UNIT - 4A | PAPER - 2

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UNIT 4A - PAPER 2
STUDY OF POLLUTION

1. Hydrosphere
2. Atmosphere

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EARTH'S HYDROSPHERE

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EARTH'S HYDROSPHERE

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HISTORY OF HYDROSPHERE

- There are several theories regarding the formation of the Earth's hydrosphere. This planet contains proportionately more surface water than comparable bodies in the inner solar system. Outgassing of water from the Earth's interior is not sufficient to explain the quantity of water.
- One hypothesis that has gained popularity among scientists is that the early Earth was subjected to a period of bombardment by comets and water-rich asteroids. Much of the water on the surface today is thought to have originated from the outer parts of the solar system, such as from objects that arrived from beyond Neptune.
- Ice ages
- During the history of Earth, there have been a series of periods in which a significant portion of the hydrosphere was locked up in the form of glacial ice. It has even been hypothesized that during the Cryogenian period, this sea ice extended all the way to the equator (see Snowball Earth).
- It is currently believed that four major ice ages have taken place during our planet's history. The current ice age began about 4 × 107 years ago, and gained in intensity during the Pleistocene. The most recent withdrawal of ice sheets occurred only 10,000 years ago.

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OTHER HYDROSPHERE

- A thick hydrosphere is thought to exist around the Jovian moon, Europa. The outer layer of this hydrosphere is almost entirely frozen, but current models predict that there is an ocean up to 100 kilometers in depth underneath the ice. This ocean remains in a liquid form due to tidal flexing of the moon in its orbit around Jupiter.
- It has been suggested that another Jovian moon, Ganymede, may also possess a sub-surface ocean. The ice covering, however, is expected to be thicker on Ganymede than on Europa.
- It includes all liquid and frozen surface waters, groundwater held in soil and rock, and atmospheric water vapour. Virtually all of these waters are in constant circulation through the hydrologic cycle. Although the components of the hydrosphere are undergoing continuous change of state and location, the total water budget remains in balance. The components of the hydrosphere have been seriously affected by the water-polluting activities of modern society.
- hydrosphere, discontinuous layer of water at or near the Earth's surface. It includes all liquid and frozen surface waters, groundwater held in soil and rock, and atmospheric water vapour.

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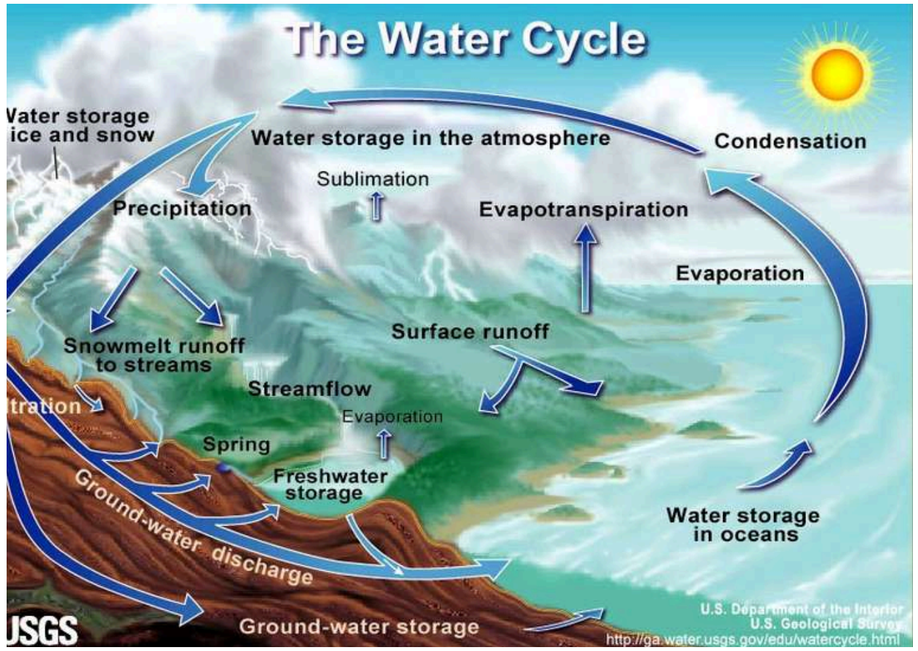
WATER CYCLE

The abundance of water on Earth is a unique feature that distinguishes our "blue planet" from others in the solar system. Approximately 70.8 percent of the Earth is covered by water and only 29.2 percent is terra firma. The average depth of the Earth's oceans is 3,794 m (12,447 ft)—more than five times the average height of the continents. The mass of the oceans is approximately 1.35 × 10^{18} tons, or about 1/4400 of the total mass of the Earth.



