envirohealthlink

Summer Institute

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

July 27 – 30, 1998

Sponsored by

Maryland Public Television

and

The Johns Hopkins University
School of Hygiene and Public Health
and
The Center in Urban Environmental Health

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The National Institute of
Environmental Health Sciences.
National Institutes of Health

1998 EnviroHealth Link Summer Institute Lesson Plan Binder*
Contents

1. Introduction
2. Maryland Public Television Educational Services
3. Biographies
4. Lesson Plans (*see table*)

Title	Grades	Subject
It's in the Air!	8	Lung function, health effects of asbestos
Now Hear This, If You Can	7-8	Noise pollution and hearing loss
Sun Smart, Skin Safe	6-8	Skin cancer and sun exposure
Sunscreen: Smoke Screen?	6-8	Effectiveness of different types of sunscreen, ozone layer
The Chesapeake Bay's Nuclear Challenges	7-8	Nuclear disasters, health effects of nuclear radiation
Exposed to Nicotine: Will They Grow?	6-8	Toxic effects of tobacco on living organisms
How Did *That* Get in My Lunch?	8	Food borne pathogens, food irradiation
What Should I Know About Pfiesteria?	6-8	Pfiesteria and health effects
Better Watch Out, Better Not Shout!	7-8	Noise pollution and effects on hearing loss and stress/concentration
Blame It on the Hormones!	7-8	Hormones used in livestock industry, effects of hormones on plants
Raindrops Keep Burning on My Head!	6-8	Acid rain, health and environmental effects
One Sniff Can Kill!	6-8	Health effects of abuse and misuse of household solvents/inhalants
Get the Lead Out!	7-8	Lead poisoning, health effects
Where's the Lead?	7-8	Lead poisoning, health effects
The Link: Pfiesteria and Nutrients	6-8	Pfiesteria, nutrient pollution
CO_2 Makes Me Blue	6-8	Health effects of excess carbon dioxide and carbon monoxide

5. Internet Resources
6. Other Resources

*NOTE: All lesson plans except "Exposed to Nicotine: Will They Grow?" are also available on the Internet at http://www.mpt.org/learningworks/teachers/ehl/

INTRODUCTION

ABOUT ENVIROHEALTH LINK

We are all connected to our environment through an intricate and delicate web of complexity. Exploring that complexity has engaged top scientists around the world for quite some time as they look at questions such as: What is the link between cancer and our surroundings? Why are entire cities' water supplies being compromised by minute bacteria? Why are so many children becoming asthmatic?

As educators, we know that our students are asking these questions as well, with equal concern. How can we best encourage them to investigate these issues scientifically to form knowledge-able answers about the link between our environment and our health?

EnviroHealth Link was developed specifically to address this educational concern. It was conceived as a comprehensive and ongoing professional development opportunity for health and science teachers at the middle school level to give them the resources they need to promote scientific and health literacy in their classes using today's technology.

Sponsored by Maryland Public Television and the Johns Hopkins University School of Hygiene and Public Health and the Center in Urban Environmental Health, EnviroHealth Link includes Summer Institutes for educators, distance learning seminars, as well as online netcourses via the EnviroHealth Link website at: <http://www.mpt.org/ehl/home.html> to support a community of learners involved in environmental health issues, research and technology.

Summer Institutes

During these four-day seminars, teachers will become learners again as Master Teachers present classroom lessons – completely integrated with a wealth of Internet resources, computer software, educational videos, and videotape and multimedia presentations – to demonstrate how effective these technologies can be as a way of enhancing their middle school students' work with environmental health issues, and as a personal resource to enhance their individual health and science curricula.

As they work through these lessons, participants will also meet with Johns Hopkins research scientists involved in environmental health research. These professionals will provide an enriched view of some of the issues raised in these lessons, such as current findings in the early detection of lung cancer.

Online Netcourse

The dialogue established at the Summer Institutes will continue throughout the school year, as participants link electronically to an array of resources at the EnviroHealth web site. There, they will interact with scientists, receive important news updates from the environmental health field and receive timely feedback and additional classroom activities and projects from their fellow participants.

Distance Learning Seminar

Originating from the studios of Maryland Public Television, the evening one-hour teleconference, held in the early spring, brings together teachers, EHL master teachers, and Hopkins scientists in environmental health considered leading researchers in the field. This event is a live interactive broadcast simultaneously broadcast to four other sites (community college and high school sites to be announced) in the state of Maryland over the fiber optic Maryland Distance Learning Network. Maryland teachers from a wide geographic area are able to attend the teleconference at a location in close proximity to their schools or homes, yet fully interact at all participating sites in discussion with their teaching colleagues and with Hopkins scientists.

ABOUT THE JOHNS HOPKINS UNIVERSITY SCHOOL OF HYGIENE AND PUBLIC HEALTH

The School of Hygiene and Public Health at the Johns Hopkins University has been designated as an Environmental Health Sciences Research Center by NIEHS and offers multidisciplinary and interdisciplinary education and training in the basic and applied professional sciences in environmental health. It operates an innovative interdisciplinary professional education program to train practicing professional in the broad environmental issues of risk analysis, assessment, and management in relationship to national policy questions of importance to government, industry, and the general public in environmental health. It has a long tradition of institutional involvement with the health needs of the community, including twelve current prevention and training initiatives in area schools and health centers.

The School's Department of Environmental Health Sciences is one of the oldest and largest such departments in the world. It focuses on a variety of issues including the hygiene of water, air, and soil; food and drug adulteration; and the causation, spread, and prevention of transmittable diseases. The Department investigates these issues through mechanism-based research and the application of this research to explore the impact of toxic molecules from the environment on organs, tissues, cells, and DNA, as well as through studies to examine the risks to health in specific populations. These investigations lead to methods that identify susceptible individuals and the rational development of prevention strategies.

The School also encompasses a number of Centers engaged in multidisciplinary research. These Centers include the Environmental Health Sciences Center, the Research and Training Center in Environmental Health Sciences, the Educational Resource Center, and the Center for Occupational and Environmental Health. Researchers here are currently engaged in a number of projects including:

- the identification of the genes responsible for airway inflammation in subjects exposed to ozone
- the effect of electromagnetic fields on workers
- investigations of the impact of lead poisoning on the brain receptors
- assessment of ultraviolet light and its role in skin cancer
- early detection of lung cancer
- chemoprevention of liver cancer in human populations

ABOUT THE NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES

Human health and human disease result from three interactive elements: environmental factors, genetic susceptibility, and age. The mission of the National Institute of Environmental Health sciences is to reduce the burden of human illness and dysfunction from environmental causes by further understanding each of these elements and how they interrelate. The NIEHS achieves its mission through a multidisciplinary biomedical research program, prevention and intervention efforts, and a communications strategy that encompasses training, education, technology transfer, and community outreach. The ultimate goal of these NIEHS activities is to define and understand the mechanism of action of toxic environmental agents on human health and to transfer this knowledge to the public.

The NIEHS is actively responding to the increasing desire of the public to understand the effects on human health of exposure to physical and chemical agents. Although the public is challenged daily to make decisions based on the risk and benefit of agents that permeate the environment, few programs prepare the public to meet this challenge. For example, in the past few years there have been media reports concerning the hazards of electromagnetic radiation, chemicals in drinking water, and pesticides in food.

While the scientific community has been tasked with making scientifically based reccomendations on the safety of chemical and physical agents, the general public has become increasingly involved in the regulatory decision making process. Therefore, there is a critical need to educate the general public about environmental health issues.

In recognition of this challenge, a public mandate in the 1900s is to reach out to students in grade school and high school to improve their scientific literacy. In 1992, the NIEHS established a priority to develop an environmental health sciences education program at the K-12 grade levels. The objectives of this program are to improve the understanding of environmental by all students and to expand career awareness for those interested in pursuing further education leading to research and service occupations in environmental health sciences. In addition to promoting the development of relevant instructional materials, the NIEHS seeks to advance the dissemination, utilization, and effective implementation of materials and curricula pertaining to environmental health science.

The NIEHS is one of eighteen institutes that comprise the National Institutes of Health.

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Dr. James R. Zabora, Associate Director for Community Research, Oncology Center, School of Medicine, Johns Hopkins University

Dr. Timothy Buckley, Division of Environmental Health Engineering, School of Hygiene and Public Health, Johns Hopkins University

Dr. Cecilia Davoli, Assistant Professor, Pediatrics and Environmental Health Sciences, Johns Hopkins University

Dr. Tomás Guilarte, Professor, Dept. of Environmental Health Sciences, School of Hygiene and Public Health, Johns Hopkins University

Dr. William Michael Foster, Dept. of Environmental Health Sciences, School of Hygiene and Public Health, Johns Hopkins University

For Resource Material Donations:

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Maryland Department of the Environment
Maryland Public Television
LaMotte Company
KCTS
E/The Environmental Magazine
Dorling Kindersley Family Learning
Bonus Point/ *wired and not wired*
Sunburst

MPT EDUCATIONAL SERVICES

MARYLAND PUBLIC TELEVISION AND EDUCATION

For more than two decades, Maryland Public Television has served the educational needs of people across the state and across the nation. Throughout the years, we have steadily increased the number of people we serve, broadening our services to meet the ever more complex needs of students of all ages. But our mission has always remained constant. MPT is dedicated to providing quality educational programming and services to teachers, children, and parents – to enrich their education and their lives.

- Each year, MPT supports K-12 teachers in their efforts to motivate students by providing educational videos, classroom materials and teacher guides to 1,200 schools that serve 812,000 students across Maryland.

- MPT's College of the Air program has one of the highest enrollments in the nation with twenty-eight area colleges enrolling approximately 18,000 students each year. In 1994, area colleges began offering AA degree programs through MPT's Going the Distance project.

- MPT continues to expand its professional development programs for teachers. Mathline trains math teachers in Maryland in a year-long program designed to improve students' math performance. MPT also hosts the NATIONAL TEACHER TRAINING INSTITUTE FOR MATH, SCIENCE AND TECHNOLOGY (NTTI). In partnership with Johns Hopkins University's Department of Environmental Health Sciences, we offer EnviroHealth Link, a comprehensive program to help middle school teachers incorporate environmental health science topics into their classroom lessons.

- With its skilled production staff and excellent facilities, MPT also creates its own award-winning educational programs, available for students in Maryland and throughout the country. And, taking advantage of ever-changing technology, MPT offers online services on the World Wide Web to enhance and broaden its educational programming

Technology has transformed how people receive and process information. We have changed, too, in how we create and distribute our educational services. But, one aspect of our service remains the same, MPT is committed to helping students reach their full potential by offering services that will motivate, enlighten, and inform them.

OUTREACH

From its inception, MPT has strived to serve the community. People of all ages use MPT as an educational resource service.

Children's Programming
Engaging the minds of children with quality, commercial-free programming that parents can trust has always been part of MPT's mission. In 1993, MPT created the Children's Channel, with over 50 hours per week of programs designed to help children learn social and intellectual skills while being entertained. Long-time favorites like SESAME STREET and newer programs like the MPT-produced KRATT'S CREATURES offer children of every age innovative, non-violent television shows. In 1995, MPT became a Ready to Learn station with programming and community outreach projects that enhance the Children's Channel daily programming. The Ready to Learn project is designed to meet the school readiness needs of preschoolers and the school success needs of older children. It offers educational messages between programs that urge children to be creative, curious and cooperative learners. It also provides supplementary print material for children and adults, a program that distributes free books to children who may not otherwise have them, and workshops for families, teachers and caregivers given through MPT Community Outreach.

> *Our whole family loves you! We turn to you as an alternative to Saturday morning cartoons. We're so glad our children have a place that has good clean fun – and learning, too!*

SESAME STREET
Preschool Educational Program (PEP)
MPT's SESAME STREET PEP trainers travel throughout the state to conduct intensive workshops for child care providers and parents, preparing them to use SESAME STREET programs and related activities to help preschoolers get ready for school success. MPT has trained 3,200 daycare providers, reaching 25,000 preschoolers statewide.

> *[PEP] is an enthusiastic, energetic and educational program for child care-providers and parents. The handbook is beneficial to both center-based and family care with or without the television. I love the program and MPT!*

GED on TV
Each year since 1975, an average of 150,000 students have used the GED series in forty-eight states. MPT offers this series to meet the needs of high school dropouts who want to take the General Equivalency Development (GED) test and receive their high school equivalency certificates. GED On TV is a television tutorial with workbooks that supplements traditional adult education classes. Over one million adults have passed the GED exam after viewing the GED series.

GED is very flexible. It makes it a lot easier to combine school with a work schedule and family and all the other things that we have in our lives.

Library Reading Stations

Maryland Public Television and Maryland's public libraries have joined forces to promote family literacy. Each of the 180 full-service library branches throughout Maryland has created an MPT Library Reading Station – a special place identified by colorful mobiles and posters where families can find books and videos featured on the children's programs broadcast by MPT. Parents can also find copies of print materials such as PTV: Families magazine and "reading Tips," and sign up for workshops on how to use public television programs as an educational tool. MPT airs promotional spots encouraging viewers to visit the MPT Library Reading Stations at their neighborhood public library. Throughout the year, special projects and activities are planned.

EDUCATIONAL SERVICES

K-12 Services
MPT provides educational videos and teacher guides to schools throughout Maryland. Each year, we air more than 340 hours of instructional programming for teachers and media specialists to record and use in classrooms. The courses range from foreign languages to economics to cultural diversity. DIFFERENT AND THE SAME, for example, is designed to help teachers talk about, understand and combat racism. 3-2-1 CLASSROOM CONTACT brings the exciting world of scientific discovery into the classroom. WHAT'S IN THE NEWS uses current events to teach geography, map skills, economics and other curriculum. MPT's online Educational Video Resource Schedule provides program descriptions and broadcast times of all the instructional series offered. Teacher manuals are generally available for many series to provide activities and information to help teachers reinforce and integrate the video into a total lesson plan.

As a home schooling family, we are grateful for the many fine programs on MPT that help to supplement our educational program.

Each month I send out a bulletin of selected MPT K-12 programs of interest to students and teachers. The response is always excellent.

College of the Air
College of the Air is a partnership involving MPT and twenty-eight colleges and universities in Maryland, Northern Virginia, Delaware and Pennsylvania. Through distance learning, students can earn credits which are transferable as required core courses or electives. In 1994, area colleges also began offering AA degree programs through MPT's Going the Distance project.

Telecourses are a convenient and practical alternative to on-campus classes. There are a wide selection of courses, from accounting to philosophy to chemistry. Academically equivalent to on-campus classes, a telecourse is an integrated learning system of weekly TV programs, a study guide, a textbook and an instructor. Although telecourse students earn these college credits at home, they have access to the same support services and privileges as on-campus students do.

Since taking a telecourse requires only a minimum on-campus attendance, it has become one of the most popular alternatives to traditionally taught classes. Each year, 15,000 students earn college credits towards a degree through College of the Air.

Telecourses worked great for me because of my situation, because of my physical limitations and because of my work schedule.

TECHNOLOGY AND EDUCATION

In the last decade, technological advances have changed the way we communicate with each other. MPT is using new technologies to their fullest to broaden the way students learn.

MARYLAND ELECTRONIC FIELDTRIPS

Maryland Electronic Fieldtrips is an annual series of live electronic visits to places that make our state unique. Fieldtrips are a favorite part of school for students. Through Maryland Electronic Fieldtrips, teachers have a chance to take their students far-reaching parts of the state without leaving the classroom.

Each Fieldtrip is broadcast live throughout the state on MPT's six-channel network. Through extensive media connections, students can talk with experts at the site. To prepare students for the trip, MPT has created project activities accessible on the World Wide Web. Classes can use the online activities and the interactive capabilities of fax, modem and telephone to pose question, suggest solutions and collaborate with students across the hall and across the state. A Fieldtrip Teacher Guide is also available, offering teachers lesson planning opportunities.

The first Fieldtrip took students to St. Mary's City to celebrate Maryland Day. On March 25, 1996, the Pride of Baltimore II set sail from this historic city to retrace the route taken by the Ark and the Dove, the two ships which brought Maryland's first colonists across the Atlantic. Students met historians and archeologists for a more complete picture of colonial life. They also had the chance to talk to the crew of the Pride. The second Fieldtrip visited Calvert Cliffs along the Chesapeake Bay, where students had a chance to study fossils, endangered species and Maryland's environment. A third Fieldtrip featured the Picasso exhibit at the National Gallery of Art in Washington, D.C.

This series of Fieldtrips gives students the chance to explore the many facets of Maryland and beyond and offers teachers the opportunity for hands-on learning.

> *My students were mesmerized. The fieldtrip package was an incredible activity. We hope that you will have some next year.*
>
> *I'm proud of the work my students did and the spirit of cooperation in which they worked. Thank you for giving us this opportunity.*

MARYLAND CONNECTS

MPT's online service provides information about our productions and current outreach and educational activities. The Home Page offers selections of Programming Schedule, MPT Productions, Highlights of the Week, and Education, which explains all of MPT's educational undertakings and it offers students and teachers in-depth exploration and project activities for some of our educational programming, such as the Maryland Electronic Fieldtrips. Our web site is designed to enhance and broaden the educational experience derived from all our televised programming.

PROFESSIONAL DEVELOPMENT

Public television's original mandate was to teach, and public broadcasting has always recognized the medium's power to inspire and inform. MPT is using its telecommunications resources and information technology to provide Maryland teachers with programs to keep their information current, their ideas fresh and their enthusiasm high.

National Teacher Training Institute
Each spring, MPT offers the National Teacher Training Institute for Science and Technology (NTTI), a program designed to increase the use of technology in math and science in K-12 classrooms. Teachers from across the state attend a two-day workshop hosted by MPT where they learn how to use television, the Internet, computer software, and other technologies to improve science and math classroom instruction.

> *The speakers were inspirational, the master teachers were great and the materials a treasure.*
>
> *It was terrific. Keep them coming. I needed this twenty years ago.*
>
> *Thank you, thank you, thank you on behalf of educators and children.*

Mathline
Mathline is a telecommunications-based professional development service designed to help schools reach their goals in mathematics education and achievement. It is a year-long program that uses online communication and videos of actual classroom instruction to provide teachers learning opportunities at times and locations they find convenient. Maryland math teachers facilitate the project, training and advising math teachers throughout the state. All teachers can also interact and collaborate with other teachers from across the U.S., sharing ideas and building a network of professional peers. Teachers particularly like the quality of the materials, the on-going support that Mathline offers, and participation according to their own schedules.

> *The variety of lessons and topics cover a wide spectrum of the **NCTM Standards**, but the best part is the opportunity to discuss from a professional standpoint what is happening in each lesson, ideas for extending the lesson, educating parents about the need for reform and a multitude of other issues. Each evening, I have a professional development experience online!*

EnviroHealth Link
MPT, in partnership with Johns Hopkins University's School of Hygiene and Public Health, has developed a professional development program to provide teachers with new scientific information and technology skills so they can better incorporate environmental health sciences topics into their classroom curricula. The program keeps teachers up-to-date with current information on this science, and offer strategies to transfer complex scientific information to their students in an understandable and usable way. The program consists of video teleconferences with research scientists, week-long summer Teacher Training Institutes to provide hands-on lab and field experience, and netcourses with access to an online community where teachers can get immediate answers to questions, updated information, and feedback from other teachers about classroom activities.

EDUCATIONAL PRODUCTION

MPT has earned a national reputation for high quality programming that meets the needs of children, adults and families. Over the years, MPT has created thousands of hours of instructional programming on topics as diverse as Constitutional history, space education and mathematics. These award-winning series are the collaboration of MPT's skilled production staff and leaders in the field of education and are used by schools across the country. Some recent productions include:

NUMBERS ALIVE!
NUMBERS ALIVE! is a ten-part series designed to help children develop number sense, a common-sense approach to using numbers. Content is based on the standards set forth by the National Council for Teachers of Mathematics and each show models authentic mathematics situations that students can apply to their own lives. The series focuses on Beyond Zero, a high school rock band with an affinity for numbers. Whether they are touring the country or having fun closer to home, they use mathematics to solve the problems they encounter. They ponder probability while playing games at an amusement park; they work with statistics as they track their results in a "Battle of the Bands" contest; they deal with fractions and measurement as they frantically try to prepare food for a surprise party. Shot on location around the country, the band's "tour spots" include a ghost town in Montana, the Everglades, New York City and an amusement park in Ohio. Each show ends with a music video which reinforces the mathematical content of the program.

The students' reactions were paramount. They loved the videos, their discussions were animated and the results were clear to me – they learned the material!

The snappy music presents an attention-grabbing way to involve/interest students in math.

ENVIROMYSTERIES
ENVIROMYSTERIES explores the relationship between our health and the environment. Students are introduced to environmental health concepts through the eyes of three high school journalists. As reporters for their high school environmental television program, they investigate the mystery surrounding an outbreak of an acute waterborne illness. Something has made members of their community sick, and all the clues lead to the local seafood served at a community fair. But are the clues misleading? Their exploration mirrors the scientific efforts of the local health department as they try to solve the mystery.

LITERARY VISIONS
Students embrace the great richness and diversity of literature through this series of twenty-six half-hour programs. Organized around the major genres of literature – fiction, poetry and drama – individual lessons focus on the elements of these genres: plot and structure, character, setting, style, symbolism and myth and theme. Hosted by Shakespearean actress Fran Dorn, the programs blend dramatization of literary works with commentary by literary critics. A highlight of the series is interviews with authors nationwide.

Students hear writers reading and interpreting their own work, as well as explaining how and why they write.

LITERARY VISIONS represents a renaissance for the study of some of the world's most important works. The dramatizations are a compelling draw for the student and the viewer, and the discussions open the door for a new level of interpretation and understanding.

MPT instructional programs have won numerous awards, including a Cine Golden Eagle, Silver Awards from the Chicago International Film Fest, Gold and Silver from the National Educational Film and Video Fest, Bronze Telly Awards, New York Festivals Category Finalist, and Peabody Awards, the most prestigious in television.

BIOGRAPHIES

FROM THE JOHNS HOPKINS UNIVERSITY

Timothy Buckley, Ph.D., M.H.S.

Dr. Buckley is an Assistant Professor at the Johns Hopkins School of Hygiene and Public Health in the Department of Environmental Health Sciences. Dr. Buckley joined the Hopkins faculty last year after five years with the U.S. EPA's National Exposure Research Lab. Having received his Ph.D. in Environmental Science from Rutgers University and a Masters of Health Science in Industrial Hygiene from Johns Hopkins University, Dr. Buckley's research has focussed on assessing total human environmental exposure through measurements in multiple environmental media and biomarkers. Over his research career, Dr. Buckley has been responsible for the concept, design, implementation, and management of several major studies involving human exposure to polycyclic aromatic hydrocarbons (PAHs), metals, volatile organic compounds (VOCs), pesticides, and polychlorinated biphenyls (PCBs) through multiple environmental media. These large-scale projects complement laboratory-based studies where controlled exposures are used to more fully investigate relationships between exposure, body burden, and effects. Dr. Buckley is currently involved in research on the exposure and effects of fine particles on susceptible persons with chronic obstructive pulmonary disease, the dermal absorption of VOCs in water and VOC biomarkers in breath.

Donald S. Coffey, Ph.D.

A prominent urological scientist, Dr. Coffey is a Professor of Urology, Oncology, and Pharmacology and Molecular Science at the School of Medicine. In addition, he serves as the Director of the Research Laboratories of the Department of Urology. His work in urological research has garnered him many accolades, including being named as a recipient for the First Society of International Urology's Yamanouchi Award. Dr. Coffey is also a member of the Principal Professional Staff at the Johns Hopkins University Applied Physics Laboratory.

Cecilia T. Davoli, M.D.

Cecilia T. Davoli, M.D. is a Developmental Pediatrician who runs the Lead Poisoning Prevention Clinic at the Kennedy Krieger Institute in Baltimore, Maryland. She has extensive experience in the management and treatment of children with lead poisoning. She devotes a lot of time to community outreach to train others in the prevention of childhood lead poisoning. Her primary clinical research at this time is participation in the long-term study, "Treatment of Lead-Exposed Children Trial", a multi-center trial of chelation in children with moderately elevated lead levels. Her faculty appointment is Assistant Professor in Pediatrics at the Johns Hopkins University School of Medicine and in Environmental Health Sciences at the Johns Hopkins University School of Hygiene and Public Health.

William Michael Foster, Ph.D.

Dr. Foster is an Associate Professor in the Department of Environmental Health Sciences. He joined the Physiology Division of the Department in 1991 and in addition to the normal responsibilities of teaching and performing research, Dr. Foster currently serves as the Co-Director of the Health Effects Assessment Laboratory (HEAL). This laboratory is a federally funded lab designed to investigate the effects of airborne pollutants upon the human respiratory system. Dr. Foster has authored approximately 60 research publications and scientific book chapters on the response of the human lung tissue to inhalation of particulate and/or oxidant gases, such as ozone. The HEAL facility is excellent for performing safe and controlled exposure of humans to airborne pollutants and includes an exercise treadmill, EKG monitors, pulmonary function testing equipments, and a specialized radionuclide imaging camera for scanning the lungs of human subjects. The primary objectives of HEAL have been to identify in humans susceptibility factors for the development of environmentally induced airway diseases and the time course of recovery for lung tissues injured by ambient exposure to ozone.

John D. Groopman, Ph.D., P.D.F.

Dr. Groopman is chair of the Department of Environmental Health Sciences and is Professor of Oncology and Associate Director of the Oncology Center for Cancer Prevention and Control. He received his academic training at MIT and NIH's National Cancer Institute's Laboratory of Human Carcinogenesis, where he was the recipient of the Institute's Career Development Award. In addition to his work at Johns Hopkins, he is chairman of both the Maryland State Legislative Committee of the American Association for Cancer Research, and of the NIEHS Special Study Section on Molecular Interventions in Environmental Disease.

Tomás R. Guilarte, Ph.D.

Dr. Guilarte is currently a Professor in the Divisions of Radiation Health Sciences and Toxicological Sciences in the Department of Environmental Health Sciences, and holds a joint appointment in the Division of Human Nutrition in the Department of International Health.

He is vice-president elect of the Neurotoxicology Section of the Society of Toxicology and a member of the Science Advisory Board of the National Center for Toxicological Research. He is also a permanent member of the Alcohol and Toxicology (ALTX)-3 study section of the National Institutes of Health. Dr. Guilarte's research interests are in the area of neurotoxicology. His laboratory is examining the role of the N-Methyl-D-Aspartate (NMDA) glutamate receptor subtype and protein kinase C in lead neurotoxicology. This is a comprehensive project which involves molecular, cellular, and behavioral approaches. His laboratory is also interested in the development and application of biomarkers of neurotoxicity

for the screening of chemicals with potential to cause brain damage as well as for the early detection of brain damage "in vivo" using brain imaging techniques.

Clifford S. Mitchell, M.D., M.P.H.

Dr. Mitchell is an Assistant Professor in the Department of Environmental Health Sciences, with a joint appointment in the Department of Medicine of the School of Medicine. He is the Deputy Director of the Occupational Medicine Residency Program, and the Clinical Director of the NIEHS Human Exposure Assessment Laboratory (HEAL). For the past several years his research has focused on indoor environments, particularly schools, and on the effectiveness of prevention programs in occupational and environmental health.

Michael A. Trush, Ph.D.

Since 1991, Dr. Trush has served as Deputy Director of the Johns Hopkins Center in Urban Environmental Health. His current areas of research include chemical carcinogens, biochemical and molecular toxicity, bone marrow toxicity and leukemia, biochemical risk analysis, and inflammatory cell biology and toxicity. In addition to his scientific research, Dr. Trush is also interested in enhancing the educational process. To that end, he has served on numerous local and national committees designed to upgrade science education. Dr. Trush began his career in science education as a high school biology teacher.

James R. Zabora, Sc.D.

James R. Zabora, Sc.D., is Associate Director for Community Research at The Johns Hopkins Oncology Center in Baltimore, MD. In addition, Dr. Zabora is a Research Associate on the faculty of The Johns Hopkins University School of Medicine, an Instructor in the Department of Environmental Health Sciences at The Johns Hopkins School of Hygiene and Public Health, and an adjunct faculty member in the Department of Sociology at Loyola College. He is the co-editor of the Journal of Psychosocial Oncology and is a former president of the Association of Oncology Social Work. In 1994, Dr. Zabora received the Association's National Leadership Award. Dr. Zabora is the author of numerous chapters and articles related to the psychosocial care of cancer survivors and their families. In 1995, Dr. Zabora was the only staff member from Johns Hopkins to be honored by the Clergy United for Renewal in East Baltimore for his contributions to the local community in cancer prevention and control. Within the Oncology Center, Dr. Zabora administers a breast cancer screening program for low income and high risk women from a number of minority populations. Based upon his success with this program such as the highest annual follow-up rate in the State of Maryland, he was appointed as Co-Director of Community Outreach and Education of The Johns Hopkins Center in Urban Environmental Health. He has also delivered numerous educational presentations on oncology-related issues including issues of minority health in the United States, Asia and Europe.

MASTER TEACHERS

Carole Blake is currently teaching eighth grade Earth Science at Crofton Middle School in Anne Arundel County. In her two years at Crofton, she has taught all ability levels from co-taught to gifted classes. Carole enjoys sharing the science of the earth and its environment with a new generation of scientists. Her love for geology stems in part from her 5 years in Oregon, where she completed her Bachelors of Science at the University of Oregon. Carole has recently completed her Master of Arts in Teaching at Johns Hopkins University.

Rosetta Jackson has twenty-five years of experience teaching middle school science and health in Baltimore City Public Schools (BCPS). As a recipient of the Baltimore City School System, Rosetta obtained a Master's degree in Science Education. She is a graduate of the Governor's Academy for Mathematics, Science and Technology and Lockheed Martin Marietta Graduate Fellows Program. Her current position is Science and Health Department Head at Roland Park Middle School, a recently recognized Maryland State Blue Ribbon School. Rosetta also serves as Director of Camp Intervention, an elementary school integrated science program whose approach to learning is through hands-on interactive activities. In her role as an educator, Rosetta has presented at local and state conferences and workshops. She completed several research internships at Nova Pharmaceutical Company-Department of Molecular Biology and The University of Maryland Hospital, Department of Cardiology. She has served as mentor and supervising teacher for university students and BCPS new teachers. Among the numerous awards for outstanding leadership and dedication to the teaching of science, Rosetta describes her most significant accomplishment and reward is when her students successfully complete high school and college and take their place in the work force as productive citizens and leaders.

Linda Massey is currently a magnet program coordinator for the Montessori Middle Schools in Prince George's County. She began teaching after earning a Masters Degree in Education from Xavier University in Cincinnati, Ohio. Seventeen years of teaching in Montessori classrooms from Kindergarten level through eighth grade have given her a broad understanding of the educational needs of students, and a wealth of experience developing cooperative learning activities that begin with hands on experimentation. Most recently, as the Montessori Science and Math teacher at Oxon Hill Middle School in Prince George's County, she had the opportunity to develop Performance Assessment Tasks which integrated math, science and language arts lessons, helping students develop higher level thinking skills, write proficiently, and understand the 'real world' relevance of their school work. She continues this work as a curriculum writer for the Prince George's County Science Office.

Timothy Price is a science teacher and science department head at G. Gardner Shugart Middle School in Prince George's County. During summers Tim has worked with the Prince George's County Department of Natural Resources and as a teacher intern at N.A.S.A. and has served on the steering committee for N.A.S.A's Earth in Space Summer Program. Since 1996 he has done Performance Assessment writing for the county. Tim has made

various presentations at the Maryland Association of Science Teachers and the Dwight D. Eisenhower Conference.

Howard Schindler has been a classroom teacher at St. Paul's School in Baltimore County for the past twenty-two years. He currently teaches human anatomy and physiology and health education at the high school level. He has also taught sixth and seventh grade life science, and is a part-time instructor at Essex Community College. Howard has served as a content writer for MPT's EnviroMysteries and as a field tester for the NSTA program *The Science of HIV*. He has also presented at national conferences for both AAHPERD and NSTA. Howard's bachelors degree is in School and Public Health; he also holds a Masters of Education.

Bennett Seidenstein has been a classroom teacher for twenty three years. He currently is teaching grade eight earth science at Crofton Middle School after having taught geology, astronomy and environmental science at Arundel High School for ten years. Ben has been a participant in the Maryland Virtual High School of Mathematics and Science grant, funded by the National Science Foundation that explored the use of computers, the Internet and modeling software in the mathematics and science classrooms. Ben enjoys presenting technology and science lessons and recently shared volcano and crater modeling lessons at the Maryland Association of Science Teachers conference, UMBC, and at a tricounty technology conference in Prince Georges County. Ben holds a Bachelors of Education degree from State University College at Geneseo, N.Y.

Donna Smith has been a science teacher for gifted middle school students for 13 of her 26 years in the Prince George's County school system. She was selected as an Outstanding Science Teacher in 1995. She has been involved in the in-servicing of beginning middle schools science teachers each school year for the past 10 years. She serves as Department Chairperson and Science Fair Coordinator. Donna is involved in writing science and health curriculum for the County and recently served as a curriculum reviewer for the book, ***Resources for Teaching Middle School Science***, published by the National Science Resources Center. Donna enjoys taking summer courses to expand her own knowledge base. She has presented at various local science conferences on topics ranging from using statistics in the science classroom to easing Science Fair fears for students, parents, and teachers. Donna has a B.S. in Chemistry from Old Dominion University and an M.S. in Science Curriculum and Instruction from Loyola College in Baltimore.

Kelly Sullivan has been a Prince George's County science teacher for the past ten years. She has taught in the magnet science program at Nicholas Orem and Gwynn Park Middle Schools. Her past achievements include Outstanding Secondary Science Teacher of the Year 1994 (Potomac Electric Power Company, PEPCO) and Outstanding Science Teacher 1995 (Southern Maryland Electric Company, SMECO).

INTERNET & MULTIMEDIA SOFTWARE TRAINING PROVIDERS

Ron Evry

Ron Evry's first forays into using a computer were with a used Timex Sinclair with a membrane keyboard and a whopping one kilobyte of RAM. Graduating to an Apple II in the late eighties, Ron explored what seemed to be limitless new vistas. Working mostly independently, he created some popular public domain Apple II utility programs, ported the commercial ***African-American Inventors and Scientists Reading Comprehension Program*** from the PC to the Apple II, and became active with Washington Apple Pi, the nation's largest Apple user group, where he currently serves as Vice-President. Ron has written on computers for the ***Washington Apple Pi Journal, II Alive*** magazine, and ***A2Central***. His five part series in on ***AppleWriter*** for ***A2Central*** is considered the definitive piece on utilizing this powerful freeware program.

For the last four years, Ron has been running the computer lab at Antietam Elementary School in Prince William County, Virginia, where he has put an emphasis on kids using computers to expand their creative and thinking abilities, as opposed to simply learning how to operate the machines. The ***Antietam Web Page***, is programmed and designed almost entirely by fourth and fifth graders and was the first elementary school page in Prince William county. His students also work extensively with ***HyperStudio*** and ***Logo***. Ron also has integrated the use of Apple II and Macintosh computers quite thoroughly at Antietam, and students there regularly transport their work from one machine to another.

Ron was a contributing researcher to the ***Internet Kids Yellow Pages*** from Osborne/McGraw-Hill, and he regularly writes about comics and computers for ***Combo Magazine***, the ***Comics Journal***, and the nationally syndicated television show, ***Flights of Fantasy***. He is the web page editor for the National Cartoonists Society and his shareware comic book font, "Witzworx", can be downloaded from the Internet.

Evelyn Walls

Evelyn, a science teacher at Francis Scott Key Elementary/Middle Technology Magnet School, has worked as a science teacher in the Baltimore City Public School System for 22 years. Evelyn has served on the School Improvement Team and as team leader of the "Tigers" Team. In this, her fourth year as team leader, she has led and strengthened this team in the areas of team planning and management.

Evelyn is also a participant in the Baltimore Learning Community (BLC). As a participant in the BLC project, her classroom has Internet access and shares information about the BLC project and her use of technology in instruction. She was a presenter at the District of Columbia Public School's: Mathematics, Science, and Technology Initiative Conference (DCMSTI) where

she demonstrated how the computer, Internet, digital camera, CD_ROMS, and other high-tech materials are serving as highly motivational and vital resources for her students in the science classroom. Evelyn has also presented at The Maryland Technology Showcase/97 and was recently named ***Technology & Learning*** magazine's Maryland state winner in the 1998 Teacher of the Year awards program, sponsored by Microsoft Corp. The annual program honors U.S. K-12 teachers who use technology to inspire students and enhance learning.

Evelyn's classroom has an open door policy, where she is always eager to share what she and her students are doing. She has been host to a Discovery Channel film crew, College Of Notre Dame, Southern area Principal's visitors from The Baltimore Urban Systemic Initiative, visitors from The University of Maryland College Park, and others.

Evelyn is also a Net-Vision Mentor/Teacher, and an instructor for The Office of Technology and Media-Baltimore City Public Schools, where she administers workshops on "Beginning Webpage Design" for teachers and other professionals.

She has worked with her students in the completion of a project on which the students themselves presented at The Environmental Symposium In New Hampshire last spring, where they showed great facility in controlling video, digital images, web sites, laser pointers, and traditional graphics.

Evelyn also assists Bill Swartwout, Francis Scott Key Technology Magnet School's Curriculum coordinator, in the development and updating of their school's Website <http://www.fsk.org>. Evelyn and Bill recently received congratulations from the ***Discovery Channel School*** and were featured in the "School Spotlight" on the ***Discovery Channel School Website*** <http://school.discovery.com/school spotlight/>, in April of 1998.

Melanie Swieconek

Melanie Swieconek is an Art/Graphics teacher at St. John the Evangelist School in Severna Park, Maryland. She has been teaching grades K-8 for over 15 years. Computer technology has become one of her passions. She uses multimedia to enhance the students' creativity. She has been selected to be a 21st Century Teacher, which requires instructing her school faculty and staff in how to use technology as a teaching tool in the classroom. Melanie works with the teachers, in preparing and carrying out cross-curriculum lessons plans that include the use of art and computer graphics in all subject areas. Her students work with ***HyperStudio, Power Point, Claris Works , Photo Shop, Aldus SuperPaint*** among others. Melanie is head of the technology committee and is the computer technology coordinator for St. John's.

She is currently working on a program to computerize report cards and is taking classes at Loyola College in Computer Education.

This year, Melanie was one of 40 teachers selected from around the U.S. (and one of 2 Maryland teachers selected) to create innovative, standards-based "Challenges" for the ***U.S. Olympic PBS Cyber School*** web site at <http://www.ibm.pbscyber-school.org/index2.html > Melanie has been a graphic artist since 1993 and has won several awards for her photography work.

LESSON PLANS

It's in the Air!

Grade 8

Recognized for excellence by

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

Overview

The students will investigate the function of the lungs and use this information to explore how the exposure to asbestos could impact on lung function. Students will need to integrate research skills and critical thinking to achieve this outcome.
Asbestos is a naturally occurring fibrous mineral which is used for insulation and other purposes in the United States. When inhaled, the fibers become imbedded in the lung tissue causing health problems such as asbestosis, lung cancer and metsothelioma.

Technology Resources

Internet Sites:

Environmental Protection Agency: The Asbestos Informer
http://www.epa.gov/region04/air/asbestos/inform.htm
This site provides background information on asbestos and its effects on health.

Environmental Protection Agency
http://www.epa.gov/epahome/browse.htm
This site provides background information on asbestos.

Asbestos Institute California
http://www.asbestos-institute.ca/
This site provides information on asbestos from the commercial point of view.

