STO-115

Pollution Investigation

Teacher Information

science take-out
just add students™

Summary

Students conduct simulated water tests for nitrates, PCBs, *E. coli* bacteria, and lead. They analyze the test results to determine the source of pollution that is affecting a lake that is a town's water supply. They also identify the potential health effects of pollution.

Core Concepts

Human activities may alter ecosystems.

Time Required

Two 40-minute class periods

Kit contains

- 4 tubes of water samples (A–D)
- 4 droppers for water samples (A–D)
- 4 strips of simulated "Nitrate Indicator Paper"
- 1 simulated "PCB Test Strip"
- 2 plastic well strips (4 wells per strip)
- 1 tube of simulated "*E. coli* Stain"
- 1 dropper for *E. coli* Stain
- 1 tube of simulated "Lead Indicator Solution"
- 1 dropper for Lead Indicator Solution
- *Pollutant Testing Procedures* sheet

Teacher Provides

- Safety goggles
- Paper towels for cleanup

Note:

You may instruct students to separate their Water Quality Report from the rest of their lab packet to make it easier for them to record their data.

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.

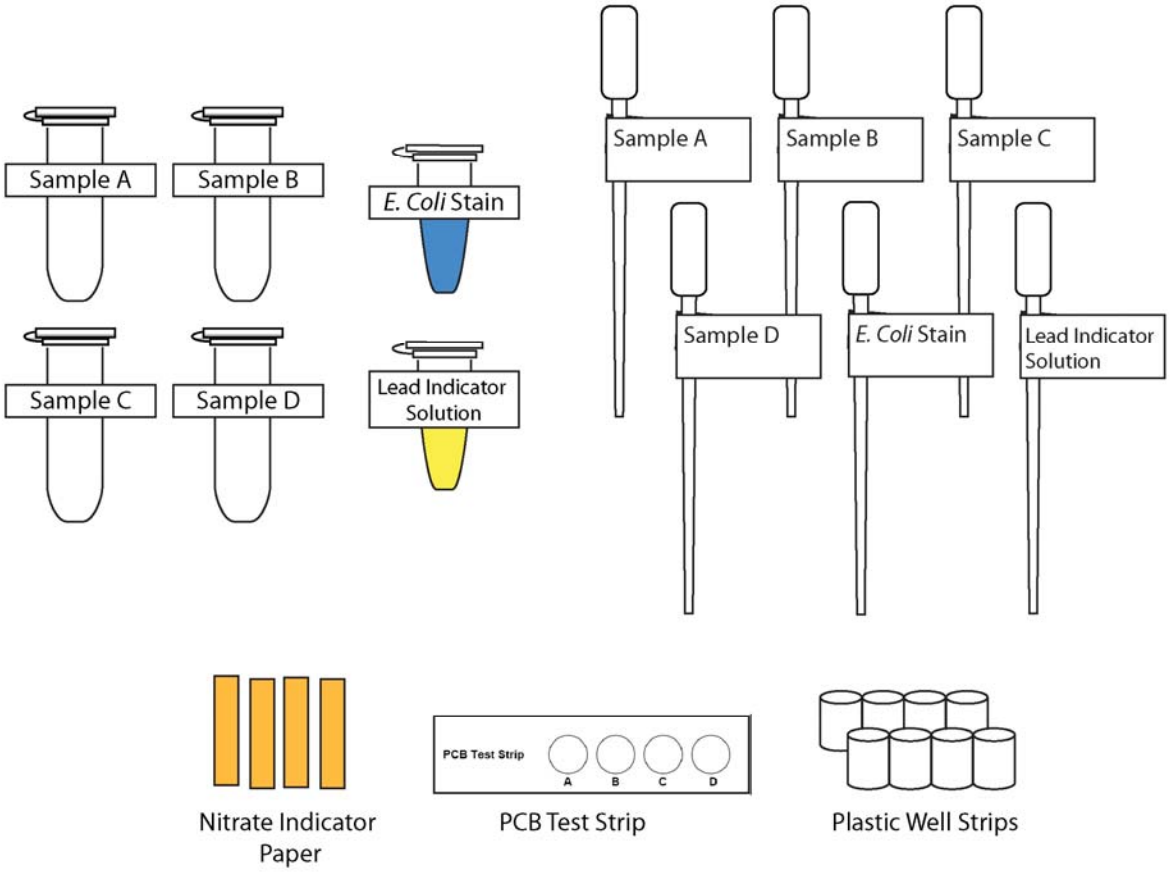
Reusing *Pollution Investigation* kits

Kits may be refilled and reused. Allow approximately 20-30 minutes for refilling 10 student 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 "PCB Test Strips" • Used "Nitrate Indicator Paper"	• Plastic well strips • All droppers	• All labeled microtubes • All labeled droppers (rinsed) • Plastic well strips (rinsed) • Small plastic bags for "Nitrate Indicator Paper" • Foam microtube racks • *Pollutant Testing Procedures* sheet *

