WATER DISTRIBUTION

The water on our planet exists in many different forms and is evenly distributed over the entire planet.

Drinking water must be fresh water, not salt water. Not all freshwater on the Earth is drinkable. Water that is drinkable (safe to drink) is called **potable** water.

A **watershed** (also called a drainage basin) is a region of interconnected rivers and streams. Canada has 9% of the world's freshwater.

A **reservoir** is an artificial lake used for storage and management.

WATER QUALITY

Water quality describes how pure (clean) the water is. Water quality can be measured by the types of substances that are found in it; including living organisms, organic material, minerals and other chemicals.

Many different substances can be present in water. Most substances that are found dissolved in water are ***salts***. The most common salt is sodium chloride (table salt). The total amount of ***all salts*** found in water is called **salinity**. Saltwater (found in oceans) has a higher salinity (average of 3.5%) than freshwater.

Water described as "hard" is high in dissolved minerals, specifically calcium and magnesium. Hard water is not a health risk, but a nuisance because of mineral buildup on plumbing fixtures and poor soap and/or detergent performance.

WATER QUALITY TESTING

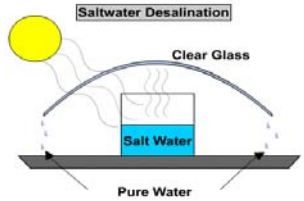
Just looking at water in a glass will not tell you if the water is safe to drink. Smelling it may give you additional information – like it may contain *hydrogen sulphide* (which is harmful to humans) giving it a rotten egg smell. Ocean water is very clear, but cannot be consumed because of its high salinity.

To determine water quality the following criteria are used:

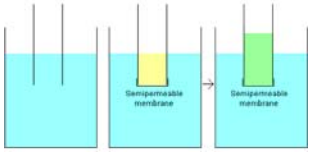
- *Taste and odour*
- *Turbidity (cloudiness) and colour*
- *Toxic substances and other pollutants*
- *Bacteria*
- *Hardness or mineral content*
- *pH (how acidic or basic the water is)*
- *Dissolved oxygen level*
- *Suspended solids (including those floating)*
- *Dissolved solids*

DESALINATION TECHNIQUES

Distillation - a process in which a liquid or vapour mixture of two or more substances is separated into its parts, by the application and removal of heat. (Desert Tent Method)



Reverse Osmosis – forces saltwater through a filter (membrane) allowing water to pass but not salt.



WAVES

Waves are "a disturbance, or variation transferring energy progressively from point to point in a medium" occurring whenever a force comes in contact with water moving along the water's surface. Although waves can move a very long distance, the water doesn't move – it acts as the medium for the ***'wave action'*** to occur. Within each wave the particles of water move in a circular motion. A boat on the surface of the water will cause a **'wash'** or **'wave action'** – which can affect other objects in the water, as well as the shoreline. Most waves are caused by the wind (a force). Stronger forces cause larger waves (Underwater earthquakes can cause **tsunamis** - 'harbour waves'). As ocean waves move closer to the shore their bottoms drag on the ocean floor and their tops rise and break onto the shore (causing damage by their force). The force of waves crashing against a shoreline can cause changes to the shape of the shoreline,

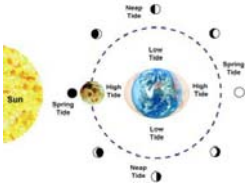
TIDES

The water level along the coast of continents changes constantly. Tides are the regular rising and falling of very large bodies of water. This water level is called a **tide**.

High tide is the highest level the water will reach on shore, while **Low tide** is the lowest level it will reach onshore.

Usually there are two high tides and two low tides each day.

The gravitational force of the moon and the rotation of the Earth on its axis cause tides.



EROSION & DEPOSITION

Moving water is a powerful force. When water wears away rock the fragments are carried as sediment and deposited elsewhere. A river's sediment-load is the amount of ***water-borne*** materials (rock, soil, organic matter) it carries. The faster the river flows, the more water-borne materials it can carry. As it slows these water-borne materials are deposited as sediment.

