7th Grade Water Inquiry

What is the Greatest Cost of Water?

A man stands on what was once a wetland. The Mesopotamian marshes in southern Iraq, drained by Saddam Hussein to punish the rebellious Marsh Arabs, were re-flooded after his fall, but they are receding again. *Photograph by Carolyn Drake, Panos*

Supporting Questions

1. Who has access to water in the Middle East?
2. How do countries in the Middle East get water?
3. How is being "water stressed" impacting populations?
4. Why are conflicts arising over water?

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What is the Greatest Cost of Water?

Georgia Performance Standard & C3 Framework Indicator	**SS7G6.**: Explain how water pollution and the unequal access to water impacts irrigation and drinking water. **D2.Geo.9.6-8.** Evaluate the influences of long-term human-induced environmental change on spatial patterns of conflict and cooperation.
Staging the Question	"When the well is dry we know the value of water" ~ Ben Franklin As a class, discuss the quote from Franklin, identifying factors that may impact the value of water.

Supporting Question 1	Supporting Question 2	Supporting Question 3	Supporting Question 4
Who has access to water in the Middle East?	How do countries in the Middle East get water?	How is being "water stressed" impacting populations?	Why are conflicts arising over water?
Formative Performance Task	**Formative Performance Task**	**Formative Performance Task**	**Formative Performance Task**
Complete a map of the Middle East showing geographic features, population density, and water sources.	Create a chart that identifies and describes the effects of water collection methods used in the Middle East.	Write 1-2 paragraphs describing how being "water stressed" impacts populations in the area, citing specific supporting evidence.	Make a claim supported by evidence about why conflicts are arising over water.
Featured Sources	**Featured Sources**	**Featured Sources**	**Featured Sources**
Source A: *Aqueduct: Water Risk Atlas*	**Source A**: *AQUASTAT Database* **Source B**: Excerpt from "Finding the Balance"	Sources from SQs 1 and 2 **Source A**: *The Water Project*	**Source A**: Clip from *Global Public Square*, "The Coming Water Wars?" **Source B**: Excerpts from: "Mideast Water Wars" **Source C**: "'Islamic State' Using Water as a Weapon"

Summative Performance Task	**ARGUMENT** What is the greatest cost of water? Construct an argument (e.g., detailed outline, poster, essay) that discusses the compelling question using specific claims and relevant evidence from contemporary sources while acknowledging competing views.
	EXTENSION Use a mindmap tool, such as Popplet, to illustrate the relationship between issues of water access in the region.
Taking Informed Action	**UNDERSTAND** Research your community's water supply. **ASSESS** Determine the most pressing water-related issue affecting your community. **ACT** Create a school-wide campaign to address this concern.

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Overview

Inquiry Description

This inquiry leads students through an investigation of water access in the Middle East using various sources that consider geographical, political and economic issues. By investigating the compelling question, students examine the geography of the region, including environmental and demographic relationships, the ecological impact of accessing water, and the subsequent political conflicts over control of natural resources. By completing this inquiry, students begin to understand issues revolving around access and control of resources, such as the consequences of power struggles that befall countries with limited access to water resources.

In addition to the Performance Standard listed previously, this inquiry highlights the following C3 Framework Indicator:

- **D2.Geo.9.6-8.** Evaluate the influences of long-term human-induced environmental change on spatial patterns of conflict and cooperation.

NOTE: This inquiry is expected to take four to six 40-minute class periods. The inquiry time frame could expand if teachers think their students need additional instructional experiences (i.e., supporting questions, formative performance tasks, and featured sources). Inquiries are not scripts, so teachers are encouraged to modify and adapt them to meet the needs and interests of their particular students. Resources can also be modified as necessary to meet individualized education programs (IEPs) or Section 504 Plans for students with disabilities.

Structure of the Inquiry

In addressing the compelling question "What is the greatest cost of water?" students work through a series of supporting questions, formative performance tasks, and featured sources in order to construct an argument supported by evidence while acknowledging competing perspectives.

Staging the Compelling Question

In staging the compelling question, "What is the greatest cost of water?" teachers may prompt students with a quote to consider the value of water in different contexts. The Ben Franklin quote, "when the well run dries, we will know the value of water," can initiate a class discussion on the factors that impact the value of water. Discussion should include a consideration of how water impacts students' daily lives through direct and hidden costs.

