STO-139

Life Support for a Developing Baby

Teacher Information

science take-out just add students™

Summary

Students create a model placenta and investigate whether alcohol and viruses can move from a mother's blood to her developing baby. They explore the effects of prenatal exposure to hazardous substances and pathogens that can cause birth defects.

Core Concepts

- The placenta is an organ in which the blood vessels from a mother and her developing baby come close together but do not connect.
- The placenta provides a developing baby with essential oxygen and food.
- Some harmful substances and pathogens can move through the placenta from a mother to her developing baby.
- Prenatal exposure to harmful substances and pathogens may be harmful to a developing baby, particularly in early stages of pregnancy.

Time Required

Two 40-minute class periods

Kit contains

- Plastic cup labeled "Placenta"
- Two pieces of dialysis tubing
- Tube of simulated "Mother's Blood"
- Tube of simulated "Baby's Blood"
- Dropper
- Alcohol and Rubella Virus Test Sheet
- Alcohol test paper
- Rubella virus test paper
- Instructions for Alcohol and Rubella Virus Tests
- Diagrams of Baby's Life Support (diagram sheet of cut-outs)
- A Baby's Life Support System (information sheet)
- Effects of Harmful Substances and Pathogens on Prenatal Development (chart)

Teacher Provides

- Safety goggles
- Paper towels for clean up
- Scissors

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.

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Teacher Notes:

- Consider laminating the **Diagrams of Baby's Life Support System** so that they can be used for multiple classes. Precutting the diagrams also reduces the amount of time required to complete the activity. If you prefer to have each student cut and tape the diagram parts to include in their lab report, you may make extra copies of the diagram sheet.
- In order to fit this lab activity into class time constraints, the baby's blood is "spiked" with simulated viruses. This eliminates the wait time needed for diffusion of substances from the mother's blood into the baby's blood. Students only test the baby's blood after diffusion.
- For an extension to the lab, consider asking students do Internet research to explore the effects of lead, nicotine, illegal drugs, alcohol, caffeine or other substances on fetal development.

Reusing *Life Support for a Developing Baby* kits

Kits may be refilled and reused. Allow approximately 15–30 minutes for refilling 10 student kits. Teachers will need to instruct students on how to handle clean-up of the 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 alcohol and virus test strips • Membrane tubes and their contents • Contents of "Placenta" cup • Used droppers	• Plastic cup labeled "Placenta" • Alcohol and Rubella Virus Test Sheet	• Cup labeled "Placenta" • Colored parts for model of uterus with baby • Tubes of "Mother's Blood" and "Baby's Blood" • Instructions for Alcohol and Rubella Virus Tests • Alcohol and Rubella Virus Test Sheet • Diagrams of a Baby's Life Support System • A Baby's Life Support System and Effects of Harmful Substances and Pathogens on Prenatal Development (2-pager)

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

- Instructions for Alcohol and Virus Tests
- Diagrams of a Baby's Life Support System
- A Baby's Life Support System (information sheet)
- Effects of Harmful Substances and Pathogens on Prenatal Development (chart)

Refills for *Life Support for a Developing Baby* kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- Instructions and Quick Guide for refilling kits
- 150 ml "Mother's Blood"
- 150 ml "Baby's Blood"
- Tube of red glitter
- Small funnel
- 2 transfer pipets (for refilling the tubes)
- 10 transfer pipets for student use
- 10 strips of Alcohol Test Paper
- 10 strips of Rubella Virus Test paper
- 10 pieces of 6" long dialysis tubing
- 10 pieces of 8" long dialysis tubing
- 10 copies of **Diagrams of a Baby's Life Support**

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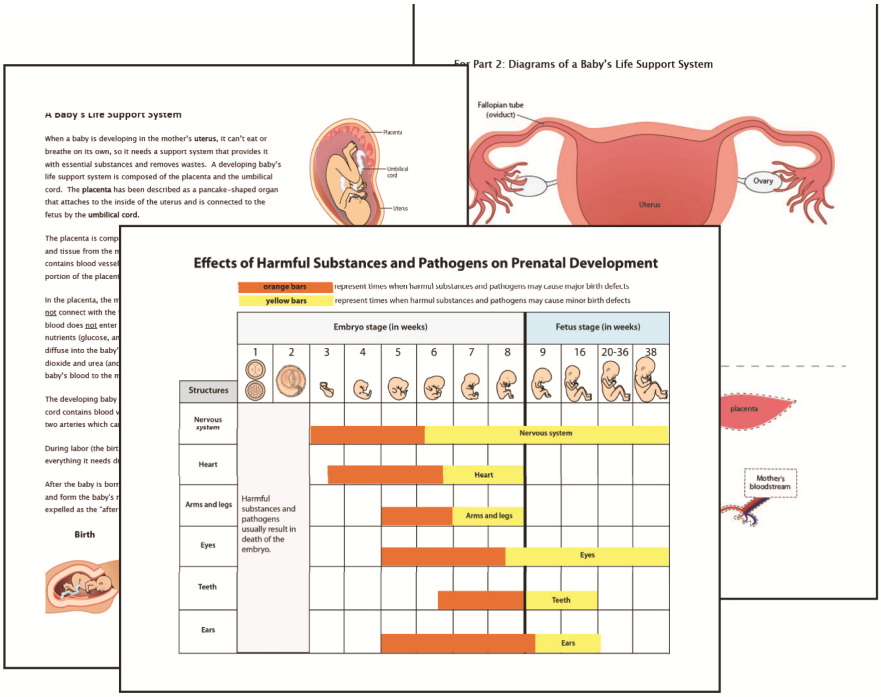
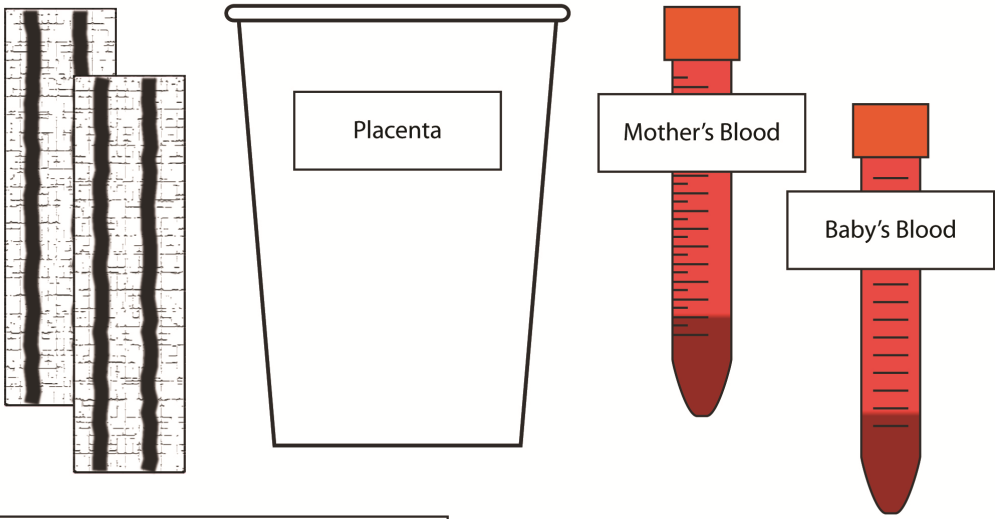
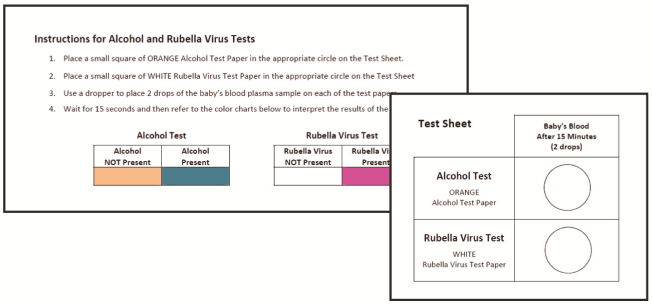
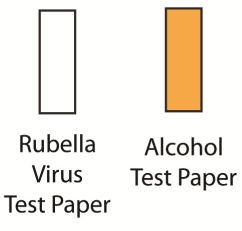
Kit Contents Quick Guide









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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.

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Life Support System for a Developing Baby

Teacher Answer Key

Part 1: What substances move from a mother's blood to her baby's blood?

When a **fetus** (developing baby) is in the mother's **uterus**, it can't eat or breathe on its own, so it needs a support system that provides it with substances essential for normal development. While in the uterus, a developing baby's life-support system is composed of the **placenta** and the **umbilical cord**. The placenta has been described as a pancake-shaped organ that attaches to the inside of the mother's uterus and is connected to the fetus by the umbilical cord.

The mother's blood usually contains oxygen and nutrients such as glucose, amino acids, and lipids. In the placenta, oxygen and nutrients **diffuse** from the mother's blood into the baby's blood. Waste products, such as carbon dioxide and urea, diffuse from the baby's blood to the mother's blood.

If the mother takes in harmful substances such as alcohol or nicotine, her blood may also contain these harmful substances. If she is sick, there may also be pathogens, such as viruses or bacteria, present in her blood.

1. **Label the diagram on the right.**
   - Fetus
   - Placenta
   - Umbilical Cord
   - Mother's Uterus

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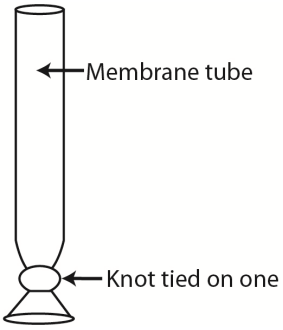
Follow the instructions below to create a model of a baby's and mother's blood vessels in the placenta. You will use this model to determine whether **alcohol** and **the viruses which cause rubella (German measles)** can move from the mother's blood into her baby's blood.

2. Fill the cup labeled "Placenta" approximately ½ full of <u>warm</u> tap water.

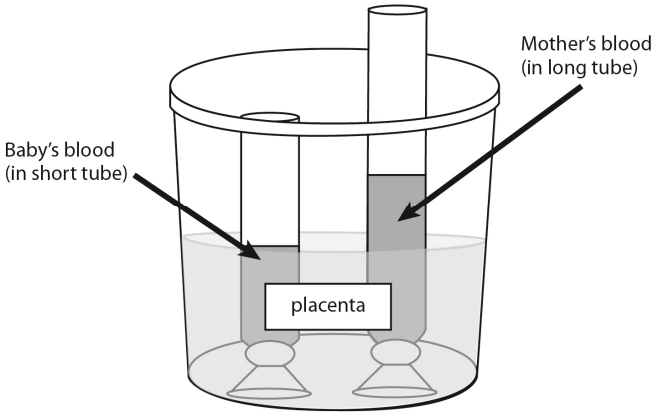
3. Prepare <u>two</u> membrane tubes:



   - Dip one end of each <u>black-striped</u> membrane tube into water to soften it.
   - Tie the moistened end of each of the black-striped membrane tubes into a knot and pull it tight to close it off. The other end should remain open.

4. The shorter membrane tube represents the baby's blood vessels.
   - Shake the tube of "Baby's Blood" to get the red blood cells (represented by glitter) mixed with the fluid in the tube.
   - Pour the entire tube of "Baby's Blood" into the <u>shorter</u> tube.
   - Replace the cap on the tube and return the tube to the kit bag.

5. Carefully set the membrane tube containing the "Baby's Blood" into the cup labeled "Placenta." See the diagram below.



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6. The longer membrane tube represents the mother's blood vessels.

   - Shake the tube of "Mother's Blood" to get the red blood cells (represented by glitter) mixed with the fluid in the tube.
   - Pour the entire tube of "Mother's Blood" into the <u>longer</u> tube.
   - Replace the cap on the tube and return the tube to the kit bag.

The mother's blood contains:

- Alcohol (she consumed an alcoholic beverage)
- Viruses (she has a case of the measles)

7. Carefully set the membrane tube containing the "Mother's Blood" into the cup labeled "Placenta."

8. Note the time _____

Wait for <u>15 minutes</u> to allow the diffusion process to occur.

While you wait, go on to complete Parts 2 and 3 (pages 5 through 9).

Answer questions 9–12 <u>after waiting for at least 15 minutes</u>.

9. The glitter in your model represents red blood cells. Do the mother's blood cells diffuse into the baby's blood? Explain how you can tell.

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10. Follow the instructions in your lab kit to test the baby's blood (in the shorter tube) for alcohol and the viruses that cause rubella (German measles). Record the results of the tests in the data table below.

11. The data table below shows the substances that were present in the mother's blood and the baby's blood at the beginning of the experiment and the data you collected from testing the baby's blood.

Harmful Substances	Present in Mother's Blood at Beginning of Experiment (yes or no)	Present in Baby's Blood at Beginning of Experiment (yes or no)	Present in Baby's Blood at End of Experiment (yes or no)
Alcohol	**yes**	**no**	
Viruses that cause rubella	**yes**	**no**	

12. What substances moved from the mother's blood to the baby's blood? Support your answer with information from the data table above.

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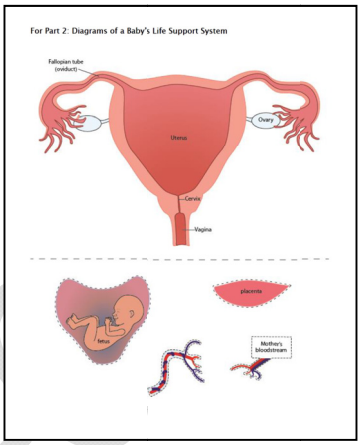
Part 2: A paper model of a baby's life support system



1. Your lab kit contains an information sheet (**A Baby's Life Support System**) and a sheet of diagrams (**Diagrams of a Baby's Life Support System**) that illustrate a developing baby and its support system.

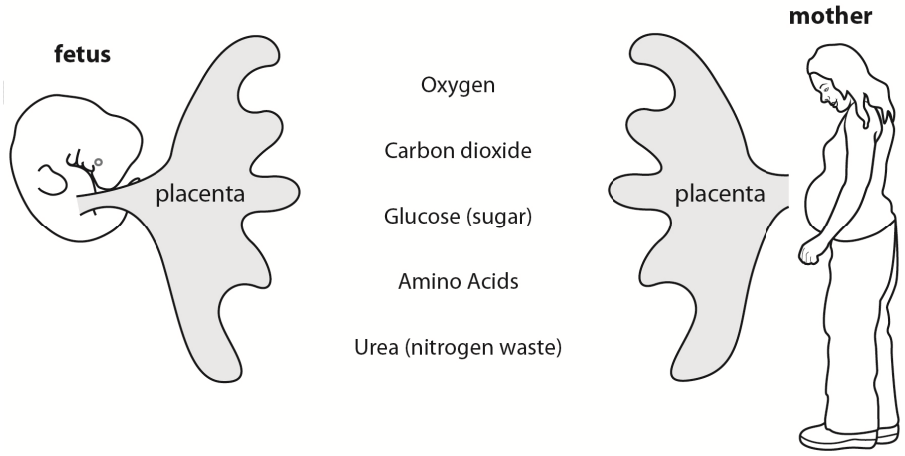
2. Cut along the dotted lines on the sheet of diagrams to create a set of five pieces that show the parts of a baby's support system.

3. Use the information in the **A Baby's Life Support System** sheet to put the cut-out pieces together to make a paper model of the support system for a developing baby.

Use your paper model and the information sheet (A Baby's Life Support System) to answer questions 4 through 8.

4. Does the maternal (mother's) blood flow directly into the fetal (developing baby's) blood? Explain why or why not.

5. On the diagram of the placenta below, draw arrows (→ or ←) to indicate the direction that each of the substances would diffuse. *Hint: Refer to the **A Baby's Life Support System** information sheet.*



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6. Explain why the placenta is essential for the normal development of a fetus.

7. The blood vessels of the mother and baby are <u>not</u> directly connected to each other. Explain how some substances in the maternal blood can enter the fetal blood.

8. In some rare cases, the placenta separates from the uterus before a baby is born. How might this effect the baby's development?

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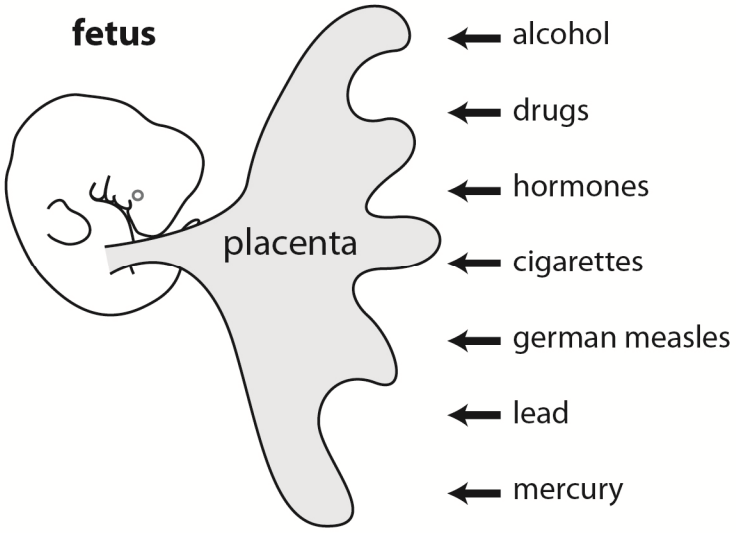
Part 3: Problems with Prenatal Development

Scientists know that prenatal (before birth) exposure to harmful substances and some pathogens (disease causing viruses or bacteria) may interfere with the normal development of a baby.



Your lab kit contains a chart (**Effects of Harmful Substances and Pathogens on Prenatal Development**) that illustrates when a baby's developing organs are most likely to be affected by harmful substances or pathogens. Use the information in this chart to answer the questions below.

1. What does the term "prenatal" mean?

2. An **embryo** is an unborn offspring in whom the major body organs are still forming. Once the major organs have formed, the unborn offspring is called a **fetus.** At the beginning of what week does an embryo become a fetus?

3. When is a mother's exposure to toxins or pathogens most likely to cause the most serious harm to a developing baby—early in pregnancy or late in pregnancy?

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4. Most women do not suspect they are pregnant until the third or fourth week of pregnancy. Which two structures of the developing baby are most likely to be seriously harmed by exposure to harmful substances before the mother realizes she is pregnant?

5. Which two structures of a developing baby's body are most likely to be damaged by exposure to harmful substances during the **fetal** stage of pregnancy?

Use the information in the two boxes below to answer questions 6 through 9.

Fetal Alcohol Syndrome

Fetal Alcohol Syndrome is a condition that results from alcohol exposure during pregnancy. Birth defects associated with fetal alcohol syndrome include physical deformities, mental retardation, learning disorders, vision difficulties and behavioral problems.

Even moderate alcohol intake, and especially periodic binge drinking, can seriously damage a developing baby. In the early months of a pregnancy, many women don't even know that they are pregnant. Therefore, it is very important for women who are thinking about becoming pregnant to adopt healthy behaviors before they get pregnant.

Mothers who drink alcohol during the first three months of pregnancy have children with the most severe problems because that is when the major organs such as the brain and the heart are developing. Even in the last six months of pregnancy, a baby's brain is still developing and may be damaged by alcohol.

Congenital Rubella Syndrome

Rubella (also called German measles) is a mild childhood illness, but it can cause serious birth defects to unborn children. About 25 percent of babies whose mothers get rubella in the first three months of pregnancy are born with one or more serious birth defects including heart problems, eye defects, hearing loss, and mental retardation.

Many women are immune to the rubella virus because they received a childhood vaccine to prevent rubella. Women who have not been vaccinated for rubella, should consider being vaccinated at least 28 days before trying to get pregnant.

Pregnant women are routinely tested for rubella immunity at an early prenatal doctor's appointment. If a pregnant woman finds out she is not immune, she should not be vaccinated during pregnancy. All she can do is try to avoid exposure to anyone with the illness.

6. Describe two symptoms of **fetal alcohol syndrome**.

7. Describe two symptoms of **congenital rubella syndrome.**

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8. Describe <u>two</u> actions women should take to prevent birth defects BEFORE they know they are pregnant. *Hint: Refer to the readings in the two boxes on the previous page.*

9. Describe <u>two</u> actions women should take to prevent birth defects AFTER they know they are pregnant. *Hint: Refer to the readings in the two boxes on the previous page.*

Be sure to go back and complete Part 1 by answering questions 9 through 12 on pages 3 and 4.

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MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): "Mother's Blood" and "Baby's Blood"

Product identity: 25% dilution of buffer pH 10

Distributor: ScholAR Chemistry; 5100 W. Henrietta Rd, Rochester, NY 14586; (866) 260-0501; www.Scholarchemistry.com

Telephone number for information: (718)338-3618 Medical emergency phone number (Chemtrec): (800) 424-9300

Date of this MSDS: 3/6/13

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients	CAS Numbers	% Weight/Volume (balance is water)
Sodium carbonate	497-19-8	0.0625%
Sodium bicarbonate	144-55-8	0.0375%

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

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

Potential Health Effects
This material is not considered hazardous.
Target organs: None known.

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: 0 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

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

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

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

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

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 yellow liquid

10. STABILITY AND REACTIVITY

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

11. TOXICOLOGICAL INFORMATION

Sodium Hydroxide: LD50 [oral, rabbit]; N/A; LC50 [rat]; N/A; LD50 Dermal [rabbit]; N/A

Material has not been found to be a carcinogen nor produce genetic, reproductive, or developmental effects.

Effects of Overexposure:
Acute: Essentially non-hazardous.
Chronic: None known.
Conditions aggravated/Target organs: none known
Primary Route(s) of Entry: Ingestion or skin contact.

12. ECOLOGICAL INFORMATION

No ecological 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

D.O.T. SHIPPING NAME: Not regulated

15. REGULATORY INFORMATION

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.

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