Pesticide and Toxic Substance Exposure Awareness Project; Inquiry Based Curriculum Enhancements

For Grades 11-12 and Beyond

High School: Health, Environmental Science, Chemistry
College: Earth Science, Environmental Science, Public Health, Environmental Health Curricula

MONTCLAIR STATE UNIVERSITY

KEAN UNIVERSITY

Introduction

Since WWII, the production of pesticides and industrial chemicals has risen rapidly, with the US generating or importing about 74 billion pounds per day (EPA Chemical Inventory Data Base), leaving Americans swimming in a sea of synthetic chemicals. These pesticides and toxic substances are a demonstration that "better living through chemistry" has been integrated in all aspects of our daily lives. These man-made chemicals are found in everything from unbreakable baby bottles, to large screen TV's and cell phones. These same chemical products then soon find their way out of the everyday products and into the environment – and ultimately into our bodies, or the bodies of other organisms around the world.

A recent biomonitoring survey conducted by the CDC, found traces of 212 toxic chemicals in Americans – including toxic metals like arsenic, cadmium, pesticides, flame retardants, PCBs, DDT, and even perchlorate, an ingredient in rocket fuel.

As scientists are getting better at detecting the chemicals in our bodies, they are discovering that even tiny quantities of toxins can have a potentially serious impact on our health – and our children's future.

Goals of this Project

The goals of this project include: 1.) heightening the awareness of the student to the ubiquitous nature of pesticides and toxic substances in the environment; 2.) the realization that we are all exposed to many toxic substances on a regular basis, 3.) the education of students who are of reproductive age, about the special effects and dangers of pesticide and toxic substance exposures, not only to themselves, but to fetuses and very young children, especially during system development stages.

The hope is that by introducing young people to these issues now, at an early age, before they enter the adult world, that they will be more prepared to take precautions, averting toxic exposures to themselves and their offspring, in the years to come.

Note about the Curriculum

The Pesticides and Toxic Substances Curriculum Enhancements have a total of 36 computer inquiry based exercises divided over 6 chapters of environmental concern. Each Chapter begins with a background introduction of the broad topic, then the exercises, followed by a comprehensive reference section.

The exercises are designed to challenge the students to expand their internet research skills, and cognitive ability to look at both sides of a problem. All of the substances discussed in this program have had a significant impact on both local and national economies and are of ubiquitous distribution. In many cases the student is challenged to identify and balance the economic benefits of the product to the environmental or human health costs that have been identified, often long after the products have been integrated into society, or even long after they are removed from the marketplace. The Power point and oral presentations are designed to strengthen organizational skills, development of a balanced argument, public speaking skills, note-taking, and interpretational skills.

Most exercises are geared for the advanced cognitive and developmental abilities of older students able to process complex concepts. Be advised that the not all of the questions posed in the exercises have a clear-cut, definitive answer or solution. In some cases, what the students would like the outcome to be may not be possible to realize within their lifetimes.

There are three exercises that may be used as an entire lesson on their own: In Chapter 2, "Reducing the use of pesticides in the agricultural environment", and "Reducing the use of pesticides in the urban environment". These exercises offer the student and instructor the maximum flexibility of topic and directional choices. The instructor should ensure, however, that no two students choose the same crop, or pest. In Chapter 3: "Plastic Pollution" has been used as a stand-alone program, especially good for Earth Day. These three exercises may also be used in earlier grades, such as middle school, or may be geared for 'standard' or 'special needs' students.

Note about Curriculum Expansion

There are far more local or regional concerns then this project can address. As this project is integrated into curricula around the nation, educators will identify specific local concerns, superfund sites, and exposure incidents. Please feel free to design and include your own computer inquiry-based exercises and share your additions with the author. This will enable the program to expand, become integrated within, and more directly relevant to more regions around the country.

When sending your contributions, please be sure to include your name and the name of your school, college or other affiliation, and all appropriate references so that proper credit can be given. Realizing that no one is infallible, comments, corrections and additions to the program are always welcome.

About the Author

Marcia Anderson designed this project solely for the benefit of protecting future generations from toxic exposure, and received no pay or profit from the creation of this program.

She holds a Bachelor of Science in Biology from Monmouth University, a second Bachelor of Science in Environmental Design: Landscape Architecture from Rutgers University, a Master of Arts in Instruction and Curriculum in Earth Science, from Kean University, is a PhD Candidate in Environmental Management at Montclair State University and is a George H. Cook Scholar.

