

GEOGRAPHY MODULE



Name:.....

Jericho (Riha or Ariha in Arabic) is known by many names, such as City of Palms, City of the Moon and City of Giants (Jabareen). As the city lies 230 metres below sea level, it is the lowest point on earth. Jericho has also been indicated as one of the oldest cities in the world! It is clear that Jericho is a remarkable place. But what does Jericho mean to you? What is your experience with, and view of, this place? Let's find out!



Task 1: Where and what is your Jericho?

1. Do you live in Jericho? Do you go to school there? Please, tell us. Write down your relationship with Jericho and why this city is important to you. Do not forget to tell which features of Jericho you think are very special. And what would be your own nickname for Jericho? _____

Now we know why Jericho is a unique place to live, we would like to learn more about its geographical position. What do you know about the location of Jericho?

2. Have a look at the map of Palestine. Indicate where the following places are located: Jericho; Jerusalem; Ramallah; Nablus; Hebron; Bethlehem. Also, mark the Dead Sea and the River Jordan on the map.

The geographical position of Jericho on the Palestinian map is now clear. But what about your Jericho? Where do you live? Where is your school situated? On the detailed map of Jericho in your Activity Book, mark the buildings, streets and areas which you visit frequently. Explain why you marked these spots. Why are these places important to you?

3. Go to your Activity Book and do the assignment 'Your Jericho'

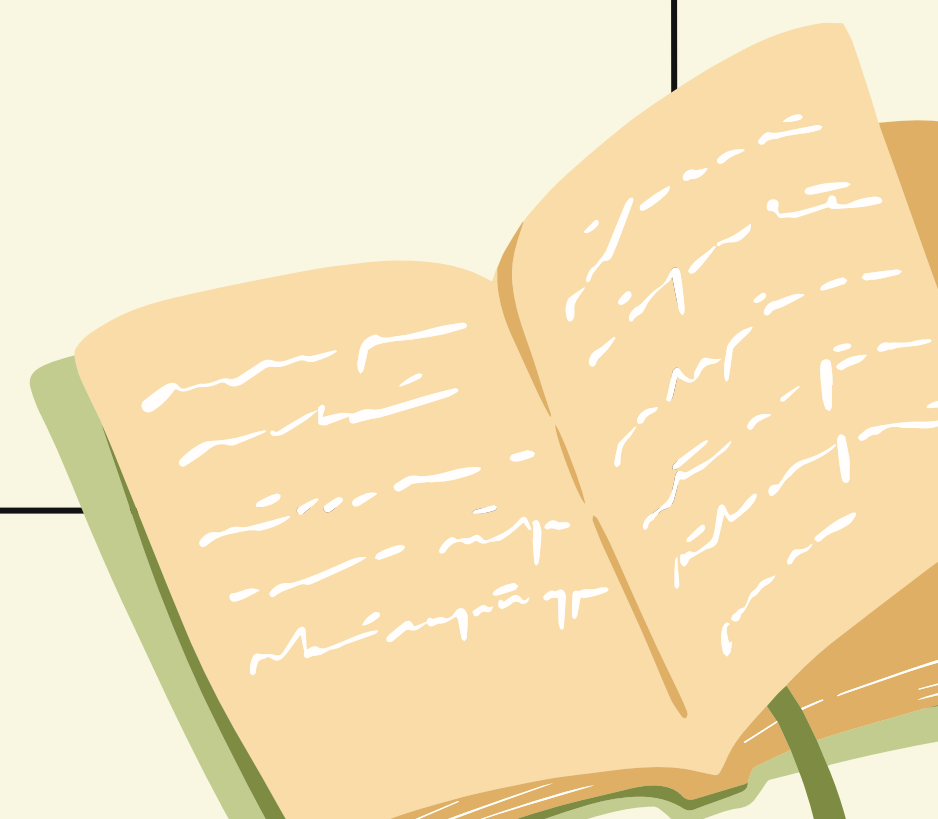


In the winter of 1957–1958 an English student took part in the archaeological excavations at Tell es-Sultan. She was so impressed by Jericho and its surroundings that she filmed her stay in the Jericho Oasis. Have a look at a compilation of her film.

4. Is the Jericho of today very different from the city in the 1950s? What do you recognise? What features have changed a lot and which aspects have not changed much? _____



5. If the student had written a diary during her stay in Jericho in the 1950s, what would she have written? Try to reconstruct a page of her diary based on the film. Use your imagination.



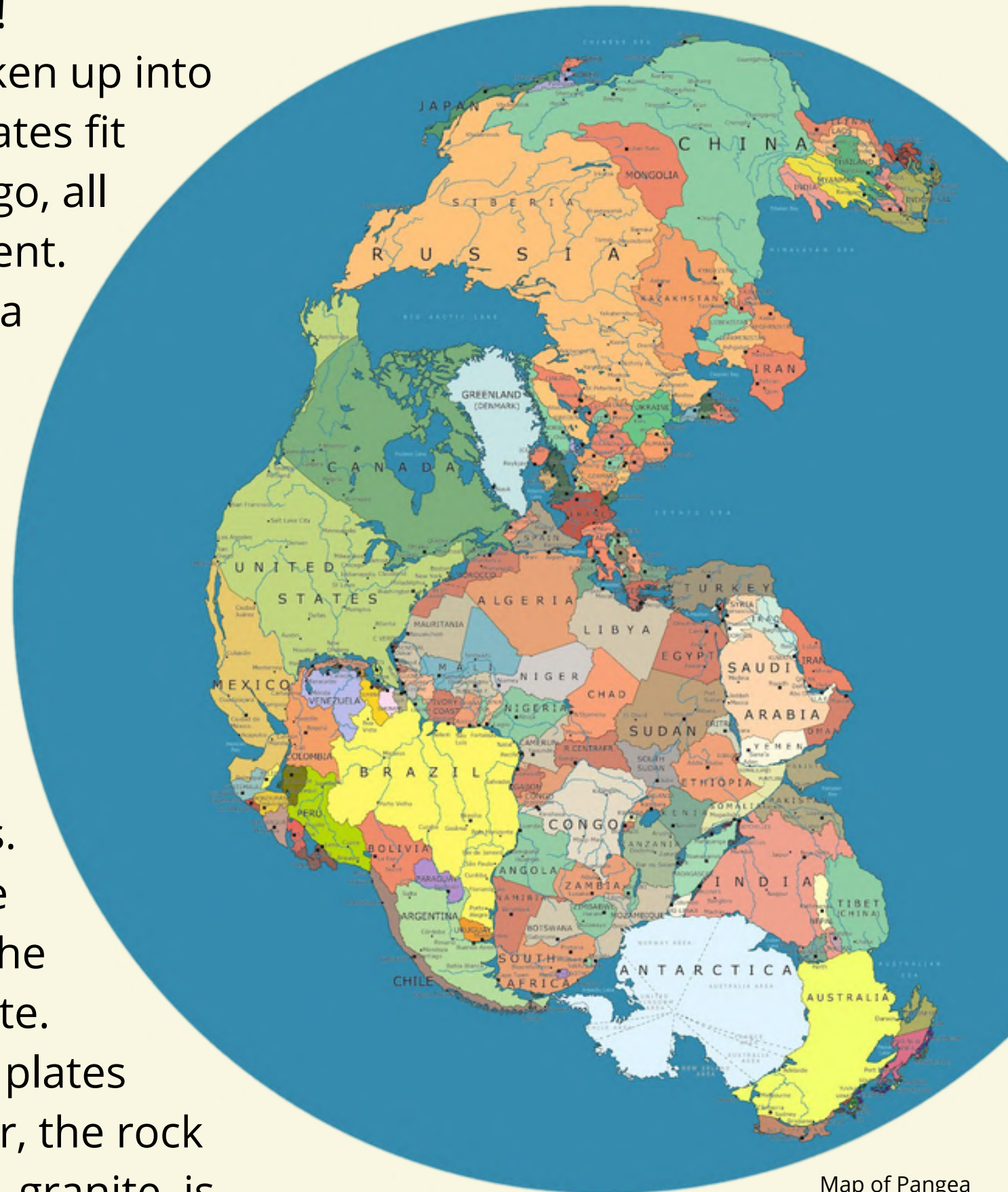
Task 2: The beginning of Jericho - geophysical features

The earth consists of different layers. The outside layer is the crust of the earth. The crust is solid and very thin. Nevertheless, it is the layer that geographers are most interested in, because it is the layer we live on!

The crust is not one big piece of rock. It is broken up into several pieces, called tectonic plates. These plates fit together like puzzle pieces. Millions of years ago, all these tectonic plates formed one supercontinent. This supercontinent was called Pangea. Pangea was surrounded by one ocean and eventually broken up.

6. Look at the map of Pangea. Pangea has drifted apart. Where was and where is Palestine? Indicate the location on the map. (Hint: you can enlarge the image on the website to make it easier to find).

Tectonic plates are divided into two categories. The first type is the oceanic plate. As the name suggests, these plates can be found beneath the oceans. The second type is the continental plate. These plates form the continents. Continental plates are much thicker than oceanic plates. However, the rock material of which continental plates are made, granite, is lighter than the material of which oceanic plates are made, basalt.