Laserdisc:

Windows On Science Volume 2
Life Science Optical Data
This laser disk is full of life science related material as it pertains to the body.
Optical Data Corporation
30 Technology Drive
Warren, New Jersey 07060
(800) 542-2481

Teacher Background Information

Asbestos is a naturally occurring fibrous mineral found in Canada, Africa, Eastern Europe and in the United States. It is a strong, flexible material which will not burn, a poor conductor of electricity, but works effectively as an insulator.

There have been references citing asbestos use by the ancient Romans (the restaurant owners would throw the table cloth into the fire after each customer left so the food would be burned off and ready for the next guest.) Asbestos was first mined in Canada in the 1870's . The long narrow fibers were widely used in construction from 1928 through 1978. Construction use included insulation, floor and ceiling tiles, and plaster.

Asbestos is mined like other minerals and comes in three main forms: chrysotile, amosite and crocidolite. The amosite and crocidolite types are like tiny needles whereas the chrysotile type fibers are pliable, cylindrical and are often arranged in bundles.

Most minerals when crushed turn to dust, however asbestos breaks up into fibers too small to be seen by the human eye.

When asbestos fibers are released into the air, people can inhale them into their lungs. The fibers become imbedded in the lung tissue causing such health problems as asbestosis, lung cancer, mesothelioma and other cancers.

In 1979, the Toxic Substance Control Act (TSCA) began to impose some regulation on asbestos-containing materials (ACM) and in 1982 the EPA issued regulations to control asbestos in schools. In 1985, the EPA established loans and grants to aid schools in conducting asbestos abatement projects.

The Asbestos Hazard Emergency Response Act (AHERA) of 1986, requires school systems to have an asbestos management plan in all schools. This plan is to evaluate the asbestos in each building and provide the best method to reduce asbestos exposure. This plan must be available to parents, students and teachers and is to be updated regularly.
Asbestos risk reduction occurs in three main ways: encapsulation, enclosure or removal. All of these procedures must be carried out by accredited abatement contractors.

Objectives

The students will be able to ...

- construct a model of the lungs to simulate the respiratory system.
- label and evaluate the functions of the respiratory system.
- understand the potential threat of asbestos in our environment
- collect and interpret data to make informed decisions about asbestos risk.

Vocabulary

Asbestos: a naturally occurring fibrous mineral found in Canada, Africa, Eastern Europe and in the United States. It is a strong, flexible material which will not burn, a poor conductor of electricity, but works effectively as an insulator.
Indoor Air Pollution: the build up of gases or particles inside a building which pose a threat to human health and comfort.
Friable: under hand pressure capable of being crushed into powder.
Toxic substance: any subsistence which could be harmful to your health.
Encapsulation: materials used to prevent the release of asbestos fibers.
Enclosure: placing the asbestos-containing material in an area where it will not be disturbed.
Mesothelioma: rare type of cancer found in the outer lining of the lung, abdomen lining and the wall of the testes.
Asbestosis: a non-cancerous respiratory disease caused by inhaled asbestos fibers which aggravate the lung tissue. Symptoms include shortness of breath, dry crackling sound in the lungs when inhaling and, if allowed to advance, could cause cardiac failure.
Respiratory system: the group of organs working to provide oxygen to the blood and remove carbon dioxide from the blood.
Bronchial tubes: main divisions of the trachea which lead to the lungs.
Alveoli: tiny air sacs in the lungs where oxygen and carbon dioxide are exchanged.

Materials

Per class:

- Computer with modem and Internet access (or copied web site resource booklet)
- Laser disc player and monitor
- Dilemma cards

Per student group: (2 students to a group)

- 3 straws
- Clear plastic bottle with top
- Clay
- 2 small balloons
- 1 large balloon
- Rubber bands: 2 small; 1 large
- Scissors
- Optional-glue
- Small mirror
- *Student activity sheets:* The Great Breathing Machine, Internet WebQuest Sheet, Town Meeting Dilemma Cards and Activity Sheet, Writing Prompt.
- Paper towels

Next

Procedure

1. Direct students through a discussion on how we breath by posing the question How can you show me that you are breathing ?

   Possible responses: My chest is moving up and down. My lungs are expanding. You can hear when I take air in through my nose and mouth. You can feel the air come through my nose and mouth.

   Have them record their responses on the student answer sheet The Great Breathing Machine.

   Suggest that you have a way that you can see the air we breath.

   Pass out the mirrors and paper towels to the students.

   Have each student hold the mirror near, but not touching their mouth. Exhale onto the mirror a couple of times and record results on the student activity sheet The Great Breathing Machine.

   Discuss why the mirror becomes fogged.

2. Show the *Windows On Science* laser disc diagram of the respiratory system. Discuss the path air takes as you inhale and exhale.
   Frame 13922 - enter-respiration
   Frame 14319 enter-trachea
   Frame 13933 - enter-nasal passages
   Frame 14321 enter -lung
   Frame 13924 - enter-pharynx
   Frame 14336-enter diaphragm
   Frame 13925- enter epiglottis
   Frame 14337-enter inhaling
   Frame 13926- enter trachea
   Frame 14338-enter exhaling
3. Pass out the materials to construct a model of the respiratory system. Have the students follow the procedure on their packets to make the models.
4. Discuss breathing. Explain the role of the diaphragm and that when it contracts you take in air and when it expands you expel air. Use a student model to show this.
5. Direct the discussion to what is traveling through our lungs as we breath. If time permits you could implement the following demonstration:
   Demonstration Materials:
   - Plastic wash bottle
   - Cotton (enough to half fill the bottle)
   - Cigarette

   Half fill the bottle with cotton.

   Cut the nozzle of the wash bottle to fit the cigarette.

   Light the cigarette and squeeze the bottle.

Allow the smoke to be drawn into the bottle, coating the cotton with its tar and residue.

6. Discuss and list on the chalk board some indoor air pollutants which you could possibly find in a school. If asbestos is not mentioned add it to the list.
7. Have the students research asbestos using the WebQuest Activity Sheet in the student activity sheet packet.
8. Come back as a group and perform "The Town Hall Dilemma" Activity.

   Read scenario to the students.

   Pass out the role cards for the town hall meeting. Explain that each person must act out the role they are given and that they must put personal feelings aside. Arrange the room so that the board members are in the front of the room and the attendees make up the audience. Provide a place for each person to come and present their views (limit presentation to 2 minutes). After all sides have been heard allow the panel (board members) to meet for a few minutes (no more than 5) then come back to the group to render their decision.
9. Have the students individually answer the writing prompt.

Extensions

Science
Order a kit from the EPA to conduct indoor air pollution tests. The kits are free to those who have an administrator ask for one on school letter head at the address below; otherwise kits can be purchased for $22.00.

Have the students conduct tests in various locations in the school.

Language Arts
Have the students write up a report /letter to the principal concerning their results.

EPA Indoor Air Quality (IAQ) Tools For Schools Action Kit
GOP order number 055-000-00503
P.O. box 37133
Washington DC, 20013-7133
Fax : (202) 484-1510
Phone: (202) 512-1800

Note: The EPA also has an IAQ Information Clearing House video free of charge for school systems. 1-(800) 438-4318

1998 EnviroHealth LinkTeam Master Teacher Team

Kelly Sullivan And Timothy Price

Name _____ Date _____

The Great Breathing Machine

1. How can you show me that you are breathing?

2. What happened to the mirror? Explain why this happened.

A Model of the Respiratory System

Per student group (2 students to a group):

- 3 straws
- Clear plastic bottle with top
- Clay
- 2 small balloons
- 1 large balloon
- Rubber bands -- 2 small; 1 large
- Scissors
- Glue

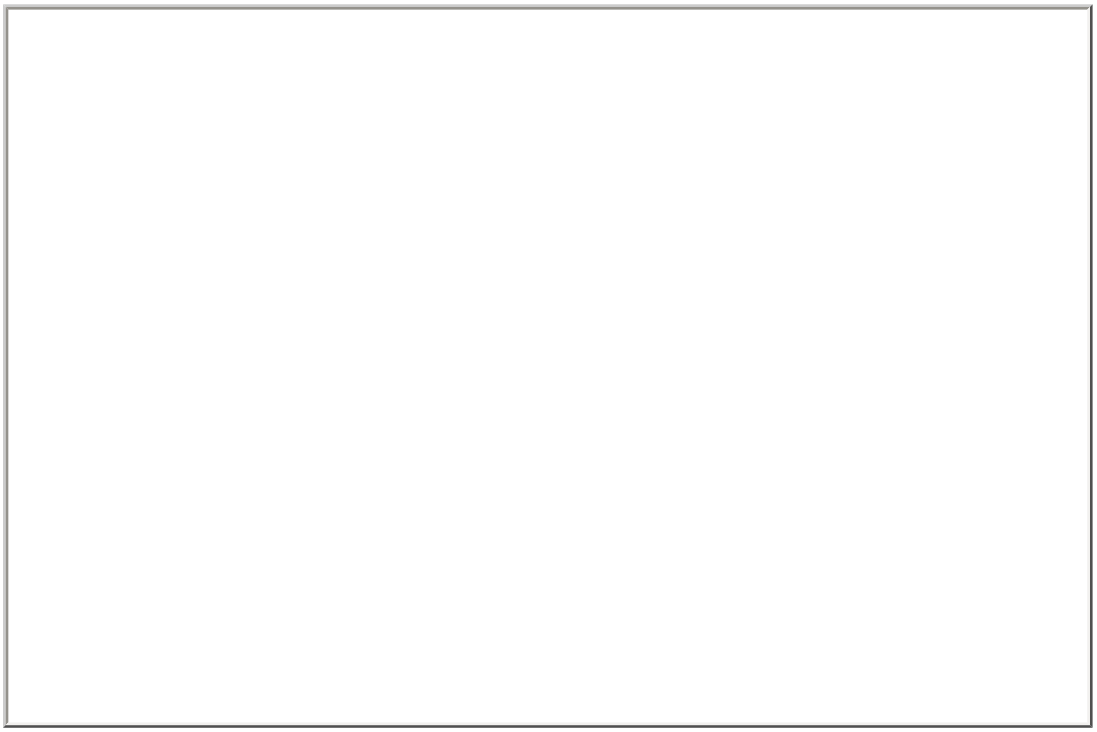
Procedure:

1. Obtain all materials above.
2. Remove all labels and and cut the bottom off the bottle. Keep the top sealed.
3. Cut the top off the large balloon and tie a knot in the stem.
4. Place the open end of the balloon around the bottom of the bottle. Secure with the large rubber band.
5. Attach each small balloon to a straw with the rubber band.
6. Poke a hole on each side of the bottle near the top. The hole should only be large enough to accommodate the balloon and straw.
7. Insert the straw (balloon side down) into the bottle and secure with clay. **You may want to glue the straw to the side of the bottle first and then cover with clay. This should be sealed tightly.**
8. Pull down on the knotted balloon at the bottom of the bottle. Record observations.

3. What happened to the two small balloons inside the bottle as you pulled down on the rubber band?

4. What does this simulate?

Draw and Label Your Model



Label: lung, trachea, bronchial tubes, diaphragm

Name _____ Date _____

Internet WebQuest Activity Sheet

List the possible indoor air pollutants which you might find in a school.

Pollutants

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

In groups of 2-4 access your web browser and type in the following URL's.

http://www.epa.gov/region04/air/asbestos/inform.htm

http://www.epa.gov/region04/air/kids/kasbet1.htm

http://www.asbestos-institute.ca/

Locate the answers to the following questions.

1. What is asbestos?

2. Where is it produced?

3. What is it used for?

4. What are some of the benefits of using asbestos?

5. Where would you be likely to find asbestos in a school building?

6. When was asbestos most widely used in the United States?

7. How do we come into contact with asbestos?

8. What is ACM?

9. What does friable mean?

10. Are there any illnesses associated with asbestos? If so what are they?

11. What is AHERA? How does it affect you?

12. Should all asbestos be removed?

13. Are there products to replace asbestos? If so what are they and what are the risks associated with these materials?

Name _____ **Date** _____

Town Hall Dilemma Cards

EPA Official
Your job is to make sure only the facts about asbestos are presented. You interject when people misrepresent the information.

Student #1
You attended one of the five schools which have asbestos problems. You really are interested in the Internet and feel you deserve to have access in your school.

Student #2
Asbestos is safe isn't it? I mean what harm could it do just to move a few tiles? Just hold your breath until the dust settles.

Student #3
You have gathered all of the facts on asbestos exposure. You feel it is your job to inform the citizens on the risks of asbestos exposure.

Lawyer For The School System
You are here to keep the peace and help the school district to look favorable in the eyes of the public.

Student #4
You attend a new school and would love to have more computers to use. You really favor the proposal to add more computers to your school.

Student #5
You chair the environmental Health club at your school. You think that asbestos poses a serious health risk. You think the school board should remove the asbestos from all school buildings.

Student #6
You have researched asbestos and think that as long as precautions are taken there is no real problem. You present information that asbestos is not a danger if handled correctly.

Board Member #1
Environmental enthusiast: You would never do anything to harm the environment. You believe that asbestos should be removed from all school buildings no matter what the cost.

Board Member #2
You own a construction company which wants to bid for the job to install the Internet lines. You want the lines to go into as many schools as possible.

Board Member #3
Your family has a history of cancer. You are concerned about the risk of asbestos exposure. You believe that all students should have Internet access.

Board Member #4
Your son has an asthma problem and attends one of the schools which needs new tiles.

Board Member #5
You really do not have an opinion yet. You do not know much about asbestos. You will need the comments of the citizens to help make your decision.

Name _____ Date _____

Town Meeting Activity Sheet

Based on the information you collected from the Internet and class discussion you will roll play a town hall meeting. You will be given a dilemma card and you must act out the role on your card regardless of your personal beliefs.

Scenario: The school board has decided that all schools should have Internet access in each classroom. They have set aside a limited budget to accommodate this maneuver. In doing the research to wire all schools, five schools were found to have asbestos in the ceiling tiles. According to the guidelines as long as the tiles are not moved they do not pose a health risk; however, wiring these schools for the Internet will cause the tiles to have to be removed at an additional cost to the school system (money the system does not have). This town meeting has been called to discuss this problem. Currently there are two proposals being discussed.
Proposal #1-wire only the new schools for the Internet and spend any extra money on new computers for these schools.
Proposal #2-wire all the schools and just don't worry about the asbestos. It's really not a problem to move some tiles around.

Each student selected should read their dilemma card.
All other students are audience members.
The board should set up a panel of desks in the front of the room to begin the hearing.
Each person should be prepared to present a 1-2 minute comment either to support or reject a proposal.
After the board hears all comments they can have 5 minutes to discuss and give their decision.

Name _____ Date _____

Writing Prompt

You have just heard the decision of the school board on what they would do about providing Internet access to schools with asbestos ceiling tiles. Pretend that you are a board member who is asked to decide what to do about the asbestos in your school system. Assume that 85% of the schools in your district have some ACM primarily found in ceiling or floor tiles and in the plumbing equipment. The cost to remove all of the materials would be in the millions. Using the information you collected from your research, provide a suggested solution for this problem.

Now Hear This, If You Can

Grades 7 - 8

Overview

Nearly 20 percent of middle and high school students nationwide suffer some degree of hearing loss. This is a rise from 5 percent just twenty years ago. Sounds louder than 80 decibels can cause permanent damage to the ear. Much of the exposure to noise pollution is involuntary; however, there are areas that can be controlled by the individual. Students will learn how we hear and the effects of noise pollution on their hearing by determining the loudness of various sounds and comparing exposure time to the loudness of the sound. They will create their own decibel scale, plot graphs of maximum exposure times, and use the graphs to predict the maximum safe exposure times for various school sounds.

Extensions include learning about methods to prevent hearing loss and writing about what they can do to protect their own hearing from further loss.

Media/Technology Resources

FOR STUDENT RESEARCH:

Computer Programs (Interactive):
How Loud Is Too Loud?
NGS Kids Network
National Geographic Society
1145 17th Street NW
Washington, DC 20036-4699
1-800-368-2728
Provides a hands-on inquiry approach to learning about sound and its effect on the human brain. Students can collect, analyze, and exchange data with network members. Reusable test kit includes six sound meters.

Explorations in Science Curriculum, Sound Unit Lessons:
Hartley/Jostens Home Learning
9920 Pacific Heights Blvd.
Suite 500
San Diego, CA 92121-4330
(800) 247-1380
Lessons provide Attention-Grabber Introduction, Computer-Simulated Laboratory, Notebook Assignments and Questions, and Reflections on the nature of sound, how sound travels, and what we can hear.

Internet Sites:
Counsel on the Environment
http://www.cenyc.org
Colorful and easy to read, this site offers a broad overview of the problems of noise pollution.

Noisy Toys
http://www.lhh.org/noise/children/toys.htm
Many toys designed to stimulate children can be dangerously loud, especially for younger children.

H.E.A.R. (Hearing Education and Awareness for Rockers)
http://www.hearnet.com
Every page of this site offers pictures of rock stars and quotes from them urging young people to protect their hearing. Designed to capture the interest of young people, the site also offers solid information in an accessible form.

Noise, Ears and Hearing Protection
http://www.netdoor.com/entinfo/noiseaao.html
Bright, colorful, and beautifully done informational web page, all about noise and hearing loss from the American Academy of Otolaryngology.

FOR TEACHER RESEARCH:

Media Resources:
Our Embattled Ears, Newsweek, 8/25/97, p.75
Recent article giving current information about noise pollution concerns.

Listen Up!, Science World, 2/23/98, p. 18
Article addresses hearing losses in teens.

Sound Power, Science World, 2/23/98, p. 7 TE
Lab activity used in this lesson.

Internet Sites:

Noise and Its Effects
http://www.nonoise.org/library/suter/ suter.htm
Teachers interested in more information about this subject should start here. This site offers a well organized, comprehensive overview of noise pollution research.

Noise Pollution Clearing House
http://www.nonoise.org
This includes a wonderful search tool offered by the Noise Pollution Clearing House which provides easy access to a plenitude of recently published articles about noise pollution.

National Resources Defense Council
http://www.nrdc.org
Four environmental awareness websites located at one address; this site also includes a great search tool.

Next

Teacher Background Information

Recognition of noise pollution and prevention of its harmful effects are two very difficult agendas. The dangers of noise pollution are well documented. In response to the dangers, some local governments have enacted noise ordinances. In 1990 New York City issued 1000 citations for violations of its antinoise ordinances. Some Southern California cities have been empowered to confiscate the big speakers installed in cars to make them into "boomcars" if the car's speakers can be heard 50 feet or more on a public street. Airports limit the number and size of airplanes taking off after a certain time at night. Even with these ordinances, noise pollution is so low a priority for the U.S. government that the EPA's Noise Control Office was closed in 1982 and the noise emission labeling requirements were dropped.

Though most of our exposure to noise pollution is involuntary and beyond the control of the average person, we are also at risk in our private lives, which is within our control. Chain saws, power lawn mowers, vacuum cleaners and dishwashers all contribute to this pollution. The public is slowly responding to the need to wear sound mufflers for the first two noise makers, yet the same protection is not accepted as being a need in the home. A food processor produces noise at the same level as a heavy truck passing on a street!

Young people are even more susceptible to hearing loss due to their noisy environments: band practice, riding a school bus, using a Walkman or boombox. If you can hear the music from a Walkman someone next to you is wearing, then damage is being done to the person's ears. Hearing thresholds change and students often are not aware of how loud their music, etc. is. Studies have shown that females are more willing to say that the music is too loud. Why males do not respond as quickly could be due their already reduced hearing or the desire to maintain a macho image.

Learning Objectives

The student will be able to . . .

- demonstrate an understanding of noise pollution and its effect on one's hearing
- demonstrate how the ear transmits sound waves to our brain
- collect, organize, graph, and interpret data
- demonstrate an ability to calculate data based on observed patterns
- demonstrate the ability to apply scientific knowledge in making personal decisions about exposure to loud sounds.

Vocabulary

decibel: unit used to measure the intensity of sound
frequency or pitch: how low or how high a sound is
hearing threshold: the degree of loudness at which one first begins to hear
intensity: the loudness or energy/force of a sound
noise: any unwanted sound
noise pollution: noise caused by human activities that is capable of causing harm

Equipment and Materials

Per Class:

- Computer with Internet access (or web page resource booklet)

Per student:

- notebook paper
- graph paper
- graphing calculator
- pencil
- colored pencils/markers
- *Activity Sheets:*
  How We Hear
  Causes of Deafness
  The Decibels of Sounds
  Preventing Hearing Loss
  Exposure Times
  Noise Pollution and Me
  Sound Power Lab

Per group of 2:

- 2 meter sticks
- sound level/noise meters
- colored pencils/markers

Sound Power Materials Lab Activity (per group of 4):

- empty toilet-paper tube
- scissors
- balloon
- 2 rubber bands
- candle
- matches
- metric ruler

For the teacher:

- Answer sheet for Activity 1, and Extenstion Activity 1

Next

Procedures

Activity 1: How We Hear

1. Ask students to hold their right hands at shoulder height as if they were taking a courtroom oath. Now instruct them to rub their thumbs and forefingers together. Ask them if they could hear a high-pitched scratching sound. Tell them to repeat using their left hands and left ears.

2. Ask students if they could hear the sound this time? Did the scratching sound clearer or louder for one ear than the other? Tell them that many people cannot hear soft scratching sounds like this. If they are not suffering from a cold or sinus infection, then they are probably experiencing a hearing loss.

3. Tell students that they are going to first learn (or review) how humans hear and then they will learn how we damage our hearing. Give students *Activity Sheet,* How We Hear to complete.

Activity 2: Causes of Deafness

1. Give students the *Activity Sheet,* Causes of Deafness. It is a reading assignment giving background information and a few questions.

2. If students have access to the Internet, this information can be obtained from the Internet sites previously listed. Students could use the Internet to obtain information in greater depth.

3. After this activity is a good time to do the Lab Activity, Sound Power which can be found in the extensions.

Activity 3: The Decibels of Sound

1. Students can use either lined paper or graph paper for the activity; however, the information is more easily seen using lined notebook paper.

2. In step 6, student should work in pairs.

3. Ideally a sound meter is needed for every 4 students; however, the data can be collected with only one meter by assigning the tasks to several students.

Activity 4: Preventing Hearing Loss

1. Give students the *Activity Sheet,* Preventing Hearing Loss. It is a reading assignment giving background information.

2. If students have access to the Internet, this information can be obtained from the Internet sites previously listed. Students could use the Internet to obtain information in greater depth.

Extensions

Math and Science
Activity 1: Exposure Times

1. These activities will help the student understand the relationship between the loudness of a noise and the exposure time and require higher thinking skills. Use teacher discretion to decide if you should model the beginning of each item.

2. Give students the *Activity Sheet,* Exposure Times, and have them complete the chart.

3. Students may construct the graph either on graph paper or with a graphing calculator.

4. The intent is for students to understand that if the safe exposure time is lower, it will not prevent their listening to loud music. The lowering of the exposure time is a recognition that loud sounds do more damage to hearing than previously thought.

Language Arts and Science
Activity 2: Noise Pollution and Me

1. Give students the *Activity Sheet,* Noise Pollution and Me.

2. You might wish to have students brainstorm this topic prior to the actual writing. Have the students create a graphic organizer to help them collect their thoughts prior to writing.

Science
Lab Activity 3: Sound Power

1. Give students the *Lab Activity Sheet,* Sound Power.

2. Any size paper tube will work for this lab. Students might try different sizes to determine if the results are the same or different.

3. It is possible to use pieces of latex gloves or even plastic wrap in place of the balloon and have good test results.

1998 EnviroHealth Link Master Teacher Team

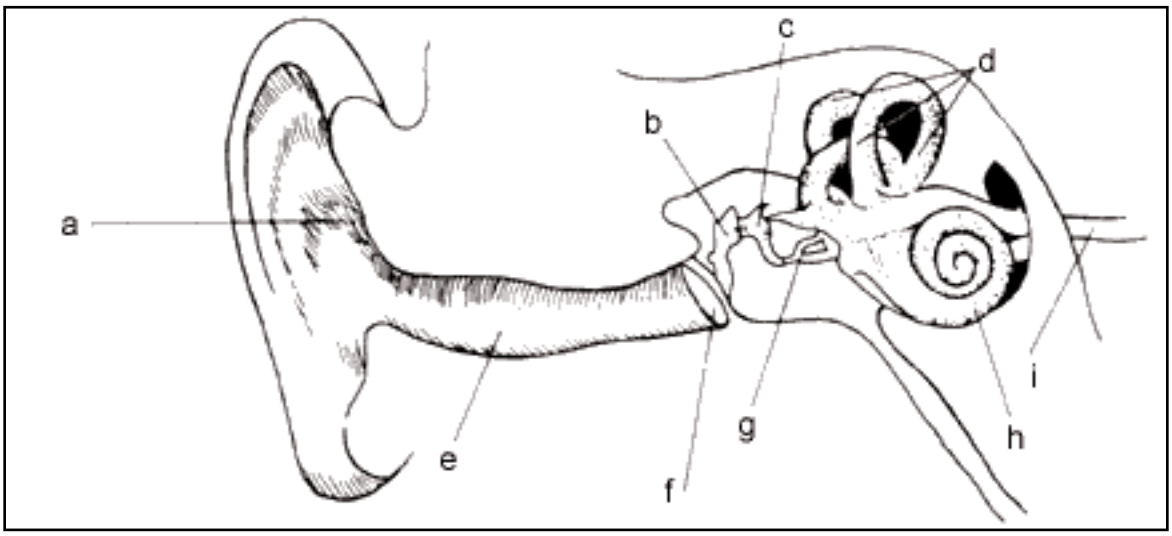
Donna Smith and Linda Massey

Name _____ Date _____

How We Hear

Our ear has three sections: the outer ear which directs sound waves to the middle and inner ear and protects the inner parts, the middle ear which protects the inner ear from shock by equalizing the pressure on the eardrum and the inner ear which transmits the sound impulses to the brain.

1. On the diagram below, divide the Human Ear into the three sections named above. Label each section and give its function.



2. As you continue reading, label the other parts of the ear which are listed below in bold print. Identify the **ear canal** which is part of the outer ear.

3. The ear canal acts like a megaphone. You can test this by cupping your hands around your outer ear and saying "something." Remove your hands and repeat what you said. Did your "bigger ears" let you hear better? _____

4. Your middle ear contains your **ear drum** which vibrates as sound waves hit it, and the three bones (**hammer, anvil, and stirrup**) which transmit the sound vibrations to nerves in the inner ear.

5. The middle ear contains the **Eustachian tube** that goes from your middle ear to the back of your throat near your mouth and nose. Have your ears ever popped when you went up in an elevator or plane? That "pop" was the sound of air moving in your Eustachian tube to equalize the pressure on both sides of your ear drum.

6. In your inner ear are the **semicircular canals** that control your sense of balance and the **cochlea** that transmits the sound waves as an electrical impulse by the **auditory nerve** to the brain. The brain then interprets these impulses as sound.

Name _____ Date _____

Causes of Deafness Activity Sheet

What can cause a loss in hearing? Everyone is affected by excess noise to some degree and some people are more sensitive to noise than others. The effect of the noise depends on loudness, pitch, length of exposure, surroundings, age, previous ear trouble, distance from the source, and the position of the source. No one is immune to the long-term effects of noise.

A loss of hearing can be caused by damage to any part of the ear. Infections, accidents, and noise pollution are the major cause of damage. Noise pollution causes the most damage. Loud, prolonged sounds damage the cochlea and the tiny hair cells (cilia) that line it. It is these cilia that transmit the vibrations (nerve impulses) to the auditory nerve. If the cilia are damaged, no message can go to the brain.

Loud sound waves bend and sometimes break the cilia. A person who has been exposed to a loud sound might describe the sensation as the ear feeling full or having pressure, buzzing or ringing (tinnitus). If the ear gets some rest from the loud sounds, the cilia will return to their upright position. Unfortunately, they never recover 100 percent and are more likely to be further damaged when exposed to more loud sounds. When cilia cells die, they are not replaced by new cells and the person has a gradual loss of hearing which can range from a constant ringing in the ear (tinnitus) to total deafness.

If loud sounds can cause deafness, then how loud is a damaging sound? To answer this question you will need a decibel chart which you will construct in the next activity. A decibel (dB) measures the intensity (or amount of energy) produced by sounds. In other words, it measures the pressure of the sound waves (an indication of loudness) on your ears. An increase of 10 dB means the new sound is 10 times more powerful than the previous sound.

1. Think about the sounds made by: a power lawn mower, a ringing telephone, a shouting voice, and a normal conversational voice. Rank them from softest to loudest.

2. The softest sound is that of a normal conversation, followed by a ringing telephone. A power lawn mower and a shouting voice tie for the loudest sound. How did your answers compare to the above ranking of sounds?

3. Where in your ranking would you put the noise in a classroom or the noise heard on a school bus full of students?

Name _____ **Date** _____

The Decibels of Sounds Activity Sheet

1. Draw a line down the center of a sheet of notebook paper.

2. Space the numbers 0-150 by increments of 10. Label these values as decibels.

3. Place each of the following sounds at the correct decibels level on your line.

Decibels	Sound
0	threshold of hearing
15	whisper
40	refrigerator
50	normal conversation
60	average home
70	telephone ring
90	power mower
90	shouting voice
100	honking horn
110	jack hammer
130	jet taking off

4. Using a red pencil, shade in an arrow that goes from 80 dB to your highest dB and write "hearing loss." Also mark 120 dB as the "onset of pain."

5. Now add the decibels of some teen sounds to your decibel line.

Decibels	Sound
110	Cassette player/Walkman
115	Rock Concert
100 - 120	Boombox

6. Let's explore your school environment and its noise levels. A quick test is to go to various parts of the school with a partner and a meter stick. Stand 1 meter away from your partner and have the partner talk to you. Can you hear the person without his/her shouting? _____ If you have to raise your voice to speak to someone 1 meter away, your environment is too noisy.

7. To do a more scientific test, you will need to use a sound level meter or noise meter. The sound level measurements are in decibels. Your teacher will show you how to operate the meter. Remember to observe these measuring instructions as you complete the activity:
    - When measuring a sound, you should be one meter from the target
    - When in a room or hall, try to position yourself near its center
    - If the sound shows varied levels, take several readings and average the values or record the highest and lowest values.

8. Record sounds from various places in your school: the cafeteria, the halls during class changes, and your classroom during a lab and during a test. Record the data on the table below.

Location of Sound	Decibels

9. Transfer the data in #8 to your Decibels of Sounds line.

10. Sounds louder than 80 dB can cause permanent damage to the ear. Teens are subjected to many sounds louder than 80 dB. Using your data on the "Decibels of Sounds" Line, describe how the noises in your school rank. Are they too loud? Would it be possible for some of these noises to cause damage to your ears? What do you think could be done to help protect your hearing?

11. Predict where you think the sounds of a school dance or sports event would be on your decibel line. The next time your school has a dance or sports event, ask your teacher to let someone record the sound levels.

12. If possible, bring a noise-producing toy to school and determine its decibels

Name _____ Date _____

Preventing Hearing Loss Information Sheet

A recent study at the University of Florida revealed that 17 percent of middle and high school students nation-wide suffer some degree of hearing loss. In a similar study done 20 years ago, only 2.5 percent of students the same age reported hearing problems. Why are teenagers suffering a loss in their hearing? Sixty-year-old men and women of the Mabban tribe have the hearing of a young person. What accounts for their good hearing ability? Could it be their silent, desert environment in the Sudan? Does this mean that a noisy environment contributes to a hearing loss?

Can hearing losses be corrected or prevented? Hearing aids cannot bring back one's hearing loss, but they can magnify the sounds to allow the person to hear better. For many people, the hearing aid will eventually not help and the person is deaf. Deafness was one of the first recognized legal causes for workmen's compensation. To help protect the hearing of workers, maximum exposure times for various sound levels were established. The chart, in "Exposure Times", shows the current noise exposure time at various dB levels allowed for workers in the United States. Some countries, such as the Netherlands, have lowered the decibels to 80 dB for an eight hour exposure time. Present studies indicate that an upper limit of 75 decibels would reduce the risk for noise-induced hearing loss even more.

There are several ways to help prevent a hearing loss: having quieter machines, using noise dampers or sound barriers, increasing the distance from the noise source, and shorter exposure items. Most important is that you are aware of your noisy environment and its effect on your hearing. "We teach kids to keep their hands off the hot stove," says Jeff Baxter of the Doobie Brothers. "Let's do the same with their hearing." Once people are aware of the noise pollution problem, they can look for solutions such as reducing exposure time to loud sounds, reducing the loudness of the sound, or wearing a protective covering such as earplugs or mufflers. Unfortunately, many of the sounds of noise pollution are ones that individuals cannot control. The Environmental Protection Agency's branch that monitored noise pollution was disbanded in 1982. Even when there were regulations and monitoring, it was difficult to enforce them. New efforts need to be made to make the public aware of the severity of the problem.

The organization HEAR (Hearing Education and Awareness for Rockers) is dedicated to raising awareness about hearing loss caused by deafening music. Rockers like Metallica, Red Hot Chili Peppers, Sonic Youth, Primus, and Jane's Addiction support HEAR's campaign to turn down the amps. DJ's report that when the volume is turned down, no complaints are made that the music is to low.

Many rockers wear earplugs-and encourage their fans to wear them too. You can receive a free pair of neon earplugs by sending a self-addressed stamped envelope to:

Hearing Is Priceless
House Ear Institute
2100 W. Third Street, 5th Floor
Los Angeles, CA 90057

Your hearing is a sense that cannot be replaces once it is lost. Helen Keller, who lost both her hearing and sight due to a childhood bout with measles that destroyed part of her central nervous system, said, "The problems of deafness are more complex if not more important than those of blindness. Deafness is a much worse misfortune because of the loss of the most vital stimulus, the sound of the voice that brings language, sets thoughts astir and helps us in the intellectual company of man".

Name _____ Date _____

Exposure Times Activity Sheet

1. For every 5 decibel increase in loudness, the maximum exposure time is cut in half. Complete the data chart by determining the exposure time in hours. Do not complete the ones with***.

	Current	Proposed
Decibels	**Time in Hours**	**Time in Hours**
75	***	
80	***	
85	***	
90	8	
95		
100		0.25
105		***
110		***
115		***

2. With the information you have just calculated, construct a line graph for the Current Exposure Time in Hours or use your graphing calculator for its construction. Your teacher can give you the steps for using the graphing calculator.

3. Plot your data points for the first line. **Do not use the Proposed Time in Hours data at this time**. Now connect the points to form a line. Extend the line in each direction to allow you to make predictions about the exposure times of other sound levels. Label this line "Current".

4. Use another color to plot your data points for the proposed exposure times and draw its best fit line. Extend this second line and label it "Proposed".

5. Complete the Decibel column by using your data from *The Decibels of Sounds Activity Sheet*. Use the two lines drawn on your graph to complete the last two columns of this chart.

Activity	Decibels	Current Exposure Time	Proposed Exposure Time
rock concert			
cafeteria			
boombox			
walkman			
classroom			

6. Think about your exposure to these various activities. Is your exposure longer than the recommended current exposure time? _____ Longer than the proposed exposure time? _____ Do you feel that you are risking a hearing loss by your exposure?_____ How would changing the exposure times affect you? _____ Would you follow the recommended changes? _____

7. Explain your feelings about your exposure risks.

8. The best earplugs are those fitted to your ear canal by an audiologist. They can reduce the intensity of a sound by 35 decibels. List the activities from your decibel graph that would be reduced to a non-harming level by such earplugs. Explain if earplugs would be practical in each of the situations on your chart.

Name _____ Date _____

Noise Pollution and Me Writing Prompt

You have been learning about noise pollution and how it can affect your hearing. Think about all you have learned. Decide what in your life could threaten your hearing and explain what you **personally** can do to better protect this valuable sense.

Name _____ Date _____

Sound Power Lab

Sound Waves cause air to vibrate. We hear sound when the vibrating air travels to our ears. What else can vibrating air do? Try this with a friend.

What You Need:

- empty toilet-paper tube
- scissors
- balloon
- 2 rubber bands
- candle
- match
- ruler

What To Do:

1. Cut two circles from the balloon, about 5 cm (2 in.) in diameter. Cut a small hole in the center of one balloon circle.
2. Stretch a balloon circle over each end of the paper-towel tube and secure with a rubber band.
3. Have a friend hold the candle, then light it.
4. Hold the tube about 5 cm (2 in.) from the candle. Make sure the hole is facing the candle.
5. Use your fingers to tap the other end of the tube softly. What happens to the candle's light?
6. Repeat steps 3 to 5, but this time tap the end of the tube firmly. What happens?

Conclusions

How does sound affect the candle's light? How does this demonstrate what loud sounds can do to the ear?

> ***Don't stop now!*** *Repeat the activity a few more times. Each time, move the candle about 2.5 cm (1 in.) farther back. How far away does the tube have to be before is stops affecting the candle?*

Answer Sheet

Activity 1: The Human Ear

a. outer ear
b. hammer
c. anvil
d. semicircular canals
e. ear canal
f. ear drum
g. stirrup
h. cochlea
i. auditory nerve

Extension Activity 1: Exposure Times

- empty toilet-paper tube
- scissors
- balloon
- 2 rubber bands
- candle
- match
- ruler

	Current	Proposed
Decibels	**Time in Hours**	**Time in Hours**
75	**	8
80	***	4
85	***	2
90	8	1
95	4	0.5
100	2	0.25
105	1	***
110	0.5	***
115	0.25	***

Sun Smart, Skin Safe

Grades 6 -8

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Overview

The Center for Disease Control states that Skin cancer is the most common and most rapidly increasing form of cancer in the United States. Many skin cancers are caused by overexposure to the sun's rays over long periods of time and are preventable with proper skin protection. Knowledge of the risk factors for skin cancer can set in motion lifelong habits that will possibly prevent many future skin cancers or even death.

Students will do research in this lesson to learn about the layers of the skin, types of skin cancer, and possible causes of cancer by conducting a WebQuest to determine the risk factors for skin cancer and by assembling a personal skin protection kit.

Technology Resources

Internet Sites:

Sunscreens: Do they cause skin cancer?
http://vvv.com/HealthNews/dsunscre.html

National Skin Cancer Prevention Education Program
http://www.cdc.gov/nccdphp/dcpc/ nscpep/skin.htm

The Darker Side of Tanning
http://www.fda.gov/cdrh/tanning.html

Introduction to Skin Cancer
http://www.maui.net/~southsky/introto.html#about

National Skin Cancer Centre: Singapore
http://www.nsc.gov.sg/

Bulletin of Sample Public Health Messages to Accompany UV Index
http://www.noaa.gov/uvb/heal.html

Online Image Database
http://tray.dermatology.uiowa.edu/DermImag.htm

Learning Objectives

Students will be able to ...

- describe the three types of skin cancer.
- describe the risk factors of skin cancer.
- assemble a personal skin protection kit.

Vocabulary

basal cell carcinoma: slow growing painless skin cancer
squamous cell carcinoma: skin cancer that usually appears on elderly patients
malignant melanoma: cancer of the pigment cells of the skin that is highly harmful
epidermis: upper layer of skin containing squamous cells
dermis: layer of skin below the epidermis containing basal cell and melanocytes
melanocytes: cells in the skin that produce melanin
melanin: skin pigment that protects us from the sun's radiation

Materials

For class:

- Computer with Internet access (or web page resource booklet)
- Overhead of skin layers
- Overhead projector

For each student:

- Copy of student *Activity Sheet*, Student Research Page: WebQuest
- Diagram of skin layers
- Copy of student critique

Next

Procedures

Day 1:
(Students should be grouped in pairs.)

