GREAT LAKES LEARNING

LESSONS & ACTIVITIES BASED ON THE MONTHLY GREAT LAKES NOW PROGRAM

EPISODE 2205 | WATER'S TRUE COST

THE COST OF DRINKING WATER

Image Credit: Great Lakes Now

OVERVIEW

Based on an independent project by the Great Lakes News Collaborative to better understand the real cost of water, this lesson will explore the costs associated with providing drinking water to communities in the Great Lakes and across the U.S. Students will learn how water infrastructure systems naturally age and need to be maintained, upgraded, fixed, or replaced, and how that life cycle of the infrastructure affects water quality and cost to communities who depend on fresh, clean water.

LESSON OBJECTIVES

- **Know** about the factors that affect the cost of water
- **Understand** how water filtration takes place
- **Be able to** model the cost of water over time from a particular set of data

WHAT YOU'LL NEED

- Computer or mobile device with Internet access to view video and online resources
- Notebooks and pencils
- Chart paper
- Sticky notes
- Markers
- Lab supplies (see individual activities for a full list)
- Copies of the Student Handouts

INTRODUCTION

Water is essential for the day-to-day lives of all people. From drinking water to cooking, as well as bathing, cleaning dishes, or washing clothes, there is no way to live without a regular source of clean, safe, and affordable freshwater. Our bodies are made up mostly of water; it's an essential essential component to our body systems. So what can happens when water is no longer safe, clean, or affordable? And more importantly, when these issues do arise, what can be done to fix the problem?

This lesson will explore the phenomenon of aging water systems to help students learn about the true cost of water. They will learn several factors that affect the cost of water for residents, how different everyday activities require water, how municipal infrastructure allows water to get to citizens, and they will create a water filter to model what happens at a municipal water treatment facility.

This lesson includes multiple activities, including lab experiments, that can span the course of several sessions or be adapted to fit the needs of your group's meeting format.

Some prior knowledge* with which students should be familiar includes:

- Proportional Reasoning
- Graphing, data analysis, and y=mx+b
- Unit conversions

Follow this QR Code or hyperlink to the Episode Landing Page!

Check out our full collection of lessons for more activities related to topics like these.

****The sequence of these activities is flexible, and can be rearranged to fit your teaching needs.***

NGSS CONNECTIONS

Phenomenon: Aging Water Systems

- HS-ESS3-1
- MS-ESS3-4
- SEP-6
- SEP-8
- 2-PS1-2
- SEP-2
- SEP-4
- SEP-5

During the course of the lesson, students will progress through the following sequence** of activities:

- Class discussion to elicit or activate prior knowledge
- Learning how water from a natural source is treated to provide clean water to homes
- Teacher notes on water infrastructure
- Learn how **Wastewater Treatment Plants** work and do a close reading of a schematic of the South Haven water treatment system
- Watch segments from *Great Lakes Now*
- Class discussion to debrief the videos
- Graph, analyze, and model the costs of water over time for citizens in different Michigan cities
- Engineer a water filter to purify water and serve as a model for water treatment plants

The lesson progresses through three major sections: **launch, activities, and closure.** After the launch of the lesson, you are ready to begin the lesson activities. Once finished with the activities, students will synthesize their learning in the closure.

If you use this lesson or any of its activities with your learners, we'd love to hear about it!

Contact us with any feedback or questions at:
GreatLakesNow@DPTV.org

TEACHER BACKGROUND INFORMATION

by Great Lakes Now Contributor, Gary G. Abud, Jr.

**This information can be presented by the teacher as notes to students at the teacher's discretion.*

Several years ago, the city of Flint, MI faced a water crisis when it was discovered that lead had been seeping into the drinking water out of aging pipes that carried its water underground to residents. The local government was faced with several major problems, including how to fix the infrastructure that caused the contamination.

Simply put, **infrastructure** is the term used to refer to the systems of water pipes, pumps, and plants that transport clean water into our homes and used water out of our homes. This includes the sewer systems, water treatment plants, water filtration technology, and more. It takes a lot of infrastructure to get clean water to flow out of your kitchen faucet or garden hose, and just as much to carry away the water that's flushed down the toilet or sink drains.

