

## The Earth's Fresh Water

Brainstorming: *How many percent of all the earth's water is fresh water?*

### Section 1 Water on the Ground

#### Water collects on the ground

*Practise correct pronunciation before doing the tasks:*

gouging [gɑudʒ], sponge [spændʒ], swamp [ɒ],

reservoir [rezəvua:], soak [əʊ], supply [sə'plai], lie -lying [lai], variety [və'raɪəti]

*Task: Fill in the missing gaps with one of the following words. There are three distractors.*

as because causes depths demonstrates enough flow melts supply why

Water can return to the earth as rain or snow which may **pile up** to great \_\_\_\_\_. Increasing pressure on the bottom layers \_\_\_\_\_ that snow to change to ice. Most of the earth's fresh water \_\_\_\_\_ is stored in glaciers and other forms of ice. Glaciers, moving masses of ice and snow, \_\_\_\_\_ downhill and out of their center. They usually move very slowly, **gouging** and reshaping the land \_\_\_\_\_ they go. In order for glaciers to exist, more snow must fall than \_\_\_\_\_ each year. Most of the glaciers are located near the poles where the energy from the sun, even in summer, is not strong \_\_\_\_\_ to melt all the ice and snow.

*Task: Do the same to complete the second part of the text. There are two distractors.*

as because beds body dams depression lying therefore varieties way

Water collects in lakes, ponds, and swamps. A **lake** forms when water collects in a hole or \_\_\_\_\_ in the earth's surface. The Great Lakes are the largest \_\_\_\_\_ of fresh water on earth. Their content of water is almost twice as much \_\_\_\_\_ all the water in the earth's atmosphere! They are thought to have been formed about 250 000 years ago, when a glacier dug the lake \_\_\_\_\_ out of the rock surface. The rock and soil that were **scooped out** of the **hollow** formed natural \_\_\_\_\_. When the southern part of the glacier melted, water filled the huge hollows and formed the lakes. Many lakes of the world were formed that \_\_\_\_\_. Some lakes form when water fills the craters of inactive volcanoes. **Reservoirs** are lakes usually formed by **damming** a river.

A **pond** (Us) is a body of water that is smaller and shallower than a lake. Ponds and lakes that are filled with water and vegetation are called **swamps** (the word comes from a Greek word meaning **sponge**.) They are low-\_\_\_\_\_ water-soaked **marshes** and **bogs**. Swamps provide a home for many \_\_\_\_\_ of plants and animals.

*Explain these words in English. Use their synonyms or describe them.*

to pile up=

to gouge= scoop out=

to dam (damming)+ a dam=

a hollow =

marsh=bog=

peat bog =

#### Grammar

*Find 2 types of the infinitive phrases in the text above.*

*a) vazba akuzativ+ infinitiv: (I want you to find them.)*

*b) vazba 1.pád+trpný rod +infinitiv: (They are supposed to be/to have been in the text.)*

## Water runs off the ground

A large amount of liquid water that falls to the earth has no place to collect. Much of this water flows directly off the surface and is known as runoff which occurs in two ways:

- **Sheet runoff** has no channels to direct its flow. It runs off as broad flat sheets of water.
- In **streams** water flows in channels between banks of soil, rock and other material. The banks give the direction of the flow.

When water falls onto a mountain ridge or when snow melts on the ridge, water will run off on both sides of the ridge. The highest land that separates the direction in which water will run off is called a **divide (Br watershed)**.

The mightiest river systems in the world begin as small flows that feed into little stream channels and these flow into larger ones until they form a river. Streams and small rivers that empty into one large river system are called **tributaries**. Eventually the large main river empties into the sea.

All the area of land that drains into a river, along with its system of streams and other tributaries, is called a **river basin / catchment area / Us watershed**.

### Check yourself

1. What are the two ways in which **runoff** occurs? How are they different?
2. What can you say about the Czech Republic as a **divide**?
3. What are the names of the entire area that serves as a source of runoff for a river system?
4. What are **tributaries**?
5. What is the synonym of broad? What is the opposite?
6. What does the word eventually mean? Possibly yes or definitely yes?  
Name some other expressions of the same meaning:

### Homework

- 1) Prepare a **short report** on a lake or a pond near your home. Find out how it was formed. Where does the lake get its water? / Which streams feed the lake? Are there any streams flowing out of the lake? Is the lake filling in with sediments and plants? Who are the main pollutants? You may add any interesting information. Is there any evidence that the lake was higher or lower than it was when you observed it?

