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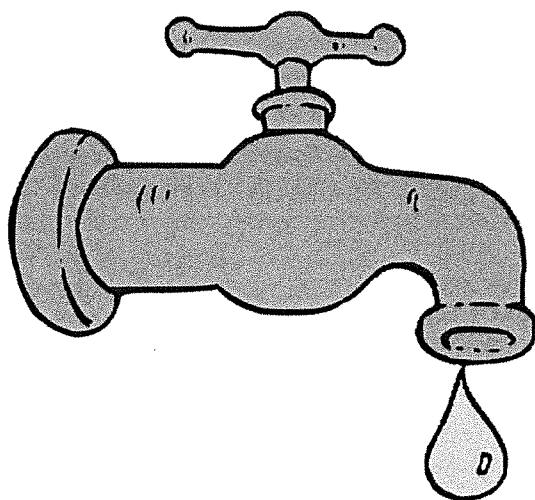
IB ESS

4.2 Access to Freshwater

Significant Ideas

The supplies of freshwater resources are inequitably available and unevenly distributed, which can lead to conflict and concerns over water security.

Freshwater resources can be sustainably managed using a variety of different approaches.



Freshwater Use

1. Humans use a lot of fresh water in their daily lives. List the uses of freshwater under the categories below. (Focus on what grey water can be used for, not necessarily what it commonly is used for).

Purified + treated freshwater	Lightly used water
"White" water	"Grey" water
<ul style="list-style-type: none">• Drinking water• Cooking• <u>showering/brushing teeth</u>• swimming pools) water parks	<ul style="list-style-type: none">• Water for cleaning the car• <u>irrigation</u>• flushing toilets• livestock farming• <u>industry</u>

Black water or sewage contains human waste and may carry disease-causing bacteria and other organisms e.g. worms



2. State a similarity and difference between white and grey water.

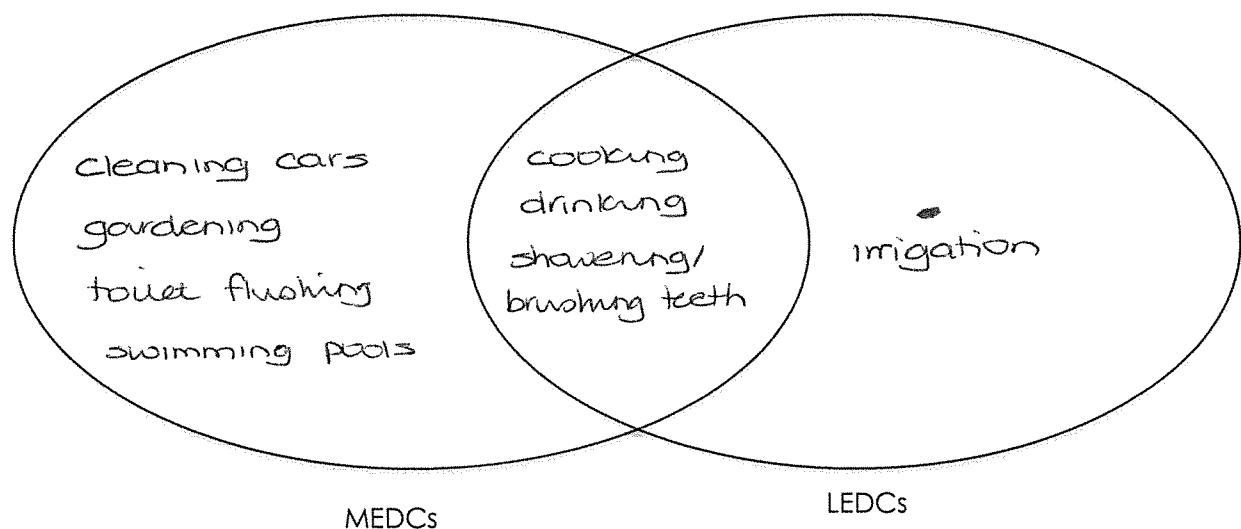
Similarity:

Both are limited and need to be used sustainably.

Difference:

Grey water can not be consumed by humans

3. Look at your lists in question 1. Categorise the uses into those mostly used by people in MEDCs, those mostly used in LEDCs, and those used in both.



4. What can you deduce from your diagram in question 3?

more water is 'wasted' in non-essential activities in MEDC, in LEDC water is for more essential activities

5. The diagram above is a type of model. Evaluate this model.

Oversimplified

There will be much variation in water used based on EVS of society

Freshwater Supply

6. Explain why the freshwater requirements of a nation increases over time with respect to:

Population

The higher the population the increased demand on water supply
(more people = more showers, flushing of toilets, cooking etc)

Industrial Development

The greater the industrial development the greater the degradation of water. Industry and electricity plants release pollutants (chemicals and heat) into surrounding water.

Expansion of farmland

The expansion of farmland increases freshwater requirement.

