

DIFFUSION (HYPERTONIC, HYPOTONIC, & ISOTONIC SOLUTIONS) “THE GUMMY BEAR LAB”

[PASS](#)

Have you ever wondered why your fingers have wrinkles after soaking in a bath tub? Your students have probably wondered the same thing at some point in their lives, which brings us as educators to a teachable moment about the concept of diffusion. Diffusion is the net movement of particles from an area of higher concentration to an area of lower concentration. This lab encourages students to explore this concept using gummy bears placed in water, which are later placed in a salt solution. Students will see how these two types of solutions dramatically impact the size of a gummy bear.

Content Background Information Required:

No background information is required for this lab. However there is a demonstration video for teachers discussing the gummy bear lab in further detail along with an example of this lesson being taught with students.

Student Objectives:

Students will:

- ☐ Develop the concept of diffusion
- ☐ Explore the impact of hypertonic, hypotonic, & isotonic solutions
- ☐ Explore the impact of varying water temperatures on diffusion
- ☐ Practice inquiry skills and the scientific method
- ☐ Accept or reject a hypothesis based on evidence they collect

Materials:

- ☐ Gummy Bears
- ☐ Clear cups or containers
- ☐ Water
- ☐ Saturated Salt Solution
 1. Add 1 $\frac{3}{4}$ c of salt to 1 liter of water
 2. Shake solution until the salt is dissolved in the water
 3. Let solution stand over night for best results
- ☐ Paper towels
- ☐ Centimeter Ruler
- ☐ Balance or scale (optional)

Lesson Preparation:

This lesson is designed to be conducted over a 3 day period. Students will be placing gummy bears in tap water and letting them stand overnight and then place the tap water soaked gummy bears in a saturated salt solution overnight.

To prepare for this lab the salt solution should be prepared a day in advance and the supplies above should be available for students to easily retrieve during this lab investigation. Additional preparation is required if students will be conducting this activity in one day. Please see detailed lesson preparation instructions below, for conducting this lab in one day.

Conducting this lesson in one day?

If you would like to conduct this lab in one day follow the procedures below:

1. 2 days prior to conducting the lab
 - Pre- soak enough gummy bears for each pair of students to have one
2. 1 day prior to conducting the lab
 - Remove previously tap water soaked gummy bears from water solution and place in a cup of saturated salt solution
 - Pre-soak enough gummy bears for each pair of students to have one
3. Day of lab
 - Each group of students will be given a regular gummy bear to examine
 - Each group of students will be given a gummy bear soaked in tap water
 - Each group of students will be given a gummy bear that has been soaked in tap water then soaked in saturated salt solution

Lesson Procedures:

Introduction-Exploring The Concept

Investigation Part 1: Gummy Bear in Water

- Begin the activity by holding a gummy bear up for the students to see
 - 🔍 Ask students what they think will happen to the gummy bear if it is placed in a cup of water?
 - 🗣️ *Students may say the dye will come off the bear and move into the water*
 - 🗣️ *Students may say nothing*
 - 🗣️ *Students may say the gummy bear will get bigger because it will soak up the water*
 - 🧑‍🔬 We want students to discuss as many outcomes as possible. This gives them the opportunity to explore a problem as scientists do. You may even write all of the possibilities on the board for the students in your group that are visual learners.
- Once students have discussed the possible answers to the question you posed...
 - 🔍 Ask students how we could test those hypotheses or predictions
 - 🗣️ *Hopefully students will say lets place a gummy bear in a cup of water and see what happens*
- After students have said let's place a gummy bear in a cup a water you may want to ask them
 - 🔍 How will we be able to record a difference in the gummy bear before and after it is placed in the water
 - 🗣️ *We want students to say the bear should be measured or weighed before it is placed in the water*
 - 🧑‍🔬 What we will be having students do is measure the length, width, and height of the bears in order to calculate the volume of water in the bears after they are placed in water. (*Volume = length x width x height*)
 - 🔍 Ask students if they know how to calculate the volume of something explaining to them that we will be measuring the volume of the gummy bears by measuring the length, width, and height of the gummy bears before and after they are placed in water
 - 🧑‍🔬 If you have access to scales you could also have students measure the weight of the gummy bears
 - 🧑‍🔬 Have students record their information in a data table they create themselves in a science lab notebook or on student handout 1.

