Contents

Unit 1

Water Cycle

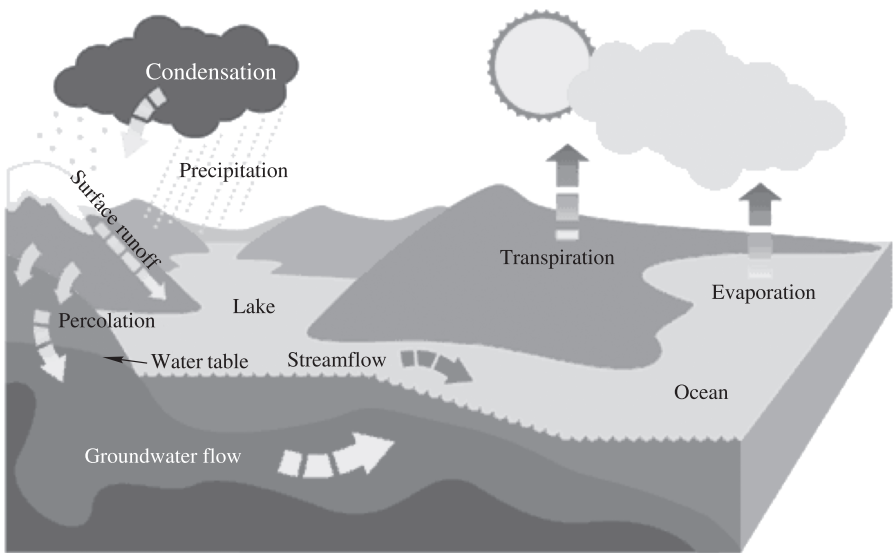
Lead-in

Water cycle, also called hydrologic cycle, involves the continuous circulation of water in the Earth-atmosphere system. Of the many processes involved in the water cycle, the most important are evaporation, transpiration, condensation, precipitation, and runoff. Although the total amount of water within the cycle remains essentially constant, its distribution among the various processes is continuously changing.

Text A

Hydrologic Cycle

1 Water has been constant in quantity and continuously in motion. Little has been added or lost over the years. The same water molecules have been transferred time and time again from the oceans and the land surface into the atmosphere by evaporation, dropped on the land as precipitation, and transferred back to the sea by rivers and groundwater. This endless circulation is known as the "hydrologic cycle".



2 The illustration shows the hydrologic cycle in which water leaves the atmosphere and falls to Earth as precipitation where it enters surface waters or percolates into the water table and groundwater and eventually is taken back into the atmosphere by transpiration and evaporation to begin the cycle again.

Evaporation

3 As water is heated by the sun, surface molecules become sufficiently energized to break free of the attractive force binding them together, and then evaporate and rise as invisible vapor in the atmosphere.

Transpiration

4 Water vapor is also emitted from plant leaves by a process called transpiration. Every day an actively growing plant transpires 5 to 10 times as much water as it can hold at once.

Condensation

5 As water vapour rises, it cools and eventually condenses, usually on tiny particles of dust in the air. When it condenses it becomes a liquid again or turns directly into a solid (ice, hail or snow). These water particles then collect and form clouds.

Precipitation

6 Precipitation in the form of rain, snow and hail comes from clouds. Clouds move around the world, propelled by air currents. For instance, when they rise over mountain ranges, they cool, becoming so saturated with water that water begins to fall as rain, snow or hail, depending on the temperature of the surrounding air.

Runoff

7 Excessive rain or snowmelt can produce overland flow to creeks and ditches. Runoff is visible flow of water in rivers, creeks and lakes as the water stored in the basin drains out.

Percolation

8 Some of the precipitation and snowmelt moves downwards, percolates or infiltrates through cracks, joints and pores in soil and rocks until it reaches the water table where it becomes groundwater.

