

Instructor Notes

Close Encounters of the Environmental Kind

This project is an investigation into the cause of death of a fictitious school janitor. Participants develop hypotheses based on information discovered by examining the labels of household chemicals and finally reach a conclusion based on the collection of all available evidence. This project emphasizes the interactions of chemicals, the role of chronic versus acute exposure to toxins, and the ability of our bodies to detoxify some chemicals.



The activity is written for workshop participants and may need modification for classroom use.

Suggested Background Readings

- An Introduction to Toxicology

National Science Education Standards for Grades 5–12

Science as Inquiry

- Abilities Necessary to Do Scientific Inquiry

Identify questions that guide scientific investigations. Students develop explanations for the cause of John Doe's death by observing evidence, collecting and recording information, and analyzing several possible answers to the problem. They recognize the relationship between the evidence and the explanation as they progress through the project.

Formulate explanations using logic and evidence. Students use scientific knowledge, logic, and evidence from their investigation to reach their conclusion about the cause of death in the scenario.

Recognize and analyze alternative explanations. After formulating their own explanation about John Doe's death, students listen to other explanations and use scientific criteria to find the preferred explanation

Science in Personal and Social Perspectives

- Natural and Human-Induced Hazards

Human-induced hazards present the need for humans to assess potential danger and risk. Students examine the risks associated with the use of household chemicals and how those risks can be limited. A discussion should ensue that focuses on the balance between the risks and benefits of the use of commercial pesticides.

Materials

Per class

- safety and usage information from the following products:
 - Clorox®
 - Comet® cleanser with Chlorinol
 - Dursban 1-D (organophosphate insecticide)
 - insect control plus fertilizer
 - ammonia
 - Drano®
 - Tagamet HB (stomach pills)
 - Home Orchard Spray
 - Roundup®
 - Ortho Wasp Killer

Procedure Notes and Outcomes

The purpose of this project is to familiarize participants with the information available on the labels of household items as it pertains to safety and proper use of the chemical. The chemicals listed in Materials provide an acceptable variety of products, but you should not feel restricted to the items on this list. However, at least one of the pesticide products should contain organophosphates to coordinate with the coroner's report. The best chemicals to use are those that are most familiar to the participants.

You may wish to display a collection of empty containers from common medications, cleaners, pesticides, fertilizers, and janitorial supplies that would provide a visual similar to what the detectives would have seen.

Plausible Answers to Questions

1. Give the names of the chemicals John was exposed to. Classify John's exposure to the different chemicals as being either acute or chronic. Justify your classification.
The chemical names should be taken from the product labels. The janitor's exposure to these chemicals was chronic; he used these chemicals repeatedly over a long period of time. However, John could have received an accidental exposure to a high, acute-level dose of the concentrated solutions of the commercial sprays he diluted and used on his home orchard. His wife's statement does not rule this out. Additionally, because his liver was nearly useless, even low doses could have become acute levels for him.
2. Form a hypothesis about how John died. Cite evidence to support your hypothesis.
Participants' original hypotheses may vary, but they should cite evidence that supports their claims.

3. Did your hypothesis match up with the coroner's conclusion? Write a brief statement about the cause of death, being certain to include supporting evidence for your argument. *One possible answer is that John was killed by the organophosphate pesticides that he worked around at the school and at home.*

John's drinking eventually stopped the normal function of the liver, which detoxifies foreign substances taken into the body. Between the workplace and his orchard at home, John was chronically exposed to organophosphate pesticides. These pesticides are themselves quite toxic, but their effects were worsened by decreased liver function due to his alcoholism.

These findings would be confirmed by the autopsy report. The autopsy report introduces the problem associated with the liver. Many factors are involved in every adverse reaction to a toxin. If the participants do not determine pesticides to be the problem but have a solid case for a different cause of death, that is acceptable. Having multiple outcomes in the same class would confirm the idea that toxicology is not a clear-cut science.

The powder on the floor was not a factor. It had been spilled in that location that day either by a student cleaning up after a laboratory exercise or by John himself while he was cleaning the area. Another non-factor was the unusual odor in the classroom. This odor came from the wasp insecticide that John had sprayed on the floor near the windows to curtail an insect problem that had persisted for weeks.