1. Distribute student worksheets and skin diagram.
2. Have students read questions to establish purpose for research.
3. Put skin transparency on overhead projector. Discuss layers of the skin emphasizing where basal and squamous cells are.
4. Explain that students will be required to assemble a personal skin protection kit in their groups.
5. Students conduct a WebQuest to answer questions using the Internet resources available (computer lab or copies of web pages).
6. Student pairs should plan who will bring items for the personal skin protection kit. (Some items suggested may be: long sleeved shirts, hats, sunscreen, sunglasses, etc.)

Day 2:

1. Students will display their personal protection kits.
2. Students will circulate to view protection kits and will fill in the student critique page with one positive reinforcement and one suggestion for improvement.
3. Sharing session to determine the most important items for a skin protection kit.
4. Discuss answers to questions on student worksheet.

Extensions

Language Arts
Students will research to determine his/her own personal risk factors for skin cancer including family history of skin cancer, sun exposure, and skin type and will write a report about their findings.

Art
Students will design and construct posters describing items needed and reasons for using personal sun protection to persuade other students to protect themselves from UV overexposure. Posters could be displayed around their school building.

Internet
Students will design and construct web pages describing items needed and reasons for using personal sun protection to persuade other students to protect themselves from UV overexposure. Counters and logs could be added to the web page to track how much it is accessed and from where it is added.

Social Studies

1. Students will research the development and use of sunscreens to present orally in class.

2. Students will research to determine if populations making use of skin protection have less occurrences of skin cancer. Students will write a written report on their findings.

Additional Resources

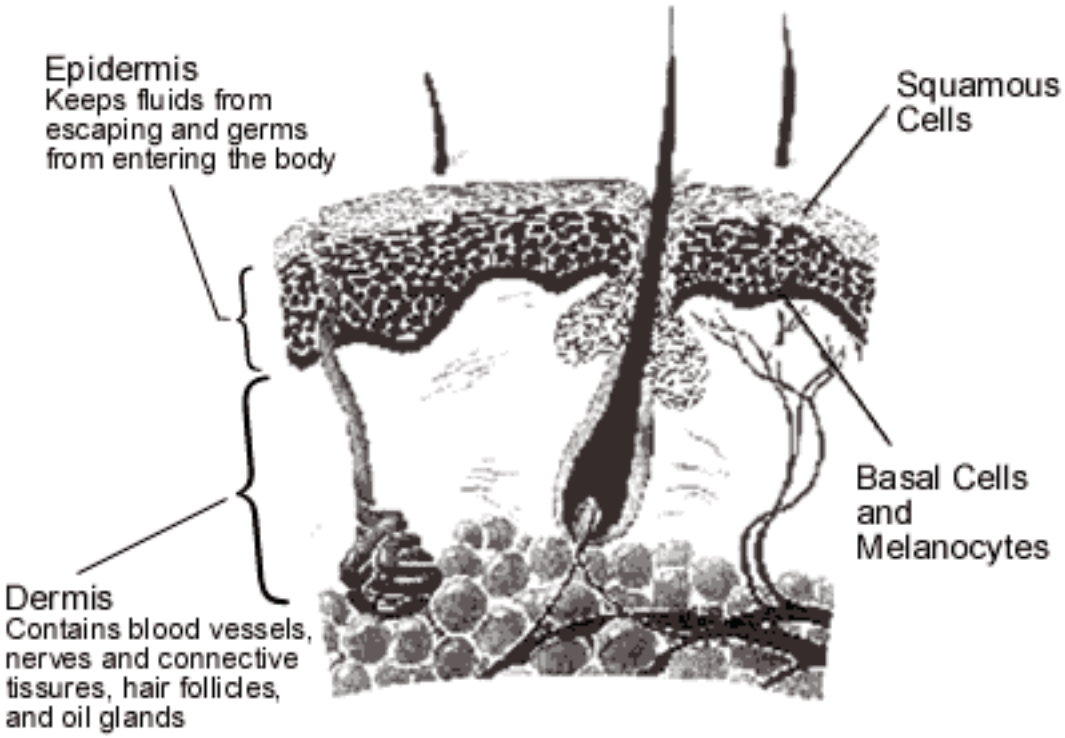
For more information on sun protection: *American Academy of Dermatology, 1-888-462-DERM*
http://www.aad.org

Skin Cancer Foundation
1-800-754-6490

1998 Envirohealth Link Master Teacher Team

Bennett Seidenstein and Carole Blake

SKIN: The Package You're In



Did You Know?

- Though tough and very complex, skin is really "paper" thin -- varying from 1/125 to 1/8 of an inch deep!
- It only takes about an ounce of sunscreen to protect exposed skin from the sun

Modified from the American Academy of Dermatology

Name _____ Date _____

Personal Skin Protection Kit Critique Sheet:

Please give one positive comment and one constructive suggestion for improvement of the kit.

	Positive Comment	Suggestion for Improvement
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		
Group _____		

Name _____ Date _____

Student Research Page: WebQuest

Directions: Use the Internet resources listed below to answer the following questions.

- *Sunscreens:* Do they cause skin cancer?
  http://vvv.com/HealthNews/dsunscre.html
- *National Skin Cancer Prevention Education Program*
  http://www.cdc.gov/nccdphp/dcpc/nscpep/skin.htm
- *The Darker Side of Tanning*
  http://www.fda.gov/cdrh/tanning.html
- *Introduction to Skin Cancer*
  http://www.maui.net/~southsky/introto.html#about
- *Bulletin of Sample Public Health Messages to Accompany UV Index*
  http://www.noaa.gov/uvb/heal.html
- *Online Image Database*
  http://tray.dermatology.uiowa.edu/DermImag.htm
- *National Skin cancer Centre: Singapore*
  http://www.nsc.gov.sg

1. Describe basal cell carcinoma.

2. Describe squamous cell carcinoma.

3. Describe malignant melanoma.

4. What is the treatment for skin cancers?

5. What are the factors that cause skin cancer?

6. What is the UV Index and how can we use it?

7. What precautions will reduce your own risk of skin cancer?

8. Why doesn't the skin of young people usually show these types of skin cancer?

9. Are tanning beds safer than natural sunlight? Explain.

10. What items would you need to protect yourself from intense sunlight for long periods of time?

Sunscreen: Smoke Screen?

Grades 6 - 8

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

Overview

Currently there is a debate about the relative effectiveness of sunscreens with SPF of greater than 15. Yearly, almost one million cases of curable basal and squamous cell carcinomas and over 40,000 cases of melanoma are detected in the U.S. Reduction of sun exposure decreases chances of illness or death from skin cancers. Skin protection is as important for children as well as adults.

Students will investigate the differences between SPF 15, 30, 45 to determine whether protection does increase above 15 SPF by experimenting with sunscreen, UV meter cards, and photo paper.

Technology Resources

Internet:
Encyclopedia.com from Electric Library (http://encyclopedia.com)
This an Internet encyclopedia that was used to create the resource sheet *"Sunscreen: Smoke Screen?* Definitions Page."

Video:
The Ozone Layer (Earth At Risk environmental video series)
Schlessinger Video Productions
P.O. Box 1110
Bala Cynwyd, PA, 19004
800-843-3620

Learning Objectives

Students will be able to ...

- state the function of the ozone layer in protecting people.
- describe causes for depletion of the ozone layer.
- give results of their investigation concerning the differences between high sunscreen SPF's.
- give results of their investigation concerning the differences between high sunscreen SPF's.

Vocabulary

(see student definition page for more complete definitions)

ozone: form of molecular oxygen, consisting of three atoms of oxygen
cfc: any organic compound consisting of chlorine, fluorine, and carbon
ultraviolet (UV) radiation: invisible electromagnetic radiation with frequencies between that of visible violet and x-rays
sunblock: substance that reflects the sun's UV rays away from the skin
sunscreen: chemically absorbs the sun's UV radiation
spf: skin protection factor
basal cell carcinoma: slow growing painless skin cancer
squamous cell carcinoma: skin cancer that usually appears on elderly patients
malignant melanoma: cancer of the pigment cells of the skin that is highly harmful

Materials

For class:

- monitor and VCR
- *The Ozone Layer* video

For groups:

- UV meter cards can be obtained from:
  South Seas Trading Company
  P.O. Box 540
  Kula, HI 96790
  E-mail info@south-seas.com
  Phone: 808-876-0090
  Fax: 808-876-0507
  http://www.maui.net/~southsky/introto.html
- photo-sensitive paper (cut in quarters)
- clear plastic transparencies (cut in quarters)
- same brand sunscreens with SPF's of 15, 30, 45
- sunlamp or cloudless, direct sunlight
- marking pen for transparencies
- tape

For each student:

- Lab activity sheet and data table: "Sunscreen: Smoke Screen?"
- Resource sheet: "Sunscreen: Smoke Screen? Definitions Page"

Next

Procedures

1. Discuss definitions of CFC, ultraviolet radiation, ozone layer, and ozone from the definitions page.

2. Students will view the first 2.5 minutes of *The Ozone Layer* video.
   Focus for viewing: (These discussion questions may be written on the board before viewing)
   - What is the purpose of the ozone layer?
   - What is ozone?
   - How is the ozone layer harmed by humans?

   BEGIN the video at the title "The Ozone Layer."
   STOP when student scholars are introduced by Kevin Seal.

3. Ask students to describe the function of the ozone layer in protecting people/life.

4. Ask students to describe causes and consequences for depletion of the ozone layer.

5. Ask students to brainstorm how humans can protect themselves from the harmful UV radiation that the thinning ozone layer cannot filter. Write on overhead/chalkboard.

6. Explain to students that they will be testing sunscreens to see how effective SPF above 15 really is. (Teachers should review lab carefully before performing it in class.)

7. Distribute lab and materials needed to each group.

8. Remind students not to remove photosensitive paper before room is darkened. Caution students not to look directly into light source.

9. Circulate while students perform lab.

10. Discuss conclusion questions at the conclusion of the lab.

Extensions

Language Arts

1. Students can research and write a report describing government efforts (not only United States) to raise public awareness to the consequences of overexposure to UV radiation.

2. Students can write persuasive letters or e-mails to congresspersons encouraging legislation to publicize the UV index and other information about UV exposure and skin cancer. Students can get e-mail addresses and mail addresses for congress persons by accessing one of the following:

   Earthlaw-E-Mail The Senate! http://www.earthlaw.org/Activist/senatadd.htm
   Congressional Email Directory
   http://www.webslingerz.com/jhoffman/congress-email.html
   Clickable Congressional E-mail Addresses and Other Info
   http://www.webcom.com/~leavitt/cong.html

Science

Students could perform the same experiment over again to test different brands of sunscreen and report their findings. Students would use different brands of sunscreen with the same SPF to determine if there is a difference in skin protection.

Internet

Students will create a display of possible skin cancers by accessing images at the University of Iowa's Online Image Database.
http://tray.dermatology.uiowa.edu/DermImag.htm

1998 EnviroHealth Link Master Teacher Team

Carole Blake and Bennett Seidenstein

Name _____ Date _____

Lab Activity Sheet and Data Table

Problem: Does the amount of UV protection change as the SPF increases past 15?

Materials:

UV meter cards
photo sensitive paper (cut in quarters)
clear plastic transparencies (cut in quarters) same brand sunscreens with SPFs of 15. 30. 45
sunlamp or cloudless, direct sunlight
marking pen for transparencies
tape

Procedure:

1. Label three transparency segments with SPF ratings.

2. Apply equal amounts (about 1/4 teaspoon) of sunscreen to three transparency segments. Be sure to spread the sunscreen evenly on each segment. DO NOT MIX SUNSCREENS (use different fingers or wash).

3. Darken room as much as possible so photo sensitive paper will not be exposed when removed from the package.

4. Cover each segment of photo sensitive paper and one UV meter card with the transparency and tape together. Close package of photo sensitive paper to protect remaining paper.

5. Expose paper and UV meter cards covered with transparency segments to light source for five minutes.

6. Remove from light source and quickly observe each segment and UV meter card.

7. Complete data table and answer conclusion questions.

Data Table

SPF	Relative Coloration	UV Meter Reading
15		
30		
45		
Control		

Conclusion/Analysis Questions:

1. Does UV protection increase as greater SPF sunscreen is used? Explain your answer.

2. Describe other ways you can protect yourself from damaging UV rays.

3. What SPF would you choose to protect yourself from intense UV exposure? Why?

Name _____ Date _____

Definitions Page

chlorothiorocarbon (CFC)- any organic compound composed of CHLORINE, FLUORINE, and CARBON. Derived synthetically from HYDROCARBONS, many CFCs (such as some FREONS) are chemically stable, nonflammable, and relatively nontoxic. Because of such properties, these compounds have been widely used in industry and in consumer products, particularly in the production of foam for insulation and other uses, as AEROSOL propellants, as refrigerants and air conditioner coolants, and as cleansing agents in the production of electronic circuit boards. The resistance of CFCs to chemical breakdown, however, enables them to persist in the environment and migrate to the upper atmosphere. There, sunlight frees their chlorine atoms to form chlorine monoxide, which destroys the OZONE LAYER. In 1987 an international treaty called for reducing CFC use by 50% by 2000. A 1992 revision called for the end of CFC production in industrial countries by 1996, and by 1993 CFC emissions had dropped dramatically.

ultraviolet radiation- invisible ELECTROMAGNETIC RADIATION with frequencies (about 1015 to 1018 Hz) between that of visible violet light and X rays; it ranges in wavelength from about 400 to 4 nanometers. Ultraviolet (UV) radiation can be detected by the FLUORESCENCE it induces in certain substances and by its blackening of photographic film. Most of the UV component of sunlight is absorbed by the OZONE LAYER of the atmosphere, but UV-B radiation (280-320 nanometers) can cause sunburn and skin cancer and UV-A radiation (320-400 nanometers) can cause photosensitivity reactions and possibly skin cancer. The National Weather Service's daily UV index forecasts the expected level of UV radiation at noon; depending on the region, it ranges from a low of I to a high of 10. Vitamin D is produced in humans by the action of UV radiation on ergosterol. a substance present in the skin. UV radiation can also be produced artificially in arc lamps, and black light is long wavelength UV radiation (365 nanometers). See also ULTRAVIOLET ASTRONOMY.

ozone layer- region of the stratosphere (see ATMOSPHERE) containing relatively high concentrations of OZONE, located at altitudes of 12-30 mi (19-48 km) above the earth's surface. The ozone layer prevents most ultraviolet (UV) and other high-energy radiation from penetrating to the earth's surface but allows sufficient UV to support the activation of vitamin D in humans to reach the earth. The full radiation, if unhindered by this filtering effect, would destroy animal tissue. Ozone in the ozone layer is formed by the action of solar ultraviolet light on oxygen. In 1974 scientists warned that certain industrial chemicals, e.g.. CHLOROFLUOROCARBONS (CFCs), HALONS, and carbon tetrachloride, could migrate to the stratosphere where sunlight could free their chlorine atoms to form chlorine monoxide, which would deplete upper-atmospheric ozone. A seasonal decrease, or hole, discovered in 1985 in the ozone layer above Antarctica was the first confirmation of a thinning of the layer; in 1994 the region of diminished ozone was nearly the size of North America and reached to S South America and S Australia. Less dramatic decreases have been found above other areas of the world, including the U.S. In 1987 an international agreement was reached on reducing the production of ozone-depleting compounds. Revisions in 1992 called for an end to the production of most of such compounds by 1996, and CFC emissions had dropped dramatically by 1993. Recovery of the ozone layer, however, is expected to take 50 to 100 years. Damage to the ozone layer can also be caused by sulfuric acid droplets produced by volcanic eruptions.

ozone- allotropic form of molecular OXYGEN (see ALLOTROPY), consisting of three atoms of oxygen instead of the more common two. Pure ozone is an unstable, faintly bluish gas with a characteristic fresh, penetrating odor. It is the most chemically active form of oxygen. Ozone is formed in the OZONE LAYER of the stratosphere (see ATMOSPHERE) by the action of solar ultraviolet light on oxygen; this layer plays an important role in preventing most ultraviolet and other high-energy radiation, which is harmful to life, from penetrating to the earth's surface. Ozone in the lower atmosphere is a pollutant that can damage lung tissue. It is produced by chemical or electrical processes, as when an electric discharge, such as lightning or from electric motors, passes through the air. Commercially, ozone is used as a disinfectant and decontaminant for air and water, as a bleaching agent, and in the production of azelaic acid (used in making plastics). Ozone is manufactured by passing dry air between two electrodes connected to an alternating high voltage.

The Chesapeake Bay's Nuclear Challenges

Grades 7 - 8

Overview

The nearby Three Mile Island accident in 1979 taught many valuable lessons to the nation as a whole, and the nuclear industry in particular. But these lessons have begun to fade into the past, But these lessons have begun to fade into the past, and today's students have no first hand memory of the incident.

The following group of activities highlights the events surrounding both the Chernobyl accident in 1986 in the Ukraine (the worst commercial accident in history), and the Three Mile Island accident, their similarities and differences, and the potential impact of prolonged radiation exposure on human health. The students will be involved in gathering information about these two nuclear power incidents through viewing a video, participating in a field experience to a nearby nuclear power plant, and performing an experiment to determine effects of exposure on animal life (brine shrimp).

Technology Resources

Video
CNN Presents, Legacy of a Meltdown.
$19.98 + $4.95 shipping and handling
1-800-799-7676 CNN
Atlanta, Georgia
This video contains a history of the events at Chernobyl and a description of the effects of the explosion on the people and environment around the plant.

Internet Sites
The Virtual Nuclear Tourist, Calvert Cliffs Nuclear Power Plant
http://www.cannon.net/~gonyeau/nuclear/calvert1.htm
Specifications and schematics of the Calvert Cliffs Nuclear facility are all available on this site.

Three Mile Island 2 (TMI-2) Recovery and Decontamination Collection
http://www.libraries.psu.edu/crsweb/tmi/tmi.htm
The Pennsylvania State University Libraries have acquired several thousand of the videotapes, reports, and photographs generated during the 1979-1990 cleanup and recovery of the Three Mile Island 2 (TMI-2) nuclear reactor. All of the materials are available for public use, and the contents of the videotape and report collections are searchable through two separate databases on this site. Links to other nuclear related web sites are also available.

AENNEA Nuclear Energy Agency
http://www.nea.fr/html/rp/chernobyl/c05.html
Everything that you ever wanted to know about the repercussions of the Chernobyl disaster can be found at this site. Morbidity and mortality are thoroughly documented and supported.

World Atom: International Atomic Energy Agency Page
http://www.iaea.or.at/worldatom
The most recent findings from researchers who are right on the sites. If you want highly detailed information, this is the site to find it. Includes information page about Chernobyl: "Ten Years After Chernobyl: What Do We Really Know?"

Teacher Background

Since the first controlled nuclear fission was accomplished in 1957, the world has had a love hate relationship with nuclear power. People love the relatively inexpensive power and the lack of visible emissions, while they hate the nuclear waste and dread the possibility of accidents like those at TMI in Pennsylvania or Chernobyl in the Ukraine.

The Chesapeake Bay is home to several functioning nuclear reactors, as well as tens of millions of people. There is a very real concern about the possible impacts of a major incident at one of these facilities on the people, and on the environment. For more information on nuclear power, consult the web pages listed above.

Learning Objectives

The students will be able to...

- explain the chain of events in two commercial nuclear disasters
- determine the types of effects of radiation exposure on animal life, in this case brine shrimp.
- evaluate the danger potential of a nuclear accident to human health.

Vocabulary

Acute Dose: A person who receives a dose of radiation over a short period of time has received an acute dose.
Alphas: Two protons and two neutrons emitted by a nucleus.
Betas: A high speed electron, emitted by the nucleus.
Chronic Dose: A person who received a dose of radiation over a long period of time has received a chronic dose.
Curie: Thirty-seven billion transformations (decay events) per second.
Erg: A unit of work and energy in the metric system that represents one dyne acting through one centimeter.
Gamma Rays: Electromagnetic waves or particles released from the nuclear of an atom.
Genetic Effect: Symptoms of exposure to something that are expressed by the offspring of the individual who was exposed. Exposure must be before conception.
Neutrons: A neutral particle with a mass of one a.m.u. that is normally contained in the nucleus.
Radiation: Transitional energy in the form of high speed particles or electromagnetic waves.
Rad: A radiation absorbed dose. One hundred ergs per gram of material.
Radioactivity: The transformation of unstable atoms to their more stable form, often resulting in the release of energy, or particles. Rem: Abbreviation for roentgen equivalent man. A measure of the biological effect of radiation.

Somatic Effect: Symptoms from exposure to something that is experienced by an individual who has been exposed.
Tetrogenic Effect: Symptoms of exposure to some harmful substance or energy that are seen in the offspring of the individual, provided that the exposure occurs during the gestation period of the offspring.
X-rays: An electromagnetic wave or photon emitted by electrical charges in electrons.

Materials

For the class:

- VCR and Monitor
- Video, *CNN Presents, Legacy of a Meltdown*
- Computer with internet access (or Web Page Resource Book), Scanner, and appropriate software package.
- European Map or globe.

For each group of 3 or 4 students:

- Local road map
- U.S. map
- Normal brine shrimp eggs, about 50, available from most supply companies such as Carolina Biological, 2700 York Road, Burlington, North Carolina 27215.
- Irradiated brine shrimp eggs, about 50
- Two glass jars of the same approximate size
- Salt water, as directed on shrimp egg package
- Artificial light source

For each student:

- Nuclear Power Plant Field Trip Data Sheet
- Irradiation Effects on Brine Shrimp Lab Sheet
- Nuclear Crisis Close to Home Activity Sheet/Writing Prompt
- Nuclear Power, World Wide Activity Sheet
- Student journal

Next

Procedures

Activity 1: Video and Discussion

To introduce the students to the significance of a commercial accident, show them the first 10 minutes of *CNN Presents, Legacy of a Meltdown* on the day before the field trip. To give students a specific responsibility while viewing the video, write the following questions on a chalkboard or overhead and have them answer them in their journal; "What were the causes of the accident at Chernobyl?", "How large an area was contaminated by the accident?", and "What measures have been taken to clean up the contamination caused by the accident?"

Show only the first ten minutes of the video, up to the point where scientists are introduced and taken through the sarcophagus. Make sure to emphasize that the design of the Chernobyl power plant is completely different from the designs used in American power plants. Also, ensure that the students know the location of Chernobyl and Ukraine by locating them on a world map, or globe. Make sure that you don't scare the students as they will be going to the power plant soon.

Activity 2: "Field Experience"

1. In preparation for the field trip, have the students read about the Three Mile Island accident. Copies of the relevant internet site are included: Inside Three Mile Island http://www.wowpage.com/tmi/

2. The students are taken on a tour through a nuclear power plant near their home town. The two plants within the Chesapeake Bay water shed are, Three Mile Island, which can be reached at (717) 944-7621, and Calvert Cliffs Nuclear Power Plant, at (410) 495-2100. During the trip, the students will need to respond to the questions on the Nuclear Power Plant Field Trip *Data Sheet* which should be attached to clipboards.

Activity 3: "The Case of the Mutated Brine Shrimp"

After the students have had some exposure to the history of nuclear power, and have toured a nuclear facility, they should become familiar with the effects of radiation on animal life.

Each group of three or four students will set up two cultures of brine shrimp. The directions that come with commercially available brine shrimp are to be followed with both cultures. The first culture is filled with normal brine shrimp. The second culture has been exposed to radiation. Contact the college nearest you with a radiology or nuclear medicine department. Give them at least six weeks notice before you need the eggs.

The students will need to make observations every day for a period of two weeks. They will use the *lab sheet* Irradiations Effect on Brine Shrimp to monitor and record the two cultures' development and behavior over time. Once the eggs have hatched, have the students check the reaction of each culture to light exposure by placing the culture in a darkened area, such as a prep room, and shine a concentrated light, such as a flashlight, on the culture. Note the reaction of the shrimp to the light. Do they avoid it, or are they drawn to it?

Extensions

Language Arts

Give the students the following scenario labeled "Nuclear Crisis Close to Home." At the teacher's discretion, the students can respond in a writing prompt, letter, or video taped group presentation. The students will need about 15 minutes of time on the computer for research of the nuclear power site nearest their home. Utilize the following web site for research concerning the nuclear plant nearest their home:

Map of all U.S. Nuclear Power Plants

(http://www.nrc.gov/AEOD/pib/disclaimer.html)

Math

Some students may question why nuclear power plants are a concern in environmental health. If a statistical approach would help illustrate the point, the students should be given the *Activity Sheet* Nuclear Power, World Wide. The students will interpret, and interpolate the graph as well as explain what factors might have caused the data recorded.

1998 EnviroHealth Link Master Teacher Team

Timothy P. Price and Kelly Sullivan

Name _____ Date _____

Nuclear Power Plant Field Trip Data Sheet

1. How much power does this facility generate?

2. Where does the power from this plant go?

3. Who changes the lights on top of the cooling towers?

4. How many radiation monitors are there? Where are they?

5. How long has the plant been in operation?

6. When will the plant be decommissioned?

7. Devise a question of your own, and answer it.

8. How safe is this plant?

9. What was the most impressive thing you saw today?

Name _____ Date _____

Irradiation Effects on Brine Shrimp Lab Sheet

Culture	Control	Irradiated
Days until hatching		
Reaction to light		
Physical appearance		
Activity		
Comments/Observations		

Name _____ Date _____

Nuclear Crisis Close to Home Activity Sheet/Writing Prompt

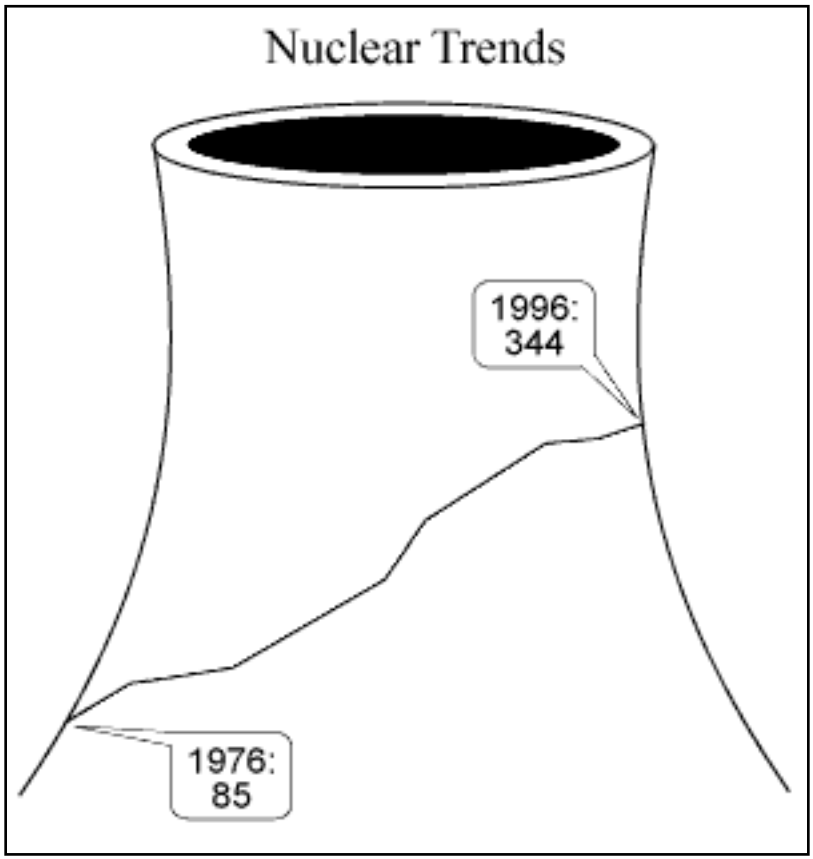
The unthinkable has happened. The nuclear power plant near your home has announced that they have lost control of the nuclear reaction. At this point, there is nothing left to do at the plant. Your family has asked you to determine what actions should be taken. Answer the following questions. Should your family evacuate? How close to the facility do you live? What are the consequences of staying? What events are likely to happen, based on the history of Three Mile Island? Should you choose to evacuate, what would be the best route to leave the area that will keep you as far away from the plant as possible? Scan a map of the region into the computer that includes both your starting and ending locations. Highlight the roads that you will take to compliment your written directions.

Name _____ Date _____

Nuclear Power, World Wide

Despite the incidents at Chernobyl and Three Mile Island, nuclear power continues to be an important power source throughout the world. In some countries, such as France and Japan, nuclear power is not only important, but embraced by the electorate. Other countries, such as Ukraine, use nuclear power despite horrible accidents.

Japan recently imported tons of highly radioactive plutonium (the most toxic substance on the earth) in a large tanker ship. The ship was escorted across thousands of miles of ocean by numerous naval vessels. The escort was to fend off terrorists, hostile military, and the pirates that infest the Indian Ocean. The transport went off without a hitch.



Net installed electrical-generating capacity of nuclear power plants worldwide, in gigawatts

What do you think?

1. What has been the percent increase in the world wide use of nuclear power in the last 20 years?

2. What steps could Japan take to reduce its reliance on nuclear power?

3. Based on the trends shown on the graph, how many gigawatts of power would you expect will be produced by nuclear power in the year 2016? How about 2036?

4. In what year or years was there the least growth in the increase of power produced by nuclear generators? What factors may have caused this slowing?

5. What are some medical conditions that you would expect to change, based on the information presented in this graph?

Source: Worldwatch Institute

How Did *That* Get in My Lunch?
Grade 8

Overview

The students will investigate the causes of food borne illness (food poisoning). Students will investigate irradiation as a way to prevent food contamination. The integration of critical thinking and research skills will be utilized to accomplish the goals of this lesson.

Although the food supply in the United States is among the safest in the world, millions of Americans are stricken by food borne illness each year.

Technology Resources

Video Resources:
The Danger Zone A Food Safety Program For Teens, United States Department Of Agriculture

Internet Sites:
Food And Drug Administration
http://www.fda.gov
This site has a resource called the bad bug book which provides information on several types of pathogens.

Center For Disease Control
http://www.cdc.gov/ncidod/EID/vol3no4/bruhn.htm
This site contains information on consumer concerns about irradiation.

http://www.cdc.gov/ncidod/EID/vol3no4/osterhol.htm
Information on the irradiation pasteurization of solid foods can be found here.

http://www.cdc.gov/ncidod/foodsafe/report.htm#sources
This is a report to the president on food safety issues.

Chemical Backgrounders: Ethylene Oxide
http://www.nsc.org/ehc/ew/chems/ethyoxid.htm
This site has detailed information about ethylene oxide.

Methyl Bromide EPA Site
http://www.epa.gov/docs/ozone/mbr/mbrqa.html
This site provides information about methyl bromide.

Irradiation
http://www.consumersinternational.org/ campaigns/irradiation/irrad.html
An excellent site with several chapters on food irradiation.

Microscope Slides May Be Obtained From:
Carolina Biological Supply Company
PO Box 6010
Burlington, NC 27216-6010
1-800-334-5551
1-800-222-7112 (Fax)
Catalog 68
D8-29-4498 *Clostridium botulinum w.m.*
1-11 ea. $3.20 12 + ea. $3.05
D8-29-4546 *Eschericia coli, w.m.*
1-11 ea. $3.10 12 + ea. $2.95
D8-29-4684 *Salmonella typhimurium,w.m.*
1-11 ea . $3.60 12 + ea. $3.40
D8-29-4726 *Staphylococcus aureus, w.m.*
1-11 ea. $3.10 12 + ea. $2.95

Teacher Background Information

Although the food supply in the United States is among the safest in the world, millions of Americans are stricken by food borne illness each year. Of the millions who become sick, some 9,000 (mostly elderly and very young) die as a result. In addition, billions of dollars are spent on the effects of food borne illness in medical costs and job productivity loss.

There are several microbial pathogens associated with food borne illness which are broken down into three main categories. Bacterial causes of food borne illness are Salmonella typhimurium, Staphylococcus aureus, Eschericia Coli and Clostridium Botulinum. Protozoan causes are Toxoplasma gondi and Cryptosporidium parvum and viral contaminants include Norwalk virus and Hepatitus A.

These contaminants can enter the food supply from a variety of sources. Sources of entry include direct contamination from the host, surface contaminants, misuse or improper sanitation including home preparation and food handling practices.

Although consumers recognize the potential seriousness of food borne pathogens, they lack information on safe handling and storage of food products.

Food irradiation is the exposure of food to high levels of electromagnetic energy for the specific purpose of destroying microbes and other contaminants. While this procedure has been approved for several food items, it is not widely used in the United States.

Irradiation has been shown to rid food of contaminants while retaining flavor, vitamins and increasing shelf life. Irradiation has been shown to be cost effective and poses less of a threat to human health than current contaminant removal methods utilizing ethylene oxide or methyl bromide.

Attitude surveys and marketing demonstrate that consumers will purchase irradiated food. While these consumers expressed some concern over the irradiation process, the threat of food borne illness and its potential dangers were more of a concern.

Learning Objectives

The student will be able to:

- define food borne illness
- identify bacterial causes of food borne illness
- understand the potential threat of food borne pathogens to human health
- identify solutions on both individual and governmental levels
- support or refute irradiation as a solution to reduce food born illness.

Vocabulary

food borne illness: digestive sickness caused by bacteria, other pathogens or chemicals in food.
irradiation: to affect or treat by exposure to radiation
ethylene oxide: gas used to rid pathogens from the food supply
methyl bromide: gas used to rid pathogens from the food supply
pathogen: a germ which causes disease

Materials

Per Class:

- Access to the Internet, modem and computer (or xerox copied web resource booklet)
- Video: *The Danger Zone*
- VCR and TV monitor

Per student group of 2:

- Slides of *Salmonella typhimurium, Staphylococcus aureus, Eschericia coli* and *Clostridium botulinum.*
- Microscope with low and high objectives
- *Student activity sheets*
  Food Bourne Illness Background
  Microbial Bugs
  How Bad is This Bug?
  Which Would You Choose?
  Gas Them or Zap Them - They All Have To Go!
- Colored pencils

Next

Procedures

1. View the film The Danger Zone (length: 23 minutes). If it is not possible to view the whole video view the following segments:
   (play) display: 00:00-01:50 -- This clip is of a girl searching for her friends in a restaurant and introduces the term food borne illness. (pause)
   (play) display: 04:00-6:45 -- This clip shows students in a classroom and the teacher explaining about bacterial contamination and The Danger Zone (pause)
   (play) display 21:39-22:44 -- This lists the steps individuals can take to prevent food borne illness. During the viewing of the film have the students (stop)

   Complete the food borne illness background activity sheet.
2. Tell the students that we are going to examine three of the bacterial pathogens associated with food borne illness (*Salmonella typhimurium, Staphylococcus aureus, Eschericia coli and Clostridium botulinum*).
3. Pass out the Microbial Bugs *student activity sheet.*
4. Students should work in groups of two to complete the microscope activity microbial bugs.
5. Now that the students are familiar with the structure of these bacteria have them access their web provider and type in the URL: http://www.fda.gov. Once this site has been accessed click on foods and then click on the bad bug book.
   Students should now complete the *student activity sheet* How Bad is This Bug? For each pathogen (*Salmonella typhimurium, Staphylococcus aureus, Eschericia coli and Clostridium botulinum*).
6. Review with your students the last question of the *student activity sheet* How Bad is This Bug?. Where could these bacteria enter our food supply? Place their answers on the board. If the following responses (from the host, surface contaminants, misuse or improper sanitation including home preparation and food handling practices) do not come up in class discussion, add them to the list and discuss.
7. Ask the students, "What measures should the government take to keep our food supply safe?" List all responses on the board.
8. Tell the students that there is a method which removes the pathogens by exposing them to high doses of energy in the form of electromagnetic radiation. This process is called food irradiation.
9. Now that they are experts on bacterial pathogens, students are going to compare methods of pathogen removal. Pass out the *student activity worksheet* Gas Them Or Zap Them-They All Have To Go! Students will now use web resources to compare irradiation, methyl bromide and ethylene oxide for pathogen removal.
10. Students will use the information collected to answer the writing prompt Which Would You Choose?

Extensions

Science
Comparing the bacterial growth in non- irradiated food verses food which has been irradiated is an excellent idea. The culture plates would need to remain sealed and proper sanitation procedures would need to be followed. Irradiation sources can be simple x-rays provided by your local dentist or physician. Proper disposal would be to have one of these facilities autoclave and burn the plates.

Field Trip Possibilities
In the Washington metropolitan area governmental agencies such as NIH and USDA are currently researching irradiation.

Home Economics
Have students visit the Home Economics classroom and record both the proper and improper food handling techniques.

1998 EnviroHealth Link Master Teacher Team

Kelly Sullivan and Timothy Price

Name _____ Date _____

Food Borne Illness Background

While viewing the video *The Danger Zone* complete the following questions using a complete sentence.

1. What is food borne illness?

2. What are bacteria?

3. Where are bacteria likely to be found?

4. What are two main categories of bacteria?

5. What do bacteria need to grow?

6. What is the danger zone?

7. List six items to remember about food borne illness prevention
    A.
    B.
    C.
    D.
    E.
    F.

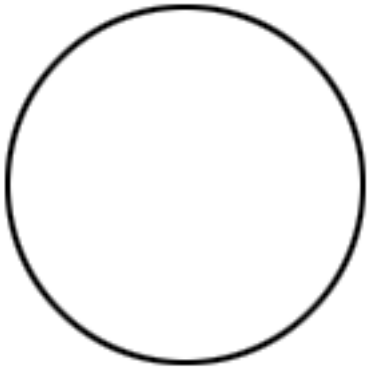
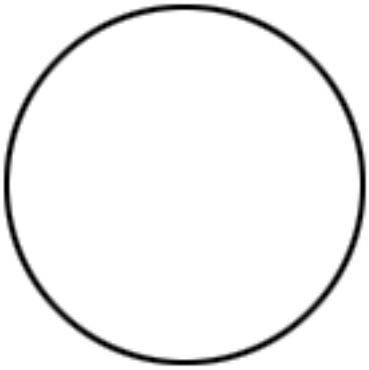
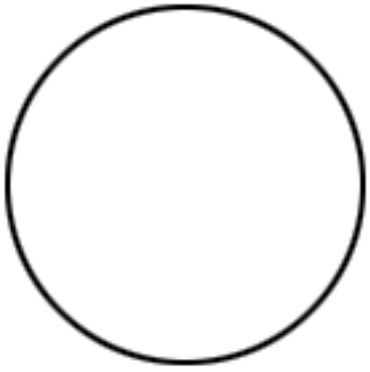
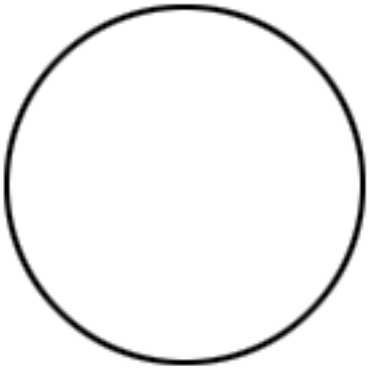
Name _____ Date _____

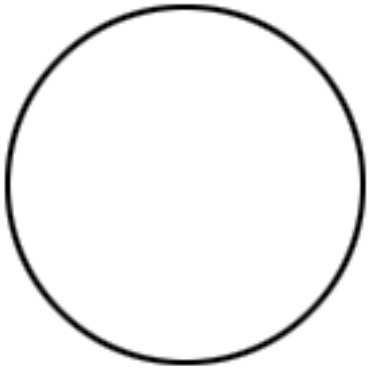
Microbial Bugs

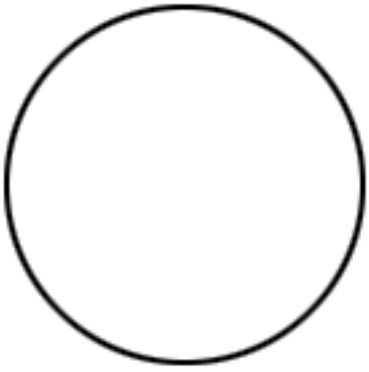
Materials:
Prepared slides of
Salmonella typhimurium,
Staphylococcus aureus
Eschericia Coli
Clostridium botulinum.