Marcia has a long background in Environmental Advocacy and Environmental Education Program Design. From designing Environmental Education programs for grammar schools, trail building projects, environmental programs for Boy and Girl Scouts of all ages, and the design and implementation of a volunteer “Summer Scouts” program for eight years.

She is a Certified Tree Expert in the State of New Jersey, was the program specialist for the Central Caribbean Marine Institute: designing the Eco-weekends and Ocean Literacy programs for CCMI and the Education Ministry of the Cayman Islands, BWI, and has designed numerous science and environmental education lecture series. (Most are posted on her Kean University Website). She has been a professor at Kean University for 13 years, teaching Geology, Geography, Earth Science and Oceanography and is also employed by the U.S. Environmental Protection Agency also designing environmental education outreach materials, especially related to pesticides and Integrated Pest Management (IPM).

This project was conceived as a result of a long background of research in toxic substances, pollution remediation, paleo-climatology and ocean issues, along with her work in the EPA.

Acknowledgements

Without the support of the following people, reading, editing, reediting and helping to make the connections necessary to move this project along, a program of this size and scope would not have been possible: Dr. Adrian Enache, US EPA; Eric Stern, US EPA, MSU; Dr. Reginald Fitzgerald, MSU; Lynne Gregory, US EPA; Maureen O’Neill, US EPA; Kathy Seikel, US, EPA; Terry Ippolito, US EPA; Schenine Mitchell, US EPA.

Pesticide and Toxic Substance Exposure Awareness

Contents

Category 1. Genetic Engineering.

Background. Genetic Engineering

1. Genetic Engineering (GE) Soy
2. Genetic Modification (GM) Corn
3. Genetic Engineering (GE) Cotton
4. GE/GM Human and Environmental Health Effects: Fact or Fantasy?

References

Background materials provided for educators:

Introductory power point presentations are available on the Kean University website: http://hurri.kean.edu/~anderson for the following topics:

1. Fate and Transport of Toxins into the Arctic (Global Distillation)
2. Current Polar issues: Climate Change and Ozone
3. Polar Bears on Thin Ice: Anthropogenic Threats and Climate Change
4. Plastic Pollution*
5. Introduction to PCBs
6. Hudson River PCBs: A Superfund Case Study
7. PCBs: Industry's Betrayal of the Public
8. Pesticides 101

And sample presentations are available for:

9. Pesticides: Apples
10. Pesticides: Bananas
11. What is the Real Price of Coffee?

Presentations 9-11 are designed for teachers/ professors to select an appropriate number of slides for a sample presentation, enabling the instructor to tailor the presentation to his/her own class level, depth of knowledge and desired length.

*A special curriculum and resource guide is provided for the Plastic Pollution presentation. This program can be easily adapted for children grades K-12 and beyond. Support materials are available from the EPA and NOAA websites. In addition pre and post presentation quizzes are provided.

Note for High School Educators

This project conforms to the National Science Core Curriculum standards for High Schools.

Specifically, this program focuses on 'Content Standard F: Science in Personal and Social Perspectives". The Core Content Standard 'F' states that " as a result of activities in grades 9-12, all students should develop an understanding of: 1.) *Personal and community health*, 2.) *Population growth*, 3.) *Environmental quality*, 4.) *Natural and human-induced hazards*, and 5.) *Science and technology in local, national and global challenges*."

The materials and exercises within this program are designed to educate students about environmental management issues within our nation including substances that we may exposed to on a daily basis, along with investigations on both specific pesticides and toxic substances and presenting the concepts of Integrated Pest Management to empower students to make decisions about potential exposures through personal choices throughout their lifetime. These issues all fall directly into the *Personal and Community Health* category. Regardless of whether students live in a rural or urban environment, there are ever-present threats of injury, illness, disease, or death, however, we can teach the students that they can manipulate the environment through a variety of mechanisms to either prevent or reduce the incidence of exposure and disease.

The quality of our environment is addressed in a number of these exercises. Natural ecosystems provide an array of basic processes that affect humans and wildlife. Humans are changing many of these basic processes, and some of these changes may be detrimental including the introduction of materials that affect the physical and chemical cycles of the Earth influencing the quality of the environment.

