Cell Membranes: Diffusion and Osmosis

Teacher Information

science take-out
just add students™

Summary

Students create a model cell and discover that small molecules, but not large molecules, can diffuse through the cell membrane. They explore the effect of osmosis on plant cells and animal cells.

Core Concepts

- Each cell is covered by a membrane that controls which molecules enter and leave the cell.
- The processes of diffusion and osmosis are important in the movement of materials into and out of cells.

Time Required

Two 40-minute class periods + homework.

Kit contains

- Dialysis tubing
- Starch packing peanut
- Cup
- Measuring cup
- Simulated "Glucose"
- Simulated "Glucose indicator paper"
- Iodine
- Stirrer
- Dropper
- Osmosis graphics

Teacher Provides

- Access to warm tap water
- Safety goggles for each student
- Paper towel 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 *Cell Membranes: Diffusion and Osmosis* 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:

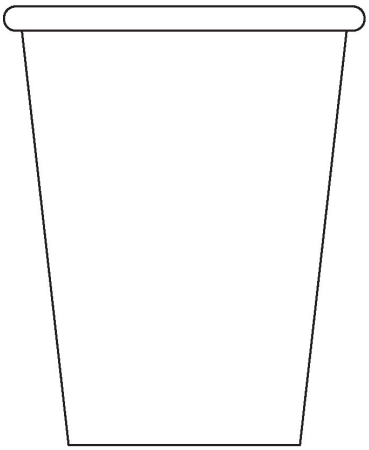
Discard	Rinse with water and dry with paper towel	Return to kit
• Used dialysis membrane and contents • Used "glucose indicator paper" strips	• Large Cup • Measuring cup • Dropper • Stirrer	• Labeled iodine and glucose tubes • Labeled plastic bag for "glucose indicator paper" • Large cup, measuring cup, dropper, and stirrer (rinsed) • Osmosis graphics*

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

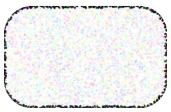
Refills for *Cell Membranes: Diffusion and Osmosis* kits are available at www.sciencetakeout.com. The **10 Kit Refill Pack** includes the following materials:

- 1 Quick Guide for refilling kit
- 10 pieces of dialysis membrane
- 10 starch packing peanuts
- 10 ml simulated "Glucose"
- 10 strips of simulated "Glucose Indicator Paper"
- 5 ml iodine
- 1 graduated transfer pipet (for teacher use)
- 1 funnel (for teacher use)

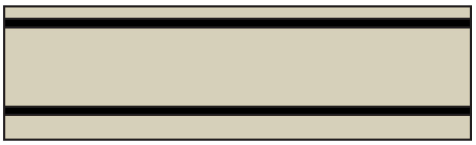
Kit Contents Quick Guide



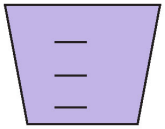
Cup



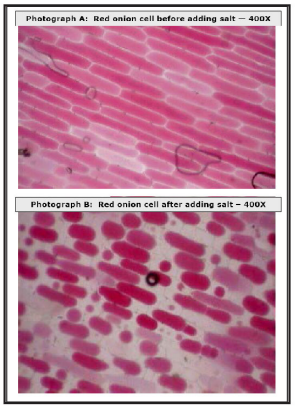
Starch packing peanut



Dialysis Tubing

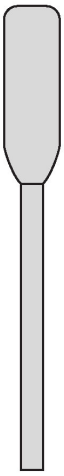


Measuring Cup

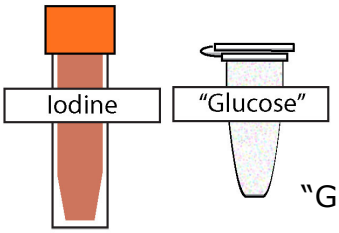


Osmosis Graphics

Stirrer



Dropper



"Glucose Indicator Paper"

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.

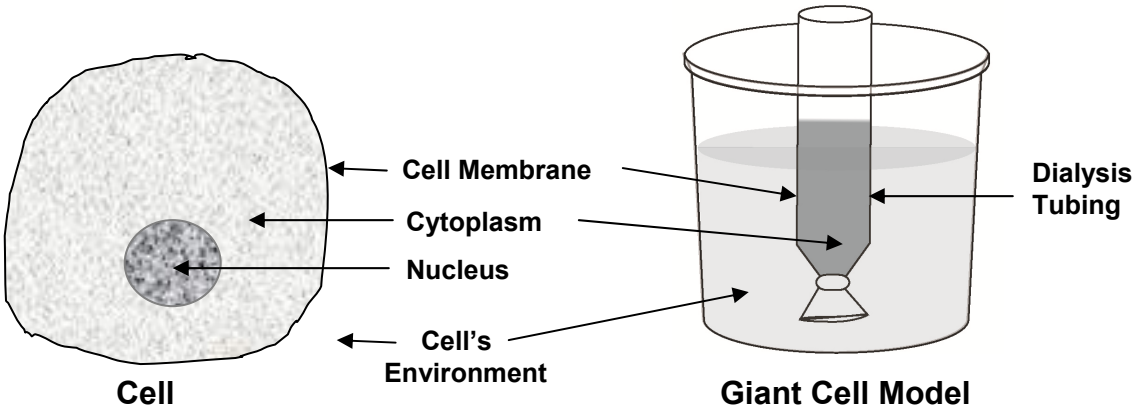
No blood or body fluids from humans or animals are used in Science Take-Out kits. Chemical mixtures are substituted as simulations of these substances.