The underground network of pipes is made up of a variety of materials and, depending on the age of the infrastructure in the community, may include some substances that can be harmful if ingested—like lead. These **pipe systems** are miles long and, like many materials, eventually wear out over time with constant use. Depending on the material the water system is made of, the deterioration of the pipe system can lead to harmful substances entering the drinking water when the pipes degrade. This is one way to characterize what happened in communities like Flint—and is now happening to Benton Harbor, MI.

Pumping stations help to get water to homes and remove excess water that might enter a system—such as when heavy rains cause flash flooding in an area. Sewers provide a place where dirty water can go to be removed from homes and kept away from places where people live, work, and play before being treated and disposed of properly. When pumping stations stop working, water pressure decreases and that can lead to major issues. The sinks in your home might run slowly, the sewers in the streets near where you live might start to overflow, or you could even get water backing up into your home through the floor drains in your basement, a utility room, or even your toilets.

Water filtration happens at facilities that treat and process water. These **water treatment plants** bring in water from nearby freshwater sources, filter out any unwanted impurities, and treat the water chemically to clean it, before pumping it out to citizens to use. At these facilities water is tested for safety and cleanliness until it passes the requirements for the water to be usable by people in the community. When filtration processes do not work as designed, the result is that citizens can't use the water to a certain extent or, in some cases, at all. There can be a variety of warnings, from having to boil your tap water to refraining from using the water altogether, that can occur as a result when harmful contaminants make it through water filtration processes.

But the problem that communities face is not just that aging infrastructure can breakdown, fail, or do damage, it's also keeping the systems working. That means operating and maintaining them, but also fixing or upgrading them when the systems need it. That all costs money—sometimes money that communities don't have. All that translates into the cost for us to have safe and clean water available to us. So, when major portions of the infrastructure need to be replaced, or even entire systems fail, the cost becomes uncharacteristically high. When this happens gradually over time, those costs typically result in higher water bills for consumers, but when a major issue in the water infrastructure happens all at once, it creates a water crisis for the community that usually is unaffordable.

Regional water authorities, state and federal governments, and even private organizations may be able to provide emergency funding to help communities to fix the problems they face in an urgent circumstance; however, situations like those eventually result in an increase in water bills to consumers in the long run.

And that's why understanding both the science of the problem—like contaminants making it into the drinking water—the social implications, and the economics behind this complex issue of clean water are all important to address.

LESSON LAUNCH

A. Warm Up

The warm up is intended to be structured as teacher-facilitated, whole-group student discussion activities. It helps students to begin thinking about the cost* of water usage by residents in a community

**Note: some mathematical unit conversion calculations and proportional reasoning skills will be necessary for this. Pre-teach that, as needed, to front load the skill.*

1. List all the things that you need clean water to be able to do in your life. Generate a class list by getting partners to share ideas and discuss as a group to come to consensus. The list might include: showering, washing dishes/clothes, watering the lawn, cooking, drinking water, etc.
2. Have them estimate **how much water (in oz)** is used in the types of activities that they listed. They can research these amounts if needed to inform their estimates—or, to check and see if their personal estimates are reasonable compared to data. *Note: they will likely estimate in gallons and then will need to change their units into ounces.*
3. Have them create a data table to display their results.
4. Build a class data table based on the averages of multiple groups' estimates of similar activities.
5. Assign groups of students to research the cost of different brands of bottled water (e.g., one group does Dasani, another Ice Mountain, etc.) so each group has one brand. Convert to cost **per ounce** of water.
6. Have students create a table that estimates the cost of the water activities if they were done using bottled water.
7. Have groups share out their findings and generate a class data table based on averaging all of their costs.

B. Bridge to Learning

After the warm-up activity has concluded, help students prepare for the learning that is about to come:

1. Ask students to consider what a monthly or annual cost for water use might be for a typical home based on the data table that they generated in the **Warm Up**.
2. Invite students to list what services they think are included in a typical water bill, and have volunteers share ideas to generate a class list.
3. Help them consider that the cost of water to residents is much more than the amount of water that is used and includes sewers, water treatment, etc., that make the cost of water higher. Show this video of a **Wastewater Treatment Plant** from PBS LearningMedia to illustrate this point.
4. Explain that today we will be learning about water's true cost and exploring some of the individual things that are involved with making safe, clean water available to our homes.