In the development of these inquiry based exercises, the research focuses on "Natural and Human-Induced Hazards" and guides the student to consider alternatives to reduce the use of chemical pesticides and other toxic substances. Human activities such as urban growth, pesticide applications and waste disposal can enhance the potential for disease and other hazards. These human induced hazards present the need for humans to assess potential danger and risk. Students will learn that many changes in the environment designed by humans bring both benefits to society, as well as cause risks. Students should understand the costs and trade-offs of various hazards – ranging from those with minor risk to a few people, to major catastrophes associated with major risk to many people.

Pesticide and Toxic Substance Exposure Awareness

Student Sign-up Sheet

Chapter 1. Fate and Transport

Background. Global Distillation: The Fate and Transport Toxins into the Arctic.

1. The Chemical Burden in the Belugas of the St. Lawrence_____
2. Bioaccumulation of Toxins in Native Arctic Eskimo Populations _____
3. Impacts of POPs in Arctic Marine Mammals _____
4. Atmospheric Dust: What is in the Air we Breathe _____
5. Airborne Mercury _____

Chapter 2. Pesticide Exposure

Background. Pesticides

1. Chemical Christmas _____
2. What is the real cost of that cup of coffee? _____
3. Organophosphate Pesticide Poisoning _____
4. Organochlorine Pesticide Poisoning _____
5. Methyl Bromide _____
6. The Case Against Malathion Spraying for WNV in New York City _____
7. Pesticide Exposure of Farm Workers _____
8. Reducing the use of pesticides in the agricultural environment _____
9. Reducing the use of pesticides in the urban environment _____

Chapter 3. Other Synthetic Organic Compounds

Background. Plastics: In Our Environment and in our Bodies

1. Polyvinylchloride (PVC), _____
2. Phthalates, _____
3. Bisphenol-A, _____
4. Formaldehyde _____
5. Dioxin _____
6. Plastic Pollution _____

Chapter 4. Children and Pesticide / Toxic Substance Exposure

Background. Children and Pesticide Exposure

1. Children and Pesticide Exposure in Food _____
2. The Toxic Legacy of 9/11 for Newborns and Children _____
3. Prenatal Exposure Risks _____

Chapter 5. Toxic Substances: Superfund Sites

Background. EPA and Superfund

1. PAHs and the 2010 BP Gulf Oil Disaster _____
2. '*The Few, The Proud, The Forgotten'*; Volatile Organic Compounds in Drinking Water at Camp Lejeune, N.C. _____
3. .Polychlorinated Biphenyls (PCBs): General Electric and Pittsfield, Mass. _____
4. The Toxic Aftermath of 9/11 _____
5. Caribbean Petroleum Refining Limited Partnership (Cidra site) _____
6. Veja Baja Solid Waste Disposal Site in Veja Baja, Puerto Rico_____
7. San German Ground Water Contamination Site, Puerto Rico_____
8. The Puerto Rican Island of Vieques _____
9. Caribe General Electric Products, Inc. (CGEP) facility, Puerto Rico _____

Chapter 6. Genetic Engineering.

Background. Genetic Engineering

1. Genetic Engineering (GE) Soy _____
2. Genetic Modification (GM) Corn _____
3. Genetic Engineering (GE) Cotton _____
4. GE/GM Human and Environmental Health Effects: Fact or Fantasy? _____

Pesticide and Toxic Substance Exposure Awareness

Directions:

Power point presentations.

- Must be 14 or more slides plus 1 cover slide and 1 reference slide. That = 16 slides.
- No more that 4 slides without graphics.
- No more that 2 slides without text.
- All photos must have credits and sources.
- All text must be referenced. Include a number or letter on the slide with corresponding letter or number on final reference slide.

The paper.

- 8 pages.
- The 8 pages does not include title page – with your name on it, nor does it include the reference page.
- Margins are not to exceed 1" in any direction.
- Font not to exceed 12 point. Spacing not to exceed 1.5.
- The 8 pages does not include photos. Paper must be 8 pages **before** photos are inserted.
- Everything needs to be referenced. Reference format (ie: MLA) is up to your teacher.

Peer Education and Review

In this part of the program students will take notes on any 8 student presentations of their choice. (the instructor should feel free to modify this number or selection distribution.) The purpose of this exercise is to keep student focus on the other presenters, by concentrating on the individual presentations and writing down key facts, students will take key concepts away with them. Constructive criticism from peers is often the most effective form of feedback.