Microscope with high and low objectives
Colored pencils

Procedure:
Working with a lab partner make detailed drawings of the above slides under both low and high power magnifications. Be sure to label your drawings and use colored pencils to represent the colors the slides have stained.





Questions:

1. Describe the structure of each bacterium:

   Salmonella typhimurium

   Staphylococcus aureus

   Eschericia Coli

   Clostridium botulinum

2. Were any of the samples alike? How so?

Name _____ Date _____

How Bad Is This Bug

Objective:
Using the Internet as a resource you will collect information on each bacterium.

Procedure:

1. Using your web browser access the **URL http://www.fda.gov.**
2. From this web site **select foods**.
3. **Select *"The Bad Bug Book"***
4. **SELECT *Salmonella typhimurium***
5. Complete the questions.
6. Complete steps 1-5 for S*taphylococcus aureus, Eschericia Coli, Clostridium botulinum.* Use a new sheet for each item.

Information On _____

1. What type of organism is this?

2. Describe the structure of this organism.

3. Which foods are associated with contamination by this pathogen?

4. What are the symptoms of being poisoned by this pathogen?

5. How long before you see these symptoms in an infected person?

6. How much of the pathogen needs to be ingested before becoming ill?

7. How long do the symptoms last?

8. Who is susceptible to this pathogen?

9. How many cases are reported annually of people becoming sick from this pathogen?

10. List any major outbreaks of this pathogen in the last ten years.

Outbreak Location	Year	Cause

11. Where can this pathogen be introduced into the food supply?

Name _____ **Date** _____

Gassed Or Zapped — They Still Must Go

Objective:
In this lesson you will compare three methods of pathogen removal ethylene oxide gas, methyl bromide gas and food irradiation.

Procedure:
Access your web browser and type in the following URL'S to obtain information about each substance. You may want to bookmark each URL so that you can move one to the other more efficiently.

http://www.epa.gov/ttnuatw1/hlthef/ethylene.html
This site has detailed information about ethylene oxide.
http://www.epa.gov/ttnuatw1/hlthef/methlbr.html
This site provides information about methyl bromide.
http://www.epa.gov/spdpublic/mbr/irad2.html
A site which compares methyl bromide and irradiation in pathogen removal.
http://www.consumersinternational.org/campaigns/irradiation/irrad.html
An excellent site with several chapters on food irradiation.

Complete the Questions

1. **Define:**
   Methyl Bromide-

   Ethylene Oxide-

   Food Irradiation-

2. **Uses Of:**
   Methyl Bromide-

   Ethylene Oxide-

   Food Irradiation-

3. **Side Effects/Risks Of Using:**
   Methyl Bromide-

   Ethylene Oxide-

   Food Irradiation-

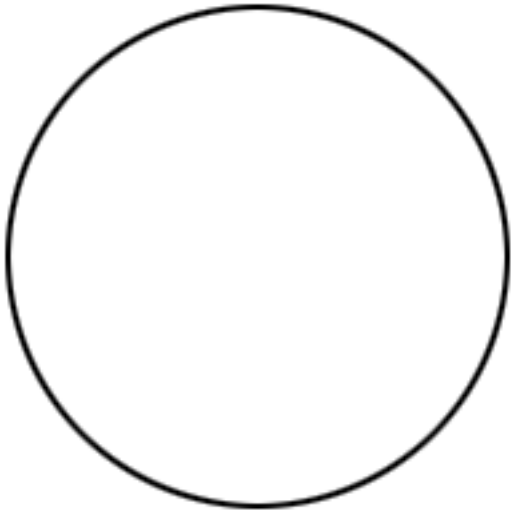
4. **Benefits Of Using:**
   Methyl Bromide-

   Ethylene Oxide-

   Food Irradiation-

   Using the Venn diagram to compare gassing and irradiation food methods.

Irradiation Of Pathogens Gases Of Pathogens



5. Which method would you use and why?

6. What are some ways that individuals can prevent food born illness?

Name _____ Date _____

Which Would You Choose?

Writing Prompt:

The President of the United States has devised a task to look into the safety of our food supply. You have been asked to serve as a student member on this task force. The President has asked you to prepare a paper addressing the concerns about bacterial contamination in the food supply. In this report, you are to address the causes of bacterial contamination, the methods of entry (of a pathogen) into the food supply and possible suggestions to prevent contamination. Include in your paper whether you support or do not support the irradiation of foods. Use the information you have collected to complete this task.

What Should I Know About Pfiesteria?

Grades 6 - 8

Overview

It was suddenly last summer that Marylanders began to feel the impact of a fairly mysterious disease that had been killing fish and affecting the health and well being of humans in North Carolina, the Chesapeake Bay and its tributaries, and other areas along the Middle Atlantic region. In September of 1997 when the school doors opened, the word Pfiesteria (as in Pfiesteria piscicida), had entered the daily vocabulary of teachers, students, and their families.

While scientists do not yet fully understand all the mystery surrounding the Pfiesteria outbreak, the following lesson with curriculum connections in science, math, health, geography, and language arts will provide students with baseline knowledge and hands-on activities in using the Internet to explore the following questions:

- What is Pfiesteria?
- What are the life stages of Pfiesteria?
- Where in the Chesapeake bay and its tributaries has Pfiesteria been reported?
- What impact does Pfiesteria have on human health and fish?

Hands-on, self-directed, and group activities will assist students in developing skills in critical thinking, observing, comparing, calculating, mapping, writing, and problem-solving.

Technology Resources

Internet Resources

About Pfiesteria piscicida - Pfiesteria in the Chesapeake Bay
http://www.mdsg.umd.edu/fish-health/ pfiesteria/index.html#bkgrd.com

This site maintained by the University System of Maryland focuses on Pfiesteria in the Chesapeake Bay, economic impact of Pfiesteria, and a chronology of Pfiesteria.

Pfiesteria & Pfiesteria-Like - Image Gallery
http://www.pfiesteria.org/pfiest.html#Toxic

NCSU Aquatic Botany Laboratory maintains this site. Electron micrographs and visual microscope photographs of Pfiesteria in 16 life stages are provided at this site.

NCSU Aquatic Botany Laboratory - Pfiesteria piscicida Homepage
Human Health Impacts
http://www.pfiesteria.org/pfiest.html#Toxic

This site provides background information, current research, and maps of confirmed Pfiesteria activity in North Carolina.

Video

Scott Broom's interview of Highlandtown Middle School's class fishing trip (Permission to use granted by Baltimore's Channel 2 -WMAR TV)

Resource Material Donations

- Chesapeake Bay Field Office - Dept. of Fish and Wildlife Services
- United States Dept. of Interior - Fish and Wildlife Services
- Chesapeake Marine Tours and Charters, Inc.

Teacher Background Information

Pfiesteria is not a virus or a bacterium. It is not contagious or infectious, and cannot be "caught" like a cold. Pfiesteria piscicida is a single-cell microorganism referred to by scientists as a toxic dinoflagellate, which means it has a whip-like tail called a flagellum. Dinoflagellates have been a natural part of marine ecosystem for thousands of years and are generally referred to under the broad heading of "algae." Unlike some other types of algae that can only float, Pfiesteria propels itself about, behaving sometimes like animals and sometimes like plants. Pfiesteria survives by eating other organisms, usually algae.

Pfiesteria can exist in up to 24 life stages, four of which may be toxic. Under specific conditions, such as high nutrient levels and the presence of large schools of fish (particularly Atlantic menhaden), Pfiesteria's population increases. This is referred to as a "bloom." During a bloom, Pfiesteria can shift forms and infect fish, emitting toxins that make their prey lethargic. The toxins also injure the skin of fish, opening bleeding sores and lesions. After the fish dies, moves away from the area, or other conditions change, the Pfiesteria within hours forms protective outer coverings and sinks to bottom of the river as a dormant cyst.

It has been well documented that humans can be affected by Pfiesteria in one of two ways; through direct contact with Pfiesteria infected water or organisms and/or by inhaling toxic aerosols from the cultures. Others, including several fishermen, a water-skier, and several people monitoring fish kills, have also complained of skin lesions and other adverse health effects, such as severe headaches, short-term memory loss, narcosis (a "drugged" effect), blurred vision, nausea/vomiting, difficulty breathing, reddening of the eyes, and kidney and liver dysfunction.

Most of the acute symptoms proved reversible over time, provided that the affected people were not allowed near the toxic cultures again. Some of these effects have recurred (relapsed) in people following strenuous exercise, thus far up to six years after exposure to the toxic fish cultures.

At this point, there are conflicting reports concerning the effects of eating Pfiesteria infected seafood. Some reports indicate there are no documented cases of seafood poisoning as a result of consuming infected seafood. On the other hand, there are a few reports that suggest human exposure can come from eating shellfish that are concentrated with the toxins. Research in this area is not extensive. Because of this uncertainty, consumers are warned to take precautions. Never eat fish that exhibit evidence of sores, disease, or dying when caught.

Since its discovery in 1988 in North Carolina, Pfiesteria has been detected in numerous bodies of waters. Last year, for the first time, researchers confirmed Pfiesteria-like organisms were the likely cause of fish kills on Maryland's lower Eastern Shore, Virginia, Florida, Delaware, and North Carolina.

Federal and state agencies in Washington, DC, Maryland, Virginia, and North Carolina have joined together to coordinate research teams, task forces, and committees to step up research and recommend steps to curb outbreaks of Pfiesteria.

Learning Objectives

Students will be able to:

- Use Flex Your Brain *activity sheet* to explore the topic of Pfiesteria.
- Research information on the Internet to describe Pfiesteria.
- Compare stages of Pfiesteria to other microorganisms.
- Construct a map illustrating areas in the Chesapeake Bay and its tributaries in which Pfiesteria has been reported.
- Measure and calculate the percentage of the Chesapeake Bay where Pfiesteria has been reported.
- Describe how Pfiesteria affects the health of humans and aquatic organisms.
- Write a letter to a public official expressing personal concerns on the impact of Pfiesteria on human health.

Vocabulary

Algae: aquatic photosynthetic organisms which are not true plants, but close relatives, often microscopic. Small algal populations are normal; overpopulation (green turbid blooms) indicates nutrient pollution.
Bloom: a severe overpopulation of aquatic algae, characterized by serious green turbidity. Can lead to anoxic conditions.
Cyst: a protective outer membrane formed around an organism, such as a protozoan, during reproduction or in response to unfavorable environmental conditions.
Dinoflagellates: a unicellular biflagellate, typically marine, algae that is an important component of plankton; usually photosynthetic.
Flagella: long whip-like moveable structure or tail extending from the cell and used in locomotion.
Narcosis: deep stupor produced by a drug. State of numbness.
Pfiesteria: a microscopic, single-cell organism that has the ability to behave like an animal under certain conditions. It belongs to a group of phytoplankton known as dinoflagellates.
Tributary: a branch (smaller stream) bringing water into a stream, river, etc.
Phytoplankton: minute, floating aquatic plants; algae

Equipment and Materials

Per class:

- TV and VCR
- Video tape of "Class Fishing Trip " (Video taping of Channel 2 news report by Scott Broom)
- Overhead Projector
- Pictures of Pfiesteria in different stages
- Blank map of the Chesapeake Bay (transparency)
- *Map of the Chesapeake Bay (large class size: identical to students)
- *Map of Chesapeake Bay Watershed (large class size)
- *Poster "Bringing The Bay Home" (large class size)
  * For maps and posters contact:
  Chesapeake Bay Field Office
  177 Admiral Cochrane Dr.
  Annapolis, MD 21401
  1-800-YOUR BAY
  or call Cindye Cowhead: (410) 573-4583

Per group/team of 2-3:

- Computer with modem and Internet access or Internet Site Resource Book (1 Per 2-3 students)
- Microscopes (2)
- Prepared slides of dinoflagellates (2 per group)

Per student:
Xerox copies of the following *activity sheets:*

- What is Pfiesteria?
- Drawing of Pfiesteria in One of Its Stages
- Drawing of a Microorganism
- Where is Pfiesteria Found?
- How Much of Our Bay is Affected?
- Flex Your Brain
- Map of the Chesapeake Bay Shorelines (blank copy)
- Extension *Activity Sheets* : Language Arts / Field Experience, How does Pfiesteria affect the human body and fish?

Additional materials per student:

- Colored pencils
- Paper and Pen
- Internet articles for Extension activities:
  --*Human Health Impacts*
  --*Medical Evaluation of Persons with Exposure to Water Containing Pfiesteria or Pfiesteria-Like Dinoflagellates*

Next

Procedures

Activity 1: Flex Your Brain About Pfiesteria
This activity is used to stimulate student's interest in Pfiesteria and consider their prior knowledge on the topic. It is a self-directed activity intended to assist students in developing critical thinking skills while investigating Pfiesteria. It provides students with an opportunity to explore the topic in an organized, self-checking way, and then identify how they arrived at their responses during each step of their investigation. Entries on the Flex Your Brain *activity sheet* are to be completed as an individual task. Procedures for implementing activity 1 are given on the activity sheet.

Note: If the video indicated for this activity is not available, consider using the following suggestions:

- Tape a television news report on Pfiesteria
- Make several slides of fish with lesions and other signs of trauma.

You might want to check out at the following web site for pictures:
Pfiesteria & Pfiesteria-Like - Image Gallery
http://www.pfiesteria.org/pfiest.html#Toxic.

Activity 2: What is Pfiesteria?

1. Students should work in groups to complete this activity; however each student is responsible for recording his/her own data on the *activity sheets.*
2. Directions for completing this activity are provided on What is Pfiesteria? *activity sheets.*
3. Students will visit two Internet sites where they will locate information needed to complete a WebQuest activity. Also, this activity provides an excellent opportunity for students to sharpen their technical skills by having them follow several links to locate specific information requested on the *activity sheet.*
4. Students will also have an opportunity to refresh their lab skills by using the microscope to observe and compare Pfiesteria to other microorganisms.
5. It is suggested that prepared slides be used in order to save time. However, the use of live microorganisms (dinoflagellates) will work just as well.

   Note: If neither is available, use pictures.
6. Class discussion of the observed similarities and differences between Pfiesteria and other microorganisms should be done before moving to the next activity.

Activity 3: Where is Pfiesteria Found?
This activity provides an opportunity for students to use their map skills and math skills to get a big picture of the areas in the Chesapeake Bay and its tributaries in which scientists have identified Pfiesteria. The writing activity in this lesson encourages students to use their critical thinking skills. After students have located the map at the indicated web site, make sure they understand how to interpret the key on the map. Encourage students to be creative in illustrating data on their map. Obtaining data from the website can be completed as a group task, however, each should create on his/her own map. Procedures for completing activity 3 are given on student's *activity sheet.*

Activity 4: How Much of Our Bay is Affected?
Students will use the maps they designed in activity 3 to determine the percentage of the Bay that is affected by Pfiesteria. Again, students will make use of their math skills to complete this activity. Depending on time, you might instruct students to convert their final answer into metric units. Teacher has the option of having students complete this activity as an individual or group task. Procedures for completing this activity are given on student's *activity sheet.*

Wrap Up

1. Have students return to their Flex Your Brain *activity sheet.*
2. Have students complete items 8 and 9 as an individual task.
3. Have students complete item 10 as a group task.
4. Have oral discussion on student's responses for items 8, 9, and 10.

Extensions

Internet WebQuest/Science: How Does Pfiesteria Affect The Human Body and Fish?

Internet Resources:
NCSU Aquatic Botany Laboratory - Pfiesteria piscicida Homepage
Human Health Impacts
http://www.pfiesteria.org/pfiest.html#Toxic
This site provides background information, current research, and maps of confirmed Pfiesteria activity in North Carolina.

Sierra Club Pfiesteria Index
http://www.sierraclub.org/wetlands/pfiesterindex.html
This site gives facts, press releases, and information about health effects on humans and wildlife.

With the increasing concerns about human health generated by the reports of fish kills, medical experts from several states have formed joint teams to evaluate these complaints and better define the possible health effects associated with environmental exposure to water which may contain toxins produced by Pfiesteria or Pfiesteria-like dinoflagellates.

It is possible that the medical evaluations and reports that are given on these Internet articles will change as medical experts continue to examine patients and make new discoveries. In this activity, students use specific Internet articles to find answers to the following questions:

- What are the different ways a person can become exposed to the toxins produced by Pfiesteria?
- What are the organs and systems of the human body that are affected by the toxins produced by Pfiesteria or Pfiesteria-Like organism?
- How does Pfiesteria affect fish?

It is suggested that students use xerox copies of the Internet articles indicated for this activity. Xerox copies will give students a better opportunity to compare medical findings presented in the different articles and will be less time consuming. Students can work in groups to complete this activity. However, each student is responsible for completing his/her *activity sheet.*

1998 EnviroHealth Master Teacher Team:

Rosetta Jackson and Howard Schindler

Extension Activity

Language Arts:

1. Use information from articles listed in the Extension Internet Resource list and all you have learned about the topic to write a formal letter to a state representative expressing your concerns for the impacts Pfiesteria has on people and fish.
2. Use your computer to type your final copy of the letter.

   NOTE: Make sure you start your letter off using the following opening:
   The Honorable _____

3. Write and send your letter to one of the Maryland Senatorial Representatives listed below:

The Honorable Barbara A. Mikulski
709 Hart Senate Office Building
Washington, DC 20510-2003

or

The Honorable Paul S. Sarbanes
309 Hart Senate Office Building
Washington, DC 20510-2003

Field Experience:

Chesapeake Marine Tours & Charters, Inc.
Program Title: Treasure Our Waters (grades 1-12)
Annapolis (410) 268-7601
Baltimore (410) 269-6776
DC (301) 261-2719

1998 EnviroHealth Master Teacher Team: Rosetta Jackson & Howard Schindler

Name _____ Date _____

Activity 2: What is Pfiesteria?

Although the name Pfiesteria might sound more like a flowering plant and a character from science fiction than a real creature, technically, it is neither a plant nor an animal. The following activities will help you learn more about this tiny microorganism called Pfiesteria (pronounced fist-eer-ee-ah).

Directions:

Step 1. Use your Internet browser to visit the following web sites:
http://www.mdsg.umd.edu/fish-health/pfiesteria/index.html
http://www.sierraclub.org/wetlands/pfiesterindex.html

A. WHAT IS PFIESTERIA?

Answer:

B. WHAT CAUSES PFIESTERIA TO PRODUCE TOXINS THAT ARE HARMFUL?

Step 2. Pfiesteria can appear in at least 24 different flagellated, amoeboid, and encysted forms or stages.

- Type in http://www.pfiesteria.org/pfiest.html
- Now click on the article called ***"Life Cylce"***

Step 3. Use the easel on the activity sheet to draw a picture of Pfiesteria in one of its stages. Make sure you identify the stage.

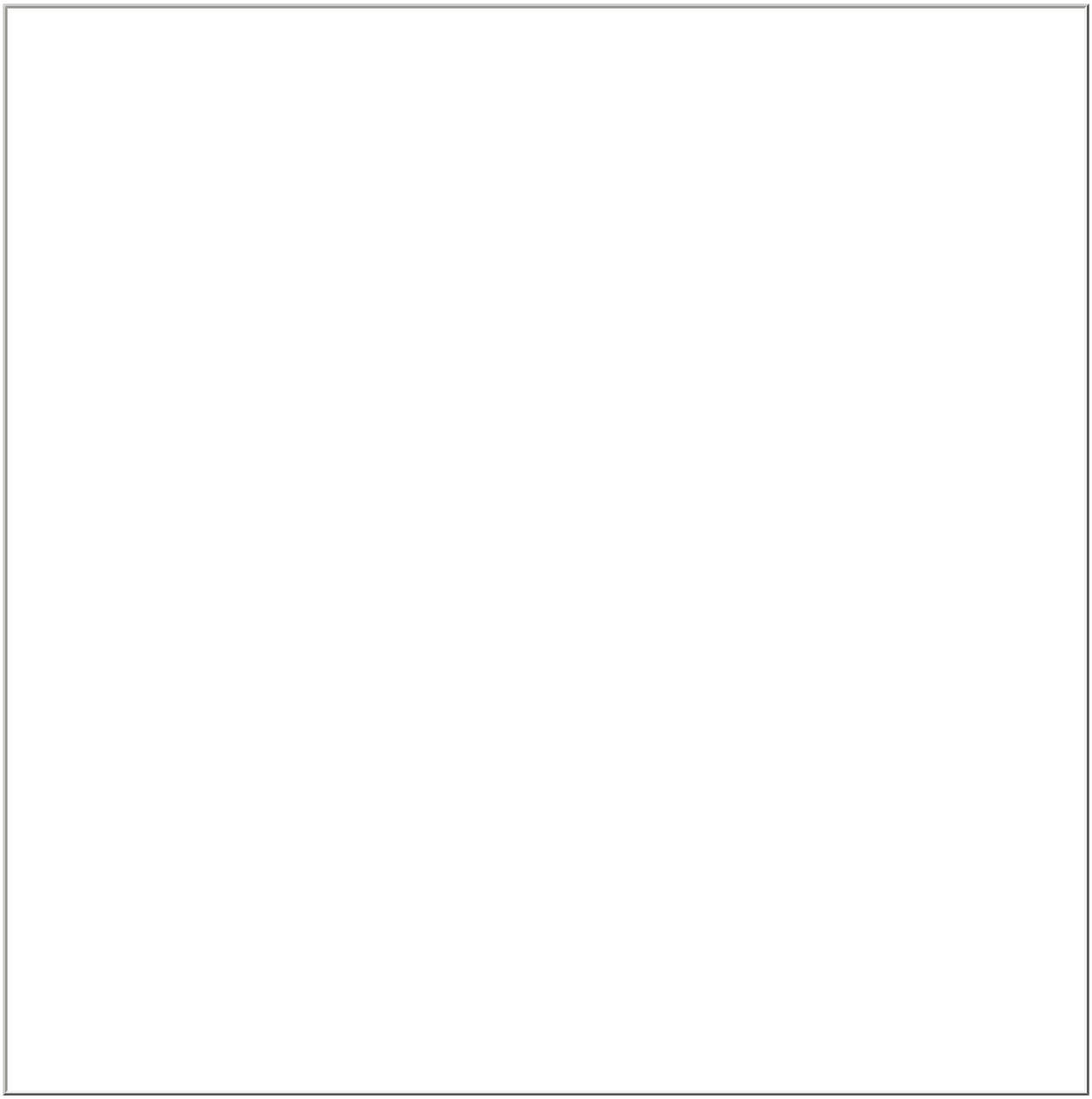
Step 4. Use your microscope to observe another type of microorganism. Use the easel on the activity sheet to draw a picture of the microorganism you just observed.

Step 5. What similarities and differences did you observe in the two microorganisms?

Name _____ Date _____

Activity 2: Drawing of Pfiesteria in One of Its Stages

Name of stage: _____



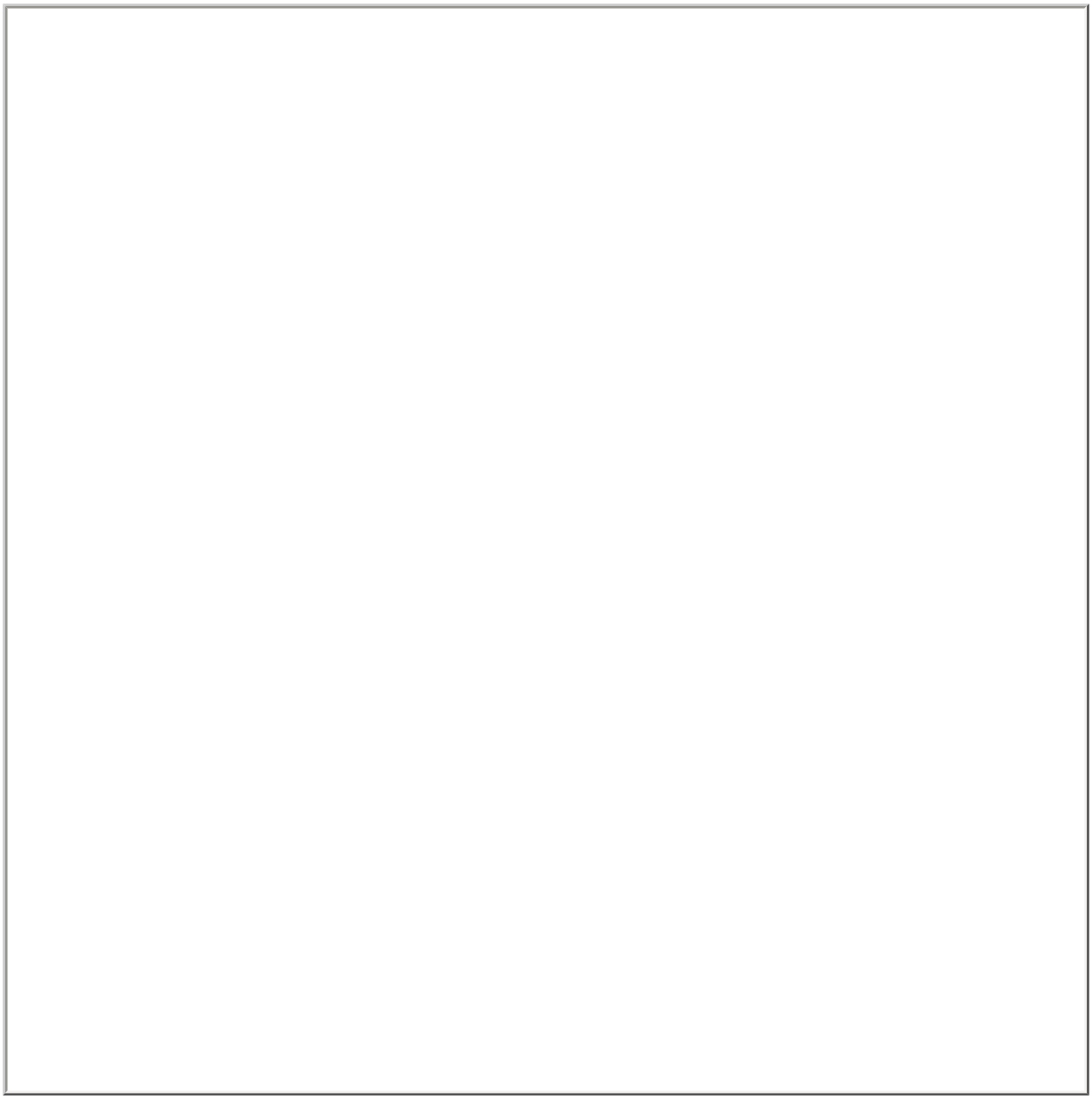
Drawing by: _____

Class: _____ Date: _____

Name _____ Date _____

Activity 2: Drawing of Microorganism

Name of microorganism: _____



Drawing by: _____

Class: _____ Date: _____

Name _____ **Date** _____

Activity 3: Where is Pfiesteria Found?

Pfiesteria organisms have been found as far north as Delaware, and as far south as the Gulf of Mexico. In the past, Pfiesteria has been a huge problem in North Carolina, where it is blamed for killing more than 7 million fish. It also may be to blame for a massive fishkill in the Indian River in Delaware in 1987. During the summer of 1997, Pfiesteria reared its ugly head again in the Chesapeake Bay, where it is perhaps to blame for killing tens of thousands of fish.

The following activities will help you learn more about Pfiesteria and the places in the Chesapeake Bay and its tributaries where scientists have positively identified Pfiesteria.

Materials Needed:

- Blank map of the Chesapeake Bay shorelines
- Colored pencils and ink pen

Directions

1. Use your Internet browser to visit the following web site: http://www.mdsg.umd.edu/fish-health/pfiesteria/index.html
2. **Click on** the article ***"Pfiesteria in the Chesapeake Bay"***
3. Read the information on the web page.
4. **Explain how Pfiesteria kills** fish.
5. **Use your mouse** to locate the map on this web page.
6. Using the information shown on the map and the materials listed above, **create your own map** showing the places in the Chesapeake Bay and the tributaries in which Pfiesteria has been reported.

   *** MAKE SURE** you include the following information on your map:
   a. an appropriate title for your map
   b. names and symbols indicating the rivers in which Pfiesteria has been reported or suspected
   c. dates Pfiesteria was reported
   d. states where the rivers are located

In addition to North Carolina and the states you identified on your map as reporting Pfiesteria, do you think people in other parts of the world should be concerned about Pfiesteria?

Check one: [YES] or [NO]

Use the space below to explain why you answered the way you did.

Name _____ **Date** _____

How Much of Our Bay is Affected?

The Chesapeake Bay is the largest and longest Bay in the United States. It covers 3,227 sq. miles of area and stretches from near the Pennsylvania-Maryland border to Cape Henry, Virginia. Your job is to find out the answer to one of the following questions:

WHAT PERCENTAGE OF THE CHESAPEAKE HAS REPORTED PFIESTERIA?

Answer: _____

Materials Needed: Calculator, student's map used in Activity 3, one sheet of notebook paper

Use the scale at the bottom of your Chesapeake Bay Shorelines map to help you find the answer to the question above. **RECORD** all your data in **Data Table A**

Directions:

1. Fold a sheet of notebook paper lengthwise to make a ruler approximately 11 inches long and 1/2 inch wide.
2. Use the paper ruler to measure the entire length of the Chesapeake Bay. Make sure you place pencil marks on your ruler to indicate the length of the Bay.
3. Now place your paper ruler on the scale at the bottom of the map to determine the length of the Bay in inches. **Record** your answer in the data table.
4. Next use your paper ruler to measure the distance between the rivers located to the extreme north and extreme south that reported Pfiesteria. Make sure you place pencil marks on your ruler to indicate this distance.
5. Place the paper ruler on the scale at the bottom of the map to determine the distance between the rivers reporting Pfiesteria. **Record** your answer in the data table.
6. Place the paper ruler on the scale at the bottom of the map to determine the distance between the rivers reporting Pfiesteria. **Record** your answer in the data table.
7. Use the data you recorded to determine the percentage of the Chesapeake Bay that has been affected by Pfiesteria.

Hint: To determine Percentage **(P)**, use this formula: **P = R / C**

C = length of the Chesapeake Bay

R = distance between the rivers reporting Pfiesteria

DATA TABLE A

Length of the Chesapeake Bay _____
Distance between the rivers reporting Pfiesteria _____
Percentage of the Bay reporting Pfiesteria _____

Name _____ Class _____ Date _____

Flex Your Brain

1. **Topic: _____**
2. What do I already know?
   1.
   2.
   3.
   4.
3. Ask a question:
   Q:
4. Guess an answer:
   A:
5. How sure am I? (circle one)

   Not Sure Very Sure

   1 2 3 4 5
6. How can I find out?
   1.
   2.
   3.
   4.
7. ***EXPLORE***
8. Do I think differently?
   [YES] [NO]
9. What do I know now?
   1.
   2.
   3.
   4.
10. ***SHARE***
    1.
    2.
    3.

Human Health Impacts

Thirteen researchers who worked with dilute toxic cultures of *Pfiesteria* sustained mild to serious adverse health impacts through water contact or by inhaling toxic aerosols from laboratory cultures. These people generally worked with the toxic cultures for 1-2 hours per day over a 5-6 week period. The effects include a suite of symptoms such as narcosis (a "drugged" effect), development of sores (in areas that directly contact water containing toxic cultures of *P. piscicida*, and also on the chest and face), uniform reddening of the eyes, severe headaches, blurred vision, nausea/vomiting, sustained difficulty breathing, (asthma-like effects), kidney and liver dysfunction, acute short-term memory loss, and severe cognitive impairment (= serious difficulty in being able to read, remember one's name, dial a telephone number, or do simple arithmetic beyond 1 + 2 = 3). Most of the acute symptoms proved reversible over time, provided that the affected people were not allowed near the toxic cultures again. Some of these effects have recurred (relapsed) in people following strenuous exercise, thus far up to six years after exposure to these toxic fish-killing cultures. Moreover, subcutaneous injection of crude toxin preparations from fish-killing cultures has induced serious learning impairment and memory loss in experimental laboratory rats (work by Drs. Levin and Schmechel at Duke University). The discovery, the "hard way," the *Pfiesteria* is unusual in its ability to produce toxins that can be easily airborne, led to requirements by state and federal officials that all further work with toxic fish-killing cultures of this dinoflagellate be conducted in biohazard level III containment systems in a limited-access facility. These precautions must be followed for any research with live toxic cultures of *Pfiesteria*.

Fish kills and fish disease events linked to *Pfiesteria* can extend for 6-8 weeks in North Carolina's estuaries, thus potentially providing the circumstances for humans in field settings to be hurt due to this dinoflagellate's toxins. However, it will not be possible to determine the extent to which people in our estuaries are being affected by *Pfiesteria* toxins, or whether it is safe to consume fish from toxic outbreak areas, until we have a way to diagnose the presence of these toxins. That will require identification of the chemical toxins produced by *Pfiesteria*, which is the subject of intensive research.

Medical Evaluation of Persons with Exposure to Water Containing Pfiesteria or Pfiesteria-like Dinoflagellaters: Interim

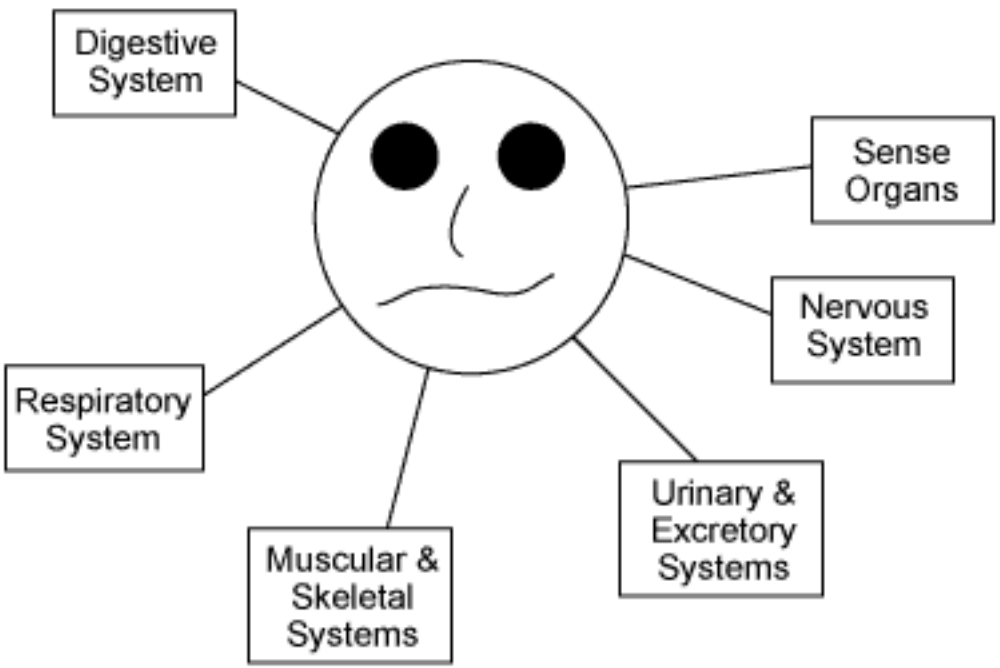
Symptom	high exposure (n=11)	moderate exposure (n=7)	low exposure (n=7)	controls (n=8)
Neurocognitives Sx confusion episodes of disorientation, new or increasing "forgetfulness" or problems concentrating	9 (82%)	6 (86%)	2 (50%)	1 (13%)
headache	9 (82%)	5 (71%)	2 (50%)	1 (13%)
skin lesions	8 (73%)	4 (57%)	1 (25%)	1 (13%)
skin burning on contact with water	5 (45%)	6 (86%)	1 (25%)	2 (25%)
diarrhea	5 (45%)	4 (57%)	2 (50%)	1 (13%)
nausea/vomiting	7 (64%)	4 (57%)	0	1 (13%)
abdominal cramps	5 (45%)	4 (57%)	1 (25%)	1 (13%)
joint pain	5 (45%)	2 (29%)	1 (25%)	2 (25%)
muscle/leg cramps	8 (73%)	2 (29%)	1 (25%)	2 (25%)
eye irritation	6 (55%)	2 (29%)	2 (50%)	4 (50%)
sinusitis	5 (45%)	5 (71%)	3 (75%)	3 (32%)
shortness of breath	2 (18%)	4 (57%)	1 (25%)	2 (25%)
pneumonia	2 (18%)	1 (14%)	0	0

Name _____ **Date** _____

How Does Pfiesteria Affect The Human Body And Fish?

There are many reports of people becoming sick after exposure to water that have the Pfiesteria organism and/or by breathing in the aerosolized toxins produced by Pfiesteria.

Directions:
Use information from the Internet articles your teacher gave you to determine how Pfiesteria affects organs and systems of the human body. Beside each diagram, write the related symptoms of persons exposed to Pfiesteria.



Discussion Questions

1. What are two ways a person can be exposed to the toxins produced by Pfiesteria?

2. What additional research is needed for scientists to determine the extent to which people are being affected by Pfiesteria?

3. Federal and state officials require that all further work with toxic fish-killing cultures of Pfiesteria be conducted in biohazard level III containment systems. EXPLAIN WHY

4. How does Pfiesteria affect fish?

Better Watch Out, Better Not Shout

Grades 7 - 8

Overview

Students will experience the effect of noise levels on concentration by participating in two tasks requiring concentration, first in a noisy environment, then in a quiet one. They will graph the results, then investigate the nature of noise pollution and its effects on both hearing loss and stress levels. Internet research opportunities and CD ROM exploration of the ear will be used to stimulate student interest and focus attention on the the harm caused to human health by noisy learning environments.

Technology Resources

Internet Sites For Student Research

Noise, Ears and Hearing Protection
http://www.netdoor.com/entinfo/noiseaao.html
This is a beautifully done, bright and colorful informational web page, all about noise and hearing loss from the American Academy of Otolaryngology.

Fun Quiz
http://www.lhh.org/noise/funquiz.htm
A funny quiz about noise from the League for the Hard of Hearing includes serious answers about the harmful effects of excessive noise.

H.E.A.R (Hearing Education and Awareness for Rockers)
http://www.hearnet.com
Every page of this site offers pictures of rock stars and quotes from them urging young people to protect their hearing. Designed to capture the interest of young people, the site also offers solid information in an accessible form.

Citizens' Coalition Against Noise
http://www.torfree.net/ip/cg343/menu.html
Among other things, this web page offers easy to read information about Noise and Society, and Noise and Your Health.

Better Hearing Institute
http://www.betterhearing.org
Students will find here a self-hearing evaluation, hearing statistics, frequently asked questions, a list of famous people with hearing loss as well as information about hearing conservation.

Right to Quiet
http://www.quiet.org
Posted by a Canadian group working against noise pollution, this has great, easy to understand information about the effects of noise pollution.

Council on the Environment
http://www.cenyc.org
Colorful and easy to read, this site offers a broad overview of the problems of noise pollution, including stress and hearing loss.

Noisy Toys
http://www.lhh.org/noise/children/toys.htm
Some toys are not as much fun as they look. Many toys designed to stimulate our children can be dangerously loud. Some examples are given here.

Internet Sites For Teacher Information

Noise and Its Effects
http://www.nonoise.org/library/suter/suter.htm
Teachers interested in more information about this subject should start here. This site offers a well organized, comprehensive overview of noise pollution research.

More Internet Links
http://www.lhh.org/links/noise.htm
Additional links provided by the League for the Hard of Hearing are located here.

Noise Pollution Clearing House
http://www.nonoise.org
This includes a wonderful search tool offered by the Noise Pollution Clearing House which provides easy access to a plenitude of recently published articles about noise pollution.