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

Kit Contents Quick Guide



Nitrate Indicator Paper

PCB Test Strip

Plastic Well Strips

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.

Pollution Investigation:

Background Information

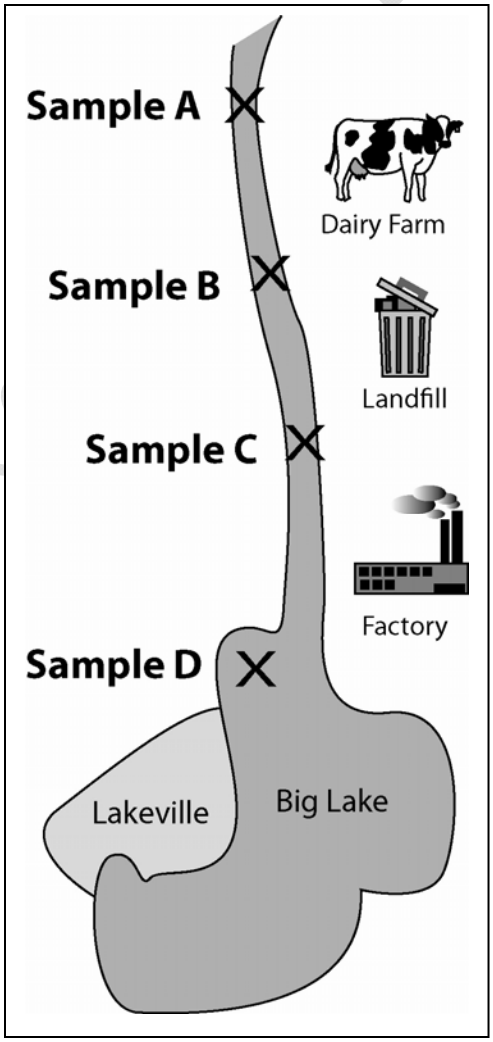
The town of Lakeville is a small town with charming old houses located on the banks of Big Lake. The people who live in Lakeville have noticed some changes in Big Lake that concern them.

- The fish population has decreased.
- The green algae population has increased.
- Deformed fish and frogs have been observed.

Big Lake is the water source for the people who live in Lakeville. People are worried that pollutants from the large dairy farm, landfill, or factory may have entered the river and been carried into Big Lake.

You work for an ecology company that does water testing. The people of Lakeville want your company to determine if the dairy farm, landfill, and factory are polluting the water in the river that flows into Big Lake. To the right is a map of Lakeville and the surrounding area.

You have water samples collected from specific locations (A–C) along the river and from the lake (D). Your job is to test the water samples for pollutants. You will then interpret the results for a report to the people of Lakeville.



You will use the materials in your water test kit to test the samples (A–D) that you collected for the following pollutant.

