ehp

LESSON:
Risk Factor Roulette

Summary:	The article "Genes and Sensitivity" suggests that a certain form of a gene predisposes some people to multiple chemical sensitivity, a disorder thought by some to be psychogenic or "all in one's mind." Students research the risk factors associated with multiple chemical sensitivity, asthma, breast cancer, and obesity, and classify them as environmental, genetic, behavior-related, or inherent.
EHP Article:	"Genes and Sensitivity," *EHP Student Edition*, June 2005, p. A157 http://ehp.niehs.nih.gov/docs/2005/113-3/forum.html#gene
Objectives:	By the end of this lesson students should be able to:

1. describe "multiple chemical sensitivity" and how it relates to genetic variation and environmental factors,
2. identify and classify risk factors for environmental health problems related to chemical sensitivity, asthma, breast cancer, and obesity.

Class Time:	2 hours
Grade Level:	10–12
Subjects Addressed:	Environmental Health, Biology, Health

▶**Prepping the Lesson (30 minutes)**

INSTRUCTIONS:
1. Read the article "Genes and Sensitivity" and review the Student Instructions and Assessing the Lesson sections.
2. Arrange for students to have access to the Internet for researching risk factors, especially if students do not have access at home.
3. If the assignment will be completed in class, provide the students with colored markers or highlighters as noted in the Materials section.

MATERIALS (per student):
- One copy of the article "Genes and Sensitivity"
- One copy of the Student Instructions
- Colored pens or highlighters in the following colors: pink, yellow, blue, and green (other colors of pens or highlighters may be substituted as long as there are four different colors)

VOCABULARY:
Chronic
Detoxification
Enzymes
Interaction
Metabolism
Multiple chemical intolerance
Neurotoxicants
Neurotransmitters
Polymorphism
Psychogenic
Rapid acetylator
Susceptibility

BACKGROUND INFORMATION:
The DNA of humans is 99% the same for every person. The remaining 1%, however, allows enough genetic variability to make each human (with the exception of identical twins) genetically unique. Most illnesses are genetically "polygenic," i.e., several different genes play roles in their development. As the human genome is explored, we understand more about why some people get sick from environmental factors while others are seemingly unaffected. And illnesses once thought to be "in a

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patient's mind" are increasingly found to be linked to specific genetic "polymorphisms," or unusual expressions of a certain gene. The search for genetic explanations for disease is exciting and holds great promise for prevention and early treatment. Gene therapy as a cure for an individual's ailments remains a tantalizing future possibility. It is important, however, to remember that genes and genetic factors account for only a small percentage of cases of a given disease or condition, even for diseases in which the genetic connections are well established, such as breast cancer.

Genetic variations are just one type of disease risk factor. Other common risk factors include inherent or demographic factors (e.g., age, sex, and race), lifestyle, or behavior-related factors (e.g., diet or smoking), and environmental factors (e.g., exposure to fine particle air pollution from diesel exhaust). Students should avoid discussing risk factors as causes of disease. Having a risk factor does not mean someone will develop a given health problem, just as being free of a risk factor does not mean someone is safe from a disease. Risk factors are useful from a public health standpoint because their use helps target prevention programs to those statistically most likely to be affected by a disease. It is rare that a doctor can say for certain that an individual's illness is caused by a specific exposure or specific genetic problem. More often, the etiology (or root cause) of a disease is a complex interaction of factors, different for each individual. By examining the known mix of risk factors for a variety of diseases, students will get a glimpse into the complexity of disease research.

RESOURCES:
Environmental Health Perspectives, Environews by Topic page. Choose Chemical Exposures, Environmental Disease, Genetic Research, Women's Health http://ehp.niehs.nih.gov/topic

American Lung Association, http://www.lungusa.org

Environmental Protection Agency, http://www.epa.gov

Healthfinder, http://www.healthfinder.gov

Web MD, http://www.webmd.com

National Cancer Institute, http://www.cancer.gov

National Institute for Environmental Health Sciences, http://www.niehs.nih.gov

▶Implementing the Lesson

INSTRUCTIONS
1. Hand out the article to students and allow them to read it. Discuss any questions they may have about the article including any vocabulary terms they do not understand.
2. Hand out the Student Instructions. Discuss the classification scheme for risk factors and give an example of each.
3. Have the students research and complete the Risk Factor Roulette Diagrams individually, or in groups, by researching the risk factors associated with each of the health problems listed. Additional risk factor arrows can be added as necessary, and then color-coded.
4. Have students present their results to the class and summarize their findings. Then lead a discussion of how public health policy might be tailored to address various types of risk factors.

