epa.gov/OGWDW/kids/bloopers.html to discuss ways in which what they do can affect the water supply. Follow this by directing teams to brainstorm ways to conserve water at home (such as turning off water while brushing, flushing only when necessary, etc.) Students should share group results and then practice the measures at home for 2 or 3 days, reporting to the class with their results. How did they feel about this experience?

4. Provide *Student Worksheet:* Background Information for students to read and discuss. Next, students will conduct an experiment as described below. They will identify and describe natural and introduced materials found in bodies of water, and observe and describe the behavior and effects of silt, sand, gravel and odor sources on water.

   Experiment:

   Fill 5 jars with water and add sugar water, white vinegar, salt water, water and citric acid to separate jars. Number the jars 1 - 5. Begin by asking students what they already know about substances in water (What makes it murky? Name some invisible substances in it.) Divide class into 5 groups and give 4 jars to each group. Direct them to fill each jar half full of water and add approximately 1/4 liter of sand to one jar, silt or clay to one and gravel to the third. Add 1/2 liter of a mixture of sand silt and gravel to the last jar. Prompt students to observe how materials settle naturally, and to sketch their findings.

Next, have students screw lids onto jars and shake vigorously. As contents settle, ask which settles fastest, slowest, and which stirs more easily after it settles. Have students demonstrate flood time or rapid water flow (rapid shaking) and low water or slow water flow (gentle or no motion). Discuss what happens when rapid flow is followed by slow flow (silt does not settle) Add 5 mL salt to each jar and observe any changes (the salt dissolves and there is no visible change). Ask where salt in water actually comes from in nature (minerals in stream bed, soil, rocks, farming).

Now have students smell the 5 odor jars prepared earlier. Can they detect different odors? Discuss what they smell. Allow students to see how many odors they accurately detected in water. Give one of the prepared numbered jars to each group, along with papers numbered 1-5. Each member should sniff the jar, and record her/his guess. Continue until all members have sniffed each jar.

5. Based on their experiment, ask students to discuss how they feel substances like those in the experiment would affect the water supply.

Next

Extension

1. Wetlands are a key part of our environment, as natural filters for our water supply. Plan a field trip to a wetland area to investigate its ecological health. Bring along pencils, paper, clipboards, garbage bags and disposable gloves. Divide the class into groups of 3 or 4. Have each group look for different sources of pollution. Designated recorders should list findings on clipboards and share with the group. Discuss the pollution observed, and note that visible pollution is usually in the form of litter. Ask what other types of pollution may be present and not visible.

   Distribute gloves and bags, and instruct students to pick up the litter. Dispose of it back at school and recycle if possible. When back in the classroom, analyze the types of litter collected. Repeat this during various seasons of the year. (Note: Conducting this as a contest can be very motivational. Consider awarding prizes for the heaviest bags.)

2. Remind students that the habitats in the water and on the surrounding land changes daily and seasonally. The inhabitants tend to adapt to some changes. Ask groups if they think the inhabitants adapt as well to changes caused by humans (dams, farming, land use). Students should support their ideas with actual observations made at nearby streams, etc.

3. Encourage Internet research at the following sites:

   Chesapeake Bay Information Center
   (http://www.dnr.state.md.us/bay/)
   Facts and links for Chesapeake Bay issues, topics, and projects

   The GLOBE Program
   Global Learning and Observations to Benefit the Environment (http://www.globe.gov)

   By becoming a GLOBE school you and your students like others around the world can collect what should be the broadest set of measurements on water quality compiled to date. To learn more about this planetary connection, go to the GLOBE Web site for details on training requirements.

   Participation in the GLOBE Program offers many rewards. The collection of data by students will result in more bodies of water being sampled at the same time than ever before. Through involvement, students will learn field sampling techniques, how to calibrate scientific equipment, how to follow written protocol, and how to record and report data via the Internet to GLOBE scientists.

4. Arrange a tour of a local water treatment plant.

5. Prepare a stream or pond tank with actual critters (like snails, frogs, toads, etc.) and recreate both natural and manmade change to observe how inhabitants react and adapt.

   ENVIROHEALTH LINK MASTER TEACHER TEAM:

   Jennie Discepelo and Howard Schindler

Name _____ Date _____

Background Information Sheet

Uncounted tons of materials are continually washed downstream into larger streams, then rivers, and eventually into the oceans of the world. Many of these materials like sand, silt, gravel and salt occur naturally. Sometimes the amount of these materials is increased dramatically in a river system through the forces of erosion. Several varieties of salt that are found in rock formations and in the soils of a watershed may run off into the river system. Natural sources of toxic substances such as lead, cadmium, zinc, etc., may wash into the system. Other substances are introduced into the system through human activity. Oil, sewage, and chemical fertilizers and pesticides are examples.

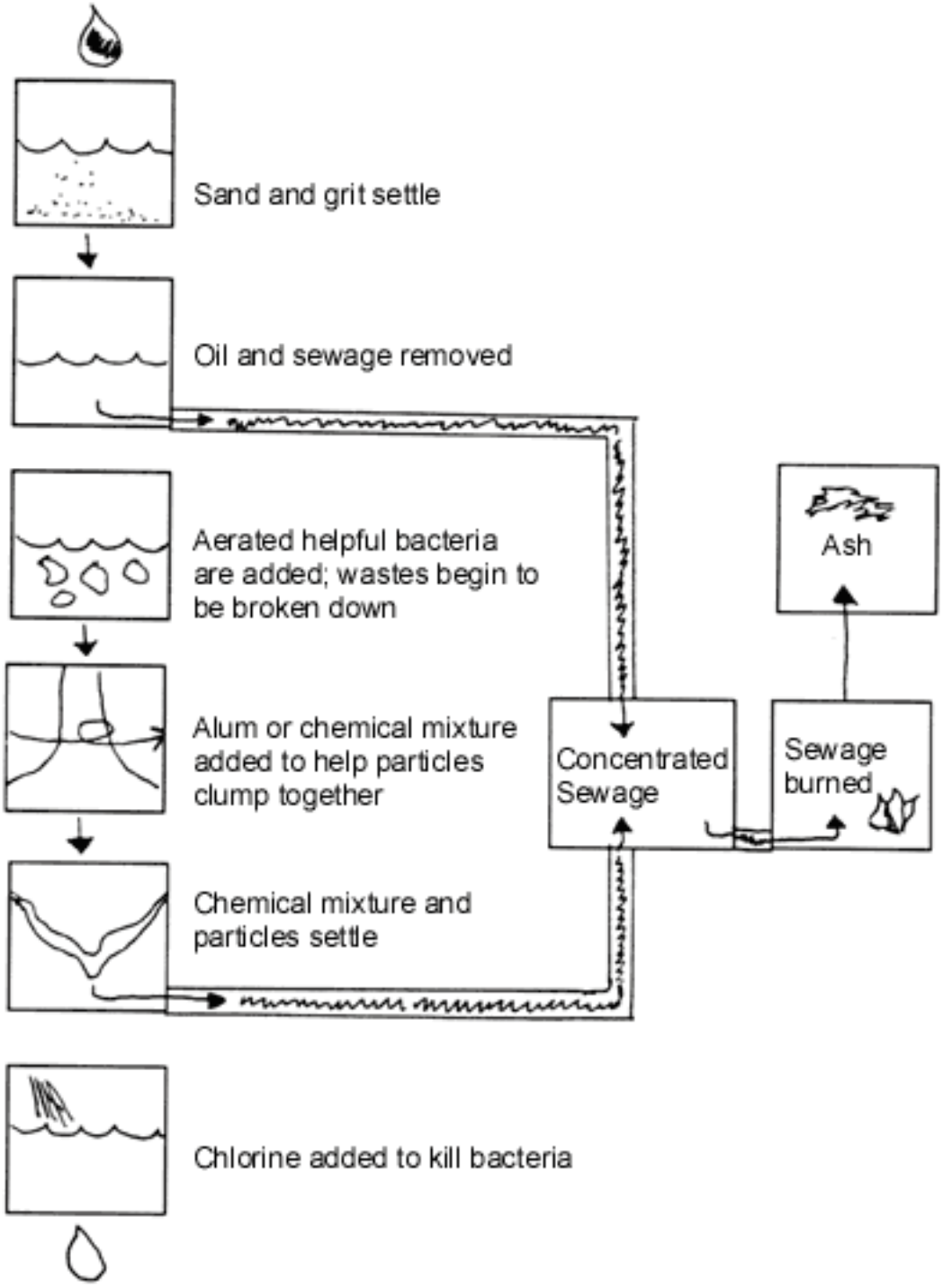
Human-caused pollution generally comes from activities that concentrate pollutants which are sometimes found in nature. Mining, agriculture, manufacturing and sewage treatment are examples of activities that sometimes concentrate harmful substances. Scientists have developed tests to see if various substances - whether naturally occurring or not - are found in water.

Storms can create local high water conditions that raise the water level and often increase the speed of flow. Such conditions can cause water to flush areas of the river banks that are not normally in contact with the water. This dumps increased levels of soil and minerals into the water and temporarily increases the turbidity causing the water to look muddy and cloudy. Increased water flow also scours the river bottoms and banks. Sand, silt, and gravel may be moved downstream if the force of the moving water is great enough.

It is clear that if materials are being carried in water, all forms of life using that water are subject to the effects of these substances. For instance, silt provides an unfavorable environment for certain plants and fish while other organisms thrive in it. Some substances are toxic.

Name _____ **Date** _____

Water Treatment Schematic



Who Dirtied the Water?

Overview

With few exceptions, students in our community rely on ground water for their drinking water and on septic tanks for their waste disposal. The intent of this lesson is to develop positive ways to change and enhance student attitudes, perception and knowledge base regarding water quality and water pollution. This lesson is designed to give students an enhanced understanding of the sources of water pollution, as well as an appreciation for who is responsible for the clean up of the polluted water.

This activity is interdisciplinary in nature and involves the use of critical thinking and analysis to solve a problem. As the teacher reads the story about the history of an imaginary site, various contents (representing contaminants) are dumped into a container of water. The story periodically asks whether the audience would boat in, swim in, or drink from the water. Following the end of the story there should be a discussion of who is responsible for polluting the water and who is responsible for cleaning it up.

Media Resources

For Teacher Background:

Environmental Protection Agency
(http://www.epa.gov/epahome/browse.htm)
You can move from this page to a variety of links focused on our water supply, water pollution and other environmental issues.

EnviroMysteries Video, "Water + ? = Trouble!" Earth Watch Segment 2, Maryland Public Television, 1996

Learning Objectives

Students will be able to . . .

- identify sources of water pollution;
- identify possible ways to prevent water pollution.

Next

Vocabulary

Runoff: the amount of precipitation that runs over the ground surface and returns to streams, rivers, or other surface water bodies.
Wetlands: a swampy or marshy area.
Sediment: matter that settles to the bottom of a liquid.
Potable: water that is safe for drinking.
Toxic: poisonous to living things.
Contaminant: the introduction of harmful or hazardous matter into the environment.

Materials

For the class:

- Clear container with a capacity greater than 1 gallon (filled 3/4 full with water)

For each student:

- A film canister labeled with boldface title, but containing one of the following:

  Beaver: wood chips
  Beaver: sand
  Runoff: charcoal
  Wetlands: dry grass
  Shellfish: crushed shells
  Hoodites: shells
  Settlers: organic garbage
  Carpenters: nails
  Farmers: potting soil
  Fisherman: nylon line
  Houses: toilet paper
  Sunbathers 1: colored paper
  Sunbathers 2: newspaper
  Sunbathers 3: plastic pieces
  Boaters: Styrofoam
  Laundromats: detergents
  Merry Maids: baking soda
  Ships: oil
  Factories 1: molasses
  Factories 2: vinegar

- Copy of *Student Worksheet*: Data Table

For the teacher:

- Copy of the story "Who Dirtied the Water?"

Procedures

1. Prior to class, label the canisters with the name of what the canister represents (not its actual contents). See list above for labels. As students enter the room, hand them a closed film canister that contains materials that will be added to the water.

2. As you read the story, each student with a canister should come forward at the point in the story when they are identified, describe what they think is in the canister (before removing the cover) and add it to the water.

3. Students should record who or what is doing the adding and the actual substance added to the water.

4. When the story is complete, students should answer the following questions on paper:

   a. Who dirtied the water?
   b. Who is responsible for cleaning it up?
   c. How could the water pollution have been prevented?

5. Divide the class into small groups (4-6 students) to discuss their answers to the questions.

6. The class should reconvene for each group to share the results of their small group discussions.

Extension

1. *Drinking Water Activities for Teachers and Students*
   Available from EPA, Office of Water http://www.epa.gov/OGWDW/kids/
   This *Jeopardy*-like game involves students in learning about the nature of water, our water supply, and water treatment options.

2. You could arrange a class visit to a local sewage and/or water treatment plant.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Howard Schindler and Jennie Discepolo

The Story

Once upon a time there was a beautiful piece of land. It was almost an island, connected to the mainland by a narrow land bridge, and surrounded on three sides by a lake. The lake was filled with clear water and was dotted with a few small green islands. (Point to the container of water). Fish and other aquatic life thrived in the water. The land was covered with trees and the land and the lake teemed with wildlife.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating in this lake?