Groundwater

9 Subterranean water is held in cracks and pore spaces. Depending on the geology, the groundwater can flow to support streams. It can also be trapped by wells. Some groundwater is very old and may have been there for thousands of years.

Water table

10 The water table is the level at which water stands in a shallow well.

The sun-powered cycle

11 Heating of the ocean water by the sun is the key process that keeps the hydrologic cycle in motion. Water evaporates, then falls as precipitation in the form of rain, hail, snow, sleet, drizzle or fog. On its way to Earth some precipitation may evaporate or, when it falls over land, be intercepted by vegetation before reaching the ground. The cycle continues in three different ways:

- Evaporation/transpiration—On average, as much as 40 percent of precipitation in Canada is evaporated or transpired.
- Percolation into the ground—Water moves downward through cracks and pores in soil and rocks to the water table. Water can move back up by capillary action or it can move vertically or horizontally under the Earth's surface until it re-enters a surface water system.
- Surface runoff—Water runs overland into nearby streams and lakes; the steeper the land and the less porous the soil, the greater the runoff. Overland flow is particularly visible in urban areas. Rivers join each other and eventually form one major river that carries all of the sub-basins' runoff into the ocean.

12 Although the hydrologic cycle balances what goes up with what comes down, one phase of the cycle is "frozen" in the colder regions during the winter season. During the Canadian winter, for example, most of the precipitation is simply stored as snow or ice on the ground. Later, during the spring melt, huge quantities of water are released quickly, which results in heavy spring runoff and flooding.

The water-climate relationship

13 Water plays a basic role in the climate system through the hydrologic cycle, but water is intimately related to climate in other ways as well. It is obvious, from a water resource perspective, how the climate of a region to a large extent determines the water supply in that region based on the precipitation available and on the evaporation loss. Perhaps less obvious is the role of water in climate. Large water bodies, such as the oceans and the Great Lakes, have a moderating effect on the local climate because they act as a large source and sink for heat. Regions near these water bodies generally have milder winters and cooler summers than would be the case if the nearby water body did not exist.

14 The evaporation of water into the atmosphere requires an enormous amount of energy, which ultimately comes from the sun. The sun's heat is trapped in the Earth's atmosphere by greenhouse gases, the most plentiful of which by far is water vapor. When water vapor in the atmosphere condenses to precipitation, this energy is released into the atmosphere. Fresh water can mediate climate change to some degree because it is stored on the landscape as lakes, snow covers, glaciers, wetlands and rivers, and is a store of latent energy. Thus water acts as an energy transfer and storage medium for the climate system.

15 The water cycle is also a key process upon which other cycles operate. For example, one needs to properly understand the water cycle in order to address many of the chemical cycles in the atmosphere.

(919 words)

New Words

1	circulation /ˌsɜːkjʊˈleɪʃən/ *n.*	循环
2	evaporation /ɪˌvæpəˈreɪʃən/ *n.*	蒸发
3	evaporate /ɪˈvæpəreɪt/ *v.*	（使）蒸发，挥发
4	propel /prəˈpel/ *v.*	推进
5	saturate /ˈsætʃəreɪt/ *v.*	使浸透，使充满，使饱和
6	runoff /ˈrʌnɒf/ *n.*	径流
7	ditch /dɪtʃ/ *n.*	沟渠，壕沟
8	creek /kriːk/ *n.*	小湾，小溪
9	percolate /ˈpɜːkəleɪt/ *v.*	渗入
10	infiltrate /ˈɪnfɪltreɪt/ *v.*	渗透
11	sleet /sliːt/ *n.*	雨夹雪
12	transpiration /ˌtrænspɪˈreɪʃən/ *n.*	蒸发作用
13	transpire /trænˈspaɪə/ *v.*	蒸发
14	vapor /ˈveɪpə/ *n.*	水蒸气
15	condense /kənˈdens/ *v.*	冷凝
16	precipitation /prɪˌsɪpɪˈteɪʃən/ *n.*	降水
17	mediate /ˈmiːdieɪt/ *v.*	调和