Map of Pangea

7. Here is a map of the world, divided into tectonic plates. Which plate is an example of an oceanic plate? And which one of a continental plate? _____

8. On which tectonic plate is Jericho situated? Use the same map as assignment 7. _____



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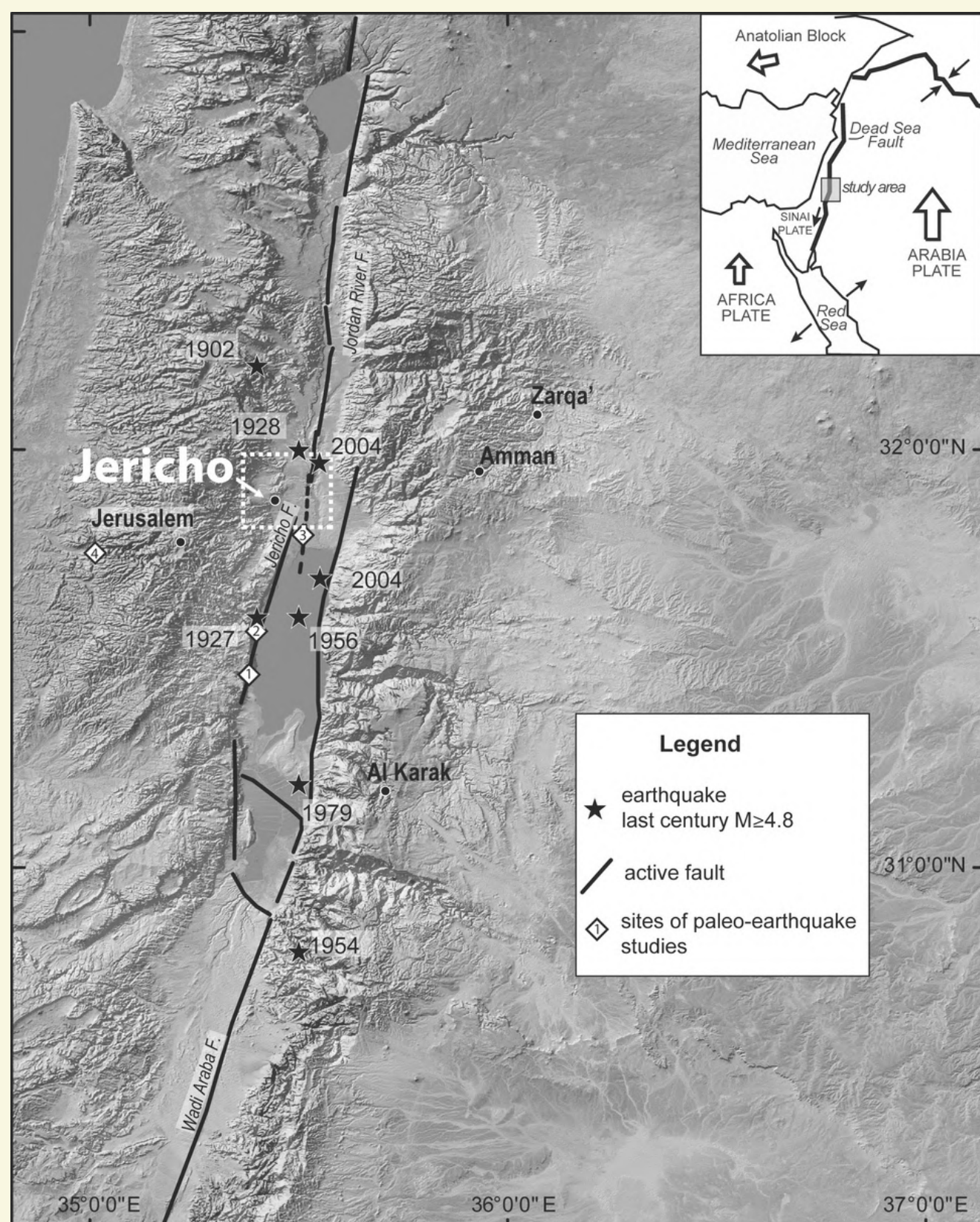
9. Use the text above about tectonic plates and fill in the following diagram:

Type of tectonic plate	Oceanic	Continental
Weight		
Thickness		
Material		

All tectonic plates can move. There are three types of plate movement. Plates can disperse (diverge), they can move alongside each other and they can move towards each other (converge). At a converging boundary between two continental plates, the plates collide, creating high mountains. At a converging boundary, between an oceanic plate and a continental plate, the oceanic plate will subduct because the basaltic plate is heavier than the granite continental plate. As the plates move towards each other, tension builds up. When the tension has built up beyond breaking point, the energy that has been stored is released in the form of shockwaves. These shockwaves are experienced by us as earthquakes.

Jericho is situated in the Jordan Valley, which is part of the Great Rift Valley. This fracture runs from north Syria to east Africa, with the Jordan Valley as the deepest section. The Great Rift Valley, of which the Dead Sea forms part, is an unstable area and the position of Jericho is above a geological fault line. For that reason, the history of the Jericho region is marked with numerous earthquakes.

10. Have a look at the map. This map shows the fault lines of the Dead Sea area and the moments in the past one hundred years when heavy earthquakes took place. When were Jericho and its surroundings struck by an earthquake? Note down two years. _____



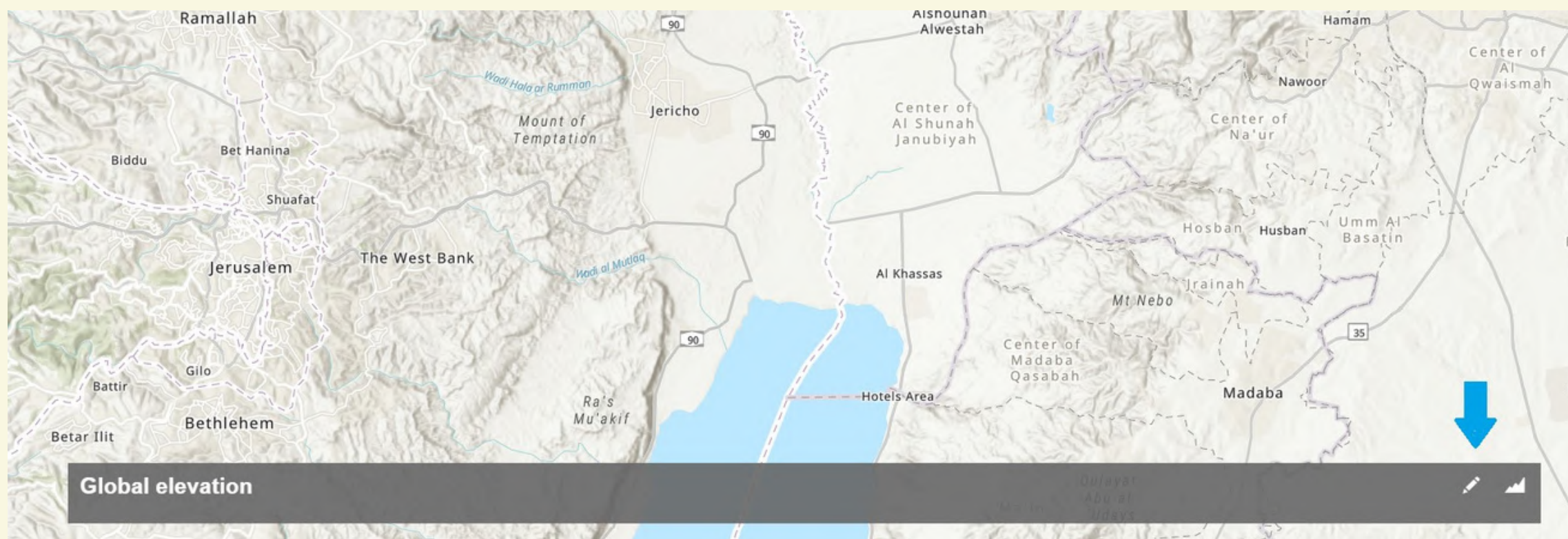
11. Have you ever experienced an earthquake yourself? Describe how you experienced this phenomenon. If you have not experienced an earthquake in your life, ask your family if they have. What is their story? What was the damage in Jericho? Did somebody get hurt? _____

Earthquakes at Tell es-Sultan, ancient Jericho (Alfonsi, Cinti, Di Mauro & Marco, 'Archaeoseismic Evidence of Two Neolithic (7,500–6,000 B.C.) Earthquakes at Tell es-Sultan, Ancient Jericho, Dead Sea Fault' in Seismological Research Letters July 2012; DOI: 10.1785/0220110144

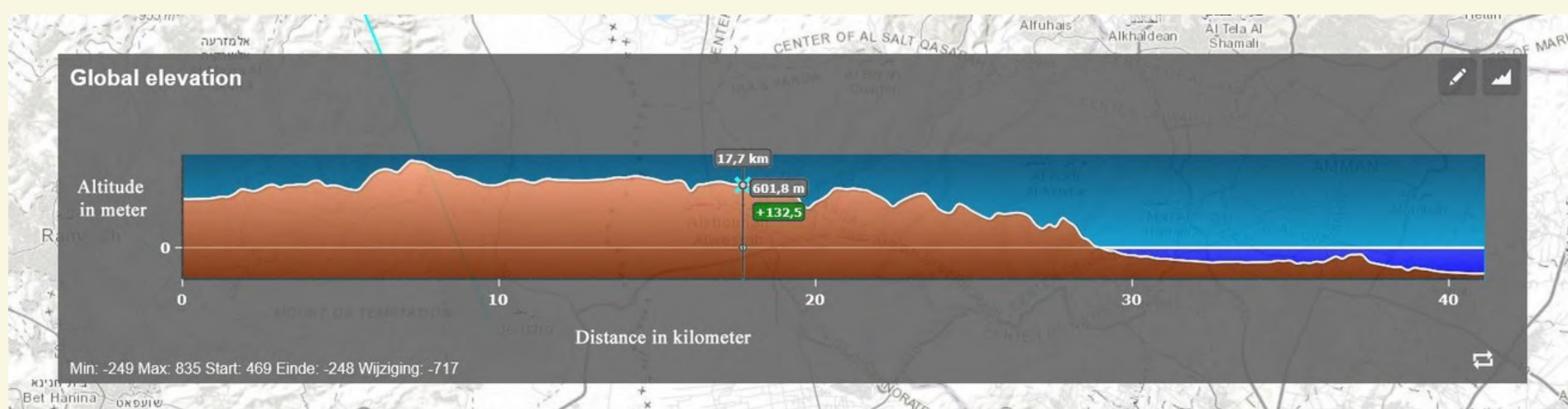


In order to find out how much the altitude in the Jordan Valley can vary, you will create an elevation profile of the line from Jerusalem to Amman, which includes Jericho.

12a. Draw a line from Jerusalem to Amman by clicking on the pencil symbol. Then click once on Jerusalem, draw a line to Amman (which crosses more or less Jericho) and double click. Wait a few seconds and the elevation profile will be created.



