Enzymes and Lactose Intolerance

Teacher Information

science take-out
just add students™

Summary

Students model the action of the enzyme lactase. They conduct tests to determine whether LACTAID, an enzyme supplement, digests lactose. They design and conduct an experiment to determine if acid interferes with the action of the enzymes in LACTAID.

Core Concepts

- Biochemical processes are made possible by biological catalysts called enzymes. Enzymes can affect the rates of chemical change.
- The rate at which enzymes work can be influenced by internal environmental factors such as pH and temperature.

Time Required

Two 40-minute class periods + homework.

Kit contains

- 5 labeled droppers (Glucose, Water, Milk, LACTAID, Acid)
- 1 LACTAID capsule
- 1 empty large tube labeled "LACTAID"
- 1 empty microtube labeled "water"
- 1 large tube of Powdered Milk
- 1 large tube of Glucose
- 1 microtube of "Acid" (white vinegar)
- 12 toothpicks
- 2 test strips (use for Parts 2 and 3)
- Plastic bag containing 12 small pieces of glucose indicator paper

Teacher Provides

- Scissors
- Tape
- Safety goggles
- Access to water
- 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 *Enzymes and Lactose Intolerance* 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:

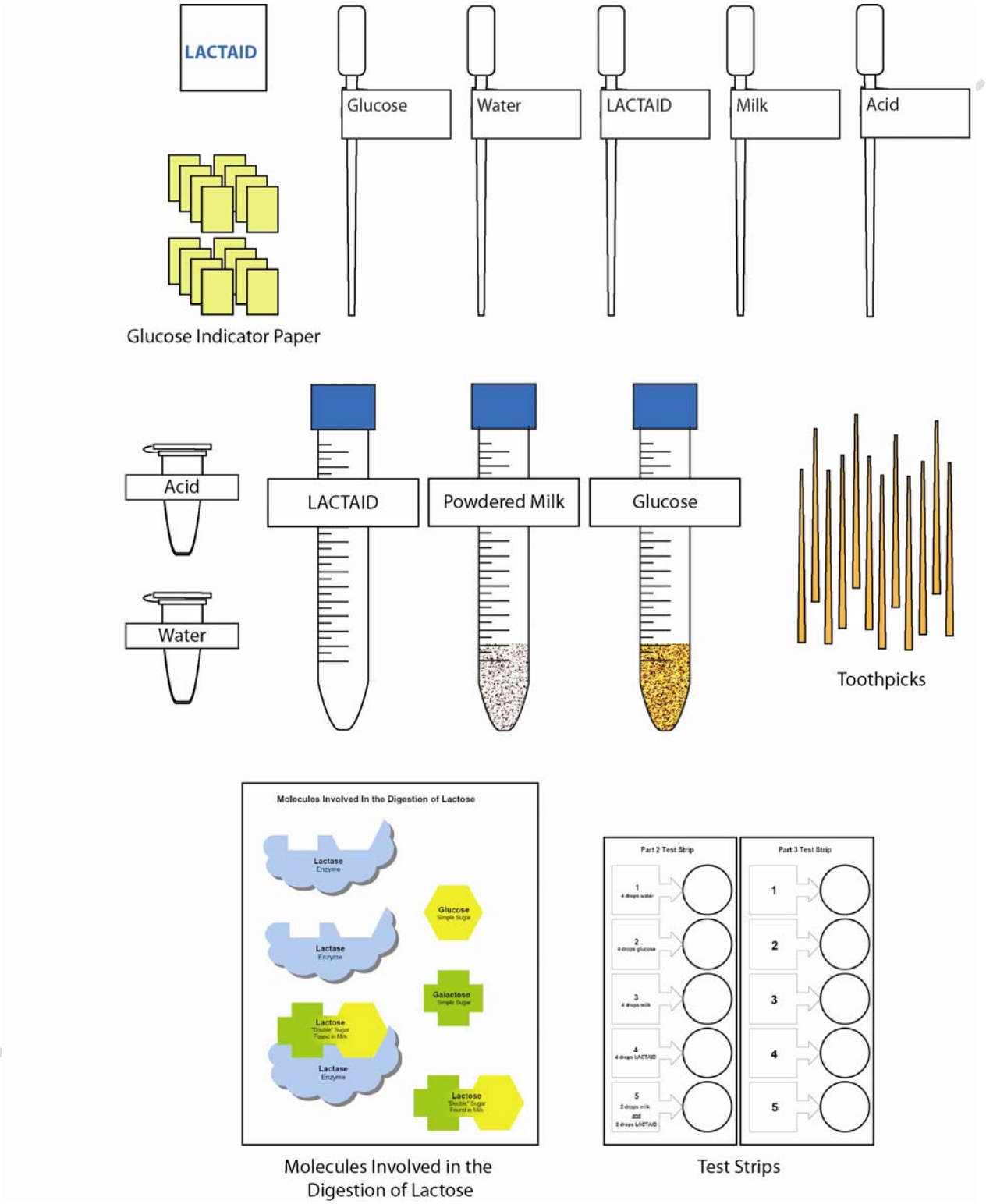
Discard	Rinse with water and dry with paper towel	Return to kit
• Used glucose indicator paper • Toothpicks • Part 2 and Part 3 Test Strips	• All tubes • All droppers	• All tubes (rinsed) • All droppers (rinsed)

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

Refills for *Enzymes and Lactose Intolerance Proportions* kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- 1 Quick Guide for refilling kit
- 2 graduated transfer pipets (teacher use only)
- 1 funnel (teacher use only)
- 10 LACTAID capsules
- 1 tube of powdered milk (20 ml)
- 5 glucose tablets
- 15 ml of "Acid" (white vinegar)
- 120 toothpicks
- 20 strips of glucose test paper
- 10 colored graphic sheets – *Molecules Involved in the Digestion of Lactose*
- 10 worksheets – *Chemical Equation for the Digestion of Lactose*
- 10 *Part 2 Test Strips*
- 10 *Part 3 Test Strips*

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.

Enzymes and Lactose Intolerance:

Introduction:

When some people eat dairy products (milk, ice cream, and cheese), they experience digestive discomforts such as flatulence (gas), bloating, cramping, and even diarrhea. These individuals do not produce enough of an enzyme called lactase, the enzyme that digests lactose, a carbohydrate found in milk.

When undigested lactose accumulates in the intestine of a person with lactose intolerance, bacteria in the intestine feed on the lactose and produce waste gases that cause flatulence and bloating. Large amounts of undigested lactose may also cause water to diffuse from the blood into the intestine resulting in diarrhea.

Part 1: Modeling Lactase Activity

Lactase is a protein enzyme that digests (breaks down) lactose (milk sugar) into glucose and galactose (smaller sugars). The chemical equation below illustrates what happens when the enzyme lactase digests lactose (milk sugar).

Lactose	**+**	**Lactase**	**→**	**Lactase-Lactose Complex**	**→**	**Glucose**	**+**	**Galactose**	**+**	**Lactase**
Substrate		Enzyme		Enzyme-Substrate		Product		Product		Enzyme

1. Your lab kit contains a sheet of labeled colored drawings of "Molecules Involved in the Digestion of Lactose." Cut these drawings out.

2. Your kit also contains a sheet with the "Chemical Equation for the Digestion of Lactose." Tape or glue the cut out drawings of the molecules in the appropriate boxes on this sheet.

3. What is the name of the molecule that is the enzyme?

4. What is the name of the molecule that is the substrate?

5. What word ending is associated with enzymes—"ose" or "ase"?

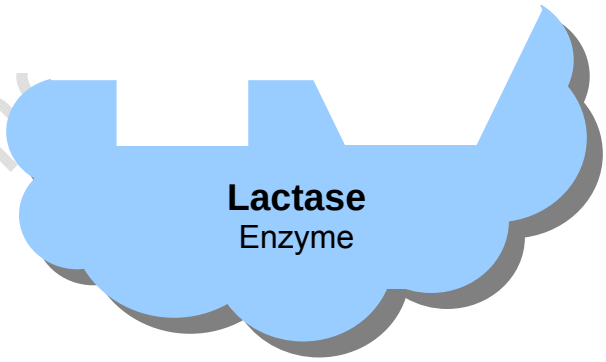
6. What two products are formed when the enzyme lactase digests lactose?

7. Enzymes are types of proteins that function as catalysts. Catalysts are substances that speed up the rate of reaction between substances. What might happen to the reaction if lactase was <u>not</u> working properly?

8. Unlike other substances involved in a chemical reaction, the enzyme is <u>not</u> consumed in the reaction. Was the lactase molecule used up (consumed) in the reaction? How can you tell?

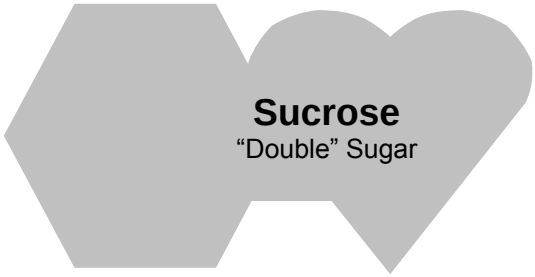
9. Notice that the lactase enzyme has a "cut out" region on its surface called the **active site** that fits with the substrate. During a reaction using an enzyme, the substrate enters the active site and forms an enzyme-substrate complex.

   - Label the active site on the lactase diagram on the right.



   - High temperatures can change the shape of enzymes. Explain why changing the shape of the active site on the lactase enzyme would decrease the rate of lactose digestion.

   - Enzymes are specific. They will only work on certain substrates. Explain why lactase can digest lactose but cannot digest other double sugars such as sucrose or maltose.



Part 2: Does LACTAID Really Digest Lactose?

There is a dietary supplement called LACTAID that contains the enzyme lactase. The makers of LACTAID promise that the lactase in this product will allow people with lactose intolerance to enjoy eating dairy products. Read the product information below from the box of LACTAID pills.

LACTAID® Fast Act

LACTAID® Dietary Supplements work naturally to break down lactose (milk sugar), so you can enjoy the dairy foods you love.

LACTAID® Fast Act contains the enzyme lactase that breaks lactose down into easily absorbed sugars.

Simply take one (1) easy-to-swallow LACTAID® Fast Act caplet with your first bite of dairy food and enjoy!

Supplement Facts
Serving Size 1 Caplet

Amount Per Caplet	% Daily Value
Sodium 5 mg	<1%*
Lactase Enzyme 9000 FCC Units	**

* Percent Daily Values are based on a 2,000 calorie diet
** Daily Value not established

www.lactaid.com/lactose/index.jhtml?id=lactaid/lactose/facts.inc

1. What is the active ingredient in a LACTAID caplet that makes it possible for people who are lactose intolerant to enjoy dairy foods?

2. What two substances will be produced if LACTAID is working properly?

Your Task:

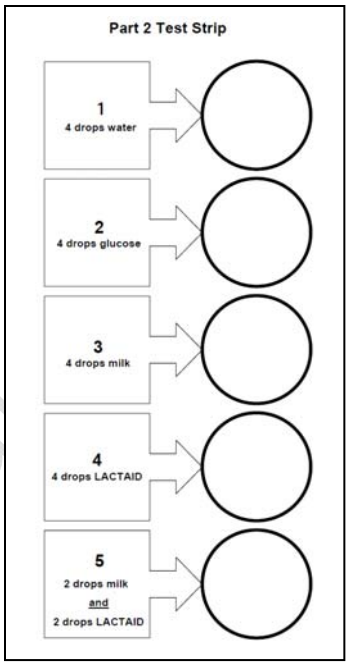
Conduct an experiment to determine if LACTAID really works to digest milk sugar (lactose).

Procedure:

3. Open the packet containing the LACTAID tablet. Place the tablet into the large tube labeled "LACTAID."

4. Add enough tap water to fill the 3 large tubes (labeled "LACTAID", "Glucose", "Powdered Milk") approximately one-half full. Cap and shake each of the tubes vigorously for three minutes to dissolve the materials in the tubes.

5. Fill the small tube labeled "Water" with tap water.



6. Take out the *Part 2 Test Strip* from your kit. Set the *Part 3 Test Strip* aside for use during Part 3.

7. Use the information in the boxes on the left of the *Part 2 Test Strip* to mix materials from the tubes in the appropriate circles on the right of the test strip. Be sure to use the appropriately labeled droppers!

8. Stir the contents in each of the test strip circles using a clean toothpick. Make sure you use a different toothpick for each circle and discard the used toothpicks.

9. Wait for 5 minutes before going to the next step.

10. Remember that when lactose is digested, glucose is produced. Follow the directions below to test the contents of each of the circles for the presence of glucose. Then, record the results in Columns 2 and 3 of Data Table 1.
    - Use a clean and dry piece of glucose indicator paper for each test.
    - Drop one piece of glucose indicator paper into the liquid in each circle.
    - Wait for 60 seconds for the color to develop.
    - If a light or dark green color develops, glucose is present.
    - If the paper stays yellow, glucose is not present.

Data Table 1

Test Strip Circle	Column 1 Put in labeled circles of Test Strip	Column 2 Results: Color of Paper	Column 3 Glucose Present (+) Glucose NOT Present (-)
1	4 drops water		
2	4 drops glucose		
3	4 drops milk		
4	4 drops LACTAID		
5	2 drops milk **and** 2 drops LACTAID		

11. Which test strip circles (1–5) contained lactose at the beginning of the experiment?

12. Which test strip circles (1–5) contain lactase?

13. In which test strip circle (1–5) is lactase digesting the lactose into smaller glucose molecules?

14. Which test strip circle (1–5) was a control to show that LACTAID does not contain glucose?

15. Which test strip circle (1–5) is a control to show that the glucose indicator paper is working properly?

16. Which test strip circle (1–5) is a control to show that milk does not contain glucose?

17. Based on the results of your experiment, can you conclude that LACTAID really works to break down milk sugar (lactose)?

    Explain how the results of your experiment support your conclusion.

18. Save the tubes and labeled droppers (LACTAID, milk, glucose, and water) for use in Part 3.

19. Discard the used *Part 2 Test Strip,* used test papers and used toothpicks.

Part 3: Could LACTAID work in a person's stomach?

One skeptical biology student suggests that LACTAID may work in lab tests but he is not sure it works if people eat it with their food. He points out that when you take a LACTAID pill, it gets mixed with the acid in your stomach. He learned in biology class that acids denature (change the shape of) enzymes so that they don't work properly.

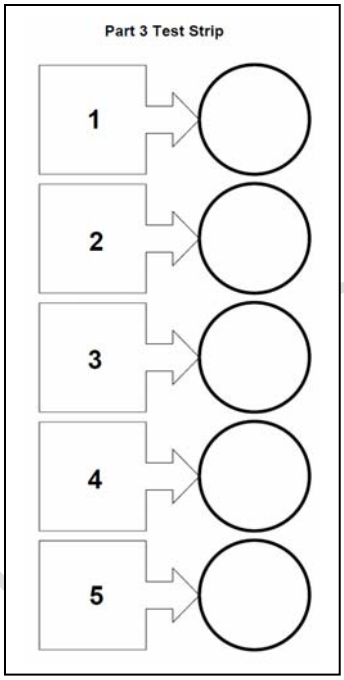
1. What is your hypothesis? Do you think that LACTAID mixed with acid will still work to digest lactose into glucose? Explain why or why not.

2. Your lab kit contains a tube of "Acid" (vinegar) that has the same pH as the contents of the stomach. The kit also contains a dropper for the "Acid" and a *Part 3 Test Strip*.

3. Design an experiment to determine if LACTAID works when it is mixed with acid.
    - In Column 1 of Data Table 2, write what substances you will mix together in the circles on your test strip. You may not need to use all of the boxes in Column 1.
    - Be certain to include controls in your experiment to show that the lactase enzyme and glucose test papers work properly.

Data Table 2

Test Strip Circle	Column 1	Column 2	Column 3
	What will you put in the labeled circles on the Test Strip?	Results: Color of glucose indicator paper	Glucose Present (+) Glucose NOT Present (-)
1			
2			
3			
4			
5			



4. Conduct your experiment by mixing the appropriate substances in the circles on the *Part 3 Test Strip*. You many not need to use all of the test strip circles. Remember to stir using a clean toothpick.

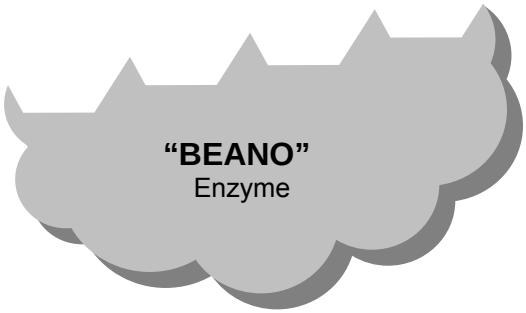
5. Add 1 piece of glucose indicator paper to each of the circles. Record the results of your experiment in Column 2 and 3 of Data Table 2.

6. Which *Part 3 Test Strip* circle (1-5) represents the control for your experiment?

7. Does LACTAID work when it is mixed with acid? Explain how you could tell from the results of your experiment.

8. Hot chocolate is made by mixing hot milk with chocolate. High temperatures denature (change the shape of) enzymes. Do you think that that LACTAID would work if you added it to a cup of hot chocolate? Explain why or why not. Use the term "active site" in your answer.

9. Some people experience gas and discomfort after eating vegetables, grains, beans, and other high-fiber foods. There is an enzyme product called "BEANO" that breaks down the complex carbohydrates (long chains of sugars) into simple sugars. Do you think that the enzyme in BEANO will work to digest the lactose in milk? Explain why or why not.



MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): "Glucose"

Product identity: Dex4 glucose tablet (dextrose)

Manufacturer: Can-Am Care Corp.
Alpharetta, GA 30022

Telephone number for information: (888)400-9770

Preparation date of this MSDS: 12/29/08

Medical emergency phone number (Chemtrec): (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Ingredient: D-Glucose anhydrous (dextrose)
CAS Number: 50-99-7
Not hazardous under OSHA Standard 29 CFR 1910.1200.
Not a WHMIS controlled substance.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

White crystalline powder; no odor. Not a fire hazard.
No significant health or environmental effects associated with this material.
HMIS Rating Health 0, Fire 1 (slight), Reactivity 1 (slight)

Potential Health Effects
EYE: May cause irritation. SKIN CONTACT: No adverse effects expected.
INGESTION: Large doses may cause gastrointestinal discomfort.
INHALATION: No adverse effect expected
SUBCHRONIC EFFECTS/CARCINOGENICITY: The material is not listed as a carcinogen or potential carcinogen by IARC, NTP, OSHA, or ACGIH.

4. FIRST AID MEASURES

EYES: Check for and remove contacts. Flood eyes with clean flowing water, low pressure and luke warm (not hot) if possible, occasionally lifting eyelids.

INGESTION: If large amounts of this material are swallowed, do not induce vomiting. Administer water if person is conscious. Never give anything by mouth to an unconscious person.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES: This materials in sufficient quantity and reduced particle size is capable of creating a dust explosion
FLASHPOINT: Not combustible METHOD USED: N/A
FLAMMABLE LIMITS: LFL: Not applicable UFL: Not applicable
EXTINGUISHING MEDIA: Non-combustible material. Use extinguishing media appropriate for surrounding fire.
FIRE-FIGHTING INSTRUCTIONS: Carbon Dioxide may be generated making necessary the use of a self-contained breathing apparatus (SCBA) and full protective equipment (Bunker Gear). Carbon dioxide is an asphyxiant at levels over 5% w/w. Sodium oxide, another thermal decomposition product existing at temperatures above 1564□F is a respiratory, eye, and skin irritant. Avoid inhalation, eye and skin contact with sodium oxide dusts.
UNUSUAL FIRE AND EXPLOSION HAZARDS: None known.

6. ACCIDENTAL RELEASE MEASURES

Scoop up into dry, clean containers. Avoid creating dust. Ventilate area of spill..

7. HANDLING AND STORAGE

Store tightly closed in a cool, dry area. Do not breath dust.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

RESPIRATORY PROTECTION: Dust mask required if total dust level exceeds 10 mg/m3.
PROTECTIVE GLOVES: General purpose for handling dry product. Impervious gloves when working with solutions.
EYE PROTECTION: Safety glasses when handling bulk material or when dusts are generated.
OTHER PROTECTIVE CLOTHING OR EQUIPMENT: no data

PROTECTIVE WORK/HYGIENIC PRACTICES: No special requirements with respect to chemical exposure beyond those provided above.

Requirements with respect to specific equipment and applications are the responsibility of the user.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: White powder. ODOR: None.
PHYSICAL STATE: Solid MELTING POINT: 146 degrees C
VAPOR PRESSURE: Not applicable. VAPOR DENSITY: Not applicable.
BOILING POINT: Not applicable. SOLUBILITY IN WATER: 1 g/1.1 ml water
% VOLATILE: Not applicable. MOLECULAR WEIGHT: 180.16
CHEMICAL FORUMULA: C6H12O6 DENSITY: 1.54
pH 5.9 for 0.5 M aqueous solution

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10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.
CONDITIONS TO AVOID: Moisture and incompatibilities.
INCOMPATIBILITY WITH OTHER MATERIALS: Reacts with sodium nitrite ply potassium nitrite, sodium peroxide plus potassium nitrate.
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon dioxide and carbon monoxide gas may be formed when heated to decomposition.
HAZARDOUS POLYMERIZATION: Not applicable.

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11. TOXICOLOGICAL INFORMATION

ACUTE ORAL EFFECTS: Acute Oral-rat LD50 = 25.8 g/kg
NTP CARCINOGEN: No
IARC CATEGORY: None

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12. ECOTOXICOLOGICAL INFORMATION

AQUATIC TOXICITY: No information

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13. DISPOSAL CONSIDERATIONS

Bury in a secured landfill in accordance with all local, state and federal environmental regulations. Empty containers may be incinerated or discarded as general trash.

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14. TRANSPORTATION INFORMATION

D.O.T. SHIPPING NAME: Not regulated D.O.T. HAZARD CLASS: None
U.N./N.A. NUMBER: None HAZARDOUS SUBSTANCE/RQ: None
D.O.T. LABEL: None

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15. REGULATORY INFORMATION

CLEAN AIR ACT SECTION 611: Material neither contains nor is it manufactured with ozone depleting substances (ODS).

FEDERAL WATER POLLUTION CONTROL ACT (40 CFR 401.15): Material contains no intentionally added or detectable (contaminant) levels of EPA priority toxic pollutants.

FOOD AND DRUG ADMINISTRATION: Generally Recognized As Safe (GRAS) direct food additive (21 CFR 184.1736).

US DEPARTMENT OF AGRICULTURE: List of Proprietary Substances - Permitted Use Codes 3A, J1, A1, G1, and L1.
CERCLA REPORTABLE QUANTITY: None
OSHA: Not hazardous under 29 CFR 1910.1200
RCRA: Not a hazardous material or a hazardous waste by listing or characteristic.

SARA TITLE III: Section 302, Extremely Hazardous Substances: None
Section 311/312, Hazardous Categories: Non-hazardous
Section 313, Toxic Chemicals: None

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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): "Acid"

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

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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)

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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.

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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.

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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

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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.

Requirements with respect to specific equipment and applications are the responsibility of the user.

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
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