Cell Membranes: Diffusion and Osmosis

Teacher Answer Key

Part 1: Diffusion

Diffusion is a process by which molecules move into or out of cells. To diffuse into or out of a cell, molecules must pass through the cell membrane.



Observing the diffusion process in real cells is difficult because they are too small to be seen easily. In this lab, you will make a giant model of a cell so that you can observe the effects of diffusion through a membrane. In your cell model:

- The dialysis tubing represents the "cell's membrane."
- The contents of the bag represent "cell's cytoplasm."
- The area outside the bag represents the "cell's environment."

A. Make a "Cell" model

1. Put warm tap water into the large plastic cup. The cup should be about ¾ full.

2. Empty the contents of the iodine tube into the cup of warm water. Iodine is a "starch indicator".

3. Close the end of the dialysis membrane tubing by making a knot at one end. Make sure you pull the knot tight.

4. Add 15 mL of hot water to the small measuring cup.

5. Add one starch "packing peanut" to the water in the small measuring cup. Pour the contents of the glucose tube into the small measuring cup.

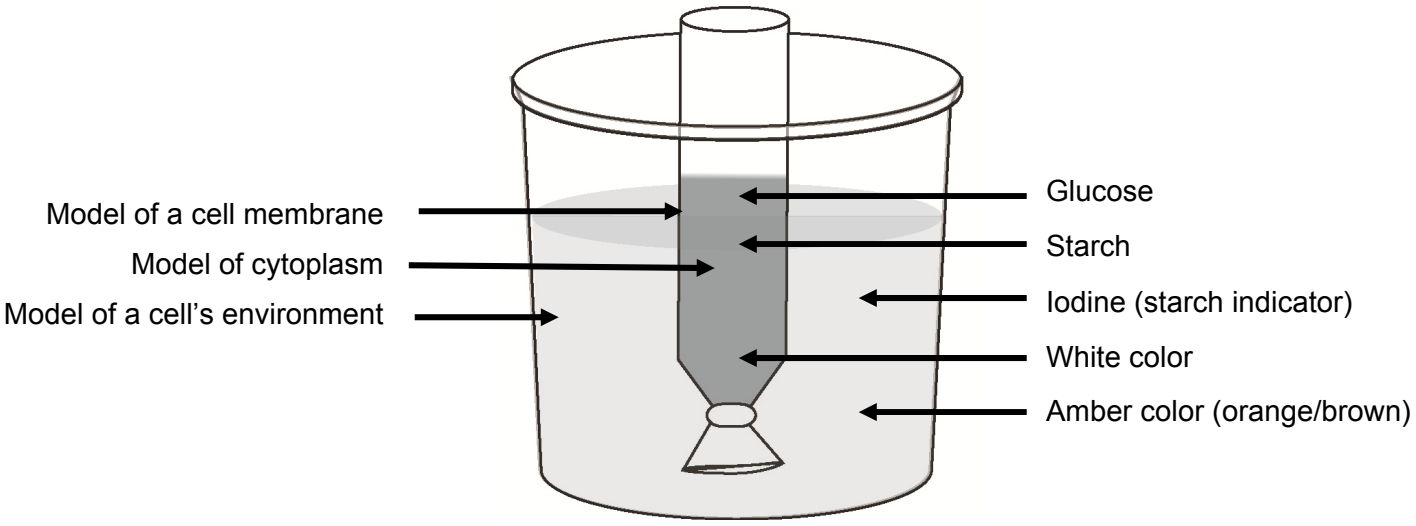
6. Mix the water, starch, and glucose thoroughly. The starch will dissolve in the hot water, but you may still see a few lumps of starch.

7. Use the plastic dropper to transfer the water, starch, and glucose mixture from the small cup into the dialysis membrane bag. Be careful not to drip any of this mixture onto the outside of the dialysis membrane bag!