Supporting Question 1

The first supporting question—"Who has access to water in the Middle East?"—helps students understand the geographic and demographic factors impacting access to water in the region. The formative performance task has students create a map that shows geographic features, population density, and water sources, so as to show the relationship between the three. The featured source for this question is an interactive atlas that provides some of the necessary information for students to create their own maps.

Supporting Question 2

For the second supporting question—"How do countries in the Middle East get water?"—students build on their geographic knowledge of the region to consider the ecological consequences of water collection techniques. The formative performance task has students create a chart that identifies and describes the effects of water collection methods. The first featured source for this question is the United Nation's Food and Agriculture Organization's country database, which provides country profiles for water management, including withdrawal and replenishment amounts. The second featured source is an article describing various methods of water extraction in the region and their relative costs and benefits.

Supporting Question 3

The third supporting question—" How is being "water stressed" impacting populations?"—asks students to consider the many ways in which being "water stressed" impacts various populations in the region. Students will write 1-2 paragraphs summarizing the impact on human populations, citing specific evidence from the featured sources. In addition to the previous featured sources, the resource for this task will further illuminate the ways in which water access impacts the human experience. The featured source for this question is an article from *The Water Project*, which highlights issues of desertification on agriculture, and subsequently, health of populations.

Supporting Question 4

For the fourth supporting question—" Why are conflicts arising over water?"—students will assess the power struggles over water access and how this conflict is affecting political and economic stability in the region. The formative task asks students to make a claim supported by evidence about why conflicts are arising over water. The first featured source, a clip from Fareed Zakaria's *Global Public Square*, introduces students to the struggle over water access manifesting into "water wars." Building on this introduction of control and conflict, the second featured source looks specifically at control of water resources within Iraq. The third featured source discusses the ways in which ISIS is using control of water as a weapon.

Summative Performance Task

At this point in the inquiry, students have examined the ways in which access (and lack of access) to water is impacting the Middle East across various facets. Students should be expected to demonstrate the breadth of their understandings and their abilities to use evidence from multiple sources to support their claims. In this task, students construct an evidence-based argument using multiple sources to answer the compelling question "What is the greatest cost of water?" It is important to note that students' arguments could take a variety of forms, including a detailed outline, poster, or essay.

Students' arguments will likely vary, but could include any of the following:

- Water extraction techniques used in the Middle East take a great toll on the environment that is depeleting water supplies.
- Access to water in the Middle East requires further stress on the environment, but is necessary to help the suffering populations.
- Dwindling access to water has made water more valuable leading to increased violence and terrorism to control it.

To extend their arguments, teachers may have students use a mindmap tool, such as Popplet, to illustrate the many connections between issues of water access in the region.

Students have the opportunity to Take Informed Action by drawing on their understandings of water access to consider an issue related to their community's water. To *understand* more about their water, students investigate the cost of their community's water (i.e., the source, extraction techniques, the extent to which it is "clean," ownership), through such sources as data from the Enviornmental Working Group, via the *New York Times* database. To *assess* the issue, students determine the the most pressing water-related issue affecting their community. To *act*, students create a school-wide campaign to address this concern. The featured sources provide possible resources to assess ownership and cleanliness/contamination of water, respectively.

Supporting Question 1	
Featured Source	**Source A:** World Resources Institute, database, *Aqueduct: Water Risk Atlas*, 2015

Accessed from: http://www.wri.org/our-work/project/aqueduct

Supporting Question 2	
Featured Source	**Source A:** Food and Agriculture Organization of the United Nations, database, *AQUASTAT Database,* 2016

Accessed from: http://www.fao.org/nr/water/aquastat/main/index.stm

Supporting Question 2	
Featured Source	**Source B:** Farzaneh Roudi-Fahimi, Liz Creel, and Roger-Mark De Souza, article, "Finding the Balance: Population and Water Scarcity in the Middle East and North Africa," *Population Reference Bureau*, 2002

Fresh Water: A Scarce and Critical Resource

Water sustains humans' health, food production, and economic development. But only 3 percent of Earth's water is salt-free, or fresh water. Moreover, nearly 70 percent of fresh water is locked in glaciers and icebergs, and is not available for human use. The fresh water that is available comes from rain or from rivers, lakes, springs, and some groundwater reserves, such as aquifers.[1](Water below the water table, contained in solid or fractured rock, is known as groundwater; aquifers are geologic formations that store, transport, and yield groundwater to wells.) Today's wells can reach water buried deep within Earth, so these freshwater supplies can be depleted on a massive scale. Most aquifers can be recharged by the annual water cycle, but water trapped in ancient underground formations cannot be renewed.

