Learning from Raisins

Overview:

Osmosis an essential process in many biological systems. This activity is designed for improving student's understanding of the concept. Through this activity students will learn that there is only a net movement of water in process of osmosis. They would know how a concentration gradient works for movement of solvent (Water) across membrane. Students can be engaged in this by performing experiment using raisins.

Concept of osmosis
Osmosis is a type of movement of solvent (such as water) which takes place across a semipermeable membrane (e.g., the outer membrane of a living cell) from a solution of lower solute concentration to a solution of higher solute concentration. Osmosis stops as soon as the solute concentration on either side of the semipermeable membrane becomes equal. In case of living cells, water plays major role as a solvent. Its concentration inside and outside the cell needs to be balanced. This is necessary to maintain the structural integrity and functional activity of cells. This is achieved by the osmotic movement of water through the cell membrane.

Time required:
2 hours or 3 class periods

Type of learning unit:
Laboratory based

Learning Objectives:

After working on this learning unit, students will understand
- the concept of 'osmosis'
- difference between osmosis and diffusion
- the role of osmosis in certain physiological processes
- concept of selective permeability of membrane for water.

Links to curriculum:
- Class VIII chapter 8 : Cell Structure and Function
- Class IX Chapter 5: The Fundamental Unit of Life

Learning from Raisins

(Students' worksheet)

Introduction

When you eat something very sweet, you immediately feel like drinking water. What could be the reason?

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Look at the following definitions:

Diffusion: Diffusion is the movement of a substance from an area of high concentration to an area of low concentration.
(https://biologydictionary.net/diffusion/)

Osmosis: Net movement of water across a semipermeable membrane from a solution of lesser to one of greater solute concentration. The membrane must be permeable to water but not to solute molecules.
(https://www.ncbi.nlm.nih.gov/books/NBK21607/#A7699)

So, now can you tell why you feel like drinking water after eating something sweet? Is it due to osmosis or diffusion?

Something from our everyday life

You would have read about diffusion and osmosis as processes in the biological context. In the table below, there are some activities mentioned Put a tick (✓) in appropriate box to indicate whether the process is diffusion or osmosis

	Example	Diffusion	Osmosis
1	Gulab jamun dipped in sugar syrup after frying.		
2	Whole raw mango stored in brine becomes salty from inside.		
3	Potato slices sprinkled with salt become wet		
4	Urine formation in kidney		
5	Adding sabza seeds in faluda or water.		

Concept check

1. How is osmosis different than diffusion?

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2. During osmosis, which one of the following shows movement?
   a. Solute
   b. Solvent
   c. Solution

3. There are some factors mentioned in following table which may/may not affect both the processes and some factors play key role in these processes; i.e. diffusion and osmosis. Put a tick (□) in appropriate boxes as per your understanding:

	Factors involved/affecting	Diffusion	Osmosis
1	Solute movement		
2	Water movement		
3	Semi-permeable membrane		
4	Concentration gradient		
5	Energy expenditure		
6	Temperature variation		
7	Movement by pressure		
8	Weight		

Now, we will perform a small activity to see how 'osmosis' works

Fun with raisins

Materials:

- Raisins (dry)
- Water (Clean potable water)
- Sugar or Sucrose
- Glass tubes of 20 mL capacity
- Measuring cylinder (10 mL capacity)
- Measuring balance
- 100 ml beaker
- Food colour
- Insulin syringe (It has fine needle to make very small prick in raisins)

Procedure:

- Before starting the activity, Prepare 10 ml of 40% sucrose solution and 10 ml of saturated sucrose solution. First, add sucrose to 5 ml of water. When all the sugar dissolves, make up the volume to 10 ml.
- Take 4 glass tubes of 15 ml capacity or 50 ml beakers. Label them with numbers 1 to 4. (One can use small paper cups, glasses, any small containers instead of tubes.)
- Weigh about 7-8 raisins (use entire ones without breaking their stalks) and record the weight in table. Put them in tube no. 1. Repeat it for tube no. 2 and 3.
- Make approx. 5 ml of food colour solution in water. Take sufficient quantity of powder to make concentrated solution.
- Now use insulin syringe to inject few drops of this colour in 7-8 raisins. (Inject the colour slowly and carefully. Do not try to inject excessive dye forcefully.)
- Weigh these dye injected raisins and put them in tube no. 4
- Add 10 mL of water in tube no. 1 and 4 .
- Add 10 ml of 40% sucrose solution in tube no. 2 and 10 ml of saturated sucrose solution in tube no. 3.
- Now put 2 - 3 drops of food colour in tube no. 1, 2 and 3. Mix it well by shaking the tubes. Add 2-3 drops of water in tube 4 instead of food colour.
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- Summarize your activity in table 1.1 given in activity sheet.
- Keep all the tubes undisturbed on a stand. Note the time.
- After about 45 minutes, carefully remove raisins from tube no. 1. Observe if you find any change in raisins.
- Blot them on tissue paper and weigh them.
- Measure the amount of water in tube. Note down your observation.
- Repeat it for rest of the tubes.
- Note down the changes that has happened.
- Note your observations in table 1.