Noise and Hearing Loss
http://text.nlm.nih.gov/nih/cdc/www/76txt.html
This is the official National Institutes of Health Consensus Development Conference Statement on noise and hearing loss; what causes it; which sounds can damage hearing; and what can be done to prevent hearing loss.

National Resources Defense Council
http://www.nrdc.org
Four environmental awareness web sites located at one address, this site also includes a great search tool.

Stop That Noise!
http://www.lhh.org/noise/stn.htm
A description is given of an educational program from the League for the Hard of Hearing that provides students with information about noise and its effects on hearing.

Teacher Background

Excessive noise can damage hearing, raise blood pressure, disturb sleep and disrupt communication. Other effects of noise include annoyance, physiological stress reactions, and psychological stress. Noise also appears to interfere with learning.

Many recent studies show that children in schools near airports, loud trains and major highways have poorer reading ability, inferior long term memory, less motivation, higher blood pressure, greater annoyance levels and more difficulty solving cognitive problems than children who attend quiet schools. Noisy learning environments are clearly associated with lower reading and math scores.

Gary Evans of Cornell's College of Human Ecology says, "We've known for a long time that chronic noise is having a devastating effect on academic performance of children in noisy homes and schools." Evans and his collaborator, environmental psychologist Lorraine Maxwell, compared children in a noisy school (in the flight path of a major international airport) with similar children in a quiet school. In another study, preschoolers in daycare centers located near elevated trains in New York City did poorer on psychomotor skills than their counterparts in quieter neighborhoods did. (Hambrick-Dixon, *Developmental Psychology,* 1985) Older students who attended schools near major New York airports had lower reading scores than did children in schools located further from the airports. (Green & Shore, *Archives of Environmental Health,* 1982)

Children living near noisy highways in Los Angeles had lower reading scores and children living near a major airport there had more difficulty solving cognitive problems. (Cohen, Glass and Singer, *Journal of Experimental and Social Psychology,* 1973 and 1980) A study of seventh and tenth graders found that the high-academic students were not affected by nearby airport noise while lower-achieving students were affected. (Maser, Sorensen, Kryter & Lukas, *Western Psychological Association Conference,* 1978)

In one New York City school, a study focused on students in grades two, four, and six. Half of the classes at each grade level were in classrooms adjacent to train tracks; the other half of the classes were on the quieter side of the building. The study showed that the reading levels of the students on the noisy side of the building were behind the reading levels of their peers on the quiet side of the building. The sixth graders on the noisy side of the building averaged as much as one year behind in reading. (Bronzaft & McCarthy, *Environment and Behavior,* 1975)

Then rubber pads were installed on the nearby train tracks and acoustic ceiling tiles were installed on ceilings of the noisiest classrooms. Those noise-abatement measures cut the noise levels in the noisy classrooms by as much as eight decibels. (Noise levels are cut in half for every ten-decibel decrease in measured sound.) A two-year study following the installation of the rubber pads and acoustic tiles showed no differences in reading levels between classes on the two sides of the building. (Bronzaft, *Journal of Environmental Psychology,* 1981)

Other studies demonstrate that noise levels in ordinary classrooms often impair childrens' speech perception, reading and spelling ability, behavior, attention, and academic performance. Noisy classrooms can encourage children to tune out not only extraneous noises, but also the teacher. Research in the effects of noise on performance indicates that irrelevant speech affects processes involving memory (e.g., reasoning, mental arithmetic, and problem solving) rather than attention. With respect to reading tasks, however, meaningful speech is more disruptive than meaningless speech (Jones, 1990).

When two or more tasks must be performed simultaneously in a noisy environment, performance on the primary task usually remains unaffected, while performance on the subsidiary task deteriorates (Hockey and Hamilton, 1970; Davies and Jones, 1975; Finkleman and Glass, 1970). Noise is more bothersome in crowded classrooms; teachers in those classrooms might resort to quieter, less effective teaching methods because of the conditions. (Gifford, *Environmental Psychology,* Allyn and Bacon, Inc., 1987)

Carl Crandell, an audiology professor from the University of Florida at Gainesville, presented a summary of scientists' recent findings. He said even in fairly quiet school environments, grade-school children with no hearing problems can make out only 71% of the words a teacher at the front of the room says. In the worst situations, students can process just 30% of the sounds. Noisy classrooms can encourage children to tune out not only extraneous noises, but also the teacher. Crandell said, If a child cannot hear, attentional and/or behavioral problems often occur. When we can get a child to hear well, we often see a reduction or elimination of those problems. Many classrooms have sound intensities 30 times higher than the maximum recommended level of 35 decibels. Classroom noise levels are often so loud they impair children's' speech perception, reading and spelling ability, behavior, attention, and academic performance.

Some problems may arise because teachers in noisy schools and parents in noisy homes may be more irritable, and reluctant to talk as much, to use as many complete sentences, and to read aloud to children. Researchers attribute increased irritability, lower productivity, decreased tolerance levels, increased incidence of ulcers, migraine headaches, fatigue, and allergic responses to continued exposures to high-level noises. Singer et al. (1990) point out that noise has been used as a noxious stimulus in a variety of investigations because it produces the same biological and psychological effects as other stressors.

Noise is considered a nonspecific biological stressor, eliciting a response that prepares the body for action, sometimes referred to as the fight or flight response. The physiological mechanism thought to be responsible for this reaction is the stimulation by noise (via the auditory system) of the brain's reticular activating system (Cohen, 1977). Rehm (1983) has reviewed 14 field studies, mostly of occupational noise exposure, and reports that the majority showed significant increases in either systolic or diastolic blood pressure, or both.

Next

Learning Objectives

Students will be able to:

- collect, organize, & display data using appropriate displays;
- demonstrate their acquisition and integration of the concept that sound is energy generated by vibrating matter;
- demonstrate understanding of the function of the ear;
- demonstrate a willingness to modify ideas about noise based on additional evidence and ideas gathered in an Internet research activity;
- demonstrate the ability to apply scientific knowledge in making personal decisions about exposure to loud sounds.

Vocabulary

stress: a mentally or emotionally disruptive influence
noise: any unwanted sound
noise pollution: sounds caused by human activities, capable of being harmful
frequency (pitch): how low or how high a sound is
hertz: a unit of frequency, equal to one cycle per second
intensity: the energy or force of a sound
decibels (dB): measure of the intensity of sound

Equipment and Materials

Per class:

- Recording of a noisy school environment, such as cafeteria or hallways
- Tape Recorder
- Stop Watch
- Overhead Transparencies of Answers to Division Problems , Answers to Noise Word Searches , Answers to Internet Scavenger Hunt Activities and Answers to CD ROM Activity Sheet: The Ear
- Class Data Collection Table
- Graphing Scientific Data: Performance Task Assessment List
- Position Paper on an Issue: Performance Task Assessment List
- Writing About Science Concepts: Performance Task Assessment List
- CD ROM: The Ultimate Human Body, Dorling Kindersley Multimedia or similar CD ROM.
- Computer with internet access and CD ROM drive

Per each group of 3-5 students:

- Data Collection Table *Activity Sheet*

Per student:

- Division Problems 1 and 2
- Noise Word Searches 1 and 2
- Internet Scavenger Hunt *Activity Sheets* (1, 2, 3 & 4)
- CD ROM *Activity Sheet:* The Ear
- Pencil
- Graph Paper

Next

Procedures

Activity 1: Engagement and Exploration

1. Record the sounds of conversation in a noisy school environment for at least ten minutes. Place tape player near the center of the class, set at high volume.
2. Ask students to name some noisy environments. Discuss how they feel in these environments. Keep a list of these feelings on the chalkboard or overhead to refer to after the lesson.
3. Ask students if they think noise levels can effect their ability to concentrate and learn. Encourage a brief discussion. Accept all responses.
4. Briefly explain the results of the studies quoted under Teacher Background Information.
5. Distribute Division Problems 1. Appoint one student to be the timekeeper. Instruct students to work as quickly and accurately as they can for three minutes. Tell the timekeeper to say Go! as she starts the stopwatch and presses PLAY on the recorder, which will create noise in the classroom. After three minutes, the timekeeper should turn off the recording and tell students to stop.
6. Display the answers. Students should trade papers, check the answers, and write the number correct in the upper right hand corner of the page.
7. Distribute Division Problems 2. Instruct students to work as quickly and accurately as they can for three minutes in silence. The timekeeper says Go! as she starts the stopwatch. After three minutes, the timekeeper should turn off the recording and tell students to stop.
8. Display the answers. Students should trade paper, check the answers, and write the number correct in the upper right hand corner of the page.
9. Repeat steps 5 through 8 using the Noise Word Search worksheets.
10. Each group should record the results of the four trials on a Data Collection Table *Activity Sheet*, then one person from the group should record the figures on the overhead transparency of the Class Data Collection Table. When all groups have recorded their results, review the components of an effective table. Emphasize adding a title, column and row headings and a key.
11. Display Graphing Scientific Data - Performance Task Assessment List, and discuss the components of an effective graph. Each student should then graph the results of the four trials.

Activity 2: Explanation

1. Explain to students that they will research the function of the ear as a mechanism for receiving and transforming the energy from sound waves.
2. If necessary, demonstrate for students how to find information about the ear on a CD ROM such as The Ultimate Human Body, from Dorling Kindersley Multimedia.
3. Distribute CD ROM *Activity Sheet:* The Ear to each student.
4. Using the CD ROM students can search for the answers to CD ROM *Activity Sheet:* The Ear in groups of two or three.

Extensions

Internet Exploration

1. Teachers whose classrooms do not have Internet access should print the web pages cited. Only one copy of each web site is needed. Placing the web pages in protective plastic pages will keep them attractive.
2. Distribute one set of the Internet Scavenger Hunt *Activity Sheets* to each student. Activity pages are provided for a scavenger hunt of six Internet sites. Although students will work in groups, each student should be required to turn in answers to the activity pages so that one or two members of each group don't end up doing all the research while the attention of other members wanders.
3. If students do not have actual Internet access, as they complete their search of each web site they must return printed copies of the web site to a central location for use by other groups.
4. Close the activity by having students prepare a position paper on the issue of noise pollution based on information gathered in the scavenger hunt. Before students begin, display Position Paper on an Issue - Performance Task Assessment List and discuss the elements of an effective position paper. If time permits, students will enjoy dividing into teams and debating whether or not there should be laws regulating the loudness of music at concerts.

Language Arts

Have students write a letter to the school principal explaining the experiment, their research, and the student's feelings and ideas about noise pollution in the school. Before students begin, display *Writing About Science Concepts - Performance Task Assessment List* and discuss the elements of effective writing.

1998 EnviroHealth Link Master Teacher Team

Linda Massey and Donna Smith

Class Data Collection Table

Mean:				

KEY

An effective table:
• has a title;
• is filled in completely and accurately;
• has row and column headings;
• has a key.

A fair table:
• has one or two elements missing.

An ineffective table:
• has more than two elements missing.

Graphing Scientific Data-

Performance Task Assessment List

1. An appropriate graph is used.
2. The title tells the purpose of the graph.
3. Both axes are clearly labeled.
4. Even intervals are marked on each axis.
5. An accurate key is provided.
6. Data is plotted accurately.
7. The graph is neat and presentable.
8. Colors, textures or other features add interest.

8 out of 8 are checked	Graph is outstanding.
6 out of 8 are checked	Graph is good.
4 out of 8 are checked	Graph is fair.
3 or less are checked.	Graph is not effective.

Position Paper on an Issue:

Performance Task Assessment List

1. The alternative positions are stated clearly.
2. Criteria for choosing a position are stated.
3. Reasons for rejecting a position are given.
4. The position is supported with research.
5. Information from research is properly referenced.
6. The research cited is pertinent and accurate.
7. Writer addresses intended audience appropriately.
8. Spelling is correct.
9. The writing is grammatically correct.

10 out of 10 are checked	Writing is highly effective.
8 out of 10 are checked	Writing is good.
6 out of 10 are checked	Writing is fair.
3 or less are checked.	Writing is not effective.

Writing about Science Concepts

Performance Task Assessment List

The first paragraph clearly states the main ideas.

1. Each main idea is developed in a paragraph.
2. Each paragraph has at least three supporting details.
3. The last paragraph is a conclusion, and sums up the points made.
4. The writer addresses the intended audience appropriately.
5. Science concepts used are appropriate and accurate.
6. The writer gives a reasonable interpretation of the data.
7. Spelling is correct.
8. Writing is grammatically correct.
9. Punctuation and capitalization are used correctly.

10 out of 10 are checked	Writing is highly effective.
8 out of 10 are checked	Writing is good.
6 out of 10 are checked	Writing is fair.
3 or less are checked.	Writing is not effective.

Name _____ **Date** _____

Data Collection Table Activity Sheet

What question do you think this experiment is designed to answer?

Based on what you already know about the question, what do you **hypothesize** will be the results of this experiment?

Record the **data** below. Put a title on your table, and appropriate headings on both columns and rows. Include a key.

Mean:				

KEY

An effective table:
• has a title;
• is filled in completely and accurately;
• has row and column headings;
• has a key.

A fair table:
• has one or two elements missing.

An ineffective table:
• has more than two elements missing.

Name _____ Date _____

Division Problem 1

2646 / 7 =	1476 / 4 =
2180 / 5 =	3996 / 4 =
1322 / 2 =	3032 / 8 =
4216 / 8 =	2796 / 3 =
1332 / 6 =	1732 / 4 =

Name _____ Date _____

Division Problem 2

591 / 3 =

4696 / 8 =

1926 / 6 =

1985 / 5 =

3570 / 6 =

5589 / 9 =

3552 / 4 =

4176 / 6 =

3213 / 9 =

5159 / 7 =

Answers to Division Problems

Answers to Division Problem 1

2646 / 7 = 378

2180 / 5 = 436

1322 / 2 = 661

4216 / 8 = 527

1332 / 6 = 222

1476 / 4 = 369

3996 / 4 = 999

3032 / 8 = 379

2796 / 3 = 932

1732 / 4 = 433

Answers to Division Problem 2

591 / 3 = 197

1926 / 6 = 321

3570 / 6 = 595

3552 / 4 = 888

3213 / 9 = 357

4696 / 8 = 587

1985 / 5 = 397

5589 / 9 = 621

4176 / 6 = 696

5159 / 7 = 737

Name _____ **Date** _____

Noise Word Search 1

noise	research	exposure	antisocial
health	impair	discomfort	sleep disruption
threat	pressure	communicate	threshold
stress	energy	interfere	

a	x	v	n	m	l	h	f	s	q	e	e	t	i	o	p
n	b	v	c	x	t	z	a	s	d	n	f	h	j	l	s
q	i	n	t	e	r	f	e	r	e	s	h	o	l	d	e
w	c	o	p	g	o	l	i	r	n	t	e	s	s	s	t
e	e	i	s	t	f	l	g	n	o	i	s	l	e	h	a
r	s	s	x	h	m	y	d	i	s	c	o	e	r	m	c
t	s	e	s	s	o	l	g	n	i	r	a	e	h	f	i
y	t	o	c	h	c	o	w	z	x	d	s	p	r	o	n
u	s	t	r	e	s	s	e	m	b	h	l	d	t	t	u
i	y	i	i	r	i	i	f	m	o	n	i	i	s	p	m
o	r	u	a	o	d	a	f	l	h	u	h	s	t	r	m
p	i	y	p	p	i	s	d	y	e	y	c	r	u	e	o
a	o	r	m	p	p	l	r	t	a	u	r	u	x	s	c
a	n	t	i	s	o	c	i	a	l	r	t	p	i	s	c
c	b	e	v	s	e	q	p	e	t	e	o	t	l	u	o
v	c	e	s	n	e	u	i	r	h	s	r	i	p	r	m
q	w	r	o	w	r	i	s	v	u	e	o	o	r	e	m
u	u	i	k	r	l	t	h	r	e	a	t	n	a	n	u
r	h	c	r	a	e	s	e	r	r	s	s	a	a	c	i

Name _____ **Date** _____

Noise Word Search 2

hertz	annoying	vibration	learning process
ear	cycles	frequency	cardiovascular
sounds	loudness	amplitude	psychological
range	damages	decibel	hazardous

l	o	u	d	n	e	s	s	s	a	n	n	o	r	g	p
m	e	e	o	a	a	d	u	g	l	a	i	y	n	l	o
l	o	v	d	n	r	n	s	n	e	n	r	c	e	t	o
g	e	a	n	e	d	u	t	i	l	p	m	a	i	s	d
b	t	v	d	p	g	o	e	y	a	g	r	r	n	e	c
r	z	i	f	h	e	s	s	o	c	n	e	d	c	r	s
a	t	i	r	a	l	i	c	n	i	c	a	i	y	u	r
o	n	s	e	z	v	v	o	n	g	i	b	o	c	o	d
e	r	t	q	a	i	c	g	a	o	e	y	v	l	l	q
b	q	w	u	r	b	p	r	l	l	t	h	a	e	e	e
u	n	e	e	d	r	u	v	a	o	d	s	s	s	i	u
n	d	e	n	o	a	e	c	r	h	v	b	c	r	o	o
j	l	a	c	u	t	i	l	o	c	c	h	u	y	s	p
m	a	e	y	s	i	n	y	n	y	e	a	l	r	r	l
w	s	e	a	r	o	o	m	y	s	e	g	a	m	a	d
s	h	e	r	r	n	e	v	e	p	n	o	r	m	n	b
e	s	i	o	a	n	e	u	o	r	e	t	s	i	g	o
c	y	g	g	o	d	s	e	u	o	h	z	t	r	e	h
h	o	t	r	i	n	u	s	t	i	n	a	b	u	l	a

Answers to Noise Word Searches

Answers to Noise Word Search 1

											e				
					t					n					
	i	n	t	e	r	f	e	r	e						e
		o			o			r				s		s	t
		i			f		g					l		h	a
		s			m	y						e	r		c
		e	s	s	o	l	g	n	i	r	a	e	h		i
					c						s	p			n
	s	t	r	e	s	s				h		d			u
			i		i				o			i		p	m
			a		d			l	h			s		r	m
			p				d		e			r		e	o
			m						a			u	x	s	c
a	n	t	i	s	o	c	i	a	l			p		s	
									t		o	t		u	
									h	s		i		r	
									u			o		e	
						t	h	r	e	a	t	n			
	h	c	r	a	e	s	e	r							

Answers to Noise Word Search 2

l	o	u	d	n	e	s	s								
						d		g						l	
						n		n				c	e		
				e	d	u	t	i	l	p	m	a			d
						o		y	a		r	r		e	
			f	h		s		o	c	n		d	c		
			r	a				n	i			i	y		
			e	z	v			n	g		b	o	c		
			q	a	i		g	a	o	e		v	l		
			u	r	b	p			l			a	e		
			e	d	r				o			s	s		
			n	o	a				h			c			
			c	u	t				c			u			
		e	y	s	i				y			l		r	
	s	e	a	r	o				s	e	g	a	m	a	d
s					n				p			r		n	
														g	
											z	t	r	e	h

Name _____ Date _____

Internet Scavenger Hunt Activity Sheet 1

Noise, Ears and Hearing Protection http://www.netdoor.com/entinfo/noiseaao.html

Answer in complete sentences. Include the question in your answer.

1. What percentage of Americans have hearing loss?

2. Discuss the most common cause of hearing loss.

3. Which part of the body is destroyed by loud noise?

4. Can dead nerve endings be restored?

5. What is measured in decibels?

6. What is measured in Hertz (Hz)?

7. At what intensity may sound become dangerous?

8. The _____ you are exposed to a loud noise, the more damaging it may be. The _____ you are to the source of intense noise, the more damaging it is.

9. How does the human body react to loud noises?

10. How does very loud noise reduce efficiency in performing difficult tasks?

Name _____ Date _____

Internet Scavenger Hunt Activity Sheet 2

Fun Quiz
http://www.lhh.org/noise/funquiz.htm

I. Take the "Fun Quiz." Put the answers you choose on your scavenger hunt paper, then check the answers.

II. Find the answers to the following questions. Answer in complete sentences. Include the question in your answer.

1. Can loud music damage your hearing?

2. If you damage your ears, can your hearing be fixed by a doctor?

3. If the music is too _____, it can hurt your hearing.

4. If you are around loud noise, how can you protect your hearing?

5. How loud are the loudest toys?

6. Will winter ear muffs keep out dangerously loud sounds?

7. Do musicians ever wear ear plugs when they practice and perform on stage?

8. Hearing loss from noise happens _____. The more noise you are around, the more chance that you will get a _____ _____. But, if you turn down the volume on toys and music today, you will protect your hearing for the _____.

Name _____ Date _____

Internet Scavenger Hunt Activity Sheet 3

H.E.A.R. (Hearing Education and Awareness for Rockers)
http://www.hearnet.com

Answer in complete sentences. Include the question in your answer.

1. What is temporary threshold shift?

2. Explain what tinnitus is and what causes it.

3. How many people experience some form of tinnitus?

4. What protects your ears from damage by loud music?

5. _____ of sound, or _____ is measured in decibels (dB)

6. What does zero dB measure?

7. How loud is normal conversation?

8. At what dB level does sound become painful?

9. If you are in front of the speakers at a rock show, what decibel level will you experience?

10. The OUTER EAR _____ _____ _____ from the air to the eardrum. Sound causes the _____ _____ to vibrate. _____ causes the three bones in the MIDDLE EAR to move. In the INNER EAR, tiny _____ _____ pick up vibrations and change them to _____ _____ along the auditory nerve to the _____.

Name _____ Date _____

Internet Scavenger Hunt Activity Sheet 4

Better Hearing Institute
http://www.betterhearing.org

Answer in complete sentences. Include the question in your answer.

1. What percentage of the population is afflicted by hearing loss?

2. What level of noise is considered hazardous?

3. Florence Henderson restored her hearing with _____ _____. Mark Herndon, drummer for the popular Alabama group, suffered a hearing loss before learning about _____ _____. Curtis Pride, first _____ major league baseball player in 50 years, hopes to encourage others to seek _____ _____ if they suspect a hearing loss.

4. **Complete the chart:**

Sound	**Decibel Level**	**Time Permitted**
whispering	_____	no limit
_____	50 dB	no limit
noisy restaurant	80 dB	_____
power mower	_____	1 hour
THRESHOLD OF PAIN	_____	danger level
jet engine	140 dB	_____

5. How can hearing loss affect people?

6. What is an important sign that a young child might have a hearing loss?

Internet Scavenger Hunt Acitvity Sheets' Answers

Answers: ***Noise, Ears and Hearing Protection*** http://www.netdoor.com/entinfo/noiseaao.html

1. One in 10 Americans has a hearing loss. (10%)
2. Excessive noise exposure is the most common cause of hearing loss. If it is loud enough and lasts long enough, noise can damage your hearing.
3. Exposure to loud noise destroys nerve endings.
4. There is no way to restore dead nerve endings; the damage is permanent.
5. Intensity, or loudness of sound, is measured in decibels.
6. Pitch is measured in frequency of sound vibrations per second, or Hertz (Hz).
7. Continual exposure to more than 85 decibels may become dangerous.
8. The longer you are exposed to a loud noise, the more damaging it is. The closer you are to the source of intense noise, the more damaging it is.
9. Some people react to loud noise with anxiety and irritability, an increase in pulse rate and blood pressure, or an increase in stomach acid.
10. Very loud music can reduce efficiency in performing difficult tasks by diverting attention from the job.

Answers: ***Fun Quiz***
http://www.lhh.org/noise/funquiz.htm

1. Loud music can damage your hearing. The damage is forever! If you listen to loud music a lot, you will lose some hearing.
2. A doctor cannot fix your hearing if it is destroyed by noise.
3. If the music is too loud, it can hurt your hearing.
4. If you are around loud noise, you'll need to use hearing protection (ear plugs or ear muffs made by special companies) to protect your hearing.
5. Some toys are even louder than a lot of power tools and rock concerts. Turn down the volume button on the toy (if there is one) or just don't use it!
6. Winter ear muffs will keep your ears warm, but won't help to keep out the dangerously loud sounds. You'll need ear plugs to do that!
7. Lots of famous musicians now wear ear plugs when they practice and perform on stage.
8. Hearing loss from noise happens slowly. The more noise you are around, the more chance you will get a hearing loss. But, if you turn down the volume on toys and music today, you will protect your hearing for the future.

Answers: *H.E.A.R. (Hearing Education and Awareness for Rockers)* http://www.hearnet.com

1. Temporary threshold shift is a form of short-term hearing loss which can become permanent.
2. Tinnitus is a ringing in the ears that often follows exposure to loud noise. For some people, the problem is temporary, but it can become permanent.
3. More than 50 million people experience some form of tinnitus, a sign that the auditory nerve has been shocked.
4. When you're places where the music is going to be loud, get some earplugs.
5. Intensity of sound, or loudness is measured in decibels (dB).
6. Zero dB is the softest sound that can be heard.
7. Normal conversation is around 40 to 60 dB.
8. Sound becomes painful at 125 dB.
9. At rock shows, the dB level can be as great as 140 dB in front of the speakers.
10. The OUTER EAR funnels sound waves from the air to the eardrum. Sound causes the tympanic membrance to vibrate. Vibrations cause the three bones in the MIDDLE EAR to move. In the INNER EAR, tiny hair cells pick up vibrations and change them to electrical impulses along the auditory nerve to the brain.

Answers: *Better Hearing Institute*
http://www.betterhearing.org

1. Hearing loss afflicts about 10% of the population.
2. Noise in excess of 85 ot 90 decibels is considered hazardous.
3. Florence Henderson restored her hearing with corrective surgery. Mark Herndon, drummer for the popular Alabama group, suffered a hearing loss before learning about hearing protection. Curtis Pride, the first deaf major league baseball player in 50 years, hopes to encourage others to seek hearing help if they suspect a hearing loss.
4. **Complete the chart:**

Sound	**Decibel Level**	**Time Permitted**
whispering	25 dB	no limit
average home	50 dB	no limit
noisy restaurant	80 dB	no limit
power mower	105 dB	1 hour
THRESHOLD OF PAIN	140 dB	danger level
jet engine	140 dB	danger level

5. People who cannot hear well often lead lives filled with anxiety, insecurity, isolation, and depression.
6. The single most important sign of possible hearing loss in the very young child is delayed development of speech and langauge.

Name _____ Date _____

CD ROM Activity Sheet: The Ear

Answer in complete sentences. Include the question in your answer.

1. What are two characteristics of sound that can be detected by the human ear?

2. Name three parts of the ear.

3. Briefly describe the function of each of the three parts of the ear.

4. Three tiny bones transmit vibrations through the middle ear. Name the bones.

5. The true sound receptors are thousands of specialized _____ _____.

6. What happens as sound waves hit the tiny hair cells?

7. What determines how we hear pitch and loudness?

8. Sound waves travel down the _____ _____ and cause the _____ to vibrate.

9. Summarize the way sound waves travel to the brain.

Answers CD ROM Activity Sheet: The Ear

1. The characteristics of sound that can be detected by the human ear include volume, pitch, and tone.
2. The ear has three parts. The outer, middle, and inner portions.
3. The outer ear funnels sound into the middle ear. The middle ear is an air-filled chamber containing the eardrum, connected to the pharynx by the eustachian tube. The inner ear contains the sensory receptors enclosed in a fluid-filled chamber called the cochlea.
4. Vibrations are transmitted through the middle ear by a sequence of three tiny bones called the hammer, anvil, and stirrup.
5. The true sound receptors are thousands of specialized hair cells.
6. The deformation of the hairs causes them to initiate electrical impulses.
7. The sensation of pitch depends on which area of the brain is stimulated. Loud sounds cause more intense stimulation of hair cells and result in the transmission of more impulses per unit time to the brain.
8. Sound waves travel down the auditory canal and cause the eardrum to vibrate.
9. The ear converts sound waves in the air to nerve impulses that are relayed to the brain, where they are interpreted as sound rather than as mere vibrations.

Blame It on the Hormones

Grades 7 - 8

Overview

In recent years, livestock producers have begun adding hormones to the feed given to their animals. Cattle (both dairy and for slaughter) are given hormones such as testosterone, estradiol, progesterone, zeranol, and trenbolone to speed their growth rate and the amount of milk or meat produced. But are these hormones as harmless as industry representatives would have us believe? After all, hormones play numerous roles in growth and development, especially in the growth and sexual hormones. Why has the European Economic Union (EEU) just banned the importation of beef that has been "implanted?" The activities outlined below will show the effects of hormones on plants, and illustrate to the students the pros and cons of hormone treatment for agricultural purposes.

Technology

Internet Sites

Some Dangers of Hormones in Milk
http://www.envirolink.org/pubs/rachel/rhwn382.htm
From Rachel's Hazardous Waste News, a fairly detailed explanation of some of the hormones used in milk production, and what they do to the milk. Numerous footnotes set this site apart from many others, and can lead you in other directions.

Beef Hormones--Hormones at Work
http://www.cargill.com/today/bulletin/b10963.htm
This page describes growth hormones banned in Europe but which have been in use among most U.S. livestock producers for years to promote faster growth and muscle build-up. About 90 percent of U.S. cattle in feedlots raised specifically for beef, rather than milk or breeding, receive growth hormones at some time during their life, according to the National Cattlemen's Beef Association (NCBA).

Beef Hormones--Scientific Studies and Official Doubt
http://www.cargill.com/today/bulletin/b10965.htm
http://www.cargill.com/today/bulletin/b10966.htm
This page describes the disagreement between proponents of hormone-treated animals: After more than 15 years of study, no scientific review has ever concluded that there is a need to ban the consumption of meat from hormone-treated animals, according to the U.S. Food and Drug Administration position. and opponents: the lack of evidence doesn't mean no danger exists. No scientific report to date ... has ever suggested that there is no potential risk from the use of these hormones.

Notmilk Homepage
http://www.notmilk.com
This home page is dedicated to reducing the consumption of milk. A detailed listing of the hormones commonly found in milk is the main draw of this page. The viewer of this page is invited to click on two pro-milk sites and compare them with Notmilk's information and health alternatives to dairy products (hundreds of recipes)

Computer software

Microsoft Paintbrush, or Mac Draw
Microsoft Power Point, or similar program

Learning Objectives

The students will be able to...

- explain the roles that hormones play in plants and animals.
- determine what dangers, if any are presented by the use of hormones in the commercial production of livestock.
- describe how the time of exposure is important when determining the effect that a hormone may have on an organism.

Vocabulary

Cholesterol: A steroid which is an important component of cell walls, and is used by the vertebrate body in the production of sex hormones, such as testosterone and estrogen.
Endocrine Gland: A ductless gland that produces hormones, and secretes them into the blood stream. The gland may have other functions.
Hormone: A specific molecule produced and secreted by a group of specialized cells (in an animal, an endocrine gland), released into the bodily fluids, which then has an effect on a specific group of target cells. Their function is to coordinate the parts of an animal's body. From the Greek hormon, which means to excite.
Phermones: Biochemicals that are chemically similar to hormones, but which are used to communicate between different individuals, as in mating between insects.
Steroids: A group of hormones. Members of this group are characterized by being composed of four fused carbon rings. Cholesterol is one of the most important.
Target Cells: Cells acted on by a hormone.

Materials

For the class:

- Several plants (African Violets, Coleus, or Philodendrons work well) from which cuttings may be taken.
- Computer with either overhead adaptor or television connector.

For each group of 3 or 4 students:

- Three 3" diameter clay flower pots.
- Small quantity of .1% butyric acid, available from any good supply catalog, or nursery.
- Potting soil sufficient to fill each pot to within 1 inch of the top.
- Water.
- China marking pencil, or other labeling media.
- Computer with Internet access, and Power Point, or a similar software package.
- Paintbrush or MacIntosh Draw software

For each student:

- *Activity Sheet:* Effects of Plant Hormones

Next

Procedures

Activity 1: Researching Hormonal Effects on Plants

Note: Be sure to review the M.S.D.S. (*Material Safety Data Sheet*) before using butyric acid, or any other chemical.

Note: There should be as little elapsed time between cutting the plug, treatment with the hormone, and planting. Avoid cutting the plugs in advance for your students.

The students will need to use three flower pots. One will be labeled control, the second experimental, and the third overdosed. Each pot should be filled to within an inch of the top with potting soil. The soil needs to be moistened, but not soaked. The clay pots will help to moderate the effect of excess watering, but care still must be taken, or the butyric acid can be diluted, or washed off. Once the pots are prepared, each group obtains a pair of cuttings from the same plant. The cuttings should be as similar in size as is feasible. Each cutting should consist of a single leaf and stem. The stem should be at least seven centimeters in length.

One cutting should simply be stuck in the soil in the control pot. The second cutting should have its cut end dipped lightly into the butyric acid, then planted in the experimental pot. The third cutting should be overdosed with the butyric acid, a thick coating should be obvious. Place it into the pot labeled overdosed. Allow the plants to grow for a period of three weeks. At the end of that time, the plants are removed from the pots, and their roots are compared. Have the students use either the Paintbrush program on the Windows system, or Macintosh Draw program to illustrate the three roots. Questions and a data table for the students to complete are included on the *activity sheet* entitled Effects of Plant Hormones.

Activity 2: WebQuest

Once the students know what a hormone is, they will be required to perform a WebQuest on the use of hormones in beef and milk production, and develop a presentation of that information, using Power Point software. Put the students into groups of four. Allow the students to research one of the following topics: how hormones function in animals, agricultural use of hormones, possible side effects of hormones, impacts of hormones in the environment, and medicinal use of hormones. (Class size may dictate that more than one group will research the same topic) Encourage the groups to take different approaches to their research. Allow sufficient time for the students to research their topic on the Internet. The scripting, and development of the Power Point presentation should take two more class periods.

Extensions

Math

A simple mathematics extension is to have the students place their Hormonal Effects on Plants data from Activity 1 on an overhead, or chalkboard. Once all of the information has been gathered, each student will make a box-and-whisker plot for both control and experimental information. This will allow for simple, visual and statistical comparisons of the data generated.

Language Arts

Once the students have seen the presentations on hormones, have them write a letter, or prepare an e-mail to the Food and Drug Administration (F.D.A.) expressing their opinions on the use of hormones on animals.

1998 EnviroHealth Link Master Teacher Team

Timothy P. Price and Kelly Sullivan

Name _____ Date _____

Effects of Plant Hormones Activity Sheet

TABLE 1

Plant	Root Length	Comments
Control		
Experiment		
Overdose		

1. Which plant's root showed the greatest growth?
2. Which plant showed the greatest growth?
3. What effect(s) does overdosing the plant with butyric acid have?
4. What function(s) are hormones likely to have in plants?
5. What effect would you expect animal hormones to have on animals?
6. What would be some possible effects of putting butyric acid on the leaves or stems of growing plants?

Raindrops Keep Burning on My Head!

Grades 6 - 8

Overview

Acid rain or acid precipitation, refers to any precipitation having a pH value less than that of normal rainwater. Atmospheric carbon dioxide (CO_2) combines with water to form carbonic acid, commonly known as carbonated water. The pH of carbonic acid generally ranges from 5.0 to 5.6 As a result, normal rainfall is acidic. Rainfall with a pH of 5.6 or higher is considered normal and rainfall with a pH below 5.6 is considered acid rain. Acid rain readings in the northeastern United States have often been in the range of 4.0 to 4.6. Acid precipitation can also occur as snow, sleet, hail, dew, frost and fog. Sometimes, acid rain is also referred to as acid deposition.

Acid precipitation is a problem that knows no boundaries. It is estimated that the cost of the damage resulting from the effects of acid precipitation in the United States alone runs into the millions of dollars annually. Acid precipitation is a suspected killer of ponds, streams, trees and wildlife. In addition, acid precipitation poses serious health risks for people.

This lesson allows students to learn about the concept of pH and to begin to think about and appreciate the impact that acid rain has on human health and the well-being of the environment.

Acid precipitation compromises the integrity and well-being of all ecosystems and their inhabitants.

- As the pH of water approaches 6.0, insects and plankton begin to disappear.
- Below the pH of 5.0, the water is largely devoid of fish and is considered to be dead.
- Animals dependent on aquatic ecosystems begin to be affected through damage to the food chain.
- Terrestrial plant life is negatively affected due to the increased acidity. Forests have also been labeled dead due to the extensive foliage damage.
- Studies indicate a like between acid precipitation and respiratory problems in children and asthmatics.
- Acid precipitation can increase the availability of some toxic elements such as aluminum, copper and mercury.

Reference:
Frequently Asked Questions, Environment Canada's A Primer on Environmental Citizenship
http://www.ns.ec.gc.ca/aeb/ssd/acid/acidfaq.html

Technology Resources

Internet Sites
For Teacher Background

Frequently Asked Questions, Environment Canada's A Primer on Environmental Citizenship
http://www.ns.ec.gc.ca/aeb/ssd/acid/acidfaq.html
A series of questions and answers concerning what acid precipitation is and how it affects ecosystems.

EPA Acid Rain Program, Acid Rain: A Student's First Sourcebook
http://www.epa.gov/acidrain/student/student2.html
A great resource for all sorts of information on acid rain. Also includes other student resources on the Internet.

USGS Tracks Acid Rain
http://btdqs.usgs.gov/jgordon/arfs.html
Some general information on the issue of acid rain.

The ABC's of Acid Rain
http://qlink.queensu.ca/~4lrm4/
A rather extensive resource of information including pictures of structures affected by acid rain.

EnviroNet Acid Rain Monitoring Project
http://earth.simmons.edu/acidrain/acidrain.html
Data collection project that looks to establish average pH value for storms that occur. Students can access gathered data and examine what happens to the pH of a storm as it moves across the Northeast. Student groups can participate at various levels of technical expertise. Monitoring takes place during December and January.

For Student Research

EPA Acid Rain Program, Acid Rain: A Student's First Sourcebook
http://www.epa.gov/acidrain/student/student2.html
A great resource for all sorts of information on acid rain. Also includes other student resources on the Internet.

The ABC's of Acid Rain
http://qlink.queensu.ca/~4lrm4/
A rather extensive resource of information including pictures of structures affected by acid rain.

Teacher Background

Acidity is measured on the pH scale which rages from 1-14. Lower numbers (1-6.9) represent acidic substances while higher numbers (7.1-14) represent alkaline or basic substances. Neutral substances are represented by 7.0 which is in the middle of the scale. The pH numbers represent the concentration of hydrogen ions. The greater the concentration of hydrogen ions, the more acidic the substance is and the lower it will register on the pH scale. Since the scale is based on logarithms, a pH of 3.0 is ten times more acidic than a pH of 4.0 and 100 times more acidic than a substance with a pH of 5.0.

Burning fossil fuels, especially those such as coal and oil that contain sulfur and nitrogen, contribute to the formation of acid precipitation. The combustion process, whether it takes place in a coal-fired electric power generating station or in car and truck engines, liberates the sulfur and nitrogen which combine with the oxygen in the atmosphere to form sulfur dioxide (SO_2) and nitrogen oxides. Once in the atmosphere, these oxides combine with water molecules to form sulfuric acid (H_2SO_4) and nitric acid (HNO_3). These air borne molecules may be carried by winds for miles.

In most areas of the United States, water systems such as lakes and streams are unaffected by some extra acidity due to naturally available buffers such as the limestone in the soil. This naturally occurring limestone is alkaline in nature and serves to keep the pH of the water close to neutral. When a geographic area lacks a sufficient limestone buffer they are particularly sensitive to the effects of acid precipitation. Their ability to neutralize acid rain is compromised. Such areas include the Rocky Mountains, and the north-central, southeastern and northwestern United States.

Learning Objectives

Students will be able to...