Later they will be given student handout #1 to record their data and class data on.

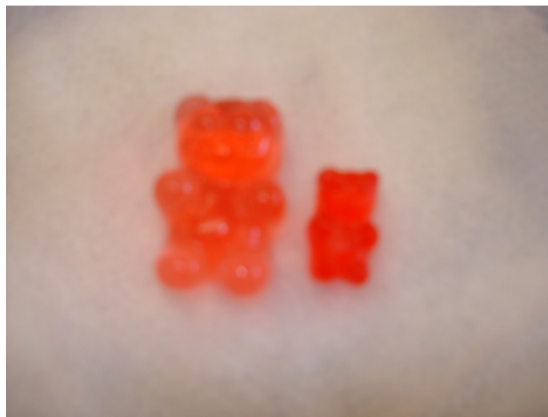


Measuring length from
bottom of bear feet to top
of bear ears

Measuring width from arm
to arm



Measuring height from the
base of the bear to the top
of one arm

- ☐ After students have completed the measurements and recorded them they can place the gummy bears in a cup with water
- ☐ Allow them to set overnight *(If you are doing this lesson in one day refer to the preparation set up above. If you already have gummy bears pre-soaked you could bring them out for students to examine at this time in the lab.)*
- ☐ After students have retrieved their cup with the gummy bear in it...
 - 🔍 Ask them what they observe about the gummy bear
 - 🗣️ *Students may say the color appears to be lighter*
 - 🗣️ *Hopefully students will notice the gummy bears appear to be bigger than the day before*







On the left: gummy bear after soaking in tap water after one night
On the right: original gummy bear

- ☐ You may have to prompt students to want to measure the swollen gummy bears.
 - 🔍 Ask them how we can tell if there is a difference in size or how much of a difference there is
 - 🗣️ *Students should say we should measure them the same way we did before they were placed in water*




-  In order to retrieve the gummy bears from the water for students to measure them, students can slowly pour the water out of the cup through a paper towel to ensure the gummy bear doesn't fall to the ground or in the sink.
-  Students will have to be cautious when pouring the water and gummy bear out because the bear will be fragile and easily burst apart.



- ☐ Once students have carefully measured the length, width, and height and/or weighed the fragile gummy bears and recorded their measurements, we can move into asking students a few questions (*This information should be recorded in the same area as the data they collected on day one.*)
 -  What do you think causes the difference in size between the gummy bear before it was placed in water and after it was placed in water
 -  *We hope students will mention that the gummy bear is filling with water*
 -  *Students may say the gummy bear is soaking up the water*
 -  What is actually happening is the principle of diffusion
 - Diffusion is the movement of particles from an area of high concentration to an area of low concentration
 - When diffusion occurs with water it is called osmosis
 - So how is this working with the gummy bear?

Since the gummy bear is sitting in water the concentration of water is higher outside of the gummy bear than inside, so the water moves into the gummy bear in an effort to create a state of equilibrium, where there is an equal concentration of water inside the gummy bear and outside the gummy bear.