Animal life flourished along a nearby river and the **BEAVER** were plentiful. A **RIVER** ran along one side of the land, carrying sediment with it as it flowed into the lake.

WETLANDS grew along the edges of the lake. Grasses from the wetlands sometimes washed into the lake and became food for the fish. In the shallow water, clams and other **SHELLFISH** thrived.

A small group of people lived on this land, which they called Hoodland. The people were called **HOODITES**. The Hoodite people fished for food and shellfish in the lake. They dumped some of their garbage near the lake. We still find the piles of the shells they left.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating in this lake?

After many years **SETTLERS** from Europe came to live in the area. The settlers built a town much larger than the Hoodite villages. Some of the town's garbage was dumped into the lake. **CARPENTERS** built houses, farms and stores that filled Hoodland valley.

As the town grew, the settlers filled the wetlands to provide more land on which to build. **FARMERS** cut down trees to clear their fields. Without trees and wetlands to hold the soil, rain carried soil into the lake.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating in this lake?

More and more **HOUSES** and shops were built, and the town of Hoodville grew into a city. Sewer pipes were constructed to remove the waste from the houses and bathrooms. The sewage flowed through the pipes into the lake.

Since the wetlands had been filled in, **RUNOFF** water washed pollution from the street directly into the lake.

FISHERMAN found that nets made of plastic were stronger than those made of rope. sometimes these nets got lost in the water.

Fisherman and other **BOATERS** sometimes threw their rubbish overboard.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating in this lake?

The city built **LAUNDROMATS** where people could wash their clothes. The detergents went down the pipes and flowed with the sewage into the lake.

People hired **MERRY MAIDS** to clean their houses. They used poisonous tile and drain cleaners, which flowed into the sewage system and into the lake.

Even swimmers and **SUN BATHERS** enjoying themselves at the lake sometimes left garbage on its beaches.

As the city grew, **SHIPS** came to unload their supplies. Sometimes these ships spilled oil into the lake.

FACTORIES built along the water's edge often dumped their toxic wastes and chemicals into the water.

Chorus:

Would you want to swim in this lake?
Would you eat fish caught in this water?
Would you like to go boating in this lake?

Complete the story by asking: Who dirtied the water? Who is responsible for cleaning it up?

Name _____ Date _____

Data Table

Directions: As you hear the story, fill in this chart.

Who is adding pollutants?	What are they adding?

Air Matters

Recognized for excellence by

http://www.scilinks.org/criteria.htm

Overview

To appreciate the job of the lungs to draw oxygen into the body, students will learn about both the composition of the air, and about surface area by seeing how increased surface area increases filtration in air filters (such as in cars). Understanding surface area also makes it possible for students to appreciate that the surface area within the lungs is much larger than that of simple hollow sacs.

Media Resources

Telephone Lung Line:
National Jewish Center for Immunology and Respiratory Medicine
1-800-552-LUNG (lung facts)

Teacher Background:

Pollen Allergy
(http://www.hoptechno.com:80/book46.htm)
This web site contains a pamphlet from the National Institutes of Health about respiratory problems.

Human Anatomy Online
Diaphram (http://www.innerbody.com/image/musc06.html)
Bronchial Alevolus (http://www.innerbody.com/image/card07.html)
Lungs (http://www.innerbody.com/image/card06.html)
You can find some interesting diagrams here, in addition to links to other pages focused on the respiratory system.

Next

Learning Objectives

Students will be able to . . .

- make observations
- collect and analyze data
- measure and calculate to determine surface area

Vocabulary

Bronchial tubes: the primary divisions of the trachea that lead into the lungs
Bronchioles: the small thin walled branches of the bronchial tubes; these terminate in the alveoli
Alveoli: tiny air sacs in the lungs where the transfer of oxygen and carbon dioxide takes place
Particulate matter: minute separate particles suspended in the air

Materials

For the class:

- Two dusty erasers
- Video camera & VCR

For each group of 2-3 students:

- Stopwatch, or clock with second hand
- Calculators
- Strips of paper the size of a ruler: one flat, and one that appears shorter because it has been folded repeatedly fan-style.
- Car air filter (obtain at least one, for demonstration/observation purposes)

For each student::

- *Student Worksheet*: Air Matters

Next

Procedures

1. To introduce the concepts of this lesson, ask students to describe air. Keep a "brainstormed" list of their descriptors to review again at the close of the lesson. Have students describe the job of the lungs in breathing; they should recognize that the lungs must bring oxygen into the body and release carbon dioxide. Review with students the basic tree-like structure of the bronchial tubes, bronchioles, and alveoli that make up the lungs. Let students guess the size of the lungs ("they are about as big as _____?"), then let them know their lungs are about the size of two footballs.

2. **Activity 1**
   Ask students where they think dust comes from and how long they believe it stays in the air. As a demonstration, students will make a timed observation of a settling dust cloud.

   NOTE: *Students with asthma or allergies may need to either sit farther away, or cover their nose and mouth with a cloth.*

   a. Set up a student with a video camera to film the demonstration. The camera should be focused on the point where the dust cloud will appear after two erasers are clapped together. The camera should be slightly closer than the closest student seat. Be sure to use a plain, dark background (such as a blackboard or black cloth).

   b. Students should be seated so that one person in the group can observe the dust cloud while another student is watching the time. When the observer believes that the dust cloud has cleared, the timer should note the time in seconds.

   c. When the last group has recorded a time, allow the camera to continue to run at least another 2-3 minutes.
   d. Students should record their observations, and find the average time for the observed dust clouds.

   e. Replay the tape, directing groups to make the same timed observations. Students should record the timed lengths of the dust cloud, and find the average.

   f. As a class, discuss comparisons between what the students observed in person, and what they observed by watching the replay.

   g. Discuss with students how long dust particles actually hang in the air. (Students might recall seeing a shaft of light from a window with dust particles floating in it.) Students should recognize that while many particles settle fairly quickly, because some particles will be very small to microscopic, they are light enough to remain suspended in the air for long periods of time.

   Activity 2
   Working in the same groups, students will compare the surface area of the two strips of paper.

   a. The strips of paper are rectangles. Have students determine the area of the flat strip of paper.

b. Each group should make a prediction about the area of the second strip of folded paper, WITHOUT flattening it. They can then share the predictions.

c. Have students flatten the second strip of paper, then determine its area.

d. Have students take apart the car air filter and determine its basic surface area. Discuss how the surface area is increased by the folds, but also by the surface itself (not smooth and flat, thus catching even more particulate matter).

e. Inform the students that if the lungs were truly only hollow sacks, they would have only about 2 sq. ft. of surface area. Instead, because of their "tree-like" structure, lungs are more like sponges than sacks. Encourage students to compare this information with what they found out about the flat and the folded strips and the air filter.

f. Have students complete the following calculation:

   The lungs have more than 600,000,000 alveoli, each of which has a surface area of about .000001 sq. ft. What is the surface area of the lungs? Amazing fact: The surface area of the lungs is about 25 times that of the skin.

3. Summarize the lesson by asking students to review the results/ conclusions from each activity. Remind students of the ways they described air at the beginning of the session. Ask them to reconsider the job the lungs are doing. What makes this job "particularly" tricky? How does increasing the surface area of a filter help make the filter more effective? Why might the extraordinary surface area of the lungs be helpful?

4. To assess this lesson, review student responses on the *Student Worksheet*: Air Matters.

Extension

Internet Research:

U.S. EPA Office of Air and Radiation Basic Facts Web Page
(http://www.epa.gov/oar/oarfacts.html)

U.S. EPA Office of Air and Radiation AirLinks Web Page
(http://www.epa.gov/airlinks/)

What increases the particulate matter in the air? This suggests two areas for further student research - learning more about natural particulate matter, such as pollen, and learning more about man-made pollutants. After researching the Internet sites above and reporting on these, students may have a lively debate to answer the question "Is it better to be in the country or in the city in the spring?"

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Sheryl Barr and Bob Keddell

Name _____ Date _____

Air Matters

WAITING FOR THE DUST TO SETTLE

Part 1: Observing the Dust Cloud

Directions:
Use the chart below to record your timed observations of the dust cloud. Be sure to find an average for your figures.

Group													AVERAGES
Live Time													
Video Time													

How long do dust particles hang suspended in the air?_____
Explain your answer in the space below.

Part 2: Surface Area

Directions:
Fill in the blanks in the chart and write a complete and concise answer to the questions below it.

Area of paper rectangle #1: _____ Prediction for area of paper rectangle #2 (folded): _____ Actual area of paper rectangle #2: _____

1. What is the surface area of the car filter? _____
   How is its surface area increased or the space it takes up in the engine?
   _____
2. The lungs have over 600,000,000 alveoli, each of which has a surface of .000001 sq. ft. Based on this, what is the surface area of the lungs?
   _____
3. How does increasing the surface are improve a filter?
   _____
4. How might the extraordinary surface area of the lungs be helpful?
   _____

Check My Breath

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http://www.scilinks.org/criteria.htm

Overview

This lesson challenges students to understand asthma: its symptoms, causes, and effect on the respiratory system. By using video, Internet sites, hands-on activities, and data charts detailing Peak Flow Rates in Liters Per Minute, students will identify their individual Peak Flow Range and calculate the percent change during a simulated asthma episode.

Media Resources

Asthma and Allergies (video, 26 minutes)
"I can't breathe!" is a desperate call uttered by millions of asthma and allergy sufferers. This program follows young children and adults managing their illness, explains promising research, and offers suggestions on preventing attacks. Available from Carolina Biological Supply Company, (800) 334-5551.

Education Weekly
http://www.edweek.org/ew/vol-16/26asthm1.h16

This web site holds a wealth of resources for educators. Use the Search Archives link on the Search Site page to find many articles and links focused on asthma. In particular, these articles are useful:

- 5/15/96: "Asthma Study Prompts Questions about Health Care"
- 3/26/97: "Features: Breathing Lessons, Part I"
- Link: "Race Plus Roaches: A Breathtaking Link" Office of Community and Public Affairs, Johns Hopkins Hospital, School of Medicine
- Link: "Helping Schoolchildren with Asthma Breathe Easier" Environmental Health Newsletter (May 1996)
- 3/5/97 "News: Health Update"
- 5/29/96 "Family Awarded $1.6 million in Asthma Death at School"

The guidelines described in this lesson could be used with these or similar articles that appear or are linked to this web site.

Next

Learning Objectives

Students will be able to . . .

- identify the problem of asthma and its relationship to the respiratory system
- use a flow meter to complete two data charts
- calculate the percent of flow increase or decrease during a simulated asthma episode

Vocabulary

Asthma: a chronic condition that causes difficulty in breathing
Trachea: passage way through which air travels from the nose to the lungs
Respiratory system: the body system through which oxygen is brought into the body and waste materials are expelled
Symptom: a sign of the existence of a body condition that is perceptibly different from what is normal
Peak Flow Meter: a device to measure how well air moves out of the lungs
Liter: a unit of capacity in the metric system equal to about 1.057 liquid quarts

Materials

For the class:

- VCR and monitor
- Computer with modem and Internet access
- One Peak Flow Meter (more than one would facilitate this lesson)
- PCV Pipe pieces the size of the tube that fits in the Peak Flow Meter (hardware stores can supply these, cut to the correct length)

For each student:

- Piece of PCV pipe
- Copy of Student Worksheet: Asthma and Allergies - Questions and Answers
- Copy of Student Worksheet: Peak Flow Rate Meter and Data Page
- Copy of Student Worksheet: Student Data Chart
- Copy of Student Worksheet: Assessment
- 6" X 6" piece of aluminum foil

Next

Procedures

1. Use the video *Asthma and Allergie*s to motivate and inform students.

2. Give students a copy of Background Information Sheet #1 on Asthma, courtesy of the National Asthma Education Program, or have them visit this program's web site at http://www.meddean.luc.edu:80/lumen/MedEd/medicine/Allergy/Asthma/asthtoc.html They can use the resources they find there to complete *Student Worksheet:* Asthma and Allergies - Questions and Answers.

3. If possible, have the school nurse or other health professional join the class to explain why and how a Peak Flow Meter is used, and to assist students as they work with this device. Students can also use Background Information Sheet #2 as a resource for this information.

4. Distribute *Student Worksheets:* Peak Flow Rate and Data Page and Student Data Charts. Review the Peak Flow Rates worksheet with students so that they understand both how to read the chart and how to identify a zone in the Peak Flow System.

5. Some of your students may know how to use a Peak Flow Meter. You might consider asking them to guide the class as you explain the step-by-step process students should follow to use the Meter to conduct their experiment.
   Step 1: Place the indicator at the bottom of the numbered scale.
   Step 2: Attach a piece of PCV pipe to the meter.
   Step 2: Stand up.
   Step 3: Take a deep breath.
   Step 4: Place the PCV pipe in your mouth and close your lips around it. Do not put your tongue in the hole.
   Step 5: Blow out as hard and as fast as you can.
   Step 6: Write down the numbers you get.
   Step 7: Conduct one more trial and find the average of the two numbers.

6. Direct students to complete an initial set of tests using the Peak Flow Meter, and record the information they find on their worksheet.