8. Gently lower the dialysis membrane bag into the cup of warm water.

9. Set the cup with membrane bag aside and allow it to sit for **at least 15 minutes**.

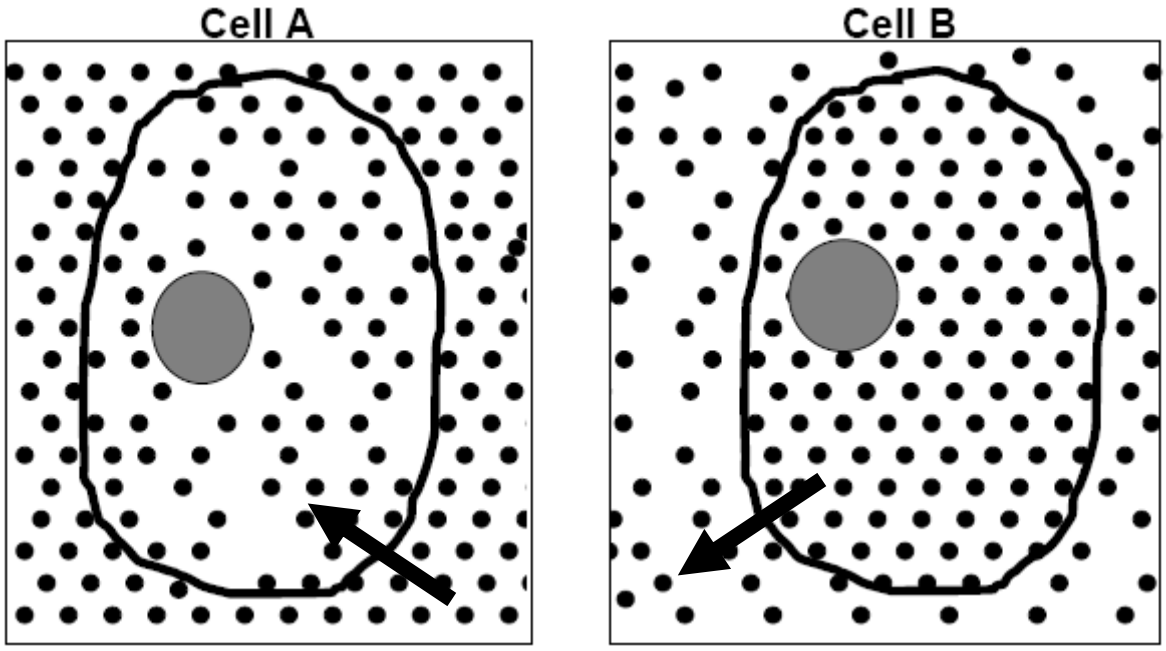
10. Label the diagram by drawing arrows between the words and the parts of the diagram of a model cell.



What is Diffusion?

Molecules are constantly moving. Collisions between moving molecules cause them to spread out. As molecules spread out they move from areas of high concentration to areas of low concentration.

Diffusion is the movement of molecules from a region of high concentration to a region of low concentration.



The small dots represent solute molecules that are dissolved in water.

11. Which cell contains a higher concentration of solute molecules (dots)? ***Cell B***

12. When molecules diffuse, they move from ***high*** (high or low) to concentration to ***low*** (high or low) concentration.

13. Draw an arrow on the diagram to indicate the direction that the solute molecules will diffuse for cell A.

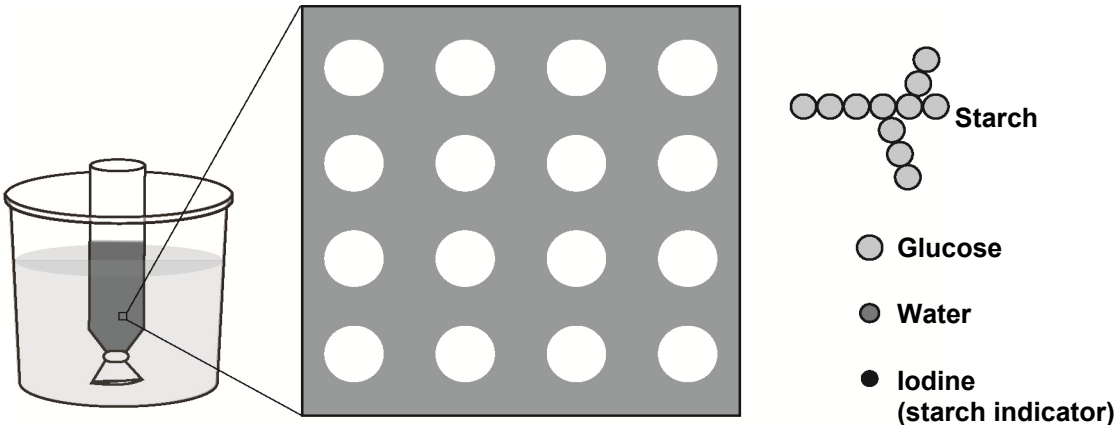
    Arrow should be drawn going INTO the cell

14. Draw an arrow on the diagram to indicate the direction that the solute molecules will diffuse for cell B.

    Arrow should be drawn going OUT of the cell

B. Predicting which molecules can diffuse through a membrane

All cells are surrounded by a porous cell membrane. The cell membrane is **selectively permeable** – it allows some molecules to enter and exit while blocking others. Small molecules can diffuse through the pores in the cell membrane, while large molecules may be blocked.