Investigation Part 2: Gummy Bear in Salt Water Solution

- ☐ For this investigation students will need to have access to the salt solution mentioned in the materials section of this lesson plan
- ☐ Students will be placing the swollen gummy bears into a cup with the salt solution
- ☐ Before they place the bears in the salt solution ask them the following question...
 -  What do you think will happen if we place the swollen gummy bears in a cup full of salt water solution
 -  *Students may suggest many different possibilities; have students write down their predictions or hypotheses that the class comes up with.*
 -  Then have students gently place the swollen gummy bears in a cup with the salt water solution

- Allow them to set overnight (*If you are doing this lesson in one day refer to the preparation set on page 2. If you already have gummy bears soaked in salt water solution you could bring them out for students to examine at this time in the lab.*)
- Once students have retrieved their cup with the gummy bear in it (soaked in salt water solution)...
 - 🔍 Ask them what they observe about the gummy bear
 - 🗣️ *Students may notice that the gummy bears are smaller than when they were soaked in tap water*
- Once students have measured the length, width, and height and/or weighed the swollen gummy bears and recorded their measurements, we can move into asking students a few questions (*This information should be recorded in the same area as the data they collected on days one and two.*)
 - 🔍 What do you think causes the difference in size between the gummy bear before it was placed in salt water
 - 🗣️ *We hope students will mention that the gummy bear is smaller but still not its original size*
 - 🗣️ *Students may say that the water seemed to move out of the gummy bear*
- Diffusion occurred again but this time the salt water caused the water to move from inside the gummy bear to outside the gummy bear and into the salt water

There was a higher concentration of water and lower concentration of solutes (salt) inside the gummy bear compared to lower concentration of water and higher concentration of solutes (salt) outside the gummy bear in the cup. Therefore the water moved from an area of higher concentration to an area of lower concentration in an attempt to reach equilibrium.

Student Handout 1 “Example”

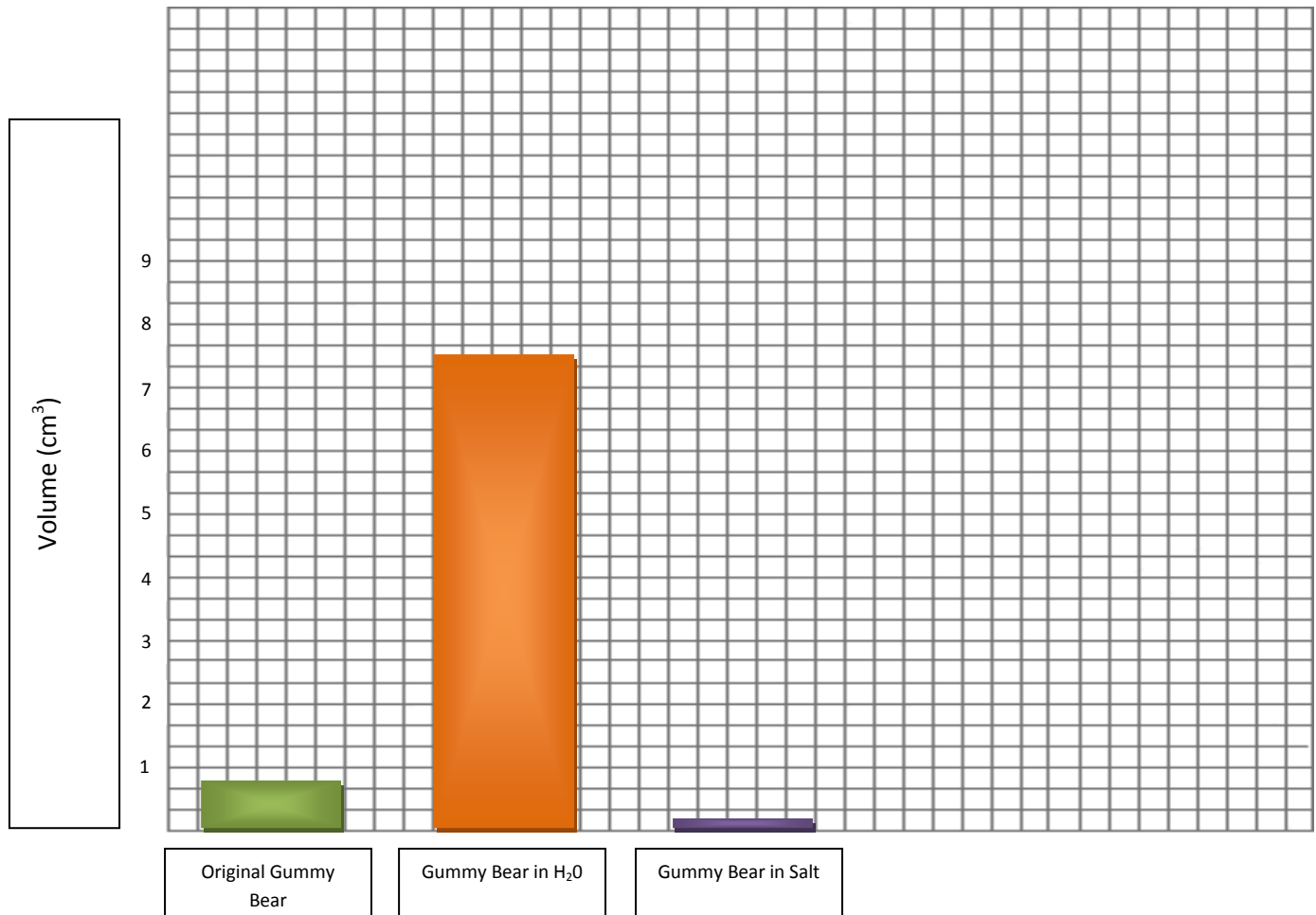
Please record your group data below:

To calculate volume (length x width x height = volume)

Gummy Bear	Length	Width	Height	Volume
Before Water	<i>2.00cm</i>	<i>1.20cm</i>	<i>0.50cm</i>	<i>1.20cm³</i>
After Water	<i>3.10cm</i>	<i>2.20cm</i>	<i>1.20cm</i>	<i>8.18cm³</i>
After Salt Water	<i>0.50cm</i>	<i>0.30cm</i>	<i>0.2cm</i>	<i>0.09cm³</i>

Please graph your findings below:

Volume (cm^3) of gummy bears when placed in tap water and salt water



- ☐ Through the visual of a graph students can really see how much bigger the gummy bear soaked in water really is compared to the others

Now that students have finished collecting the data, we can begin to help them develop the concept of diffusion.

Below is one way for students to develop the concept of diffusion themselves. Begin by drawing Figure 1 on the board for the class to see, but draw it without the arrows and the solution labels: hypotonic, hypertonic, and isotonic.

Figure 1

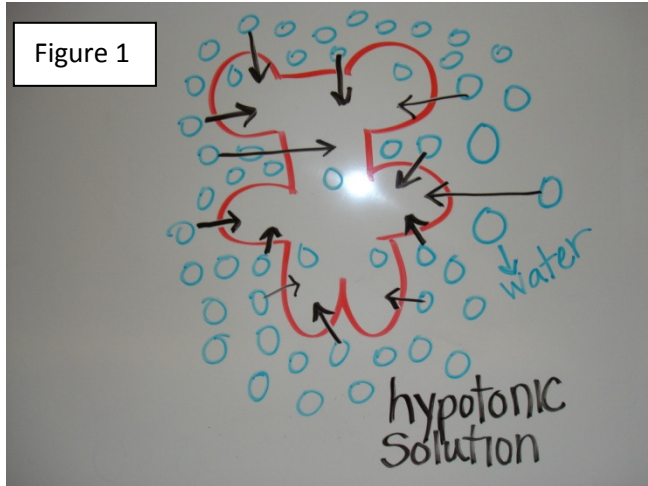


Figure 1 represents the gummy bear that was placed in tap water overnight. Explain to students that the blue circles represent water molecules.

