IZZY PRAYING MANTIS

INTEGRATED PEST MANAGEMENT

Unit 3 Lesson 5
Acid Rain Ruin

Focus Areas: Biodiversity; Science

Focus Skills: Observation, experimentation, critical thinking

Level of Involvement: AVERAGE

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INTEGRATED PEST MANAGEMENT

University of Connecticut
College of Agriculture and Natural Resources
Cooperative Extension System

IZZY PRAYING MANTIS

Dedicated to Reducing Pesticides

Unit 3 Lesson 5: Acid Rain Ruin

Focus Areas: Biodiversity; Science
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HIPPO = Pollution

Objectives

* To identify the causes of acid rain
* To examine the effects of different acid solutions on the germination of seeds
* To correlate the results of this experiment to the effects of acid rain on terrestrial ecosystems

Essential Questions

* What causes acid rain?
* How does the pH of a pond affect native organisms?
* How does acid rain affect the disease rate of trees?
* How does acid rain upset the balance of nature?

Essential Understandings

* Most scientists agree that normal rain has a pH of 5.6. Acid rain is defined as any precipitation that has a pH less than 5.6.
* Acid rain affects a lake and ponds ability to support plants and aquatic wildlife.
* The upset in the balance of nature is causing widespread infestations of insect species that threaten to wipe out entire species of trees.

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Background

In the United States, over 200 million tons of polluting gases and particles enter the air every year, mainly through combustion of fossil fuels.Each fuel is made up of different chemicals and each releases a different waste when it is burned. The following is a list of wastes that are produced when certain fuels are burned. These wastes pollute the air and are viewed as causing the two major environmental problems facing the balance of nature — acid rain and global warming.

Carbon dioxide — from all fuels
Carbon monoxide — primarily from gasoline
Hydrocarbons — from gasoline
Nitrogen oxides — primarily from gasoline and fuel oil
Sulfur dioxide — primarily from coal and fuel oil containing sulfur
Sulfur oxides — primarily from gasoline

These polluting gases are spewed into the atmosphere from a variety of sources including factories, industrial plants, coal-fired power utilities, motor vehicles, aircraft, and other forms of transportation. Natural sources, such as volcanic eruptions, also add to atmospheric polluting gases. Sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are released into the air where they are carried by the prevailing winds for hundreds of miles.

As the winds travel over mountain regions, such as the Adirondacks, the Appalachians, and the Catskills, the moisture they contain cools and condenses into clouds. When these clouds reach the point of saturation, the precipitation, the resulting rain, snow, sleet, hail or even fog, contain high concentrations of sulfur and oxygen pollution. The sulfur dioxide becomes sulfuric acid and the nitrogen becomes nitric acid. While there are materials in the soil to neutralize acidity, acid rain is leaching out these minerals faster than nature can replace them. Rivers, lakes and streams lack this ability to neutralize acidity and show adverse effects more rapidly.

The devastation affects rivers, lakes, and streams that were famous for fishing and waterfowl. As populations decrease, these waters continue to lose their capacity to support life. Blooms of algae suffocate ponds and lakes, causing rapid declines in fish populations. Infestations of insects have threatened vast numbers of other species. Hardwood forests have stopped growing, evergreens are losing their needles and spruce forests are dying by hundreds of acres each year. The effects of acid rain on the balance of nature appear to be at the brink of disaster.

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Vocabulary

acid rain — precipitation that contains high concentrations of pollutants such as sulfuric and nitric acids

carbon dioxide — a colorless gas produced from fuel combustion

carbon monoxide — a colorless, odorless toxic gas produced from fuel combustion

hydrocarbon — an organic compound like methane produced from organic matter decomposition

nitric acid — a transparent, colorless corrosive liquid form of nitrogen

nitrogen — a colorless, odorless gas that makes up 4/5 of the air

oxide — any compound of an element that contains oxygen

sulfur — a pale-yellow, nonmetallic element occurring widely in nature; used in gunpowder, insecticides and many pharmaceuticals; produced as a by-product of burning fossil fuels

sulfuric acid — sulfur and oxygen pollution in liquid form with a suffocating odor; used in a variety of chemicals, including fertilizer, paints and explosives

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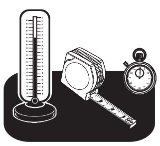
Challenge