Pores in the membrane allow some small molecules to pass through

1. Explain why the dialysis tubing membrane is a "selectively permeable" membrane.

   It has pores that will allow some molecules to pass through but blocks others.

2. Put an X in front of the molecules that you predict (based on the model above) will be able to diffuse through the pores in the dialysis membrane.

   _**X**_ water _**X**_ iodine _**X**_ glucose ____ starch

   Why do you think these molecules will be able to diffuse through the membrane?

   They are small enough to fit through the pores in the membrane.

Remember that you put:
- **Water, starch, and glucose into the dialysis bag**
- **Water and iodine (starch indicator) in the cup outside the dialysis bag**

3. Put an X in front of the molecules you think will be present INSIDE the dialysis bag at the end of the experiment.

   _**X**_ water _**X**_ iodine _**X**_ glucose _**X**_ starch

4. Put an X in front of the molecules you think will be present OUTSIDE the dialysis bag at the end of the experiment.

   _**X**_ water _**X**_ iodine _**X**_ glucose ____ starch

C. Test your predictions

To determine which molecules have diffused through the membrane, you will use **chemical indicators**. Chemical indicators change color when the substance you are testing for is present. The chart below shows the chemical indicators that you will use and what colors they turn to indicate the presence of the substances you are testing for.

Indicator Chart

Chemical Indicator	Positive Test (If substance is present)	Negative Test (If substance is NOT present)
Iodine (starch indicator)	Blue-black when starch is mixed with iodine	Amber (orange-brown) when starch is not present
Glucose Indicator Paper	Green or blue when glucose is present	Orange when glucose is not present

1. Originally the mixture in the dialysis bag "cell" was white and the mixture in the cup was amber (orange-brown).
   - What color is mixture inside the "cell" (bag) now? ***Blue-black***
   - What color is the mixture outside the bag now? ***Amber (orange-brown)***

2. Use the information in the Indicator Chart, above. Explain why the color inside the bag changed. Hint: what substance diffused into the bag?

   Iodine (starch indicator) diffused into the bag. A blue-black color results when iodine is mixed with starch.

3. Did starch diffuse out of the bag (yes or no)? ***No***

   How can you tell?

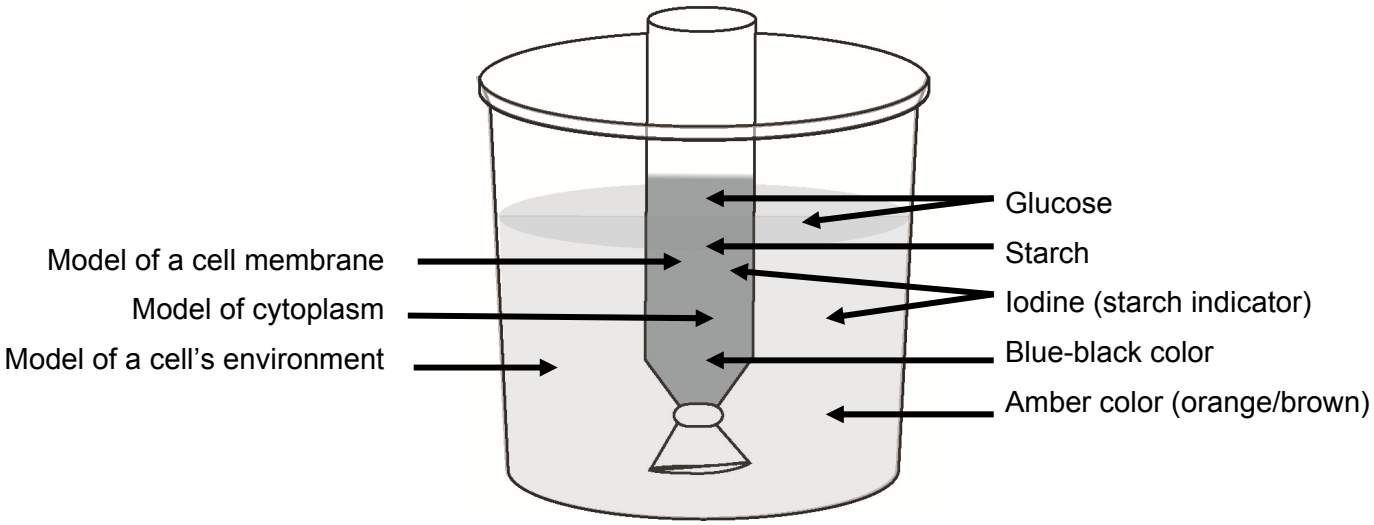
   The solution outside of the bag did not turn blue-black.