7. Show students how to use the aluminum foil to narrow the opening on their PCV pipe. The narrowing of the opening replicates what happens to asthma sufferers during an episode. Ask students to conduct two more trials with the Peak Flow Meter, record the results, and find their average.

8. Demonstrate how to use the mathematical formula for percent of change to find the Zone in which students would fall during this simulated asthma attack.

9. If only one Peak Flow Meter is available, chose students of various heights to complete these tests.

10. Ask students to complete *Student Worksheet*: Assessment

Next

Extension

1. *Weekly Reader* web site
   http://www.edweek.org/ew/vol-16/26asthm1.h16
   Using the program *Webwhacker*, download this site and its links to disk. Have teams of students use this web site to outline the information they find in the article "Breathing Lesson Part I" and five additional articles. Use the jigsaw cooperative learning technique to have students share what they have found in these articles. If the *Webwhacker* is not available, you can print the articles and have students complete the jigsaw activity.

2. *Asthma and Allergies* video

3. *Internet Sleuth* web site
   http://www.isleuth.com
   Explain to students that a search engine is a program on the Internet that searches databases for documents that match key words supplied by the user. One type of search engine is called a Unified Search Engine. It accesses several search engines at once, increasing the user's chance of finding the information they need. Direct students to use Internet Sleuth to search for information related to the search term "asthma" and other vocabulary terms from this lesson. What organizations are they learning about who are concerned with allergies? Identify and use other questions that might be valuable for your class.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Bob Keddell and Sheryl Barr

Next

Name _____ Date _____

Asthma and Allergies: Questions and Answers

Directions: Answer these questions in complete sentences.

1. What is asthma?

2. What is normal breathing?

3. What are the symptoms of asthma?

4. What happens during an episode of asthma?

5. What causes asthma?

6. What causes asthma episodes?

7. Is there a cure for asthma?

8. How can asthma episodes be prevented or controlled?

Peak Flow Rate Meter and Data Page

PEAK FLOW RATE IN LITERS PER MINUTE

Height	Average Rate	Range	Height	Average Rate	Range
40"	150	110-190	56"	330	240-420
41"	160	115-205	57"	340	245-435
42"	170	120-220	58"	360	260-460
43"	180	130-230	59"	375	270-480
44"	190	135-245	60"	390	280-500
45"	200	145-255	61"	400	290-510
46"	210	150-270	62"	415	300-530
47"	220	160-280	63"	430	310-550
48"	230	165-295	64"	445	320-570
49"	240	175-305	65"	460	330-590
50"	250	180-320	66"	480	345-615
51"	260	190-330	67"	500	360-640
52"	270	195-345	68"	515	370-660
53"	280	200-360	69"	530	380-680
54"	300	215-385	70"	550	395-705
55"	315	225-405	71"	570	410-730

THE PEAK FLOW ZONE SYSTEM

The peak flow numbers are put into zones that are set up like a traffic light.

GREEN ZONE (80 - 100 percent of your personal best number) signals *all clear*. No asthma symptoms are present, and, if you had asthma, you would take your medicine as usual.
YELLOW ZONE (50 - 80 percent of your personal best number) signals *caution*. If you had asthma, you might be having an episode that requires an increase in your medicines, or your doctor might have to change your medicine plan.
RED ZONE (below 50 percent of your personal best number) signals *medical alert*. If you had asthma, you would have to take an inhaled beta2-agonist right away and call your doctor immediately if your peak flow number did not return to the Yellow or Green Zone and stay there.

Name _____ Date _____

Student Data Chart

Directions: Complete these charts using the numbers you find when using the Peak Flow Meter. Use the example below to help you determine your zone

STUDENT DATA CHART 1: NORMAL						
Name	Height in inches	Range	Liter per minute			Above/below normal
			Trial 1	Trial 2	Average	
Example: Tommy	52	195-345	220	200	210	Normal

STUDENT DATA CHART 1: WITH NARROWED AIR PASSAGES						
Name	Height in inches	Range	Liter per minute			Above/below normal
			Trial 1	Trial 2	Average	
Example: Tommy	52	195-345	160	140	150	Yellow

TO DETERMINE YOUR PEAK FLOW ZONE

1. Use the formula - Percent of change = amount of change/normal liters per minute
2. Determine the decimal equivalent and convert to percentage
3. Subtract the percent of change from 100% and use information on Peak Flow Rate Meter & Data Chart

EXAMPLE: Normal average for Tommy is 210. Narrow airways average for Tommy is 150
1. 210 - 150 + 60
2. 60/210
3. 60: 210 = .285 = 29%
4. 100% - 29% = 71% = **YELLOW ZONE**

Name _____ Date _____

Performance Task Assessment

Directions: Complete the first two columns of this chart.

PERFORMANCE TASK ASSESSMENT LIST			
	ASSESSMENT POINTS	EARNED POINTS	
	POSSIBLE POINTS	SELF-EVALUATION	TEACHER EVALUATION
TASK			
All questions on worksheet "asthma and Allergies - Questions and Answers" are answered in complete sentences			
The worksheet "Student Data Chart - With Narrowed Air Passages" is complete, including averages			
The worksheet "Student Data Chart - With Narrowed Air Passages" is complete, including averages			
The Peak Flow Zones are identified in the Student Data Chart			
MATHEMATICAL WORK			
Calculations are done accurately			
TOTAL			

Name _____ Date _____

Background Information Sheet #1

Information courtesy of the National Asthma Education Program web site

ASTHMA

Asthma is a chronic lung disease that lasts a long time . It cannot be cured only controlled.

- Airways are inflamed. That is, airway lining are swollen.
- Airways narrow and breathing becomes hard to do. This narrowing gets better (but not all the way in some patients), sometimes by itself, some times with treatment.
- Airways are super sensitive. They react to many things, such as cigarette smoke, pollen, or cold air. Coughing, wheezing, tight chest, difficult breathing, or an asthma episode may result. A more complete list of things that can cause some people's airways to react is given later (see, "What Causes Asthma Episodes").

What Are the Symptoms of Asthma?
The main symptoms of asthma are:

- Shortness of breath,
- Wheezing,
- Tightness in the chest, and
- Cough lasting more than a week.

Not all people with asthma wheeze. For some, coughing may be the only symptom of asthma. Coughing often occurs during the night or after exercise. It's important to know that treatment can reverse asthma symptoms. And it's important to treat even mild symptoms of asthma so that you can keep the symptoms from getting worse.

Normal Breathing
When you breathe in, air is taken in through the nose and mouth. It goes down your windpipe, through your airways, and into the air sacs. When you breath out, stale air leaves the lungs in the reverse order.

What happens During an Episode of Asthma?
Asthma affects the airways in your lungs. During an episode of asthma:

- the lining of the airways becomes swollen (inflamed)
- The airways produce thick mucus.
- The muscles around the airways tighten and make the airway narrower.

These changes in the airways block the flow of air, making it hard to breath.

You need to know the ways that asthma affects the airways so you can understand why it often takes more than one medicine to treat the disease. Very simply, some medicines relax the airways and others reduce (and even prevent) the swelling and mucus.

What Causes Asthma?
The basic cause of asthma is not yet known. What we do know is that asthma is mot caused by emotional factors such as troubled parent-child relationship. In short, asthma is not "all in one's head". It is instead a chronic lung disease.

What Causes Asthma Episodes

People with asthma have airways that are super sensitive to things that do not bother other people who do not have asthma. These things are called triggers because when you are near or come in contact with them, they may start an asthma episode. Your airways may become swollen, produce too much mucus, and tighten up. Common triggers for asthma episodes include the following:

- Dander (or flakes) from the skin, hair, or feathers of all warm-blooded pets (including dogs, cats, birds, and small rodents)
- House dust mites
- Cockroaches
- Pollens from grass and trees and mold
- Molds (indoor and outdoor)
- Cigarette smoke; wood smoke; scented products such as hair spray, cosmetics, and cleaning products; strong odors from fresh paint or cooking ; automobile fumes; and air pollution
- Infections in the upper airway, such as colds (a common trigger for both children and adults)
- Exercise Showing strong feelings (crying, laughing)
- Changes in whether and temperature.

Is There A Cure for Asthma?

Asthma cannot be cured, but it can be controlled. You should expect nothing less.

How Can Asthma Episode Be Prevented

To prevent asthma episodes you will have to work closely with your doctor to:

- Develop a medicine plan that keeps you from getting symptoms.
- Plan ways to avoid or reduce contact with your triggers.

How Are Asthma Episodes Controlled?

To control when they occur, you will have to work out a medicine plan with your doctor that includes:

- Treating symptoms early,
- Doing the right things for any changes in symptoms , and
- Knowing when a doctor's help is needed and seeking help right away.

What Can a Patient with Asthma Expect From Treatment?

With proper treatment most people with asthma will be able to:

- Be active without having asthma symptom. This includes participating in exercise and sports.
- Sleep through the night without having asthma symptom.
- Prevent asthma episodes (attack).
- Have the best possible peak flow number-lungs that work well
- Avoid side effects form medicines.

Name _____ Date _____

Background Information Sheet #2

Information courtesy of the National Asthma Education Program web site

HOW TO USE A PEAK FLOW METER

A peak flow meter is a device that measures how well air moves out of your lungs. During an asthma episode the airways of the lungs begin to narrow slowly. The peak flow meter can be used to find out if there is narrowing in the airways hours, even days, before you have any symptoms of asthma. By taking your medicine early (before symptoms) you nay be able to stop the episode quickly and avoid a serious episode of asthma. Peak flow meters are used to check your asthma the way blood pressure cuffs are used to check high blood pressure.

The peak flow meter can also be used to help you and your doctor:

- Decide if your medicine plan is working well.
- Decide when to add or stop medicine.
- Decide when to seek emergency care.
- Identify triggers, or things that cause your asthma symptoms to increase.
- Talk about asthma with more knowledge.

All patients ages 5 and older who have moderate or severe asthma should think about using a peak flow meter.

How to use a Peak Flow Meter

1. Place the indicator at the base of the numbered scale.
2. Stand up.
3. Take a deep breath.
4. Place the meter in your mouth and close your lips around the mouthpiece
   Do not put your tongue inside the hole.
5. Blow hard and as fast as you can.
6. Write down the number you get.
7. Repeat steps 1 through 6 two more times.
8. Write down the highest of the three numbers achieved.

Find Your Personal Best Peak Flow Number

Your personal best peak flow number is the highest peak flow number you can achieve over a two-week period when your asthma is under good control. Good asthma control is when you feel good and do not have any asthma symptoms.

Each patient's asthma is different and your best peak flow may be higher or lower than the average usual number for someone of your height, weight, and sex. This means that it is important for you to find your own personal best flow number.

To find out your personal best peak flow number, take peal flow readings:

- Every day for 2 weeks
- Mornings and evenings (when you wake up and about 10-12 hours later)
- Before and after taking inhaled beta2-agonist (if you take this medicine)
- As instructed by your doctors

The Peak Flow Zone System

Once you know your personal peak flow number, your doctor will give the numbers that tell you what to do. The peak flow numbers are put into zones that are set up like traffic light. This will help you know what to do when your peak flow number changes. For example:

> **Green Zone**(80 to 100 percent of your personal best number) signals all clear. No asthma symptoms are present, and you may take your medicines as usual.
>
> **Yellow Zone**(50 to 80 percent of your personal best number) signals caution. You may be having an episode of asthma that requires an increase in your medicines. Or your overall asthma may not be under control, and the doctor may need to change your medicine plan.
>
> **Red Zone**(below 50 percent of your best personal number) signals a medical alert. You must take an inhaled beta2-agonist right away and call your doctor immediately if your peak flow number does not return to the Yellow or Green Zone and stay in that zone.

Discuss with Your Doctor What to Do When Peak Flow Number Change

The most important thing about peak flow is how much it changes from your personal best number and from one reading to another.

Don't Forget...

- A decrease in peak flow of 20-30 percent of your personal best may mean the start of an asthma episode.
- When this happens - follow your asthma control plan.

Tossing Toxics

Overview

In this lesson, the student will use Internet research skills to find information relating to water pollutants and human health. Students will present this information using concept mapping. Specific facts will be used to develop a "Toxics First Aid File" for the students' home.

The theme for this lesson centers around the idea expressed by Steven VanMatre, educator and poet, "Words are just that, words and nothing more. Reality lies in doing, not thinking."

Media Resources

The Environmental Protection Agency, Office of Water
(http://www.epa.gov/OGWDW/programs.html)
EPA is a valuable resource for specific fact sheets relating to pollutants found in water. The fact sheets describe chemicals found in water, what they are used for, its effects on health, how and where it is produced, what happens when it is released, how to test for it, allowable limits in the water supply, as well as the states and industries in which it is found.

Learning Objectives

Students will be able to . . .

- Access and analyze Internet data to determine chemicals present in batteries
- Catagorize different types of batteries
- Graphically display data using pie and bar graphs, by computer or by hand
- Conduct a survey and present results graphically

Next

Vocabulary

Cathode: an electrode through which electrons enter an electrical device or medium
Anode: an electrode through which electrons leave an electrical device or medium
Incinerator: a piece of equipment such as a furnace, used to dispose of garbage or other waste material by burning it to ashes
Landfill: an area where garbage and other waste materials are disposed of in a deep hole in the earth that is generally sealed with clay and soil.