- 🔍 Ask students what happened to the water in this scenario
- 🗣️ *Students should say the water moved into the gummy bear*
- 📝 You can draw the arrows after students mention the water moves in to the gummy bear

Figure 2

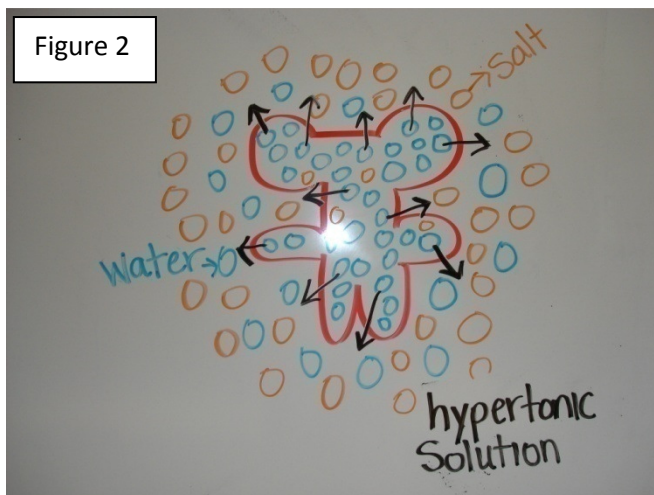


Figure 2 represents the gummy bear that was placed in tap water overnight then placed in salt water overnight. Explain to students that the blue circles represent water molecules and the orange circles represent salt molecules

- 🔍 Ask students what happened to the water in this scenario
- 🗣️ *Students should say the water moved out of the gummy bear.*
- 📝 You can draw the arrows after students mention the water moves in to the gummy bear

- 🔍 Ask students what similarities they see in what is happening with the water in each of these situations
- 🔍 You may even have to ask students directly where does there seem to be a higher concentration of water in each of the scenarios
- 🗣️ *Hopefully students will notice that the water is moving from an area of higher concentration to an area of lower concentration in each of the scenarios*

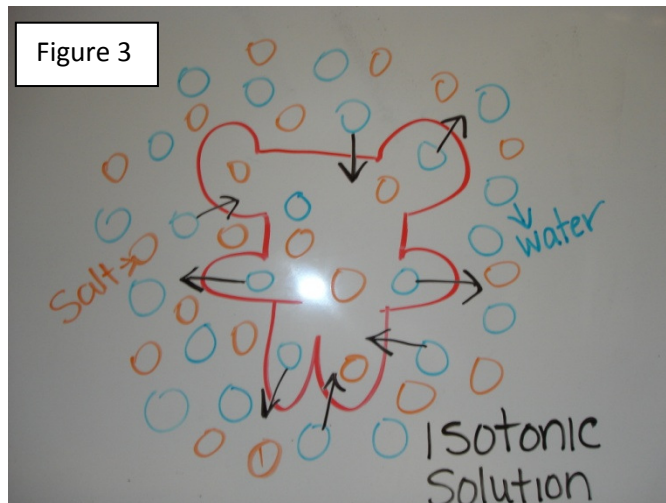


Figure 3 represents a gummy bear that is in a solution where the concentration of water and salt is the same inside as out.

- 🔍 Ask students what they think will happen to the water in this scenario
- 🗣️ *Students may have a variety of answers.*
- 📝 What really happens is water does move in and out but at the same rate to maintain equilibrium. You can draw the arrows as you are explaining this.

- At this point you can give students student handout 2 to fill out.
- Students are asked to draw the gummy bear diagrams above and explain what happens in each scenario
- At this point you can give students the names of each of the types of solutions, but rather than giving them a standard definition see if the class can agree on an understanding of each type of solution.
 1. Hypotonic Solution = concentration of dissolved substances is lower outside than in, causing water to enter “swelling”
 2. Hypertonic Solution = concentration of dissolved substances is higher outside than in, causing water to exist “shrinking”
 3. Isotonic Solution = concentration of dissolved substances is equal inside and out, causing water to enter and exit at the same rate “same”
- How does this all relate to students?
 - Have students look at the simulation of red blood cell in the three different types of solutions on the website below
 - <http://www.coolschool.ca/lor/BI12/unit4/Uo4Lo6/rbc.html>
 - Through the simulation students can gain an understanding of how having these types of solutions in their own bodies could cause problems.
 - Turn this investigation into an English credit by having students research and report on their findings on the impact of dehydration on the body in relation to hypertonic solutions.