4. Test the contents of the cup using the orange glucose indicator paper. Refer to the Indicator Chart, above. Did glucose diffuse out of the bag (yes or no)? ***Yes***

   How you can you tell?

   Testing the liquid in the cup resulted in a blue or green color that indicates the presence of glucose.

5. Draw arrows between the words below and the parts of the diagram of a model cell.



Final (end) state

6. Put an X in front of the molecules that diffused through the membrane.

__X__ water __X__ iodine __X__ glucose ____ starch

7. Put an X in front of the molecules that could not diffuse through the membrane.

____ water ____ iodine ____ glucose __X__ starch

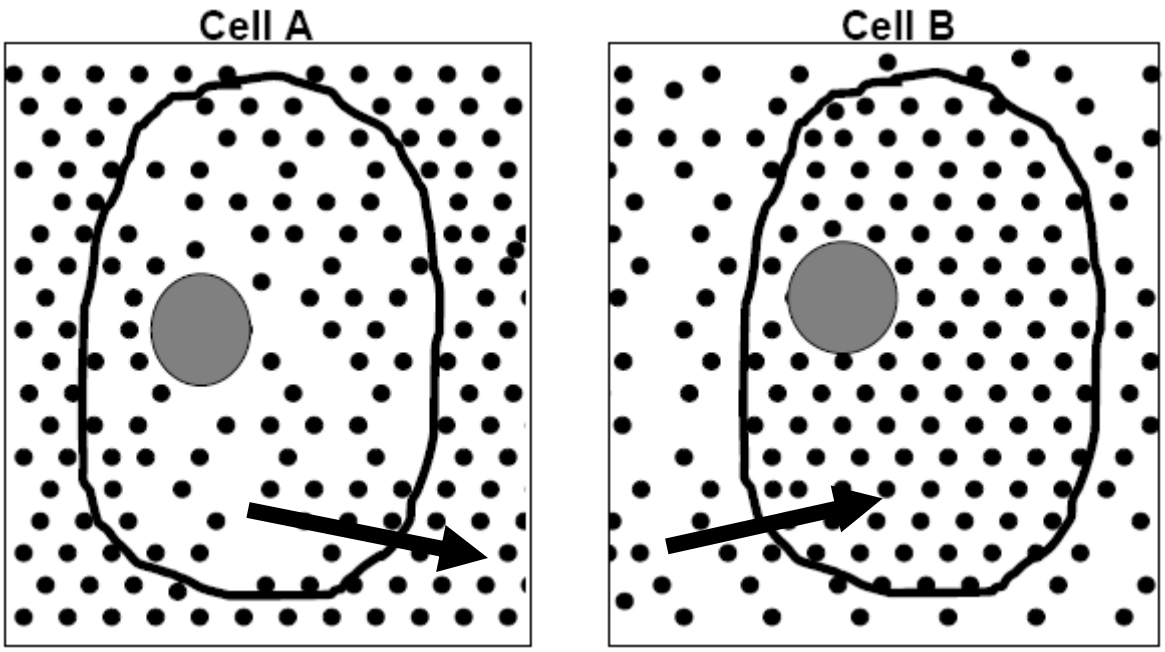
8. Why can some substances diffuse through the **selectively permeable** membrane while others cannot diffuse through the membrane?

Small molecules can diffuse through a selectively permeable membrane but larger molecules cannot.

Part 2: Osmosis

Osmosis is a special term for the diffusion of water through a selectively permeable membrane. During osmosis, water molecules diffuse from a region of high water concentration to a region of low water concentration.

To understand how osmosis affects cells, you will need to pay attention to the water concentration in solutions. Adding a solute, such as salt or sugar, to water decreases the concentration of water.



The small dots represent solute molecules that are dissolved in water.

1. Adding solute, such as salt, to water will _(***decrease***)_ the water concentration?

2. Which cell contains the highest concentration of **water**, Cell A *or* Cell B? ***Cell A***

3. Water will move by osmosis from a region with a _(***high***)_ water concentration to a region with a _(***low***)_ water concentration.