### Useful vocabulary:

Br **pond** = Us **small lake** = rybník, **pool** = tůňka, **tarn** = **mountain lake**, **bayo** [baiu:] = oxbow lake, **moorland** = vřesoviště, **marsh** = travnatá bažina, **alga**, pl. **algae** = řasy, **blue green** = sinice; **mud**, muddy = bláto;  
**fishing out** = výlov, **carp** = kapr, **pike** = štika, **trout** [au] = pstruh, **eel** [i:l] = úhoř,  
**catfish** = sumec, crayfish – rak;  
**coypu** [koipu:] = nutrie, **punt** [a] = pramice/plť,

2) Do the **ROPOT** of this section.

3) Go through the **Terms and Definitions of Section 2** and read the texts.

## Section 2 Water in the Ground

### Porosity and permeability

**Task: Choose the most suitable connector from the choices below the text.**

Most of the earth's liquid fresh water is found neither in lakes <sup>1</sup> \_\_\_\_\_ in rivers, but in the ground. Water can sink into the ground through open spaces - **pore spaces** - between particles in a process called **infiltration**. The total volume of the pore spaces in a certain volume of material is called **porosity**.

The degree of porosity varies with the kind of rock. Pore spaces among round-shaped particles of loose materials like sand can account for about one third of the total volume. Sandstone is quite porous <sup>2</sup> \_\_\_\_\_ frequent pore spaces between the sand grains and the cementing material. Other kinds of rock, such as granite, which may consist of interlocking crystals or tightly pressed layers, will have a very low porosity or no porosity at all.

Water does not infiltrate into all materials at the same rate. It will soak into a dry sandy soil almost immediately, <sup>3</sup> \_\_\_\_\_ it may form a puddle on top of clay soil. We say that sand has a high **permeability** – the ease with which water flows through a material. <sup>4</sup> \_\_\_\_\_ higher the permeability, the faster a liquid can pass through the material.

Porosity and permeability are closely related, but they are not the same. A rock with a high porosity does not necessarily have a high permeability. Some sediments, <sup>5</sup> \_\_\_\_\_ clay, can have a high porosity, and yet a low permeability. This is because permeability depends on the number and size of the pore spaces and whether these pore spaces are interconnected. Clay is made up of flat, irregular particles that may be many times smaller than sand particles. When they fill the pore spaces among round-shaped sand particles, they greatly reduce the permeability of the material.

- |   |                   |                |                    |                          |
|---|-------------------|----------------|--------------------|--------------------------|
| 1 | <i>not</i>        | <i>no</i>      | <i>nor</i>         | <i>none</i>              |
| 2 | <i>therefore</i>  | <i>whereas</i> | <i>because of</i>  | <i>while</i>             |
| 3 | <i>because of</i> | <i>and so</i>  | <i>that is why</i> | <i>on the other hand</i> |
| 4 | <i>when</i>       | <i>the</i>     | <i>if</i>          | <i>as</i>                |
| 5 | <i>so</i>         | <i>such as</i> | <i>such</i>        | <i>so as</i>             |

Another factor that affects the size of pore spaces and permeability is **packing**. Water will pass more quickly through loosely packed soil, but when soil is tightly packed, the flat particles of clay can fit together almost like a jigsaw puzzle. Water passes through very slowly, if at all. The soil becomes more tightly packed as the distance below the surface increases because at greater depths the weight of the overlying material pressing down on it is greater.

**The word it refers to:** *distance*      *packing*      *water*      *soil*      *weight*

Pore spaces are not always needed for high permeability. Basalt or granite is not very porous, but if it has **cracks** in it, and the cracks are interconnected, water can pass through very rapidly. Such kinds of rock would have a low porosity but a high permeability.

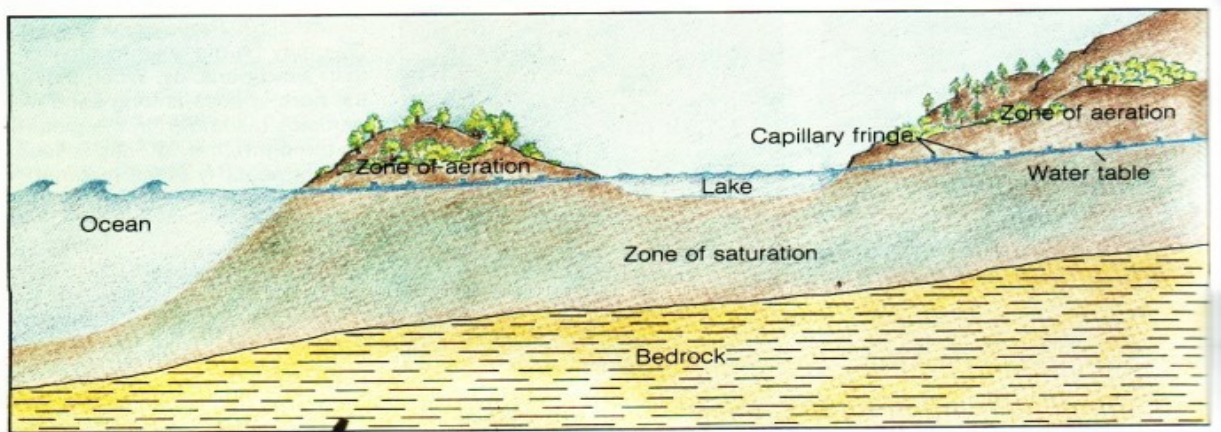
**The word it refers to:** *permeability*      *porosity*      *granite*      *pore spaces*

### Check yourself

1. Explain the difference between porosity and permeability.
2. What does the permeability depend on?
3. What does the packing of soil depend on? –
4. Give the opposites of: rounded      tightly      permeable      regular      porous

**Homework: Prepare the completion of the following text.**

## Zones of water in the ground



**Task: Complete the text with the most appropriate part or the whole sentence A-H.**

- A) placing the end of a paper towel in the water, and watching what happens.
- B) to the soil particles at or near the surface.
- C) no water to pass through.
- D) against the downward pull of gravity.
- E) pulling it downward through the pore spaces, cracks, and other openings in the ground.
- F) depending on the depth of the soil below the surface.
- G) keeps the soil in the zone of aeration damp long after it rains.
- H) the soil or permeable rock becomes saturated.

The water that infiltrates the earth's surface becomes part of the huge supply of the ground water. Gravity acts on ground water, <sup>1</sup> \_\_\_\_\_ .

The amount of water in soil often varies, <sup>2</sup> \_\_\_\_\_. After a rain has soaked into the ground, the layer of soil near the surface is usually moist, but not soaking wet. Most of the rainwater has passed down through the pore spaces of this layer and is in a lower layer of soil. But some water does remain behind, clinging <sup>3</sup> \_\_\_\_\_. This layer of the soil is known as the **zone of aeration** because the pore spaces in this layer contain air as well as water.

Water clings to soil particles in the zone of aeration because water molecules are attracted to many other kinds of molecules. This attraction of water molecules to other kinds of molecules is called **adhesion**. It is this process of adhesion that <sup>4</sup> \_\_\_\_\_ .

As long as the ground is permeable, gravity continues to pull ground water deeper into the earth. But at some point the ground water reaches a layer of soil or rock that is **impermeable**. It allows <sup>5</sup> \_\_\_\_\_. Once the descending ground water hits an impermeable layer, the **bedrock**, it begins to collect there. Ground water will fill up the pore spaces above the impermeable layer. As the pore spaces fill with water, <sup>6</sup> \_\_\_\_\_ .

This saturated layer of soil or permeable rock is known as the zone of saturation. The boundary, which is the top of the **zone of saturation**, is called the **water table**.