Materials

For the class:

- A large diagram of the human body (organs and systems outlined)
- Various old batteries (for display only)
- Index cards
- Yarn or string
- Computer with modem and Internet access
- Examples of various kinds of batteries

For each student group:

- *Student Worksheets:*
  Inside a Battery
  Battery Fact Sheet

For each student:

- *Student Worksheet*:
  Pollution and Our Bodies
- De-Tox Your Home Brochure (Free from Chesapeake Bay Foundation 410-268-8816, with permission to reproduce and distribute.)
- One sheet Mr. Yuk stickers

Next

Procedures

1. To introduce students to the problems of wasting and polluting the water supply, access EPA Kid's Home Page and click on BLOOPERS (Embarrassing Moments in the Life of a Water Drinker) Discuss each topic mentioned and focus specifically on batteries. Alternately, you could make a transparency of this sheet and use it to guide your discussion.

2. Based on the data they collect from looking at the EPA's web site (http://www.epa.gov), students should list on separate index cards the name of a chemical pollutant and mount it on a bulletin board containing a large outline of the human form and its systems. They can use yarn to connect the card to the affected body part. Once the large poster is completed, students can complete a copy of the body and chart for their own use.

3. Using *Student Worksheet*: Battery Facts, "De-Tox Your Home" brochures, and Drinking Water Fact Sheets from EPA web site, direct students to design a "Concept Map" of toxic materials found in batteries (zinc, lead, mercury, nickel, cadmium, silver, electrolytes, sulfuric acid) and their related health issues.

4. Use a display of various old batteries (single use disposable batteries, smaller button size batteries, and rechargeable batteries) to introduce an exploration of what batteries can do for us -- and to our environment.

5. Review and discuss topics from the *Student Worksheet:* Battery Fact Sheet and Inside a Battery Diagram.

6. In a large group, ask the following questions of your students:
    - How have you used batteries in the past?
    - What electronic gadgets do you have that use batteries?
    - How many batteries do you have and what types are they? Do you prefer one brand to the other? Which last longer, are stronger, etc.?
    - Has one of your batteries ever exploded? If so, what happened?
    - How do you generally dispose of old batteries?
7. Break into small groups and have each group develop questions for a Survey (see "DeTox Your Home Guide"). Use the survey with various groups (parents, peers, staff). Assign each team a method for presenting their results to the whole group (graphs, charts, oral reports, etc.)

Next

8. Using Battery Diagram, groups should design and present charts showing data about Battery Breakdown (single use and rechargeable). This would work well with a pie graph. The team may also use the handouts to make a bar graph of the percentages of toxic metals from discarded batteries.

9. Based on data and facts presented in this part of the lesson, have students discuss the same questions from introduction again. Encourage them to compare these with the answers they first gave, and look for changes based on new learning.

10. Students should plan a public service brochure aimed at encouraging consumers to use rechargeable batteries and write/draw a rough draft of what the brochure should look like. This information could also be displayed on large battery-shaped posters.

11. As a related Art activity, students may opt to design an advertisement explaining risks and problems of batteries. The ad character or spokes- person could be a "Bad Battery Bunny." After these posters and brochures, etc. have been shared, student teams could report their survey findings, and note learning based on the above activities.

12. Students could use Chesapeake Bay Foundation materials to read labels of toxics in their homes and identify ingredients. They could investigate the health hazards of these toxic materials by visiting the EPA web site.

    They can then use the information gathered to make a card file with:
    1. Acids/bases and other toxic solutions and materials for each.
    2. Danger posed by each substance and steps to take if spilled, or ingested.

    At the conclusion of this activity, distribute Mr. Yuk stickers to students for use in their homes. Chemicals that contain these toxics should be stored out of reach of children in the home.

Extension

Students could present information they gathered graphically.

Review all EPA fact sheets and graph which pollutants are present and how much is being released in our state. Other topics (leaks, storm sewers, lawns, hot water and garbage disposal) could be developed as future health lessons to be part of a learning module.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Jennie Discepolo and Howard Schindler

Name _____ Date _____

Battery Fact Sheet

Americans love electronic gadgets. Our country alone buys approximately 2.5 billion batteries a year. We throw away more than 90% of them. Toxic materials such as mercury are contained in disposable batteries. When a used battery ends up in a landfill, these harmful materials can leak out or may fall to the ground from incinerator stacks.

This is an obvious problem. Is there a solution?

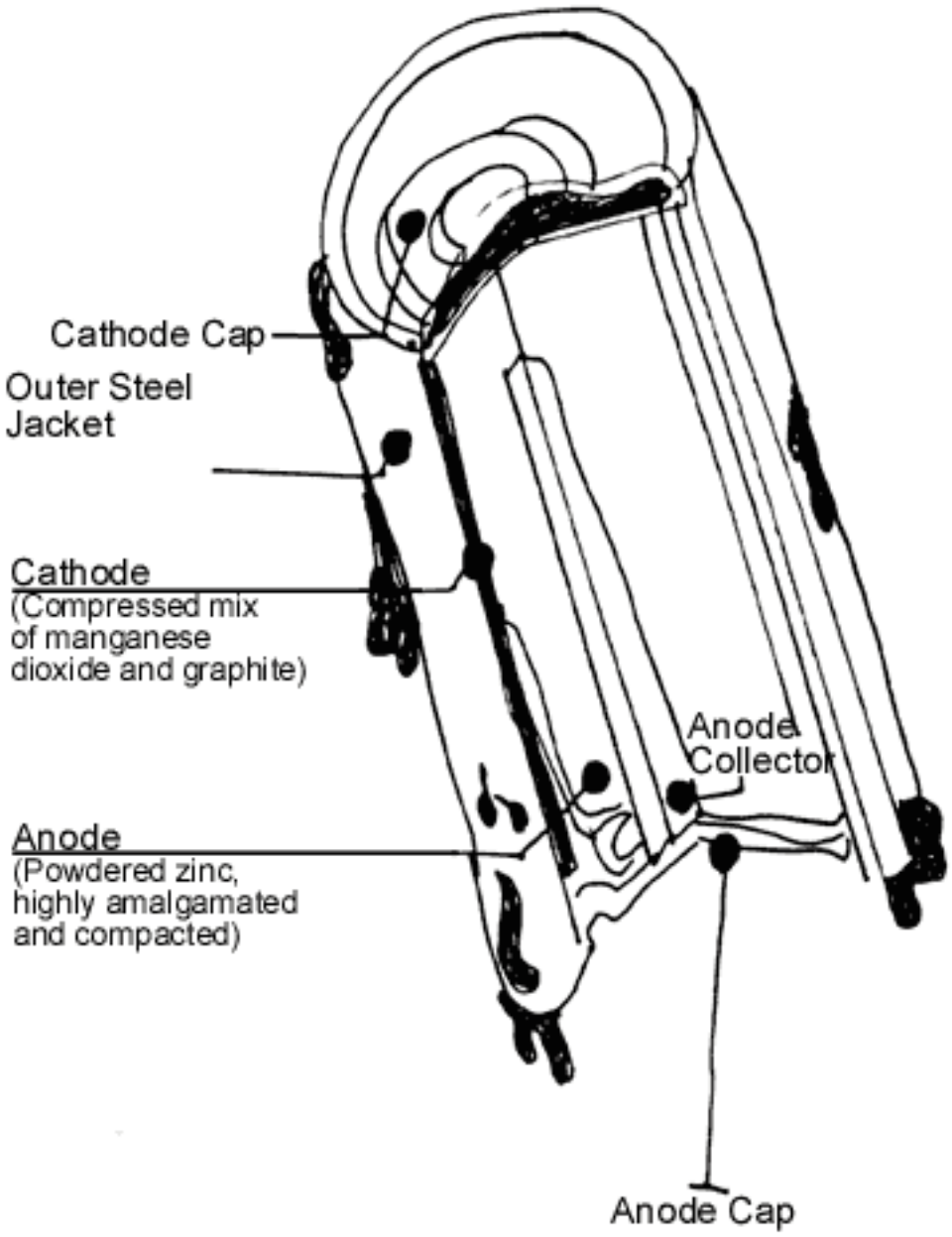
Most single use disposable batteries are designed to work with little or no mercury. Those small, button-sized batteries from watches and cameras, are made with silver oxide or lithium. Most rechargeable batteries contain nickel and cadmium.

On a positive note, rechargeables have reduced landfill waste. They can be recharged 300 to 100 times. But, they put more than a million kg of highly toxic cadmium into the environment each year.

Name _____ **Date** _____

Inside a Battery

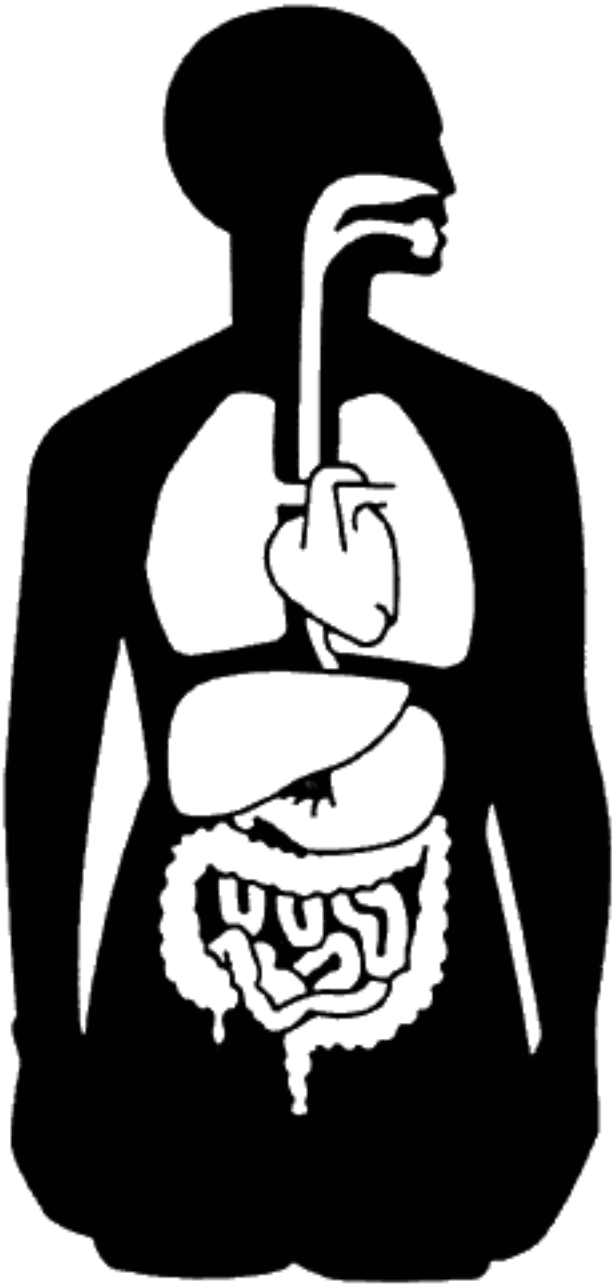
Alkaline Manganese Cell



Mercury is added throughout to prevent chemical reactions that could cause the cell to explode.

Name _____ Date _____

Pollution and Our Bodies



Every Breath You Take

Recognized for excellence by

http://www.scilinks.org/criteria.htm

Overview

In this lesson, students will explore the nature of the air we breathe by observing petri dishes that have accumulated particulate matter from the atmosphere. They will use their observations to make mathematical calculations and inferences about the effect of this matter on breathing.

Note to Teachers:

When students understand that we breathe to bring oxygen into our bodies, they often continue to equate air with oxygen. To appreciate the composition of air, students need to understand that air contains both gases and particulate matter, and that oxygen is only about 21% of the gases. For the lungs to do the job of oxygen intake, they must pull enough oxygen from this mix to fuel the body.

Media Resource

CD-ROM: **A.D.A.M., The Inside Story* ,
A.D.A.M. Software, Inc.
1600 Riveredge Parkway, Suite 800
Atlanta, GA, USA 30328

Learning Objectives

Students will be able to . . .

- identify the components of air
- estimate by sampling
- find averages
- make calculations to state numerical relationships (percents)

Next

Vocabulary

Cilia: small hairlike projections throughout the nasal passages and upper respiratory tract that capture particulate matter
Particulate matter: minute separate particles suspended in the air

Materials

For each group of 3 - 4 students:

- Petri dishes with grid, coated with a thin layer of petroleum jelly
- Microscopes
- Computer with CD-ROM drive

For each student:

- Calculator
- Copy of *Student Worksheets*:
  What's in the Dish?
  Breathing Particles

Next

Procedures

1. Place petri dishes coated with a thin layer of petroleum jelly at appropriate outdoor sites at least a week before the first student activity. They will collect particulate matter that settles out of the air.

2. As an opening discussion for these activities, direct students to think about what it means to say "catch your breath." Ask them what they are "catching" when they breathe, and what is happening when they are having trouble "catching their breath." Also, ask students to consider why breathing in through their nose is better than through their mouth.

