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Thematic Lesson 1 of 3:

Basic Concepts
Environmental Health 101

Summary Students are introduced to basic environmental health concepts in the context of an air quality study that used personal monitoring devices to measure exposure.

Lesson Type **Short**—this lesson will take 20–30 minutes to implement.

Thematic—this lesson can be used alone or as part of a series of lessons to develop deeper understanding of a topic or concept. This lesson is part of the "Basic Concepts" series of thematic lessons, which will include additional lessons on toxicology and risk assessment (to be published in May 2009).

***EHP* Article** Backpack on Board: Individual Air Monitoring Predicts Prenatal Exposure to PAHs
Environ Health Perspect 116:A490 (2008)
http://www.ehponline.org/docs/2008/116-11/ss.html#back

Objectives By the end of this lesson, students should be able to
- define basic environmental health terms (*environment, environmental health, pollutant, source, exposure, dose, response*, and *risk*)
- identify the application of those terms from an article describing an environmental health study
- differentiate between three different fields of science within the environmental health sciences (toxicology, epidemiology, and exposure assessment)

Class Time 30 minutes

Grade Level Middle school, high school, college

Subjects Addressed Biology, Chemistry, Environmental Science

Aligning with Standards

SKILLS USED OR DEVELOPED
- Classification
- Communication (note-taking—oral, written)
- Comprehension (listening, reading)
- Critical thinking and response

SPECIFIC CONTENT ADDRESSED
- Environmental health sciences
- Exposure science
- Personal exposure monitoring
- Polycyclic aromatic hydrocarbons (PAHs)

NATIONAL SCIENCE EDUCATION STANDARDS MET

Science Content Standards

Unifying Concepts and Processes Standard
- Systems, order, and organization
- Change, constancy, and measurement
- Evidence, models, and explanation

Science as Inquiry Standard
- Understanding about scientific inquiry

Life Science Standard
- Behavior of organisms

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Science and Technology Standard
- Understanding about science and technology

Science in Personal and Social Perspectives Standard
- Personal and community health
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

History and Nature of Science Standard
- Nature of scientific knowledge

Prepping the Lesson (15 minutes)

INSTRUCTIONS

1. Download the *EHP* article "Backpack on Board: Individual Air Monitoring Predicts Prenatal Exposure to PAHs" at http://www.ehponline.org/docs/2008/116-11/ss.html#back.
2. Review the Background Information, Instructions, Assessing the Lesson, and Student Instructions for this lesson.
3. Make copies of the article and the Student Instructions.

MATERIALS

per student
- 1 copy of the *EHP* article "Backpack on Board: Individual Air Monitoring Predicts Prenatal Exposure to PAH," preferably in color
- 1 copy of the Student Instructions

VOCABULARY

- dose
- environment
- environmental health
- epidemiology
- exposure
- exposure assessment
- pollutant
- polycyclic aromatic hydrocarbons (PAHs)
- response
- risk
- source
- toxicology

BACKGROUND INFORMATION

This lesson provides sufficient background information for a basic introduction to environmental health. Please refer to other lessons in the "Basic Concepts" thematic series for more in-depth development of related concepts in toxicology and risk assessment (these lessons will be available in May 2009).

RESOURCES

Environmental Health Perspectives, Environews by Topic page. http://ehp.niehs.nih.gov/. Choose Chemical Exposures, Risk Assessment

Agency for Toxic Substances and Disease Registry. Glossary of terms (abridged dictionary of terms used by the agency in communicating with the public), http://www.atsdr.cdc.gov/glossary.html

Centers for Disease Control and Prevention. Environmental health (includes general information, statistics, and educational materials on a variety of environmental health topics), http://www.cdc.gov/Environmental/

Dictionary.com (online dictionary; source of several of the definitions in the Student Instructions), http://www.dictionary.com

National Institute of Environmental Health Sciences. Environmental health topics (includes general information and educational materials on a variety of environmental health topics), http://www.niehs.nih.gov/health/topics/index.cfm

Implementing the Lesson

INSTRUCTIONS

1. Distribute the Student Instructions, and have students complete Step 1.
2. Ask students to share their definitions with the class.
3. Have students complete Steps 2 and 3. Discuss and review with the class as needed to clarify the concepts.