- Write the name and topic of each selected student presentation.
- Write down 3 key facts that the presenter highlighted in his/her presentation.
- Write down one question for each presenter on the topic they discussed.
- Select the two presentations that influenced you the most and why.
- Select two presentations that were unimpressive and give constructive criticism for improvement.

Student Name. _____ Date: _____

Peer Education and Review

No. ___ Presenter Name: _____ Topic: _____

1. _____

_____

2. _____

_____

3. _____

_____

Question for presenter: 1. _____

Constructive Criticism: _____

No. ___ Presenter Name: _____ Topic: _____

1. _____

_____

2. _____

_____

3. _____

_____

Question for presenter: 2. _____

Constructive Criticism: _____

No. ___ Presenter Name: _____ Topic: _____

1. _____

_____

2. _____

_____

3. _____

_____

Question for presenter: 3. _____

Constructive Criticism: _____

Sample Power point Grading Rubric

Student Name: _____ Period/Section:_____ Date: _____

Held Audience Interest	1
Prepared on-time	2
Graphics or visuals	3
Text	
Content: Clear, interesting	2
Scientifically accurate	3
amount (not too much, too little)	2
grammar	1
Layout:	
Contrast of background to text	2
Balance photos/art to text	2
Photos have captions or other ID	1
Cover Slide complete	
Name of Student, year and period	1
Title of project	1
Cover graphic	1
Reference slide complete	
At least 6 references	3
Photos referenced	2
Quality of presentation	
Articulate: Words pronounced correctly	1
Did not read totally off of slides	2
Can be heard in back of room	1
Kept on topic	1
Interacted with audience (eye contact /questions)	1

Total Points 33 _____

Missing slides	-3 points each
Really spectacular project up to	+3 bonus points

Grade /33

Pre - Project Questions

Determining the Base Line of Knowledge

1. Genetic Engineered foods are perfectly safe to directly consume and feed to livestock.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
2. Genetically Engineered products are perfectly safe to grow near organic farms.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
3. Very small amounts of pesticides or toxic substances do not affect the health of small children or infants.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
4. Children are currently rated for toxic substance exposures on the same scale of a 180 lb. adult, as their metabolisms are roughly the same.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
5. Toxic substances bioaccumulate in the fatty tissues both humans and animals.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly
6. Toxic substances, pesticides or pesticide metabolites can be passed onto infants through breast milk.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
7. Toxic substances, pesticides or pesticide metabolites can be passed onto unborn fetuses through the placenta.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree

Content.

a. Which of the following is not how pollutants are transported around the globe?
   a. Via air currents b. via plate tectonics c. via ocean currents
   d. via bioaccumulation e. via the biotic food chain

b. Which of the following is not true of Global Distillation?
   a. When persistent organic pollutants (POPs) are released into warmer, they evaporate and are carried back by winds to cooler areas, where they condense and descend back to Earth.
   b. When the summer sun vaporizes toxic chemicals, the air currents blow them further toward their hemispheric pole and they drift downward again.
   c. Global distillation is responsible for the transportation of toxins to equatorial areas as readily as to Arctic regions.
   d. It is a process which sorts chemical contaminates by their ability evaporate.
   e. Chemicals easily dissolved in water keep re-vaporizing and are thus continuously drawn to the northern latitudes and higher altitudes.
   f. In the Arctic, the toxins can no longer be uplifted into to the atmosphere.

3. When persistent organic pollutants (POPs) are released into warmer climates _____
   a. They evaporate and are carried back by winds into cooler areas.
   b. They condense and descend back to Earth.
   c. They overwinter in the soil, snow and water.
   d. All of the above are true

4. What are some of the chemicals found in household dust?
   a. Pesticides that are sprayed onto crops by farmers
   b. Aerosols released into the air by coal combustion
   c. Toxins released into the air from gasoline engines
   d. Chemicals released molecule by molecule into the air then attach to fine clay or dust particles.

e. All of the above are found in most homes

5. Arctic inhabitants and marine mammals are especially susceptible to lipophyllic toxins because:___ (select which answer is not true)
   a. They bioaccumulate in the fatty tissues
   b. They are easily dissolved in water and are transported through the currents.
   c. They are taken up by primary consumers and gradually move up the food chain
   d. They are apex predators, eating the fatty tissues of animals lower in the chain.
   e. Dissolved in the whales' fat, are concentrations of some toxic chemicals at the highest levels ever recorded in a living organism.