Some water in the soil moves upward, <sup>7</sup> \_\_\_\_\_. This upward movement of water in soil is called **capillary action**. You can observe capillary action at home by taking a small amount of water, <sup>8</sup> \_\_\_\_\_. Capillary action is caused by cohesion and adhesion.

**Cohesion** is the attraction of one molecule to another molecule of the same kind. By the process of adhesion, water molecules at the top of the water table are attracted to molecules of the soil particles above. Then, when water molecules have attached themselves to molecules of soil particles, they attract other water molecules to themselves by the process of cohesion. In soil, these forces of adhesion and cohesion lift a little water upward from the zone of saturation to an area called the **capillary fringe**, which is just above the water table.

The damp soil in the zone of aeration receives its moisture from water that infiltrates down from the surface. The soil particles in the capillary fringe get their moisture from the zone of saturation by capillary action. If the pore spaces in the capillary fringe are small, the water will rise higher than if the pore spaces are large. The height of the capillary fringe ranges from about 2.5 cm or less in sands and gravels to as much as 60 cm or more in silty soils.

#### PERMEABILITY

Translate the following story. Use proper grammar rules. Check the words **in bold**.

Učitel filozofie jednoho dne přišel do třídy. Když se studenti usadili, vzal ze šuplíku **nádobu** a naplnil ji až **po okraj** kameny. Potom se zeptal studentů, zda si **myslí**, že **je** nádoba plná? Studenti s ním souhlasili, že **je**. (sousednost!)

Potom profesor vzal krabičku s kaménky a **vysypal** je do nádoby s kameny, zatřásl nádobou a samozřejmě, že kaménky propadaly mezi kameny.

Profesor se zeptal znovu. Je teď nádoba plná? Studenti se **pousmáli a souhlasili, že **je**.**

Ale profesor vzal krabičku s velmi **jemným** pískem a vysypal ho do nádoby. Samozřejmě písek vyplnil i ty nejmenší **mezírky** mezi kameny. Ted už byla nádoba opravdu plná.

Potom profesor řekl: „Touto ukázkou jsem chtěl **znázornit**, že život je jako tato nádoba. Kameny **znázorňují** důležité věci ve vašem životě, jako jsou vaše rodina, partner, zdraví, děti..., všechno, co je tak důležité, že kdybyste to ztratili, bylo by to velmi **zničující**. Kaménky znázorňují ostatní, méně důležité věci. Například vaše zaměstnání, dům, auto... A písek je všechno ostatní. **Drobnosti**.

Když dáte písek do nádoby jako první, nezůstane vám žádné místo pro kameny.

To stejné platí i v životě. Když budete ztrácet čas a energii na drobnosti - materiální věci, nikdy nebudete mít čas na věci, které jsou skutečně důležité.“

Pak přistoupil student a ptá se profesora. Myslíte, že je nádoba už plná?

Profesor **připustil**, že ano. Student vzal půllitr piva a vlil ho do nádoby.

Pivo se **vsáklo** do písku. **Ponaučení?** Na pivo se **vždycky místo** najde!!

#### Conversation Topic

*Some people claim they can find underground water with a stick. This is called **witching** or **dowsing** [au]. Have you ever tried this technique? If so, have you succeeded? If no, have you seen someone using it? Is it scientific? give your opinion. Support your reasoning.*