Determine the effects of acid solutions on different types of seeds

Logistics

Time: 45 minutes (additional 5 minutes to observe over 1 to 2 weeks)
Group size: 15 to 25
Space: a classroom

Materials




safety glasses
seeds: radish, lettuce, melon, squash, beans, etc.
5 petri dishes
graduated cylinder
metric rulers
masking tape
pH indicator paper or pH meter (narrow range)
distilled water
rainwater or melted snow (optional)
tumblers
medicine droppers
solutions ranging from pH 2 to 6
Handout 1 Data Sheet for Plant Germination and Growth *
Handout 2 pH Scale *
Handout 3 Written Document Analysis Worksheet *
Newsweek article *What's Killing the Frogs?* *
K-W-L chart *
Assessment for a Graph *

* single copy provided

Preparations

1. Prepare 5 solutions of various pH strengths ranging from 2 to 6.
2. Prepare copies of Handout 1 Data Sheet for Plant Germination and Growth.
3. Prepare copies of Handout 3 Written Document Analysis Work Sheet (for **Follow Through** only).

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Activity

Introduction

1. Develop the K portion of a K-W-L chart with participants to determine their prior knowledge of acid rain.

2. Complete the W portion of a K-W-L chart.

3. During the next two weeks, have participants gather news articles and research on acid rain in order to answer the questions generated in the W portion of the K-W-L chart. Discuss and post these on a classroom bulletin board under the P of HIPPO (for Pollution) that illustrates the HIPPO dilemma. Use the information from the **Background** section.

Involvement

1. Place a piece of filter paper in the bottom of each petri dish.

2. Wet each filter paper with 3.0 ml of one of the test solutions (**Note:** The solutions range from pH 2 to pH 6.). Use appropriate safety procedures when handling solutions.

3. Distribute seed samples evenly among the petri dishes. Each dish should have a few seeds of each type.

4. Label each petri dish with the seed type and pH solution strength.

5. Distribute Handout 1 Data Sheet for Plant Germination and Growth.

6. Observe the seeds every other day for a two-week period and complete Handout 1.

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Follow Up

1. Create a graph illustrating the results of the observations.

2. Compare the graphs and discuss the implications regarding the impact of acid rain on the natural environment.

3. Complete the L portion of the K-W-L chart.

Assessment

Evaluate the data sheets and graphs generated using the Assessment for a Graph.

Follow Through (To be used as a crucial homework assignment)

Focus Areas: Biodiversity; Science, Language Arts
Focus Skills: Comprehending expository material, analysis of environmental problems

1. Read the *Newsweek* article, *What s Killing the Frogs?*

2. Complete Handout 3 Written Document Analysis Worksheet.

3. Create a flow chart to illustrate the reason for the decrease in the United States frog population.

4. Draw and share conclusions regarding the effect of residual pesticides on animal populations in an ecosystem.

Extension

Generate a list of additional species threatened by pesticide contamination.

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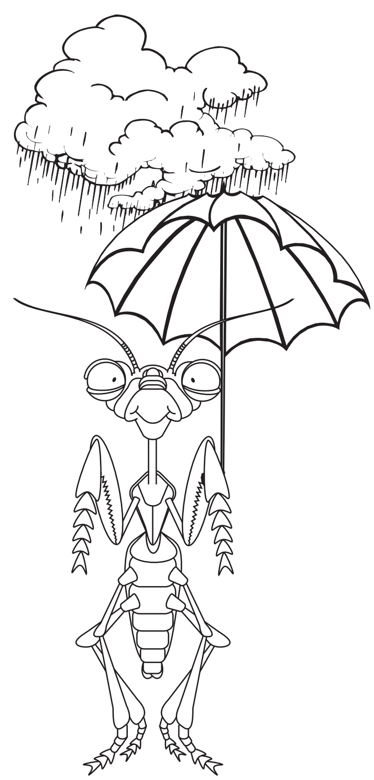
Notes



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Notes

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K-W-L Chart

What we **K**now	What we **W**ant to Know	What we **L**earned

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Handout 1

Data Sheet for Plant Germination and Growth

Name: ____

Date	# of Plants	Height in cm.	Description of New Plant Growth: Color and Pattern	General Condition of Plants in Petri Dish #_____ Description of Appearance