12b. You have created an elevation profile of the line from Jerusalem to Amman. The horizontal axis indicates the distance between Jerusalem and Amman in kilometres. What is the distance between these two cities? _____



An example of an elevation profile

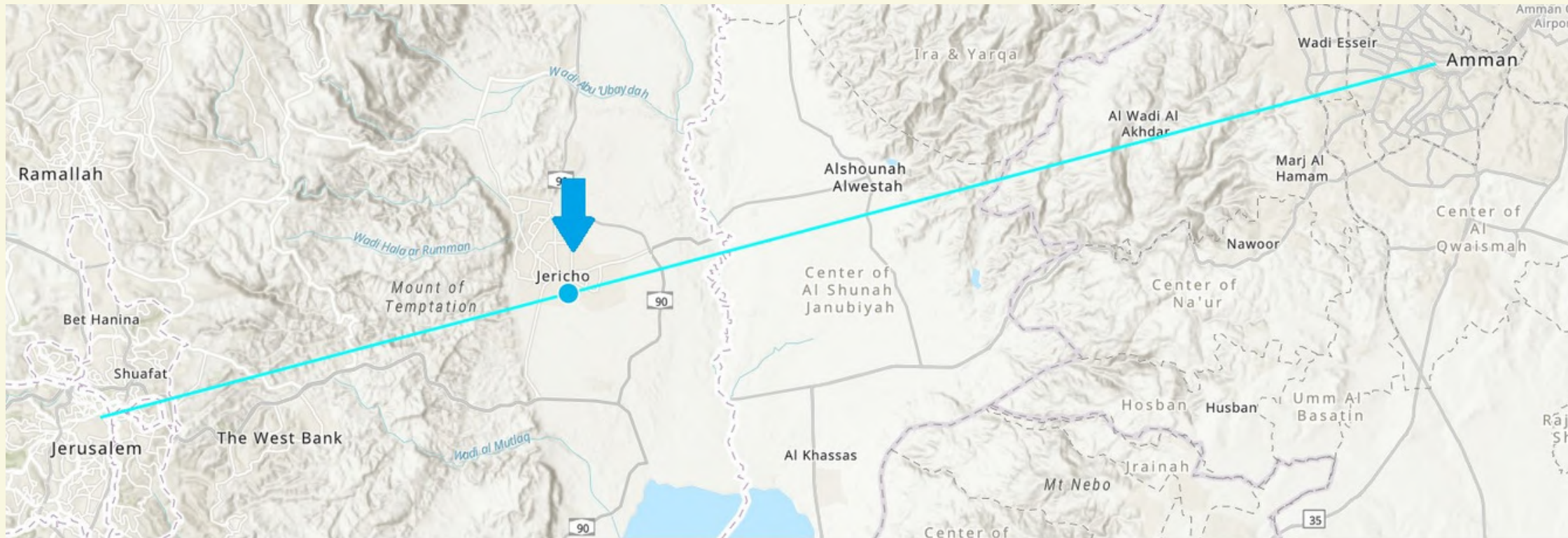
12c. The vertical axis indicates the elevation level of the area. If you move the cursor along the horizontal axis, the elevation level of the particular spot is indicated by the number of metres above or below sea level. Move the cursor to the highest point on the map.

- What is the elevation level of that spot? _____
- And what is the elevation level at the lowest point? _____
- So, if a traveller walked from Jerusalem to Amman, what would be the maximum height difference? _____

12d. If you move the cursor in the graphic, a marking point in the geographical map will indicate the exact location. Move the cursor to the location of Jericho.

- Find the elevation level the city is situated on. _____

- Can you explain why people call Jericho 'the lowest city in the world'? _____



Imagine that you are a traveller and have walked from Jerusalem to Amman, via Jericho. When you come home, you want to give your family an impression of this incredible journey.

13. Make a drawing of the landscape you have crossed during the trip, based on the elevation profile (question 12). Here is an example of how artist and traveller David Roberts visualised his view over the Jordan Valley in 1843.



David Roberts, Descent upon the Valley of Jordan, 1843



Task 3: Water in the West Bank

Jericho is known as one of the first places in the world where nomadic hunter-gatherers started to settle, grew crops and domesticated animals (as will be discussed in the History module). One of the most important conditions for this process was the perennial presence of water. Nowadays water is still a vital element for people living in this region. But where does the water come from?

14. Regarding the water supply Palestine depends on three main natural water sources. Have a look at the map and note down which source(s) are important for the West Bank and which for Gaza.

Name of the water source	West Bank	Gaza
1)		
2)		
3)		



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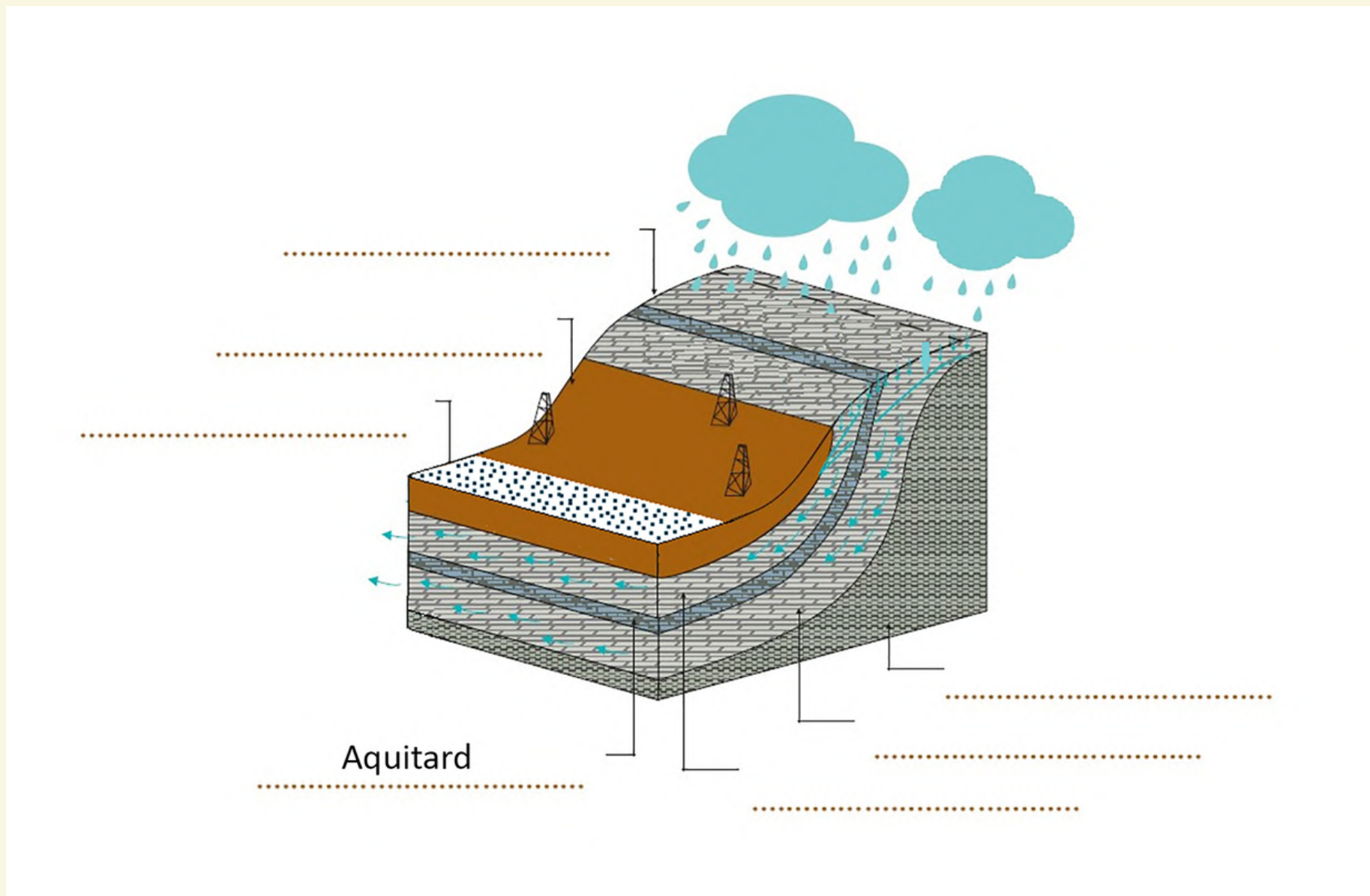
The map you just used mentions the term 'aquifer'. An aquifer is an underground geological formation or layer that stores and/or transmits groundwater, such as wells and springs. Another geological phenomenon is the aquitard: an underground layer that transmits water at slower rates than an aquifer. Aquifers and aquitards can succeed each other.

The most productive underground water basin in Palestine is the Mountain Aquifer (number 2 in the map of assignment 14). The basin is recharged every year by rain water falling over the mountains and the upper slopes, and is used for agricultural, industrial and domestic purposes in the area.

15. Below you will see a cross-section of the western part of the Mountain Aquifer at the West Bank. Have a good look at this drawing and fill in the following terms at the correct dotted line. As you can see we have already filled in one term on the right spot.