#### Homework – Listening test in ROPOT: Geysers and Hot springs

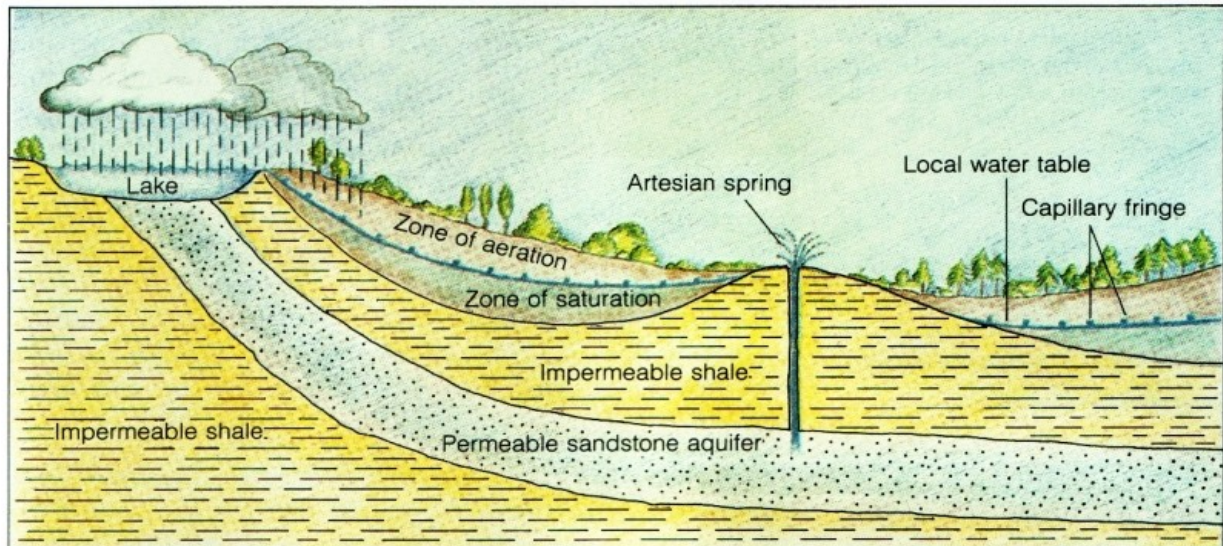
You can check your answers to these questions:

1. How are **geysers and hot springs** formed?
2. Which types of **conduits** does the speaker describe?
3. How do **open conduits** act?
4. What happens in more **restricted conduits**?

#### Geysers in Yellowstone National Park (YNP)

1. Which **famous geyser** are the tourists expecting to see?
2. What time is the **next prediction**?
3. Are there any **active volcanoes** in Yellowstone National Park?
4. What was said about **past eruptions**?
5. How far from the earth surface does a column of hot magma **below** Yellowstone National Park rise?
6. Are geysers **the only** magma driven features in YNP?

## Water comes out of the ground



In general, the water table is more or less parallel to the earth's surface. But if the ground slopes or the impermeable layer slopes, then gravity will cause ground water to move slowly toward the lowest level. If the water table intersects the earth's surface on a slope, it will flow out of the ground in a **spring**. Many ponds and lakes are fed by underwater springs, but if they are not located in a hollow or basin, they can also feed water into a stream finding or creating a channel over a period of time.

There is a type of spring that is not fed by water from the local water table. In a special arrangement of underground rock layers there is a middle layer of permeable rock which passes between two layers of impermeable rock. This combination is called an **artesian system**. Water can pass through the middle layer called **aquifer** (from two Latin words that mean to carry water). Depending on the length of the aquifer, it may take hundreds or even thousands of years for water to travel the full length.

The downward flow and the weight of the water force it to the surface wherever there is a crack or break in the layer of impermeable rock above the aquifer. The flow of water from an aquifer is called an **artesian spring**. Due to pressure in the aquifer, water sometimes gushes up above the surface like a fountain.

Sometimes water erupts from the earth in a spectacular way. In areas of volcanic activity, ground water may sink to great depths through very deep cracks (conduits) and be heated by hot magma or by hot igneous rocks. Because the pressure is much greater at these depths, the boiling point of water is raised well above 100°C. Suddenly, the superheated water changes to steam which forces the water resting on it out through openings in the rock above. Such a feature where water and steam are erupted out of the earth's surface is called a **geyser**. [Br gi:zə, Us gaizə]

### Check yourself

1. *What materials form aquifers?*
2. *Which rock is commonly found in the impermeable top and bottom layers?*
3. *What is the speed of water in an aquifer? Why?*
4. *How does an artesian spring originate?*  
*What causes an artesian spring to gush up out of the ground?*  
*Describe a diagram that shows this.*
5. *Describe an artesian system.*
6. *Compare an artesian spring and a geyser.*  
*How are they similar and how are they different?*
7. *Where can geysers be found?*  
*Do you know any famous locations?*
8. *Why do you think Old Faithful got its name?*
9. *Revise the underlined verbs from the text.*

### **TASK: Reading for Information**

1. Read about a **career of a hydrologist** in AW textbook on p. 358 and discuss your possible interest.
2. What does a hydrologist measure?
3. What does he look for?
4. What does he work on?