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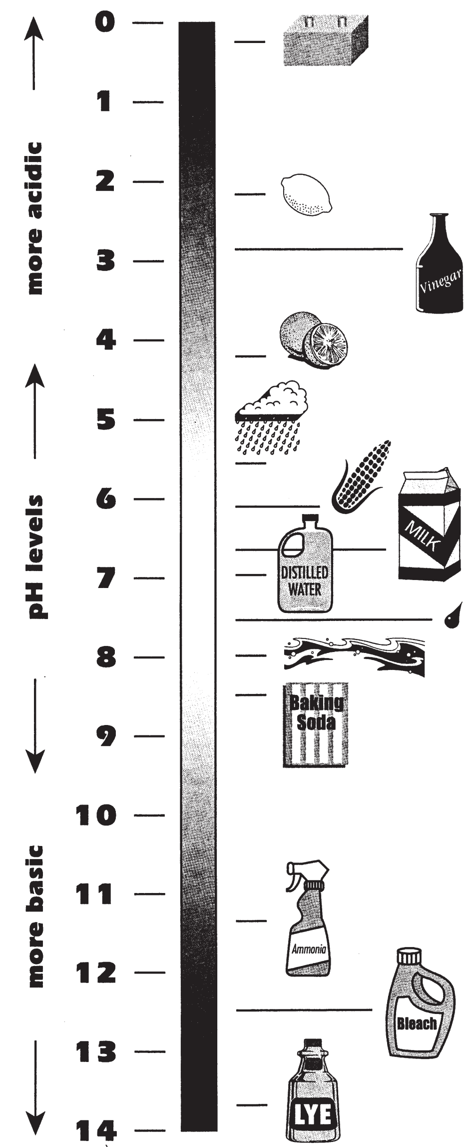
Handout 2

pH Scale



The acidity of solutions, including rain or snow, is measured on a scale known as the pH scale. The scale is numbered from 0 to 14. A pH value of 7 is neutral, neither acidic or basic. Values less than 7 are acidic, above 7 are basic. Most scientists agree that "normal" rain has a pH of 5.6. Acid rain is defined as any wet precipitation which has a pH less than this.

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Handout 3

Written Document Analysis Worksheet

1. Title of document:____

2. Date of document: ________________________

3. Source of document: ________________________________

4. Audience for whom document was written: ________________________

5. Main idea(s) of document: ______________________________________

____

____

6. Three important points made in the document (should support main idea)

   1. ____

   ____

   2. ____

   ____

   3. ____

   ____

7. A question I still have regarding the topic of the document:________________

____

____

8. My thoughts/feelings about the topic of the document: ____________________

____

____

____

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Assessment for a Graph

Criteria	Possible Points	Points Earned
1. There is an explanatory main title.	______	______
2. Starting points and intervals are appropriate.	______	______
3. Axes are clearly and correctly labeled.	______	______
4. The data is plotted correctly.	______	______
5. The graph is easily understood.	______	______
6. Space is used well.	______	______
7. The graph is neatly done.	______	______

Comments:

Assessment for a Graph

Criteria	Possible Points	Points Earned
1. There is an explanatory main title.	______	______
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6. Space is used well.	______	______
7. The graph is neatly done.	______	______

Comments:

What's Killing the Frogs?

Scientists are finding that even low levels of pollutants can harm amphibians—and possibly people

PHOTO RESEARCHERS

NEVER AGAIN: Golden toads are thought to be extinct

BY FRED GUTERL

AS A BOY, GARY FELLERS SPENT summers chasing after frogs in the lakes and ponds of Yosemite National Park. He even kept a field notebook, just like naturalists in the early 20th century who described mountain yellow-legged frogs covering the lakeshores. When Fellers returned years later to the park as an ecologist for the U.S. Geological Survey, he was dismayed. "I've gone back to many of the same sites, and frogs don't occur there anymore," he says. "It's not just that they're not abundant. They're absent."

Lately Fellers has been trying to figure out why half the frogs in Yosemite seem to have disappeared. When he collects tadpoles in the park and releases them in Lassen Volcanic National Park to the north, they thrive. But when he tries to raise Lassen tadpoles in Yosemite, they fare as poorly as the natives: they are often born with 1 leg, or 3 legs, or in some cases as many as 10. The likely cause: pesticides wafting over the Sierra Nevada mountains from fruit and nut farms in California's Central Valley.