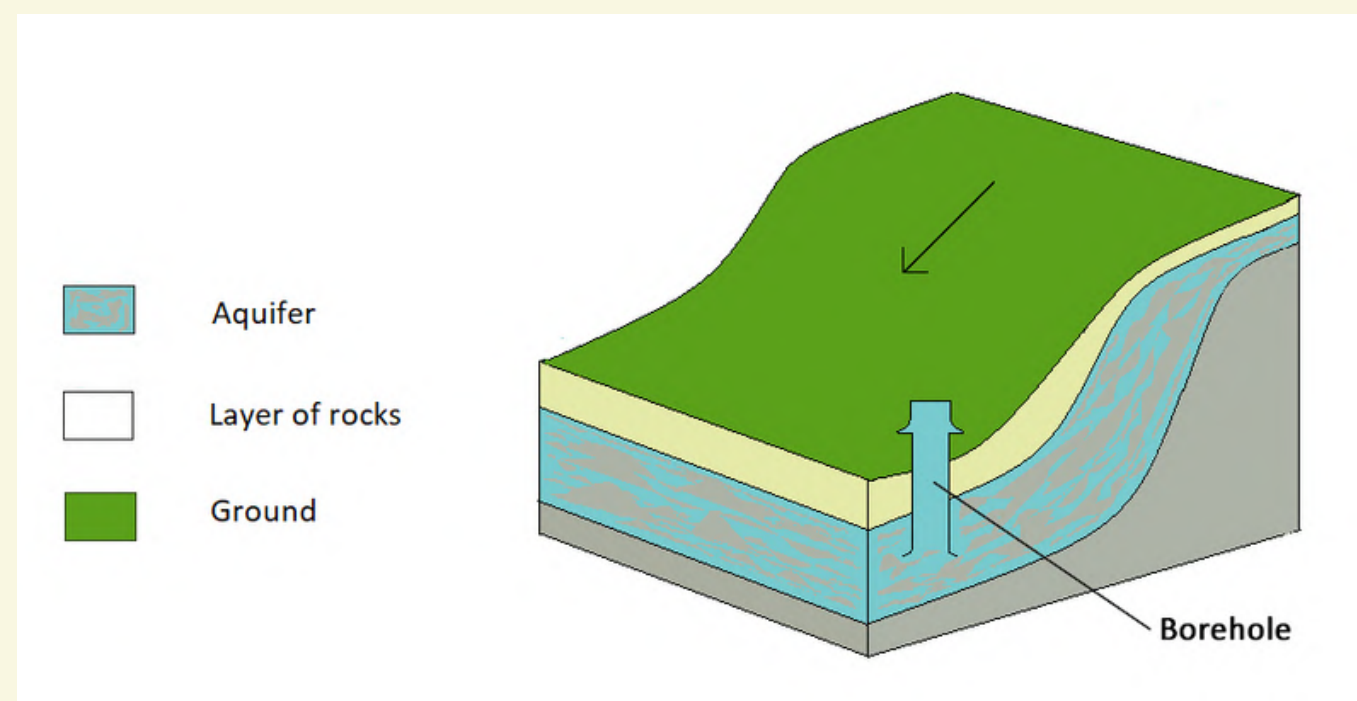
Aquitard	Lower aquifer
Aquitard	Foothills and lower slopes
Coastal plains	Mountains and upper slopes
Upper aquifer	



Cross-section aquifer (redrawn by Jet Jong based on Abusaada, Flow dynamics and management options in stressed carbonate aquifer system, the Western Aquifer Basin, Palestine (Doctoral dissertation, 2011), p. 44, fig 2.1)

Although the Mountain Aquifer is a prosperous water source for millions of people living in the West Bank and Israel, it is not an infinite source. The quantity and quality of the water are even being endangered by human activities. Over-abstraction is one of the menaces for the water quantity. People use boreholes to abstract water from aquifers as is explained in this drawing. With the help of a borehole, a narrow shaft bored in the ground, water is extracted from the aquifer.

16. In what way can this method of water extraction cause problems for the water resources of the West Bank? Keep in mind the way the aquifers are usually recharged (see text above assignment 15).



Water extraction (drawn by Jet Jong)

Also due to natural causes water from the aquifer flows away from the West Bank. As water searches for the lowest level, the flow direction at the western part of the Mountain Aquifer is from the east (mountains and upper slopes) to the west (coastal plain).

17. Have a look at the map. The blue arrows indicate the direction of the groundwater flow. Explain why the western part of the West Bank loses water because of this natural feature.



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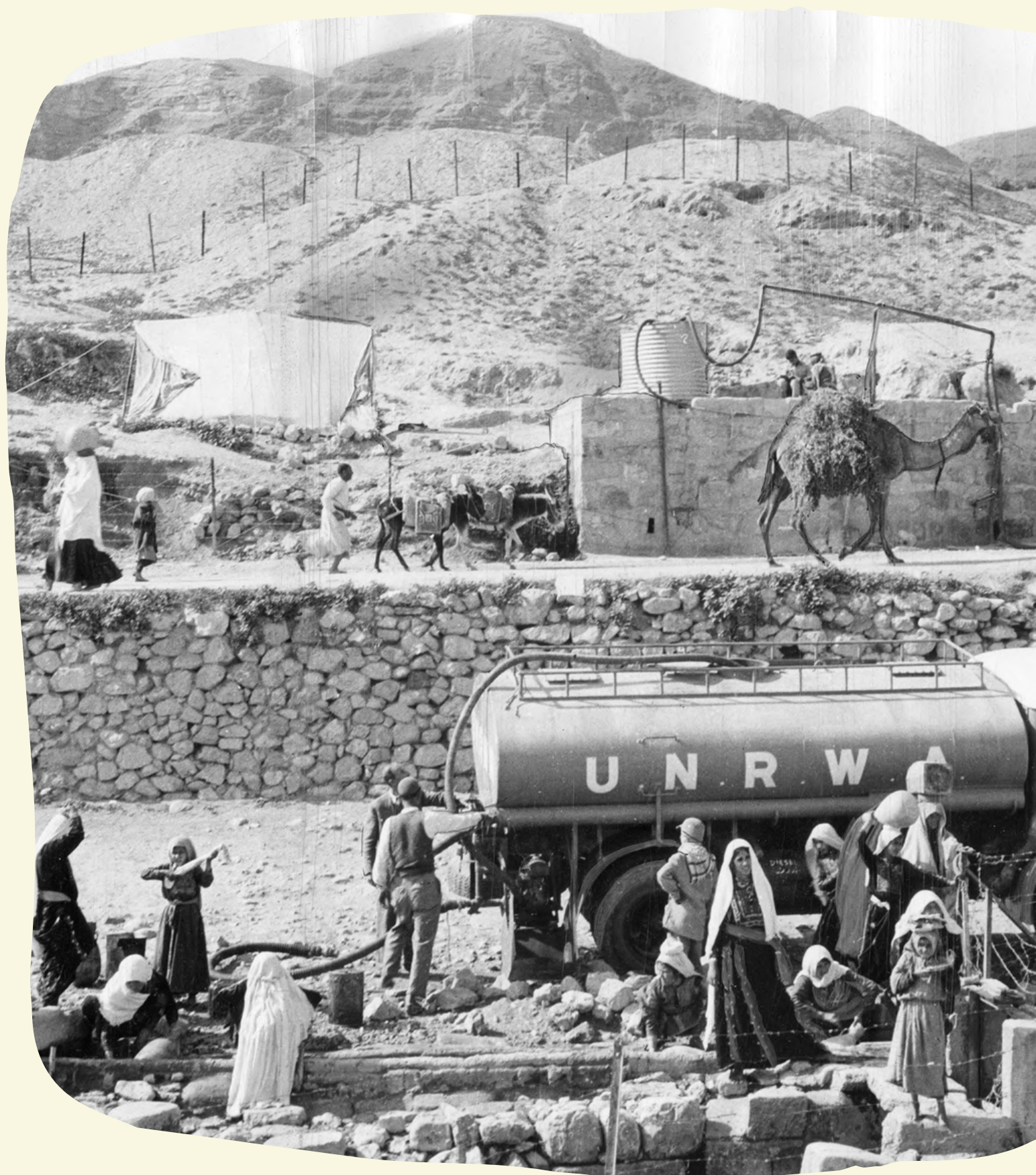
Beside the quantity of water, the quality of water is also an area of concern. In the shallow aquifers that are part of the Mountain Aquifer there is some pollution of water. **18.** What reasons for this pollution can you think of? _____

Water in Jericho

What about Jericho? Although Jericho has an arid climate, the city has been known for ages as a fertile oasis. For that reason people settled here even 10,000 years ago and became some of the first farmers in the world! The combination of the presence of a perennial spring and fertile soil created the ideal conditions for them.

The water sources in the vicinity of Jericho are mainly fed by the deeper Mountain Aquifer. One important spring is situated in Jericho itself: Ain es-Sultan. This spring is currently the main water source for the city as the Jericho Municipality has provided residents with this spring water through the public water network since 1955.

19. Have a look at this photo. The Canadian journalist David Spurgeon took the photo in 1956. It shows an UNRWA truck filling water from Ain es-Sultan destined for one of the refugee camps at Jericho. What can you conclude from the date and activity shown in the picture? _____



20. How do you get your drinking water today? Is your house connected to the public water network? And how about your school? _____



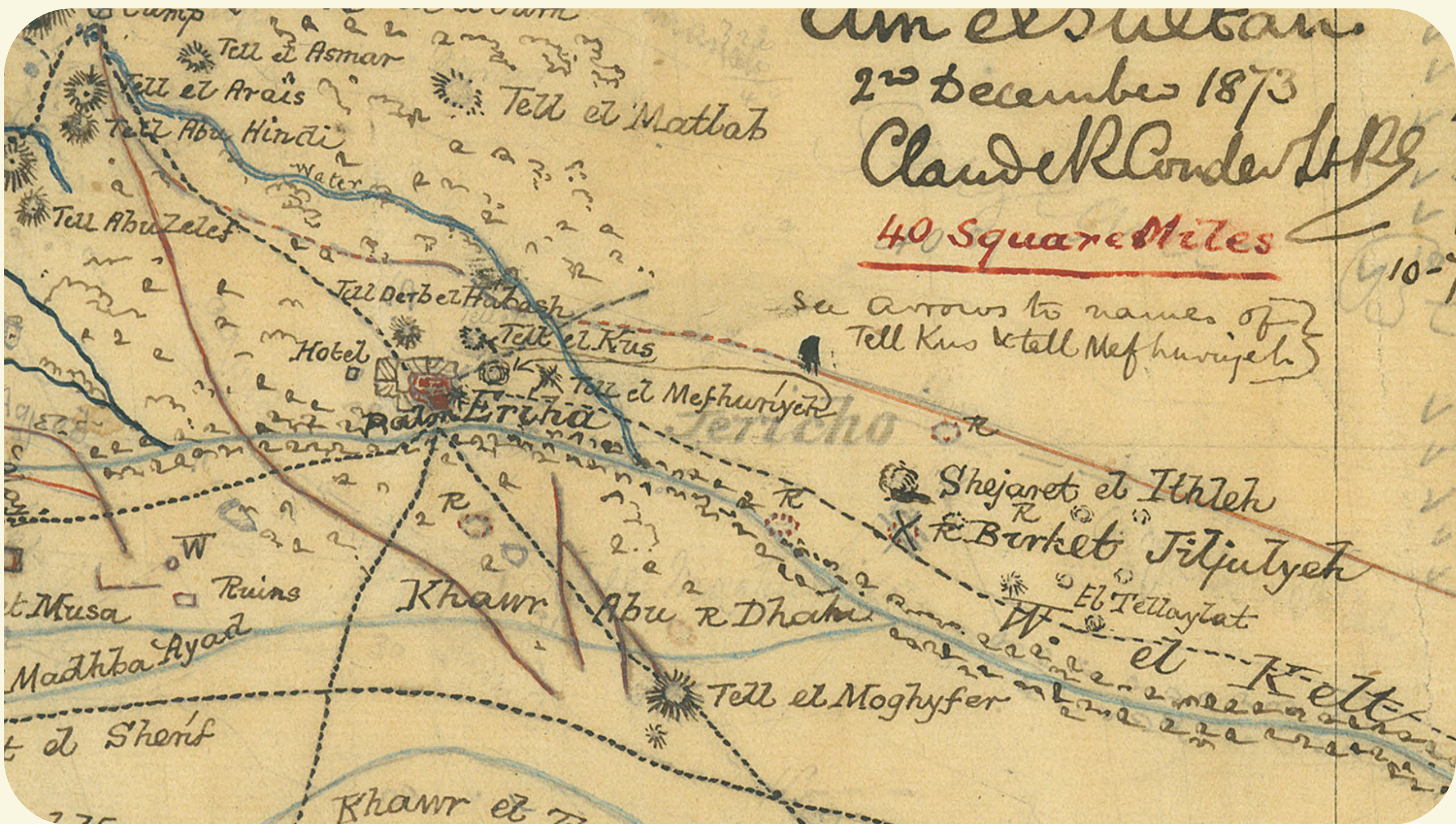
A United Nations Relief and Works Administration truck pumping water in Jericho (photo: David Spurgeon)

