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How to Use This Book

As classroom teachers we are well aware of the myriad tasks that face you on a daily basis in your professional life. Time is your worst enemy. Research, planning and preparation are all activities which must precede instruction. This book was written in an attempt to assist you in preparing, in a time-efficient way, for quality science instruction. The structure of this book was designed with you in mind. The book is divided into a number of sections. The first section deals with how the book can be used in an inquiry-based environment.

Subsequent sections of the book are referred to as modules and provide you with the in-depth information, activities and connections to help you in your classroom. Features of every module include:

- **Science background:** Provides a brief explanation of the science concepts needed for a basic understanding of the science discipline being discussed. A number of diagrams are included to assist in clarification of the ideas presented. More importantly, references to the activities are also provided in context within the section.

- **Activities:** Each activity is presented in a lesson plan format that provides you with information relating to the objectives that the activity addresses, a list of materials needed for the activity, and the procedure to follow in conducting the activity. A section on related children's literature specific to the activity is given and the books listed are described in the annotated bibliography. The final section of each activity consists of connections to other subject areas that may be explored. Inquiry-based student lab pages are provided for most of the activities to assist you in the lessons.

As you use this book it is important to realise that activities can be adapted to meet the needs of your students and your classroom environment. There is no set formula for accomplishing this task. The expert on your students' capabilities and behaviour is you. We cannot make absolute suggestions as to how you will adapt anything in this book to your particular situation with your particular students. Each of the activities can be adapted for students who are very talented simply by letting them do more of the exploring. You may wish to ask more questions at the end of each investigation, or have students use journals to record predictions, prior knowledge, and then what they learnt from the investigation. You may ask them how their results can be applied in the real world around them. These strategies are effective in making the activities more challenging for the students.

Each of the activities can be adapted for students who are not skilled in science investigation simply by giving more direction. Depending on the activity, you may prefer to lead the students through the activity by example, step by step, with the entire class in unison. For some students it may be best to read and review the instructions as a group before beginning the investigation. Perhaps the best procedure for some activities is to have the students complete one task each day over a period of several days. Some of the activities within this book may not be appropriate for your students to complete. In that case, you may want the students to simply watch, and/or take notes, and/or answer questions regarding activities you choose to do as demonstrations.

For the activities that you choose to do as student-centred, hands-on and minds-on science experiences, you have many choices for organising your class. You may consider grouping the students in your classroom; in most activities, groups of two to five can be effective. While large groups require fewer materials and equipment as a class unit, they are sometimes difficult to manage. Large groups may also cut down on the active participation of each student. Groups of three are favoured by the authors, although the research on ideal group size is not definitive. The key is to structure the activities in a way that works for you as the manager of a classroom environment.

The materials, including equipment and supplies, required for each activity are appropriate for a small group or individual. Many of the listed items are inexpensive or easy to locate, but some science equipment must be purchased if not available in your school. For sources of the equipment, you may wish to consider commercial suppliers if you have a budget for purchasing materials. If you only have a small budget for science, you may consider contacting your senior school or local secondary school science department as a source of materials and equipment, such a balances. In most science departments, supplies of the kind required in this book are not rare. For example, hydrochloric acid is usually stored in concentrated forms in large bottles, and making a dilute solution for you does not represent a problem for the science specialist. In fact, being used as a resource by a primary/middle school teacher would be a compliment for most upper secondary science teachers.

Moving through a Membrane

Purpose:
- Describe osmosis by conducting an activity, observing the phenomenon, and writing the results.
- Conclude that a common egg is actually a very large, single cell.

Materials Needed:

2 eggs	3 small bowls
water	salt
vinegar	corn syrup

Introduction: The common chicken egg is actually one cell. The largest single cell is the egg of the ostrich. While expensive, they can be obtained from farms that raise ostriches. The shell of an egg is a protective layer of calcium carbonate that is deposited around the cell membrane. This activity uses the selectivity of the cell membrane to allow water to pass back and forth, but the shell must first be removed. The activity, then, is in two parts. The first part is the process to remove the calcium carbonate by dissolving the shell in vinegar, and the second step shows osmosis, or the passage or diffusion, of a material through a semipermeable membrane (the inner membrane of the chicken egg).