3. **Activity 1:**
   In groups of 3 - 4, students will make observations of particulate matter collected in the petri dishes by observing the particles under a microscope.

   a. Petri dishes should be set on a clear grid transparency (1 cm squares) under the microscope. (Petri dishes are available which already have grid markings. If you cannot find these, you or your students can make and transparency grids and put them in the bottom of the dishes before putting the petroleum jelly in them.)

   b. Instruct each student in turn to study the particles they see in one square; each student in the group should observe a different area of the dish. They should record their data and observations for four different squares, listing the number of particles found in each square according to size (small, medium, large) and providing a brief description of the material they observe. Encourage students to attempt to identify what they see whenever possible, e.g., hair, insect piece, leaf piece, etc.
   c. Ask students to determine the area (or approximate area, if students are not familiar with finding the area of a circle) of the petri dish surface in square centimeters.

   d. Within their groups, students should tally totals and find the average number of smallest, medium, and largest particles. This is the average number of each size particle found per square centimeter.

   e. Using those figures, students should estimate the amount of each size particle found in the petri dish by multiplying the average for each square by the area of the dish.

4. **Activity 2:**
   Background: When we breathe, much of the particulate matter is captured by the cilia, small hair like structures, lining the nose and bronchial passages. The nasal passages twist and turn, forcing the air from each breath to travel through more area of cilia than when we breathe through our mouth. What the cilia does not capture is captured by the moisture and mucus. One reason for breathing through the nose is that the air is more effectively filtered by the time it gets to the lungs. Smoking, especially cigarettes, overwhelms and destroys the cilia lining the nasal and bronchial passages, which is one reason smokers develop "smokers' cough" - their bodies are trying other ways to rid themselves of the grit and grime from the air.

   a. Have students follow the directions on the *Student Worksheet*: Breathing Particles to reinforce this concept.

b. In their groups, have students explore for more information about the respiratory tract using a CD-ROM such as *A.D.A.M., The Inside Story*. They should study the diagrams and listen to the brief narrations about breathing, then share orally what they have learned.

5. **Activity 3:**
   When we breathe, we are taking oxygen into the body. Have the students complete the following calculations:

   a. Of the gases in air, oxygen makes up about 21%. If we breathe about 250 ml. of air with each breath, how much oxygen do we breathe in each breath?

   b. Assume that the volume of gases released is the same as the volume of gases inhaled because of the carbon dioxide released by the body. If the exhaled air is 16% oxygen, how much oxygen was taken in by the body?

   c. If the amount of oxygen that the body takes in is reduced because of a high amount of particulate matter and gases other than oxygen (as when smoking) to 18% of each breath, and the amount of oxygen in exhaled air remains the same, how much is the oxygen intake reduced?

6. Summarize these activities for students by referring to the opening discussion, and ask students to consider again what it means to "catch" their breath? What are we capturing? How? The students should recognize that the body is accomplishing an incredible feat to pull in the oxygen we need under normal conditions because air is NOT mostly oxygen. With this in mind, they should better appreciate the potential health hazards of something like smoking. In discussion, you may relate what they have learned today with other environmental conditions that cause lung problems, such as mining (consider the history of "black lung" disease).

7. To assess student progress, review student responses and check answers to the calculations from Activity 3.

Extension

Students can extend their observations of particulate matter in the atmosphere by comparing different indoor environments, or comparing indoor and outdoor environments by placing petri dishes with petroleum jelly in different locations for a specified amount of time. Students could also study particulate matter suspended in the air for longer periods by hanging the petri dishes in different locations to capture what is floating. They can use *Student Worksheet*: What's in the Dish? to record and compare observations and data.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

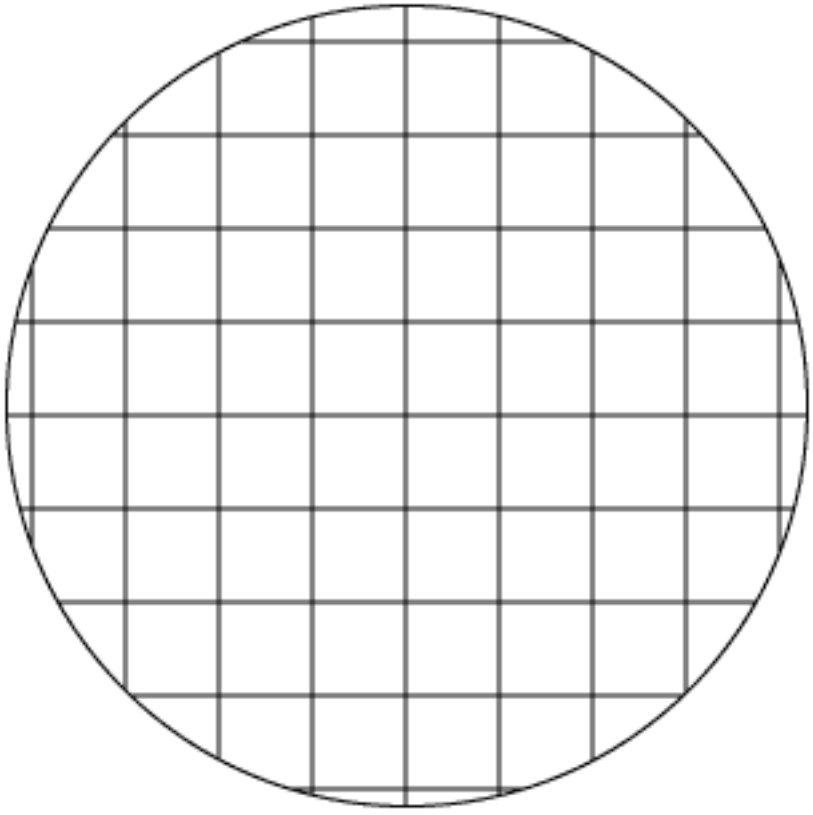
Sheryl Barr and Bob Keddell

Name _____ **Date** _____

What's in the Dish?

Directions:
Use this form to record your observations of particulate matter captured in petri dishes.

In the circle below, sketch what your dish looks like. Number from 1-4 the squares chosen by each member of the group for closer study.



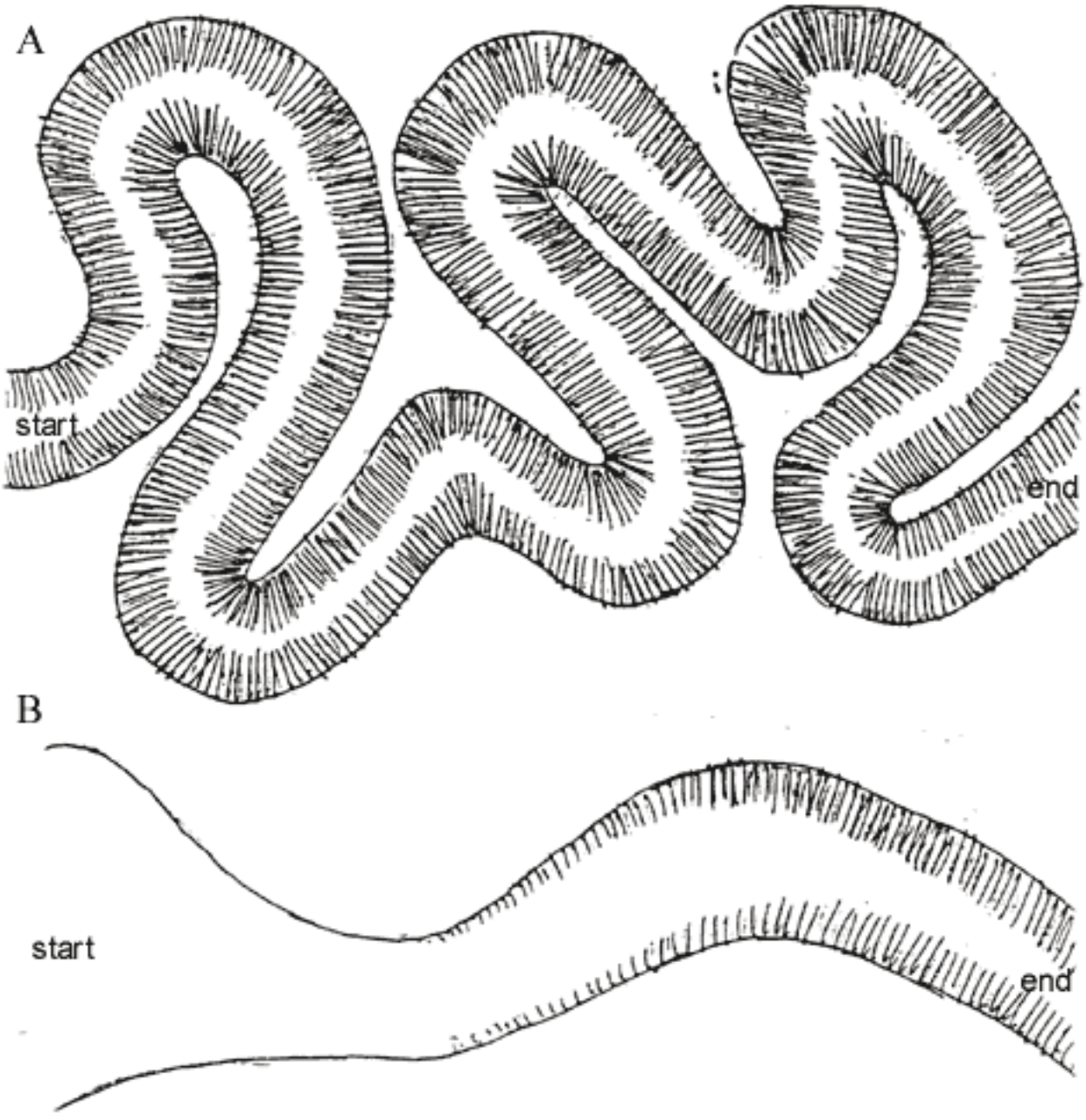
Record your observations in the chart below.

	Number of particles, by size			Description or Identification
	Smallest	Medium	Largest	
Square #1				
Square #2				
Square #3				
Square #4				
Average				Area of the petri dish
ESTIMATED # PER SQ. CM				

Name _____ **Date** _____

What's in the Dish?

Directions:
Imagine that your pencil point is a small particle. With your pencil, try drawing a line from start to finish in each passage below. Do this fast as you can without letting your "particle" get "caught" by crossing any lines or touching the sides.



Now, on the back of this paper, explain which diagram (A or B) represents the nasal passages and which represents the mouth. Make the connection -- how does this simulation show that breathing through your nose is indeed better than breathing through your mouth?

Sneeze, Wheeze, Move

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Overview

This lesson challenges students to understand pollen: its source, its relationship to allergies, and how it can affect the choice of home for some people who are susceptible to this powdery substance. Through the use of CD-ROM technology, Internet sites, hands-on activities, charts, and maps, students will play the role of company president and give a specific recommendation on living locations that would be best for one of the company's most productive workers.

Media Resources

A.D.A.M. The Inside Story CD-ROM
This widely-distributed CD-ROM by A.D.A.M. Software, Inc. contains animations of pollen-causing allergies.

Pollen Allergy
http://www.hoptechno.com:80/book46.htm
This web site contains a pamphlet from the National Institutes of Health about allergies and pollen. Students will use this site for their research to answer questions on the Student Worksheet: Pollen Allergy - Questions and Answers.

Next

Learning Objectives

Students will be able to . . .

- identify flower parts
- focus a dissecting microscope
- identify an allergy problem and its relationship to the respiratory system
- describe causes, effects, and consequences of pollen
- identify hazardous conditions and model measures that can help eliminate them
- use a map of the United States to locate major cities
- interpret and analyze information on a chart
- identify seasonal changes based on botanical regions

Next

Vocabulary

Pollen: a powdery substance produced by the anthers of flowers
Allergy: a condition that produces an unfavorable reaction to substances such as pollen and food
Immune system: the organs of the body that help it resists infection
Histamine: a chemical compound in the body involved in allergic reactions
Antibody: a protein formed in the blood in reaction to exposure to certain substances that it then attacks and destroys
Stamen: the male fertilizing organ of a flowering plant that contains pollen
Asthma: a chronic allergic condition that affects the body's ability to breathe
Pollination: to fertilize with pollen
Pistil: the seed-producing part of a flowering plant
Anther: the part of a flower's stamen that contains pollen
Allergic reaction: a body response to exposure to an allergen
Filament: the slim threadlike strand that supports the anther
Style: the narrow extension of the ovary of a plant that supports the stigma
Petal: a brightly colored outer part of the flower head

Materials

For the class:

- Computer with modem and Internet access
- Dissecting microscopes or microscope projector
- Overhead projector

For each group of two students:

- One cut flower
- Toothpicks
- Plastic petri dish or slide
- Copy of *Student Worksheet*: Background Information on Pollen Allergy
- Copy of *Student Worksheet*, State-by-State Calendar for Allergy Seasons

For each student:

- Copy of *Student Worksheet*: Pollen Allergy-Questions and Answers
- Copy of *Student Worksheet*: Pollen Allergy Connection
- Copy of *Student Worksheet*: Botanical Regions of the United States
- Copy of *Student Worksheet*: Assessment
- United States atlas

Teacher resources:

- Transparencies of Student Worksheets

Next

Procedures

1. Make transparencies from materials included in this lesson.

2. Use the *A.D.A.M.* CD-ROM to motivate students. As a class, watch the animations concerning respiration and pollen. Survey students to find out how many have "allergies."