NOTES & HELPFUL HINTS:
• Students can access a wide variety of consumer-oriented health information websites to find risk factor information. A discussion about the variability and credibility of information available on the web might be in order if students find sites offering questionable or conflicting information.
• Students may be unfamiliar with the idea of obesity as an environmental health issue. The study of how our "built environment" (i.e., our homes, workplaces, and cities) contributes to our becoming sedentary and obese is a new field within environmental health. Students should be aware of the structural factors in our society that contribute to the society-wide trend toward obesity.

▶Aligning with Standards

SKILLS USED OR DEVELOPED:
Classification
Communication (note taking, oral, written—including summarization)
Comprehension (listening, reading)
Research
Tables and figures (creating, reading)

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SPECIFIC CONTENT ADDRESSED:

Unifying Concepts and Processes Standards
- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and equilibrium
- Form and function

Science As Inquiry
- Understanding about scientific inquiry.

Life Science Standards
- Molecular basis of heredity

Science in Personal and Social Perspectives Standards
- Personal and community health
- Environmental quality
- Natural and human-induced hazards

NATIONAL SCIENCE EDUCATION STANDARDS MET:

Plan an inquiry-based science program
- Develop student understanding, and nurture community of science learners
- Work within and across disciplines and grade levels

Guide and facilitate learning
- Support inquiries when interacting with students
- Orchestrate discourse among students about scientific ideas
- Model inquiry, curiosity, openness to new ideas and data, and skepticism

Ongoing assessment of teaching & student learning
- Report student achievements and opportunities to learn

Create learning environments that provide time, space, and resources for learning science
- Create setting that is flexible and supportive of inquiry
- Make tools, materials, media, and resources available to students
- Use resources outside of the school

Develop communities of science learners that reflect the intellectual rigor of scientific inquiry, and attitudes and social values conducive to scientific learning
- Nurture collaboration among students

▶Assessing the Lesson

A partial list of risk factors for each disease has been provided below for the completion of the Risk Factor Roulette Diagrams. This is by no means an exhaustive list of risk factors; students will likely find more. Classifying the risk factors into environmental, genetic, behavioral, or inherent traits may be difficult for some factors since they may fall into more than one category. Teachers should allow flexibility in student classifications, as long as the student has a clear rationale for his/her choice. For instance, one risk factor for breast cancer is "having no children"—this could be called an inherent trait or could be considered a behavioral trait. Students should come away from this exercise with an understanding of the complex nature of risk analysis, and the limitations of genetic research for explaining environmental health problems.

Risk Factor Color-coding
- Pink: Genetic
- Yellow: Environmental
- Blue: Behavioral
- Green: Inherent

Multiple Chemical Sensitivity Risk Factors
- Being female (G—Inherent)
- Having depression/anxiety disorders (G—Inherent)
- Being 30–50 years of age (G—Inherent)

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- Having certain genetic polymorphisms (*CYP2D6*, *NAT2*) (P—Genetic)
- Environmental exposures to dyes, perfumes, solvents (Y—Environmental)

Asthma Risk Factors
- Family history (P—Genetic)
- Exposure to bleach, household chemicals (Y—Environmental)
- Exposure to air pollution (Y—Environmental)
- Exposure to cockroaches (Y—Environmental)
- Smoking (B—Behavioral)
- Obesity (B/P—Behavioral/Genetic)

Obesity Risk Factors
- High blood pressure (G—Inherent)
- Parents obese (P—Genetic)
- High-fat diet (B—Behavioral)
- Living in a suburb (Y—Environmental)
- Living in the South (Y—Environmental)
- Inactivity (B—Behavioral)

Breast Cancer Risk Factors
- Exposure to DES (synthetic hormone) *in utero* (Y—Environmental)
- Being female (G—Inherent)
- Being Caucasian (G—Inherent)
- Having no children (B—Behavior)
- Exposure to certain pesticides, radiation (Y—Environmental)
- Human genetic polymorphism BRCA1, BRCA2 (P—Genetic)
- Smoking (B—Behavioral)
- Taking hormone replacement therapy (B—Behavioral)

▶**Authors and Reviewers**

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Step 1: Read the article "Genes and Sensitivity."

Step 2: Write in the risk factors identified in the article for multiple chemical sensitivity (MCS) onto the arrows pointing to the circle marked "MCS" on the Risk Factor Roulette Diagram handout.

Step 3: Use the Internet or other resources to research additional risk factors for MCS and the environmental health problems in the other three circles (asthma, obesity, and breast cancer).

Step 4: Write in a risk factors on each arrow pointing to the appropriate circle. Add more arrows as necessary to include additional risk factors.

Step 5: Classify the risk factors with highlighters or pens using the following key:

Pink: Genetic
Yellow: Environmental
Blue: Behavioral
Green: Inherent

RISK FACTOR ROULETTE

MCS

ASTHMA

BREAST
CANCER

OBESITY

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