6. Which statement is not true:
   a. Human babies have a body burden of over 100 toxins, upon birth.
   b. Common organochlorine contaminants such as PCBs and DDT are found in all people.
   c. We inhale contaminants in the air that are attached to atmospheric dust.
   d. The body burden of toxic chemicals in people living in the arctic is much lower than of those people living at much lower latitudes.
   e. Many of the substances banished decades ago, such as DDT and PCBs, have not quietly faded away. PCBs are still present in virtually every household dust sample ever tested.

7. The Mad Hatter is someone exposed to large amounts of which toxic chemical?
   a) lead b) mercury c) cadmium d) organochlorines e) dioxin

8. Our greatest chemical exposure threat comes from _____
   a. toxins in fog
   b. pesticide laced snowflakes
   c. dioxins in raindrops
   d. chemicals carried via trans-oceanic wind currents
   e. Brominated flame retardants in the air we breathe
   f. The foods that we eat

9. The greatest toxic exposure threats to the people living in the far North are from:
   a. Atmospheric transport of contaminants from more southerly countries
   b. Marine transport of contaminants from Eurasia across the Pacific Ocean
   c. Volatized chemicals from the atmosphere deposited into the Pacific Ocean.
   d. Toxins found in the fatty tissues of the locally caught marine mammals, fish and caribou.

10. Increased levels of environmental pollutants in Alaska or other Arctic environs are a problem because: (Circle all that apply)
   a. These contaminants do not originate in the Arctic.
   b. They cannot be reduced through local action.
   c. Ecosystems of the Arctic terminate with large numbers of tertiary carnivores.
   d. Native Arctic people consume a high proportion of locally caught marine mammals and fish.
   e. Arctic residents may suffer serious health effects from these pollutants.

11. The contaminant loads in biota including marine mammals (and humans) _____ (Circle all that apply)
   a. Are directly related to the age of an organism
   b. Males have a higher contaminate load than females
   c. Females of reproductive age have a lower contaminant levels after giving birth
   d. Newborns already have contaminants upon birth
   e. Females also transfer contaminants to their offspring in milk.

12. Which of the following is not true of Atmospheric dust?
    a. Persistent Organic Pollutants dissolve in water and flow downhill
    b. It binds to soil and sediment particles and rise as dust
    c. It consists of mostly clay and dust particles picked up from agricultural fields and deserts.
    d. It hovers over us in clouds, then they fall as rain, fog, sleet and snow
    e. Blow in wind and are redeposited in swimming pools, bird baths reservoirs glacial aquifers and move into groundwater.

13. The fate and transport of methyl mercury (Circle all that are true)
    a. Autism is directly associated with POPs and high levels of airborne methyl mercury.
    b. Mercury travels thousands of miles then falls to the Earth as rain or snow or becomes attached to dust particles in the air
    c. Sinks into streams, lakes oceans , soil, farms or into your home
    d. Taken up by algae, plants or animals and winds up into the food chain

Post - Project Questions

Determining Knowledge Gained

6. Genetic Engineered foods are perfectly safe to directly consume and feed to livestock.

a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree

7. Genetically Engineered products are perfectly safe to grow near organic farms.

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    c. Sinks into streams, lakes oceans , soil, farms or into your home
    d. Taken up by algae, plants or animals and winds up into the food chain

Recall.

1. I knew a lot about Genetic Engineering before this class.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
2. I already knew that toxic substances, pesticides or pesticide metabolites can be passed onto infants through breast milk.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree
3. I already knew about the relationship of fatty tissues and bioaccumulation of toxic substances in both humans and animals.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly

Evaluation

4. In general, this was a worthwhile exercise and a good use of class time.
   a. strongly agree b. moderately agree c. agree d. disagree e. strongly disagree

5. Which general topics were the most interesting to you? (Choose two only)
    a. Genetic engineering
    b. Waste management: includes garbage, plastics, tires
    c. The toxicity of plastics
    d. Pesticides and effects on young children
    e. Pesticides and effects on farm workers and the environment
    f. Toxic substances and waste products from manufacturing and their effects on the environment and human health.
    g. Toxic substances and waste products from the refinery process and their effects on the environment and human health.
    h. Fate and transport of pesticides and toxic substances
    i. Other: _____

Suggestions: