Human Physiology

ETC Press Inc.

Scope and Sequence

Expectations for 9-12

Students will develop their observational skills by using their senses and selected observational tools. They will gather and record information in a number of ways, and they will reflect on these findings to identify patterns or connections, make predictions, and test and refine their ideas with increasing accuracy.

Students will explore the way objects and phenomena function, identify parts of a system, and gain an understanding of increasingly complex cause and effect relationships. They will examine change over time, and they will recognize that change may be affected by one or more variables.

Students will reflect on the impact that the application of science, including advances in technology, has had on themselves, society and the environment. They will be aware of different perspectives and ways of organizing, and they will be able to consider how these views and customs may have been formulated. Students will examine ethical and social issues in science-related contexts and express their responses appropriately. They will use their learning in science to plan thoughtful and realistic action in order to improve their welfare and that of other living things and the environment. Students will communicate their ideas or provide explanations using their own scientific experience and that of others.

Scope and Sequence

Learning will include the development of the following knowledge, concepts and skills		Possible learning outcomes in science

Transdisciplinary theme
 	
Human Physiology
 	
An inquiry into the natural world and the way things work; the interaction between the various systems of the human body; the impact of scientific and technological advances on society and on the human body.
 	
Central Idea
 	
The human body is made of several different systems. These systems must work together in order to preserve life.
 	
Key concepts
 	
• Organ Systems
• The human body
 	
Related concepts
 	
• Change
• Growth
• Connections
 	
Lines of inquiry
 	
• Functions of various organ systems
• Processes associated with the systems
• Factors affecting the organ systems
	Science Strands
	
	Human organ systems
	
	Science Skills
	
	1. Observe carefully in order to gather data
	2. Use a variety of sources to gather data and incorporate it into presentable ideas
	3. Use scientific vocabulary to explain observations and experiences
	4. Identify or generate a question or problem to be explored
	5. Plan and carry out systematic investigations, manipulate variables as necessary
	6. Make and test predictions
	7. Interpret and evaluate data gathered in order to draw conclusions
	8. Consider scientific models and applications of these models (including their limitations)
		The student will be able to:
		
		• Recognize that the human body is made of several systems, all of which need to work together in order to sustain and maintain proper living conditions.
		• Identify the structures and parts of the major organ systems as follows:
		  • Circulatory system
		  • Digestive system
		  • Endocrine system
		  • Integumentary system
		  • Lymphatic system
		  • Immune system
		  • Muscular system
		  • Nervous system
		  • Reproductive system
		  • Respiratory system
		  • Skeletal system
		  • Urinary system
		  • Vestibular system
		• Analyze similarities and differences in the major systems that are found in all living organisms
		• Be aware of the role each system plays in the process of maintaining life

Materials List

ETC recommends obtaining your materials from a reputable scientific company. We currently recommend Carolina Biological Supply Company. The following list is based on items obtained from Carolina Supply Company. Before ordering please verify the item # and the price.

Website: www.carolina.com

Human Physiology			
Item #	**Product**	**Qty**	**Price Each**
146510	Thyroxine Powder for Tadpole Growth Experiment	1	$5.95
146552	Bullfrog Tadpole, Living Medium, up to 2 in. Pk 12 (Nevada Permit Req.)	1	$16.60
228764	Carolina's Perfect Solution Sheep Eye, Plain, 1 Per Bag	3	$1.95
311126	Sarfish Development, w.m.	1	$10.15
311132	Starfish Development, sec 7 µm H&E	1	$9.20
312952	Mammal Compact Bone, c.s. 7 µm H&E	3	$6.00
849165	Bromthymol Blue, 0.04% Aqueous, Laboratory Grade, 500 mL	1	$6.25
867821	Hydrochloric Acid, 0.1 M (0.3% v/v), Laboratory Grade, 500 mL	1	$5.95
868600	Indophenol, Laboratory Grade, 1 g	3	$9.50
879378	Pepsin, Reagent Grade, 20 g.	2	$8.95
888360	Sodium Bicarbonate, Powder, Reagent Grade, 500 g	1	$6.25
895511	Acid/Base Indicator Strips, Pckg 100 each	1	$3.60

MSDS Material Safety Data Sheet

Making Limewater:

Limewater is used in many science experiments and is easy to make on your own. Put 1 teaspoon of **calcium hydroxide** in a clean glass jar, up to 1 gallon in size. (Limewater is a saturated solution, which means there will be some extra chemical that doesn't dissolve. A teaspoon will result in a fully saturated solution whether you use a gallon jar or a smaller one.) Fill the jar with distilled or tap water. Shake the jar vigorously for 1-2 minutes, then let it stand for 24 hours. Being careful not to stir up the sediment, pour the clearer solution off the top of the jar through a clean **coffee filter or filter paper**. Repeat the filtering step if necessary to obtain a clear limewater solution. Store in a clean jar or bottle.

When carbon dioxide is bubbled into limewater, calcium carbonate ($CaCO_3$) is produced. It precipitates out as a white suspended solid, making the solution appear cloudy.

DANGER! HARMFUL IF SWALLOWED OR INHALED. CAUSES BURNS TO SKIN AND EYES. CAUSES SEVERE IRRITATION TO RESPIRATORY TRACT.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects
Inhalation: Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Can cause chemical bronchitis.

Ingestion: Gastric irritant. Ingestion may be followed by severe pain, vomiting, diarrhea, and collapse. If death does not occur in 24 hours, esophageal perforation may occur, as evidenced by fall in blood pressure and severe pain. A narrowing of the esophagus may occur weeks, months, or years after ingestion, making swallowing difficult.
Skin Contact: Corrosive. May cause severe burns and blistering, depending on duration of contact.

Eye Contact: Corrosive. May produce severe irritation and pain. May induce ulcerations of the corneal epithelium. Can cause blindness.

Chronic Exposure: Prolonged or repeated skin contact may produce severe irritation or dermatitis.

Aggravation of Pre-existing Conditions: Persons with pre-existing skin problems or impaired respiratory function may be more susceptible to the effects of this substance.

First Aid Measures
Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

Ingestion: DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact: In case of contact, wipe off excess material from skin then immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.

Eye Contact: Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

MSDS Material Safety Data Sheet

BROMOTHYMOL BLUE SOLUTION

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1. Product Identification
Synonyms: 3,3',-Dibromothymolsulfonphthalein, sodium salt in aqueous solution; Bromothymol Blue 0.04% (w/v) Aqueous pH 6.0 to 7.6
CAS No.: 34722-90-2
Molecular Weight: 646.35
Chemical Formula: C27H27Br2O5SNa
Product Codes: D472

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2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Bromothymol Blue Sodium Salt	34722-90-2	< 1%	No
Water	7732-18-5	> 99%	No

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3. Hazards Identification
Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
No adverse health effects expected from inhalation.
Ingestion:
Large doses may cause stomach upset.
Skin Contact:

Not expected to be a health hazard. May cause slight irritation.
Eye Contact:
Splashes may cause irritation.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

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4. First Aid Measures
Inhalation:
Not expected to require first aid measures.
Ingestion:
If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

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5. Fire Fighting Measures
Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

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6. Accidental Release Measures
Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust.

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7. Handling and Storage
Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage, direct sunlight, and freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection
Airborne Exposure Limits:
None established.
Ventilation System:
Not expected to require any special ventilation.
Personal Respirators (NIOSH Approved):
Not expected to require personal respirator usage.

Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Safety glasses.

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9. Physical and Chemical Properties
Appearance:
Light green to clear amber solution.
Odor:
Odorless.
Solubility:
Completely soluble in water.
Specific Gravity:
ca. 1.0
pH:
No information found.
% Volatiles by volume @ 21C (70F):
No information found.
Boiling Point:
ca. 100C (ca. 212F)
Melting Point:
ca. 0C (ca. 32F)
Vapor Density (Air=1):
Essentially the same as water.
Vapor Pressure (mm Hg):
Essentially the same as water.
Evaporation Rate (BuAc=1):
Essentially the same as water.

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10. Stability and Reactivity
Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
No hazardous decomposition products.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
No incompatibility data found.
Conditions to Avoid:
No information found.

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11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Bromothymol Blue Sodium Salt (34722-90-2)	No	No	None
Water (7732-18-5)	No	No	None

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12. Ecological Information
Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

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13. Disposal Considerations
Dilute with water and flush to sewer if local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information
Not regulated.

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Bromothymol Blue Sodium Salt (34722-90-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Bromothymol Blue Sodium Salt (34722-90-2)	No	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Bromothymol Blue Sodium Salt (34722-90-2)	No	No	No	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Bromothymol Blue Sodium Salt (34722-90-2)	No	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information
NFPA Ratings: Health: 0 Flammability: 0 Reactivity: 0
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
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MSDS Material Safety Data Sheet

HYDROCHLORIC ACID

1. Product Identification

Synonyms: Muriatic acid solution; 10:1 Dilute Hydrochloric acid; Hydrochloric acid volumetric solutions (0.2 - 2.0 N)
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl in water
Product Codes:
J.T. Baker: 0325, 0335, 0336, 4655, 5612, 5616, 5620, 5622, D010, D011, XL-231, XL-232
Mallinckrodt: 6388, H162, H163

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2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	0.7 - 8%	Yes
Water	7732-18-5	92 - 99%	No

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3. Hazards Identification

Emergency Overview

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Health hazards given on this data sheet apply to concentrated solutions of hydrochloric acid. Hazards of dilute solutions may be reduced, depending upon the concentration. Degree of hazard for these reduced concentrations is not currently addressed in the available literature.

Inhalation:

Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea, and in severe cases, death.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

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4. First Aid Measures
First aid procedures given apply to concentrated solutions. Exposures to dilute solutions may not require these extensive first aid procedures.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

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5. Fire Fighting Measures
Fire:
Not considered to be a fire hazard. May react with metals or heat to release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water or water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

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6. Accidental Release Measures
Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material

(e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

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7. Handling and Storage
Store at room temperature. Store in a dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection
Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
2 ppm (Ceiling), A4 Not classifiable as a human carcinogen
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, Industrial Ventilation, A Manual of Recommended Practices, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties
Appearance:
Clear, colorless solution.
Odor:
Pungent, hydrochloric acid.
Solubility:
Infinitely soluble.
Specific Gravity:
ca. 1

pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100 (as water and acid)
Boiling Point:
ca. 100C (ca. 212F)
Melting Point:
ca. 0C (ca. 32F)
Vapor Density (Air=1):
Essentially the same as water.
Vapor Pressure (mm Hg):
Essentially the same as water.
Evaporation Rate (BuAc=1):
Essentially the same as water.

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10. Stability and Reactivity
Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight, incompatibles.

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11. Toxicological Information

Hydrochloric acid: Inhalation rat LC50: 3124 ppm/1H; Oral rabbit LD50: 900 mg/kg. Investigated as a tumorigen, mutagen, reproductive effector.

--------\Cancer Lists\----------

	---NTP Carcinogen---		
Ingredient	Known	Anticipated	IARC Category
Hydrogen Chloride (7647-01-0)	No	No	3
Water (7732-18-5)	No	No	None

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12. Ecological Information
Environmental Fate:
For Hydrochloric Acid (Concentrated Solutions):
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
For Hydrochloric Acid (Concentrated Solutions):
This material may be toxic to aquatic life. LC50 Shrimp: 100-300 ppm/48-hr/salt water; LC100 trout: 10 mg/l/24-hr; TLm mosquito fish: 282 ppm/96-hr.

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13. Disposal Considerations
Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information
Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID SOLUTION
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID SOLUTION
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 20L

International (Air, I.C.A.O.)

Proper Shipping Name: HYDROCHLORIC ACID SOLUTION
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 20L

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---

Ingredient	TSCA	EC	Japan	Australia
Hydrogen Chloride (7647-01-0)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\---

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\---

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information
NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0
Label Hazard Warning:
DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In all cases get medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 7.
Disclaimer:
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MSDS Material Safety Data Sheet

2,6-DICHLOROINDOPHENOL SODIUM SALT

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1. Product Identification

Synonyms: 2,6-dichloro-4-[(4-hydroxyphenyl)imino]-2,5-cyclohexadien-1 -one sodium salt
CAS No.: 620-45-1
Molecular Weight: 290.08
Chemical Formula: O:C6H2(Cl2):N-C6H4ONa
Product Codes:
J.T. Baker: H116
Mallinckrodt: 3054

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2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
2,6-Dichloroindophenol Sodium Salt	620-45-1	90 - 100%	Yes

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3. Hazards Identification

Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 1 - Slight
Reactivity Rating: 0 - None
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
No adverse health effects expected from inhalation.
Ingestion:
Extremely large oral doses may cause gastrointestinal disturbances.

Skin Contact:
No adverse effects expected.
Eye Contact:
High concentrations of dust may cause mechanical irritation.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

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4. First Aid Measures
Inhalation:
Not expected to require first aid measures.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

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5. Fire Fighting Measures
Fire:
As with most organic solids, fire is possible at elevated temperatures or by contact with an ignition source.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures
Remove all sources of ignition. Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air. Use non-sparking tools and equipment. Reduce airborne dust and prevent scattering by moistening with water. Pick up spill for recovery or disposal and place in a closed container.

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7. Handling and Storage
Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Isolate from oxidizing materials. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection
Airborne Exposure Limits:
None established.
Ventilation System:

In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties
Appearance:
Dark green powder.
Odor:
Odorless.
Solubility:
Freely soluble.
Density:
No information found.
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity
Stability:
Stable under ordinary conditions of use and storage. Hygroscopic.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, nitrogen oxides and hydrogen chloride when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, moisture, air, incompatibles.

---

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
2,6-Dichloroindophenol Sodium Salt (620-45-1)	No	No	None

---

12. Ecological Information
Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations
Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information
Not regulated.

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
2,6-Dichloroindophenol Sodium Salt (620-45-1)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	--Canada-- Korea	DSL	NDSL	Phil.
2,6-Dichloroindophenol Sodium Salt (620-45-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
2,6-Dichloroindophenol Sodium Salt (620-45-1)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	-RCRA- CERCLA	261.33	-TSCA- 8(d)
2,6-Dichloroindophenol Sodium Salt (620-45-1)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information
NFPA Ratings: Health: 0 Flammability: 1 Reactivity: 0
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****

MSDS Material Safety Data Sheet

PEPSIN

---

1. Product Identification
Synonyms: Pepsin A; Pepsin NF; Pepsinum; Puerzym
CAS No.: 9001-75-6
Molecular Weight: 34500
Chemical Formula: Not applicable.
Product Codes:
J.T. Baker: 2844
Mallinckrodt: 2629

---

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Pepsin A	9001-75-6	100%	Yes

---

3. Hazards Identification
Emergency Overview

WARNING! MAY CAUSE IRRITATION TO SKIN AND EYES. MAY CAUSE ALLERGIC SKIN REACTION.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 1 - Slight
Reactivity Rating: 0 - None
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
May cause sensitisation by inhalation.
Ingestion:
Large doses may cause gastro-intestinal upset. May cause an allergic reaction.
Skin Contact:

May cause irritation, allergic reaction. May result in reddening, burning sensation.
Eye Contact:
May cause irritation.
Chronic Exposure:
Possible hypersensitivity, dermatitis.
Aggravation of Pre-existing Conditions:
Individuals with dermatitis or hypersensitivity to material may be more susceptible to the effects of the substance.

---

4. First Aid Measures
Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
If large amounts were swallowed, give water to drink and get medical advice.
Skin Contact:
Immediately flush skin with plenty of soap and water. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

---

5. Fire Fighting Measures
Fire:
As with most organic solids, fire is possible at elevated temperatures or by contact with an ignition source. Being an animal protein, Pepsin is assumed to be combustible. Avoid inhalation of combustion fumes. Pepsin powder may, on being transferred from container to container, generate static electrical charge, which could discharge violently.
Explosion:
Fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures
Remove all sources of ignition. Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air. Use non-sparking tools and equipment. Reduce airborne dust and prevent scattering by moistening with water. Pick up spill for recovery or disposal and place in a closed container.

---

7. Handling and Storage
Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection
Airborne Exposure Limits:
None established.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, Industrial Ventilation, A Manual of Recommended Practices, most recent edition, for details.
Personal Respirators (NIOSH Approved):
For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties
Appearance:
White to light yellow powder.
Odor:
Characteristic odor.
Solubility:
Soluble in water.
Specific Gravity:
No information found.
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity
Stability:
Stable under ordinary conditions of use and storage. Somewhat hydroscopic.
Hazardous Decomposition Products:
Burning may produce carbon monoxide, carbon dioxide, nitrogen oxides.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Tannin, alkalis, salts of heavy metals, strong oxidizers.
Conditions to Avoid:

Moisture, heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Pepsin A (9001-75-6)	No	No	None

---

12. Ecological Information
Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations
Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information
Not regulated.

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Pepsin A (9001-75-6)	Yes	Yes	No	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	--Canada-- Korea	DSL	NDSL	Phil.
Pepsin A (9001-75-6)	Yes	No	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Pepsin A (9001-75-6)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

	-RCRA-	-TSCA-

Ingredient	CERCLA	261.33	8(d)
Pepsin A (9001-75-6)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information
NFPA Ratings: Health: 1 Flammability: 1 Reactivity: 0
Label Hazard Warning:
WARNING! MAY CAUSE IRRITATION TO SKIN AND EYES. MAY CAUSE ALLERGIC SKIN REACTION.
Label Precautions:
Avoid contact with eyes, skin and clothing.
Keep container closed.
Wash thoroughly after handling.
Label First Aid:
In case of skin contact, immediately flush skin with plenty of soap and water. Remove contaminated clothing and shoes. Wash clothing before reuse. Get medical attention. In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****
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MSDS Material Safety Data Sheet

SODIUM BICARBONATE

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1. Product Identification
Synonyms: Sodium hydrogen carbonate; sodium acid carbonate; baking soda; bicarbonate of soda
CAS No.: 144-55-8
Molecular Weight: 84.01
Chemical Formula: NaHCO3
Product Codes:
J.T. Baker: 3506, 3508, 3509, 3510
Mallinckrodt: 7285, 7396, 7397, 7412, 7749, 7903

---

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Bicarbonate	144-55-8	99 - 100%	No

---

3. Hazards Identification
Emergency Overview

As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Green (General Storage)

Potential Health Effects

Inhalation:
High concentrations of dust may cause coughing and sneezing.
Ingestion:
Extremely large oral doses may cause gastrointestinal disturbances.

Skin Contact:
No adverse effects expected.
Eye Contact:
Contact may cause mild irritation, redness, and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

---

4. First Aid Measures
Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
Give several glasses of water to drink to dilute. If large amounts were swallowed, get medical advice.
Skin Contact:
Not expected to require first aid measures.
Eye Contact:
Wash thoroughly with running water. Get medical advice if irritation develops.

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5. Fire Fighting Measures
Fire:
Not considered to be a fire hazard.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Special Information:
Use protective clothing and breathing equipment appropriate for the surrounding fire.

---

6. Accidental Release Measures
Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal. Small amounts of residue may be flushed to sewer with plenty of water.

---

7. Handling and Storage
Keep in a well closed container stored under cold to warm conditions, 2 to 40 C, (36 to 104F). Protect against physical damage. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection
Airborne Exposure Limits:
None established.
Ventilation System:
In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.
Personal Respirators (NIOSH Approved):

For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear protective gloves and clean body-covering clothing.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties
Appearance:
White crystalline powder.
Odor:
Odorless.
Solubility:
7.8g/100g water @ 18C (64F).
Density:
2.2
pH:
8.3 (0.1 molar @ 25C (77F))
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
Not applicable.
Melting Point:
60C (140F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity
Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Gaseous carbon dioxide.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Reacts with acids to form carbon dioxide. Dangerous reaction with monoammonium phosphate or a sodium-potassium alloy.
Conditions to Avoid:
Heat, moisture, incompatibles.

---

11. Toxicological Information

Investigated as a mutagen, reproductive effector. Oral rat LD50: 4220 mg/kg. Irritation data: human,skin, 30mg/3D-I mild, rabbit,eye, 100 mg/30 S, mild.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Bicarbonate (144-55-8)	No	No	None

---

12. Ecological Information
Environmental Fate:
No information found.
Environmental Toxicity:
For Sodium Bicarbonate:
48 hour EC50 Daphnia magna (water flea) : 2350 mg/L.
96 hour LC50 Lepomis macrochirus (bluegill) : > 5000 mg/L.
120 hour EC50 Nitzschia linearis (diatom) : 650 mg/L.

This material is not expected to be toxic to aquatic life.

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13. Disposal Considerations
Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information
Not regulated.

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Sodium Bicarbonate (144-55-8)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	--Canada-- Korea	DSL	NDSL	Phil.
Sodium Bicarbonate (144-55-8)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Bicarbonate (144-55-8)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	-RCRA- CERCLA	261.33	-TSCA- 8(d)
Sodium Bicarbonate (144-55-8)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: No Chronic: No Fire: No Pressure: No
Reactivity: No (Pure / Solid)

Australian Hazchem Code: None allocated.
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information
NFPA Ratings: Health: 1 Flammability: 0 Reactivity: 0
Label Hazard Warning:
As part of good industrial and personal hygiene and safety procedure, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes and clothing.
Label Precautions:
None.
Label First Aid:
Not applicable.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****

Bones

Notes and Tips

Background tips:

Depending on how thick the bone is, demineralization can take anywhere from 5 to 7 days to complete. Remind students to check the bones daily.

NOTE: Any part of a bone that touches the glass of a beaker will NOT decalcify and the experiment will result in failure. Line the beaker with gauze to help the bones to decalcify more evenly.

NOTE: HCL is an acid that will cause damage and harm. Please make sure that your students have a safety sink available when dealing with this chemical.

Remind students to always begin on low power when focusing their microscope and then move to a higher power magnification.

Points of Interest and observations:

1. Water loss causes bones to become brittle
2. Mineral loss causes bones to become more flexible
3. Demineralizing bones requires that they soak in HCL. HCL contains water which in turn is absorbed by the bones. That water must be removed before they obtain masses.
4. A slide of demineralized bone would show that the cells of the bones have collapsed. Such a bone would lack such characteristics as a Haversian canal or osteocytes.
5. When demineralized bone is dried, students will observe that the bone actually falls apart. The reason for this is because there is nothing there to hold the bone together.
6. After completing the experiments, ask the students what would happen if a person was on a diet lacing calcium. Such a person could have reduced growth, bone deformities, or weak bones, since the bones would lack mineral density.

Teacher's Notes

Human Digestion

Notes and Tips

Constructions:

1. To make 0.2% solution of hydrochloric acid dilute 2 mL of concentrated HCL to a final volume of 1L with distilled water.
2. To make a 1% sodium bicarbonate solution dilute 10 gr. of sodium bicarbonate to a final volume of 1 L with distilled water.
3. To make a 1% pepsin solution dilute 1 gr. of pepsin to a final volume of 1 L with distilled water.

* To speed up the results and make the observations within a time period of 24 hours instead of 48 hours then place the test tubes in an incubator that is functioning at 37 ^{o}C.

Answers to Observations:

1. Answers will vary based on observations
2. Answers will vary based on observations

Analysis

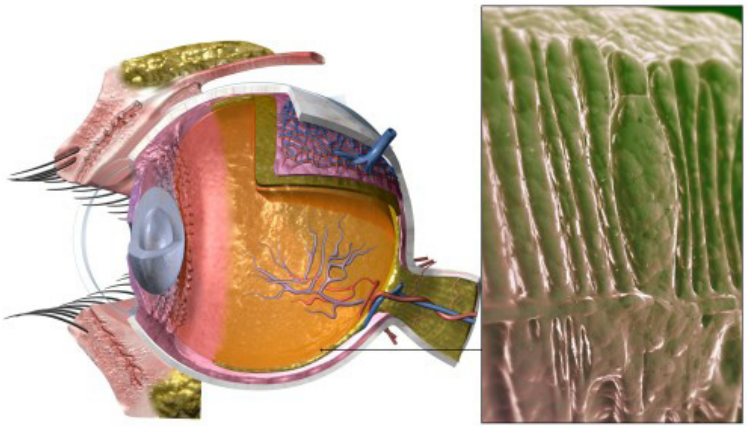
3. We need them to show that neither water, pepsin, nor acid alone would be able to digest much protein. They act as controls.
4. Pepsin requires acid in order to complete the digestion.
5. Answers will vary however, you should accept all the answers that list protein foods. Pepsin digests only protein.
6. No, however, accept all hypothetical answers since students do not have a background that allows them to understand that enzymes are required to digest lipids.

Teacher's Notes

Sheep's Eye Dissection

Notes and Tips

It would be best for the students to compare the eye they are dissecting with that of a human eye.



Answers to Observations:

1. The pupil controls the amount of light that enters the eye. In low light the pupils open up to allow a greater amount of light to enter. In bright light, the pupils tighten and become smaller so that too much light doesn't enter the eye.
2. The sensory receptors in the retina are called photoreceptors. The eye has two different types of photoreceptors and they are called the rods and cones.
3. The optic disk is the area where neurons from the retina exit and blood vessels enter through the back of the eye. At that particular spot there are no photoreceptors, therefore, there is no visual stimulation at that particular area.
4. The lens is rather hard and transparent. However, it is very elastic and can be stretched.
5. At the front of the eye the sclera becomes thin and transparent and it becomes the cornea. The choroid on the other hand changes and it is modified into the iris.
6. If the cornea became cloudy it would prevent light from entering the eye and reaching the retina. As a result it would cause black spots in the visual field.
7. The retina contains photoreceptors, which convert light energy into electrical energy and which in turn is converted into electrical pulses which are transported through the nerve to the brain allowing you to see. If the retina becomes detached then light hits the back of the eye unevenly causing some regions to not get any light. If the retina is not reattached then serious vision problems could result, even blindness.

Teacher's Notes

How Thyroxine affects From Development

Notes and Tips

For best results have students work in groups of no more than three.

Background information:

A hormone is a chemical that is secreted into the bloodstream by cells of the endocrine system.

Metamorphosis is the word that is used to describe the changes that take place in an organism from an immature stage to a mature stage.

It would be helpful for students to review the life cycle of a frog.

Answers to Observations:

1. Data will vary.
2. Using more than one tadpole allowed the students to obtain better and more accurate results.
3. Thyroxin increases the rate a tadpole grows and goes through metamorphosis.
4. The solution with the largest amount of thyroxin caused the greatest amount of change in the development of the tadpoles.

Teacher's Notes

Embryonic Development

Notes and Tips

Remind your students that their drawings should be informative and not artistic.

Locate photographs of mammalian development and supply your students with those pictures as they compare the different stages between the starfish and mammals.

Answer to background questions:

A fertilized egg becomes a completely developed organism through cell differentiation and cell division.

Answers to Observations:

1. When the embryo reaches the gastrula stage.

2. All the cells look rather spherical until the gastrula stage is reached. After that some of the cells begin to look flat, elongated or irregular. As development continues the cells tend to get smaller and smaller.

3. The nuclei do not change is size as the cells continue to change and develop.