Procedure: See instructions on student lab sheet.

Answer Key For Questions:
1. Cell
2. The egg in sugar water became larger than the other egg. The egg in salt water was smaller.
3. The egg in sugar water absorbed water and changed in size.
4. The egg in salt water shrunk in size because water left the egg.
5. They will shrink and shrivel if left in the water for a long enough period of time.
6. There are salts found in both the pool and the oceans which cause water to move out of the cells in your hand.
7. They would shrink in size because water would leave the cells.
8. Fresh water is important for moving water into cells and replacing existing water that may have salts in it.

Portals for Expansion:

Study of Society
- Write about countries in which pure drinking water is not as plentiful as it is in Australia and about the processes they use to obtain fresh water.

Mathematics
- Weigh each of the eggs before and after the experiment to calculate the percentage change in the weight of the egg caused by the movement of water.

Name

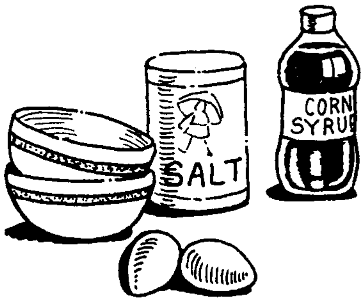
Moving through a Membrane

Procedure: **Dissolving the Eggshell**

1. Record how a chicken egg feels when holding it. Describe the shell.
2. Carefully place two eggs, without cracks, into a small bowl. Cover them completely with vinegar.
3. Keep the eggs in the vinegar for 24 hours.
4. Rinse the eggs after the shells have been removed in clean water. Describe how the eggs feel and look.

Eggs Not Soaked in Vinegar	Eggs Soaked in Vinegar

Observing Osmosis



1. Fill two bowls about two-thirds full with water.
2. Stir 30 mL (2 tablespoons) of salt into one bowl of water.
3. Add 120 mL (½ cup) of corn syrup to the other bowl.
4. Place one rinsed egg in each bowl.
5. Observe what happens to the eggs during the next 12–24 hours.
   How does each egg look now? Draw each egg to show what has happened.

Sugar water	Salt water

Questions:

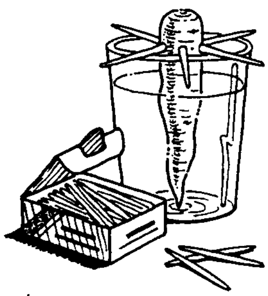
1. The egg is surrounded by a membrane without any smaller divisions. What is the term that describes this unit building block of life?
2. Which egg became larger? smaller?
3. Which egg shows that material can move *into* a cell?
4. Which egg shows that material can move *out* of a cell?
5. If you put your hand in salt water, what will happen to the cells of your hand?
6. Why is your hand 'shrivelled up' after you come out of the ocean or swimming pool?
7. What would happen to the cells in your body if you drank salt water?
8. Why is fresh water important to cells in your body?

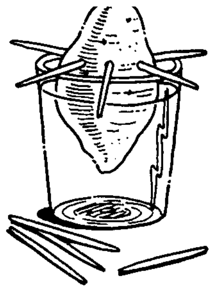
Where Are Your Roots?

Purpose:
- Recognise the two major types of root systems (taproot and branching root systems) by growing one of each and noting the differences.
- Recognise common foods as originating from roots.

Materials Needed:
toothpicks
2 tall clear plastic drinking cups or large plastic jars
sweet potato
small carrot
water

Procedure: See instructions on student lab sheet.





Answer Key For Questions:
1. Answers will vary. For example, depending on the outcome of the experiment the sweet potato should produce leaves.
2. Answers will vary.
3. The carrot plant should develop a root system.
4. Carrot
5. Sweet potato
6. We eat the root of the plant.

Portals for Expansion:

Study of Society
- Interview individuals from other regions or countries to find out if their foods are similar to your foods.

English
- Write a report about farmers who raise potatoes for sale and profit.

Science
- Try this activity with radishes, beets or other tubers that are found in the produce section of the supermarket. Use containers of damp sand instead of water to sprout roots.

Mathematics
- Start two identical plants in containers. Compare their growth when one plant is fed a commercial plant food with the water. Measure and graph the height of the plants over the length of the activity.