Rapid population growth has exacerbated the water scarcity MENA faces. While natural factors such as intermittent droughts and limited freshwater reserves can cause scarcity, high population growth imposes additional pressures.[2] Experts measure water availability in terms of the amount of annual renewable fresh water per person. A country is considered "water stressed" when its total renewable freshwater resources lie between 1,000 cubic meters and 1,700 cubic meters per person per year. "Water-scarce" countries have an average of less than 1,000 cubic meters of renewable fresh water per person per year. Twelve of the world's 15 water-scarce countries are in MENA […]

These thresholds for water scarcity and water stress do not reflect the freshwater resources that may eventually become accessible for human use. Accessibility is determined by a nation's ability to collect and transport water to users and by the quality of the water. Human activities often pollute existing sources of fresh water, making it unusable or expensive to treat and reuse. Once water is available for human use, however, many factors affect how that water is used.

Balancing Water Scarcity and Human Demand

MENA countries have increasingly been adopting new strategies for balancing their scarce water resources and growing demand for fresh water, although their options may be dictated by a number of different factors. For example, low-income countries, such as Yemen, would not be able to purchase the high-tech equipment available to high-income countries, such as Saudi Arabia. Even for high-income countries, purely technological solutions relieve only some of the demand for water. In the long term, slowing population growth in the region and creating effective policies and programs for improved water management are key to the region's sustainable development.

Strategies for Increasing Supply

Most governments have traditionally focused on increasing access to fresh water by locating, developing, and managing new sources, despite the high costs often involved. As new natural sources of water become scarcer and more expensive, however, MENA countries are turning to other options, such as desalination and treatment and reuse of wastewater, while continuing to use older methods.

***Qanats* and Rainwater Harvesting** *Qanats*, or chain wells, a traditional method for bringing water to the surface, consist of a series of horizontal tunnels bored into a cliff or mountainous area. These interconnected tunnels are sloped, allowing water to drain out and create an oasis in an otherwise arid area. The largest number of *qanats* are found in Iran. Rainwater harvesting, another ancient method for collecting water from

roofs, cisterns, and other sources, diverts runoff into ponds and reservoirs for agricultural use. In Egypt, Bedouin farmers have rehabilitated degraded agricultural land by storing runoff water in wadis (dry riverbeds that become ponds after heavy rains) and by constructing earthen dikes.[5]

Sequential Water Use Sequential water use involves capturing and treating water that has been used in one sector so that it can be directed to other uses. Domestic use requires the cleanest water, so the ideal order is for water to be used in the household first, then in industry, then in agriculture.[6] Urban wastewater, often referred to as "brown water," can be treated and channeled from towns and cities onto nearby farms, increasing crop yields and decreasing the need for chemical fertilizers. For example, most of Israel's sewage is purified and used to irrigate farm land.[7] Wastewater from Tunis is used to irrigate citrus and olive orchards near the city, as well as golf courses, hotel gardens, and certain crops.[8]

Desalination Extracting salt from seawater is extremely expensive. Desalination provides a clean and reliable source of water, but it uses large quantities of heat and has some negative environmental consequences. Sixty percent of the world's desalination capacity lies in the oil-rich Gulf states; 30 percent of the world's total is in Saudi Arabia, which has facilities on the coasts of both the Red Sea and the Gulf of Aden. Since the 1950s, Kuwait has been the pioneer in developing desalination to supply fresh water for domestic use.

Trading Water There are a number of ways to transport water from one region to another, including shipping it by boat, transporting it via pipeline, towing it in large water bags (Medusa bags), and carrying it overland in vehicles. Importing water could help MENA governments meet the increased demand, reducing the potential incentive for people to migrate. But the ecological impacts of major water transfer schemes can be significant: Pumping water from one basin to another area may seriously affect local ecosystems and hydrology.[9]

Strategies for Managing Demand

Successful policies and programs for managing water supplies might involve strategies for promoting more desirable patterns and levels of water use. Options include reallocating water away from agriculture, increasing irrigation efficiency, instituting voluntary conservation measures, involving communities in water management plans, and finding more effective distribution mechanisms.

Water Reallocation For most MENA countries, reallocating water away from agriculture and toward the domestic and industrial sectors may be a critical, although controversial, way to adjust to water scarcity. Such policies can satisfy the needs of growing urban populations, but they can also threaten food security and the livelihood of farmers. Moreover, such shifts may be politically sensitive, especially where local tribes control water resources, and may raise legal issues.

