Experiment
10

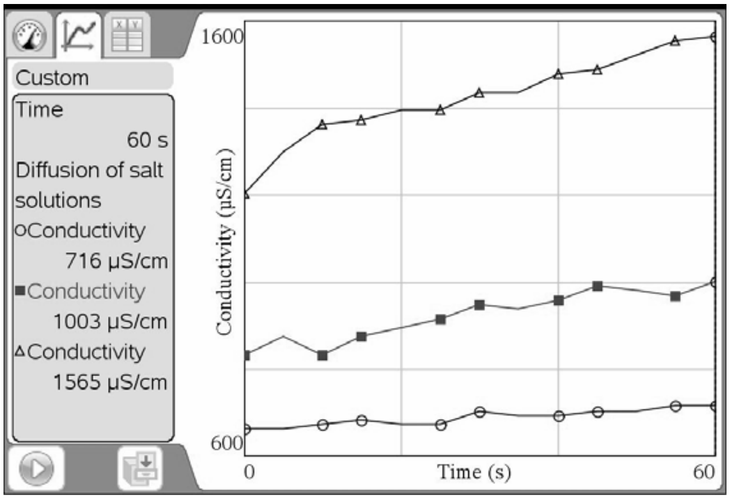
TEACHER INFORMATION

Diffusion through Membranes

1. Editable Microsoft Word versions of the student pages and pre-configured TI-Nspire files can be found on the CD that accompanies this book. See *Appendix A* for more information.
2. If the water in your area is very soft, you may want to use tap water instead of distilled water. Test to see if the conductivity of the tap water is less than about 50 mg/L salt.
3. Provide each group with pre-cut, hydrated dialysis tubing. The tubing must be soaked in water for at least ten minutes prior to use. The tubing should be soft and flexible.
4. Use dialysis tubing clamps if at all possible, as this will speed things up greatly. If desired, use dental floss or string to tie off the dialysis tubing. The floss works exceptionally well. You may want to show students how to tie off the dialysis tubes.
5. Have students check their dialysis tubes for leakage. This should be done before each experiment. Leaky tubes should be replaced.
6. Any sugar may be used in Part II. Table sugar is inexpensive and readily available.
7. To prepare 5% sugar solution, add 50 grams of sugar to make one liter of solution (300 mL per group is needed).
8. To prepare 1% salt solution, add 10 grams of NaCl to make one liter of solution (15 mL per group is needed).
9. To prepare 5% salt solution, add 50 grams of NaCl to make one liter of solution (30 mL per group is needed as they will use the 5% salt solution twice).
10. To prepare 10% salt solution, add 100 grams of NaCl to make one liter of solution (15 mL per group is needed).
11. The 0–2000µS/cm range works well for this experiment. The ionic concentration is approximately proportional to the conductivity of the solution.

SAMPLE RESULTS

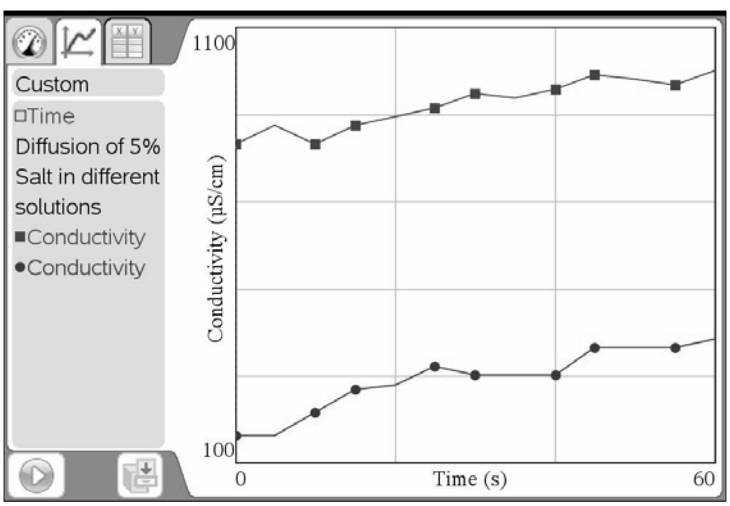
Part I



Typical graph for Part I –1% salt (○), 5% salt (■) and 10% salt (△).

Table 2	
Salt concentration (%)	Rate of diffusion (µS/cm/s)
1	0.9
5	2.8
10	4.5

Part II



Typical graph for Part II–5% salt solution diffused into distilled water (■) and 5% sugar solution (●).

Table 3	
Solution	Conductivity (µS/cm)
Distilled water	34
Sugar water	36

Table 4: Summary of Data	
Solution	Rate of diffusion (µS/cm/s)
5% salt	2.8
5% salt / 5% sugar	2.8

ANSWERS TO QUESTIONS

1. Rate of diffusion should increase with increasing salt concentration.
2. The rate of diffusion should increase as the concentration gradient becomes steeper. The rate of the 10% salt solution should be the greatest and the rate of the 1% salt solution should be the lowest of the three.
3. The rate of the 10% salt solution should be approximately ten times that of the 1% solution, while the rate of the 5% salt solution should be five times that of the 1% solution.
4. The conductivity should be the same, as neither will conduct appreciably. Neither molecule is electrically charged.
5. Student answers will vary. The rates of diffusion should be the same.

ANSWERS TO EXTENSIONS

1. Based on the sample data, this value is about 1.8 µS/cm/s.
2. Based on the results from the experiment in part 1, the concentration gradient between the organism and the external environment would be the determinant in the amount of oxygen diffusing across its membrane. The organism would tend to migrate to a position in the pond where the dissolved oxygen concentration was in line with its requirements for oxygen and other essential metabolic needs.
3. In considering the results of part 2 and basing these on how a single celled organism would respond to its own waste, an oxygen concentration gradient will still exist favoring the movement of oxygen into the organism. As the concentration of oxygen in the external environment surrounding the organism declines due to the release of waste, diffusion of dissolved oxygen into the organism too will decline.
4. Answers will vary.
5. Since dissolved oxygen is more plentiful or at a greater concentration at lower liquid temperatures, ectotherms would be more active at lower temperatures.