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WATER CYCLE

- The water cycle (or hydrologic cycle) describes the methods of transport for water in the hydrosphere. This cycle includes water beneath the Earth's surface and in rocks (lithosphere), the water in plants and animals (biosphere), the water covering the surface of the planet in liquid and solid forms, and the water in the atmosphere in the form of water vapor, clouds, and precipitation. Movement of water within the hydrosphere is described by the hydrologic cycle. It is easy to see this motion in rivers and streams, but it is harder to tell that there is this motion in lakes and ponds.

- The characteristics of the ocean that affect its motion are its temperature and salinity. Cold water is denser than warm water, and salt water is denser than freshwater. The combination of the water's temperature and salinity determines whether it rises to the surface, sinks to the bottom, or stays at some intermediate depth.

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HYDROLOGICAL CYCLE

- Insulation, or energy (in the form of heat and light) from the sun, provides the energy necessary to cause evaporation from all wet surfaces including oceans, rivers, lakes, soil and the leaves of plants. Water vapor is further released as transpiration from vegetation and from humans and other animals.

- Aquifer drawdown or over drafting and the pumping of fossil water increases the total amount of water in the hydrosphere that is subject to transpiration and evaporation thereby causing accretion in water vapor and cloud cover which are the primary absorbers of infrared radiation in the earth's atmosphere. Adding water to the system has a forcing effect on the whole earth system, an accurate estimate of which hydrogeological fact is yet to be quantified.

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LIFE

- All currently recognized forms of life rely on an active hydrosphere. All organic chemistry indicative of life occurs with water as its solvent. The water cycle in the Earth's hydrosphere allows for the purification of salt water into freshwater. The action of both evaporation and wetland swamps serves to remove a large portion of atmospheric pollutants from the atmosphere (i.e. acid rain). Through this process, the water cycle purifies the gaseous atmosphere. Although most life on the planet exists in the saltwater oceans, humans are particularly interested in the hydrosphere because it provides the fresh water we depend upon.

- The search for life on other celestial bodies in our solar system is focused on first locating water. The hydrospheres of other planetary bodies are also the focus of research, to find places that humans can inhabit without having to transport all their water with them.

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WATER MASSES AT THE EARTH'S SURFACE

- Oceans-1370 cubic kilometers- 97.25%
- Ice caps and glaciers-29.0 cubic kilometers-2.05%
- Deep groundwater-5.3 cubic kilometers-0.38%
- Shallow groundwater-4.2 cubic kilometer-0.30%
- Lakes-0.125 cubic kilometers-0.01%
- Soil moisture-0.065 cubic kilometers-0.005%
- Atmosphere-0.013 cubic kilometers-0.001%
- Rivers-0.0017 cubic kilometers-0.0001%
- Biosphere-0.0006 cubic kilometers-0.00004%
- Total- 1,408.7 cubic kilometers- 100%

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DISTRIBUTION AND QUANTITY OF THE EARTH'S WATER

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RAIN WATER

About 110,300 cubic kilometres of rain fall on land each year. The total water in the atmosphere is 0.013×10^6 cubic kilometres, and this water, owing to precipitation and evaporation, turns over every 9.6 days. Rainwater is not pure but rather contains dissolved gases and salts, fine-ground particulate material, organic substances, and even bacteria. The sources of the materials in rainwater are the oceans, soils, fertilizers, air pollution, and fossil-fuel combustion.

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LAKE WATER

Although lake waters constitute only a small percentage of the water in the hydrosphere, they are an important ephemeral storage reservoir for fresh water. Aside from their recreational use, lakes constitute a source of water for household, agricultural, and industrial uses. Lake waters are also very susceptible to changes in chemical composition due to these uses and to other factors.

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OTHER BODIES OF WATER

- Ocean waters and waters trapped in the pore spaces of sediments make up most of the present-day hydrosphere
- The total mass of water in the oceans equals about 50 percent of the mass.