3. Continue to motivate by distributing a cut flower to each pair of students. Use the transparency you have made of the Student Worksheet: Pollen Allergy Connection to guide them thourhg an examination of the parts of the flower, concentrating on the pollen. Direct students to examine the magnified grains of pollen on the transparency, or use a microscope projector to display pollen. Alternately, students could prepare slides of pollen and examine them under a microscope. Explain that these irregularly-shaped grains can irritate the nose and cause problems for people.

4. Assign teams of students to a computer to visit the web site on *Pollen Allergy* at http://www.hoptechno.com:80/book46.htm, or distribute copies of the information found there, along with the Student Worksheet: Pollen Allergy - Questions and Answers. Assign each pair one question to answer. Teams are to prepare a concise answer to the question within 15 minutes. During that time, work with teams to assure their responses are accurate as well as concise. At the end of 15 minutes, teams should share their answers to be recorded by other students. This would be an ideal place to explore vocabulary terms found on the first page of this lesson.

5. Distribute atlases and copies of Student Worksheets: State-by-State Calendar for Allergy Seasons and Botanical Regions of the United States to each student. Help students locate the 10 cities included on the worksheet. Ask them "What region is each city located in?"

6. Assign one member of the student team to take the role of the company president. The other will take the role of the company's best employee.

7. Present the following problem that each team of students must solve.

   "You are the president of a major company that has offices in eleven cities. Your company's best worker is having major allergy problems and has come to you and said that she must quit her job because she can no longer work in this location with all the pollen problems. You explain that you know about allergies, but that you do not want to lose her. You offer to find her a home in another part of the country where there is less chance of allergy problems. You would transfer her and pay for her family to move to another city where the company has offices. You pull out your 'State-by-State Calendar for Allergy Seasons' and together, the two of you rank the cities. Trees, grasses, and ragweed all provoke the employee's allergies, but trees have the worst effect. In what region and city should the employee relocate?"

8. Direct students to complete the worksheet by writing a persuasive letter.

9. Direct students to complete their portion of the *Student Worksheet*: Assessment.

Next

Extension

CNN: Allergy Report
http://www-cgi.cnn.com/WEATHER/allergy/index.html
There is a sample school allergy report form located at this site. You could ask students to complete the form.

Internet Sleuth web site
http://www.isleuth.com
Explain to students that a search engine is a program on the Internet that searches databases for documents that match key words supplied by the user. One type of search engine is called a Unified Search Engine. It accesses several search engines at once, increasing the user's chance of finding the information they need. Direct students to use Internet Sleuth to search for information related to the search term "allergy" and other vocabulary terms from this lesson.

ENVIROHEALTH LINK MASTER TEACHER TEAM:

Bob Keddell and Sheryl Barr

Name _____ Date _____

Background Information Sheet

Information courtesy of the U.S. Department of Health and Human Services,
Public Health Service, National Institutes of Health

Millions of Americans suffer from sneezing, coughing, itching, runny noses, and watering eyes when the pollen starts to fly. Each spring, summer, and fall tiny particles are released from trees, weeds, and grasses. These particles, known as pollen, hitch rides on currents of air. Although their mission is to fertilize parts of other plants, many never reach their targets. Instead, they make unscheduled detours into human noses and throats. At these sites, the pollen can trigger the allergic reaction that doctors call pollen allergy, or seasonal allergic rhitinis, and that many people know as hay fever (depending on the season in which the symptoms occur).

Of all the things that can cause an allergy, pollen is one of the most pervasive. Many of the foods, drugs, or animals that cause allergies can be avoided to a great extent; even insects and household dust are not inescapable. However, short of staying indoors when the pollen count is high - and even that may not help - there is no easy way to evade windborne pollen. Yet there ARE some ways to ease the symptoms of hay fever - and scientists are working to find more and better approaches to allergy treatment.

The National Institute of Allergy and Infectious Diseases, a part of the National Institutes of Health, conducts and supports research on allergic diseases. The goals of this research are to provide a better understanding of the causes of allergy, to improve the methods for summarizes what is known about the causes and symptoms of pollen allergy, as well as what medical researchers are doing to help people who suffer from it.

WHAT IS AN ALLERGY?

An allergy is a sensitivity to a normal harmless substance, one that does not bother most people. The allergen (the foreign substance that provokes a reaction) can be a food, dust particles, a drug, insect venom, or moldspores, as well as pollen. Allergic people often have a sensitivity to more than one substance.

WHY ARE SOME PEOPLE ALLERGIC TO THESE SUBSTANCES WHILE OTHERS ARE NOT?

Scientists think that people inherit a tendency to be allergic, although not to any specific allergen. Children of allergic parents are much more likely to develop allergies than other children. Even if only one parent has allergies, a child has a one in four chance of being allergic. Another factor in the development of allergies seems to be exposure to allergens at certain times when the body's defenses are lowered or weakened such after a viral infection, during puberty, or pregnancy. (However, some women find that during pregnancy their hay fever symptoms diminish.) People with pollen allergies often develop sensitivities to other troublemakers that are present all year such as dust and mold. Year-round allergens like these cause perennial allergic rhinitis, as distinguished from seasonal allergic rhinitis, or hay fever.

WHAT IS AN ALLERGIC REACTION?

Normally, the immune system functions as the body's defense against invading agents (bacteria and viruses, for instance). In most allergic reactions, however, the immune system is responding to a false alarm. When allergic persons first come into contact with an allergen, their immune systems treat the allergen as an invader and mobilize to attack. The immune system does this by generating large amounts of a type of antibody (a protein) called immunoglobulin E, or IgE. (only small amounts of IgE are produced in nonallergic people.) Each IgE antibody is specific for one particular allergen. In the case of pollen allergy, the antibody is specific for each type of pollen: one antibody may be produced to react against oak pollen and another against ragweed pollen, for example.

These IgE molecules attach themselves to the body's mast cells, which are tissue cells, and to basophils, which are cells in the blood. When the enemy allergen next encounters the IgE, the allergen attaches to the antibody like a key into a lock, signaling the cell to which the IgE is attached to release (and in some cases top produce) powerful inflammatory chemicals like histamines, prostaglandins, leukotrienes, and others. The effects of these chemicals on various parts of the body cause the symptoms of allergy.

WHAT IS POLLEN?

Plants produce the microscopic round or oval grains called pollen in order to reproduce. In some species, the plant uses the pollen from its own flowers to fertilize itself. Other types must be crossed-pollenated; that is, in order for fertilization to take place and seeds to form, pollen must be transferred from one flower of one plant to that of another plant of the same species. Insects do this job for certain flowering plants, while other plants rely on wind transport.

The types of pollen that most commonly cause allergic rations are produced by the plain-looking plants (trees, grasses, and weeds) that do not have showy flowers. These plants manufacture small, light, dry pollen granules that are custom-made for wind transport; for example, samples of ragweed pollen have been collected 400 miles out at sea and 2 miles high in the air. Because airborne pollen is carried for long distances, it does little good to rid an area of an offending plant-the pollen can drift in from many miles away.

In addition, most allergic (allergy -producing) pollen comes from plants that produce it in huge quantities - a single ragweed plant can generate a million grains of pollen a day.

The chemical makeup of [pollen is the factor that determines whether a particular type is likely to cause hay fever. For example, pine tree pollen is produced in large amounts by a chemical composition of pine pollen appears to make it less allergic than other than other types. Moreover, because pine pollen tends to fall straight down and its not widely scattered, it rarely reaches human noses.

Among North American plants, weeds are the most prolific producers of allergenic pollen. Ragweed is the major culprit, but others of importance are sagebrush, redroot pigweed, lamb's quarters, Russian thistle (thumbweed), and English plantain.

Grasses and trees, too, are important sources of allergenic pollens. Although there are more than 1,000 species of grass in North America, only a few produce highly allergenic pollen. These include timothy grass, Kentucky bluegrass, Johnson grass, Bermuda grass, redtop grass, orchard grass, and sweet vernal grass. Trees that produce allergenic pollen include oak, ash, elm, hickory, pecan, box elder, and mountain cedar.

It is common to hear people say that they are allergic to colorful or scented flowers like roses. In fact, only florists, gardeners, and others who have close contact with flowers are likely to become sensitized to pollen from these plants. Most people have little contact with the large, heavy, waxy pollen grains of many flowering plants because this type of pollen is not carried by wind but by insects such as butterflies and bees.

WHEN DO PLANTS MAKE POLLEN?

One of the most obvious features of pollen allergy is its seasonal nature - people experience its symptoms only when the pollen grains to which they are allergic are in the air. Each plant has a pollinating period that is more or less the same from year to year. Exactly when a plant starts to pollinate seems to depend on the relative length of night and day - and therefore on geographical location - rather than on the weather. (On the other hand, weather conditions during pollination can affect the amount of pollen produced and distributed in a specific year.) Thus, the farther north you go, the later the pollinating period and the later the allergy season.

A pollen count - familiar to many people from local weather reports - is a measure of how much pollen is in the air. This count represents the concentration of all the pollen (or of one particular type, like ragweed) in the air in a certain area at a specific time. It is expressed in grains of pollen per square meter of air collected over 24 hours. A pollen count is an approximate and fluctuating measure, but it is useful as a general guide.

Pollen counts tend to be highest on warm, dry, breezy days and lowest during chilly, wet periods. Moreover, the pollen concentration in an area can be changed by population growth, land use, tree plantings and cutting, industrialization, and pollution.

WHAT IS POLLEN ALLERGY?

The signs and symptoms of pollen allergy are familiar to many:

- Sneezing, the most common, may be accompanied by a runny or clogged nose
- itching eyes, nose, and throat
- Allergic shiners (dark circles under the eyes caused by restricted blood flow near the sinuses)
- The "allergic salute" (in a child, persistent upward rubbing of the nose that causes a crease mark on the nose)
- Watering eyes
- Conjunctivitis (an inflammation of the membrane that lines the eyelids, causing red-rimmed eyes).

In people who are not allergic to pollen, the mucus in the nasal passages simply moves these foreign particles to the throat, where they are swallowed or coughed out. But something different happens to a pollen-sensitive person.

As soon as the allergy-causing pollen lands on the mucous membranes of the nose, a chain reaction occurs that leads the mast cells in these tissues to release histamine. This powerful chemical dilates the many small blood vessels in the nose. Fluids escape through these expanded vessel walls, which causes the nasal passages to swell and results in nasal congestion.

Histamine can also cause itching, irritation, and excess mucus production. Other chemicals, including prostaglandins and leukotrienes, also contribute to allergic symptoms.

Some people with pollen allergy develop asthma, a serious respiratory condition. While asthma may recur each year during pollen season, it can eventually become chronic. The symptoms of asthma include coughing, wheezing, shortness of breath due to a narrowing of the bronchial passages, and excess mucus production. Asthma can be disabling and can sometimes be fatal. If wheezing an shortness of breath accompany the hay fever symptoms, it is a signal that the bronchial tubes also have become, involved indicating the need for medical attention.

HOW IS POLLEN ALLERGY DIAGNOSED?

People with a pollen allergy may at first suspect they have a summer cold - but the "cold" lingers on. For any respiratory illness that lasts longer than a week or two, it is important to see a doctor.

When it appears that the symptoms are caused by an allergy, the patient should see a physician who understands the diagnosis and treatment of allergies. If the patient's medical history indicates that the symptoms recur at the same time each year, the physician will work under the hypothesis that a seasonal allergen like pollen is involved. The doctor will also examine the nasal mucous membranes, which in persons with allergic conditions often appear swollen and pale or bluish.

Skin Tests

To find out which types of pollen are responsible, skin testing may be recommended using pollens commonly found in the local area. A diluted extract of each kind of pollen is applied to a scratch or puncture made on the patient's arm or back or injected under the patient's skin. With a positive reaction, a small, raised, reddened area with a surrounding flush (called a wheal and flare) will appear at the test site. The size of the wheal can provide the physician with an important reaction diagnostic clue, but a positive reaction does not prove that a particular pollen is the cause of a patient's symptoms. Although such a reaction indicates that lgE antibody to a specific pollen is present in the skin, respiratory symptoms do not necessarily result.

Blood Tests

Skin testing is not advisable in some patients such as those with certain skin conditions. Diagnostic tests can be done using a blood sample from the patient to detect levels of lgE antibody to a particular allergen. One such blood test is called the RAST (radioallergosorbent test). Although the RAST offers some advantages over skin testing, it is expensive to perform, takes several weeks to yield results, and is somewhat less sensitive. Skin testing remains the most sensitive and least costly diagnostic tool.

HOW IS POLLEN ALLERGY TREATED?

There are three general approaches to the treatment of pollen allergy; avoidance of the allergen, medication to relieve symptoms, and immunotherapy or injection treatments (commonly called allergy shots).Although no cure for pollen allergy has yet been found, one of these strategies or a combination of them can provide various degrees of relief from allergy symptoms.

Avoidance

Complete avoidance of allergenic pollen means moving to a place where the offending plant does not grow and where its pollen is not present in the air. But even this extreme solution may offer only temporary relief since a person who is sensitive to one specific weed, tree, or grass pollen may often develop allergies to others after repeated exposure. Thus, persons allergic to ragweed may leave their ragweed-ridden communities and relocate to areas where ragweed does not grow, only to develop allergies to other weeds or even to grasses and trees in their new surroundings. Because relocating is not a reliable solution, allergy specialists strongly discourage this approach.