Also in the distant past Ain es-Sultan was very important for people living in Jericho. Beside this spring, two wadis (dry riverbeds) in the area were responsible for the transportation of water from two groups of springs which were connected to the Mountain Aquifer.

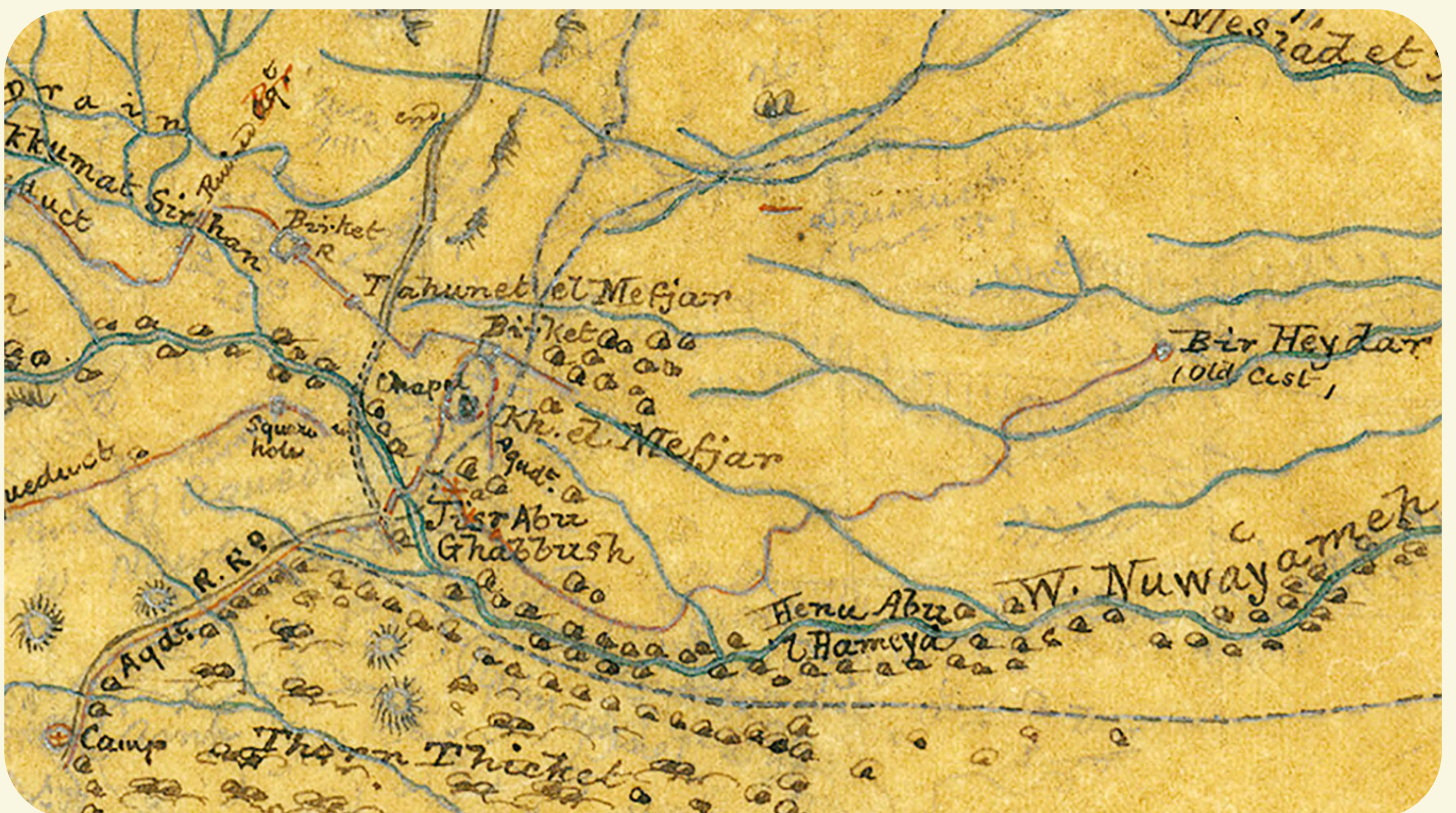
In the winter of 1873–1874 British researchers explored the region and made several geographical maps. Here you see two details of maps made during that campaign. In one map the location of Eriha (Jericho) has been indicated. In the other the position of Kh. el Mefjar (Khirbet al-Mafjar or Hisham's Palace) can be noticed.

21. Study the maps and try to find out which important wadi runs across the city of Jericho and which one across Khirbet al-Mafjar. (Hint: in maps Wadi is frequently abbreviated as "W.")

Site	Wadi
Eriha	
Kh. el Mefjar	



Detail of a map of the Jericho region (Courtesy Palestine Exploration Fund (PEF-M-WS-136))



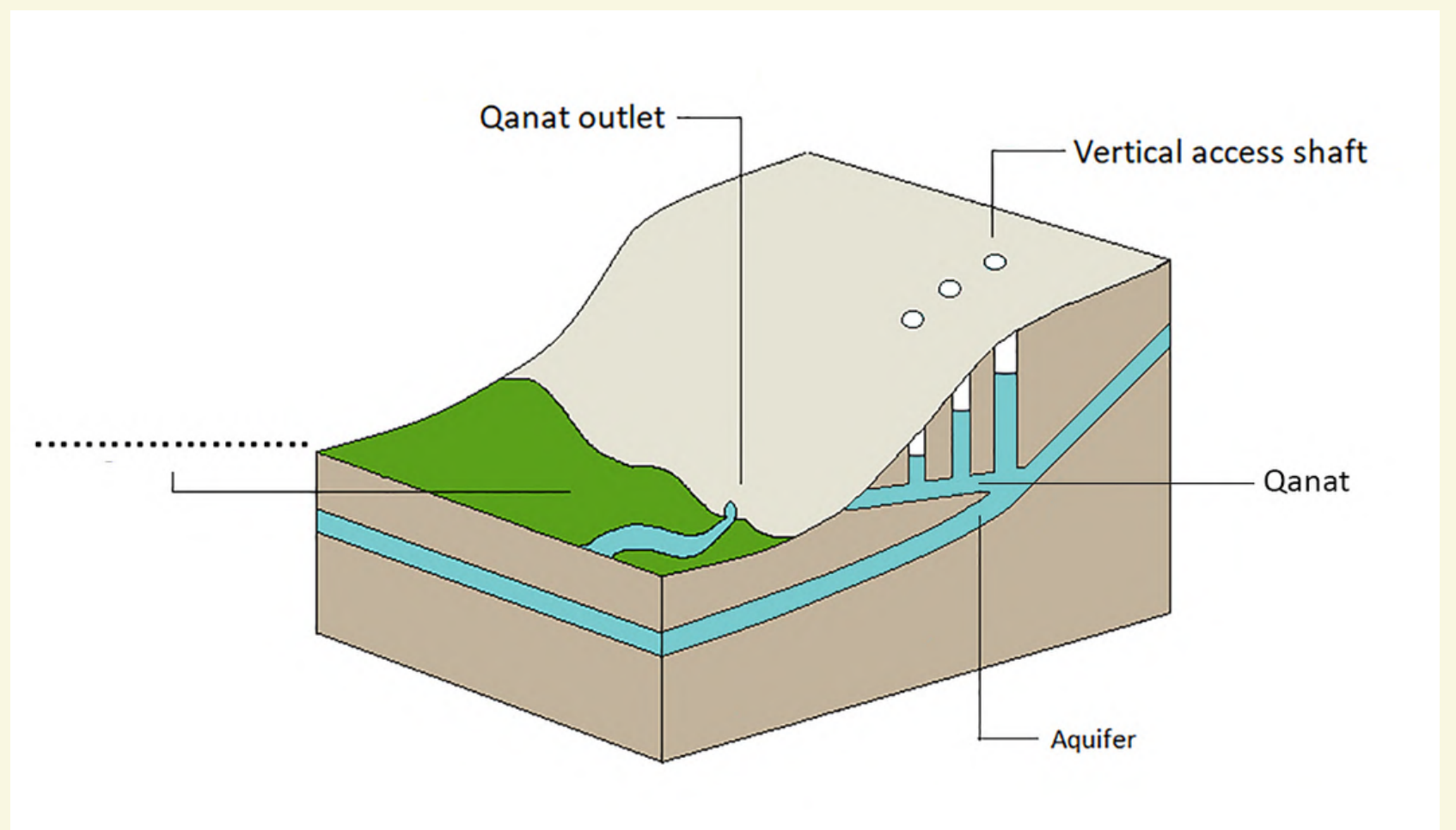
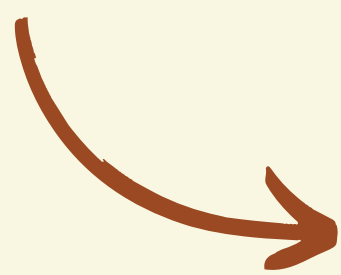
Detail of a map of the Jericho region (Courtesy Palestine Exploration Fund (PEF-M-WS-132))



22. On another map a river – running from north to south – has been drawn. Which river is it, do you think? _____

If water was not able to get close enough to the settlement in a natural way, people had to take action. A well-known phenomenon in arid climates is the Qanat. Qanats are an ancient water transfer system wherein groundwater from mountainous areas, aquifers and sometimes from rivers, was brought through one or more underground tunnels to points of re-emergence, such as an oasis.