Pollutant to be tested	Caused by…
Nitrates	Pollution from sewage or fertilizer run-off
E. coli bacteria	Pollution from untreated sewage
PCB chemicals	Pollution from factories and industrial garbage
Lead	Pollution from factories and old lead-based paint

Part 1: Testing and Interpreting Nitrate Levels

High levels of nitrates may be caused by artificial fertilizers or by nitrogen-rich sewage being washed into rivers, lakes, and aquifers. Nitrates cause an excessive enrichment of the water, leading to a rapid growth of plants such as green algae. Decomposers then feed on the dead green algae and use up a lot of the oxygen in the water. The reduced oxygen content in the water may cause the death of fish and other water animals.

A high level of nitrates in drinking water is harmful to newborn babies, and it is also thought nitrates contribute to stomach cancer, although the evidence for this is unproven.

Read the information on nitrate pollution in the box above.

1. Refer to the ***Pollutant Testing Procedures*** sheet in your kit. Follow the "Testing for Nitrates" instructions to test each of the water samples (A–D) for the presence of nitrates.

2. Record the results of your tests in the ***Water Quality Report*** sheet (on the last page of this packet). Write "Safe" or "Unsafe" in each of the appropriate boxes.

Hint: You should separate your Water Quality Report from the lab packet so that it is easier to record your data.

3. What is the most likely source of the nitrate pollution in the lake? Support your answer with evidence from the test results.

4. How does nitrate pollution affect the plant life in the lake?

5. How does nitrate pollution lead to the decreased populations of fish in the bay.

6. What human health problems that may result from high levels of nitrates in Lakeville's water supply?

Part 2: Testing and Interpreting Lead Levels

Lead is a highly toxic metal that has many industrial uses. People are exposed to lead from the air, soil, household dust, food, drinking water and some consumer products. Lead gets in the air from factories, smelters and refineries. Lead can also enter some drinking water systems from old lead pipes or lead solder. Old lead-based paint can be a source of lead exposure in homes that were built before 1978 (when it became illegal for house paint to include lead). Some consumer products and toys that are manufactured in other countries and imported to the United States have been found to contain lead.

Exposure to lead can have serious health impacts, and can even be fatal at high doses. Lead builds up in the body, and exposure to even very low levels can be harmful. There is evidence that lead is especially harmful to infants, young children and pregnant women. Lead can permanently affect children's development, including intellectual and behavioral development. Lead has also been found to cause bone problems in older women.

Read the information on lead pollution in the box above.

1. Refer to the ***Pollutant Testing Procedures*** sheet in your kit. Follow the "Testing for Lead" instructions to test each of the water samples (A–D) for the presence of lead.

2. Record the results of your tests in the ***Water Quality Report*** sheet. Write "Safe" or "Unsafe" in each of the appropriate boxes.

3. Tests have shown that many of the children living in Lakeville have high levels of lead in their blood. What is the most likely source of lead? Support your answer with evidence from the test results.

4. What health problems that may result from high levels of lead in children who live in Lakeville?

Part 3: Testing and Interpreting PCBs Levels

PCBs (Polychlorinated Biphenyls) are types of chemicals that were manufactured from 1929 until 1979, when their manufacture was banned. PCBs were used in electrical equipment, paints, plastics, rubber products, pigments, and many other applications. Today, PCBs can still be released into the environment from improper disposal of products made before the use of PCBs was banned. Once in the environment, PCBs do not readily break down and therefore may remain for long periods of time, cycling between air, water, soil and living organisms. PCBs can be absorbed by plants and passed through the food chain to small organisms, fish, and then humans.

PCBs can cause cancer in animals. PCBs have also been shown to cause a number of other serious health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system and other health effects. The different health effects of PCBs may be interrelated, as alterations in one system may have significant implications for the other systems of the body.

Read the information on PCB pollution in the box above.

1. Refer to the ***Pollutant Testing Procedures*** sheet in your kit. Follow the "Testing for PCBs" instructions to test each of the water samples (A–D) for the presence of PCBs.

2. Record the results of your tests in the ***Water Quality Report*** sheet. Write "Safe" or "Unsafe" in each of the appropriate boxes.

3. What is the most likely source of PCBs contamination in the lake? Support your answer with evidence from the test results.

4. What health problems that may result from high levels of PCBs in Lakeville's water supply?

Part 4: Testing and Interpreting *E. coli* Bacteria Levels

E. coli bacteria are found in the intestines of animals and humans and may get into water as a result of sewage contamination. Most types of *E. coli* bacteria are harmless but some types of *E. coli* are harmful because they cause food poisoning and other gastrointestinal illnesses. If there are high levels of *E. coli* in water it is likely that other harmful types of bacteria are also present in the water.

Read the information on *E. coli* pollution in the box above.

1. Refer to the ***Pollutant Testing Procedures*** sheet in your kit. Follow the "Testing for *E. coli* Bacteria" instructions to test each of the water samples (A–D) for the presence of *E. coli*.

2. Record the results of your tests in the ***Water Quality Report*** sheet. Write "Safe" or "Unsafe" in each of the appropriate boxes.

3. What is the most likely source of *E. coli* contamination in the lake? Support your answer with evidence from the test results.

4. What health problems that may result from *E. coli* in Lakeville's water supply?

Part 5: Report to the Community

You will be meeting with the Lakeville community members to report on the results of your testing.

1. Complete the ***Water Quality Report*** by:
    - Identifying the source or sources for each of the pollutants.
    - Recommending at least 2 actions the community could take to improve the safety of their water supply.

2. One person asked whether it really is safe to conclude that the factory is not a pollution source. Do you think it is safe to conclude that the factory is not a source of pollution that could threaten the health of people who live in Lakeville? Explain your answer.

Report Prepared by _____

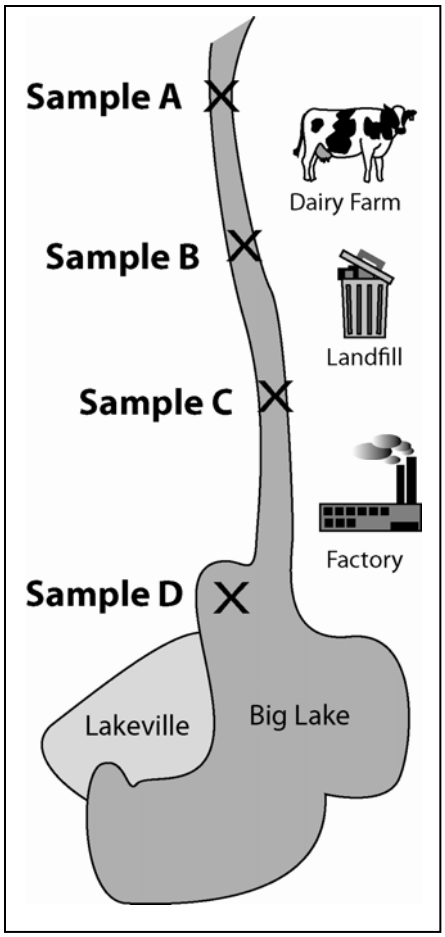
Water Quality Report

Pollutant	Sample Collected at			
	Site A	Site B	Site C	Site D
Nitrates				
Lead				
PCBs				
***E. coli* bacteria**				

Based on the information in the data table and the map, what is the source for each of these pollutants?

- Nitrates:
- Lead:
- PCBs:
- *E. coli* bacteria:

List two actions that the community could take to reduce their exposure to pollution.



MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Names (as printed on the label): Sample A, B, C and D

Product identities: Sample A = pH 6 buffer Sample B = pH 8 buffer Sample C and Sample D = pH 12 buffer

Distributor: Microessential Laboratory Inc. PO Box 10824, 4224 Avenue H, Brooklyn, NY 11210

Telephone number for information: (718)338-3618 Date of this MSDS: 12/31/08
Medical emergency phone number (Chemtrec): (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Product	Ingredients	CAS Numbers	% Weight/Volume (balance is water)
pH 6 buffer	Potassium phosphate monobasic Sodium phosphate dibasic	7778-77-0 7558-79-4	0.38% 0.08
pH 8 buffer	Potassium phosphate monobasic Sodium phosphate dibasic	7778-77-0 7558-79-4	0.05% 0.40%
pH 12 buffer	Sodium phosphate tribasic Sodium phosphate dibasic	7601-54-9 7558-79-4	0.35% 0.10%

For all the ingredients OSHA PEL: TWA – none estab. STEL – none estab.
ACGIH TLV: TWA – none estab. STEL – none estab.
NIOSH REL: TWA – none estab. STEL – none estab.
NIOSH ILDH: none estab.