C. Close Reading a Photo

Start by explaining that cities have special facilities called water treatment plants where they clean the water before it goes to residents in the community, but also where they treat waste water that comes out of homes or businesses and into the sewer systems. Then, distribute the **South Haven Water Treatment System schematic** and ask students what they notice and wonder about it. Next, discuss why they think the system is designed as it is and how facilities might affect costs. Revisit their earlier list of water services.

D. Background Information Notes

Explain that we are going to build on these ideas and experiment to learn more about water treatment and the cost of water in this lesson. Then give the notes from the **Teacher Background Information**.

ACTIVITY 1: WATCH A GREAT LAKES NOW SEGMENT

This activity is a video discussion of a *Great Lakes Now* episode segment.

First, inform students that they will be watching a *Great Lakes Now* segment discussing the rising cost of drinking water and how water crises—like the one they will learn about in Benton Harbor, MI—affect water costs. During the video they need to jot down four things they took away from the video using the **4 Notes Summary Protocol**.

Then, if students are not already familiar, introduce them to the 4 Notes Summary Protocol, which they will use after they finish watching the video, where they write down one of each of the following notes:

- **Oooh!** (something that was interesting)
- **Aaah!** (something that was an ah-ha moment)
- **Hmmm…** (something that left them wanting to know more)
- **Huh?** (a question they have afterward)

Next, have students watch the **1st segment** from episode 2205 of *Great Lakes Now* called **Unpaid Bills**.

Last, have students complete their individual 4 Notes Summary and then discuss those in groups of 3-4 students.

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

Post-Video Discussion

After the groups have had time to go over their 4 Notes Summaries, invite a handful of students to share out some of their notes, eliciting at least 1-2 of each of the 4 Notes and listing those somewhere for the whole group to see.

Ask students to turn back and talk with their groups to make connections between the *Great Lakes Now* video and what they remember from the warm-up activities.

How is what we saw in the video the related to what we discussed earlier in this lesson?

After giving the groups some time to talk, bring the whole group back together for a shareout and discussion of ideas.

In this culminating discussion, the goal is to help students make connections between the video and what they discussed during the warm up activities earlier in the lesson about all the things that factor into the cost of water usage for communities.

Once the discussion finishes, have each student write a "**Sum It Up**" statement in their notebooks. This is a single sentence that captures the big idea of what was just learned.

Have 2-3 students share out their **Sum It Up** statements before concluding this activity.

ACTIVITY 2: BUILD A WATER FILTER

This activity introduces students to the basic process of water filtration—using gravity filtration—to help them develop a model for what happens at the municipal level with water treatment. They will construct a simple filter in a plastic water bottle and use it to filter two kinds of "polluted" water: water with **insoluble** "pollutants" and water with **soluble** "pollutants." A discussion of soluble/insoluble may be of benefit prior to beginning this lab, especially if those terms are unfamiliar.

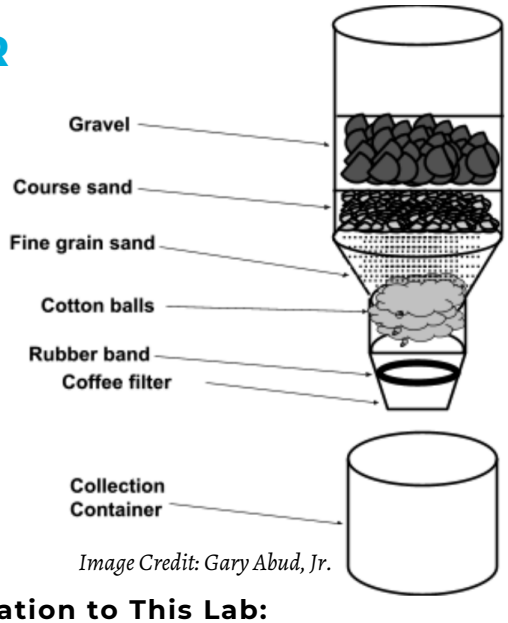


Image Credit: Gary Abud, Jr.