**TASK: Watch the video *Water in the Yucatan Caves* (link in the syllabus) and answer these questions. You can check your answers in the ROPOT.**

- 1) True/false? Flooded caves in Mexico have been cut off the surface since the last Ice Age.
- 2) True/false? Yucatan peninsula has no rivers, lakes or streams on its surface.
- 3) True/false? The flooded caves have not influenced the life on the surface significantly.
- 4) Why do divers carry strings while exploring new trails? (2 reasons)
- 5) How do cavers call the narrow gaps they need to get through?
- 6) When fresh and salt water meet, which of them floats on the heavier layer?
- 7) True/false? Salt water erodes the limestone chemically more than fresh water.

**TASK: Find the facts about the water supply of the Czech Republic to answer these questions:**

1. Where are the main groundwater supplies concentrated?
2. What is the volume (in km<sup>3</sup>) of groundwater contained in the aquifers of the Bohemian Cretaceous Basin?
3. What is the percentage of very high quality potable waters in this area?
4. By comparison, what is the total water run-off from the whole territory of the Czech Republic?
5. How big are water supplies in dam reservoirs?
6. Where are the well-known mineral water springs enriched with carbon dioxide?

The CR, situated on the so-called European **roof**, plays an important role as a main water-**divide** between the Black, Baltic and North Seas. An important part of a geological environment is its groundwater. The Czech Republic's main groundwater **supplies** are concentrated in the lowlands, especially in the Bohemian Cretaceous **Basin**. Nearly 80% of the 83 km<sup>3</sup> of groundwater contained in the **aquifers** of that area represent very high quality **potable** waters.

By comparison, the total water **run-off** from the whole territory of the Czech Republic is 15.2 km<sup>3</sup>, while the amount of surface water supplies in dam **reservoirs** is only 0.62 km<sup>3</sup>. The varied geology and tectonics of the Czech Republic provide its rich range of mineral waters, some of which have medicinal benefits.

The traditional spas in the western part of Bohemia, namely Karlovy Vary (Carlsbad), Mariánské Lázně (Marienbad) and Františkovy Lázně (Franzenbad), are well-known for their mineral water springs enriched with carbon **dioxide** from deep below the earth's surface. Karlovy Vary, along with Teplice and Velké Losiny in Northern Moravia, are also famous for their thermal waters.

**Homework: 1) Two ROPOTs (Terms and definitions + interactive Revision test)**

**2) Prepare the following Revision**

**1) Translate:**

- a) Čím vyšší je propustnost, tím rychleji může tekutina procházet horninou.
- b) Přehřátá voda se mění na páru a ta žene vodu, která spočívá na ní, ven otvory v hornině nad ní.
- c) V pouštní oblasti dochází k odpařování z půdy brzy po té, co se přežene bouřka.
- d) Odhaduje se, že Velká jezera obsahují dohromady téměř dvakrát více vody než je jí v atmosféře.
- e) Domníváme se, že Velká jezera se vytvořila asi před 250 000 lety.  
The Great Lakes ...  
*(Use nominative+ passive + infinitive)*
- f) Sumerové zvýšili obsah soli v půdě **do takové míry**, že se již nedaly pěstovat plodiny.

**2) Add suitable nouns from our texts:**

Permeable  
Recycling  
Invisible  
Melting  
Sheet

*Example:* ancient *people*  
loose  
irregular  
cemented  
capillary  
inactive

**3) Give synonyms (words of similar meaning):**

sink into –  
moist –  
rapid –

*Example:* proof - *evidence*  
gouge –  
cling to –  
flow into –

**4) Form the nouns (Vytvoř tvary podstatných jmen):**

Contain -                      deepen -                      widen -                      empty -  
Evaporate -                      dry -                      freeze -

**5) Give the forms (minulý čas a přičestí trpné) of these verbs:**

cling –                                      raise –  
sink –                                      rise –  
soak –                                      flow –  
feed –                                      fly –  
dig-                                      lie -