Less Water-Intensive Crops A number of MENA countries rely heavily on their own production of cereals, which have a low return per unit of land and water. Switching to less water-dependent crops, selling them in the international market, and importing cereals could help conserve water. But while the strategy may make economic sense, countries often feel that it is strategically important and a matter of national pride to produce their own cereals.

Efficient Technologies Better technologies may help reduce long-term costs and improve efficiency. Studies have shown, for example, that drip irrigation cuts water use by between 30 percent and 70 percent and increases crop yields by between 20 percent and 90 percent, compared with traditional irrigation. Drip systems deliver water directly to plants' roots, through a network of perforated plastic tubing installed on or below the soil surface.[10]Another successful technique, fertigation, involves applying fertilizer to irrigation water through the use of computer-controlled drip techniques. It economizes on water and fertilizer use, and limits soil salinization and groundwater pollution.[11] Israeli farmers, who use highly efficient drip-irrigation techniques, have more than doubled their food production in the last 20 years without increasing their use of water.[12]

Distribution Efficiencies Other measures for improving distribution, such as repairing leaking distribution systems and sewer pipes, expanding central sewage systems, metering water connections, and rationing and restricting water use, can also play important roles. For example, Jordan's construction codes mandate that buildings be constructed in accordance with water conservation specifications.[13]

Public Education and Community Involvement Involving communities in adopting new strategies can increase acceptance of new water systems. Communities can be taught to maintain and operate water systems, and can help determine what type of system best suits local conditions. In Tunisia, for example, there are nearly 2,500 water associations that are managing drinking and irrigation water systems.[14] Water conservation measures that rely on the community are often more effective when they provide income for the community. In Jordan, for example, the Business and Professional Women's Organization trains poor women to demonstrate and sell water conservation devices, such as shut-off nozzles for hoses, aerators for faucets, and waterless soap.

Conservation Countries are adopting a variety of ways to encourage voluntary conservation, including plans integrating religious messages with conservation practices. In 1998, for example, the Gulf states asked local religious leaders to devote their Friday speeches to the theme of Islam and water conservation for World Water Day. The Israeli Water Commission has estimated that implementing voluntary conservation measures could reduce the country's domestic use by 55 million cubic meters a year.[15] Many conservation messages have also been incorporated into school curricula throughout the region.

Economic Considerations MENA governments have traditionally subsidized the cost of providing safe water to citizens, but they are increasingly looking for ways to pass part of the cost on to consumers. Possible strategies include imposing water tariffs; charging for extracting water; pricing water at cost; offering conservation subsidies; and charging more during certain times of the day or seasons of the year.[16] International research shows that households, who receive most of the benefit from piped water, are willing to pay 3 percent to 5 percent of their income for access to clean water.[17] Water-use restrictions, pricing policies, wastewater quality requirements, and impact fees can motivate industrial and commercial users to reduce their water use. In one Jordanian steel mill, for example, daily water demand fell from 450 cubic meters to 20 cubic meters when cooling water was recycled.[18] Such incentives can help discourage industrial water pollution and agricultural inefficiencies, but they may be difficult to implement and enforce.[19]

Additional Strategies

Some strategies can relieve water scarcity in the short term. Other strategies address more systemic issues that help achieve long-term goals. These longer-term strategies include implementing legal and institutional reforms, increasing regional cooperation (see Box 1), and slowing population growth.

Instituting Legal and Institutional Reforms Complicated systems of water rights, land rights, social and civic institutions, and legal regimes can sometimes undermine water management; reform could improve how water resources are regulated.[20] Such changes may involve legal and institutional reforms, reorganizing the public and private sectors, and nongovernmental organizations' participation.[21] Jordan, for example, placed all responsibility for resources planning and monitoring under the control of the Ministry of Water and Irrigation.[22] Previously, several agencies had overseen water use, leading to short-term planning, sporadic enforcement of water resources laws, and limited surveillance of water pollution.

Slowing Population Growth The 1994 United Nations International Conference on Population and Development (ICPD) provided an opportunity for countries to examine their population challenges and discuss possible solutions for achieving socially equitable, sustainable development for each country. The ICPD Programme of Action focuses on human development, providing a framework for slowing population growth and improving people's lives. It calls for a wide range of investments to improve health, education, and rights –

particularly for women and girls—and to provide reproductive health information and services to help people achieve their desired family size.