Materials*:

- plastic bottle (20oz) - rinsed, empty
- gravel
- sand (coarse grain and fine grain)
- 6-8 cotton balls
- 1 rubber band
- 1 coffee filter paper
- Scissors
- Plastic spoon
- "polluted" water (dirt, food dye, etc.)

Procedure:

1. Students should cut the water bottle about ⅓ of the way up from the bottom to yield two pieces. The longer piece should have the neck of the bottle and be able to sit nested inside of the shorter piece, which will be the collection container.
2. Remove the cap of the water bottle and secure the coffee filter over the cap using the rubber band. Cut the filter paper, if necessary, to fit best.
3. Then proceed to add the filtering materials in order from finest to coarsest: first cotton swabs, then fine sand, next course sand, and last gravel.
4. Place the mouth-end of the water bottle into the smaller cut section to hold the filtered water when it drips out the end of the filter.
5. Pour some of the "polluted" water into the filter and observe what happens as it runs through. Repeat for both the soluble and insoluble types.
6. Observe differences in the **filtrate** (what comes out of the filter) in each run through of your filter between the soluble and insoluble "pollutants."

Materials can be pre-made into kits by measuring 4-5 spoonfuls of each material into separate sandwich bags, and putting those with the other materials into a brown paper bag.

Optional Variation to This Lab:

This lab can also be done as a design challenge to help students appreciate the economic factors involved with water filtration. To do so, the teacher would assign an arbitrary value to a unit amount of each filtration material (e.g., 1oz of coarse gravel = $500) and give students either a) a budget to work within to produce their water filter, or b) the challenge to build the best filter for the lowest cost. Students would keep track of the amounts of each material, and might even test some of the materials first to determine which of the—and how much of each of the—materials they want to use in designing their filter. Then, when they test their filters, they should present their budgets alongside their design and report the results connected to the cost.

<u>Debrief the Water Filter Lab:</u>

After students finish filtering their water, have the class share some observations from the lab aloud and then engage the class in a post-lab discussion using the following prompts to get the discussion started:

- Which type of water filtered better?
- How did filtration differ with each pollutant?
- How does our model water filter compare to the water filtration that a city has to do with source water?
- What considerations do you think cities need to take into account as they design and build water treatment facilities to clean the water that goes to residents?

ACTIVITY 3: WATCH A GREAT LAKES NOW SEGMENT

This activity is a video discussion of a *Great Lakes Now* episode segment.

First, inform students that they will be watching a *Great Lakes Now* segment discussing the way that water bills have affected communities, especially during the COVID-19 global pandemic. During the video they need to jot down four things they took away from the video using the **4 Notes Summary Protocol**.

Then, if students are not already familiar, introduce them to the 4 Notes Summary Protocol, which they will use after they finish watching the video, where they write down one of each of the following notes:

- **Oooh!** (something that was interesting)
- **Aaah!** (something that was an ah-ha moment)
- **Hmmm…** (something that left them wanting to know more)
- **Huh?** (a question they have afterward)

Next, have students watch the **2nd segment** from episode 2205 of *Great Lakes Now* called **Hitting Home**.

Last, have students complete their individual 4 Notes Summary and then discuss those in groups of 3-4 students.

***Teaching Tip*: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.**

Post-Video Discussion

After the groups have had time to go over their 4 Notes Summaries, invite a handful of students to share out some of their notes, eliciting at least 1-2 of each of the 4 Notes and listing those somewhere for the whole group to see.

Ask students to turn back and talk with their groups to make connections between the *Great Lakes Now* video and what they remember from the warm-up activities.

How is what we saw in the video the related to what we discussed earlier in this lesson?

After giving the groups some time to talk, bring the whole group back together for a shareout and discussion of ideas.

In this culminating discussion, the goal is to help students make connections between the video and what they did in estimating the cost of water bills using bottled water costs in the warm up activities earlier in the lesson.

Once the discussion finishes, have each student write a "**Sum It Up**" statement in their notebooks. This is a single sentence that captures the big idea of what was just learned.

Have 2-3 students share out their **Sum It Up** statements before concluding this activity.