Notes & Helpful Hints

- This lesson can be implemented with the other lessons in the "Basic Concepts" thematic series to develop a more in-depth understanding of environmental health.

Assessing the Lesson (steps not requiring teacher feedback are not listed below; see Student Instructions for complete step-by-step instructions)

Step 1 **How do you define *environment* and *environmental health*? Be prepared to discuss your definitions with the class.**

Definitions may vary depending on students' level of experience with the concept of environmental health. Be sure definitions for each concept contain the following information:

Environment

Basic definition: "1. the aggregate of surrounding things, conditions, or influences; surroundings; milieu; 2. the air, water, minerals, organisms, and all other external factors surrounding and affecting a given organism at any time" (http://dictionary.reference.com/browse/environment).

Students often focus on the outdoors or nature being the environment. Although this is one aspect of the environment, the definition of "environment" needs to be expanded beyond that. In environmental health, the environment is often described as where you live, work, and play. Essentially your environment is everything that surrounds you at any point in time—even the people around you.

Environmental health

Basic definition: "all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviors" (World Health Organization, http://www.who.int/en/).

Sometimes students define "environmental health" as the health of the environment. Although that is included in some broader definitions of the term, environmental health really focuses more on how the environment affects human health.

Step 2 **Read the article "Backpack on Board: Individual Air Monitoring Predicts Prenatal Exposure to PAHs." As you read, look for examples of the concepts listed below, and identify an example of each from the article. An example of the first concept (*pollutant*) is provided for you. One of the concepts is not explicitly discussed in the article; identify which concept it is.**

b. According to the article, what was the source of the pollutant?

Examples from the article:

- "the incomplete burning of wood, coal, oil, and other organic substances"
- "coal-burning municipal furnaces and industries were the source of most ambient PAHs in the city"

c. According to the article, how and when did exposure to the pollutant occur?

Examples from the article:

- "most of the women's exposure was to outdoor pollutants that penetrated indoors"
- "their personal PAH exposure correlated closely with outdoor levels of the pollutants"
- "exposure increased significantly during the winter months, with levels declining in the summer"

d. According to the article, what dose of the pollutant did the study participants receive?

The article does not discuss dose. The study looked at exposure (the amount of pollutant to which people were exposed in their environment) but not necessarily dose (the amount of pollutant that actually made its way into people's bodies). To identify dose, the individuals participating in the study would have to have given a blood sample or some other biologic sample. So the answer is, we do not know the dose.

e. What potential health-related responses to the pollutant were mentioned in the article?

Examples from the article:
- "PAHs are ubiquitous carcinogenic compounds"
- "cancer, developmental abnormalities, and asthma"

NOTE: PAHs are linked with additional health effects and responses beyond those mentioned in the article.

f. In the study referred to in the article, what specific risk factors were looked at?

Examples from the article:
- health status (pregnancy)
- lifestyle (including exposure to secondhand tobacco smoke)
- time of year (winter)

NOTE: students may identify additional risks, such as age (e.g., the fetus has a higher risk), that are not explicitly described in the article. Make sure the responses are logical and demonstrate an understanding of the meaning of "risk."

Step 3 **Read the following information and answer the questions.**

a. Which of the three fields of science defined above best describes the type of research you read about in the article?

Exposure assessment

b. Describe the research methods and length of time of the study.