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UNIT - 4B | PAPER - 2

WATER POLLUTION

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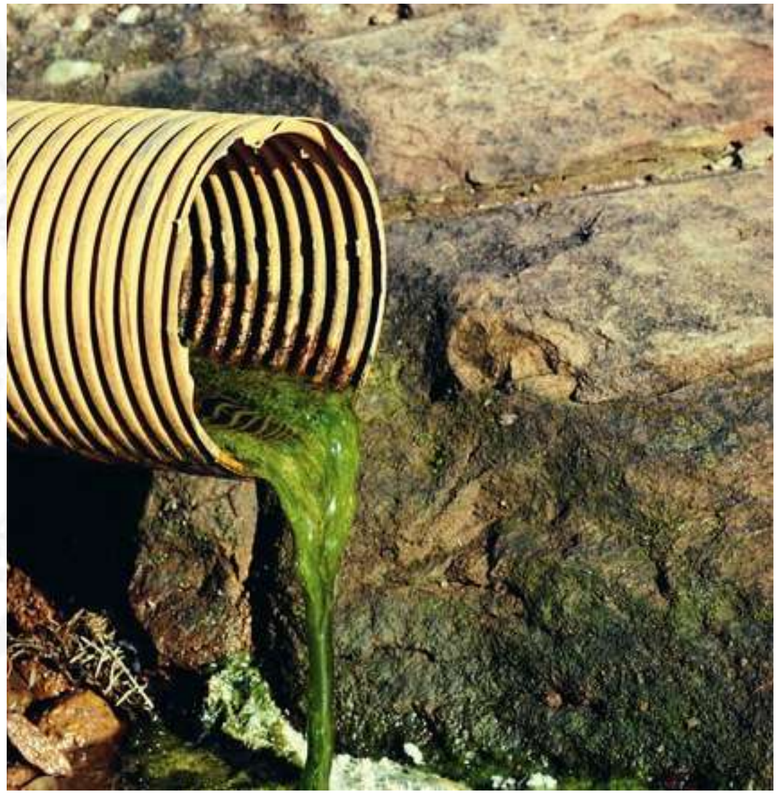
WATER POLLUTION

- ¨Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.
- ¨Water pollution affects plants and organisms living in these bodies of water; and, in almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities



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INTRODUCTION TO WATER POLLUTION

Water pollution is a major global problem. It has been suggested that it is the leading worldwide cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. An estimated 700 million Indians have no access to a proper toilet, and 1,000 Indian children die of diarrheal sickness every day. Some 90% of China's cities suffer from some degree of water pollution, and nearly 500 million people lack access to safe drinking water. In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well. In the most recent national report on water quality in the United States, 45 percent of assessed stream miles, 47 percent of assessed lake acres, and 32 percent of assessed bay and estuarine square miles were classified as polluted.

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GROUNDWATER POLLUTIONS

Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, sometimes referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. non-point source may be irrelevant. A spill or ongoing releases of chemical or radionuclide contaminants into soil (located away from a surface water body) may not create point source or non-point source pollution, but can contaminate the aquifer below, defined as a toxin plume. The movement of the plume, called a plume front, may be analyzed through a hydrological transport model or groundwater model. Analysis of groundwater contamination may focus on the soil characteristics and site geology, hydrogeology, hydrology, and the nature of the contaminants.

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CAUSES OF WATER POLLUTION

- The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration.
- While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant. High concentrations of naturally-occurring substances can have negative impacts on aquatic flora and fauna.
- Many causes of pollution including sewage and fertilizers contain nutrients such as nitrates and phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms consequently clogs our waterways, use up dissolved oxygen as they decompose, and block light to deeper waters.
- Pollution is also caused when silt and other suspended solids, such as soil, wash off plowed fields, construction and logging sites, urban areas, and eroded river banks when it rains

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POLLUTED RIVER IN THE UNITED KINGDOM

The pollution of rivers and streams with chemical contaminants has become one of the most crutial environmental problems within the 20th century. Waterborne chemical pollution entering rivers and streams cause tramendous amounts of destruction

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MICROORGANISMS THAT CAUSES HUMAN HEALTH PROBLEMS :

- Burkholderia pseudomallei
- Cryptosporidium parvum
- Giardia lamblia
- Salmonella
- Novovirus and other viruses
- Parasitic worms (helminths).