Accessed from:
http://www.prb.org/Publications/Reports/2002/FindingtheBalancePopulationandWaterScarcityintheMiddleEastandNorthAfrica.aspx

Supporting Question 3	
Featured Source	**Source A:** Alexandra Barton, report, "Water in Crisis – Middle East," *The Water Project*, 2016

The Middle East has experienced many environmental concerns lately. Water resources are becoming increasingly scarce, especially for the millions there who already lack access to sanitary water. Some of these countries, including Yemen, the United Arab Emirates, Saudi Arabia, and Iraq, are facing unique problems that require global, immediate attention. Beside their neighboring location , one shared factor of all these countries is their lack of water resources and poor water management.

The Middle East has some of the largest oil reserves in the world, which produces most of the area's wealth. Even so, the region's climate and environment make living harsh. The Middle East requires water resources and suitable land for agriculture. Much of the land that is available for producing food is destroyed by increasing desertification.

Desertification is a sweeping environmental problem, with vast effects in countries such as Syria, Jordan, Iraq, and Iran. Universal causes for a spread of arid environment are unsustainable agriculture practices and overgrazing. Agriculture uses 85 percent of water in this region. It is common to misuse land by heavy irrigation in the Middle East. In the area droughts are more frequent, and contribute to the changing landscape. The overuse of water in agriculture is affecting the countries' already undersized water resources.

Jordan, located in the Syrian Desert, and Yemen, on the southern tip of the Arabian Peninsula, both endure severe water scarcity in the Middle East. For example, Jordan'saverage freshwater withdrawal is less than ten percent of Portugal's average, despite being the same size. The cost of water in Jordan increased thirty percent in ten years, due to a quick shortage of groundwater. Yemen has one of the highest worldwide rates of malnutrition; over thirty percent of its population does not meet their food needs . In recent years, Yemen has not been able to produce enough food to sustain its populations. Water scarcity has damaged the standard of living for inhabitants of the Middle East.

The United Arab Emirates, located on the Arabian Peninsula, is famous for its luxurious cities filled with lavish resorts, shopping, and attractions. The livelihoods of these extravagant emirates might create the assumption that water scarcity is not a problem for these rich states. In reality, however, the UAE is confronted with a serious depletion of their available water resources. A report from the Emirates Industrial Bank in 2005 said that the UAE had the highest per capita consumption of water in the world. Additionally, for the past thirty years the water table of this region has dropped about one meter per year. At this current rate, the UAE will deplete its natural freshwater resources in about fifty years. Even with a large amount of desalination plants to reduce water deficiency, the UAE needs to adjust its water use habits before its energy consumption doubles in 2020.

Desalination plants are an overuse of water resources in the Middle East. Seventy percent of desalination plants in the world are located in this area, found mostly in Saudi Arabia, the United Arab Emirates, Kuwait, and Bahrain. While the plants produce water needed for the arid region, they can manufacture problems for health and the environment. The seawater used most in desalination plants has high amounts of boron and bromide, and the process can also remove essential minerals like calcium. Also, the concentrated salt is often dumped back into oceans where the increased salinity affects the ocean's environment. The plants harm local wildlife and add pollutants to the region's climate. In addition, desalination is the most energy-costing water resource. The Pacific Institute explains that the high use of energy results in raised energy prices and higher prices on water produced, hurting the consumer. The water produced can be beneficial towards substituting

any lack of freshwater, but these areas have tendencies towards overuse of their natural resources. Concerns with the large amount of desalination plants in the Middle East focus on the improper dependency they will cause, instead of encouraging alternate forms of water and energy and conserving freshwater.

The Middle East has numerous struggles with its current water resources, and the region needs more than one solution to generate an optimistic environmental position for the future.

Facts and Statistics: https://thewaterproject.org/water-scarcity/water_stats

Accessed from: https://thewaterproject.org/water-crisis/water-in-crisis-middle-east

Supporting Question 4	
Featured Source	**Source A:** Global Public Square,video, *The Coming Water Wars?* 2013

Video clip accessed from: http://globalpublicsquare.blogs.cnn.com/2013/03/22/the-coming-water-wars/

Transcript:

Imagine a large body of water – about the size of the Dead Sea – simply disappearing. It sounds like a science fiction movie. But it's not. It's happening in real life – and we've only just found out.