- test the pH of various substances
- understand and explain the pH scale
- understand the causes and impacts of acid precipitation
- use telecommunications to upload and download information

Vocabulary

Acid: compound that releases hydrogen ions in solution.
Acid Rain: rain that has a pH greater than 5.6. Formed when air-borne pollutants combine with water vapor.
pH Scale: measurement system that ranges from 0 to 14 and indicates the relative acidity (hydrogen ion concentration) and alkalinity (hydroxide ion concentration) of a substance.

Distilled Water: pure water, without impurities, registers 7.0 on the pH scale

Equipment and Materials

pH Lab Activity

For class:

- Computer with Internet access

For each student:

- protective eye wear
- copy of Measuring pH *Activity Sheet*

For each group of 4 students:

- 5 pieces of wide range pH paper and color chart (pH range 3-12)
- 24 ounces of distilled water (available at grocery stores)
- 2 ounces of white vinegar
- 4 ounces of ammonia
- 4 ounces each of cola soda and orange juice
- 5 cups (8 ounce)
- 5 plastic stirring spoons
- marking pen
- WebQuest *Activity Sheet*

Next

Procedure

For teacher:

Distribute all necessary materials to each of the groups.

For students:

1. Number the cups 1-5.
2. Pour 1/2 cup (4 oz) of distilled water into each of the 5 cups.
3. Add one spoonful (approx. 1 tablespoon) of white vinegar to cup #2.
4. Add one spoonful of ammonia to cup #3.
5. Add 4 oz. of cola soda to cup #4.
6. Add 4 oz of orange juice to cup #5.
7. Dip an unused, clean strip of pH paper in cup #1 (distilled water) for about 2 seconds and immediately compare with the color chart. Write down the approximate pH value and color on the *activity sheet.*
8. Repeat step #7 using an unused, clean strip of pH paper for cups #2,#3,#4,and #5.
9. Complete the analysis section of the Measuring pH *Activity Sheet.*

Extensions

Internet WebQuest: Utilizing the listed web sites, students will answer the questions listed on the WebQuest *Activity Sheet.*

Computer Activity: Acid Precipitation Monitoring Project
This project is one of many monitoring projects that are administered by EnviroNet, http://earth.simmons.edu/, a teacher enhancement project funded by the National Science Foundation and supported by Simmons College (Boston, MA). The purpose of the project is to have students become more knowledgeable regarding the issue of acid precipitation. Students collect data in their local area during a set period of time (e.g., December 8-18 and January 5-16) established each year by the program administrators.

The locally collected data is then submitted electronically and is used to establish an average pH value for storms that occur. Students and teachers will then be able to analyze what happens to the pH of precipitation as it travels across the Northeast. Students can determine which areas of the country are contributing to the acidity of the precipitation and where the acid precipitation is falling. Long term analysis will also be possible.

Specific protocols are established by the project administrators according to the level of participation. Three levels of participation are available depending on the interest, knowledge and intellect of the students and the sophistication of the project desired by the teacher. The three levels are: entry, exploratory and research. Participation in the monitoring project requires on-line registration after which, registered groups will receive a username/password. This is required for both data transfer and retrieval.

Reference Information

EnviroNet: Acid Precipitation Monitoring Project
http://earth.simmons.edu/

Simmons College
Project Coordinator
Robert Berlo
Gardner High School
200 Catherine Street
Gardner, MA 01440
email: berlo@whale.simmons.edu

1998 Envirohealth Link Master Teacher Team

Howard Schindler and Rosetta Jackson

Group Members: _____ _____

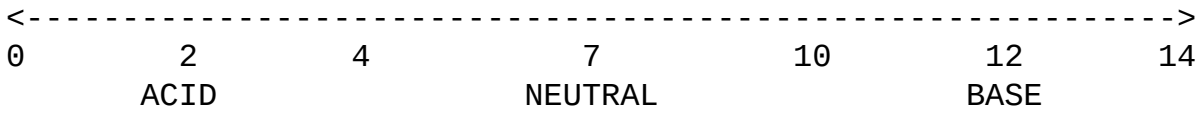
_____ _____

Measuring pH Activity Sheet

Cup Number	pH	Color
#1: Distilled Water		
#2: Vinegar		
#3: Ammonia		
#4: Cola Soda		
#5: Orange Juice		

Analysis

1. Locate each of the tested substances on the pH scale below. Place a vertical arrow to correspond to the substance tested. Label each arrow with the name of the substance tested.



2. Is the vinegar an acid or a base?

3. Is ammonia an acid or a base?

4. Did distilled water have a neutral pH?

5. What is the pH of cola soda and orange juice?

6. Explain why you think we are not hurt by drinking cola soda or orange juice even thought they both have acid pH.

Group Members: _____ _____

_____ _____

Internet WebQuest Activity Sheet

Using the following Internet sites, answer the questions below.

- ***EPA Acid Rain Program, Acid Rain: A Student's First Sourcebook.***
  http://www.epa.gov/acidrain/student/student2.html
  A great resource for all sorts of information on acid rain. Also includes other student resources on the Internet.
- ***The ABC's of Acid Rain***
  http://qlink.queensu.ca/~4lrm4/
  A rather extensive resource of information including pictures of structures affected by acid rain.

Answer the following questions incomplete sentences.

1. What is acid precipitation and how is it caused?

2. Explain the effect that acid precipitation has on the animals and places that live in lakes and streams.

3. How are people affected by acid precipitation?

4. What effects does acid precipitation have on buildings, statues and other man-made materials?

5. If the United States government passed a law prohibiting the use of fossil fuel, predict what consequences there might be. Consider both ecological and economic consequences. Explain whether these consequences would be positive or negative. Use the back of this sheet if necessary.

One Sniff Can Kill!

Grades 6 - 8

Overview

Many substances commonly found in the home (solvents, fuels, cleaning and sanitizing agents, etc.) are often misused and abused. This abuse or misuse by mainly young people can lead to health problems or even life threatening situations.

This lesson aims to arm students with the information to be aware of these problems so that they can make informed intelligent decisions concerning these issues. Students will be investigating the effect of abuse or misuse of inhalants on the human body by performing a WebQuest to recognize dangerous common inhalants and to prevent abuse.

Technology Resources

Internet:
National Institute on Drug Abuse
http://www.nida.nih.gov/
Information on all types of drug abuse, search engine of National Institute on Drug Abuse web pages.

National Inhalant Prevention Coalition Web Site
http://www.inhalants.org/
This site gives health information on inhalant use and its effect on the body. Spanish text available.

Learning Objectives

Students will be able to...

- recognize dangerous inhalants commonly found in households.
- state the possible harm caused by abuse of these substances.
- suggest ways to prevent abuse and misuse.

Vocabulary

inhalant: gas or vapor inhaled with the purpose of reaching a high.
solvent: chemical capable of dissolving another substance.
huffing/sniffing: the act of inhaling harmful substances to reach a high.
substance abuse: the misuse of a substance to reach a high.
Sudden Sniffing Death Syndrome (SSDS): user can die instantly from the use of inhalants

Materials

For Class:

- Computer with Internet access (or web page resource booklet)
- examples of household products (correction fluid, glue, rubber cement, hair stray, air freshener, nail polish remover, etc.)
- video camera
- television with VCR
- cassette recorder
- tapes (VCR and audio)

For Each Student:

- *Student Activity Sheet:* Nothing To Sniff At

Next

Procedures

1. Homework on previous day: Students should (with parental guidance) list all household chemicals under the kitchen sink, in cleaning closet, under the bathroom sink, in the garage, or wherever found.
2. Class will construct a master list of household substances.
3. Pass out *Student Activity Sheet:* Nothing To Sniff At.
4. Students will list substances they believe are considered inhalants.
5. Review vocabulary words and meanings.
6. Students will perform WebQuest to check and verify their list of substances and complete *Student Activity Sheet*: Nothing To Sniff At, describing short and long term affects of abuse.
7. As a class, share results and discuss ways to prevent misuse and abuse of these common household substances.
8. Students will write a script for a public service announcement (PSA) to increase awareness and discourage misuse and abuse of these substances.
9. Students will produce audio or video segments in order to present their concept.

Extensions

Computer/Print Graphics
Using a computer and desktop publishing, students will design and create brochures to promote their public service announcement (PSA).

Language Arts
Write a fictional story about a student who uses inhalants. The story should include health problems, behavioral changes and memory loss associated with inhalant use to inform others of the problems of inhalant misuse and abuse.

1998 EnviroHealth Link Master Teacher Team

Carole Blake and Bennett Seidenstein

Name _____ Date _____

Nothing To Sniff At

Directions:
Answer the following questions using the web resources listed below. Use the information gained from answering these questions to create a script of an informative public service announcement designed to increase awareness of inhalant abuse.

National Institute on Drug Abuse (http://www.nida.nih.gov/): Information on all types of drug abuse, search engine of National Institute on Drug Abuse web pages.

National Prevention Coalation Web Site (http://www.inhalants.org/): This site gives health information on inhalants use and effect on the body. Spanish text available.

1. What substances on your list do you consider to be inhalants?

2. List ways inhalation abuse damages the brain.

3. Summarize how inhalation abuse damages:
    - Blood
    - Heart
    - Liver
    - Lungs
    - Kidneys
    - Muscle
    - Bone Marrow
    - Nervous System

4. What are the signs and symptoms of a long-term inhalant user?

5. Can inhalant use be treated?

6. What can you do if someone you know is abusing inhalants?

7. Describe three ways that you could prevent inhalant abuse.

Get the Lead Out!

Grades 7 - 8

Overview

Students will view parts of a video which introduces the topic of lead poisoning. They will explore the harmful health effects of lead poisoning as they respond to the video, small group discussion, a reading activity designed to stimulate critical thinking, graphing and data analysis. Internet research opportunities will be used to stimulate student interest and focus attention on the dangers of lead poisoning. Finally, students will demonstrate their understanding of the lesson by designing a pamphlet to educate parents about problems associated with exposure to lead.

Technology Resources

Internet Sites For Student Research

California Dept. of Health Services,
Childhood Lead Poisoning Prevention Branch
http://www.parentsplace.com/health/safetyrecalls/gen/0,3375,10087,00.html
This is a nicely illustrated informational web page about preventing lead poisoning.

Lead Facts
http://www.leadpro.com/facts.html
Written at a reading level accessible to middle school students, this site includes information about the harmful effects of exposure to lead.

Centers for Disease Control and Prevention (CDC)
National Center for Environmental Health (NCEH)
Childhood Lead Poisoning Prevention
http://www.cdc.gov/nceh/programs/lead/faq/cdc97a.htm
Offers a highly accessible overview of lead poisoning.

Childhood Lead Poisoning in Georgia
http://www2.state.ga.us/Departments/DHR/faclead.html
Information about lead poisoning is attractively presented here by the State of Georgia.

New York City Department of Health
Lead Poisoning Prevention Program http://www.ci.nyc.ny.us/nyclink/html/doh/html/lead/leatw.html
This web site offers a guide to eating well to help prevent low level lead poisoning. It offers lists of healthy foods high in calcium and iron and low in fat.

Internet Sites For Teacher Information

Lead Poisoning Prevention Program http://www.ci.nyc.ny.us/html/doh/html/lead/lead.html
This page provides links to documents about lead poisoning prevention, symptoms and safety standards.

Office of Pollution Prevention and Toxics: Lead Programs http://www.epa.gov/opptintr/lead/
Access to information on all aspects of the Federal lead poisoning prevention program, with a special focus on the efforts within EPA's Office of Pollution Prevention and Toxics (OPPT) is offered at this site. Also included are downloadable pamphlets about preventing lead poisoning in the home.

Lead Programs: Office of Prevention and Toxics Lead Page
http://www.epa.gov/opptintr/lead
EPA's Office of Pollution Prevention and Toxics provides a variety of lead-related information, including publications related to provisions of Title X (1992 Lead-Based Paint Hazard Reduction Act).

HUD Search Tools
http://www.hud.gov/search.html
HUD's Web Site Search Tool will allow you to conduct searches of all the documents on HUD's Web Server by term. HUD's GILS Search Engine locates sources of electronic media available to the public. A search of GILS will not usually produce specific information, but rather instructions on how to retrieve the information you desire.

CDC Web Search
http://www.cdc.gov/search.htm
Search of documents published by the Centers for Disease Control and Prevention (CDC), located in Atlanta, Georgia, USA, an agency of the Department of Health and Human Services.

Video
Lead Poisoning, A Parent's Guide to Prevention, a community service videotape available at Blockbuster Video Stores. This 18-minute video gives practical steps for keeping the home lead safe for children as well as providing background information on lead poisoning. The video is available for a free, two-week loan through the National Lead Information Center (1-800-424-5323). In addition, it is available through Blockbuster stores nation-wide in the community service section.

Computer Software
Claris Works 4.0
Hyper Studio

Teacher Background

Lead is a soft, lustrous, silvery metal which occurs in the Earth's crust at about 15 parts per million. It has been used by humans since ancient times in coins, utensils, and ceramic glazes. Romans used lead pipes to carry drinking water. Its softness and malleability make lead useful for sheathing telephone and television cables, and because of its low melting point it is used in solder. Lead compounds have been added to gasoline to improve engine efficiency. The greatest single use of lead metal today is in the plates of storage batteries for automobiles.

The usefulness of lead has made it common in human environments and has created innumerable problems. Lead is now known to be a powerful neurotoxin that interferes with the development and functioning of the kidneys, red blood cells, and central nervous system. High levels of lead exposure can result in coma, convulsions, and death. When young children are exposed to it, the development of their central nervous systems and brains is impaired.

Childhood lead poisoning is associated with decreased growth, reduced IQ, learning disabilities, attention deficit disorder and hyperactivity, impaired hearing, lower educational achievement, higher rates of high school drop-out and increased behavioral problems. It is estimated that lead poisoning has tripled the number of children needing special education.

Childhood lead poisoning is the number one environmental health risk for children today. Children aged 9 months through 5 years are at the greatest risk. In the United States, about one in eleven children have high levels of lead in their blood, according to the Center for Disease Control and Prevention. 10 micrograms per deciliter of blood is a toxic level.
Eighty percent of childhood lead poisoning occurs at home. Lead-based paint is the most common source of lead poisoning in children. Some children are poisoned by eating paint chips - they taste sweet. Most children are poisoned by invisible lead dust created when lead paint deteriorates from age, from being exposed to the elements, and because of friction such as the opening and closing of a door or window. If proper precautions are not taken, remodeling or renovating an older home (pre-1977) can generate a large amount of dust. Even small jobs done during routine maintenance like painting can generate lead dust. Because it does not break down naturally, lead can remain a problem until it is removed.

Lead in soil comes from lead-based paint chips flaking from homes, factory pollution, and from the use of leaded gasoline. Lead levels in soil are usually higher in cities, near roadways, and next to homes where crumbling lead paint has fallen into the soil. The amount of lead in soil is measured in parts per million (ppm). Soil naturally has small amounts of lead in it, about 50 ppm. 200-500 ppm of lead is commonly found in city soil. 1000 ppm is defined as hazardous waste. Lead in dirt clings to fingers, toys and other objects that children normally put in their mouths.

Roman slaves extracted and prepared the lead for building water pipes, and Pliny describes a disease among the slaves that was clearly lead poisoning. Because of the toxicity of lead, lead water pipes are no longer being installed, and the use of lead in paints, glazes, gasoline and solder is restricted. The removal of lead from gasoline and from the solder in tin cans has had a huge impact. Deaths from lead poisoning, which were quite common, are very rare today. One of the last hurdles is paint in housing.

Lead is used to make paint last longer. The amount of lead in paint was reduced in 1950 and further reduced again in 1978. Houses built before 1950 are very likely to contain lead paint while houses built after 1950 will have less lead in the paint. House paint sold today has very low levels of lead. The United States and England are the last industrialized nations to address the lead paint issue. The ill-effects of lead are so well documented that Germany, Australia, Japan and many other countries banned the use of lead in residential paint in the early 1920s. France started banning lead in paint in the 1870s.

Learning Objectives

Students will be able to . . .

- graph and analyze scientific data;
- demonstrate their acquisition and integration of the concept that lead is a highly toxic substance, especially for young children;
- demonstrate the ability to apply scientific knowledge in making personal decisions about exposure to lead;
- read for global understanding, to develop a personal response to scientific information;
- write to inform.

Vocabulary

lead: a soft, malleable, ductile metallic element
poison: any substance that causes illness, injury or death
ingest: to take in by swallowing
toxic: harmful, destructive or deadly
prevention: keeping something from happening

Equipment and Materials

For class:

- Video: *Lead Poisoning A Parent's Guide to Prevention,* a community service videotape available at Blockbuster Video Stores
- Television with a VCR
- Overhead Projector
- Overhead Transparency of table titled: Association of Housing Age and Condition with Blood Lead Levels
- Overhead Transparency of Graphing Scientific Data: Performance Task Assessment List

For each student:

- *Get the Lead Out!* Video *Guide Sheet*
- Internet Scavenger Hunt *Activity Sheet*
- Preparing a Hyper Studio Presentation

For each group of 3-5 students:

- Resource Handout "A Story of Three Children"
- A computer and modem with Internet access. Teachers who do not have Internet access in their classrooms can print the web pages listed for the Internet Scavenger Hunt. The pages can then be placed in binders in plastic page protectors. Only one copy of each web site is needed. The binders are placed in a central location, and the groups are instructed to use one at a time and return the binders to that location as they finish so that other groups can use them.
- A computer with Claris Works 4.0
- and HyperStudio installed.

Next

Procedures

Activity 1: Engagement and Exploration

1. Before beginning the lesson, FAST FORWARD the videotape to the first frame and pass out Get the Lead Out! Video *Guide Sheet* to each student.
2. Divide the class into groups of three to five. Emphasize that this is a group learning activity and each person in the group must be prepared to present the group answers to the class.
3. Introduce the topic of lead poisoning by telling students they are going to explore the number one environmental threat to the health of young children in America.
4. To focus and engage students' viewing attention ask the students to watch the beginning of the tape to find out who Rosa is, and what her mother thinks might cause brain damage in a young child.
5. BEGIN the videotape. PAUSE at the frame that shows the video's title: Lead Poisoning A Parent's Guide to Prevention to give students time to answer question #1 on their *activity sheets.*
6. Call on two or three students to read their answers aloud.
   Answer: Ingestion of lead paint can cause brain damage and mental retardation.
7. Direct the students to listen next for specific effects of lead poisoning. BEGIN the videotape. STOP at the frame that shows the words: Number One Environmental Threat to Children to give students time to answer question #2 on their *activity sheets.*
8. Ask two or three students to read their answers aloud. Answer: Lead poisoning is associated with difficulty learning to read and write, and behavior problems.
9. Pass out A Story of Three Children. Instruct students to read the handout in their groups and use it to answer question #3 on their *activity sheet.*
10. Have students share their answers with members of their group. Then call on one person from each group to report to the class on the opinions of the group. Answers will vary. Answers should be in complete sentences and include a reasonable justification.
11. BEGIN the videotape. STOP at the frame that shows the words: How a child is poisoned. Ask students for a show of hands from those who have changed their opinion about question #3.
12. Display the Overhead Transparency of Association of Housing Age and Condition with Blood Lead Levels. Instruct students to use this table to complete questions #4 and #5 on their *activity sheet.* Review with them the elements of an effective graph before they begin work., using an overhead transparency of Graphing Scientific Data - Performance Task Assessment List.
13. Have students share their answers to #5 with members of their group. Then call on one person from each group to report to the class on the data analysis of the group.
14. Ask students to read over questions #6, #7, and #8. BEGIN the videotape. STOP the videotape at the words: How Can You Help to give students time to answer these questions. Allow students to help each other in their groups.
15. Call on one person from each group to report to the class on the answers found by their group. Answers:
    - The most dangerous source of lead poisoning is chipping and peeling paint.
    - Three million children in the U.S. have been lead poisoned.
    - Friction when windows are opened and closed creates lead dust.

16. FAST FORWARD to Frame 0280 which shows the words: Have Your Child Tested. Direct students to read over questions #9 through #14 on their *activity sheets.* Ask them to wait until the videotape stops before answering these questions. BEGIN the videotape. STOP at the words: Caution Renovating Can be Hazardous to give students time to answer questions #9 through #14 on their *activity sheets.* Allow students to help each other in their groups.
17. Have students share their answers with members of their group. Then ask one person from each group to report to the class on the answers found by the group. Answers:
18. Windows and floors should be regularly cleaned to protect children from lead paint.
19. Closing the bottom window and opening the top window keeps children from coming into direct contact with lead dust in the window well.
20. It is important to wash a child's hands before meals and at bedtime.
21. Keeping a child's fingernails trimmed will prevent lead dust from accumulating under the nails.
22. A lead poisoned child might not look sick or feel sick, so the only sure way to detect lead poisoning is through a blood test.
23. Foods high in iron and calcium like beans, milk, cheese and cooked greens help protect the body from absorbing lead.
24. FAST FORWARD to Frame 0462 which shows the words: Other Sources of Lead. Direct students to read over questions #15 through #18 on their activity sheets, then BEGIN the videotape. STOP at the words Jobs that Involve Lead to give students time to answer questions #15 through #18 on their *activity sheets.*
25. Have students share their answers with members of their group. Then call on one person from each group to report to the class on the group's answers. Answers:
    - Gas emissions and chipping house paint have contaminated the soil with lead.
    - Lead particles are most likely to enter drinking water from lead pipes when the water stands overnight.
    - Run cold water until you feel a drop in temperature to be sure there is no lead in it.
    - Food stored in imported or handmade ceramics coated with lead glazes can absorb lead.

Activity 2: Explanation and Elaboration

Distribute Internet Scavenger Hunt *Activity Sheets* to each student. The rules of the scavenger hunt are printed on the *activity sheet.* Have students read the rules, then ask two or three students to summarize the rules.

Although students will work in groups, each student should be required to turn in answers to the *activity sheets* so that one or two members of each group don't end up doing all the research while the attention of other members wanders.

If students do not have actual Internet access, as they complete their search of each web site they must return printed copies of the web site to a central location for use by other groups.

Extensions

Computers/Graphic Design
Have students design a pamphlet using Claris Works 4.0 or other software with clip art. to educate their parents about the dangers of lead poisoning. Share *Pamphlet about Science Concepts - Performance Task Assessment List* with them before they begin work.

Computers/Language Arts

1. Assign groups of two or three students to design a presentation using HyperStudio, summarizing what the group learned about lead poisoning.
2. Give the students Preparing a Hyper Studio Presentation before they begin work.Allow students five minutes to read Preparing a HyperStudio Presentation.
3. Set time limits for each part of the presentation preparation. For example, Step One is, "Group members sign up to take responsibility for equal portions." Five minutes should be enough time for students to make these choices.
4. If a computer can be hooked up to a television, students enjoy showing their HyperStudio stacks to the class. These stacks can also be printed and displayed on a bulletin board.

1998 EnviroHealth Link Master Teacher Team

Linda Massey and Donna Smith

Name _____ Date _____

Association of Housing Age and Condition with Blood Lead Levels

In 1994 in Youngstown, Ohio, investigators obtained blood lead levels from 1- to 3-year-old children who had lived their entire lives in one house; the investigators obtained data on the age of the children's housing from county auditor data. the relationship of housing age and average blood lead levels was as follows:

Year House Built	**Mean Blood Lead Level (ug/dL)**
Before 1940	6.82
From 1940 to 1959	3.38
From 1960 to 1979	3.01
From 1980 onward	2.48

Gemmel, D. in: Proceedings of the 25th Public Health Conference on Records and Statistics
Publication:
"Childhood Lead Poisoning Prevention"
National Center for Environmental Health (NCEH)
CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

Name _____ Date _____

Graphing From Scientific Data

Performance Task Assessment List

1. An appropriate graph is used.
2. There is a main title that tells the purpose of the graph.
3. Appropriate and even intervals are marked on each axis.
4. An accurate key is provided.
5. Data is plotted accurately.
6. The graph is neat and presentable.
7. Colors, textures or other feature are used.

8 out of 8 are checked	Graph is outstanding.
6 out of 8 are checked	Graph is good.
4 out of 8 are checked	Graph is fair.
3 or less are checked	Graph is not effective.

Name _____ Date _____

Get the Lead Out! Video Guide Sheet

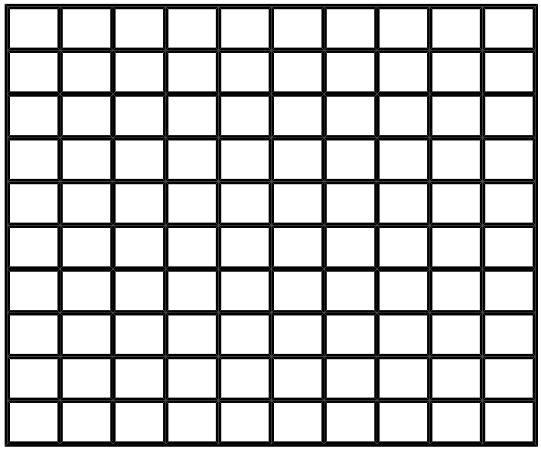
Answer in complete sentences. Include the question in your answer.

1. What effects can ingestion of lead paint have on young children?

2. What are two other effects of lead poisoning?

3. Which of the three children in *A Story of Three Children* do you think is most at risk for lead poisoning? Justify your answer.

4. Construct a graph of the data from the table titled "Association of Housing Age and Condition with Blood Lead Levels". Remember to include a title that tells the purpose of the graph, an accurate key, labels on each axis and even interval markings on each axis. Plot the data accurately and neatly, use colors and textures to add interest.



5. Do you think the experimental data you graphed in question #4 was gathered in a fair test? Explain your answer using information about the variables and how they were controlled.

6. What is the most dangerous source of lead poisoning?

7. How many children in the U.S. have been lead poisoned?

8. How does household dust become contaminated with lead dust?

9. What areas of a home should be regularly cleaned to protect children from lead paint?

10. How would closing the bottom window and opening the top window prevent lead poisoning?

11. When is it important to wash a child's hands?

12. How will keeping a child's fingernails trimmed protect the child from lead poisoning?

13. Why is the only sure way to detect lead poisoning through a blood test?

14. What are some food that help protect the body from absorbing lead?

15. How has the soil become contaminated with lead?

16. When are lead particles most likely to enter drinking water from lead pipes?

17. How long should you let cold water run to be sure there is no lead in it?

18. When can ceramic dishes be a source of lead poisoning?

Group Members _____ _____

_____ _____

Internet Scavenger Hunt Activity Sheet

You have 40 minutes to find as many answers as possible on the list below. There are four Internet sites to visit, so try to work quickly. The team with the most correct answers from the list at the end of the time wins.

California Department of Health Services
http://www.parentsplace.com/health/safetyrecalls/gen/0,3375,10087,00.html

1. What is the best way to clean up lead dust?
2. True or False: If you think paint might contain lead, you should bur or scrape it off.
3. Name four calcium-rich foods and four iron-rich foods.
4. Do not use _____ or _____ dishes for serving, preparing or storing food or drink unless you know that they do not contain _____.
5. Find three hobbies that might be dangerous because they involve using lead.

Centers for Disease Control and Prevention (CDC)
National Center for Environmental Health (NCEH)
Childhood Lead Poisoning Prevention
http://www.cdc.gov/nceh/programs/lead/faq/cdc97a.htm

1. Can you find a typographical error on this web page?

2. If a child is at risk for lead exposure, what can prevent a lifetime spoiled by the irreversible damage caused by lead poisoning?

3. What is the percentage of homes built before 1978 in the U.S. that have lead-based paint in them?

4. Why do more that one-fifth of African-American children living in housing built before 1946 have elevated blood levels?

5. Lead poisoning can cause _____ _____, _____ _____, and at very high levels, _____, _____ and even _____.

6. Why are children between 12 and 36 months of age more likely to take lead in than are older children, if there is lead in their homes?

Lead Poisoning Prevention Program
http://www.ci.nyc.ny.us/nyclink/html/doh/html/lead/leatw.html

1. How can 3 meals a day, and healthy snacks help protect children when they are hungry from lead poisoning?

2. There are three things that protect children's bodies from absorbing lead. What are they?

3. Which is more likely to contain lead - water from the hot water tap or water from the cold water tap?

4. True or False: You can get lead out of water by boiling it.

5. Find three vegetables high in CALCIUM.

6. Find two iron-enriched foods.

7. What are four fruits high in Vitamin C?

Childhood Lead Poisoning in Georgia

http://www2.state.ga.us/Departments/DHR/faclead.html

1. What agency says that lead poisoning is the number one environmental health hazard for young children?

2. Explain the statement: "Children are more easily and severely injured by lead than adults, even at low levels in the blood."

3. What are four effects of lead exposure during the first six years of life?

4. The most common cause of lead poisoning is exposure to lead-based _____ or _____ in _____ houses.

5. True or False: Lead-poisoned children are found in both rural and urban areas.

Preparing a Hyper Studio Presentation

Follow this sequence in preparing your presentation:

1. Group members sign up to take responsibility for equal portions. Each member must prepare and deliver part of the presentation.
2. Individuals create Hyper Studio cards.
3. Check accuracy of each other's facts, spelling, grammar and punctuation.
4. Cards are then combined into a single stack. Buttons, sound effects and other special effects are added.
5. Group practices all parts of the presentation. Practice making eye contact, being poised, speaking clearly and loudly. Practice pronunciation of difficult words.
6. Go through the entire sequence at least twice before presenting to the class.

Order of Cards:

1. The first card clearly states the learning objective.
2. Card two briefly outlines the section's main ideas.
3. Each of the main ideas from Card two is restated and fully explained on its own card, using examples and descriptions.
4. The next to the last card is a practice activity to help classmates master the material. Some good activities are:
    - True/False questions
    - Matching vocabulary to definitions
    - Short answer questions
    - Sequencing
    - Best of all - be creative! Come up with your own ideas!
5. The last card has five questions that check your classmates' understanding of the stated learning objectives of the unit.

A Story of Three Children

When Tim was born, his parents were very young. They wanted to finish college, so they moved into campus housing built in 1975. They both work part time at a local restaurant and take turns going to school full time. When they are working or in class, Tim's grandfather takes care of him in the house he built in 1960. Tim and his grandfather watch a little TV, spend some time on the back porch watching the traffic on the highway go past, take walks to Winton Woods Park, and play in the back yard in Grandpa's garden. Sometimes Grandpa lets Tim help him with repairs around the house. Three-year-old Tim is sad when his mom or dad leaves him, but he has a good time most of the day, and he loves his time with Grandpa.

At Winton Woods Park, Tim met a little girl named Sherisse. Sherisse comes to the park with her mother just about every day on the bus. Sherisse lives in the city about three mils north of the park. Her home is four floors up in a low income housing project built in 1982. Her mother dropped out of high school and is having a hard time finding a job. She stays home with Sherisse most days. They go to the park to play almost every day. Sometimes they walk to the nearby library and on Tuesdays and Thursdays they do most of their shopping at a local open air market. Sherisse's mother loves her very much, but two-year-old Sherisse can be stubborn when she doesn't get her way, and sometimes it wears her mother out taking care of her all day.

The market where Sherisse and her mother buy milk and cereal is owned by Mr. and Mrs. Jones. Their little boy Andrew is four years old. Andrew doesn't come in to the store very often. When Mr. Jones comes downtown to check on his stores, he leaves Andrew with their live-in housekeeper, Marion. Andrew's bedroom is upstairs in the big old Victorian house. He loves to stand at the window and watch for Daddy to come home. Sometimes Marion lets him watch the carpenters who are repairing the porch on the third floor, or the gardeners who are planting bulbs and pansies in the front yard. He loves to dig in the dirt with his hands, looking for bugs. Marion always makes a fuss about how dirty he gets his clothes, but that doesn't bother Andrew!

Where's the Lead?
Grades 7 - 8

Overview

Lead poisoning is the number one environmental health hazard for young children, according to the U.S. Centers for Disease Control and Prevention. Exposure to lead during the first six years of life can damage the brain or central nervous system, causing reduced IQ, reading disabilities, and behavioral problems. Lead poisoning is preventable.

To understand how to detect the presence of lead in various substances, students will conduct lead identification tests using traditional science indicators and a commercial test kit. Levels of lead are stated in micrograms per deciliter or parts per million. Students will conduct a serial dilution to help them recognize the significance of such measurements and to decide whether the amount is a health concern.

Media/Technology Resources

For student/teacher research:
Internet Resources:

Lead Facts
http://www.leadpro.com/facts.html
Written at a reading level accessible to middle school students, this site includes information about the harmful effect of exposure to lead.

California Department of Health Services,
Childhood Lead Poisoning Prevention Branch
http://www.parentspalce.com/health/safetyrecalls/gen/0,3375,10087,00.html
Informational web page about preventing lead poisoning.

National Center for Environmental Health (NCEH
Childhood Lead Poisoning Prevention
http://www.cdc.gov/nceh/programs/lead/faq/cdc97a.htm
Comprehensive overview of lead poisoning.

Lead Poisoning Prevention Program
http://www.ci.nyc.ny.us/html/doh/html/lead/lead.html
Provides link to documents about lead poisoning prevention, symptoms and safety standards.

Media Resources:
For teacher research:

"Parts per Million," *Science Scope*, May 1991, pages 12 - 15

Teacher Background Information

Some of these activities require the use of lead and/or lead compounds. In the Material Safety *Data Sheet* solid lead metal is not listed as hazardous. Compounds such as lead nitrate do carry cautions for handling but are not prohibited for use in middle school labs. Students should be cautioned to carefully wash their hands with soap and water after using the lead and not to put their hands in their mouths during the activity. (Disposable gloves could be used.)

Several lead identification methods are given in this lesson. The easiest to perform is the traditional laboratory one using an indicator. Most lead testing kits require the samples being sent away for test results but Lead Alert™ allows for instant on-site results. It is user friendly. Cost might be a factor if all students are allowed to run the test. Lead Alert™ kits are available at Hechinger's and other local hardware stores. It can also be ordered from:
Pace Environs, Inc.
Cary, NC
1-800-884-6073

Lead Alert™ kits contain test cards with number circles. These cards could be cut so that each lab group could have at least one circle for testing. The swabs can also be cut if needed. It should be noted that if the amount of lead is below the threshold established by the federal guidelines as hazardous, there will be no positive test result. The kit also has materials for testing water, but the sample must be sent to a commercial lab to obtain results.

The purpose of these activities is for students to learn how lead identification tests are performed. It is not for the actual testing of suspect lead sources. Paint chips from old houses will usually give a positive test but having the chips in the classroom can in itself be a hazard. Crazed or cracked ceramic dishes found in thrift shops offer a safer and good chance of a positive lead test. Better results might be obtained if the dish is broken, and small pieces of it are tested. Considering these problems and the fact that positive test results can not be guaranteed, it is recommended that lead metal or a lead sinker be used.

In test 2, good results require a sample of lead metal/sinker being soaked in white vinegar and using the resulting solution in the test with the sodium iodide. Soaking a ceramic piece in vinegar does not give a good, if any, positive test result.

For serial dilution, the lead nitrate solution should be a 10% solution. Dissolve ten grams of lead nitrate in 90 grams (mL) of water.

Learning Objectives

Students will be able to ...

- recognize sources of lead poisoning
- describe the relationship of time to the reaction of the lead metal and acid
- identify the presence of lead using lead specific indicator
- perform a serial dilution procedure
- understand concentrations expressed as parts/million, parts/billion, and in micrograms/deciliter
- express concentrations in scientific notation

Vocabulary

chelation: a process to remove lead from the bloodstream in which an organic chemical binds itself to a metal such as lead and is excreted in the urine
encapsulating: to enclose as in a capsule or other protective barrier
hazardous: dangerous
indicator: shows the presence of a specific substance by a color change, a tattletale
insoluble: does not dissolve in water
leaching: to remove a substance by dissolving it in suitable solute
lead: a soft malleable, ductile, heavy metal, an element known to early man
lead salts: lead compounds containing lead and a non-metal
precipitate: an insoluble substance (solid) that forms during a chemical reaction
serial dilution: a process that dilutes a substance by using the same amount of water to each succeeding step
solute: part of the solution that does the dissolving, most common are water and acids
threshold: the point at which a stimulus or substance is strong enough to produce an effect

Equipment and Materials

Per Student

- one copy of each *Activity Sheet:*
  Lead: Public Enemy Number One
  Lead Identification Tests
  How Much Is That?
  Conversion Exercises
- lab apron
- safety goggles
- disposable gloves (optional)

Per Group of 2 Students:
Lead Identification Tests Lab Activity

- lead nitrate
- sample of lead metal or lead sinker
- sodium iodide solution
- Lead Alert™ test circle and cotton swab
- medicine dropper
- 50 mL beaker
- small test tube
- graduated cylinder
- white vinegar or a dilute acid
- watch or clock with second hand
- soap/detergent/sponges/paper towels

How Much Is That?

- Chemplate™ (spotplate or microplate)
- medicine dropper
- paper towel
- tap water
- small beaker for rinse water
- 10% solution of lead nitrate
- calculator with scientific notation
- sodium iodide solution
- Lead Alert™ test kit

Conversion Exercises

- calculator with scientific notation

For the teacher:

- Answer Sheet

Next

Procedures

Activity 1: Lead: Public Enemy Number One

1. Give each student a copy of the *Activity Sheet*, Lead: Public Enemy Number One.
2. This *activity sheet* contains general background information about the dangers of lead to human health. Students can read this for homework. Class discussion should follow.

Lab Activity 2: Lead Identification Tests

1. Students will work in groups of 2 but each student should have their own copy of the *Lab Activity Sheet*, Lead Identification Tests.
2. Students should complete Tests 1 and 2. Test 3 is optional due to expense and availability of test kit. Test 3 could be done as a demonstration.
3. Students will need to thoroughly wash their hands, equipment, and lab tables with soap/detergent/sponges upon completion of the lab.

Extensions

Math and Science
Lab Activity 1: How Much Is That?

1. Students will work in groups of 2 but each student should have his/her own copy of the *Lab Activity Sheet*, How Much Is That?
2. It is very easy for students to obtain incorrect results in this activity. Make certain that they have read the procedures and that you have discussed/demonstrated the steps with them.
3. Demonstrate the technique of holding the dropper perpendicular to ensure uniform drops.
4. Also demonstrate rinsing the medicine dropper by removing the rubber bulb and run water through the glass pipette/tube.
5. You must place 10 drops of lead nitrate in cup 1 (see step 2).
6. Scientific notation might be a new concept for your students. Beginning with step 15, you might want to model how to convert or do as a whole class activity.

Math and Health
Activity 2: Conversion Exercises

1. Give each student a copy of the *Activity Sheet*, Conversion Exercises.
2. Students can work alone or in groups of
3. Since conversions are somewhat tedious, each conversion could be assigned to a different student/group.
4. To complete the conversions, students must know that one microgram per deciliter is equal to one part per billion. This information is in the first paragraph of How Much Is That?

1998 EnviroHealth Link Master Teacher Team

Donna Smith and Linda Massey

Name _____ Date _____

Lead:Public Enemy Number One Information Sheet

Lead is an element known in earliest civilizations. Its atomic number is 82 and its atomic mass is 207. It is a very heavy metal that is also soft, ductile, and malleable. Its chemical symbol, Pb, comes from the Latin word for the element plunbum. Uses of lead are many. Romans mad pipes for carrying their water supply. A lead compound has been added to paints to make them last long and to gasoline to prevent knocks. Loosed is the covering for car batteries and is used in solder. Lead compounds are used in the making of glass, children's toys, and miniblinds; glazes for pottery; vulcanizing of rubber; and in insecticides. Lead has the property of stopping radiation and is used to protect patients being X-rayed. These lead aprons are totally covered so as not to be a hazard. The average American home contains more than 200 sources of lead.

