Acid Rain and Buffers

Teacher Information

science take-out
just add students™

Summary

Students create mini-models of lakes with different lake bottom materials—sand and limestone. They add simulated acid rain to the lakes to determine which lake bottom material acts as a buffer to keep the pH of the simulated lake water relatively constant.

Core Concepts

- Acid rain decreases the pH of aquatic ecosystems.
- Some ecosystems are less susceptible to acid rain damage.
- Buffers act to keep the pH of solutions relatively constant.

Time Required

One 40-minute class period + homework.

Kit contains

- Sand
- Limestone
- Simulated "Acid Rain"
- pH paper and pH color chart
- Plastic dropper
- Stirrers

Teacher Provides

- Tap water
- Safety goggles
- Paper towels for clean up

Warning: Choking Hazard

This Science Take-Out kit contains small parts. Do not allow children under the age of seven to have access to any kit components.

Reusing *Acid Rain and Buffers* kits

Teachers will need to instruct students on how to handle clean-up and return of the re-usable kit materials. For example, Teachers might provide the following information for students:

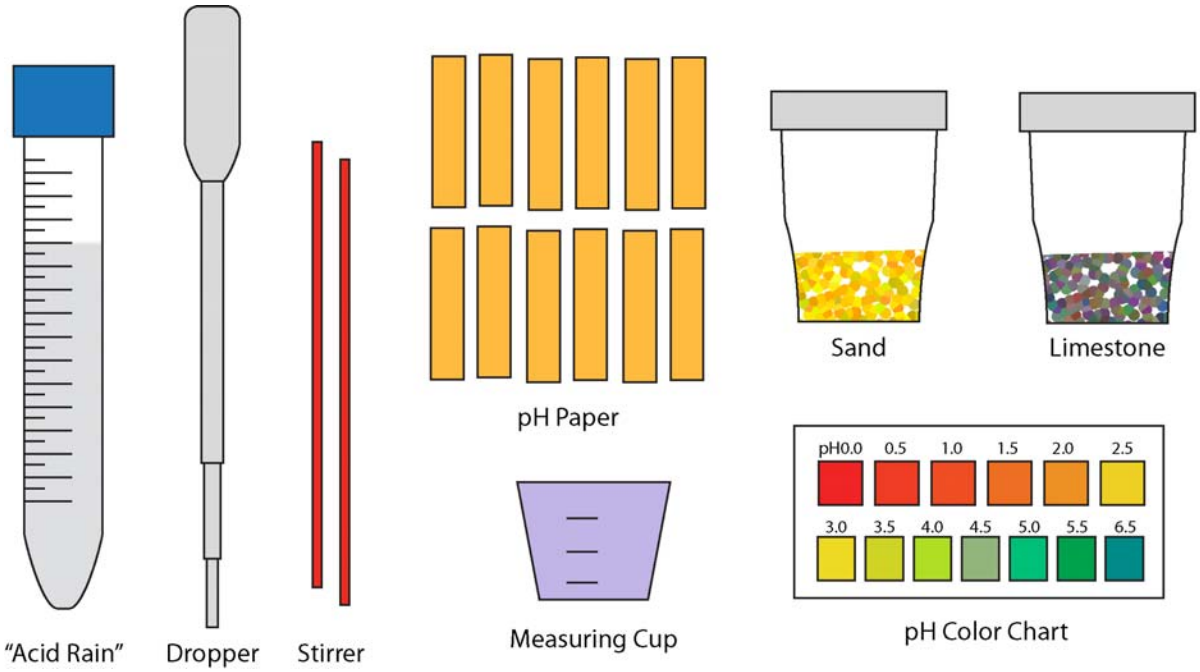
Discard	Rinse with water and dry with paper towel	Return to kit
• Used pH paper • Sand • Limestone	• Clear plastic containers • Droppers • Stirrers • Measuring Cup	• Plastic bag (for pH paper) • pH Color Chart* • Tube of "Acid Rain" • Plastic containers, droppers, stirrers and measuring cup (rinsed)

*Note: Consider laminating printed parts of the kits that will be reused.

Refills for *Acid Rain and buffers* kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- 1 Quick Guide for refilling kit
- Graduated transfer pipet
- Sand
- Limestone
- Simulated "Acid Rain"
- pH paper

Kit Contents Quick Guide



Read these instructions before using Science Take-Out kits

Parental or Adult Supervision Required

This kit should be used only under the supervision of an adult who is committed to ensuring that the safety precautions below, and in the specific laboratory activity, are followed.