WEATHERING

Erosion of the landscape can also occur as a result of chemicals in the water. These chemicals can eat away rock forming **caves and sink holes**.

'Frost wedging' can also breakup rocks when water enters cracks and freezes.

RIVER PROFILE

A stream profile is a description of its characteristics, including:

- flow rate
- steepness of stream's bed
- erosion rate of its banks.

The **source** of a river may be high in the mountains, where a glacier is melting. As small streams form together into one **channel**, the volume and speed of the river grows. In the early stages, the river is flowing very quickly and usually fairly straight. As the river reaches lower elevations it begins to slow, causing curves to form (**meanders**), until it reaches a fairly flat flood plain and the sediment it has picked up is deposited in a fan-shaped deposit called a **delta**.

WATERSHEDS

A watershed is all the area of land that drains into one main lake or river. It can contain many smaller streams, rivers and even lakes, which all eventually drain into a larger lake, sea or ocean.

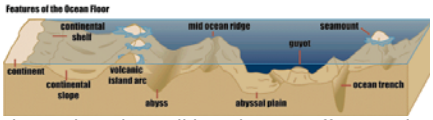
The location of the highest land on the continent determines the direction that a watershed drains. This high land is called the **Continental Divide**. In North America it is in the Rocky Mountains.

On the **West side** of the divide, the rivers all flow into the Pacific Ocean.

On the **East side** of the divide, the rivers flow into either the Arctic Ocean or the Atlantic Ocean.

OCEAN BASIN & DRAINAGE

The Earth is in a constant state of change. The **Theory of Plate Tectonics** explains how the lithosphere (crust of the Earth) is in pieces and these pieces are moving because of convection currents in the magma. Some of these plates are moving toward other plates, some are moving away and some are moving in opposite directions beside each other.



The changing lithosphere affects the drainage patterns of the continents. The Continental Divide marks the division whereby the rivers drain west and east from the divide. Continental drainage systems were also created and are affected by the movement of ice.

GLACIERS

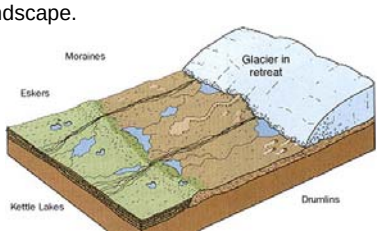
Large bodies of moving Ice are called **glaciers**. Those covering large areas of land are called ***continental glaciers*** or ***icecaps***. Continental glaciers cover Antarctica and Greenland. Glaciers also form high in the mountains and move through valleys between mountain peaks. These are called ***valley glaciers***. As glaciers move, pieces of rock – embedded in the ice help to shape the landscape by gouging out chunks of the land as the glacier moves.

Glacial movement depends on the climate. In colder climates, little melting occurs and the glacier continues to grow or move forward (this is called an *advancing glacier*).

If the climate is warmer, the glacier melts faster than it grows and leaves the rocks, soil and large boulders it once contained. These glaciers are called *retreating glaciers*.

GLACIAL LANDFORMS

As glaciers advance or retreat, they create specific **glacial features** across the landscape.



Another glacial feature, an **erratic** - a very large boulder (piece of the mountain carried by the glacier to the valley floor).Many are found where retreating glaciers have left them, like this one near Okotoks, AB.

CLIMATE

Climate is the average weather measured over a long period of time. Large bodies of water, like the oceans and the Great Lakes, influence the weather and the climate in their regions. Water holds the heat longer than most substances and so cities that are close to large bodies of water have warmer climates.

The main effect that water has on climate is that *extreme temperatures are less likely to occur in cities near large bodies of water*, because water heats up and cools down very slowly – whereas in places where there is not very much water, the land heats up quickly and cools down quickly – and that is where the extremes are felt.

The **rain shadow** created by the Rockies makes the climate very dry in Southern Alberta.