Expressions

1	air current	气流
2	subterranean water	地下水
3	hydrologic cycle	水循环
4	water table	地下水位
5	capillary action	毛细管作用
6	sub-basin	子流域；分流域
7	moderating effect	调节效应
8	greenhouse gases	温室气体
9	latent energy	潜能
10	storage medium	存储介质
11	chemical cycle	化学循环

Notes

The Great Lakes 北美五大湖是世界最大的淡水湖群，即北美洲的苏必利尔湖、密歇根湖、休伦湖、伊利湖和安大略湖这五个相连湖泊的总称，又称大湖，有“北美大陆地中海”之称。北美五大湖除密歇根湖属于美国外，其余四湖均跨美国和加拿大两国。五大湖总面积超过24万平方千米，其中美国占72%，加拿大占28%。总蓄水容量约228,000亿立方米，约占全世界淡水湖总量的1/5。

Exercises

I. Read each of the following paraphrases and then write the word it represents on the line provided.

1 a small stream _____

2 a mixture of rain and snow or hail _____

3 something that drains or flows off, as rain water _____

4 to make more dense or compact _____

5 a substance that is in a gaseous state at a temperature below its boiling point _____

6 the process in which a liquid changes state to vapor _____

7 any form of water, such as rain, snow, sleet, or hail, that falls to the Earth’s surface _____

8 (of plants) to lose (water in the form of water vapour), especially through the stomata of the leaves _____

9 to cause (a liquid, for example) to permeate a substance by passing through its pores _____

10 the gaseous envelope surrounding the Earth or a heavenly body; the air _____

II. Find the Chinese equivalents for the following expressions.

1 hydrologic cycle
2 air current
3 water table
4 capillary action
5 subterranean water
6 sub-basin
7 storage medium
8 chemical cycle
9 latent energy
10 moderating effect

III. Discuss the following questions.

1 How is water evaporated into the atmosphere?
2 What are the main forms of precipitation?
3 How is underwater formed according to the passage?
4 What are the different ways in which water cycle continues?
5 What role can large water bodies play in climate? Why?

IV. Choose the best answer to each of the following questions or statements.

1 In the hydrologic cycle water leaves the land surface into the atmosphere by _____.

A. precipitation B. evaporation
C. air D. water

2 What keeps the hydrologic cycle in motion?

A. Wind. B. Rain.
C. Sun. D. Water.

3 Plants can play a role in the hydrologic cycle by _____.

A. evaporation　　B. percolation

C. condensation　　D. transpiration

4 Which of the following is NOT the form of precipitation?

A. Hail.　　B. Sleet.

C. Hurricane.　　D. Snow.

5 Coastal regions or areas close to large water bodies tend to have _____ weather.

A. hot　　B. cold

C. mild　　D. rough

V. Translate the following sentences into Chinese.

1 Water vapor is also emitted from plant leaves by a process called transpiration.

2 As water vapor rises, it cools and eventually condenses, usually on tiny particles of dust in the air.

3 Heating of the ocean water by the sun is the key process that keeps the hydrologic cycle in motion.

4 Rivers join each other and eventually form one major river that carries all of the sub-basins' runoff into the ocean.

5 Water plays a basic role in the climate system through the hydrologic cycle, but water is intimately related to climate in other ways as well.

VI. Translate the following sentences into English.

1 水蒸气凝结时，会再变成液体或直接变成如冰雹、雪之类的固体。(condense)

2 显而易见，气候与水循环密切相关。(relate)

3 水蒸发进入大气需要很多能量，这些能量最终来自太阳。(evaporation)

4 降水的形式通常有下雨、下雪和冰雹。(precipitation)

5 沿海或大的湖泊附近地区的冬天不会太冷，夏天较凉爽。(mild)

VII. Translate the passage into Chinese.

It is obvious, from a water resource perspective, how the climate of a region to a large extent determines the water supply in that region based on the precipitation available and on the evaporation loss. Perhaps less obvious is the role of water in climate. Large water bodies, such as the oceans and the Great Lakes, have a moderating effect on the local climate because they act as a large source and sink for heat. Regions near these water

bodies generally have milder winters and cooler summers than would be the case if the nearby water body did not exist.