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ORGANIC WATER POLLUTANTS

- Detergents
- Disinfection by-products found in chemically disinfected drinking water, such as chloroform
- Food processing waste, which can include oxygen-demanding substances, fats and grease
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds
- Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from stormwater runoff. Tree and bush debris from logging operations
- Volatile organic compounds (VOCs), such as industrial solvents, from improper storage. Chlorinated solvents, which are dense non-aqueous phase liquids (DNAPLs), may fall to the bottom of reservoirs, since they don't mix well with water and are denser.
- Various chemical compounds found in personal hygiene and cosmetic products

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INORGANIC WATER POLLUTANTS

- Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
- Ammonia from food processing waste
- Chemical waste as industrial by-products
- Fertilizers containing nutrients--nitrates and phosphates--which are found in stormwater runoff from agriculture, as well as commercial and residential use
- Heavy metals from motor vehicles (via urban stormwater runoff) and acid mine drainage
- Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land clearing sites

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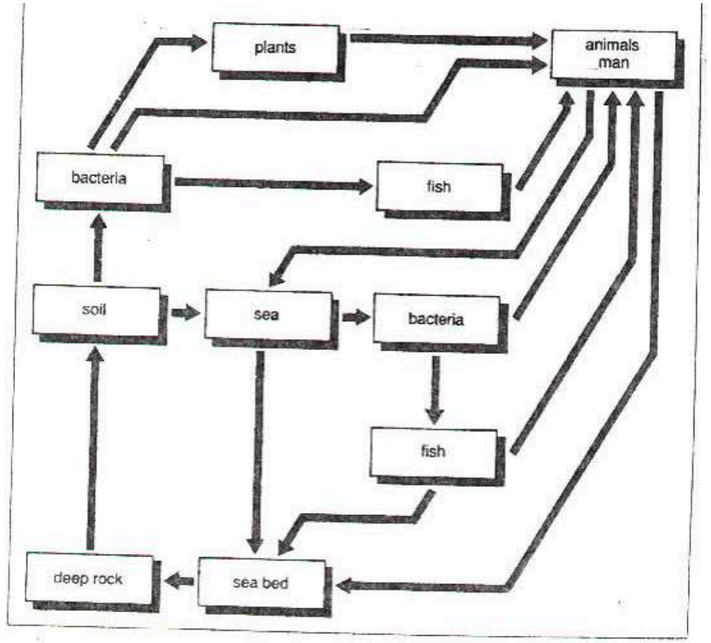
PATHOGENS

Pathogens are another type of pollution that prove very harmful. They can cause many illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. Pathogens include such organisms as bacteria, viruses, and protozoan. These pollutants enter waterways through untreated sewage, storm drains, septic tanks, runoff from farms, and particularly boats that dump sewage. Though microscopic, these pollutants have a tremendous effect evidenced by their ability to cause sickness.



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ADDITIONAL FORMS OF WATER POLLUTION

Three last forms of water pollution exist in the forms of petroleum, radioactive substances, and heat. Petroleum often pollutes waterbodies in the form of oil, resulting from oil spills. The previously mentioned Exxon Valdez is an example of this type of water pollution. These large-scale accidental discharges of petroleum are an important cause of pollution along shore lines. Besides the supertankers, off-shore drilling operations contribute a large share of pollution. One estimate is that one ton of oil is spilled for every million tons of oil transported. This is equal to about 0.0001 percent. Radioactive substances are produced in the form of waste from nuclear power plants, and from the industrial, medical, and scientific use of radioactive materials. Specific forms of waste are uranium and thorium mining and refining. The last form of water pollution is heat. Heat is a pollutant because increased temperatures result in the deaths of many aquatic organisms. These decreases in temperatures are caused when a discharge of cooling water by factories and power plants occurs.

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CLASSIFYING WATER POLLUTION

- The major sources of water pollution can be classified as municipal, industrial, and agricultural.
- Municipal water pollution consists of waste water from homes and commercial establishments.

DRILLING

pollution is a growing problem, particularly devestating to coastal wildlife. Small quantities of oil spread rapidly across long distances to form deadly oil slicks. In this picture, demonstrators with "oil-covered" plastic animals protest a potential drilling project in Key Largo, Florida. Whether or not accidental spills occur during the project, its impact on the delicate marine ecosystem of the coral reefs could be devastating.