4. Draw arrows, on the diagrams above, to indicate the direction of **osmosis** for Cell A and for Cell B.

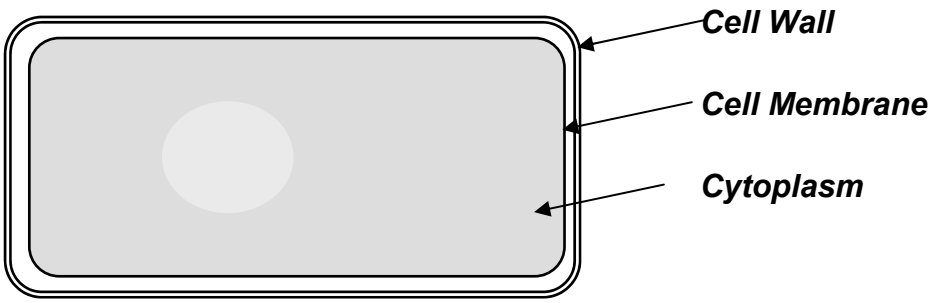
A. Osmosis and Plant Cells

A student prepared a microscope slide of red onion cells mounted in distilled (pure) water:

Photograph A on the Osmosis and Red Onion Cells colored sheet illustrates what the student saw when she observed the slide at using a microscope (400X magnification).

1. In the space below, draw and color <u>one</u> red onion cell mounted in water. Label the cell wall, cell membrane, and cytoplasm.

Diagram of red onion cell mounted in distilled water – 400X



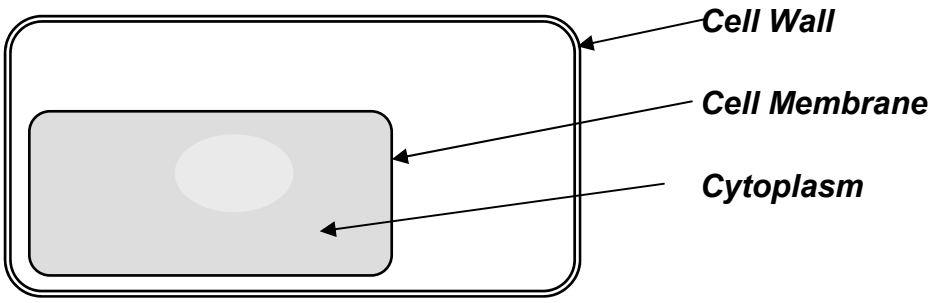
The student then took another piece of red onion skin and made a second microscope slide using <u>salt water</u>.

The student observed the red onion cells mounted in salt water using 400X magnification and noticed a change in the cells from her previous observations.

Photograph B shows what the red onion cells mounted in salt water looked like.

2. In the space below, draw and color <u>one</u> red onion cell mounted in salt water. Label the cell wall, cell membrane, and cytoplasm.

Diagram of red onion cell mounted in salt water – 400X



3. Did the onion cells lose water or gain water when they were placed in salt water? How can you tell?

The cells lost water because they got smaller.

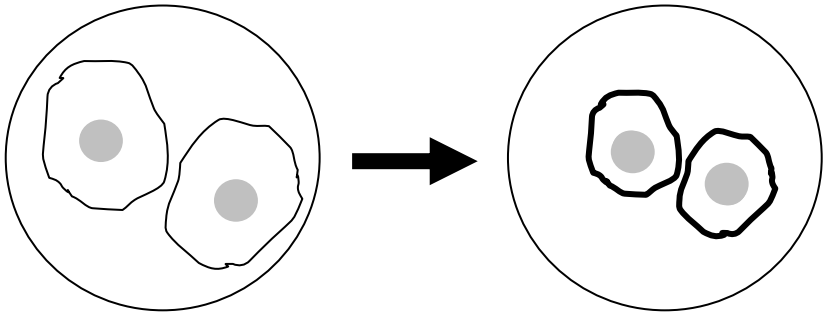
4. Use your understanding of <u>osmosis</u> to explain what caused this change in the amount of water inside the red onion cells.

Osmosis is the diffusion of water from a region of high water concentration to a region of low water concentration. Water moved out of the cell because the concentration of water inside the cell was higher than the concentration of water in the salt solution.

B. Check Your Understanding

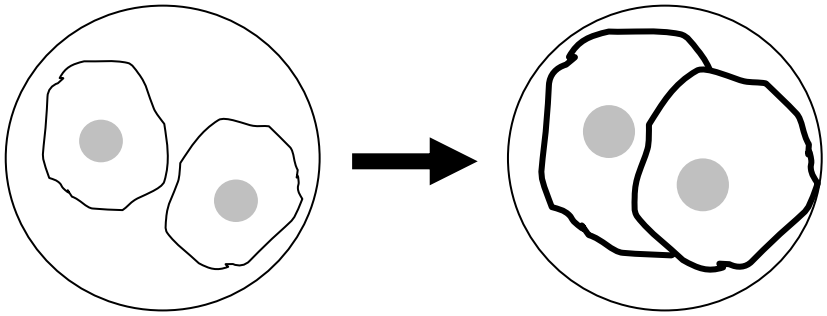
1. Tissue fluid (the liquid that surrounds cells) and cell cytoplasm have the same concentration of salt and water. A student observed a slide with two animal cells mounted in normal tissue fluid.