OCEAN CURRENTS

Ocean currents can also affect climate. Currents are streams of water that move within a larger body of water. They can be caused by: wind, temperature differences in the water, salinity differences in the water and Earth's rotation.
Currents cause water to move from place to place. Surface currents are caused by steady winds. The currents that affect Labrador and Scotland are surface currents. If they start near the equator (like the **North Atlantic Current** does), they are warm. If they start near the North Pole, they carry very cold water (like the **Labrador Current** does). When the current flow to their respective shores, they can influence the climate of the land. The temperature of the ocean current not only affects the **air temperature**, but they also affect the **amount of precipitation** that an area receives. Warm air (warm currents) hold more moisture than cold air (cold currents).

DIVERSITY

Diversity refers to the variety of different kinds of organism species (both plant and animal) living in a particular ecosystem or environment. A rich variety of organisms living and interacting within a water ecosystem indicates a healthy ecosystem. The more species you find, the more likely you will also find more oxygen, and less pollutants.

Large bodies of water like oceans and lakes have layers or **zones**. Some organisms live in only one or two zones, while other organisms can live in all three. In Canada lakes are affected by extreme changes in temperature. Organisms living in the freshwater ecosystem of a lake or pond must be able to adapt to these changes in order to survive.

LAKE ZONES	SPECIES
Upper Zone – is the area of a lake from the shore down to where the aquatic plants stop growing	Plants – bulrushes, water lilies Animals – small fish, clams, insects, snails, worms, leeches, and frogs
Middle Zone – is the open water area that still has light penetration.	***Phytoplankton*** are food for fish that live here. Some of the fish that live in this zone also travel to the deeper zone.
Lowest/Deep Zone – is where no light penetrates, so no plants grow there. Food for organisms living in this zone comes from the zones above, in the form of waste.	Deep water fish (large size species)

OCEAN ZONES	SPECIES
Estuary – is where fresh and saltwater mix forming ***brackish*** water.	- Marshes provide habitat for many kinds of plants, insects and other animals that can tolerate the brackish water.
Intertidal Zone – is the shoreline of an ocean.	Plants and animals withstand the pounding of the waves and the rise and fall of tides.
Continental Shelf – is warmer water than out in the deep ocean and this area has full light penetration.	Many plants and animals because of the rich nutrients available. ***Phytoplankton*** are food for fish that live here.
Oceanic Zone – is where very little light penetrates, so no plants grow there. Food comes from the zones above,	Deep water fish (large size species)

AQUATIC ADAPTATIONS

An **adaptation** is a *physical characteristic* or *behaviour* of a species that increases that species' chances of survival in a particular environment. All living things are adapted to live in particular environments. As changes occur within their environment, those organisms that can adapt to the changes have a better chance of surviving than those organisms that cannot adapt to the changes.

There are **five factors** that have led to the development of adaptations by aquatic species, including: **temperature, light, pressure, salinity and water movement**.

POPULATIONS

WATER QUALITY

WATER USE

IMPACT ASSESSMENT

POPULATIONS

The study of populations looks at groups within a particular species. A **population** is a group of organisms of the same species ***that live in a particular area***. .

Natural changes in animal populations are not unusual, but the rapid decline in a species is a cause for concern. What caused the decline is important to know because it affects other species within the ecosystem as well.

A change in a population can mean an increase or a decrease in the number of individuals in that population. It can also mean the change in the number of males and females, or a change in the numbers of old and young individuals. A population within an ecosystem changes as a result of something happening in that ecosystem.

SEASONAL CHANGE

Extreme temperature changes cause populations to swell in the summer and disappear in the winter. The disappearance of a population may mean only that surviving individuals are dormant, or hibernating in the winter months. Breeding cycles can also cause seasonal changes in populations.

SHORT-TERM CHANGE

Short-term changes take place over a relatively short period of time and don't last very long. They happen irregularly and may be part of a natural event, or caused by human activities.