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THERMAL POLLUTION

Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. Thermal pollution, unlike chemical pollution, results in a change in the physical properties of water. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Elevated water temperatures decreases oxygen levels (which can kill fish) and affects ecosystem composition, such as invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters.

Thermal pollution can also be caused by the release of very cold water from the base of reservoirs into warmer rivers.

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OIL SPILL CLEAN-UP

Workers use special nets to clean up a California beach after an oil tanker spill. Tanker spills are an increasing environmental problem because once oil has spilled, it is virtually impossible to completely remove or contain it. Even small amounts spread rapidly across large areas of water. Because oil and water do not mix, the oil floats on the water and then washes up on broad expanses of shoreline. Attempts to chemically treat or sink the oil may further disrupt marine and beach ecosystems.

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GLOBAL WATER POLLUTION

Workers use special nets to clean up a California beach after an oil tanker spill. Tanker spills are an increasing environmental problem because once oil has spilled, it is virtually impossible to completely remove or contain it. Even small amounts spread rapidly across large areas of water. Because oil and water do not mix, the oil floats on the water and then washes up on broad expanses of shoreline. Attempts to chemically treat or sink the oil may further disrupt marine and beach ecosystems.

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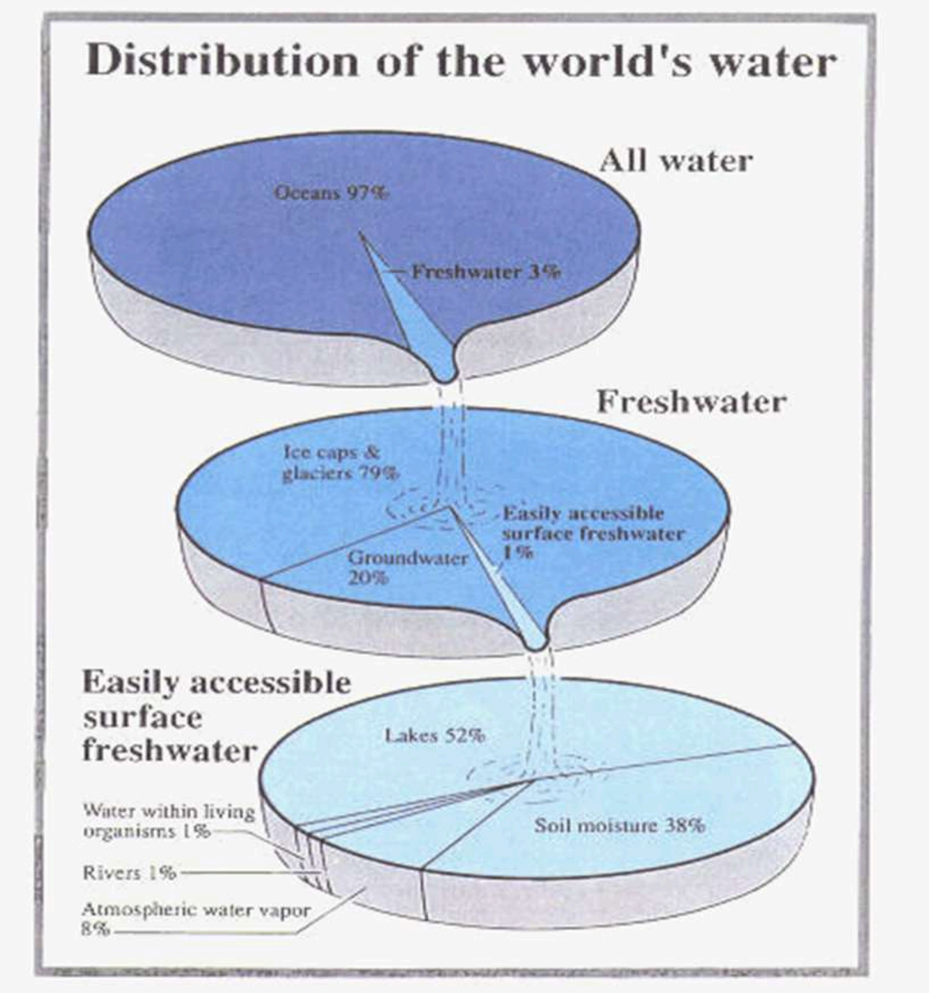
DISTRIBUTION OF THE WORLD'S WATER



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CONCLUSION

Clearly, the problems associated with water pollution have the capabilities to disrupt life on our planet to a great extent. Congress has passed laws to try to combat water pollution thus acknowledging the fact that water pollution is, indeed, a seriousissue. But the government alone cannot solve the entire problem. It is ultimately up to us, to be informed, responsible and involved when it comes to the problems we face with our water. We must become familiar with our local water resources and learn about ways for disposing harmful household wastes so they don't end up in sewage treatment plants that can't handle them or landfills not designed to receive hazardous materials.