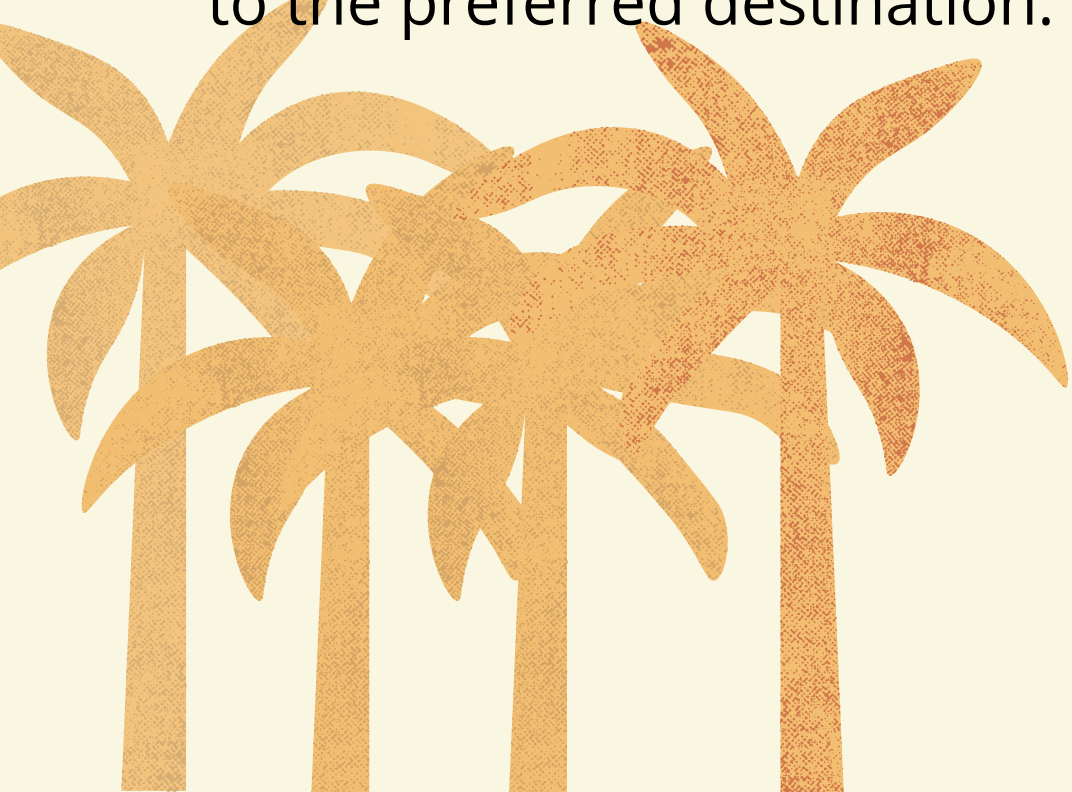
23. Here is a cross-section with a Qanat. The water transferred by the Qanat can be used in different ways. What is the water in this cross-section being used for? Fill in your answer on the dotted line in the drawing.



Qanat (drawn by Jet Jong)

24. In what other ways will people use the water from the Qanat? _____

Sometimes it was necessary to alter the course of the water in a wadi. In that case aqueducts were built. Thanks to these constructions, including bridges, the water could be transferred to the preferred destination.

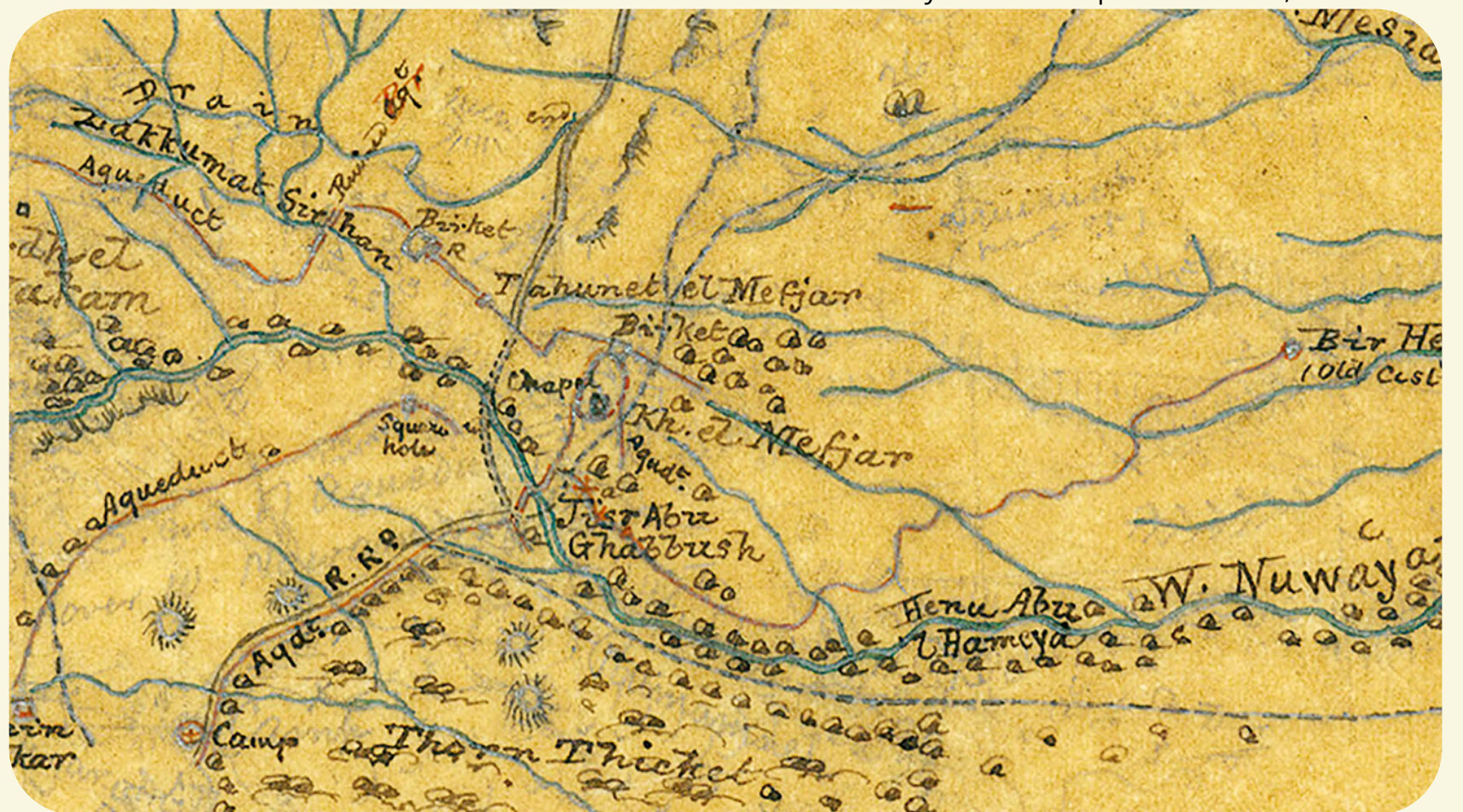


Aqueduct bridge over the Wadi Nueima, north of Jericho.



Courtesy Palestine Exploration Fund, PEF-P-824

25. Have a look at the map. It is the detailed map of Khirbet al-Mafjar again. If you look very closely, you will notice the position of several aqueducts in the vicinity of the site. How many aqueducts can you count? (Hint: sometimes 'aqueduct' is spelt like 'aqdt')



Detail of a map of the Jericho region (Courtesy Palestine Exploration Fund (PEF-M-WS-132))

26. Why do you think people in the past made the efforts to build all those aqueducts in this specific location? _____

Thanks to the presence of the water, people could start agriculture here thousands of years ago. Despite drought, the Jericho Oasis was known because of its fertility. It is even depicted as such in the famous Madaba map. This map is part of a mosaic floor which represents the Middle East and was found in a 6th century church in Madaba, Jordan.



Detail of the Madaba map

27. Describe what you see in this detail of the map.



Detail of the Madaba map (Herbert Donner)

28. Now have a look at the way Jericho is depicted in the Madaba map. Give as detailed a description as possible. _____

One of the features of Jericho that the Madaba map shows, are the palm trees. Even in the Tenach and the Bible Jericho is referred to as the 'City of Palms' (Deuteronomy 34:3; 2 Chronicles 28:15). The date palms of Jericho were already famous in the distant past. Several ancient historians and geographers wrote about them. Recently, scientists have been able to grow six date palms from 2,000-year-old date stones found in the Dead Sea area! These six date palms/seeds were grown from ancient seeds that were uncovered in dusty boxes at an archaeological site, during excavations in the 1960s.

29. Do you think it is important to do research on such old dates? Why should researchers study them or not? Explain why you think such research is needed or not. _____

30. Do you like dates? In what kind of dish would you like to try these (old) dates? _____

Task 4: Climate change and Jericho

In the scheme you can notice three questions about the climate of Jericho. These 'What will happen if...' questions aim to stimulate you to think about the possible consequences of climate change.

31. First think of these issues yourself and write down your view in the scheme. Then discuss the issues with other students and write down the most solid standpoints in the scheme.