Water is needed for irrigation of crops and drinking/creaming for livestock



7. Briefly describe the ways that the following can limit the supply of freshwater.

Industrialisation

Release pollutants into the water thereby decreasing the supply of clean freshwater

Irrigation of farmland

extraction of freshwater supply, much of the water evaporates and leaves behind water with increased salinity

Use of pesticides

Pesticides will wash into rivers and lakes. If persistent they will cause bioaccumulation

Use of fertilisers

Fertilizers wash into rivers and lakes and could cause eutrophication

High extraction rates from aquifers

Lower the water table which could result in salt water intrusion reducing availability of freshwater



8. Explain how the following issues linked to climate change can influence the availability of water.

Factor	Effect on water supply
Rising sea level	<ul style="list-style-type: none"> • salt water intrusion of brackish ecosystems and aquifers. • Reduce available freshwater
Changing rainfall patterns	<ul style="list-style-type: none"> • some areas will experience more heavy rains - this will result in flooding and contamination of water by sewage and other water pollutants. • some areas will experience droughts resulting in over extraction of water from aquifers.
Changes in amount and timing of snow melt	<ul style="list-style-type: none"> • more snow melt will disturb the deep ocean currents (thermohaline currents). This will lead to increased temperatures in north western Europe • Excess snow melt will reduce albedo increasing atmosphere and ocean temperatures and increasing snow melt. • Snow melt will occur earlier in spring

9. Outline how water scarcity can lead to conflict.

Conflicts may arise over the use of water in upper basin countries for hydropower or irrigation, and the reduced availability in lower basin countries e.g. Egypt and Ethiopia over the Nile



10. Describe and explain the distribution of freshwater and water scarcity around the globe.

Consider addressing at least the following ideas: Is it distributed evenly around the globe? Can we use saltwater somehow? Why doesn't everyone do that? Are we damaging freshwater at all? In what circumstances is there a large amount of freshwater but still a water scarcity issue? Why?

Only 2.6% is freshwater and over 68% of that is in ice-caps and glaciers. Ground water is 30.1% of the total fresh water. Rivers and lakes make only 0.3%.

Many societies are now primarily dependent on groundwater and this is not sustainable as the water is non-renewable.

Increase in population has increased the demand for water as well as pollution of water (industrial, domestic and sewage).

Desalination is an option (as most of the water on Earth is saline) but the costs in terms of energy are high and so is currently only possible in wealthy countries which are water-stressed and near the sea e.g. Oman, Saudi. The by-product of desalination is returned to the sea increasing the density of the water which then sinks and damages ocean-bottom ecosystems.

Each human should have access to 40 litres per day (Agora 21).

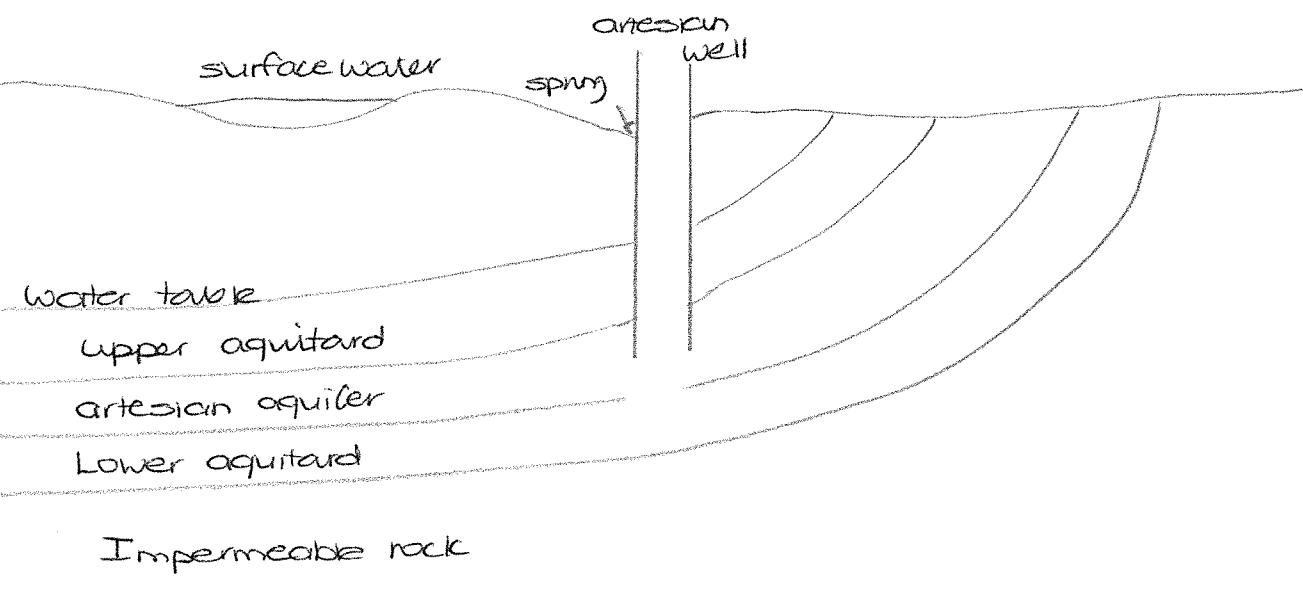
Much of the world has access to far less than this e.g. Namibia but other areas have more e.g. France like food it is not that there is not enough worldwide, it is that the distribution is uneven.