A **pioneering study** from NASA and the University of California Irvine shows how the Middle East is losing its fresh water reserves. As you can see from the satellite imagery in the video, we're going from blues and greens, to yellows and reds: that's 144 cubic kilometers of lost water between 2003 and 2009. What do we mean by "lost water"? Most of it comes from below the Earth's surface, from water trapped in rocks. In times of drought, we tend to drill for water by constructing wells and pumps. But the Earth has a finite supply. NASA's scientists say pumping for water is the equivalent of using up your bank savings. And that bank account is dwindling.

This could have serious implications. Conflicts over water are as old as the story of Noah – in 3,000 BC. The Pacific Institute lists 225 such conflicts through history. What's fascinating is that nearly half of those conflicts took place in the last two decades. Are we going to see a new era of wars fought over water?

Consider that NASA's study is of one of the most volatile regions in the world. We tend to think of the Middle East and its upheavals as defined by oil. Perhaps in the future it will be defined by water. We often talk of a world of nuclear haves and have-nots, but a world of water haves and have-nots could be even more dangerous.

Part of the problem is that the world's needs have changed. Look at the population boom. We've gone from 4 billion people in 1975, to around 7 billion today. The United Nations projects we will hit 9 billion by 2050. Meanwhile, as India, China, and Africa continue to add millions to their middle classes, global demand for all kinds of food and products will increase. All of those products cost money – except for water, which we like to think of as abundant and free. Yet water is the resource we need to worry most about. According to the World Health Organization, more than 780 million people – that's two-and-a-half times the population of the United States – lack access to clean water. More than 3 million people die every year from this shortage. As our needs expand, so will the shortfall.

What can be done? Most of our water is actually wasted – and the United States is actually one of the worst culprits. We can change that. Singapore already treats sewage water to convert it into clean drinking water. We need to consider large-scale desalinization, where the United Arab Emirates and Saudi Arabia are world leaders. And remember, agriculture uses up as much as 70 percent of water. We need to fund research into more effective crops. A village in India reportedly set a world record this month for rice produced in a single hectare. How? Simply by changing when the seedlings were planted, a process which saves water.

Perhaps most simple and effective would be to put some kind of a price on water – so that people use it with a greater sense of efficiency and care.

All kinds of innovations are underway.

Next month the United Nations will mark World Water Day and the international year of water cooperation. It's a good time to start thinking about big global measures to regulate the world's most important resource.

Supporting Question 4	
Featured Source	**Source B:** Fred Pearce, article, "Mideast Water Wars: In Iraq, A Battle for Control of Water," *Yale Environment 360,* 2014

There is a water war going on in the Middle East this summer. Behind the headline stories of brutal slaughter as Sunni militants carve out a religious state covering Iraq and Syria, there lies a battle for the water supplies that sustain these desert nations.

Blood is being spilled to capture the giant dams that control the region's two great rivers, the Tigris and Euphrates. These structures hold back vast volumes of water. With their engineers fleeing as the Islamic State (ISIS) advances, the danger is that the result could be catastrophe — either deliberate or accidental.

AHMAD AL-RUBAYE/AFP/Getty Images

A Kurdish fighter looks at smoke rising on the horizon following U.S. airstrikes on Islamic State militants at Mosul Dam.

"Managing water works along the Tigris and Euphrates requires a highly specialized skill set, but there is no indication that the Islamic State possesses it," says Russell Sticklor, a water researcher for the CGIAR, a global agricultural research partnership, who has followed events closely.

The stakes are especially high since the Islamic State's capture earlier this month of the structurally unstable Mosul Dam on the Tigris, which Iraqi and Kurdish forces, supported by U.S. airstrikes, succeeded in retaking last week. Without constant repair work, say engineers, the Mosul Dam could collapse and send a wall of water downstream, killing tens of thousands of people.

Fights over water have pervaded the Middle East for a long time now. Water matters at least as much as land. It is at the heart of the siege of Gaza – the River Jordan is the big prize for Israel and the Palestinians. And over the years, water has brought Iraq, Syria and Turkey close to war over their shared rivers, the Euphrates and Tigris.

The Euphrates flows out of Turkey, and through Syria and into Iraq, before entering the Persian Gulf via the Mesopotamian marshes. The Tigris rises further east in Turkey and flows through territory currently controlled by the Kurdish army in Iraq. There, it follows a parallel path to the Euphrates before the two rivers mingle their waters in the southern marshes.