Safety Goggles and Gloves Strongly Recommended

We encourage students to adopt safe lab practices, and wear safety goggles and gloves when performing laboratory activities involving chemicals. Safety goggles and gloves are not provided in Science Take-Out kits. They may be purchased from a local hardware store or pharmacy.

Warning: Choking and Chemical Hazard

Science Take-Out kits contain small parts that could pose a choking hazard and chemicals that could be hazardous if ingested. Do not allow children under the age of seven to have access to any kit components. Material Safety Data Sheets (MSDS) provide specific safety information regarding the chemical contents of the kits. MSDS information for each kit is provided in the accompanying teacher instructions.

Chemicals Used in Science Take-Out Kits

Every effort has been made to reduce the use of hazardous chemicals in Science Take-Out kits. Most kits contain common household chemicals or chemicals that pose little or no risk.

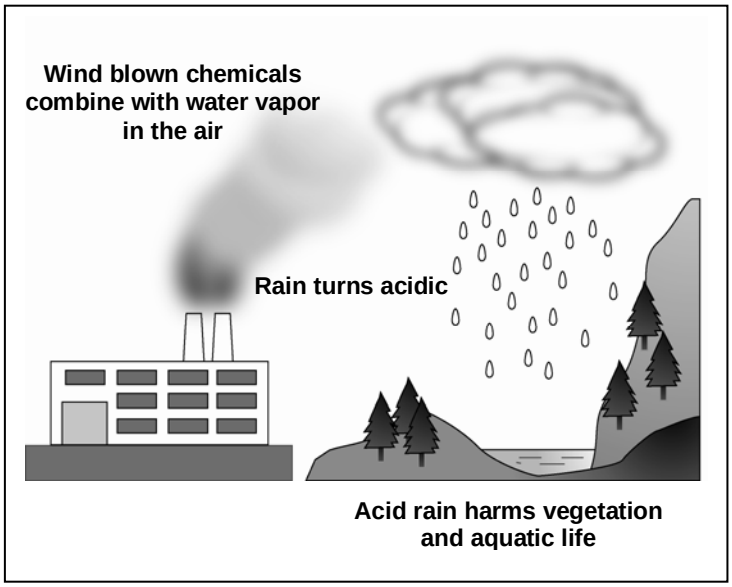
General Safety Precautions

1. Work in a clean, uncluttered area. Cover the work area to protect the work surface.
2. Read and follow all instructions carefully.
3. Pay particular attention to following the specific safety precautions included in the kit activity instructions.
4. Goggles and gloves should be worn while performing experiments using chemicals.
5. Do not use the contents of this kit for any other purpose beyond those described in the kit instructions.
6. Do not leave experiment parts or kits where they could be used inappropriately by others.
7. Never taste or ingest any chemicals provided in the kit - they may be toxic.
8. Do not eat, drink, apply make-up or contact lenses while performing experiments.
9. Wash your hands before and after performing experiments.
10. Chemicals used in Science Take-Out experiments may stain or damage skin, clothing or work surfaces. If spills occur, wash the area immediately and thoroughly.
11. At the end of the experiment, return ALL kit components to the kit plastic bag. Dispose of the plastic bag and contents in your regular household trash.

No blood or body fluids from humans or animals are used in Science Take-Out kits. Chemical mixtures are substituted as simulations of these substances.

Acid Rain and Buffers: *Teacher Answer Key*

The burning of fossil fuels such as coal, heating oil and gasoline releases chemicals into the atmosphere. These chemicals combine with water vapor in the air to form acid rain that harms the environment.



The effect of acid rain on a lake may be reduced through natural buffers present in some materials on the bottom of the lake. **Buffers** are chemicals that act to keep the pH of a solution relatively constant.

In this activity, you will determine which type of lake bottom material (sand or limestone) is best for buffering the effects of acid rain.