Ecologists first sounded the alarm about frogs and other amphibians in the early 1990s. Since then, they've stomped around enough swamps and ponds to know for certain that the decline is both real and steep: 32 species have gone extinct around the world in the last few decades, and 200 more are in decline. The reasons are varied: climate change, infectious diseases and new malls and housing developments play a role. But what scientists have learned recently about pesticides is especially worrisome, not only for the frogs but for what it implies about human health.

Since frogs live in the water, lay eggs in the water and absorb oxygen through their skin, they are hypersensitive to water pollutants. Fellers has found pesticides at the bottom of lakes and ponds in Yosemite. When absorbed, the chemicals damage the frogs' nervous systems. If frogs are having so much trouble in protected parks like Yosemite, they are likely to be faring even worse where pollution is more extreme.

Even low doses of pesticides are proving harmful. Last month Tyrone Hayes, a biologist at the University of California, Berkeley, reported in Proceedings of the National Academy of Sciences that trace amounts of atrazine, a common herbicide, acts as an "endocrine disruptor"—it interferes with the secretion of natural hormones. Tadpoles exposed to atrazine developed deformed genitals. This may shed some light on why so many frogs in recent years have been found with deformities, but it also underscores a knowledge gap. Scientists have learned a lot about how various pollutants kill laboratory mice and people, but they know little about such nonlethal effects as deformed legs and hermaphroditic genitals. "We really don't have a good understanding of what low-level hormones and endocrine disruptors may have on wildlife or on people," says Don Sparling, a wildlife toxicologist at USGS in Laurel, Md.

Coal miners used to use canaries to warn of lethal gases. Scientists are beginning to learn what the world's disappearing frogs are trying to tell us. ■

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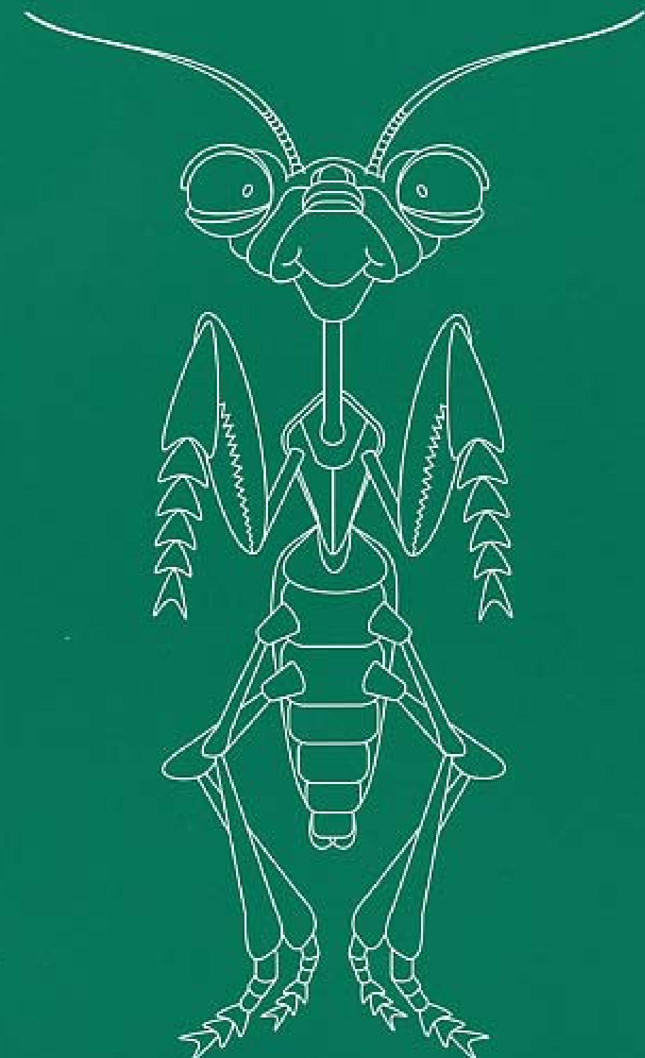

"What's Killing the Frogs?"

"pH Scale"
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"Newton's Apple Episode #1509: 'Greenhouse Effect - How Does the Loss of Ozone Affect our Climate?'"
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