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POLLUTED WATER

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EARTH'S HYDROSPHERE AND WATER POLLUTION

- Hydrosphere: Discontinuous layer of water at or near the Earth's surface.
- Water pollution is the contamination of water bodies.

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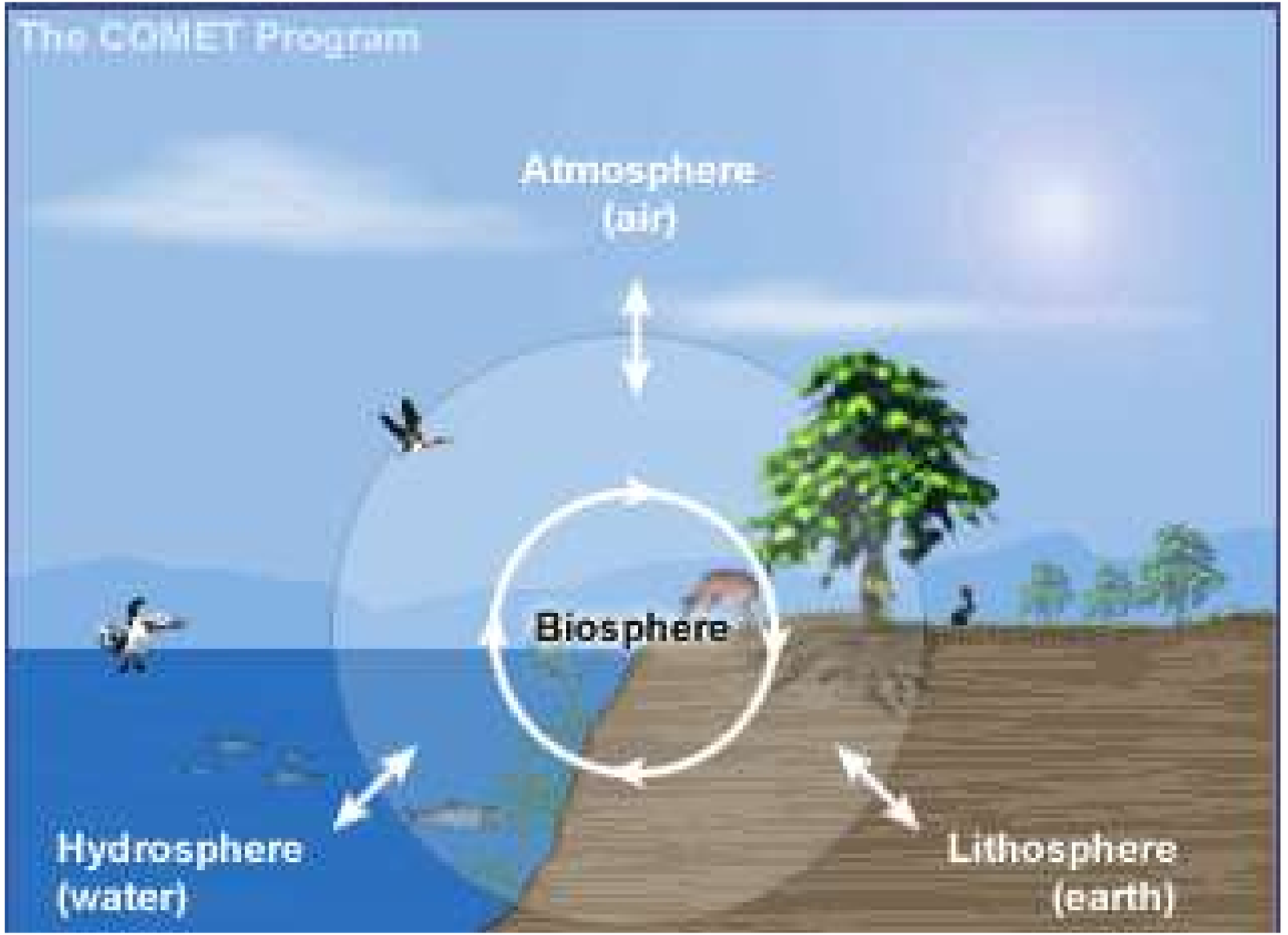