The body doesn't need lead, yet everyone absorbs it in varying amounts from a variety of sources. Minute amounts of lead often occur in food (100-300 micrograms/kilogram of food), beverages (20-30 micrograms per liter), public water supplies (100 micrograms/ liter), and the air we breathe (2.5 micrograms/cubic meter of air). An average person excretes 2 milligrams of lead daily via the kidneys and intestinal track. Under normal circumstances, more lead is excreted than ingested each day. However if a person is exposed to an excess of lead, the excess is stored in soft tissue where it attacks the central nervous system or in bones where it affects the bone marrow. Toxicologists use a chelating agent to remove excess lead from the body. The lead chelate that is formed is excreted in the urine. Unfortunately, if the lead is already in the brain tissue, it cannot be removed.

Who's most likely to be poisoned by lead? Children. Being smaller, they need less lead to reach lead amounts that are considered toxic. Ten micrograms per deciliter of blood are the maximum amount allowed in children's blood. There am nearly 2 million recorded cases of children who are brain damaged as a result of exposure to lead. A child who is consistently exposed to an amount of lead equal to 3 grains of sugar will suffer irreversible brain and/or neurological damage. Pregnant woman are at a greater risk for lead poisoning because the lead can cross through the placenta and harm the fetus. Lead poisoning often causes behavioral problems, learning difficulties, hearing loss, and reduced IQ in children. Sometimes a child who has been diagnosed as inattentive or intellectually deficient is really suffering from lead poisoning.

Poor, ill-fed children often become anemic and develop an appetite trait that makes them crave paint. One attraction to the paint is that lead salts have a sweet taste. Eating the paint helps relieve their hunger pangs for the moment. Any young child living in a house containing lead is at risk for lead poisoning since they tend to chew on things, especially something that might have a sweet taste. The dirt outside a home contains lead from car exhausts when lead was an additive to gasoline. Even through lead is no longer added to gasoline, the lead in the soil remains. Some of that dirt makes it way into the house. Small children crawling on the floor get the dirt on than hands and those hands often go into their mouths.

Children are more at risk from lead paint poisoning and lead in dust but they also can be poisoned from the lead in glazed ceramic pottery. Most china, porcelain, and earthenware contain varying amounts of lead in their glazes. If properly fired during manufacture, such dishes aren't dangerous as a source of lead poisoning. Great Britain, Japan, and the United Stated are among the countries having strict regulations and, thus, safe ceramic dishes, The danger comes from pottery that is imported, sold as crafts, not properly glazed or that has cracks or very won glazes. Then lead leaching will occur when the piece is exposed to acid solutions such as vinegar, coffee, or orange juice.

Some strategies to prevent lead poisoning are:

- Evaluating your house. If you home was built before 1978, check for peeling paint especially around door and window sills. If the house contains lead based paint, it should be removed by someone who is trained in encapsulating lead paint. Children, pregnant women, and pets should not live in the house during the time the paint is being removed.
- Keep the dirt outside. Houses near areas of heavy traffic usually have lead in the soil. Use a doormat with stiff, abrasive fibers to wipe your shoes on or take your shoes off upon entering the house. Insist that everyone entering the house follow this rule.
- Check pottery and pipes. Be aware that lead can also leach into foods or liquids that are stored in lead crystal. If your plumbing is old then there is a greater chance that lead solder was used, and you should have your water tested.
- Eat regular, balanced meals. Children whose bellies are empty or are iron- or calcium-deficient will absorb more lead. Doctors recommend the avoidance of fats which promote lead absorption and a diet rich in iron and calcium.
- Have the family tested. All children should be tested for lead by the age of 12 months. Children who are at higher risk should be tested even at a younger age and at least once a year.

Being aware of the hazards of lead is the first step in preventing future lead poisonings. The second stop is learn how to test for lead's presence. In the following activities you will learn how to detect the presence of lead, and what amount of lead is considered a hazard. But first, let's see how much you learned about lead.

Questions:

1. Rank from most to least, the three greatest sources of lead poisoning in a child.

2. Explain why a child would be attracted to paint and chew on a painted surface.

3. Samuel's family brought a painted pitcher at a craft show. They are planning to use it to hold orange juice. Do you think this is a good idea? Support your answer with information from the reading.

4. Explain why children are more at risk for lead poisoning than adults.

Name _____ Date _____

Lead Identification Tests Lab Activity Sheet

Chemists identify the presence of an element, such as lead, in a substance by using a specific chemical that reacts with the element in a way that can be observed. Usually the test involves a color change. Below are three tests that can be used to identify the presence of lead.

Test 1

Procedures:

1. Describe the two chemicals you are to use, lead nitrate and sodium iodide, using terms such as "clear", "cloudy", "colorless", etc.
2. Put 10 ml of $Pb(NO_3)_3$, lead nitrate, solution in a test tube.
3. Carefully add 3-5 drops of NaI, sodium iodide, to the lead nitrate.
4. Record the color change in the table below.

Chemical	Desciption
$Pb(NO_3)_3$	
NaI	
PbI_3	

Lead iodide is a precipitate that forms when sodium iodide is added to a lead compound. Its bright yellow color makes it an excellent indication of lead's presence.

Test 2

Lead and lead compounds will react with an acid forming a lead compound. In this test you will first forma a lead compound using white vinegar or a dilute acid. You will also test the resulting liquid at various time intervals to see how long it takes the lead to react with the acid solution.

Procedures:

1. Obtain a 1cm X 2cm piece of lead metal or a small sinker and place in a 50mL beaker.
2. Cover with 25 mL of white vinegar or dilution solution of an acid.
3. Every 5 minutes, remove a small amount (a dropper full) and test for the presence of lead using the indicator, sodium iodide.
4. If there is no positive test result by the end of the class, leave overnight and test again the following day.
5. Record your results in the table below.

Time					
Color Change					

Questions:

1. Write a statement that describes the relationship between time and lead's reaction to the acid. How could this be a hazard for exposure to lead?

2. Some water supplies are slightly acidic. If the pipes in a house are old with lead solder used on them, would there be a chance that the water could become contaminated with lead? Justify your answer.

Test 3

There are many lead testing kits on the market. Most are expensive and require you to mail you sample to them. *Lead Alert* ^{TM} is a home testing kit that can be purchased at local hardware stores. It can be used by the homeowner with instant results. In this activity, you are going to learn how this lead testing kit can be used.

Procedures:

1. Place 2-3 drops of leaching solution on one end of the cotton swab.
2. Hold the swab upright, and perpendicular to the test surface.
3. Rub the moistened swab tip on the test surface for about 15-20 seconds.
4. Next, rub the swab on one of the numbered circles on the test card.
5. If any shade of pink or rose appears on the test circle OR the swab, the result is positive for amounts of lead at or above the threshold established as hazardous by federal action guidelines.
6. If a yellow color appears but quickly disappears, or if there is no color change, then the test result is negative.

Results:

Material Tested					
Test Results					

Questions:

1. Juan was studying about lead pollution in school. He was worried about the paint in his home because the house was very old. He convinced his parents to buy a test kit and test paint surfaces in the rooms where his little sister might be playing or sleeping. The test showed a positive test for lead. What should his family do about this problem?

2. Elsa also got her family to test the painted surfaces in her house. The top layer of paint gave a negative result but when her father ran a test where the newer paint was chipped and an older layer was exposed, the test result was positive. What might her family do about the problem?

3. Kysha's mother had a lovely ceramic serving dish that had belonged to her great-grandmother. The dish had a few cracks in it so Kysha ran some tests to see if lead was leaching from the cracks. The test was positive for lead. Kysha knew that her mother would be upset if she couldn't use the dish for special occasions. What types of food should not be served in the dish?

Group Members _____

How much is That? Lab Activity Sheet

In "Lead: Public Enemy Number One", you read about various amounts of lead in terms such as micrograms per deciliter or milligrams per liter. One milligram per Liter is equal to one part per million. One microgram per deciliter is equal to one part per billion. Which quantity is larger, one million or one billion? _____ If you answered "one billion", you were correct. Which is larger, one part per million or one part per billion? _____ If you answered "one part per million" you were correct. These measurements are very small and somewhat difficult to imagine, so here are some comparisons to help you.

- One part per million is one second in 12 days of your life.
- One part per billion is one second in 32 years of your life.
- One part per million is one penny in $10,000.
- One part per billion is one penny in $10,000,000.
- One part per million is one pinch of salt in 20 pounds of potato chips.
- One part per billion is one pinch of salt in 10 tons of potato chips.
- One part per million is one inch in 16 miles.
- One part per billion is one six-inch step on a journey to the sun.

In this activity, you will perform a serial dilution of lead nitrate to understand concentration levels of parts per million (ppm) and parts per billion (ppb). You will also test the dilutions to determine what concentration of lead nitrate is detectable with the Lead Alert™ kit.

Materials:

- Chemplate™ (spotplate or microplate)
- medicine dropper
- paper towel
- tap water
- small cup for rinse water
- 10% solution of lead nitrate solution
- Lead Alert™ kit or sodium iodide
- calculator with scientific notation

Procedures:

1. Fill the large reservoir of the chemplate with tap water.
2. Your teacher will place 10 drops of lead nitrate solution in cup 1.
3. Hold your dropper perpendicular to the cup to ensure uniform drops.
4. Using your medicine dropper, remove one drop of lead nitrate solution from cup 1 and add it to cup 2.
5. Rinse your medicine dropper thoroughly.
6. Now add 9 drops of clean water fro the large oval cup in you chemplate to cup 2.
7. Mix thoroughly.
8. Using your medicine dropper, remove one drop of solution from cup 2 and add it to cup 3.
9. Rinse your medicine dropper thoroughly.
10. Add 9 drops of clean water from the large oval cup in your chemplate to cup 3.
11. Mix thoroughly.
12. Repeat this procedure for cups 4 through 9. Each cup receives one drop of the solution from the preceding cup and 9 drops of tap water.
13. After cup 9 has been completed, your teacher will assign you one of the 9 cups to test for the presence of lead using the Lead Alert^{TM} kit.
    OR
    Add one drop of sodium iodide (NaI) to each spot.
14. Record the results of your lead test on your data table below.
15. If using the Lead Alert^{TM} kit, you will need to share your results with the class.
16. Follow your teacher's directions for clean up and return of materials.

Data Table

Cup	Test Results	Concentration	Scientific Notation
1			
2			
3			
4			
5			
6			
7			
8			
9			

17. Determine the concentrations of the various cups and record them in the data table.

- Cup 1 contains a 10% dilution of lead nitrate,m which is 1 part in 10 or a 1/10 dilution.
- Cup 2 contains a solution of lead nitrate that is 10 times more dilute than cup 1. It contains 1/10 of 1/10 or 1/100 (one part per hundred) of the original solution.
- Each succeeding cup contains 1/10 less of the original solution. Continue to calculate to find a patter for writing numbers as scientific notation.

18. Another way to express the concentrations is to use scientific notation. Scientific notation is a convenient shorthand to write very large or very small numbers. Study the chart below to find a pattern for writing numbers as scientific notation.

10	= 1 x 10	= $1x10^{1}$
100	= 1 x 10 x 10	= $1x10^{2}$
1,000	= 1 x 10 x 10 x 10	= $1x10^{3}$
10,000	= 1 x 10 x 10 x 10 x 10	= $1x10^{4}$
1/10	= 0.1	= $1x10^{-1}$
1/100	= 0.01	= $1x10^{-2}$
1/1000	= 0.001	= $1x10^{-3}$
1/10000	= 0.0001	= $1x10^{-4}$

19. Calculators with scientific notation such as TI-30 can be used to determine the value in scientific notation. Enter a value such as 0.0024. Press the scientific notation key (EE on the TI-30) Press =. The screen shows 2.4 -03 which is written as 2.4 x 10^{-3}.

20. Use a calculator to write the concentrations as scientific notation.

Questions:

1. What is the number of the cup in which the lead test is first negative? _____
2. What is the concentration of the solution in this cup? _____
3. Do you think there is any lead nitrate present in this cup even though it produces a negative test for lead? Explain why you think this.
4. Do you think any lead nitrate is present in cup 9? Explain why you think this?
5. Lead tests will not identify a very small amount of lead nitrate. Describe what you could do to see if there is any lead nitrate in cup 9.
6. Ten micrograms of lead per deciliter of blood are the maximum amount allowed in children's blood. How many parts per million is this? In what cup would this concentration have appeared?

Name _____

Conversion Exercises Activity Sheet

Listed below are the limits for lead or the amounts of lead in the human body and some of the health problems caused by exceeding these amounts. Convert each amount of lead into parts per billion and/or scientific notation. Record answers on the chart.

1. The EPA has set the maximum limit for lead in drinking water as 15 micrograms/deciliter.
2. At a lead level of 25 micrograms/deciliter, high blood pressure occurs and red blood cell production slows.
3. For pregnant women, a risk of damaging her unborn child's brain can begin at blood levels as low as 15 micrograms/deciliter.
4. Irreversible damage to the nervous system and kidneys can begin at around lead levels of 30 to 40 micrograms/deciliter.
5. Predicted lead concentrations in snow by the year 2000 are above 250 parts per trillion.
6. The Center for Disease Control has set the maximum safe level for lead in the blood as 24 micrograms/deciliter
7. Backyard dirt analyzed by a New Jersey scientist was found to have lead levels as high as 1800 ppm. The average world soil lead levels is 18 PPM What might be the cause of having such a high amount of lead in the soil?
8. Dr. Herbert Needleman analyzed baby teeth for lead levels. He found that children whose teeth had 10 PPM or less had IQs 4 points higher than those whose teeth had 20ppm or more.
9. The allowable amount of lead in the blood has decreased over the years as more has been learned about lead's dangers. In 1960, it was 60 micrograms/deciliter, by 1978 the amount had been lowered to 30 micrograms/deciliter, and in 1991 it was decided that 10 micrograms/deciliter could be hazardous.
10. If a child's blood lead level is between 15-20 micrograms/deciliter, it is recommended that the doctor test for lead again in a few months and that parents are taught how to minimize the exposure to lead. At 20-25 micrograms/deciliter, the Health department inspects the home to rid it of the lead source. Over 25 micrograms/deciliter, chelation treatment is begun to draw excessive lead out of the child's body.

Lead Conversion Chart

	Blood Lead Level	Parts per Billion	Scientific Notation
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Name _____

Answer Sheet

Activity 1: Lead Public Enemy Number One

1. lead in paint, dust, glazed ceramic pottery are the leading causes of poisoning.
2. Lead salts found in paint have a sweet taste.
3. No. Often orange juice can leach lead from glazed ceramic pottery. No guarantee that the pottery was properly sealed when made.
4. Because they are smaller, children can be poisoned by a smaller amount of lead. Body weight is factor in how much lead is poisonous.

Lab Activity 2: Lead Identification Tests

Test 1:

Chemical	Description
$Pb(NO_3)_3$	clear, colorless liquid
NaI	clear, colorless liquid
PbI_3	yellow solid

Test 2:

Table 2: Answers will vary. A yellow precipitate should form.

Questions:

1. Lead can leach into an acid solution in less than 24 hours. Acid rain could react with the lead in dust; vinegar could leach lead from a crystal cruet, juices and other acid foods could leach lead from poorly glazed ceramic pottery.
2. Water running through old pipes could react with the lead solder if the water is acid.

Test 3: Result: Answers will vary.

Question:

1. If possible, paint should be removed. If not possible, surfaces should be painted. Sister should be watched so she will not chew on paints. She should be under a doctor's care.
2. If possible, paint should be removed or at least covered with another layer of pint. All chipped areas should be covered.
3. Dish should only be used to hold non-liquid foods. Avoid any that might contain an acid (vinegar or juices) such as pickles, salads, etc.

Extension
Lab Activity 1: How Much is That?

Cup	Test Results	Concentration	Scientific Notation
1	The positive yellow color will slowly fade in successive cups. The color is usually not visible starting with cup 5 or 6.	1/10 (100,000 ppm)	$1x10^{-1}$
2		1/100 (10,000 PPM)	$1x10^{-2}$
3		1/1000 (1,000 PPM)	$1x10^{-3}$
4		1/10,000 (100 PPM)	$1x10^{-4}$
5		1/100,000 (10 PPM)	$1x10^{-5}$
6		1 PPM	$1x10^{-6}$
7		1/10 PPM (100 ppb)	$1x10^{-7}$
8		1/100 PPM (10 ppb)	$1x10^{-8}$
9		1/1,000 PPM (1 ppb)	$1x10^{-9}$

Questions:

1. First negative in cup 5 or 6.
2. Answers will vary. See chart above.
3. Yes, but too little is present for a positive test.
4. Answers will vary. Students should support their position
5. Answers will vary. Evaporate some of the water, so the concentration of lead nitrate is greater. Evaporate all the water and look for evidence of lead nitrate crystals under magnification.
6. 10,000 PPM; cup 2

Extension
Activity 2: Conversion Exercises

Lead Conversion Chart

	Blood Lead Level	Parts per Billion	Scientific Notation
1	15 micrograms/dL	15	15×10^{-9}
2	25 micrograms/dl	25	25×10^{-9}
3	15 micrograms/dl	15	15×10^{-9}
4	30-40 micrograms/dl	30-40	$30\text{-}40 \times 10^{-9}$
5	250 ppt	0.25	0.25×10^{-9}
6	24 micrograms/dl	24	24×10^{-9}
7	1800 PPM	1.8	1.8×10^{-9}
8	20 PPM	20	20×10^{-9}
9	10 micrograms/dl	10	10×10^{-9}
10	20-25 micrograms/dl	20-25	$20\text{-}25 \times 10^{-9}$

The Link:
Pfiesteria and Nutrients
Grades 6 - 8

Overview

The Chesapeake Bay is a body of water, and like a human body, its health depends on what goes into it. Since the early 1980's, a scientific consensus emerged that excessive nutrients, such as nitrogen and phosphorus were the primary pollution problem in the Bay. The first sign of trouble in the Chesapeake Bay tributaries came during the summer of 1997 when more than 15,000 fish turned up dead and local watermen had several unusual health complaints. The outbreak of Pfiesteria was the wake-up call that the health of the Bay was in trouble.

No scientific documentation has confirmed exactly what triggers Pfiesteria to become toxic, however, one thing that is fairly well established by leading researchers is that the vast majority of Pfiesteria outbreaks are associated with waterways that have been heavily polluted with high levels of nutrients, such as nitrogen and phosphorus. Regardless of the source, areas of highly concentrated animal agriculture have become the prime source of concern as a possible link between Pfiesteria and nutrients.

Although the link or correlation between excessive nutrients and toxic outbreaks of Pfiesteria continues to be researched and is not well understood, the following lesson will provide students with baseline knowledge and hands-on activities using laboratory techniques and the Internet to explore the possible link between Pfiesteria and nutrients. Activities with curriculum connections in environmental science, math and language arts will give students an opportunity to develop skills in the areas of critical thinking, problem-solving, graphic organizing, interpreting, comprehending, predicting, and writing.

Technology Resources

Internet Resources:

Pfiesteria Facts and Theory
http://www.bayjournal.com/9710/pfbook.htm
The Alliance for the Chesapeake Bay presents fact sheets on Pfiesteria and related web sites.

The Possible Link Between Pfiesteria and Concentrated Animal Feed Lots
http://www.nwf.org/pubs/reports/paralysis/possible.html
National Wildlife Federation presents reports on pollution paralysis and related links on environmental education, press releases, water quality, Clean Water Act, and publications.

Know Your Nitrogen
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/NonpointSourcePollution/know%20your%20nitrogen.pdf
Part of the Pennsylvania Deptartment of Environmental Protection's "Forest Buffer Toolkit". *(You will need Adobe Acrobat Reader to access this Adobe PDF File.)*

Teacher Background Information

Resources:

Reducing Nutrients Likely To Lessen Risk Of Pfiesteria
http://web.gmu.edu/bios/bay/journal/97-11/pfiest.htm
This Bay Journal site contains reports on nutrient concentration in the Bay and Bay Journal issues from 1994-1998.

Other Resources:

- Calculators, TI-30X Scientific Calculator, Frey Scientific-100 Paragon Parkway, Mansfield, OH 44903
  Tel. 1-800-222-1332
- The Monitor's Handbook, LaMotte Co., PO Box 329 Chestertown, MD 21620,
  Tel.1-800-344-3100
- Chesapeake Bay Watershed Activity Guide, U.S. Fish and Wildlife Foundation, 1994, 180 Admiral Cochrane Dr. Suite 535, Annapolis, MD 21401,
  (410) 224-2732
  in Baltimore (410) 841-6348
- Video: *It's Our Bay*, produced by Baltimore Gas & Electric and the Maryland Department of Natural Resources, (410) 976-2255.

For Resource Donations:

- Chesapeake Marine Tours & Charters, Inc. - PO Box 3350, Annapolis, MD. 21403
  Tel. (410) 269-6776
- Maryland Department of Natural Resources - Tawes State Office Bldg. C-4, Annapolis, MD 21401,
  Tel. (410) 976-2255

Teacher Background Information

Scientists say it is too soon to know exactly what triggers Pfiesteria to become toxic, but most suspect "nutrients loading," that is, an excess of nutrients pouring into waters in which bacteria live. The nutrients could come from many sources, including sewage-treatment plants. In the Chesapeake Bay area which is home to about 625 million chickens (outnumbering humans about 500 to 1), poultry manure is the leading suspect.

Chicken manure is commonly used as fertilizer on farmlands around the affected waterways. The nitrogen and urea in the manure are converted to ammonia and, ultimately, to nitrate in the soil. When it runs off into the water, it brings excessive levels of nitrogen.

Phosphorus fertilizer generally is applied as a compound of phosphate. Phosphate is not very mobile in soil: it tends to remain attached to solid particles rather than dissolve in water. However, soil erosion can carry a considerable amount of phosphate to streams. About 17.5 million tons of nitrogen and 4 million tons of phosphorus are applied annually in manure and commercial fertilizers. Phosphorus tends to spur algae blooms in fresh water, while nitrogen is primarily responsible for algae growth in salt water. Baywide, phosphorus concentrations have dropped significantly over the years, largely as the result of phosphate detergent bans passed by the Bay states in the 1980's, and upgrades at sewage treatment plants. Nitrogen levels have remained steady or declined slightly.

In addition to the nutrients coming from animal waste, it is important to emphasize that many activities and facilities used by the average homeowner contribute to the nutrient problem in our Bay. The use of lawn fertilizers, septic tanks, household cleaners, automobiles, lawn tools, and electricity are just a few of the sources that generate nitrogen.

Nutrients are chemical elements that are essential to plants and animals on land and aquatic life, but in high concentrations they can lead to unwanted consequences. Pfiesteria thrives in polluted nutrient-rich water. Too many nutrients in water produce algal blooms that can suffocate the critters that should live there and provide the perfect environment for unwelcome guests like Pfiesteria.

Because Pfiesteria is an animal and not a plant, it is less likely to respond directly to nutrient enrichment. While nutrients set up the conditions for the nontoxic stages of Pfiesteria to grow, it is the presence of fish excretions - not nutrients - which cause the microbe to transform into toxic life stages. Because Pfiesteria's preferred food is microscopic algae, one might expect Pfiesteria to be more abundant where its preferred food supply is more abundant. Thus, it might be indirectly linked to nutrient enrichment through its food supply.

Learning Objectives

Students will be able to ...

- List on a graphic organizer possible environmental factors that trigger the proliferation of Pfiesteria.
- Sequence the events associated with excessive nutrients in water.
- Explain in writing the possible link between Pfiesteria and excessive nutrients.
- Calculate the amount of nitrogen generated from activities around the home.
- Perform an experiment that simulates conditions in the Chesapeake Bay associated with excessive nutrients.

Vocabulary

Nutrients: substances that all living organisms need for growth and reproduction. Two major nutrients, nitrogen and phosphorus, occur naturally in water, soil, and air. Nutrients are present in animal and human waste and chemical fertilizers. All organic material such as leaves and grass clippings contains nutrients.
Nutrient Loading: adding nutrients to a system. In particular, nitrates and phosphates added to aquatic systems can often cause microorganisms such as algae to undergo a population explosion.
Algae: aquatic photosynthetic organisms which are not true plants, but close relatives, often microscopic. Small algal populations are normal; overpopulation (green turbid blooms) indicate nutrient pollution.
Bloom: a severe overpopulation of aquatic algae, characterized by serious green turgidity. Can lead to anoxic conditions.
Eutrophication: the result of overloading an aquatic system with nutrients (sewage, phosphate), producing an overgrowth of algae, low dissolved oxygen, and little aquatic life.
Toxic: a substance is said to be toxic if it harms or kills plants or animals by direct action.
Toxin: any poisonous product of animal or vegetable cells. The toxins produced by harmful bacteria cause the symptoms of many diseases.
Effluent: any treated or untreated liquid waste that flows from a point source (e.g., treatment plants, industrial outfall, into any surface waterbody).
Parameter: any measured property

Equipment and Materials

Per student:

- Calculator
- Xerox copies of:
  - The Trigger *Activity Sheet*
  - A Little Too Much *Activity Sheet*
  - Know Your Nitrogen *Activity Sheet*
  - Bay In A Beaker *Activity Sheet*
  - Effects of Nutrients in The Bay

Per group/team of 3 or 4:

- Computer with modem and Internet Access or Internet Site Resource Booklet (containing xerox copies of the Internet articles used in this lesson)
- Xerox copy of an electric bill
- Empty fertilizer bag
- Empty bottles of assorted household cleaners
- Magnifying glass (optional)
- Tablespoon
- Aluminium foil paper
- Labels for jars
- Paper and pens to make a chart
- 5 clean 1-liter beakers or quart jars
- Commercial lawn fertilizer (do not use a fertilizer with weed control or powdered fertilizer)
- Safety goggles
- Water quality test kits (containing nitrogen and phosphorus testing supplies)

Note: For a catalogue of water sampling test kits and supplies, contact:
The LaMotte Company
PO Box 329
Chestertown, MD 21620
Phone: 1-800-344-3100

Per class:

- Newspaper and magazine articles on Pfiesteria (enough to make a display on the board)
- Video: *It's Our Bay*
  Produced by Baltimore Gas & Electric and Maryland Dept. of Natural Resources
- Overhead projector
- Transparencies:
  The Trigger
  A Little Too Much
  Connecting the Links
- A large bucket of water from a pond, stream, aquarium, or the Bay
- Microscope

Procedures

(Time Required: 2 teaching periods)

Teaching Tips:

You should not hesitate to adapt the materials and activities to make them more appropriate for your students or to provide additional instructions where necessary.

Stimulate the discussion with probing questions and keep the discussion focused. Periodically summarize what has and what has not been dealt with and/or resolved. Review each activity and decide which activities you will have the class complete as group tasks or individual tasks.

Activity 1: KICK-OFF

1. Display on the board several news articles on Pfiesteria
2. Open discussion by saying "Pfiesteria occurs naturally in the Chesapeake Bay and may have existed for thousands of years."
3. Have students respond to the following question: Why is Pfiesteria suddenly such a big topic in the news?
4. Point out to class that the activities in today's lesson will give them an opportunity to find out what some scientists believe triggers Pfiesteria to change from its harmless form into a toxic form that kills fish and has adverse effects on humans.
5. Divide students into groups of 3-4. Explain to class that in some of the activities they will work in assigned groups. However, each student is expected to complete his/her own *activity sheets.*

Activity 2: THE TRIGGER

1. Distribute a copy of *Activity Sheet:* The Trigger to each student.
2. Direct class to focus their attention on the introduction. Read the introduction aloud to class.
3. Ask class the following question: What does the phrase "toxic form" mean?
4. Point out to the class that Pfiesteria can appear in 24 different forms (or life stages). Of the 24 stages, Pfiesteria is only harmful in 4 of the stages during which time it produces toxins that are harmful to fish and humans.
5. Make sure students team up with their assigned group members.
6. Explain to students that their task is to visit the Internet site listed below to find out what environmental factors scientists believe trigger Pfiesteria to change into its toxic forms.
   Pfiesteria Facts and Theory
   http://www.bayjournal.com/97-10/pfbox.htm
7. Have students use the graphic organizer located on *Activity Sheet,* The Trigger to record their data.
8. Instruct students to respond to all discussion questions located on the *activity sheet.*
9. Use a transparency or board to record students' data.

Activity 3: A LITTLE TOO MUCH

Although nutrients such as nitrogen and phosphorus are essential for life and occur naturally in the Chesapeake Bay and other water systems, when the Bay receives too many nutrients, the system gets out of balance. The major purpose of this activity is for students to increase their understanding of what happens when too many nutrients enter a water system.

1. Have students remain in their assigned groups to complete this activity.
2. Give each student a copy of *Activity Sheet:* A Little Too Much.
3. Point out to students that in this web activity, they are to locate the Internet article called: The Possible Link Between Pfiesteria and Concentrated Animal Feed Lots at the following Internet address:
   NWF Report: Pollution Paralysis (http://www.nwf.org/pubs/reports/paralysis/rptlinks.html)
4. Explain to students they are to use the information from this Internet site and the diagram called Effects of Nutrients in the Bay to find out what happens when too many nutrients enter a water system.
5. Have students complete the flow chart and answer all discussion questions on their *activity sheets.*
6. Use a transparency that contains a flow chart similar to the one on the *activity sheet* to record student's findings. Depending on time, teacher can have student volunteers write the answers on the transparency.

Activity 4: KNOW YOUR NITROGEN

Note: This activity requires materials which must be gathered prior to this lesson.

This group activity examines activities around the home which generate nitrogen. It focuses on those activities or facilities over which we have at least some control: areas in which choices can be made to reduce the amount of nitrogen we put into our Bay.

1. Have students locate the Web activity called Know Your Nitrogen Worksheet located at the following Internet site:
   http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/NonpointSourcePollution/know%20your%20nitrogen.pdf
   (You will need Adobe Acrobat Reader to access this Adobe PDF File.)
2. If computers with Internet are not available, locate this activity in the Internet Site Resource Book.
3. This activity contains five parts. Assign each group one part to complete.
   Note: If students do not have some of the required information to use, make up numbers for them.
4. Record group results on a chart drawn on the board. Discuss results

Activity 5: BAY IN A BEAKER

This simple experiment is an excellent way to show the effects of over-enriching a water system with too many nutrients (nitrogen and phosphorus). Students will measure nitrate and phosphate levels in mini-bay systems using test kits from The LaMotte Company.

Note: This experiment must be set up several days (approximately 11 days) prior to this lesson. If you wish to speed up the experiment, add an equal amount of algae culture or small bits of algae collected from s nearby pond, stream, aquarium, or the Bay to each water sample.

Tips:

- Collect a large bucket of viable pond, stream, aquarium, or Bay water. The water must be a source of active organisms, both plant and animal. A microscope may be needed to verify how active the organisms are.
- Be sure to agitate the water before introducing it to the other jars. There should be, as near as possible, equivalent concentrations of life forms in each of the experimental jars.
- The experiment should be placed in a cool, well-lit spot (sunny spot) not in direct sunlight which can heat up the water. Stir the water every few days.
- Make sure students are familiar with the procedures for using the test kits. If necessary, demonstrate to class the proper procedures for using the test kits.
- Since students will be measuring the nutrient levels several days after the experiment has been set up, it is essential that nitrogen and phosphorus levels are measured when the water samples are first collected and set up.
- Have students work in groups to complete this activity.

Other options for this activity:

- For more advanced groups you may want to give the students all the materials and challenge them to design their own experiment to test the effects of fertilizers (nutrients). Be reminded, this option will require more time.
- Students can design a chart, collect data over a 4- to 6-week period, and interpret the data.

Extensions

Language Arts
Instruct students to list in their lab journals several things they can do (starting today) in their own lives to reduce the number of nutrients which they and their families may add to the Bay.

Internet and Language Arts
Have students use the Internet to find current web documents on what the Environmental Protection Agency is doing to enforce the Clean Water Act and regulate commercial livestock farms as a pollution source. A good starting web site for this activity is the State, Local, and Tribal Environmental Network:
http://www.epa.gov/regional/statelocal/laws.htm

Internet: WebQuest
Have students find out what is being done to combat Pfiesteria by visiting the following web sites to get details:

Maryland Dept. of Natural Resources:
http://www.dnr.state.md.us/

University of Maryland:
http://www.mdsg.umd.edu/fish-health (pfiesteria)

United States Dept. of Agriculture(USDA):
http://www.nal.usda.gov/wqic/pfiest.html

Sea Grant:
http://www.seanet.com/~tzhre/pfiest.htm

NSCU Aquatic Botany Laboratory (Pfiesteria Page):
http://www.pfiesteria.org/pfiest.html#Toxic

Virginia Institute of Marine Sciences:
http://www.vims.edu/welcome/news/pfiesteria

Social Studies
Have students use the Internet to find out who regulates water pollution in their city, county or state. What are the federal regulations on water quality? What is the impact of these regulations on industries (including farmers)? What are the greatest water quality problems in their local area? How do they affect the jobs and health of people living in their area?

Language Arts
Instruct students to write a letter to the Chesapeake Bay Foundation telling what they have been learning and ask for booklets that tell what ordinary people can do to reduce waste pollution in the Bay.
Alliance for the Chesapeake Bay
6600 York Road
Baltimore, MD 21212

Science Using Your Classroom Aquarium

- Does your classroom aquarium grow lots of algae? If you feed fish, they will produce waste products which are very much like fertilizer. Have students design a plan on how to reduce or avoid water pollution in their classroom aquarium.
  Hint: Do not overfeed the fish, remove algae from the sides of the tank, and do frequent water changes which reduce the level of waste products.
- Compare your classroom aquarium with the mini-bay set-ups used in the experiment in this lesson. How are they the same? Different? Where do the nutrients that support algal growth on the walls of your aquarium come from?
  Hint: The waste products from fish urine and feces. Think about what is used as fertilizer in organic gardens.
  Hint: Animal manure is used as fertilizer in organic gardens. Where did the animals get the nutrients in their waste?
  Hint: From the food they ate which directly or indirectly came from plants.

Field Trip Resources
Chesapeake Bay Foundation Field Trips
410-268-8816
or 1-800-445-5572 (ask for Kristin Urban)

Chesapeake Bay Maritime Museum
St. Michaels, Maryland
410-745-2916 or www.cbmm.org

Chesapeake Marine Tours & Charters, Inc.
Baltimore - 410-269-6776
Annapolis 410-268-7601
DC-301-261-2719

1998 EnviroHealth Master Teacher Team

Rosetta Jackson and Howard Schindler

Name _____ Class _____ Date _____

Activity 2: The Trigger

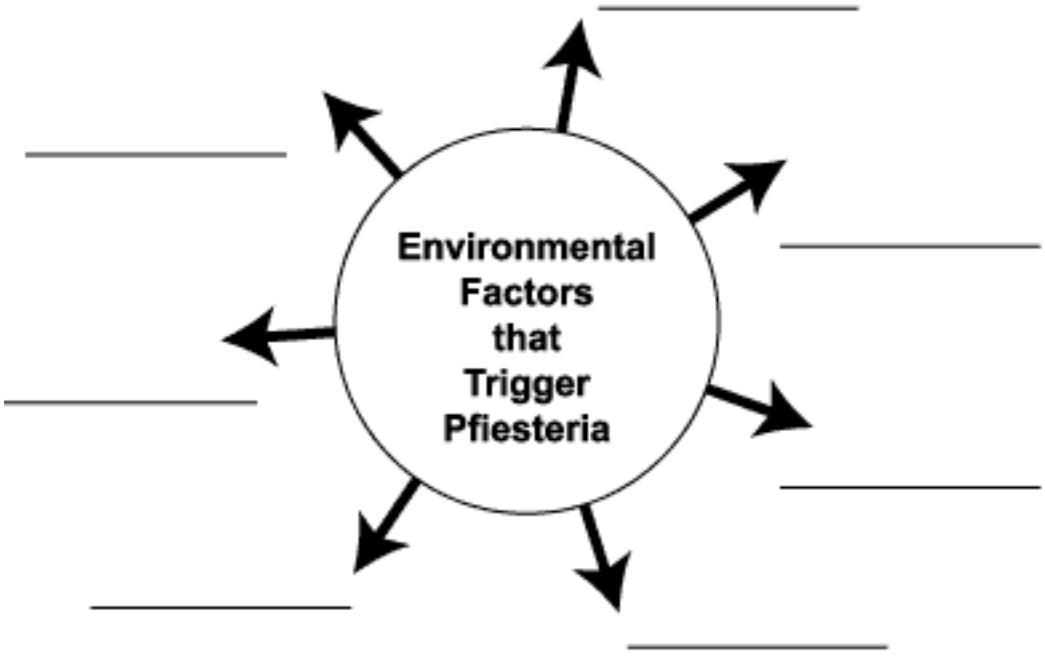
Scientists do not know exactly what triggers Pfiesteria to turn deadly and kill fish. However, scientists believe there are several environmental factors that come together to trigger the toxic form of Pfiesteria

Directions :

1. Use your Internet browser to find the article called **"Pfiesteria Facts and Theory"** located at the Internet address below:
   http://www.bayjournal.com/97-10/pfbox.htm
   OR
   Locate the Internet article in the **Internet Site Resource Book** if you do not have access to a computer with Internet.

2. Use your mouse to click on the article called **"What Causes Pfiesteria to Turn Deadly?"**

3. Use the information from the Internet article to complete the graphic organizer and question below.



What two nutrients play a role in triggering Pfiesteria to change into its different life forms?

Name _____ Class _____ Date _____

Activity 3: A Little Too Much

The two main nutrients polluting the Bay are nitrogen and phosphorus. These two nutrients found in commercial fertilizer and animal waste like chicken manure are commonly used as fertilizer on farmlands and on lawns.

Environmentalists and some scientists believe excessive nutrients (nitrogen and phosphorus) in the water create an environment rich in algae which Pfiesteria use as a food supply. Although these nutrients are essential for life and occur naturally in water, air and soil, too much of them is BAD NEWS for the Bay and GOOD NEWS for Pfiesteria.

Directions:

1. Use your Internet browser to find the article called *"The Possible Link Between Pfiesteria and Concentrated Animal Feed Lots"*, located at the following the Internet address: http://www.nwf.org/nwf/pubs/reports/paralysis/possible.html

   (If you do not have access to a computer, locate the Internet article in your Internet Site Resource Book)

   and

2. Make sure you have a copy of the diagram called *"Effects of Nutrients in The Bay"*.

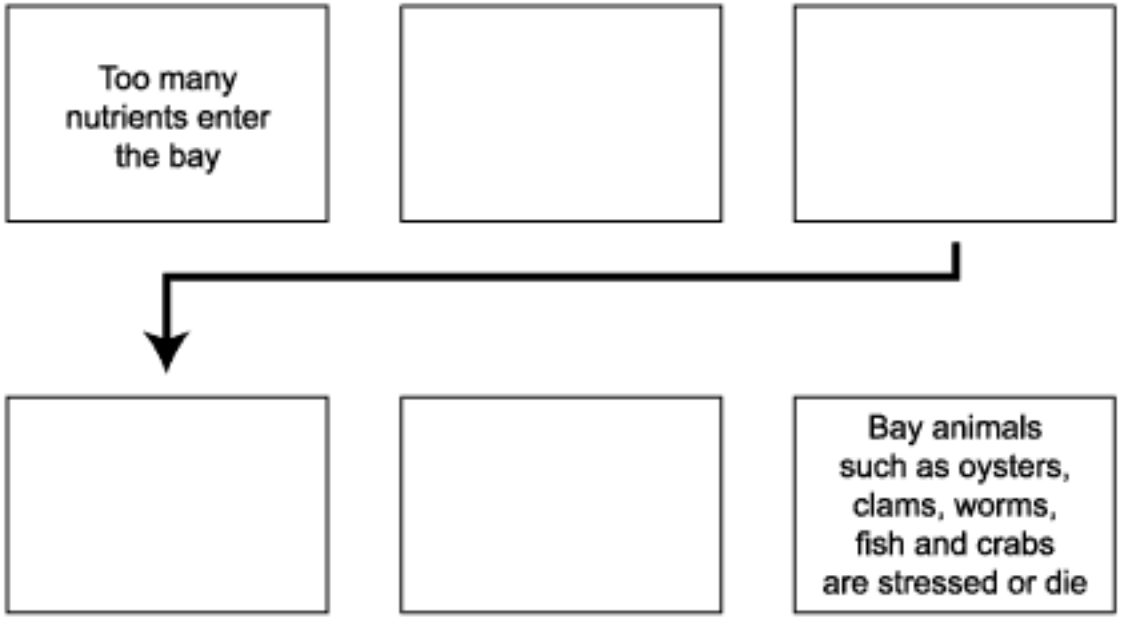
3. Use the information from both sources to help you complete the flow chart and discussion questions below.