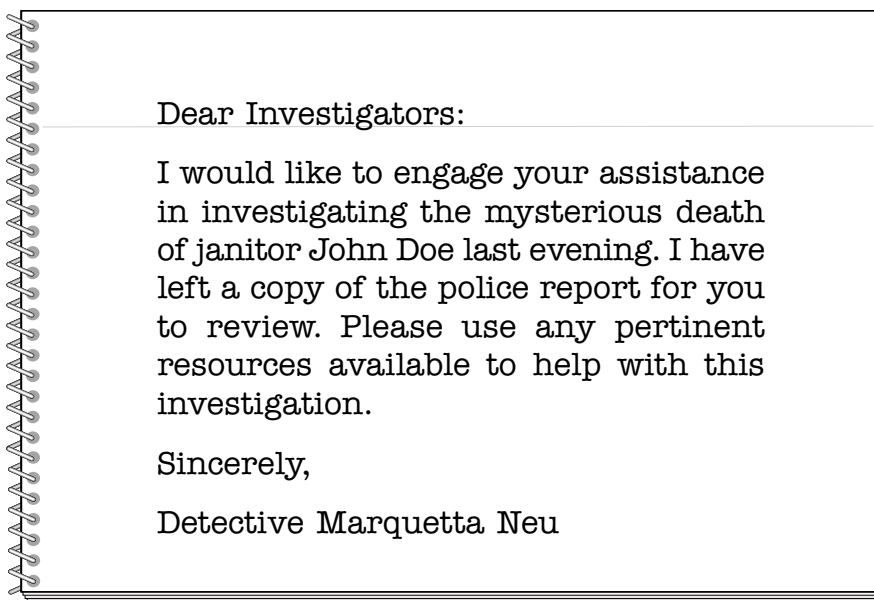
Extensions

1. As a class, discuss other causes of individual susceptibility. Within normal populations (i.e., non-alcoholics on conventional diets), the activity levels of known detoxification pathways in the liver can vary by more than 40 fold. If John had not been an alcoholic, discuss what tests the coroner could have done to show that a low dose of the pesticides could still have been the cause of death. (A post-mortem liver tissue test might have indicated a possible low level of the necessary detoxification enzyme. This test could be followed with a DNA test showing the lack of a normal gene for that function. DNA tests for most of the main pathways are becoming increasingly available.)
2. Consider a scenario where the janitor had his young children with him while he was applying fertilizers in the family's apple orchard. Have the class research the susceptibility of children to such chemicals.

Activity Instructions

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What killed janitor John Doe? You will investigate this mystery and form a conclusion based on the evidence you gather.



Procedure

1. First read the official police report. Then examine the types of chemicals that John Doe was exposed to over the course of his workday. Find the following information for each of the suspect chemicals and then answer question 1.
 - Product name
 - What is the product used for?
 - Classify into one of three categories based on the product label: Danger/Poison, Warning, Caution
 - What are the health hazards associated with this product?
 - What are the possible routes of human exposure (skin absorption, ingestion, inhalation)?
 - List the active ingredients in this product. Examine the list of inert ingredients for any potential problems.
 - What are the directions for using this product?

- List the first-aid instructions.
 - How should this product be stored?
 - What is the suggested disposal method for this product?
 - What does the EPA registration number on the container tell you?
2. Look at John's work schedule. Could the speed and direction of the wind on the days he worked outside with chemicals contribute to his exposure to them? Examine the statement taken by the police from John's wife. What further information do you gain from her testimony? Answer question 2.
 3. After you have formed an initial hypothesis, read the coroner's report with the autopsy findings. Discuss the report in your group, then answer question 3.

Questions

1. Give the names of the chemicals John was exposed to. Classify John's exposure to the different chemicals as being either acute or chronic. Justify your classification.
2. Form a hypothesis about how John died. Cite evidence to support your hypothesis.
3. Did your hypothesis match up with the coroner's conclusion? Write a brief statement about how the evidence supports the coroner's conclusion on the cause of death.

Official Police Report:

Date: May 19, 2000

Location of Incident: Beasley Middle School
D-1 Science Lab
8300 Florence Lane
Somewhere, KY

Approx. Time of Death: 4:00 PM

Officers: Detective Marquetta Neu
Detective Patrick McKenna

8:00 PM

The body of John Doe, daytime janitor, was discovered on the floor face down near the long lab station. There was no evidence of a struggle. A broom was located near his right hand. A pile of white powder was on the floor. This powder was determined to be Comet cleanser. An unusual odor was present in the classroom that was determined to come from insecticide sprays that were used that day to combat an insect problem in the lab.

Medical reports suggested a history of excessive drinking that almost destroyed his liver. He was also being treated for an ulcer.

John's Work Schedule:

April, May, June

- Monday: Lawn duty (mowing and fertilizing grass)
- Tuesday: General maintenance
- Wednesday: Floors, bathrooms, garbage disposal (English and Social Science wings)
- Thursday: Floors, bathrooms, garbage disposal (Life and Physical Science wing)
- Friday: Lawn duty (weeding and pesticide spraying)

Janitor John's Wife's Statement:

"John mixed commercial sprays to use on the fruit trees in our private orchard. He also regularly applied fertilizers to our 30-acre farm. He had many health problems. Often he would complain of dizziness, headaches, abdominal pain, and restlessness, and occasionally, he would vomit. Recently, he developed an ulcer. He was not taking any prescription medication, but he did take many over-the-counter antacids such as Tagamet. The doctor warned him that if didn't stop smoking and drinking excessively he could develop more serious health problems. The doctor also said that because of his long-term alcoholism his liver was almost completely useless."

Coroner's Report:

Name of Deceased: John Doe

Date: May 25, 2000

Sex: M Height: 5 feet 8 inches Weight: 180 lb.

Blood Type: AB Approximate Age: 50

Physical Description of the Body (wounds, scars, or other markings):

Tattoo on left arm

Foreign Materials on or Around the Body:

Comet Cleanser with Chlorinol

Autopsy

Diseases: Extensive Liver Damage, Stomach Ulcer

Toxicology

Toxins: Organophosphate Pesticides

Drugs: Tagamet, Alcohol, Aspirin

Conclusions

Cause of Death: Organophosphate poisoning

The victim's liver was almost completely useless. Therefore the toxic organophosphates that entered his system accumulated over time until the toxin reached a level that killed him.

Coroner Signatures: _____ **Date:** _____

_____ **Date:** _____