There are other ways to evade the offending pollen: remaining indoors in the morning, for example, when the outdoor pollen levels are highest. Sunny, windy days can be especially troublesome. If persons with pollen allergy must work outdoors, they can wear face masks designed to filter pollen out of the air reaching their nasal passages. As another approach, some people take their vacations at the height of the expected pollinating period and choose a location where such exposure would be minimal. The seashore, for example, may be an effective retreat for many with pollen allergies.

Air conditioners and filters. Use of air conditioners inside the home or in a car can be quite helpful in reducing pollen levels. Also effective are various types of air-filtering devices made with fiberglass or electrically charged plates. These can be added to the heating and cooling systems in the home. In addition, there are portable devices that can be used in individual rooms.

An allergy specialist can suggest which kind of filter is best for the home of a particular patient. Before buying a filtering device, it is wise to rent one and use it in a closed room (the bedroom, for instance) for a month or two to see whether allergy symptoms diminish . The air flow should be sufficient to exchange the air in the room five or six times per hour; therefore, the size and efficiency of the filtering device should be determined in part by the size of the room.

Devices that may not work. Persons with allergies should be wary of exaggerated claims for appliances that cannot really clean the air. Very small air cleaners cannot remove dust and pollen - and no air purifier can prevent viral or bacterial diseases such as influenza, pneumonia, or tuberculosis. Buyers of electrostatic precipitators should compare the machine's ozone output with Federal standards. Ozone can irritate the nose and airways of persons with allergies, especially asthmatics, and can increase the allergy symptoms. Other kinds of air filters such as HEPA (high efficiency particulate air) filters do not release ozone into the air.

Avoiding Irritants. During periods of high pollen levels, people with pollen allergy should try to avoid unnecessary exposure to irritants such as dust, insect sprays, tobacco smoke, air pollution, and fresh tar or paint. Any of these can aggravate the symptoms of pollen allergy.

Medication. For people with seasonal allergies who find they cannot avoid pollen, the symptoms can often be controlled with medication available by prescription or over the counter. Effective medications that can be prescribed by a physician include antihistamines, corticosteroids, and cromolyn sodium - any of which can be used alone or in combination. There are also many effective antihistamines and decongestants that are available without a prescription.

Antihistamines. As the name indicates, an antihistamine counters the effects of histamine, which, as described before, is released by the mast cells in the body's tissues and contributes to the allergy symptoms. For many years, antihistamines have proven useful in relieving sneezing and itching in the nose, throat, and eyes and in reducing nasal swelling and drainage. But many people who take antihistamines experience some distressing side effects: drowsiness and loss of alertness and coordination. In children such reactions can be misinterpreted as behavior problems. Several new types of antihistamines that cause fewer of these side effects are now being developed and marketed.

Nasal Decongestants. Over-the-counter products containing decongestants can be helpful in relieving blocked nasal passages. These drugs constrict the blood vessels in nasal tissue, lessening swelling and mucus production. Nasal decongestants, although available as nasal sprays, may be taken orally; these include compounds such as ephedrine, phenyl-propanolamine hydrochloride, and pseudoephedrine hydrochloride. Because these drugs can raise blood pressure, increase the heart rate, and cause nervousness in some people, persons with allergies should check with their doctors before using decongestants.

People with allergic rhinitis should avoid using decongestant nasal sprays because frequent or prolonged use can lead to a "rebound phenomenon," in which the initial effect of shrinking the nasal passages is followed by increased swelling and congestion. When this occurs, a person often will use the spray in higher doses, or more frequently, in an attempt to get relief from congestion. Instead of improving nasal congestion, however, such use of nasal sprays only intensifies the problem.

Corticosteroids. Until recently, corticosteroids, although very effective in controlling allergic disorders, were not widely used for pollen allergy because their prolonged use can result in serious sided effects. Corticosteroids relieve the symptoms of pollen allergy by reducing nasal inflammation and inhibiting mucus production. Locally active steroids that penetrate the nasal membrane are now available as nasal sprays in measured-dose spray bottles. When used this way, the drug affects only the nasal passages rather than the entire body. The side effects, which are minimal when the spray is used in recommended doses, can include nasal burning and dryness and a sore throat.

Cromolyn sodium. Another effective agent that is available by prescription as a nasal solution is cromolyn sodium. Unlike antihistamines or steroids, cromolyn sodium is believed to control allergic symptoms by preventing the mast cells from releasing histamine. In clinical trials, cromolyn sodium has been proven safe and effective and, in contrast to some other allergy medications, appears to cause no drowsiness. Unlike antihistamines and decongestants, corticosteroid nasal sprays and cromolyn sodium nasal solutions must be used for several days to weeks before there is any noticeable reduction in symptoms.

Combination therapy. Sometimes antihistamines, cromolyn sodium, or nasal corticosteroids are not effective when used alone, but when prescribed in combination, these agents can often provide significant, if not total, relief from hay fever.

Immunotherapy. If environmental control methods and medication prove to be inadequate to control a person's symptoms, a physician may recommend immunotherapy (commonly called allergy shots). The aim of this treatment is to increase the patient's tolerance to the particular pollen to which he or she is allergic.

Diluted extracts of the pollen are injected under the patient's skin. The patient receives small doses once or twice a week. Working up to larger doses that are given less often. The size of the largest dose depends on the patient's tolerance and the treatment's effect on the patient's allergy symptoms. Since it takes time to build up tolerance, prolonged treatment may be needed before the patient's symptoms are relieved.

Immunotherapy is not without problems. It can be expensive, and may require months before improvement is apparent. Further, it does not work well for some people and, if the size of the dose or frequency of shots is not carefully monitored, the injections can cause allergic reactions. These reactions can be quite mild - redness and swelling at the site of the injection - or potentially serious systemic reactions such as hives, generalized swelling, or shock. Immunotherapy is therefore only one part of a physician's overall treatment plan for an allergic patient.

WHAT IF POLLEN ALLERGY IS NOT TREATED?

As anyone with allergies knows, allergic symptoms are annoying and, in severe cases, debilitating. As a rule, however, an allergy to pollen does not progress to serious pulmonary or other diseases. Occasionally, when pollen allergy is not treated, complications may occur. These include swelling of the nasal passages and Eustachian tubes leading to the ears, which may prevent proper drainage and airflow and lead to secondary infection of the sinuses or to middle ear problems.

HOW CAN MEDICAL RESEARCH HELP?

Research on hay fever is proceeding on several fronts. Scientists are conducting what happens to the body in allergic disease. By knowing how this process works, they can devise ways to prevent sensitization to allergens or to prevent allergic symptoms. Meanwhile, clinical researchers are seeking better immunotherapy materials and methods as well as more effective drugs with fewer side effects.

To speed the process of applying the findings from laboratory research to the treatment of allergy patients, the National Institute of Allergy and Infectious Diseases (NIAID) supports a network of Asthma and Allergic Disease Centers throughout the United States. At the centers, laboratory scientists work closely with clinical allergy specialists to expand our knowledge of allergic disease.

Regulating lgE Antibody A basic approach to the treatment of allergy is to prevent the immune system cells from making significant amounts of lgE antibody. NIAID-supported investigators are studying a number of naturally occurring factors that may control this process. By inhibiting the production of lgE, we could prevent allergic reactions and eliminate the need for drugs to control symptoms.

A possible new approach to regulating the production of lgE is by taking advantage of the complex feedback network of the immune system. Each molecule of lgE antibody contains a unique sequence of amino acids located on its surface near where the foreign substance or antigen attaches. This unique sequence is called an idiotype, and it enables the antibody to recognize a specific antigen. Because the body recognizes the idiotype as a foreign substance itself, another antibody is produced in response to the idiotype, which is called an anti-idiotype or antibody against an antibody. An anti-idiotype antibody can suppress the production of lgE by providing a turn-off signal to the cells that produce it. In experimental work in animals, anti-idiotype antibodies have been somewhat successful in controlling the lgE response to specific types of pollen. Such antibodies, while promising, need further development and testing.

Stimulating lgG Production. Scientists believe that immunotherapy works in part by stimulating the body to manufacture lgG, which is an antibody that blocks the effects of the allergen. By competing with lgE in combining with the allergen, these lgG antibodies apparently interfere with lgE's ability to react with pollen. A goal of immunotherapy research is to find more efficient ways to trigger the production of lgG while minimizing allergic reactions to the treatment.

Modifying Pollen Extracts. Among the most promising innovations is the development of modified pollen extracts that appear to reduce allergic reactions to the material used in immunotherapy. In addition, because the patient would be able to tolerate large doses of the extracts, fewer injections would be needed to induce the needed high levels of the lgG blocking antibody.

One type of modified extract called allergoids has been developed by NIAID-supported investigators. Allergoids are produced from extracts subjected to a treatment process using formaldehyde. In clinical testing, allergoids appear to reduce the incidence of allergic reactions to immunotherapy while stimulating the production of protective lgG antibodies.

Other NIAID-supported scientists have developed purified allergens modified through a process called polymerization. With the use of this method, small molecules of purified material are joined into large clusters called polymers. Studies with these polymers have also been clinically promising.

As another approach to immunotherapy with pollen extracts, molecules of polyvinyl alcohol or polyethylene glycol are combined with the allergen. In attaching to the extracts, these molecules function as carriers that suppress the immune reactions. Such combined molecules are referred to as copolymers, and some are capable of activating cells (suppresser T cells) that, in turn, suppress the production of lgE. Other copolymers work directly on lgE-making cells to shut off lgE synthesis. In tests with ragweed pollen linked to polyethylene glycol, the patient's responses were very encouraging.

Still other methods of modifying pollen extracts are being developed and tested. As immunotherapy is improved, those who suffer from pollen allergy will benefit from safer, more effective treatment.

Local Nasal Immunotherapy. A different approach to the treatment of hay fever is the use of the local nasal immunotherapy (LNTT). This procedure also utilizes pollen extract, but it avoids systemic side effects by acting only on nasal tissue. LNIT has been studied over the last several years by NIAID-supported researchers to determine whether it is safe and effective.

In the LNIT testing thus far, water-based extracts and allergoids have not proven to be effective in small doses. Higher doses used in testing have produced allergic symptoms and therefore are not effective. In current studies, investigators are using high doses of polymerized extracts, which appear to be effective and cause minimal side effects. Further testing is needed to determine the usefulness of this approach.

WHAT ABOUT THE FUTURE?

Because allergies result from a disorder of the immune system, scientists studying allergic diseases-are benefiting from exciting new developments in immunology. The revolution taking place in molecular biology has led to significant advances in understanding how the immune system works, with applications to nearly every medical field. These advances offer the promise of better diagnosis and treatment of pollen allergy - and the hope that one day allergies will be preventable as well.

Name _____ Date _____

Pollen Allergy
Questions and Answers

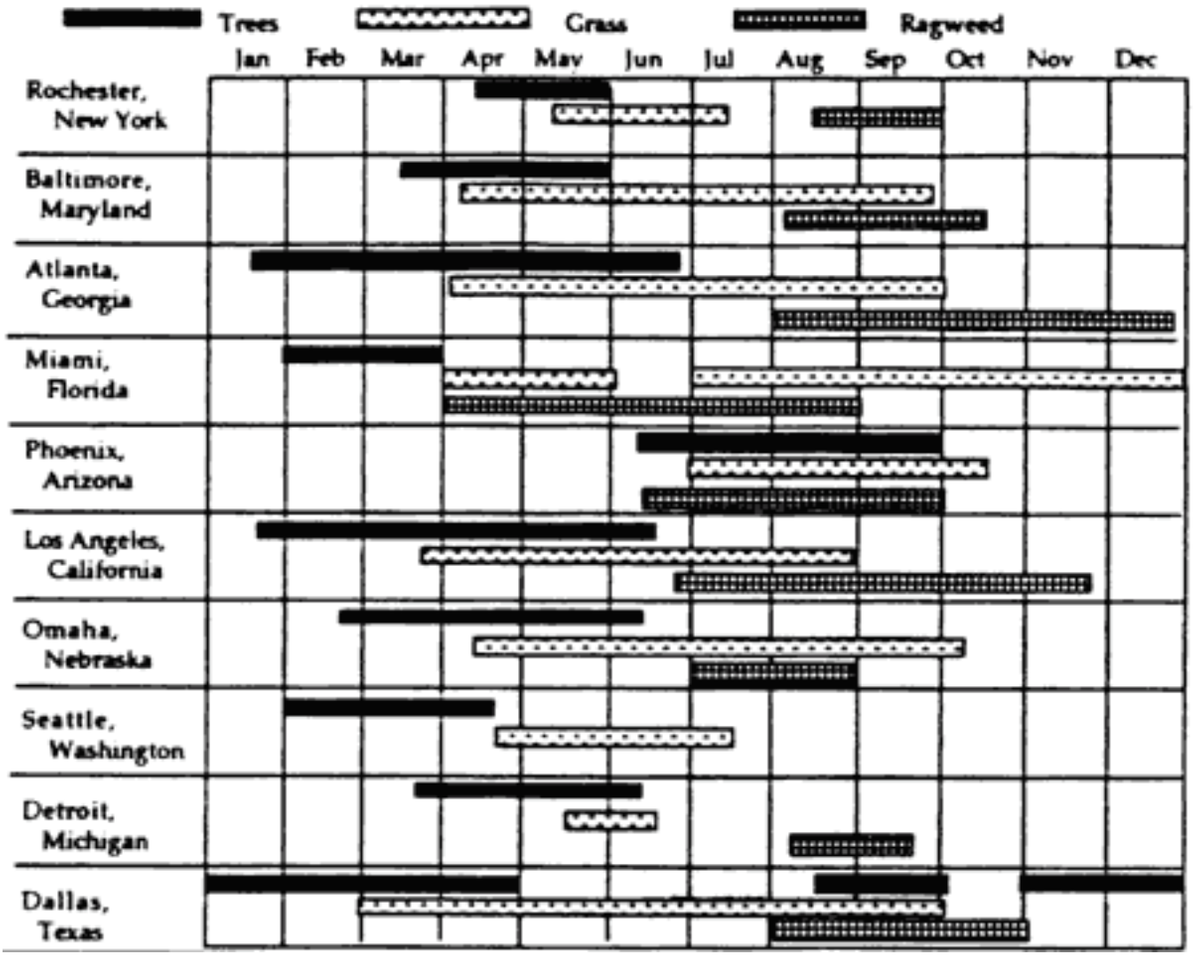
Directions:

You can find the answers to these questions by visiting this Internet site:
http://www.hoptechno.com:80/book46.htm

1. What is an allergy?
2. What is an allergic reaction?
3. What is pollen?
4. When do plants make pollen?
5. What is a pollen allergy?
6. How is a pollen allergy treated?
7. What is the future for medical research in this field?
8. What organizations can help with further information?