3. HAZARDS IDENTIFICATION – for all pH buffer products

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. INHALATION: n/a
INGESTION: May cause gastrointestinal discomfort and mouth burns.

4. FIRST AID MEASURES – for all pH buffer products
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.

5. FIRE FIGHTING MEASURES – for all pH buffer products

NFPA Rating: Health: 1 Fire: 0 Reactivity: 0

Extinguisher Media: Any means suitable for extinguishing surrounding fire
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 – for all pH buffer products
Ventilate area of spill. Clean-up personnel should wear proper protective equipment and clothing. Absorb material with suitable absorbent and containerize for disposal.

7. HANDLING AND STORAGE – for all pH buffer products

Store in a cool dry place. This Material is not considered hazardous. Handle using safe laboratory practices.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION – for all pH buffer products

Respiratory Protection: n/a

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 – for all pH buffer products

Melting Point: ~0°C Boiling Point: ~100°C
Vapor Pressure: information not available Vapor Density: information not available
Specific Gravity (H_2O=1): ~1 Percent Volatile by Volume: >99
Evaporation Rate: information not available Solubility in Water: soluble
Appearance and Odor: Clear colorless liquid

10. STABILITY AND REACTIVITY – for all pH buffer products

Stability: Stable Materials to Avoid: strong acids and bases
Hazardous Decomposition Products: none known Hazardous Polymerization: will not occur

11. TOXICOLOGICAL INFORMATION

Ingredient	Toxicity (oral-rat) LD_{50}
Potassium biphthalate	3200 mg/kg
Sodium phosphate monobasic	7100 mg/kg
Sodium phosphate dibasic	17 g/kg
Sodium phosphate tribasic	7400 mg/kg

Effects of Overexposure (for all pH buffers):
Acute: Essentially non-hazardous. Possible irritation of eyes/skin/stomach
Chronic: None known. Conditions aggravated/Target organs: none known

Target Organs: Eyes, skin, and gastrointestinal tract. Primary Route(s) of Entry: Ingestion or skin contact.

12. ECOLOGICAL INFORMATION – for all pH buffer products

No ecological data available

13. DISPOSAL CONSIDERATIONS – for all pH buffer products

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 – for all pH buffer products

EPA regulations: RCRA Hazardous waste number (40 CFR 261.33) – not listed
RCRS Hazardous waste classification (40 CFR 261) – not classified
SARA Toxic Chemical (40 CFR 372.65) – not listed
SARA EHS (Extremely Hazardous Substance (40 CFR 355) – not listed
OSHA regulations: Air Contaminant (29 CFR 1910.1000) – not listed

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.

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): "e Coli Stain"

Product identity: 0.05% bromothymol blue solution

Distributor: Science Take-Out, LLC. PO Box 205, Pittsford, NY 14534

Telephone number for information: (866)260-0501 Medical emergency phone number (Chemtrec): (800) 424-9300

Date of this MSDS: 7/6/09

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	CAS Numbers	% Weight/Volume	TLV Units
Bromothymol blue sodium salt	34722-90-2	0.05%	None established
Water	7732-18-5	99.95%	None established

3. HAZARDS IDENTIFICATION – for all pH buffer products

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 slight irritation. INHALATION: n/a
INGESTION: May cause gastrointestinal discomfort

4. FIRST AID MEASURES

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.

5. FIRE FIGHTING MEASURES

NFPA Rating: Health: 1 (slight) Fire: 0 Reactivity: 0
Extinguisher Media: Any means suitable for extinguishing surrounding fire
Firefighting Procedures: Firefighters should wear full protective equipment and NIOSH approved self-contained breathing apparatus.
Unusual Fire and Explosion Hazards: None

6. SPILL OR LEAK PROCEDURES

Ventilate area of spill. Clean-up personnel should wear proper protective equipment and clothing. Mop up, or absorb material with suitable absorbent and containerize for disposal.