Question	Your view	View other students
What will happen if the Dead Sea dries out?		
What will happen if the amount of rainfall decreases?		
What will happen if groundwater gets saltier?		

The climate in the Jericho Oasis is characterised as arid, or dry. However, not all arid climates experience high temperatures. An arid climate typically receives less than 250 mm of rainfall per year and the extent of evaporation is higher than the rainfall. Arid desert climate landscapes have almost no vegetation, except in oases. Like the Jericho Oasis!

32. What is it like to live in an arid climate? Tell us how you are dealing with the following aspects in the winter and summer:

- Clothing:

Winter: _____

Summer: _____

- Food:

Winter: _____

Summer: _____

- School:

Winter: _____

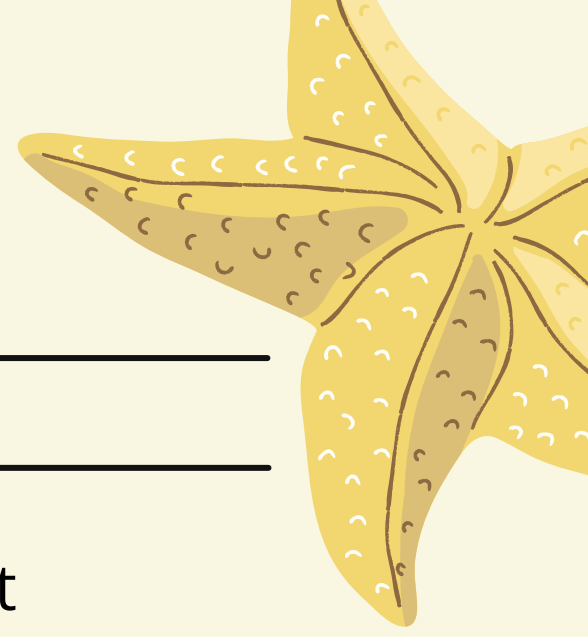
Summer: _____

- Outdoor activities:

Winter: _____

Summer: _____





33. What other aspects are typical for living in an arid climate? _____

34. In an arid desert climate, landscapes have almost no vegetation. How is it possible for Jericho to have vegetation? Use the terms spring, wadi and aquifer in your answer. _____

Rainfall

The climate in the world is changing. Climate change has many consequences for the earth and its population. Jericho has to deal with climate change. Not only will temperatures in the Jericho Oasis get higher, the amount of rainfall will also decrease. Besides, the rainfall will vary a lot. So when it rains, it rains heavily in a short period of time: downpours.

35. What kind of problem for Jericho could be caused by heavy rainfall? _____

36. Can you think of a short-term and long-term solution to solve this problem? _____

Higher temperatures

To make agriculture possible in an arid climate, irrigation is needed. Irrigation is adding water to agricultural crops in case of a shortage of rainfall.

37. In what way do higher temperatures and less frequent rainfall influence this process? _____

A consequence of irrigation, and a decrease of rainfall, is salinisation of agricultural land. This means that groundwater becomes saltier.

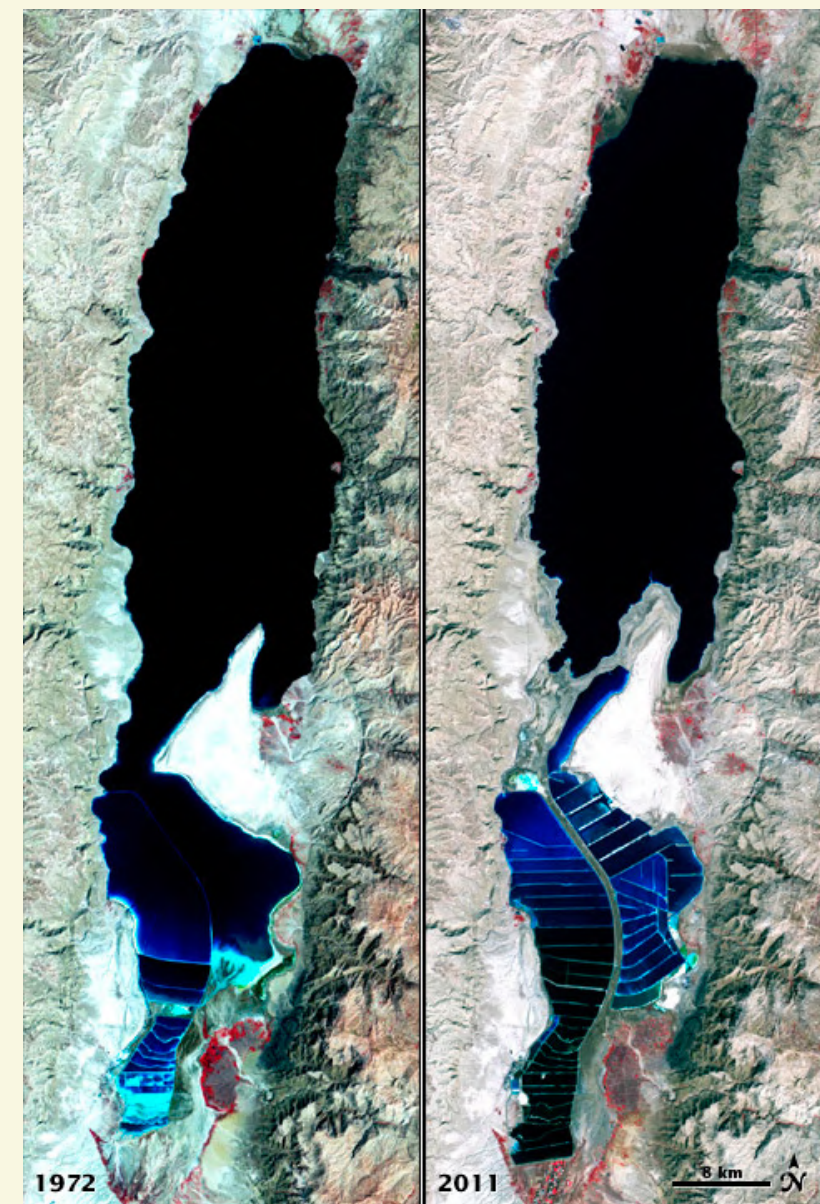
38. Can you explain why agricultural production is at risk because of this? _____

But how can the salinisation of agricultural land due to higher temperatures be explained? We will demonstrate it step by step. First have a look at the Dead Sea itself. You have read that temperatures in the Jericho Oasis have become higher. There are two consequences of higher temperatures and drought:

- more water is drained from the Jordan for agricultural, industrial and domestic purposes in the area;
- there is a higher evaporation rate of the water from the Dead Sea.



39. Both these consequences have the same effect on the sea level of the Dead Sea. Take a look at the satellite images of the Dead Sea. One satellite image was taken in 1972, the other one in 2011. The black spot in the middle of the images is the Dead Sea. What effect of higher temperatures can you notice on basis of these images? _____



Satellite images (<http://earthobservatory.nasa.gov>)

As you probably know, sea water tastes salty. Average seawater contains almost 35 gram dissolved salts per litre.

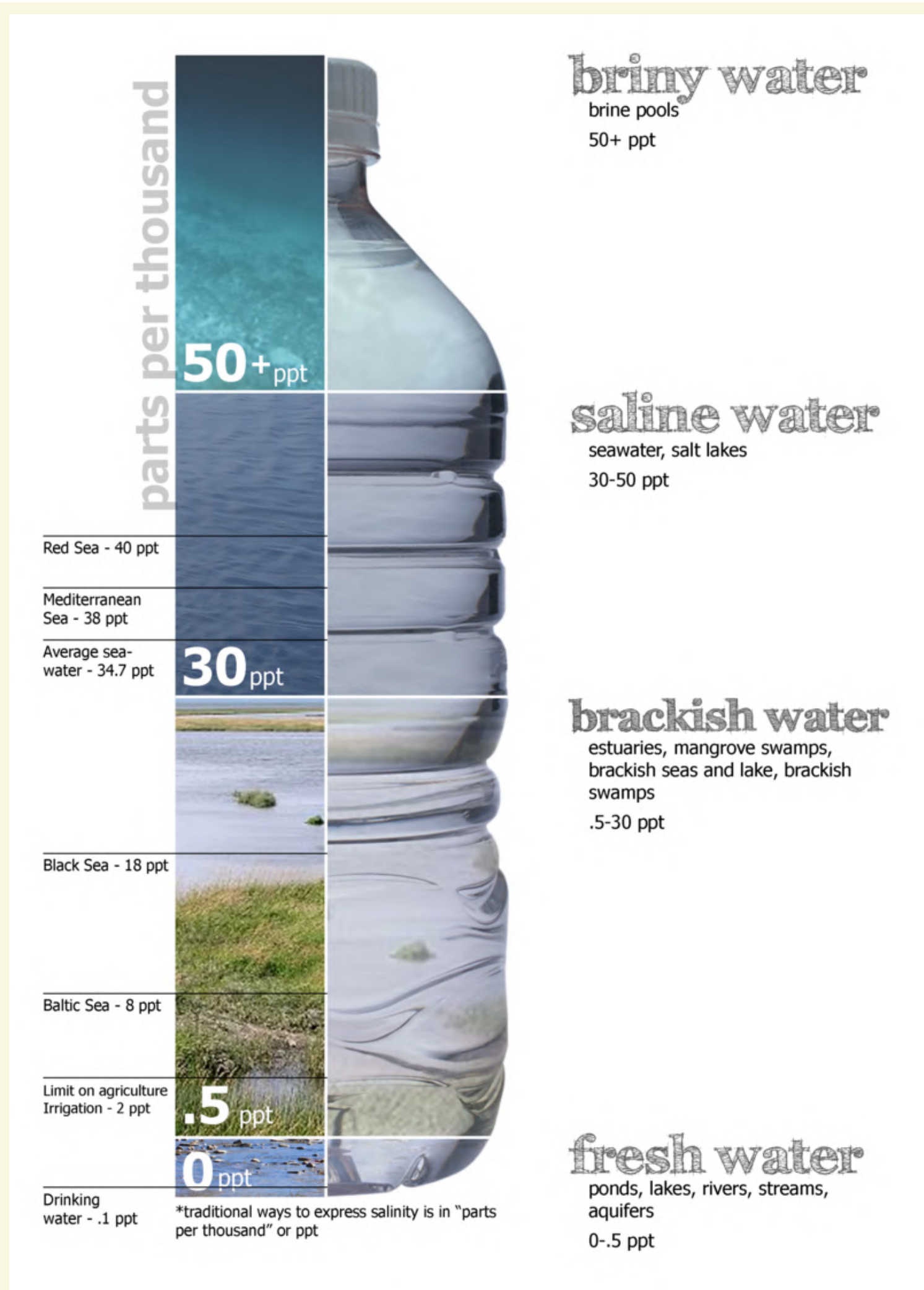
40. Take a look at the salinisation diagram (the bottle). The left side of this diagram represents the salinity of different kinds of water. 30 ppt means 30 grams per litre. Fill in the first three sections of the following scheme.