Text B

Water's Journey Through Time

1 Earth is the only planet in our solar system with extensive liquid water—other planets are too hot or too cold, too big or too small. Though Mars appears to have had water on its surface in the past and may still harbor liquid water deep below its surface, our oceans, rivers, and rain are unique as far as we know, and they are life-sustaining. Understanding the processes and reservoirs of the hydrologic cycle is fundamental to dealing with many issues, including pollution and global climate change.

The Hydrologic Cycle

2 The hydrologic cycle can be thought of as a series of reservoirs, or storage areas, and a set of processes that cause water to move between those reservoirs. The largest reservoir by far is the oceans, which hold about 97% of Earth's water. The remaining 3% is the freshwater so important to our survival, but about 78% of that is stored in ice in Antarctica and Greenland. About 21% of freshwater on Earth is groundwater, stored in sediments and rocks below the surface of Earth. The freshwater that we see in rivers, streams, lakes, and rain is less than 1% of the freshwater on Earth and less than 0.1% of all the water on Earth.

The Ocean and the Atmosphere

3 Water moves constantly between these reservoirs through the processes of evaporation, condensation and precipitation, surface and underground flow, and others. The driving force for the hydrologic cycle is the sun, which provides the energy needed for evaporation just as the flame of a gas stove provides the energy necessary to boil water and create steam. Water changes from a liquid state to a gaseous state as it evaporates from the oceans, lakes, streams, and soil. Because the oceans are the largest reservoir of

liquid water, that is where most evaporation occurs. The amount of water vapor in the air varies widely over time and from place to place; we feel these variations as humidity.

4 The presence of water vapor in the atmosphere is one of the things that makes Earth livable for us. In 1859, Irish naturalist John Tyndall began studying the thermal properties of the gases in Earth's atmosphere. He found that some gases, like carbon dioxide (CO_2) and water vapor, trap heat in the atmosphere (a property commonly called the greenhouse effect), while other gases like nitrogen (N_2) and argon (Ar) allow heat to escape to space. The presence of water vapor in the atmosphere helps keep surface air temperatures on Earth in a range from about –40°C to 55°C. Temperatures on planets without water vapor in the atmosphere, like Mars, stay as low as –100°C.

5 Once water vapor is in the air, it circulates within the atmosphere. When an air package rises and cools, the water vapor condenses back to liquid water around particulates like dust, called condensation nuclei. Initially these condensation droplets are much smaller than raindrops and are not heavy enough to fall as precipitation. These tiny water droplets create clouds. As the droplets continue to circulate within the clouds, they collide and form larger droplets, which eventually become heavy enough to fall as rain, snow, or hail. Though the amount of precipitation varies widely over Earth's surface, evaporation and precipitation are globally balanced. In other words, if evaporation increases, precipitation also increases; rising global temperature is one factor that can cause a worldwide increase in evaporation from the world's oceans, leading to higher overall precipitation.

6 Since oceans cover around 70% of Earth's surface, most precipitation falls right back into the ocean and the cycle begins again. A portion of precipitation falls on land, however, and it takes one of several paths through the hydrologic cycle. Some water is taken up by soil and plants, some runs off into streams and lakes, some percolates into the groundwater reservoir, and some falls on glaciers and accumulates as glacial ice.