   In the circle on the right, draw what he should see if he added a concentrated salt solution to the slide.



Cells in normal tissue fluid **Cells after concentrated salt solution was added**

   In the circle on the right, draw what he should see if he added distilled (pure) water to the slide.



Cells in normal tissue fluid **Cells after distilled (pure) water was added**

2. You digest the starch that you eat into glucose molecules. These glucose molecules are then absorbed and transported through the blood to all of the cells of your body.

   If you didn't digest starch, what would happen?

   Your cells would not get the glucose that they need.

3. Drinking seawater (salt water) can be dangerous. If you drink seawater, water will diffuse __(***out of***)__ your body cells and into your digestive cavity.

4. Spreading salt on roads to reduce icy driving conditions can kill nearby plants. If there is a lot of salt outside a plant then water will diffuse __(***out of***)__ the plants.

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name (as printed on the label): Iodine

Product identity: Lugol solution (iodine/potassium iodide solution)

Chemical Name: Product is mixture CAS Number: See section 2
Formula: See section 2

Distributor: Scholar Chemistry
5100 West Henrietta Road
West Henrietta, NY 14586

Telephone number for information: (866)260-0501
Date of this MSDS: 10/5/08
Medical emergency phone number (Chemtrec): (800) 424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Principal Hazardous Components: Potassium Iodide (CAS# 7681-11-0) 3%
Iodine (CAS# 7553-56-2) 2%

TLV and PEL units: Potassium Iodide: No information found
Iodine: ACGIH-TLV Ceiling 0.1 ppm
OSHA-PEL Ceiling 0.1 ppm, Ceiling 1 mg/m3

3. HAZARDS IDENTIFICATION

Emergency Overview

Harmful if swallowed, inhaled or absorbed through the skin. May cause irritation to eyes, skin and mucous membranes. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting.

Potential Health Effects:
Eyes: May cause irritation. Skin: May cause irritation.
Ingestion: May cause gastrointestinal discomfort.
Inhalation: May cause irritation to respiratory tract.

4. FIRST AID MEASURES

Emergency and First Aid Procedures:

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

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

Ingestion - If swallowed, if conscious, give plenty of water to dilute, and get medical attention immediately. 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 and quiet, and get medical attention.

5. FIRE FIGHTING MEASURES

Flash Point: Non-flammable NFPA Rating: None established
Extinguisher Media: Use dry chemical, CO2 or appropriate foam.
Flammable Limits in Air % by Volume: No information available
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: When heated to excessive temperatures may emit toxic and corrosive fumes of iodine.

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

Precautions to be Taken in Handling or Storing: Store tightly closed in a cool, dry, well ventilated area away from incompatible materials. Suitable for storage in any general chemical storage area.

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 at all times.
Other Protective Clothing or Equipment: Lab coat, apron, eye wash, safety shower.

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight: No information available
Melting Point: No information available
Boiling Point: Approximately 100 degrees C
Vapor Pressure (mm Hg): 14 (water)
Vapor Density (Air=1): 0.7 (water)
Specific Gravity (H_2O=1): 1.0
Percent Volatile by Volume: 95%
Evaporation Rate (BuAc=1): <1
Solubility in Water: Soluble, product is aqueous solution
Appearance and Odor: Dark amber liquid with characteristic odor of iodine.

10. STABILITY AND REACTIVITY

Stability: Stable
Conditions to Avoid: High temperatures and excessive heat
Incompatibility (Materials to Avoid): Contact with ammonia fumes may cause formation of explosive nitroiodide.
Hazardous Decomposition Products: Free iodine
Hazardous Polymerization: Will not occur

11. TOXICOLOGICAL INFORMATION

Toxicity Data listed for individual components
Potassium Iodide: orl-mus LCLo: 1862 mg/kg
Iodine: orl-rat LD50: 14g/kg

Effects of Overexposure:
Acute: See section 3
Chronic: Potassium Iodide and Iodine: Mutation data cited. Reproductive data cited. Not listed as causing by IARC, NTP, OR OSHA

Conditions Aggravated by Overexposure: Preexisting conditions of the eyes, skin, nose and throat.

Target Organs: No information available

Primary Route(s) of Entry: Inhalation, ingestion, irritation in eyes or skin contact.