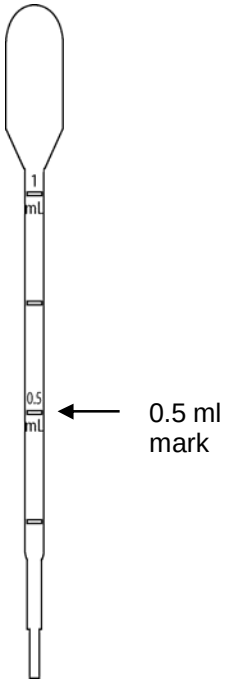
A. Investigate the effects of acid rain on lakes with sand bottoms

Prepare a model "lake" with sand:

1. Add 15 ml of tap water to the container of sand to represent a "lake."
2. Stir for 1 minute to mix the sand with the "lake" water. Allow 60 seconds for the sand to settle to the bottom of the "lake".
3. Use a strip of pH paper to test the initial pH of the "lake." Record your results in the Data Table on page 4.

Simulate acid rain by adding drops of acid to the model "lake"

4. Use a graduated dropper to add 0.5 mL of acid to the lake. Stir for 30 seconds. Measure and record the pH of the water.
5. Add an additional 0.5 mL of acid rain to the lake. Stir for 30 seconds. Measure and record the pH of the water in the Data Table.
6. Add an additional 0.5 mL of acid rain to the lake. Stir for 30 seconds. Measure and record the pH of the water in the Data Table.
7. Add an additional 0.5 mL of acid rain to the lake. Stir for 30 seconds. Measure and record the pH of the water in the Data Table.



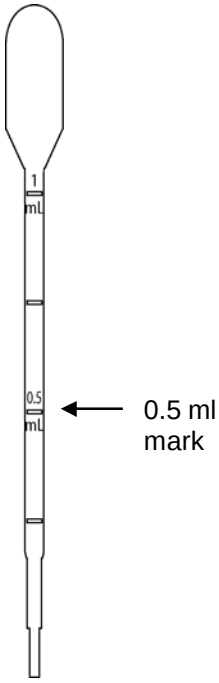
B. Investigate the effects of acid rain on lakes with limestone bottoms

Prepare a model "lake" with limestone:

1. Add 15 ml of tap water to the container of limestone to represent a "lake."
2. Stir for 1 minute to mix the limestone with the "lake" water. Allow 60 seconds for the limestone to settle to the bottom of the "lake".
3. Use a strip of pH paper to test the initial pH of the "lake." Record your results in the Data Table.

Simulate acid rain by adding drops of acid to the model "lake"

4. Use a graduated dropper to add 0.5 mL of acid to the lake. Stir for 30 seconds. Measure and record the pH of the water.
5. Add an additional 0.5 mL of acid rain to the lake. Stir for 30 seconds. Measure and record the pH of the water in the Data Table.
6. Add an additional 0.5 mL of acid rain to the lake. Stir for 30 seconds. Measure and record the pH of the water in the Data Table.
7. Add an additional 0.5 mL of acid rain to the lake. Stir for 30 seconds. Measure and record the pH of the water in the Data Table.
8. On the grid on the next page, prepare a **line graph** that summarizes the results of your data. Mark appropriate scales on the graph axes. You should have 2 lines on your graph – one line for the lake with sand and one line for the lake with limestone.



Data Table:

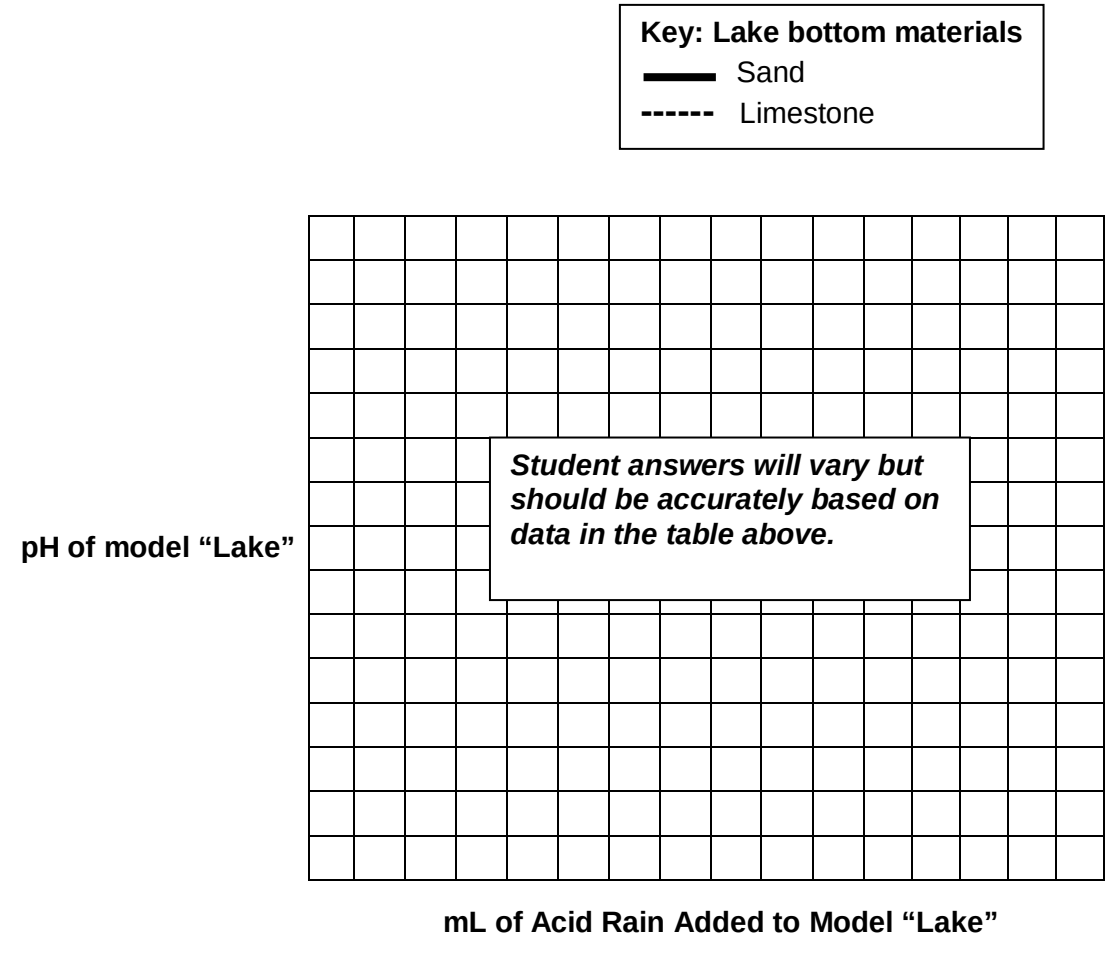
The Effect of "Acid Rain" on the pH of model lakes with different lake bottom materials

mL of "Acid Rain" added to "Lake"	pH of Model "Lake"	
	Sand	Limestone
0 (initial)		
0.5 mL		
1.0 mL		
1.5 mL		
2.0 mL		

Student answers will vary but the pH of the "lake" with limestone decreases more slowly than the pH of the "lake" with sand.

Graph:

The Effect of "Acid Rain" on the pH of model lakes with different lake bottom materials



Conclusions

1. What is a buffer?

   A buffer is a chemical that acts to keep the pH of a solution relatively constant.

2. Does adding "acid rain" increase or decrease the "lake's" pH? ***Decreases***

3. Which "lake" bottom material was best at buffering the effects of acid rain? Support your answer with evidence from your data table or graph.

   The limestone is the best buffer. The pH did not decrease as rapidly in this cup.

4. Your blood contains proteins and other chemicals that act as buffers. Why might having buffers in your blood be important for maintaining homeostasis?

   The buffers would keep blood from becoming to acidic or too basic.

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): Acid Rain

Product identity: Vinegar (dilute acetic acid)

Distributor: Wegman's Food Markets, Inc.
Rochester, NY 14603

Telephone number for information: (585)764-5400
Date of this MSDS: 10/5/08
Medical emergency phone number (Chemtrec): (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Ingredient: Vinegar Chemical Name: Acetic Acid
CAS Number: 64-19-7 Formula: CH_3COOH
Synonyms: Ethanoic Acid
Principle Hazardous Components: Acetic Acid (CAS#64-19-7) 4-6%
TLV and PEL units: ACGIH-TLV 10ppm(TWA), STEL 15ppm
OSHA-PEL 10ppm(TWA)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Do not ingest. Avoid skin and eye contact. Avoid exposure to vapor or mists.

Potential Health Effects

EYES: May cause irritation.
SKIN: May cause irritation.
INGESTION: May cause gastrointestinal discomfort.
INHALATION: May cause irritation to respiratory tract.

4. FIRST AID MEASURES

Emergency and First Aid Procedures:

EYES - Flush with water for at least 15 minutes, raising and lowering eyelids occasionally. Get medical attention if irritation persists.

SKIN - Thoroughly wash exposed area for at least 15 minutes. Remove contaminated clothing. Launder contaminated clothing before reuse. Get medical attention if irritation persists.