The Hydrologic Cycle on Land

7 The amount of precipitation that soaks into the soil depends on several factors: the amount and intensity of the precipitation, the prior condition of the soil, the slope of the landscape, and the presence of vegetation. These factors can interact in sometimes surprising ways—a very intense rainfall onto very dry soil, typical of the desert southwest,

often will not soak into the ground at all, creating flash-flood conditions. Water that does soak in becomes available to plants through soil moisture and groundwater. Plants take up water through their root systems, which mostly draw water from soil moisture; the water is then pulled up through all parts of the plant and evaporates from the surface of the leaves, a process called transpiration. Water that soaks into the soil can also continue to percolate down through the soil profile below the water table into groundwater reservoirs, called aquifers. Aquifers are often mistakenly visualized as great underground lakes; in reality, groundwater saturates the pore spaces within sediments or rocks.

8 Water that doesn't soak into the soil collects and moves across the surface as runoff, eventually flowing into streams and rivers to get back to the ocean. Precipitation that falls as snow in glacial regions takes a somewhat different journey through the water cycle, accumulating at the head of glaciers and causing them to flow slowly down valleys.

Humans and the Hydrologic Cycle

9 The properties of water and the hydrologic cycle are largely responsible for the circulation patterns we see in the atmosphere and the oceans on Earth. Atmospheric and oceanic circulation are two of the major factors that determine the distribution of climatic zones over the Earth. Changes in the cycle or circulation can result in major climatic shifts. For example, if average global temperatures continue to increase as they have in recent decades, water that is currently trapped as ice in the polar ice sheets will melt, causing a rise in sea level. Water also expands as it gets warmer, further exacerbating sea level rise. Many heavily populated coastal areas like New Orleans, Miami, and Bangladesh will be inundated by a mere 1.5 meter increase in sea level. Additionally, the acceleration of the hydrologic cycle (higher temperatures mean more evaporation and thus more precipitation) may result in more severe weather and extreme conditions. Some scientists believe that the increased frequency and severity of El Niño events in recent decades is due to the acceleration of the hydrologic cycle induced by global warming.

10 Even more immediately, the finitude of Earth's freshwater resources is becoming more and more apparent. Groundwater can take thousands or millions of years to recharge naturally, and we are using these resources far faster than they are being replenished. The water table in the Ogallala Aquifer, which underlies 175,000 square miles of the U.S. from Texas to South Dakota, is dropping at a rate of 10–60cm per year due to extraction

for irrigation. Surface waters around the world are largely contaminated by human and animal waste, most noticeably in countries like India, where untreated rivers provide the drinking and washing water for more than one billion people. Although legislation like the Clean Water Act in the United States and water conservation practices such as the use of low-flow toilets and showerheads in parts of the world has begun to address these issues, the problems will only grow as world population increases. Every spring and well, every river and sea does indeed flow from the same source, and changes affect not just one river or lake, but the whole hydrologic cycle.

(1,239 words)

New Words

1	harbor /ˈhɑːbə/ *v.*	包含
2	reservoir /ˈrezəvwɑː/ *n.*	水库
3	sediment /ˈsedɪmənt/ *n.*	沉积物
4	flame /fleɪm/ *n.*	火焰
5	humidity /hjuːˈmɪdɪti/ *n.*	湿度
6	nitrogen /ˈnaɪtrədʒən/ *n.*	氮
7	argon /ˈɑːgɒn/ *n.*	氩
8	particulate /pɑːˈtɪkjəleɪt/ *n.*	微粒状物质
9	accumulate /əˈkjuːmjʊleɪt/ *v.*	积累，积聚
10	aquifer /ˈækwɪfə/ *n.*	含水层
11	visualize /ˈvɪʒuəlaɪz/ *v.*	设想
12	inundate /ˈɪnəndeɪt/ *v.*	淹没
13	finitude /ˈfɪnɪtjuːd/ *n.*	有限性
14	recharge /ˌriːˈtʃɑːdʒ/ *v.*	恢复
15	replenish /rɪˈplenɪʃ/ *v.*	补充，再装满
16	underlie /ˌʌndəˈlaɪ/ *v.*	成为……的基础
17	extraction /ɪkˈstrækʃən/ *n.*	抽取
18	contaminate /kənˈtæmɪneɪt/ *v.*	污染
19	showerhead /ˈʃaʊəhed/ *n.*	莲蓬式喷头