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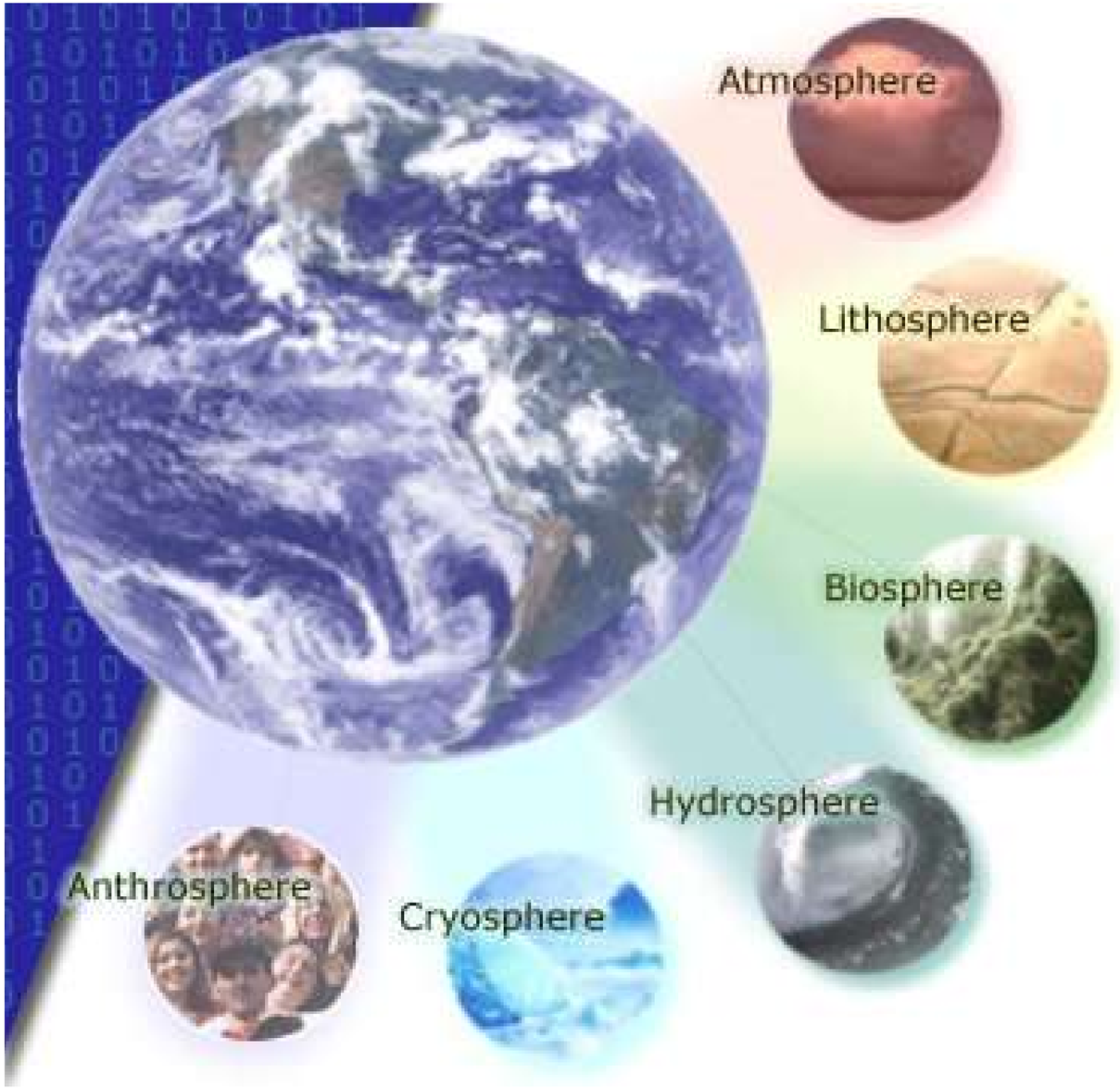

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