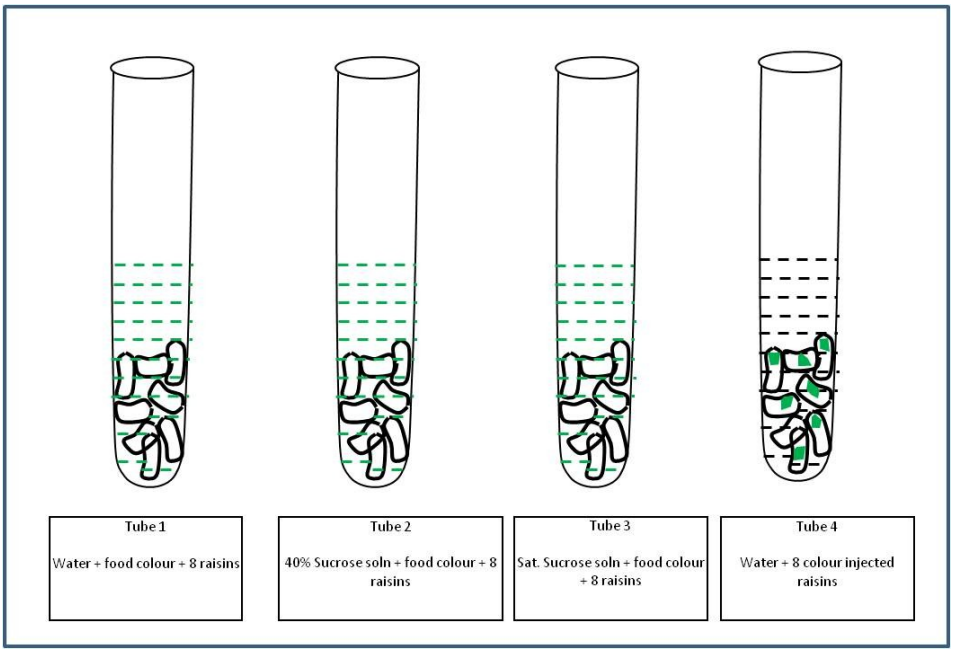

Table 1: Write the findings from your experiment in the table below

Tube no.	Raisins (Dry/ dye injected)	10 ml Water (+/-)	10 ml Sucrose Soln. (+/-)	Food colour in water (+/-)
1				
2				
3				
4				

(+ is for added and – is not added)

Table 2 Write about the shape before and after and also the volume of liquid from each tube. Shape could be 'swollen', 'less swollen' or 'no change'.

Tube No.	Initial shape	Final shape	Initial weight (mg)	Final weight (mg)	Difference (mg)	Initial liquid (ml)	Final liquid (ml)	Difference (ml)
1.						10		
2.						10		
3.						10		
4.						10		

1. Now that you have recorded all the details and done all calculations, can you tell if the weight difference same in all tubes? How will you calculate? (per gram? Percentage?)

2. Why did raisins change in shape?

3. What according to you was going in?

4.Why were different concentrations of sucrose used? What happens in tube no. 3?

5. Why is this not simple diffusion? Which tube can be used to demonstrate?

6. We added 2-3 drops of water in tube 4 instead of food colour. Why it was necessary?

Osmosis around you

If you take a look around, you will find many examples of osmosis in your everyday life. There are many fishes which live in salty water. How do they survive in such salty water?

Can you think of any other examples in the human body/environment where osmosis plays an important role?

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Note for teachers

Extended activity

- Students can work out several variations by changing parameters like
  - Different solvents (Alcohol, liquid soap)
  - Temperature (low or high)
  - Type of solute (salt, soda)
  - weight of raisins
- They can use different biological materials like dried fig, dried vegetables, fruits, *sabza* etc. and try a similar experiment.

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