Expressions

1	condensation nuclei	凝结核
2	flash-flood	暴洪
3	soil profile	土壤剖面
4	circulation pattern	环流模式
5	climatic zone	气候带
6	climatic shift	气候变化
7	ice sheet	冰原，冰盖
8	global warming	全球变暖

Notes

1 **Greenland** 格陵兰岛，位于北美洲东北部，是丹麦属地之一，世界上最大的岛屿。格陵兰岛地处于北美洲与欧洲的交界处，沟通了北冰洋和大西洋，西部与加拿大隔海峡相望，北部濒临北冰洋，南部濒临大西洋，东部通过丹麦海峡与欧洲的冰岛隔海相望。

2 **The Clean Water Act** 清洁水法案。1972年，美国联邦政府颁布了旨在治理水污染的清洁水法案，该法案主要包括两大部分：第一部分是授权联邦政府对于市政污水处理设施建设提供资金援助；第二部分是关于工业和市政污水排放的法律规范和执法措施。清洁水法案大大减少了美国的水资源污染。

Exercises

I. Read each of the following paraphrases and then write the word it represents on the line provided.

1 to house or contain _____

2 a place where a great stock of anything is accumulated _____

3 a measure of the amount of water vapor in the atmosphere _____

4 to make impure or unclean by contact or mixture _____

5 to charge again with electricity _____

II. Find the Chinese equivalents for the following expressions.

1 condensation nuclei

2 flash-flood

3 circulation patterns

4 climatic zone
5 climatic shift
6 ice sheet

III. Discuss the following questions.

1 Why will global warming have a great influence over the water cycle?
2 Why is water vapor in the atmosphere indispensable for the living of human beings?
3 Where does most precipitation happen? Why?
4 In water cycles, what usually happens to precipitation falling on land?
5 What will happen if the acceleration of the hydrologic cycle continues?

IV. Decide whether the following statements are true or false according to the text.

_____ 1 Other planets besides Earth in the solar system are likely to have extensive liquid water.
_____ 2 As far as we know, the largest reservoir on Earth is the oceans.
_____ 3 Water vapor plays a critical role in producing greenhouse effect in the atmosphere.
_____ 4 Global temperature falling is likely to lead to higher overall precipitation.
_____ 5 Wind is the main driving force of the water cycle.
_____ 6 Plants on Earth can make some contributions to precipitation.
_____ 7 Global rising temperature may result in more severe weather around the world.
_____ 8 The increase of world population may lead to the decrease of global water amount.
_____ 9 The use of low-flow toilets and showerheads can help to solve the issue of fresh water resources to some extent.
_____10 The hydrologic cycle may be affected by human beings.

V. Translate the following sentences into English.

1 就像煤气炉的火焰为烧开水提供所需的能量那样，太阳为水循环提供能量。(provide)
2 海洋是最大的液态水储存库，大部分水分蒸发发生在海洋。(occur)
3 全球气温上升会引起蒸发量的增加，从而导致更大的降水量。(global temperature)
4 植物通过根系吸收水分，而根系主要是从土壤中吸取水分。(take up)
5 如果全球平均气温继续上升，极地地区的冰雪将会融化，导致海平面上升。(melt)

VI. Translate the passage into Chinese.

Earth is the only planet in our solar system with extensive liquid water—other planets are too hot or too cold, too big or too small. Though Mars appears to have had water on its surface in the past and may still harbor liquid water deep below its surface, our oceans, rivers, and rain are unique as far as we know, and they are life-sustaining. Understanding the processes and reservoirs of the hydrologic cycle is fundamental to dealing with many issues, including pollution and global climate change.