LONG-TERM CHANGE

Also result from natural events or human activities. A landslide can change the course of a river or stream. Addition of a new species to an area may result in overpopulation of that species because there are no natural enemies. These changes can cause ripple effects because of the interactions that occur within every ecosystem.

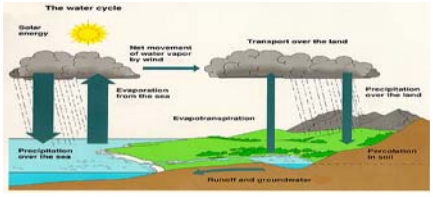
WATER QUALITY

Water quality can change when natural events or human activities affect what is being added or taken from the water. Some species can tolerate certain changes because those changes are within their ***range of tolerance***. Other species may have a very different range of tolerance to certain conditions and will not be able to survive.

Acid rain can kill a lake. The lake's death results from altering the conditions, which specific species can tolerate. Those species which depend (in the food chain)on the species that die will also perish. When light is blocked by **algal bloom** growing on the surface of the water. water plants, which produce oxygen for other organisms in the water, die (because they don't get enough light). When there is not enough oxygen in the water, other organisms also perish, and soon, the lake cannot support any life at all (it dies).

WATER CYCLE

Water is recycled around the world through the **water cycle**. This doesn't mean that any one area will always have the same amount of water. In fact, it means just the opposite. No one area can expect the same amount of water year after year. This is because of other natural cycles and human intervention (use) that can cause changes to occur.



WATER USE

There are **direct** (*domestic* or *personal use*) and **indirect** (*industrial* and *agricultural*) ways that humans use water.

Many indirect uses can have negative effects on Earth's water supply. Negative effects may include:

- Pollution of surface and groundwater
- Depletion of groundwater supply

Power stations – can discharge warm water into lakes or rivers (thermal pollution) killing organisms that cannot tolerate the increased temperature.

Factories – may add toxic chemicals (which can cause tumors, birth defects, sterility and even death) or, add to the thermal pollution problem.

IMPACT ASSESSMENT

There are benefits and costs to using water.

Water Use	Benefit (+)	Cost (-)
Agriculture (irrigation)	Food Economy Jobs	Soil salinity Decreases vegetation Depletes groundwater supplies
Industry (coolant, solvent, washing, diluting pollutants)	Jobs Consumer Products Services	Pollution contributor Depletes groundwater supplies
Domestic	Convenience Jobs	Cost

IMPACTS ON WATER

Runoff – from **farmland** contains fertilizers that can cause excessive plant growth. It may also contain toxic chemicals (pesticides and herbicides) that can kill living organisms.

Habitat destruction takes away the places where animals and plants can live and interact in an aquatic ecosystem.

Sewage – contains large amounts of nitrogen, which causes micro-organism populations to increase. These micro-organisms use up the oxygen in the water and may organisms can die as a result.

Oil Spills – from ships transporting oil from place to place can cause harm to plants and animals in, on or near the water.

One way to help guard against problems with water quality is to monitor the water supply.

To **monitor** means to observe, check, or keep track of something for a specific purpose. Town and city water supplies have to be monitored on a regular basis to ensure that the quality of the water remains high.

Water technicians (***freshwater biologists***) regularly measure the level of chemicals in the water and the numbers and kinds of different species of organisms. They also make observations on how it looks and smells. In this way they can identify potential problems in the water supply and adjust the treatment of the water to eliminate them. Research scientists use monitoring techniques (evidence of toxins in the water and living organisms) to help them develop technologies to help protect the environment.

PROBLEM SOLVING NEEDS MORE THAN SCIENCE AND TECHNOLOGY

Problem solving requires a strong **commitment** from people. They need to decide what needs to be done and then commit themselves and others to get it done. In many cases the solutions will require money and a way to raise it so the solution can be implemented without delay.

Water systems everywhere need to be monitored and cleaned up if they are causing a problem. The solutions to many of the problems may already be available, or new technologies should be developed to address the concern. Most importantly people must work together to solve the problems, because our water supply is our life source and without it, we will all perish.