12. ECOLOGICAL INFORMATION

EPA Waste Numbers: None

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.): Potassium iodide: No Iodine: No

SARA Section 313:

Chemicals Name List:	Potassium iodide: No	Iodine: No
Chemical Category:	Potassium iodide: No	Iodine: No

CERCLA Section 103 RQ(lbs.): Potassium iodide: No Iodine: No

RCRA Section 261.33: Potassium iodide: No Iodine: No

16. ADDITIONAL INFORMATION

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

MATERIAL SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

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

Product identity: Sodium Bicarbonate (Baking Soda)

Manufacturer: Church & Dwight Co., Inc.
469 N. Harrison Street
Princeton, NJ 08543
Telephone number for information: (609)683-5900 (USA)

Manufacturer's Issue date of this MSDS: 9/17/02

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

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2. COMPOSITION/INFORMATION ON INGREDIENTS
Chemical Ingredient: Sodium bicarbonate % by Weight: 100%
CAS Number: 144-55-8
Not hazardous under OSHA Standard 29 CFR 1910.1200.
Not a WHMIS controlled substance.

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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 0, Reactivity 0

Potential Health Effects
EYE: Not an eye irritant. SKIN CONTACT: Not a skin irritant.
INGESTION: Material is practically non-toxic. Small amounts (1-2 tablespoonfuls) swallowed during normal handling operations are not likely to cause injury as long as the stomach is not overly full; swallowing larger amounts may cause injury (see Note in Section IV).
INHALATION: None known.
SUBCHRONIC EFFECTS/CARCINOGENICITY: Based on published studies on its effects in animals and humans, sodium bicarbonate is not teratogenic or genotoxic. Only known subchronic effect is that of a marked systemic alkalosis. The material is not listed as a carcinogen or potential carcinogen by IARC, NTP, OSHA, or ACGIH.

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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.

NOTE TO PHYSICIAN: Large doses may produce systemic alkalosis and expansion in extracellular fluid volume with edema.

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5. FIRE FIGHTING MEASURES
FLAMMABLE PROPERTIES: 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.

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6. ACCIDENTAL RELEASE MEASURES
Scoop up into dry, clean containers. Wash away uncontaminated residue with water.

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7. HANDLING AND STORAGE
Store in cool, dry areas and away from incompatible substances (see Section 10). Sodium Bicarbonate reacts with acids to yield carbon dioxide gas which can accumulate in confined spaces. Do not enter confined spaces until they have been well ventilated and carbon dioxide and oxygen levels have been determined to be safe.

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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: Full cover clothing. Apron where splashing may occur when working with solutions.

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 crystalline powder. ODOR: None.
PHYSICAL STATE: Solid pH AS IS: Not Applicable
pH (1% SOLN. w/v): 8.2 VAPOR PRESSURE: Not applicable.
VAPOR DENSITY: Not applicable. BOILING POINT: Not applicable.
FREEZING/MELTING POINT: Not applicable.
SOLUBILITY IN WATER: 8.6 g/100 ml @ 20□C.
BULK DENSITY (g/cc): 62 lb/Ft3 % VOLATILE: Not applicable.
VOLATILE ORGANIC COMPOUNDS: Not applicable. MOLECULAR WEIGHT: 84.02

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable.
CONDITIONS TO AVOID: Temperatures above 65□C (150□F).
INCOMPATIBILITY WITH OTHER MATERIALS: Reacts with acids to yield carbon dioxide. Also may yield free caustic in presence of lime dust (CaO) and moisture (i.e., water, perspiration).
HAZARDOUS DECOMPOSITION PRODUCTS: Heating above 100□C may cause dangerous levels of carbon dioxide gas to be present in confined spaces. Yields sodium oxide if exposed to temperatures above 850□C. Avoid inhalation, eye and skin contact with sodium oxide.
HAZARDOUS POLYMERIZATION: Not applicable.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: The material was minimally irritating to unwashed eyes and practically non-irritating to washed eyes (rabbits).
SKIN EFFECTS: Not a skin irritant or dermally toxic. Not a contact sensitizer.
ACUTE ORAL EFFECTS: Acute Oral-rat LD50 = 7.3 g/kg
ACUTE INHALATION: LC50 (rat) > 4.74 mg/l

12. ECOTOXICOLOGICAL INFORMATION

AQUATIC TOXICITY: Daphnids: EC50 = 4100 mg/l; Bluegill: LC50 = 7100 mg/l
Rainbow Trout: LC50 = 7700 mg/l

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.

14. TRANSPORTATION INFORMATION

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

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

Sodium Bicarbonate is reported in the EPA TSCA Inventory List.

This material is listed on the Canadian DSL.

This material is not listed as carcinogen or potential carcinogen by NTP, IARC, OSHA, ACGIH or NIOSH.

This material is neither a volatile organic compound nor does it contain VOCs.
NATIONAL STOCKING NUMBER: 6810002646618, Contract No. DLA 40086C1831
NSF STANDARD 60: Corrosion and Scale Control in Potable Water. Max use 200 mg/l.
EUROPEAN INVENTORY (EINECS): 205-633-8
JAPANESE INVENTORY (MITI): 1-164
AUSTRALIAN INVENTORY (AICS): Carbonic acid, monosodium salt.

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.