Discussion Questions

1. Water systems that are over-enriched with nutrients sound like a good thing, but they are not. Use the space below to EXPLAIN WHY.

2. List several reasons presented in the Internet article that will help explain why scientists suspect there is a link between agriculture feed lots and the Pfiesteria problem in the Chesapeake Bay.

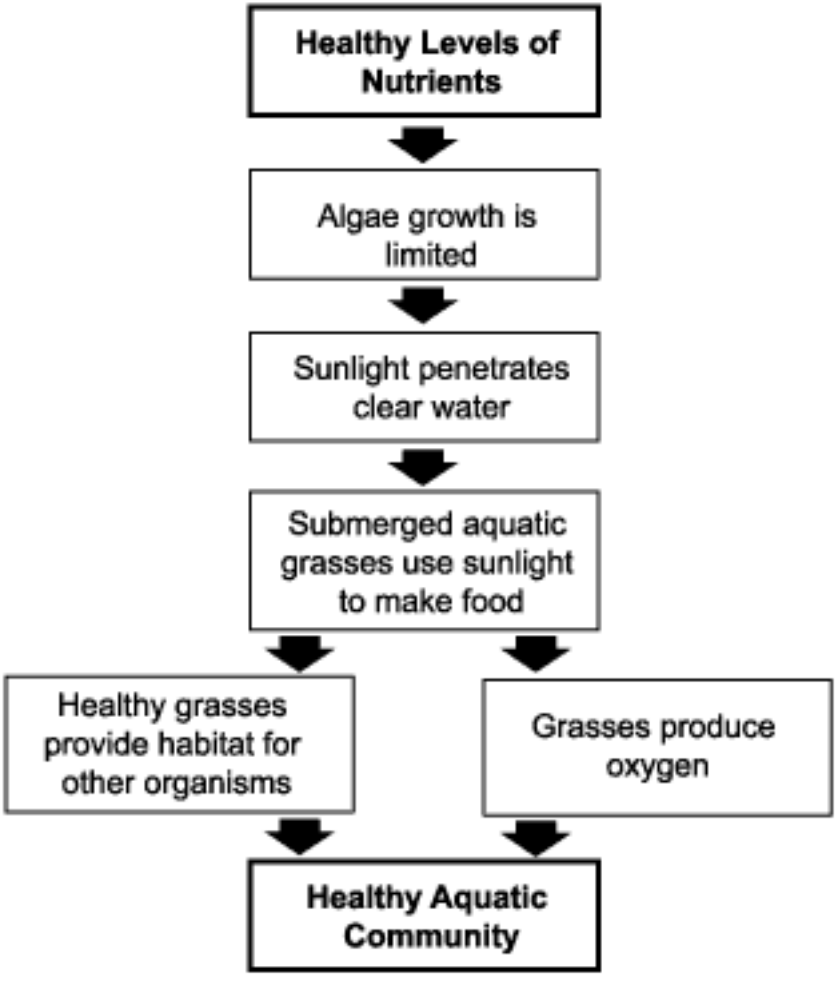
Flowchart


Too many nutrients enter the bay
Bay animals such as oysters, clams, worms, fish and crabs are stressed or die

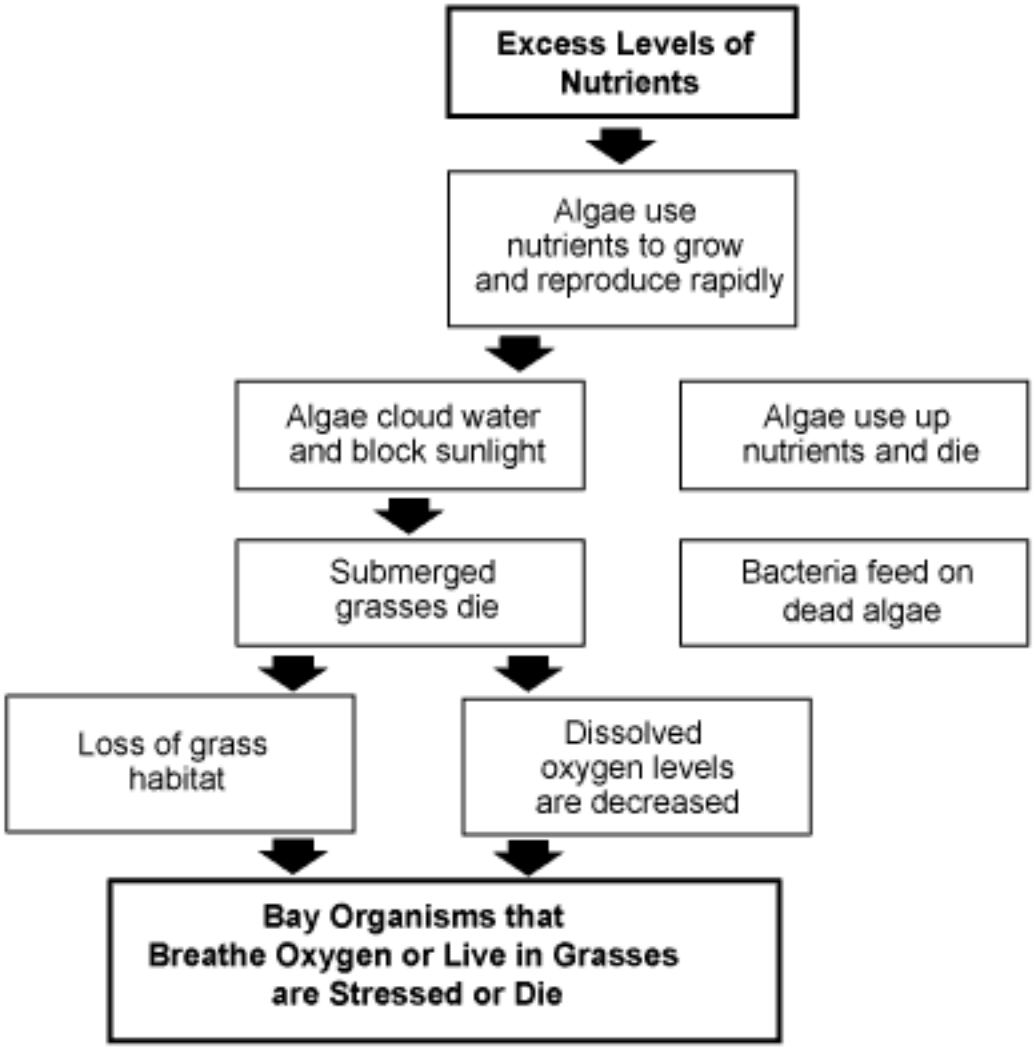
Effects of Nutrients in The Bay

Adapted from *Chesapeake Choices and Challenges, your Watershed and the Bay*, 1995

A. Healthy Level of Nutrients



B. Excess Level of Nutrients



Name: _____ **Class:**_____ **Date:** _____

Activity 4: Know Your Nitrogen

It is easy and convenient to blame the Pfiesteria problem on the nutrients concentrated in animal manure that are spread on farmland as fertilizer. However, all of us contributor to the Pfiesteria problem in the Bay by the activities that we undertake each day. From driving our cars, to flushing our toilets, to fertilizing our beautiful green lawns, we represent another source of the Bay's excess nutrient problem.

The following activities will help you examine some activities around your home that generate nitrogen.

Directions:

1. Use your Internet browser to find the article called "Know Your Nitrogen Worksheet" at the following web site: *(You will need Adobe Acrobat Reader to access this Adobe PDF File.)*
   http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/NonpointSourcePollution/know%20your%20nitrogen.pdf
   or
   If you do not have a computer, locate this website activity in the Internet Site Resource Book.
2. Your teacher will assign to you one of the activities to complete.
3. Use your calculator and other required materials to complete the activity you have been assigned.
4. Be prepared to share your answer(s) with the class.

PART 1
Lawn Fertilizers

Step 1: On the back of the fertilizer bag, note the parts of nitrogen, phosphorus, and potassium per bag. Nitrogen is the first number in the 3-digit formula. A 12-4-8 fertilizer, for instance, would contain 12 percent nitrogen on a weight basis.

Step 2: Determine the size of your lawn in square feet. (1 acre = 43,560 square feet). Commercial fertilizers give recommendations for pounds of fertilizer per 1000 square feet. Divide the size of your lawn (in square feet) by 1000 square feet. (Hint: Your lawn is 2 acres)

Step 3: Determine how many pounds of fertilizer are recommended per 1000 square feet. (A typical recommendation would be 1.5 lbs. per 1000 sq. ft.) Multiply this number by the factor arrived at in STEP 2.

Step 4: Take Step 1's nitrogen figure (the first number in the N-P-K formula) and multiply by the total pounds of fertilizer arrived at in Step 3. This is the total pounds of nitrogen you're applying in one application.

Step 5: Multiply the total pounds of nitrogen arrived at in Step 4 by the number of times a year you fertilize your lawn with this formula. (Hint: Your lawn is fertilized 3 times a year)

TOTAL POUNDS OF NITROGEN: _____

PART 2
On-lot Septic Systems

The average amount of nitrogen produced by a person in septic system effluent over one year is estimated to be 9.9 pounds.

Step 1: Total the number of people living in your household.

Step 2: Multiply the number of people in your household by 9.9 pounds for a total annual amount.

TOTAL POUNDS OF NITROGEN: _____

PART 3
Automobiles

Step 1: Estimate the number of miles driven per week for each of your family's cars and total the miles driven per week. (Note: Make up a number if your family does not own a car)

Step 2:Multiply this mileage by .004 (an approximate average of the pounds of nitrogen emitted by 1996 model cars over one mile).

Step 3: Multiply this number (lbs. of nitrogen emitted/one week) by 52 week/yr for an annual amount.

TOTAL POUNDS OF OXIDES: _____

PART 4
Electricity

Electric generation plants powered by coal (fossil fuel) emit .0024 pounds of nitrogen oxides per kilowatt hour of electricity produced.

Step 1: Over the course of a year, record the kilowatt hours of electricity used by your household, which is noted on your monthly electric bill.
(Hint: *Multiply the total number of kilowatt hours for the month by 12*)

Step 2: Total the year's kilowatt hours and multiply by .0024 for an annual amount of nitrogen oxide emissions contributable to your household.

TOTAL POUNDS OF NITROGEN OXIDES: _____

PART 5
Household Cleaners

Step 1: Many of the cleaners we use around the house contain ammonia (a form of nitrogen). We use six ounces as an average per use amount for the typical household. Decide which cleaners you use around your house.

Step 2: Multiply six ounces by the number of times you use each of the cleaners in one year.
(Hint: *you use one of the cleaners at least once each week*)

Step 3: Divide the total by 16 to calculate the number of pounds of each cleaner used in one year.

Step 4: Sum the total pounds of ammonia-containing cleaners routinely used over one year.

TOTAL POUNDS OF NITROGEN-CONTAINING CLEANERS: _____

PART 6
Lawn Tools

Nitrogen Oxide Emission Rates:
• lawn mower — .0053 lb/hour
• rear engine riding mowers — .0163 LB/hour
• lawn/garden tractor — .026 LB/hour
• snow blower — .0066 LB/hour

Step 1: For each type of equipment noted above, determine how many weeks a year you typically use the equipment.

Step 2: For each season, determine how many hours a week each tool is typically used.

Step 3: For each equipment piece, multiply number of hours/week by the total weeks used in one years.

Step 4: Sum the totals for each small gas-powered engine.

TOTAL POUNDS OF NITROGEN OXIDES: _____

ADD IT UP

ADD ALL OF THE ABOVE FIGURES: _____

This number is an estimate of how many pounds of nitrogen-containing compounds your household generates on a yearly basis.

Where do you think this nitrogen ends up?

Name: _____ **Class:**_____ **Date:** _____

Activity 5: Bay in a Breaker

(modified from Chesapeake Watershed Activity Guide, 1994)

The main pollutants in the Chesapeake Bay are nutrients. The two primary nutrients are nitrogen (N) and phosphorus (P). Nitrogen and phosphorus are essential for life and both of them occur naturally in soil, water, and air. Animal manure which contains a lot of nitrogen and phosphorus is used as a fertilizer on farms and lawns and releases nutrients into the water. If nutrients are required for life, then how can too many nutrients such as nitrogen and phosphorus cause problems for the Chesapeake Bay and its tributaries?

Purpose:

- To demonstrate how lawn and farm fertilizers can have a negative impact on the Bay.

Materials:

- 5 clean quart jars or 1 liter beakers
- Labels for jars
- Fertilizer
- 1 gallon of water from stream, pond, aquarium or the Bay
- Magnifying glass (optional)
- Aluminum foil
- ***"Bay in a Beaker"*** Activity Sheet
- Water Quality Parameter Table

Procedure:

1. Wash the jars, making sure to rinse them well.
2. Prepare the water samples.
    - Fill the first jar with 750 ml of tap water. Label this jar "Tap Water" and set it aside.
    - Fill each of the remaining four jars with 750ml of water from a nearby stream, pond, aquarium or Bay.
    - Label the second jar "No Nutrients Added" and set it aside.
    - Add 10 mg. of fertilizer to the third jar and label it "10 mg of fertilizer"
    - Add 30 mg. of fertilizer to the third jar and label it "30 mg of fertilizer"
    - Add 60 mg. of fertilizer to the third jar and label it "60 mg of fertilizer"
3. Follow the directions on your water quality test kits to measure the nitrate and phosphorus levels in each jar. Record the nutrient levels in the data table under "Initial Levels". Cover the jars with foil and place them in a cool, sunny spot but not in direct sunlight which can heat up the water.
4. Every few days, stir the water and check the samples for any algae growth on the glass. It might be a thin grey or green film or small green splotches.
5. In about 11 days, measure the nitrate and phosphorus levels again. Record your nutrient level in the data table under "Final Levels".

What do you think will happen to the jars with more servings of nutrients? Write your **hypothesis** here:

Data Table

Jar #	Amount of Nutrients	Initial Nitrate Levels	Final Nitrate Levels	Initial Phosphate Levels	Final Phosphate Levels	Comments
1						
2						
3						
4						
5						

1. What did the fertilizer represent?

2. What was the purpose of having jar #1 in this experiment?

3. What was the purpose of having jar #2 with no fertilizer in this experiment?

4. How did the amount of fertilizer affect the growth of the algae?

5. Was your hypothesis right?

6. In which jar (mini-bay) do you think Pfiesteria would be most likely to survive? EXPLAIN WHY.

7. Discuss how the mini-bay relates to the Chesapeake Bay.

The table below gives typical levels of some major water quality parameters.

Significant Levels of Water Quality Parameters

Parameter	Level	Comments
dissolved oxygen	1-2 mg/L	will not support fish
	< 3 mg/L	stressful to most aquatic organisms
	5-6 mg/L	usually required for growth and activity
nitrate (as NO_3 - N)	<1 mg/L	unpolluted water
	>10 mg/L	unsafe for drinking water
phosphate	>0.03 mg/L	contributes to increased plant growth (natural eutrophication)
	>0.1 mg/L	cultural eutrophication
turgidity	Secchi depth > 1 m	favors SAV growth
	high values	can damage gills and interfere with ability of fish to find food
pH	6.5 - 8.2	optimal for most organisms
total dissolved solids (TDS)	< 10 mg/L	rainwater
	<500 mg/L	municipal water system
	100 - 2000 mg/L	rivers
	35,00 mg/L	seawater

From: The Monitor's Handbook, LaMotte Co. (1992)

CO_2 Makes Me Blue

Grades 6 - 8

Recognized for excellence by

Selected by Science Educators SCILINKS From NSTA

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

Overview

Carbon dioxide and carbon monoxide are dangerous indoor air pollutants. These colorless, odorless gases can be released in the home unknown to the residents. Detection of these gases can present health problems or even death from overexposure to carbon dioxide and carbon monoxide. Accidents with carbon dioxide are easy to prevent if one is informed.

Students will observe how carbon dioxide affects a lighted candle and apply the information gathered to the home situation.

Students will perform a WebQuest utilizing teacher-assigned web sites to explore the topic of carbon dioxide poisoning in homes.

Technology Resources

Internet

T & T SERVICES, CO Removal
http://www.co-removal.com/coremoval.html
Topic is removal of carbon monoxide gas from warehouses

Ann Arbor, Michigan: Air Pollution Project
http://communityhigh.org/pollution
Air pollution resource reviews, student air pollution pages and projects.

The ERP NC Childhood Lead Poisoning Prevention Site
http://checc.sph.unc.edu/rooms/library/Leadpage/leadsite.htm
Many links to background informatin, sources of lead, and prevention/abatement.

Indoor Air Quality in Homes
http://www.epa.gov/iaq/homes.html
An introduction to indoor air quality.

Kid Safe Home Page
http://www.drpaula.com/products/kidsafe/
Information and protection against Sudden Infant Death Syndrome (SIDS)

Learning Objectives

Students will be able to ...

- identify common sources of carbon dioxide.
- state how to prevent release of carbon dioxide.
- state possible health effects from overexposure to carbon dioxide.
- identify where CO2 detectors should be placed in the home

Vocabulary

carbon dioxide: (CO2) colorless, odorless incombustible gas, formed during respiration, combustion, and organic decomposition.
carbon monoxide: (CO) colorless, odorless, highly poisonous gas, formed by the incomplete combustion of carbon.
asphyxiate: to suffocate.

Materials

Teacher Demonstration

- plastic gallon container
- short candle
- matches
- vinegar
- baking soda
- beaker

Per Class

- Computer with Internet access or web resource booklet
- carbon dioxide and carbon monoxide detector(s) Per Student

- Student activity sheet: CO2 Makes Me Blue

Next

Procedures

Activity 1: Teacher Introductory Demonstration

1. Cut around the screw top on the plastic container to enlarge the hole.
2. Place about 4 tablespoons of baking soda in the bottom of the gallon container.
3. Light the short candle, put a few drops of melted wax in the bottom of the beaker.
4. Place the short candle on top of the melted wax in the bottom of the beaker,
5. Gently pour enough vinegar into the plastic container to dampen all of the baking soda. (Beware: The reaction bubbles up quite a bit)
6. Shortly after the reaction slows, gently pour the colorless carbon dioxide into the beaker and have the students observe what occurs. (Candle should go out.)
7. Discuss what has happened and why. How could this affect us at home?

Activity 2: WebQuest

Utilizing the WebQuest Activity Sheet students will access information to:

- research sources of CO2 in the home to compare with their own homes in a diagram.
- suggest ways to prevent overexposure to CO2 in the home.
- describe how CO2 poisoning is treated.
- show prevention methods for their home.

Extensions

Field Experience
Students will investigate how homes are inspected by listing items observed by a home inspector on a site visit.

Social Studies WebQuest

Students will search the EPA web site to determine whether the information given by corporate web sites about CO2 is accurate. Students will create a graphic organizer to display the information.

Indoor Air Quality in Homes
http://www.epa.gov/iaq/homes.html

1998 EnviroHealth Link Master Teacher Team

Bennett Seidenstein and Carole Blake

Name _____

WebQuest Activity Sheet: CO_2 Makes Me Blue

Directions:

Answer the following questions using the web resources listed below. Use the information gained from answering these questions to create a sketch of your home, labeling CO_2 sources and where CO_2 detectors should be placed.

T&T Services: CO Removal
Removal of Carbon Monoxide Gas from Warehouses.
http://www.co-removal.com/coremoval.html

Ann Arbor, Michigan: Air Pollution Project
Air Pollution resouce reviews, student air pollution pages and projects.
http://communityhigh.org/pollution

Indoor Air Quality in Homes
An introduction to indoor air quality.
http://www.epa.gov/iaq/home.html

Discussion Questions:

1. What are possible sources of CO_2 in the home?

2. When do most cases of CO_2 poisoning occur? Why?

3. What are the symptoms of CO_2 exposure?

4. Describe how CO_2 poisoning is treated.

5. How is Sudden Infant Death Syndrome (SIDS) connected to CO_2 poisoning in the home?

6. How can CO_2 poisoning in the home be prevented?

7. In your opinion, do you feel that CO_2 poisoning is a major concern for people who live in newly constructed houses or who have recently installed a new furnace? Be sure to back up your answer with examples from your research.

8. On a separate sheet of paper or below, describe and sketch (cross section) and label the locations IN YOUR HOME where CO_2 detectors should be located.

INTERNET RESOURCES

internet resources

The Internet is undergoing constant change and rapid growth. Web site addresses (URL's) can change suddenly. Use a search engine to locate a site if the URL appears to be incorrect, and please e-mail Cynde at cyndemutryn@mpt.org with any corrections!

It must be emphasized that these Internet resources are greatly enhanced in the educational setting when teachers can knowledgeably guide students' use and effectively integrate information, entertainment, and resources into current curricular themes.

Choose the section you'd like to look at:

Search Engines

There are many ways to search the Internet. One way is to look at a large "Table of Contents," such as the web sites below which are designed to go out onto the Internet and search the Web's hundreds of thousands of other servers for information requested. Search engines are like electronic scouts that do nothing but search and tell people what can be found and where. Please note that search engines are NOT the same: if you are unable to locate a site on one, try another, and another...!

- Dogpile http://www.dogpile.com/
- Yahoo http://www.yahoo.com
- Yahooligans http://www.yahooligans.com/
- Internet Sleuth http://www.isleuth.com/

Environmental Health Resources

- Maryland Public Television http://www.mpt.org/
- Johns Hopkins University - School of Hygiene & Public Health http://www.jhsph.edu/
- The National Institute of Environmental Health Sciences http://www.niehs.nih.gov/
- K-12 Environmental Health Science Education Web Site http://www.niehs.nih.gov/od/k-12/k12home.htm
- Exploring the Environment http://www.cotf.edu/ete/
- Institute for Environmental Toxicology http://www.iet.msu.edu/
- Environmental Health Perspectives http://ehpnet1.niehs.nih.gov/EHPhome.html
- Environmental Health Clearinghouse http://infoventures.com/e-hlth/
- Starfish - Educational Resource for Sustainability http://www.starfish.org/
- Center for Occupational & Environmental Medicine http://www.coem.com/
- Children's Environmental Health Network http://www.cehn.org/
- Sharing Environmental Education Knowledge http://www.seek.state.mn.us/
- The Microbe Zoo http://commtechlab.msu.edu/sites
- ThinkQuest's "Dangerous Little Monsters Under the Microscope" http://library.advanced.org/11743
- American Environmental Health Foundation http://www.aehf.com/
- Earth Watch Field Research http://www.earthwatch.org/ed/home.html
- Nuclear Science and Technology http://shell.rmi.net/~jgraham/Nuclear_Science.html
- Radiation and Us http://www.sph.umich.edu/group/eih/UMSCHPS/radrus.htm
- Chernobyl: A Nuclear Disaster http://tqd.advanced.org/3426/
- U.S. EPA Office of Air and Radiation Basic Facts Web Page http://www.epa.gov/oar/oarfacts.html
- Radon in Earth, Air and Water http://sedwww.cr.usgs.gov:8080/radon/radonhome.html
- Toxic Waste Internet Resources http://www.igc.org/igc/issues/tw/or.html
- Ozone Depletion http://solstice.crest.org/environment/eol/ozone/ozone.html
- Ozone ACTION http://www.ozone.org/
- Educating Young People About Water http://www.uwex.edu/erc/ywc/
- The Environmental Protection Agency, Office of Water http://www.epa.gov/OGWDW/programs.html
- Office of Ground Water and Drinking Water http://www.epa.gov/OGWDW/index2.html
- Drinking Water: Kids' Stuff http://www.epa.gov/OGWDW/kids/
- Facts about Water http://www.epa.gov/OW/facts-quotes/facts.html
- The Water Quality Association Home Page http://www.wqa.org
- Water: A Never - Ending Story
- Surf Your Watershed http://www.epa.gov/surf2/
- Give Water a Hand http://www.uwex.edu/erc/
- River of Words http://www.irn.org/row
- Take A Cool Tour of Water http://www.nwf.org/nwf/kids/cool/index.html
- WetNet http://www.wetlands.ca/
- Wetlands Round Table Unit
- Louisiana Coastal Erosion Interactive Lesson Plan http://www.leeric.lsu.edu/index3.htm
- Clean Water Act http://even.tamuk.edu/cwa/
- Scorecard http://www.scorecard.org
- U.S. EPA AirLinks (Gateway to Air Pollution Information) http://www.epa.gov/airlinks/
- Snapshots of Science & Medicine http://science-education.nih.gov/snapshots.nsf
- BrainPOP http://www.brainpop.com/

Environment

- The Environmental Protection Agency's web site http://www.epa.gov
- EPA Students and Teachers Page http://www.epa.gov/epahome/students.htm
- EPA Student Center http://www.epa.gov/students/
- EPA Kids' Page http://www.epa.gov/OGWDW/kids/index.html
- A Citizen's Guide To EPA's Superfund Program http://www.epa.gov/unix0008/sf/citizen.html
- Enviroene http://es.epa.gov/index.html
- Common Chemicals Found at Superfund http://www.epa.gov/docs/oerrpage/superfnd/web/oerr/atsdr/index.htm
- Region 3 Superfund Sites http://www.epa.gov/reg3hwmd/super/npllist.htm
- The Environmental Defense Fund http://www.edf.org/
- The Environmental Education Network http://www.envirolink.org/enviroed/
- Environmental Working Group http://www.ewg.org/
- The Texas Environmental Center: Internet Resources http://www.tec.org/tec/othernews.html
- The Global Recycling Network http://grn.com/grn/
- The Academy of Natural Sciences Environmental Research Division http://www.acnatsci.org/erd/ea/KYE_mainpage.html
- World Resources Institute Environmental Education Pagehttp://www.wri.org/wri/enved
- InfoJump Environment and Nature http://www.dominis.com/Zines/ByCategory/Environment/
- Science and the Environment E-Journal http://www.voyagepub.com/publish/voyage.htm
- Environmental Database for Schools http://www.soton.ac.uk/~engenvir/
- Environmental Contaminants Encyclopedia http://www.aqd.nps.gov/toxic/
- EnviroNet http://earth.simmons.edu/
- EE-Link http://eelink.net/
- The Amazing Environmental Organization Web Directory http://www.webdirectory.com/
- Rivendell Educational Archive http://www.watson.org/rivendell/index.shtml
- Grounds and Gardens http://www.newhorizons.org/gng_intr.html
- E-Patrol http://www.sprint.com/epatrol/
- The Evergreen Project Adventures http://www.mobot.org/MBGnet
- Environmental and Energy Daily News http://www.serve.com/commonpurpose/news.html
- Living Things http://www.fi.edu/tfi/units/life/
- Center for Environmental Education at Antioch New England http://www.cee-ane.org
- Environmental Literacy Council http://www.enviroliteracy.org
- The GLOBE http://www.globe.gov
- Sierra Club Environmental Education http://www.sierraclub.org/
- ERIC Clearinghouse for Science, Mathematics, and Environmental Education http://www.ericse.org
- Bureau of Land Management's Environmental Education Homepage http://www.blm.gov/education/education.html
- NOAA Environmental Information Services http://www.esdim.noaa.gov
- Earth Force http://www.earthforce.org/
- The Clean and Green Club http://www.worldkids.net/clubs/green/
- The Earth Angels http://members.aol.com/Halo4Earth/index.html
- SEAC: Student Environmental Action Coalition http://www.seac.org
- Sierra Student Coalition http://www.ssc.org
- EPA Student Center http://www.epa.gov/students
- Free the Planet! http://www.essential.org/freetheplanet
- MY DNR www.dnr.state.md.us/mydnr
- Sustainable Development Timeline http://iisd.ca/timeline/

Health/Medicine

- InteliHealth http://www.intelihealth.com/IH/ihtIH
- National Center for Health Education (NCHE) http://www.nche.org
- Martindale's Health Science Guide http://www-sci.lib.uci.edu/HSG/HSGuide.html
- HealthAtoZ http://www.healthatoz.com/
- Medical Matrix http://www.slackinc.com/matrix/
- American Medical Association Site http://www.ama-assn.org/
- Mayo Clinic's Health Oasis http://www.mayohealth.org/
- National Jewish Medical and Research Center http://www.NationalJewish.org
- MedicineNet http://www.medicinenet.com/
- KidsHealth.Org http://kidshealth.org/index2.html
- Bandaids and Blackboards http://funrsc.fairfield.edu/~jfleitas/contents.html
- Maryland Dept. of Health and Mental Hygiene http://www.dhmh.state.md.us/
- Go Ask Alice! http://www.goaskalice.columbia.edu/
- OnHealth.com: Your Personal Guide to Health http://www.onhealth.com/ch1/index.asp
- Longevity Game! http://www.northwesternmutual.com/games/longevity/longevity-main.html
- KidSource Online for Healthcare http://www.kidsource.com/
- Health Information Resources http://nhic-nt.health.org/AlphaKeyword.htm
- HealthFinder http://www.healthfinder.gov/
- National Women's Health Information Clearinghouse http://www.4woman.org/
- The Wellness Web: The Patient’s Network http://www.wellweb.com/
- drkoop.com http://www.drkoop.com/
- American Medical Association Health Insight http://www.ama-assn.org/insight/gen_hlth/atlas/torso/navbar.htm
- WebMedLit http://www.webmedlit.com/
- Personal Trainer http://www.itdc.sbcss.k12.ca.us/curriculum/personaltrainer.html
- Emerging Infections Information Network http://www.info.med.yale.edu/
- Neuroscience for Kids http://weber.u.washington.edu/~chudler/neurok.html
- BioTech http://biotech.icmb.utexas.edu/
- Access Excellence http://www.accessexcellence.org/
- Cells Alive! http://www.cellsalive.com/
- The Cell http://tqd.advanced.org/3564/
- Body Systems Web Resources for Students http://www.stemnet.nf.ca/CITE/systems.htm
- Human Anatomy Online http://www.innerbody.com/htm/body.html
- Human Anatomy Online II http://www.gsm.com/products/hastud.htm
- Teach Your Patients About Asthma http://www.meddean.luc.edu:80/lumen/MedEd/medicine/Allergy/Asthma/asthtoc.html
- American Academy of Allergy, Asthma, and Immunology http://www.aaaai.org
- American College of Chest Physicians (ACCP) http://www.chestnet.org/
- Asthma Management Handbook http://hna.ffh.vic.gov.au/asthma/amh/amh.html
- Claritin Allergy Report Web Site http://www.allergy-relief.com/index.php3
- Allergy and Asthma FAQ http://www.cs.unc.edu/~kupstas/FAQ.html
- Pollen Allergy Info http://www.hoptechno.com:80/book46.htm
- The Real Scoop on Tobacco http://www.itdc.sbcss.k12.ca.us/curriculum/tobacco.html
- Foundation for a Smoke-Free America http://tobaccofree.com
- Tobacco-Related Internet Resources http://www.tobacco.org/Resources/tobsites.html
- The Food and Nutrition Information Center http://www.nal.usda.gov/fnic

- Tufts University Nutrition Navigator http://navigator.tufts.edu/
- The Nutrasweet Homepage http://www.nutrasweet.com/html/home.html
- A Recall on the Drug Aspartame http://www.dorway.com/recall.html
- International Food Information Council (IFIC) http://ificinfo.health.org/brochure/food-add.htm
- Food Additives and Processing Aids http://ifse.tamu.edu/CKNOWLEDGE/FoodAdditives.html
- Food Risks: Perception vs. Reality http://vm.cfsan.fda.gov/
- Food Finder http://www.olen.com/cgi-bin/food2
- Food Zone http://kauai.cudenver.edu
- University of Pennsylvania OncoLink http://cancer.med.upenn.edu/
- Fact Sheets from the National Cancer Institute http://wwwicic.nci.nih.gov/clinpdq/facts.html
- CancerNet http://cancernet.nci.nih.gov/
- Cancer Research Foundation of America http://www.preventcancer.org/
- Cancer Resource Center http://www.mayo.ivi.com/mayo/common/htm/canhpage.htm
- American Institute for Cancer Research http://www.aicr.org
- SunGuardMan Online http://www.SunGuardMan.org/core.html

Science

- Eisenhower National Clearinghouse http://www.enc.org/
- Internet Resources for Science and Mathematics Education http://www.inform.umd.edu/UMS+State/UMD-Projects/MCTP/Technology/MCTP_WWW_Bookmarks.html
- The Guide (to Math and Science Reform) http://www.learner.org/theguide
- Maryland Association of Science Teachers Online http://mast.walkersville.fr.k12.md.us
- CRPC GirlTECH Lesson Plans http://www.crpc.rice.edu/CRPC/Women/GirlTECH/Lessons/
- TERC http://www.terc.edu/
- Oasis http://www-co-cas.colorado.edu/oasis/
- Electronic Games for Education in Math and Science http://www.cs.ubc.ca/nest/egems/home.html
- The Explorer http://explorer.scrtec.org/explorer/
- Newton's Apple http://www.askeric.org/Projects/Newton/
- Nova Odyssey of Life http://www.pbs.org/nova/teachers
- National Science Teachers Website http://www.nsta.org/
- Math and Science Gateway http://www.tc.cornell.edu:80/Edu/MathSciGateway/
- "Possibilities! - Using the Internet in the Science Classroom." http://kendaco.telebyte.com/billband/Possibilities.html
- The Center for Science Education http://cse.ssl.berkeley.edu/
- Science Education and the Internet http://www.acs.oakland.edu/~eabyrnes/webthesis.html
- Global Lab http://globallab.terc.edu/home.html
- Al Bodzin's Home Page http://www.ncsu.edu/servit/bodzin/
- "Incorporating the World Wide Web in the Science Classroom" http://unr.edu/homepage/jcannon/
- Ronald J. Riley's Invention/Inventors Site http://www.rjriley.com/
- The Science Teachers Lounge http://www.deepwell.com/ccimino/
- The Australian Virtual Science and Technology Center http://mag-nify.educ.monash.edu.au/
- Joan Berger's (INCREDIBLE LIST OF) Science Web Sites http://www.inform.umd.edu/mdk-12/resource/www/science.html
- 1999 Carolina® Science and Math http://www3.carolina.com/general/Cat.htm
- Science Learning Network http://www.sln.org/
- Schoolnet http://www.schoolnet.ca/
- Sympatico http://www1.sympatico.ca/home
- Science Update & Why Is It? http://www.aaas.org/EHR/Sciup/documents/home.html
- The Why Files http://whyfiles.news.wisc.edu/welcome
- Exploratorium http://www.exploratorium.edu/
- Science Web Goes to the Movies http://scienceweb.dao.nrc.ca/movies/movies.html
- Ontario Science Centre http://www.osc.on.ca/
- SCIENCE HOBBYIST http://www.amasci.com/
- Mad Scientist http://www.madsci.org/
- IMSENET: Instructional Materials in Science Education http://www.ncsu.edu/imse/
- Access Excellence: A Place in Cyberspace for Biology Teaching & Learning http://www.gene.com/ae/
- Chem-4-Kids http://www.chem4kids.com
- Chem Team http://dbhs.wvusd.k12.ca.us/ChemTeamIndex.html
- MIT Chemistry Review http://www.med.unibs.it/~marchesi/review.html
- PALS http://pals.sri.com
- Using the Internet as an Effective Science Teaching Tool http://www.gsu.edu/~mstjrh/nsta.html
- The Brainium http://corp.brainium.com/

- Living Things http://www.fi.edu/tfi/units/life/
- ERIC Clearinghouse for Science, Mathematics, and Environmental Education http://www.ericse.org

Addendum

- Snapshots of Science & Medicine http://science-education.nih.gov/snapshots.nsf
- BrainPOP http://www.brainpop.com/
- MY DNR http://www.dnr.state.md.us/mydnr
- SunGuardMan Online http://www.SunGuardMan.org/core.html
- Learning About Urban Heat Islands http://EETD.LBL.gov/HeatIsland/LEARN/
- Sustainable Development Timeline http://iisd.ca/timeline/
- National Library of Medicine's PubMed http://www.ncbi.nlm.nih.gov/PubMed/
- The Online Medical Dictionary http://www.graylab.ac.uk/omd/
- The Visible Human Viewer http://www.npac.syr.edu/projects/vishuman/VisibleHuman.html
- AltaVista Translations http://babelfish.altavista.com/
- Ron Evry's Links http://surf.to/edlinks
- Free E-Mail Address Directory http://www.emailaddresses.com/
  Your source for free e-mailing!
- GetNetWise http://www.getnetwise.org/index.shtml

OTHER RESOURCES

1998 EnviroHealth Link
Resource Room Donations/Contacts

ACCESS ERIC
1600 Research Blvd.
Rockville, MD 20850-3172
Phone: 800-LET-ERIC
www.askeric.org
askeric@askeric.org

American Chemical Society
Education Division
1155 Sixteenth Street, NW
Washington, DC 20036
Phone: 800-209-0423

Annenberg, CPB Math & Science
Collection
901 E Street NW
Washington, DC 20004
Phone: 800-556-4376
Web: www.learner.org

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Phone: 800-334-5551

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Annapolis, MD 21403
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www.chesapeakebay.net/bayprogram

Chesapeake Bay Maritime Museum
P. O. Box 636
St. Michaels, MD 21663-0636
Phone: 410-745-2916

Department of the Environment
2500 Broening Highway
Baltimore, MD 21224
Phone: 800-633-6101
Web: www.mde.state.md.us

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1929 Kenny Road
Columbus, OH, 43210
Phone: 800-621-5785
Email: cd_request@enc.org Maryland

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Research for Better Schools
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Email: mathsci@rbs.org

Environmental Action
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Global Schoolhouse
7040 Avenida Encinas #104-281
Carlsbad, CA 92009
Phone: 760-721-2972
Email: helper@gsn.org

Great Plains National/GPN
P. O. Box 80669
Lincoln, NE 68501
Phone: 800-228-4630
Fax: 800-306-2330
Email: gpn@unlinfo.unl.edu

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Ann Arbor, MI 48104
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Seattle, WA 98109
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Chestertown, MD 21620
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Living Classrooms Foundation
Weinberg Education Center
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Baltimore, MD 21231
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Owings Mills, MD 21117
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Web: www.mpt.org

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Baltimore, MD 21224
Phone 410-631-3172

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Omaha, ME 68127
Phone 800-955-5570
Email: info@edsoft.com
Web:
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Troy, OH 45373
Phone: 937-676-2514
Email: jthoreen@igc.apc.org
Web: eelink.umich.edu/naee.html

National Institute of Environmental Health Sciences
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Research Triangle Park, NC 27709
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Email: Rozier@NIEHS.NIH.GOV
Web: www.niehs.nih.gov

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1290 Wall St. W
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Fax: 201-804-1404
Email: daknereg@aol.com

Southern Regional Education Board's
Evalutech Website
Web: www.sret.sreb.org
www.evalutech.sreb.org

Steck-Vaughn
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United States Geological Survey
P. O. Box 25286
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Denver, Colorado 80225
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United States Department of the Interior
U. S. Fish and Wildlife Service
Patuxent Research Refuge
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