The two rivers water a region long known as the "Fertile Crescent," which sustained ancient Mesopotamian civilizations. They were the first rivers to be used for large-scale irrigation, beginning about 7500 years ago.

The first water war was also recorded here, when the king of Umma cut the banks of irrigation canals alongside the Euphrates dug by his neighbor, the king of Girsu.

Not much has changed. The dependence persists, and so do the disputes. The main difference today is that the diversion dams are bigger, and supply hydroelectric power as well as water. And that is why in recent months, many of the key battles in Iraq's civil war have been over large dams.

The Islamic State's quest for hydrological control began in northern Syria, where in early 2013, it captured the old Russian-built Tabqa Dam, which barricades the Euphrates as it flows out of Turkey. The dam, which is the world's largest earthen dam, is a major source of water and electricity for five million people, including Syria's largest city Aleppo. It also irrigates a thousand square kilometers of farmland.

Wikimedia Commons/Yale Environment 360

Key dams along the Tigris and Euphrates rivers.

The Islamic State's control of the Tabqa Dam has been haphazard, to say the least. In May, the reservoir behind it, Lake Assad, dramatically emptied. Many blamed Turkey for holding Euphrates water back behind its own dams upstream. But the Arab news service *Al Jazeera*quoted engineers at the dam as saying that their new masters had ordered them to maximize the supply of electricity. That required emptying the reservoir's water through the dam's hydroelectric turbines.

Since late May, the Islamic State has been trying to refill the reservoir by rationing electricity from the dam, with blackouts in Aleppo for 16 to 20 hours a day. Meanwhile, other fighting groups have shut down a water pumping station, cutting off clean water supplies for a million people in Aleppo. The UN's under-secretary for humanitarian affairs, Valerie Amos, condemned this as a "flagrant violation of international law."

From the Tabqa Dam, the Euphrates flows downstream through Iraq. Close to Baghdad, in the center of the country, it meets the Fallujah Dam, which diverts water for massive irrigation projects that produce the crops

that feed the country. In early April, Islamic State forces captured the dam. Reports of what happened next are confused, but it appears that the troops immediately shut the dam and stopped flow downstream.

This left towns such as Karbala and Najaf, a Shiite holy city 160 kilometers away, without water. But it also caused the reservoir behind the dam to overflow east, flooding some 500 square kilometers of farmland and thousands of homes as far as Abu Ghraib, about 40 kilometers away on the outskirts of Baghdad. Later, the rebels reopened the dam, causing flooding downstream.

This mayhem may have been a simple failure by Islamic State fighters to understand the hydrology of the river and the consequences of how it operated the dam. It may initially have been an attempt to deprive Shiite communities downstream of water. But Ariel Ahram, a security analyst at Virginia Tech University, suggests the eastward flooding was a deliberate act to repel Iraqi government forces attempting to retake the dam. The UN secretary-general's special representative in Iraq, Nickolay Mladenov, called the flooding deliberate, and demanded the restoration of "legitimate" control of the river. The Iraqi government says it has since recaptured the Fallujah Dam. But the conflict in the area continues, and events remain very worrying for anyone downstream.

But the battle for the Fallujah Dam may be a sideshow compared to that for much bigger Haditha Dam, further upstream on the Euphrates. This is the first Iraqi structure on the river after it flows out of Syria. At eight kilometers across, it is Iraq's second largest dam. It regulates the river for the whole of Iraq, providing the majority of water for irrigation, as well as generating a third of the country's electricity. It keeps the lights on in Baghdad.

Islamic State fighters controls nearby towns, and in recent weeks have launched repeated offensives to capture the Haditha Dam, which the Iraqi government is equally determined to hold onto. "If the dam fell, then a large source of electricity for the capital could be shut down," says Sticklor.

If the Sunni rebels want to use water as a weapon of war against the Shiite south of the country, the Haditha Dam would be a potent weapon. "They could disrupt downstream flow, either by withholding water or releasing a wall of floodwater, as they did from Fallujah this spring," says Sticklor. "It would have a potentially crippling effect on food production and economic activity in central and southern parts of the country."
It could also be lethal. The water behind Haditha has long been recognized as a potential weapon of war. In late June, employees at the dam told the *New York Times* that Iraqi government generals were prepared to open the floodgates against Islamic State forces rather than giving up the dam.
[…]

Accessed from:
http://e360.yale.edu/feature/mideast_water_wars_in_iraq_a_battle_for_control_of_water/2796/

Supporting Question 4	
Featured Source	**Source C:** Matthias von Hein, article, "'Islamic State' Using Water as a Weapon," *Deutsche Welle,* March 3, 2016

The terror group "Islamic State" has taken control of six of the eight major dams in Syria and Iraq. It is systemically exercising control by using water. The decline of "IS" now actually poses another kind of threat.