Name _____ **Date** _____

State-by-State Calendar for Allergy Seasons



Directions:
Study the chart above. It shows a city-by-city analysis of the seasons for the pollens that most affect your worker. She can no longer live in New Orleans, Louisiana because she suffers allergies all year there. Which city should the company transfer her to? Rank them in order, from most desirable to least desirable.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Assignment:
On your own paper, write a two-paragraph letter that tries to persuade your best worker to move to the cities you rated number one and number two, as being the best for her allergies. Paragraph one should identify these cities and explain why you think it would be most desirable for her to live there. In paragraph two, you should try to persuade the worker to move to this city and stay on as a part of your company.

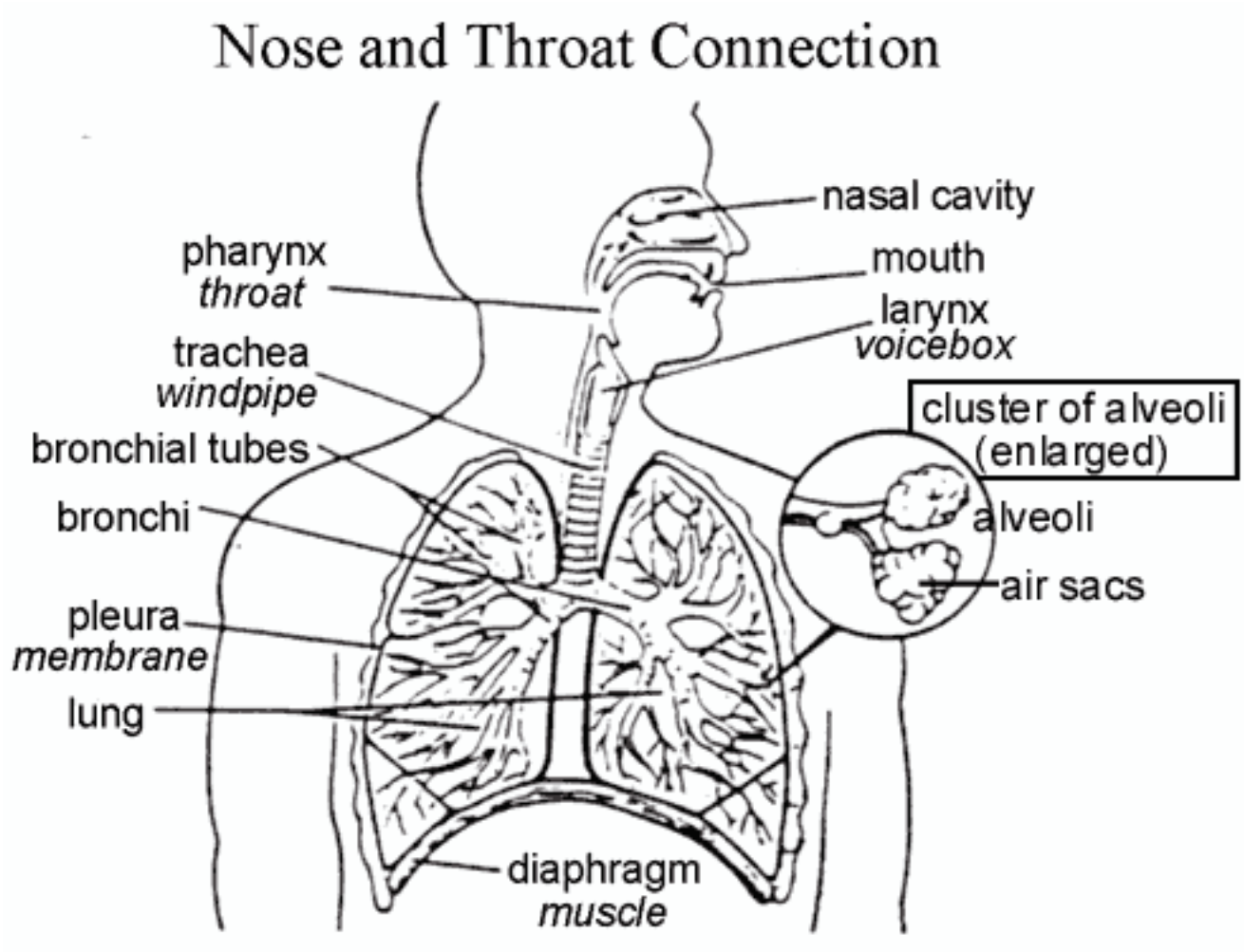
Name _____ Date _____

Botanical Regions of The United States

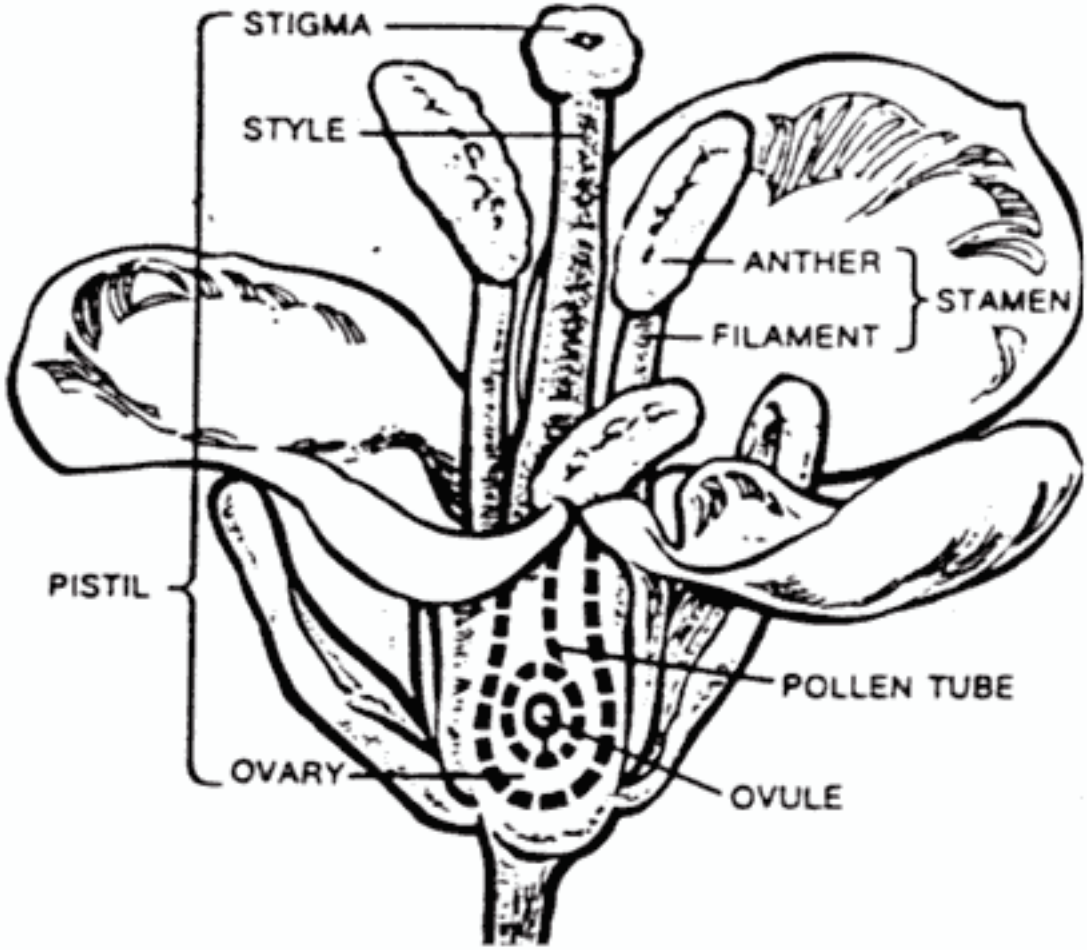
Directions:
Mark and label the ten potential cities where your best worker could live.

Name _____ **Date** _____

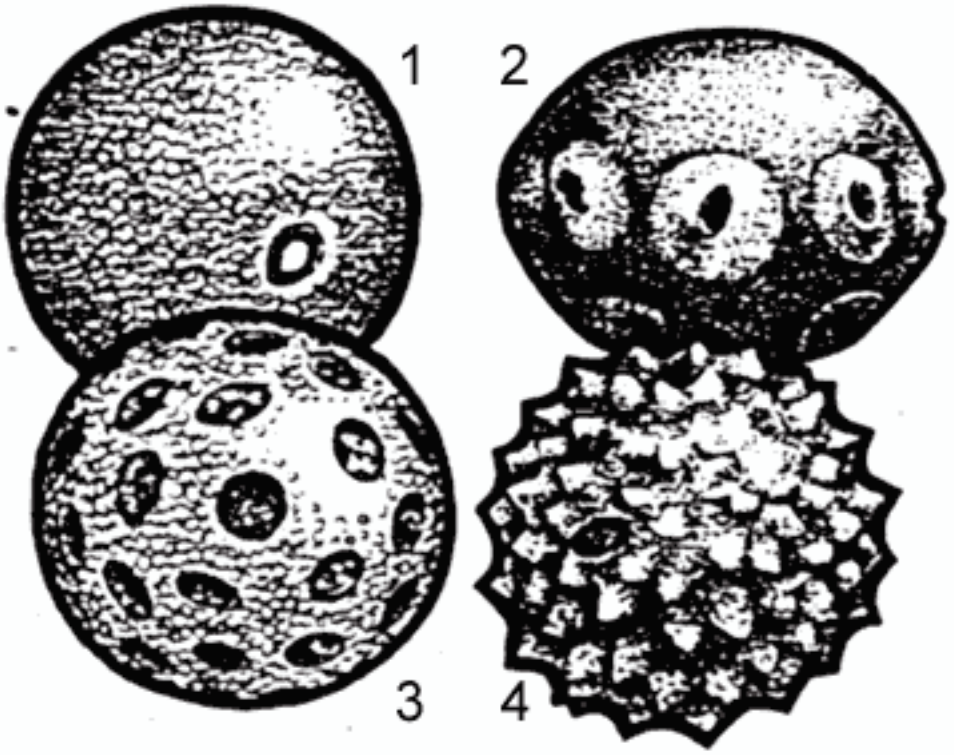
Pollen Allergy Connection



Flower Diagram



Microscopic Pollen



1. *PHLEUM PRATENSE*, ventral view, 35µ in diameter
2. *JUGLANS NIGRA*, side view dorsal side uppermost, 34µ in diameter
3. *SALSOLA PESTIFER*, 27.5µ in diameter
4. *AMBROSIA TRIFIDA*, 17.7µ in diameter

U.S. Botanical Regions

Name _____ Date _____

Performance Task Assessment

Directions:
Complete the first two columns of this chart.

PERFORMANCE TASK ASSESSMENT LIST			
	Assessment Points	Earned Points	
	Possible Points	Self-Evaluation	Teacher Evaluation
TASKS			
All questions on worksheet "Pollen Allergy - Questions and Answers" are answered in complete sentences			
All ten cities are labeled on worksheet "Botanical Regions of the United States"			
The ten cities are ranked on the worksheet "State-by-state calendar for Allergy Seasons"			
Persuasive Writing			
There is a two-paragraph structure to the argument			
There is a clear opening statement of position			
Writing contains good content (concepts and main ideas)			
Writing is clearly supportive of the employee			
The conclusion is strong and summarizes the position			
GROUP WORK			
Helps the pair get tasks done well and on time			
Helps the pair work harmoniously			
TOTALS			