Resource Sheet 1: Unlock Underwater Mysteries

Do you remember your last long car trip? You likely saw many different kinds of landscape, such as forests, fields, rivers and wetlands. Did you notice that each type of area seemed to be home to different kinds of animals and plants?

What you noticed is what scientists have described as *ecosystems* (different types of functional units that result from the interactions of living and non-living components) and *habitats* (the areas that provide food, water, shelter and space for wildlife, all arranged just right for a particular species). Ecosystems can be viewed on a broad scale (such as a lake, a river or a wetland) and on a small scale (such as a fast-moving rapid in a river or a rock in the rapid).

It's often easy to see differences in the landscape and the different creatures that live in each one, if you drive along a road on land. The greater challenge is to understand that underwater landscapes are different, too. And that each underwater landscape is also home to different groups of animals and plants.

Aquatic ecosystems may look the same to the untrained eye. But remarkable mysteries are waiting to be unlocked if you take the time to explore such places. For instance, most lakes look like sheets of water when viewed from above. But did you know that there are different kinds of lakes (such as shallow and deep lakes)? Did you know that each kind of lake also has different types of spaces, or zones, such as shorelines, surfaces, bottoms and mid-water columns? In fact, each of these zones can also vary in an astonishing number of ways! And each space seems to best fit certain plants and animals. Let's get more acquainted with some of these amazing aquatic places.

Types of Aquatic Ecosystems

What types of aquatic ecosystems could you expect to see if you were to travel under the water? Here's a list of three main types to help you get started in unlocking underwater mysteries.

- **Freshwater Ecosystems:** Freshwater ecosystems consist of moving water systems (*lotic*), such as streams and rivers, and standing water systems (*lentic*), such as ponds and lakes. They also include wetlands such as marshes, swamps, fens and bogs.
- **Brackish Waters:** Brackish waters (mixed saltwaters and freshwaters) are the aquatic areas between fresh and saltwater ecosystems and include estuaries — those unique and productive places where rivers meet the ocean.
- **Saltwater Ecosystems:** Saltwater ecosystems can include tide pools, the inter-tidal zone, the continental shelf and the open ocean.

You are off to a great start by knowing about these main ecosystems, but there's more. For instance, within each of these ecosystems, there are a number of physical, chemical and biological variables to consider:

- **Physical Variables:** Physical variables such as depth, temperature, water pressure, water clarity (clearness) and bottom type.
- **Chemical Variables:** Chemical variables such as oxygen, nutrients and salt concentrations.
- **Biological Variables:** Biological variables, that is, the presence of other living things that may be friendly, hostile or neutral.

Did you know that each new combination of these variables creates a different and special ecosystem that, in turn, provides habitat for countless fascinating creatures? One way of appreciating the variety and bounty of the world under the water is to experience it. Power up your imagination and unlock even more mysteries of the deep by taking a fantasy dive to discover what makes underwater ecosystems so special.

Physical Variables

Did you notice how you felt free from the effects of gravity when you "dove" into the water? That's one very striking aspect about underwater "space." Your explorations can easily go in all directions — up, down and all around. Many living things, both plant and animal, have less need to be attached to a surface in this environment. Life can be found almost everywhere you look, even suspended effortlessly in front of your face. This presents some interesting living opportunities when compared with terrestrial environments.