7. HANDLING AND STORAGE

Store in a cool dry place. Handle using safe laboratory practices.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection: None required
Ventilation: Local Exhaust: Preferred
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

Melting Point: <2°C
Vapor Pressure: Ca 50 @ 20°C
Specific Gravity (H_2O=1): ~1
Evaporation Rate: ~ same as water
Appearance and Odor: Green liquid

Boiling Point: >98°C
Vapor Density: ~ same as water
Percent Volatile by Volume: information not available
Solubility in Water: soluble

10. STABILITY AND REACTIVITY

Stability: Stable
Materials to Avoid: none known
Hazardous Decomposition Products: none
Reactive under what conditions: none known

11. TOXICOLOGICAL INFORMATION

Toxicity (rat) LD_{50}
Acute oral toxicity = information not available
Acute toxicity from vapor = information not available

Effects of Overexposure:
Acute: Irritation of eyes/skin
Chronic: Irritation of eyes/skin
Target Organs: Eyes, skin.
Primary Route(s) of Entry: Ingestion

12. ECOLOGICAL INFORMATION No data available

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 No data available

15. REGULATORY INFORMATION No data available

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.

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): "Lead Indicator Solution" (simulated)

Product identity: Yellow food coloring – 1% Inorganic salts – 99%

Manufacturer: Science Take-Out, LLC
P.O. Box 205
Pittsford, NY 14534

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

---

2. COMPOSITION/INFORMATION ON INGREDIENTS
This product contains no hazardous materials as defied by the OSHA Hazards Communications Standard
Chemical Ingredients: Food coloring (1%); Inorganic salts (99%)
Chemical Name: N/A CAS Number: N/A
Formula: N/A Synonyms: N/A
Principle Hazardous Components: No Data TLV and PEL units: No Data
OSHA-PEL 10ppm (TWA): No Data

---

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
Avoid skin and eye contact.

Potential Health Effects EYES: May cause irritation. SKIN: May cause irritation.

---

4. FIRST AID MEASURES 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.

---

5. FIRE FIGHTING MEASURES No data available

---

6. SPILL OR LEAK PROCEDURES
Wear proper eye and skin protection. Mop/wipe spill area. Rinse with water.

---

7. HANDLING AND STORAGE Avoid eye and skin contact

---

8. EXPOSURE CONTROLS/PERSONAL PROTECTION
Respiratory Protection: N/A Ventilation: N/A
Protective Gloves: Natural rubber, Neoprene, PVC or equivalent.
Eye Protection: Splash proof chemical safety goggles should be worn.
Other Protective Clothing or Equipment: None

---

9. PHYSICAL AND CHEMICAL PROPERTIES
Molecular Weight: No data Melting Point: N/A
Boiling Point: No data Vapor Pressure: No data

Vapor Density (Air=1): No data Specific Gravity (H_2O=1): No data
Percent Volatile by Volume: No data Evaporation Rate (BuAc=1): No data
Solubility in Water: Soluble Appearance and Odor: Yellow liquid

---

10. STABILITY AND REACTIVITY
Stability: Stable Conditions to Avoid: No data
Incompatibility (Materials to Avoid): None Hazardous Decomposition Products: No D
Hazardous Polymerization: Will not occur

---

11. TOXICOLOGICAL INFORMATION
Toxicity Data: No data Effects of Overexposure: See section 3
Target Organs: Eyes and skin Primary Route(s) of Entry: Eye or skin contact.
Conditions Aggravated by Overexposure: See section 3

---

12. ECOLOGICAL INFORMATION No data

---

13. DISPOSAL CONSIDERATIONS Can be disposed of in the trash or down the sink.

---

14. TRANSPORTATION INFORMATION D.O.T. SHIPPING NAME: N/A

---

15. REGULATORY INFORMATION N/A

---

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.