Student Handout 3: Questions & Answers

Student handout 3 consists of Biology I EOI style questions covering content introduced in this lesson as well as the bubble lab lesson on the Biology I virtual classroom. Questions 3 & 4 ask students to identify dependent and independent variables from the experiment in this lab. This topic is covered in great detail in the bubble lab lesson but can be reviewed in this lesson. *Answers: 1= b 2= b 3= c 4= a or b*

Extensions or Applications for this lesson:

Highly Qualified Extension For Professional Development Points (See HQ Section of this lesson for more information):

Extension activity:

Introducing students to cell structure would be a natural extension to this lab.



Ask students: What process allows particles and materials to flow into and out of the cell?



Diffusion



Diffusion occurs across the cell membrane allowing water, oxygen, and other vital particles into the cell. A cell is the very smallest unit of living matter. All living things including plants and animals are made up of cells and each structure in a cell serves a specific purpose in the day to day operation of a cells processes.



Have students explore cell structures and cell types by assigning each student a structure to present to the rest of the class

- Students should be able to present each structures purpose and function to the cell
- Have students make their assigned structure out of craft materials and allow them to attach their structure to a giant class cell which will be displayed in the room
- Have students do this activity for a plant cell and an animal cell, and then have students analyze the similarities and differences.
- Have students replicate the gummy bear activity with a plant Elodea

Website resources for cell structure and function are available under the resources section of this lesson. Students should be able to make connections between their topic and its connection to particles which diffuse across the cell membrane.

Cell structures:

Nucleus	Golgi Apparatus
Cell Membrane (Plasma Membrane)	Ribosomes
Endoplasmic Reticulum (Rough & Smooth)	Lysosomes
Vacuoles	Chloroplasts
Mitochondria	Cell Wall

Once you have conducted the, “Diffusion: The Gummy Bear Lab”, lesson, go to the HQ section of this lesson to submit answers to a few questions to gain professional development points towards building a house in Biology Sciences. Additional professional development points can be gained by developing and conducting the extension lesson idea discussed above.

PASS Objectives: Biology I**Process and Inquiry Standards:**

- ☐ Observe and Measure
 - ✓ 1.1, 1.2, 1.3
- ☐ Experiment
 - ✓ 3.1, 3.2, 3.3, 3.4, 3.5
- ☐ Interpret and Communicate
 - ✓ 4.1, 4.2, 4.3, 4.4, 4.5 4.7, 4.8
- ☐ Model
 - ✓ 5.1
- ☐ Inquiry
 - ✓ 6.1, 6.2, 6.4

Content Standards and Objectives

- ☐ The Cell
 - ✓ 2.1
- ☐ The Behavior of Organisms
 - ✓ 6.1, 6.2

PASS Objectives: Middle School Science**Process and Inquiry Standards: 6th, 7th, & 8th grade science**

- ☐ Observe and Measure
 - ✓ 1.1, 1.2, 1.3
- ☐ Experiment
 - ✓ 3.1, 3.2, 3.3, 3.4, 3.5
- ☐ Interpret and Communicate
 - ✓ 4.1, 4.2, 4.3, 4.4, 4.5
- ☐ Inquiry
 - ✓ 5.1, 5.3, 5.4

Content Standards and Objectives: 8th grade science

- ☐ Properties & Chemical Changes in Matter
 - ✓ 1.2

Content Standards and Objectives: 7th grade science

- ☐ Properties & Physical Changes in Matter
 - ✓ 1.1
- ☐ Structure & Function in Living Systems
 - ✓ 2.1
- ☐ Behavior & Regulations
 - ✓ 4.1

Content Standards and Objectives: 6th grade science

- ☐ Physical Properties in Matter
 - ✓ 1.1
- ☐ Structure & Function in Living Systems
 - ✓ 3.1