- **Temperature:** The temperature of the water is likely the next thing you will notice. It is an important factor for all aquatic species. Some like it warm; others must have it cold. When you have gone swimming, you have probably experienced a range of water temperatures due to season or location. You may even have swum down through the water column and noticed the temperature getting colder. In very deep lakes and in the ocean, temperatures can become very inhospitable to warmth-loving creatures like us. Even in summer, the depths can approach a chilly 4° C in freshwater and closer to 0° C in the ocean.
- **Currents:** If you chose a river or stream for a dip, or even parts of the ocean, the next thing you might notice is the movement of the water. Currents present certain challenges to plants and animals that want to stay in one place in the water. Life in moving water can be a struggle unless you find a way to attach yourself to something solid or hide in eddies, or simply "go with the flow."
- **Light Penetration and Depth:** Now, let's go deeper — down into the cold, dark depths of a deep lake or the ocean. As you descend you will notice two more changes: the growing darkness and the growing pressure. Even in the clearest water, light can penetrate only so far. The actual depth that light reaches is further influenced by water *clarity* (clearness). In a muddy creek, light may penetrate only centimetres below the surface. In a clear lake or ocean, it might filter down dozens of metres. But, go deep enough and you will have complete darkness. Since most plants need light to grow, both depth and water clarity determine where they might survive.
- **Pressure:** As for water pressure, you may have already experienced the painful pressure in your ears as you dive to the bottom of a deep swimming pool. Imagine descending a kilometre or more, where tonnes of water overhead create bone-crushing pressure that unprotected humans cannot survive. Amazingly, even here, you would find creatures that have adapted so well to these extreme conditions that they would die if they were removed from this level of pressure.

Despite myths about "bottomless" lakes, if you dive deep enough you will eventually reach the bottom. The bottom of any water body can vary greatly from place to place — sandy, muddy or rocky — and can attract different creatures and plants.

The presence of surface ice in certain seasons or even year-round on a body of water also affects light penetration and prevents oxygen in the air from entering the water.

Finally, do not overlook the obvious — the environment in which you are suspended is overwhelmingly *liquid*. That means you must consider an entire set of other features that affect life under water — chemical variables.

Chemical Variables

The liquid around you contains a large number of helpful and harmful *chemicals* that you cannot escape, even for a moment.

- **Oxygen:** Terrestrial species, like you, get oxygen in the form of a gas (which draws from the mixture of gases called "air"). Many aquatic species, however, extract dissolved oxygen from the water by means of specialized organs such as gills. Dissolved oxygen levels vary greatly from place to place in the underwater world and depend on a number of things, such as water temperature, the amount of plant photosynthesis happening, and the amount of mixing between the surface waters and deeper waters. High oxygen levels are of particular importance to species such as trout. Bass, on the other hand, thrive with far less oxygen.
- **Nutrients:** Nutrients are also part of our underwater chemical environment. Aquatic plants need the same nutrients as their terrestrial counterparts. Whether they are rooted on the bottom or totally suspended in the water, photosynthetic plants, such as algae, take in phosphorus, nitrogen and other nutrients. Their growth creates the base for aquatic food chains. Unfortunately for some animal species, high nutrient levels can lead to low oxygen levels. For more information on this process of *eutrophication*, go to the *Environment Canada* website: **www.ec.gc.ca/water/en/manage/poll/e_plant.htm**.
- **Salts:** Obviously, the level of different "salts" in the water is another major chemical factor and distinguishes freshwater, saltwater and brackish environments. Animals and plants that live in and "drink" saltwater must have special adaptations to keep their internal body environment in chemical balance with a salty outside environment.

A final thought about water chemistry: As you explore beneath the water surface, you should be aware that you are immersed in a "soup" of natural and synthetic chemicals — many of which are toxic. Some of these are things that you and your neighbours have poured down the drain, sent to the landfill, or sprayed on lawns and fields.

Biological Variables

All living things depend on other living things. For example, food and shelter are provided by one type of organism for another. So, biological variables themselves affect "who else" can live as neighbours (friendly and otherwise) in a particular underwater neighbourhood. Plant and animal species have adapted to be successful in virtually all underwater situations.

- **Biodiversity:** The infinite variety of aquatic spaces that results from physical, chemical and biological variables can lead to incredible biodiversity. Plants and animals have become specialized over time, suited to very specific conditions. The result: in the coastal waters off British Columbia, for example, the biodiversity of plants and animals may reach 7,000 known species. Scientists suspect that there are at least that many more species waiting to be discovered there. Did you know that across Canada there are about 35,000 known aquatic species? About half of these are found in saltwater habitats and the other half in freshwater.