INGESTION - Do not induce vomiting. If swallowed, if conscious, give plenty of water immediately and call a physician or poison control center. Never give anything by mouth to an unconscious person.

INHALATION - Remove to fresh air. Give oxygen if breathing is difficult; give artificial respiration if breathing has stopped. Keep person warm, quiet, and get medical attention.

5. FIRE FIGHTING MEASURES

Flash Point (Method Used):109F (cc)

NFPA Rating:
Health: 2
Fire: 2
Reactivity: 1

Extinguisher Media: Use dry chemical, CO2 or appropriate foam.

Flammable Limits in Air % by Volume: 5.4%LEL 16.0%UEL

Autoignition Temperature: No data available

Special Firefighting Procedures: Firefighters should wear full protective equipment and NIOSH approved self-contained breathing apparatus.

Unusual Fire and Explosion Hazards: No data available

6. SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled:

Ventilate area of spill.
Eliminate all sources of ignition.
Remove all non-essential personnel from area.
Clean-up personnel should wear proper protective equipment and clothing.
Absorb material with suitable absorbent and containerize for disposal.

7. HANDLING AND STORAGE

Store above 62 degrees F, away from direct heat, ignition sources and oxidizers. Other Precautions: Do not reuse container. Residue may make empty containers dangerous.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection: A NIOSH/MSHA chemical cartridge respirator should be worn if PEL or TLV is exceeded.

Ventilation: Local Exhaust: Preferred Mechanical(General): Acceptable
Special: No Other: No

Protective Gloves: Natural rubber, Neoprene, PVC or equivalent.
Eye Protection: Splash proof chemical safety goggles should be worn.
Other Protective Clothing or Equipment: Lab coat, apron, eye wash, safety shower.

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight: 60.05 Melting Point: 16.7C
Boiling Point: 118.1C Vapor Pressure: 11.4 at 20C
Vapor Density (Air=1): 2.07 Specific Gravity (H_2O=1): 1.049
Percent Volatile by Volume: 100 Evaporation Rate (BuAc=1): 0.97
Solubility in Water: Miscible
Appearance and Odor: Clear colorless liquid with pungent odor.

10. STABILITY AND REACTIVITY

Stability: Stable Conditions to Avoid: Heat, ignition sources, metals
Incompatibility (Materials to Avoid): Oxidizers, strong alkalis, metals, amines, cyanides, sulfides, chromic acid, nitric acid, hydrogen peroxide, carbonates.
Hazardous Decomposition Products: COx
Hazardous Polymerization: Will not occur

11. TOXICOLOGICAL INFORMATION

Toxicity Data: aihl-mus LC50: 5620 ppm/1H orl-rat LD50: 3530 mg/kg
skin-rbt LD50: 1060 mg/kg

Effects of Overexposure: Acute: See section 3
Chronic: Mutation and reproductive effects data cited. Not listed as causing cancer by IARC, NTP, or OSHA.
Conditions Aggravated by Overexposure: Respiratory conditions
Target Organs: Eyes, skin, and respiratory tract.
Primary Route(s) of Entry: Inhalation, ingestion or skin contact.

12. ECOLOGICAL INFORMATION EPA Waste Numbers: D002 D001

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods: Dispose in accordance with all applicable Federal, State and Local regulations. Always contact a permitted waste disposer (TSD) to assure compliance.

14. TRANSPORTATION INFORMATION D.O.T. SHIPPING NAME: Not regulated

15. REGULATORY INFORMATION

EPA TSCA Status: On the TSCA Inventory List.
Hazard Category for SARA Section 311/312 Reporting: Acute
SARA EHS Section 302 TPQ(lbs.): No
SARA Section 313 Chemicals Name List: No Chemical Category: No
CERCLA Section 103 RQ(lbs.): 5,000 RCRA Section 261.33: No

16. ADDITIONAL INFORMATION

The information provided in this Material Safety Data Sheet represents data from the manufacturer and/or vendor and is accurate to the best of our knowledge. By providing this information, Science Take-Out LLC makes no guarantee or warranty, expressed or implied, concerning the safe use, storage, handling, precautions, and/or disposal of the products covered or the accuracy of the information contained in this fact sheet. It is the responsibility of the user to comply with local, state, and federal laws and regulations concerning the safe use, storage, handling, precautions, and/or disposal of products covered in this fact sheet.