An abundant water supply means life, but excess water or water scarcity can mean death. Grave concerns have arisen over the dams that the so-called "Islamic State" (IS) has strategically taken in northern Iraq and Syria. IS controls six of the eight large dams on the Euphrates and Tigris rivers and is now continuously attacking a seventh one.

IS is specifically using the natural resource as a weapon, observes the conflict researcher Tobias von Lossow at Berlin's Institute for International and Security Affairs (SWP). "On one hand, IS is damming the river to retain water and dry up certain regions, thereby cutting off the water supply to villages and communities. On the other hand ,it has also flooded areas to drive away their inhabitants and to destroy their livelihoods," said von Lossow in an interview with DW.

Man-made disaster

IS did not come up with the idea of using water as a weapon. In World War I, the Belgian town of Niewpoort opened the gates of the Yser River at high tide and systematically flooded Flanders. The weapon proved successful at halting the advancing German army. About 25 years later, a similar plan came to a tragic end: To stop the invading Japanese during the second Sino-Japanese War, Chinese ruler Chiang Kai-shek had the Yellow River dikes in the province of Henan blown up on June 9, 1938. It was expected that the Japanese army would drown. Instead, an estimated 800,000 people drowned in the massive floods and the advancing Japanese were not halted.

Water has also been used as a weapon in the Middle East. In the 1990s, Iraqi dictator Saddam Hussein had the marshes in southern Iraq drained. His goal was to punish the Shiites in the area for an uprising against his regime and to take away their livelihoods.

IS pursuing environmental warfare

SWP researcher von Lossow says all warring parties in Syria have used water as a weapon, although no group does it as often as IS. He said, "IS uses water systematically and consistently. IS uses the entire range of possibilities and variations of water warfare." Von Lossow cites examples: In May 2015, IS took the Euphrates dam in Ramadi. IS then cut back half the water in the downstream flow of the Euphrates and thus limited the water supply in five provinces. In 2014, IS was able to use a dam on the Euphrates near the Iraqi city of Fallujah to defend and attack: First, the terrorist organization retained water to repel Iraqi troops on the upstream side. Then, it drained water and caused massive damage downstream and as a consequence, 60,000 people had to flee.

This background explains the international alarm when IS fighters captured the dam on the Tigris in Mosul in August 2014. It is the largest Iraqi dam and almost half of Iraq's power supply relies on its operation, as does the water supply in the Kurdish regions. Control of the dam meant that IS could have dried up large parts of Iraq. At worst, IS could have blown up the already crumbling dam, which would have resulted in a 20 meter high tidal wave in Mosul. It would have still been five meters high by the time it reached Baghdad, and then a

half million people would have lost their lives. With massive American air support, Iraqi troops and Kurdish fighters were able to recapture the crucial dam in just over a week.

Water, a weapon of mass destruction

Apart from cutting off water and flooding, there is another way of using water as a weapon: contamination or poisoning. In December 2014, IS made water unsafe to drink south of Tikrit by putting crude oil in it, according to von Lossow. IS wanted to use this method on European soil in July 2015: IS supporters tried to poison the largest water reservoir in the Kosovan capital Pristina but were exposed just before they committed the act.

The greatest threat is the mounting pressure on IS, says von Lossow. If IS is pushed back by the military and is weakened, it would lose large parts of its territory and population. Subsequently, IS would see itself forced to fight its final battle against its enemies while it stands on the verge of the apocalypse. In this situation, IS could possibly try to blow up dams on the Euphrates and Tigris, thereby opening the floodgates, making water a weapon of mass destruction.

Accessed from: http://www.dw.com/en/islamic-state-using-water-as-a-weapon/a-19093081

Taking Informed Action	
Featured Source	**Source A:** The Nature Conservancy, map, *Where Does Your Water Come From?* 2016

Accessed from: http://www.nature.org/ourinitiatives/habitats/riverslakes/placesweprotect/where-does-your-water-come-from.xml

Taking Informed Action	
Featured Source	**Source B:** Charles Duhigg, et.all, article, "Toxic Waters" Database, *New York Times*, 2012

Accessed from: http://projects.nytimes.com/toxic-waters/contaminants