Students should include the following information:

- "The researchers assessed the exposure of 341 nonsmoking pregnant women."
- "Pregnant women were recruited from prenatal clinics in the center and outskirts of the city. Each was given a backpack equipped with an air monitor to wear for a 48-hour period during the second trimester. Before they went to sleep, the subjects placed the device alongside their beds. A subset of 78 women also used the device for 48-hour periods in their first and third trimesters. To account for seasonal variations in pollution, an approximately equal number of women were enrolled each season. Subjects also completed questionnaires about their health and lifestyle, including exposure to secondhand tobacco smoke."

c. What additional information would you like to have as a result of or related to the research described in the article?

Student answers will vary. Look for clearly written, thoughtful questions that logically connect with or extend the research.

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Give us your feedback! Send comments about this lesson to ehpscienceed@niehs.nih.gov.

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STUDENT INSTRUCTIONS:

Basic Concepts
Environmental Health 101

Step 1 How do you define *environment* and *environmental health*? Be prepared to discuss your definitions with the class.

Environment:

Environmental health:

Step 2 Environmental health entails a number of important basic concepts, including *pollutant*, *source*, *exposure*, *dose*, *response*, and *risk*. These concepts are defined further down in this step. Read the article "Backpack on Board: Individual Air Monitoring Predicts Prenatal Exposure to PAHs." As you read, look for examples of the concepts listed below, and identify an example of each from the article. An example of the first concept (pollutant) is provided for you. One of the concepts is not explicitly discussed in the article; identify which concept it is.

a. A *pollutant* is a substance, such as certain chemicals or waste products, that makes the air, soil, water, or other natural resource unclean or unsuitable for a specific purpose. What was the pollutant in the article?

Polycyclic aromatic hydrocarbons (PAHs) are the class of pollutants described in the article.

b. The *source* is the place of origin for a pollutant/chemical. According to the article, what was the source of the pollutant?

c. *Exposure* is contact with a chemical by swallowing, breathing, or direct contact (such as through the skin or eyes). Exposure may be either short-term (acute) or long-term (chronic). According to the article, how and when did exposure to the pollutant occur?

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d. *Dose* is the amount of a chemical that actually gets into the body. Dose is typically measured in unit of chemical per unit of body weight (e.g., milligrams of chemical/kilogram of body weight). According to the article, what dose of the pollutant did the study participants receive?

e. *Response* refers to changes in body function or health after the chemical has entered the body. The amount and type of change (or response) depends on the type of chemical, the dose of the chemical the person receives, the length of time a person has been exposed to and received a dose, and the person's individual health and genetics. What potential health-related responses to the pollutant were mentioned in the article?

f. *Risk* is the probability that something will cause injury or harm. There are many factors that influence risk among individuals or populations, including socioeconomic status, proximity to a pollution source, body size, age, sex, general behaviors, health status, and genetic makeup. In the study referred to in the article, what specific risk factors were looked at?

Step 3 Read the following information, and answer the questions that follow.

In Step 1 you were asked to define *environmental health*. The study of environmental health—the environmental health sciences—actually involves many different fields of science. Three of them are *toxicology*, *epidemiology*, and *exposure assessment*.

- *Toxicology* is the study of toxic substances. Toxicologists look at the dose–response relationship of different chemicals to answer questions such as these: How much of a chemical would it take to kill a person in a given period of time? What is the lowest dose of a chemical at which we do not see a response? What different responses occur at different doses? What is the biologic mechanism of action (that is, what does the chemical cause to happen in the body that results in a specific response)?
- *Epidemiology* is the study of the cause, distribution, and control of disease in populations. Epidemiologists address questions such as these: Who is affected by a particular disease? How many people have a particular disease? Why do some people get a disease while others do not? What factors affect a person's risk for catching or developing a specific disease? How is a particular disease spread? What factors might control the spread of disease?
- *Exposure assessment* is the process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with. Scientists studying exposure assessment address questions such as these: Who is exposed the most to a certain agent? How are people exposed? How big a dose do people receive?

a. Which of the three fields of science defined above best describes the type of research you read about in the article?

b. Describe the research methods and length of time of the study.

c. What additional information would you like to have as a result of or related to the research described in the article?

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