Kind of water	Drinking water	Black Sea	Red Sea	Dead Sea
Salinity (gram/liter)	1.	2.	3.	4.

You may have noticed that the graphic does not mention the salinity of the Dead Sea. But we can help you. A one litre bottle of drinking water weighs about 1,000 grams. One litre of Dead Sea water weighs more than 1,200 grams!

41. Are you able to calculate the salinity of the Dead Sea? Write down your answer in the scheme.

42. Why did the creator of the graphic not mention the salinity of the Dead Sea in his graphic?



Salinity of water (Peter Summerlin)

43. The graphic also indicates the salinisation limit on water used for agriculture irrigation. Why is it better to not use sea water for irrigation purposes? _____

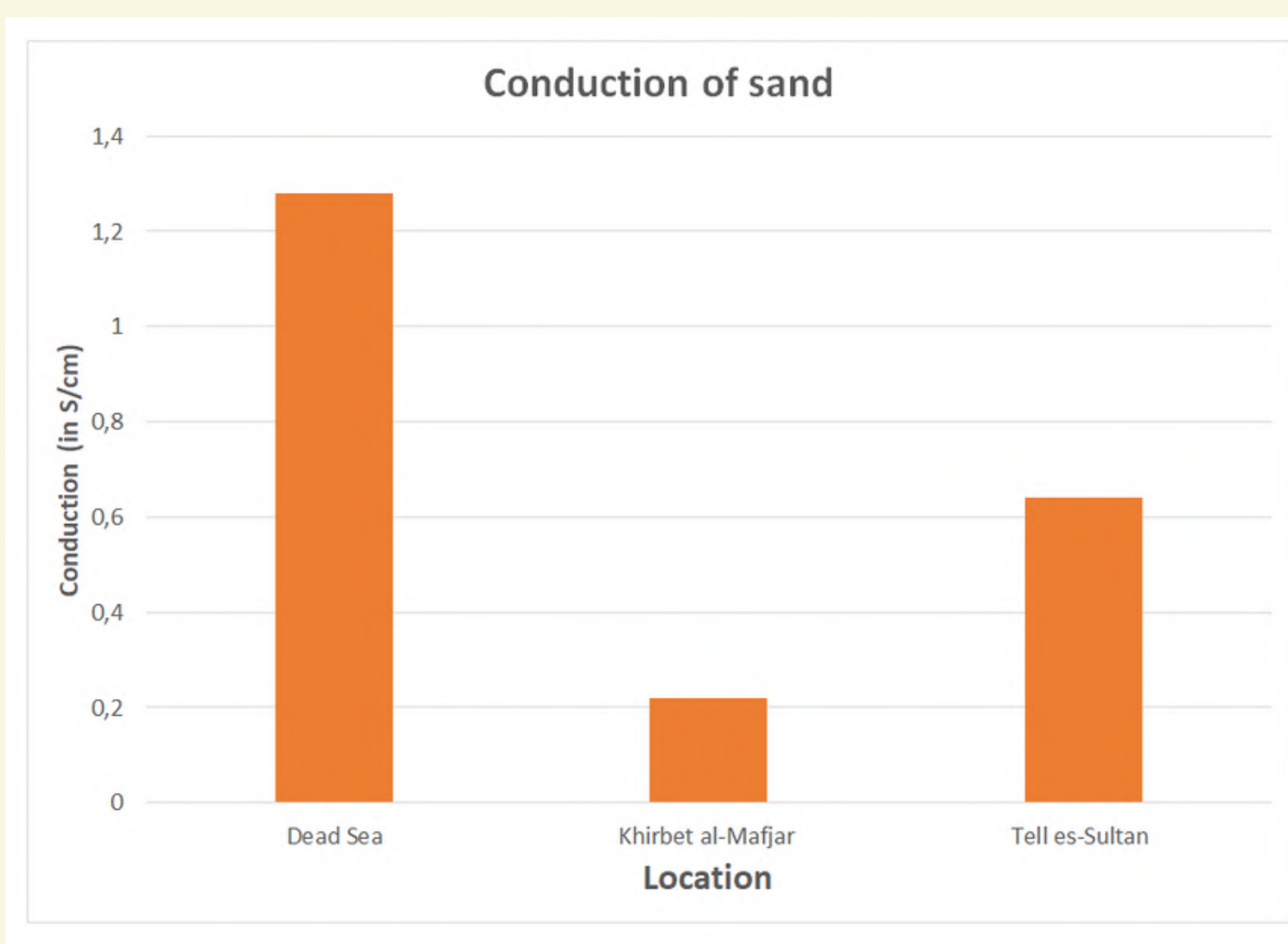
In order to explain that salinisation will increase when the temperature is structurally higher, you will do the assignment 'Salts in the soil' in your Activity Book. That assignment will also demonstrate that salinisation of the agricultural land is a negative consequence of irrigation.

Go to your Activity Book and do assignment 'Salts in the Soil'

In January 2020 we went to the Dead Sea and to Jericho. During that trip, we did some salt tests. We gathered sand from the Dead Sea shore, Tell es-Sultan and Khirbet al-Mafjar. The sand monsters were dissolved in water and subsequently the conduction of the water was determined. The higher the conduction, the higher the salinity of the sand.

44. Have a look at the graphic and fill in the numbers and terms of the scheme on the correct spot.

45. Can you explain why the salinisation is higher on one site than the other (exclude the Dead Sea)? _____

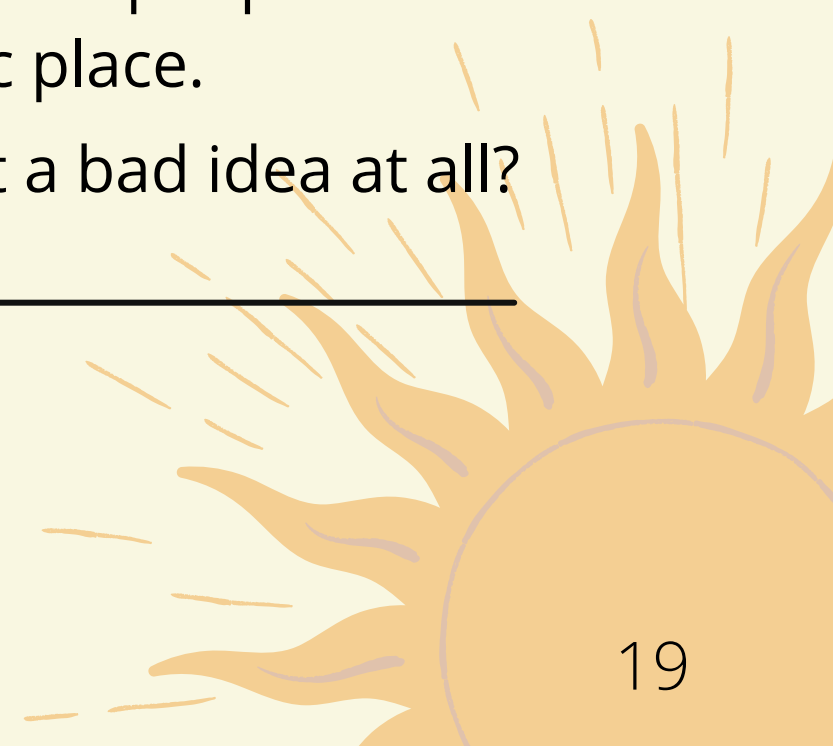


0,22	0,64	1,28	low	medium	high
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	Dead Sea	Khirbet al-Mafjar	Tell es-Sultan
Conduction			
Salinity			

Have a look again at assignment 23. There we explained that in the past people built Qanats, underground tunnels, in order to transfer water to a specific place.

46. Considering the present climate change, why is such a Qanat not a bad idea at all?



47. Read the text below and mark the right words.

Climate change is a **national/global** problem. Some changes are already visible, but many will become more serious between now and the end of the century. For example: there are **negative/positive** developments of rainfall on agricultural production: annual rainfall is likely to **increase/decrease** by 10% in 2020, 20% in 2050 to an **increase/decrease** of 35% in 2100. Due to the greater variations in rainfall, the floods **increase/decrease** but there is not enough rain to charge groundwater for the **aquifers/wadi**. Also, the Dead Sea level is **rising/dropping**. This reduces the quality of the soil and groundwater and results in salinisation of the agricultural land. And there is more drought and more **desertification/vegetation**. There is more/no need for crop water. However, if we all act **together/alone**, we **can/can't** change things around!

48. You started Task 4 – Climate change and Jericho – by discussing three aspects of climate change. Have your views changed after working on Task 3? How about the views of other students? Fill in the scheme.

Question	Your view	View other students
What consequences do the climate changes have on the Jericho Oasis?		
What can we do to stop climate change?		

Before going to the last Task of this module, you can find out what you have learned from this module by playing an exciting game.

Go to your Activity Book and play '30 Seconds of Geography'

Task 5: Your Jericho

When you have finished all the assignments of Tasks 1 to 4, you are ready to start with the final assignment. The main aim of this assignment is to let you reflect on your Jericho: you will write down (and draw if you want) your relationship with, views on and feelings about Jericho. In this reflection you explain the way you have to deal with the geophysical features of the region in daily life and how global climate change can affect your life in the future. You may use maps, drawings and pictures in the reflection. Discuss with the teacher what form your reflection may take, for example, diary, essay, PowerPoint, film, collage, vlog, etc.