Water scarcity is not just a measure of how much water there is but of how we use it. There may be enough water in a region but it is diverted for non-domestic use. Agriculture uses 10 times more water than domestic use but again as populations increase the need for food will increase.



Enhancing Freshwater Supplies

11. Draw a labeled diagram to show the structure of an aquifer.



12. State what is meant by "aquifer".

13. Look at the following ways to increase water supply. Describe and evaluate each one.

Method	Brief Description	Evaluation
Build reservoirs	made by controlling water flows. Usually formed by the construction of dams across rivers or diversion structures	Dams trap sediment which are needed for habitats downstream lead to extinction of aquatic species + birds
Redistribute water	Water is redistributed through water networks and grids e.g. SW USA	Expensive to build so more common in MEDCs than LEDCs can lead to conflict

Desalination	Removal of salt from sea water	Expensive (due to energy demands), only available to countries by sea. Waste salt is produced.
Rainwater harvesting	Make use of the available water before it drains away	Can be achieved with high or low technology. Efficient use or storage of water can be achieved.
Recharging aquifers	<ul style="list-style-type: none"> - detain and deflect surface run-off so it can infiltrate into aquifer - directly injecting water into aquifer 	Technology is still being developed. Can be expensive.
Closed-water car washes	Wash cars in a closed-water system that reduces run-off, evaporation	Reduces oil pollution of surface water
Grey water recycling	Water from domestic use (not sewage) can be re-used for other purposes	Irrigation of crops, flushing toilets, gardening possible but not fit for drinking
Use drought resistant crops	Selecting crops that require less irrigation	Contamination of water supplies through fertilizers and pesticides can be addressed.



Reduce fertilizer and pesticide use	Choose plants that are more resistant	can reduce the productivity of the crops
Use organic (instead of chemical) fertilisers	Fertilisers will release nutrients slower and so more likely to be absorbed by plants	: less run off and eutrophication not suitable for large-scale farming
Water treatment by factories	Factories can remove the pollutants before they discharge the water	not enforced in many countries Hard to monitor/assess
Reduce temperature of water discharge	Use cooling tower to lower temperature so water does not cause thermal pollution	not enforced in all countries some of the water is lost by evaporation



CASE STUDY: Freshwater and Conflict

Conduct your own research to answer the following questions about water scarcity in North Eastern Africa.

A helpful article regarding the freshwater supply of the Nile Basin can be found at:

<http://www.futuredirections.org.au/publication/conflict-on-the-nile-the-future-of-transboundary-water-disputes-over-the-world-s-longest-river/>

14. List the countries that rely on the River Nile for freshwater.

Burundi, DR Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, South Sudan, Tanzania and Uganda

15. State why the above nations are motivated to claim a share of freshwater from the Nile.

It is the only major renewable source of water in the region

16. Describe how freshwater distribution has changed as a consequence of the Entebbe agreement.

Prior to this agreement the Nile Water Agreement allocated Egypt $\frac{3}{4}$ of the total water volume and Sudan $\frac{1}{4}$.

The Entebbe Agreement allowed countries of the Upper Nile Basin (Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda) to build dams and undertake other water development projects.



17. Discuss, using specific examples, the instances of conflict over the freshwater resources from the River Nile. In your answer, include historical instances and speculations about future conflicts.

- Nile's origin is outside the border of Egypt yet it takes the lion's share of the water
- A 1929 treaty between Egypt and Burundi, Kenya, Rwanda, Tanzania and Uganda awarded 57% of the water to Egypt and approval was required by Egypt for any major water project
- In 1959 Egypt and Sudan signed the Nile Water Agreement in which Egypt was allocated 3/4 of the total water volume and Sudan 1/4
- 2010 Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda signed the Entebbe Agreement which was rejected by Egypt + Sudan
- 2011 Entebbe Agreement came into effect allowing the countries of the Upper Nile basin to build dams and undertake water projects
- 2011 Ethiopia announced plans for construction of Great Ethiopian Renaissance Dam (GERD) - previously they had not made use of the Nile
- 2014 Ethiopia turned down Egypt's demand that it suspend construction of the dam
- GERD will be the largest dam in Africa. The construction has triggered many protests, especially from Egypt. There is some concern that it could result in the evaporation of 3 billion cubic metres of Nile water (Egypt's Aswan Dam is responsible for the evaporation of 12 billion cubic metres of Nile water annually). Together these dams could lead to much reduced flow downstream.
- The Nile is also threatened by many environmental pressures - climate change, salinization, pollution, land degradation, reduced river flow and increased likelihood of droughts and floods.
- Large-scale water development carry a dual threat - conflict with neighbouring countries and internal conflict. Egypt, with its over-dependency on the Nile see the building of the GERD as a threat to its national security. Cooperation with other countries will be more feasible than military threat which they might not be able to carry through.
- UN backed plan suggests using the Nubian Sandstone Aquifer 400 years of water available here. Egypt, Chad, Libya + Sudan have agreed to the plan.