ACTIVITY 4: READ ABOUT WATER AFFORDABILITY

The issue of water quality and affordability is so vast and complex that it can be helpful to focus in on a few key aspects of the problem to facilitate learning. This activity intends to help students more fully grasp the impact that high water bills have on citizens.

In this activity, students will use a **Think Pair Square Protocol** for discussing the what they will read.

First, have students partner up and distribute the article **High Cost of Water Hits Home** by Circle of Blue from *Great Lakes Now*. Allow time for students to individually read the article, and have them jot down three things they learned in the article.

Then, give students time after reading to discuss the article that they read with their partner. Have students share which three points they noted from the article and how those points connect to each other. The pair should come up with a statement to summarize all of their article takeaways.

Next, have two student pairs join up, standing near each other to form the four corners of a square, to discuss the article and what they talked about in their pairs. Encourage them to come to a consensus about which point they found most important or interesting in the article.

Last, have each group come up with a summary statement of the most important point from their discussion and ask for a volunteer in each group to share that most important point with the whole group.

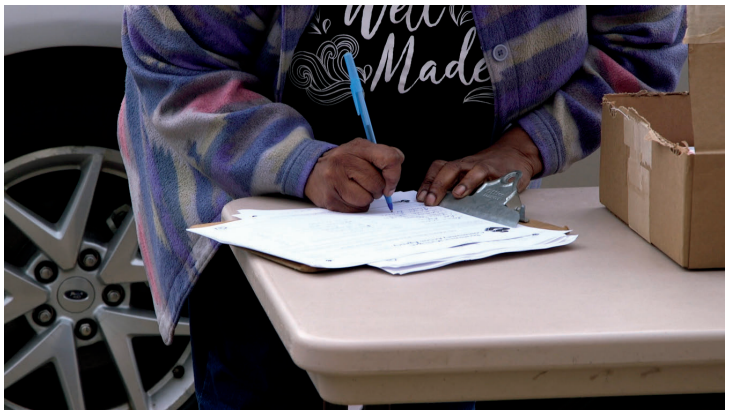


Image Credit: Great Lakes Now

As student groups share out their most important point, record their ideas on the board and have students copy the list of student ideas down into their notebooks.

After the shareout is complete, ask students to return to their groups and discuss one last question based on the article:

Based on the article, should all cities have an income-based payment option for water bills for citizens like the one described in Philadelphia?

After giving the groups some time to discuss this question, invite conversation from the entire class to see what consensus can be reached.

Further Learning: Interested to know how cities can prevent water crises? Check out segment 3 entitled, "Preventing Future Water Crises" from Great Lakes Now episode 1031—Pipes and Ports.

ACTIVITY 5: MODELING THE COST OF WATER

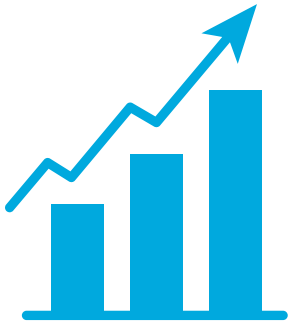


Image Credit: Gary Abud, Jr.

If the cost of water has been increasing over the years, will it continue to increase into the future? What kind of utility costs can students in classrooms today expect when they get to be adults with their own households in the future? By engaging students in mathematical modeling, this activity aims to provide students further understanding of the costs of water and how to estimate the impact of cost increases for water on citizens, like themselves as future adults.

Students will be given historical data for the cost of water utility bills for several major cities. They will proceed to mathematically model* the data in order to determine trends over time and analyze the data* to make forecasts into the future. (*Note: use handout **Mathematical Modeling the Cost of Water**)

Procedure

First, assemble students into groups and explain to them that they are going to be analyzing water utility bill data from some major cities and trying to determine how much it would their utility bills might cost if they lived in that city as an adult in the future. Allow students to choose which city's data they will work for the activity, or you can assign each group a different city. All groups can, alternatively, use data for the same city.

Then, review with the whole group what a linear model is and how to generate one by graphing data points, finding a line of best fit, determining the slope and y-intercept for that line, and writing a slope-intercept equation for that line, e.g., y=mx+b.

You may want to also review the skills of **extrapolation** (finding a data point outside of your range based on the mathematical model for your data) and **interpolation** (finding a data point within your range based on the mathematical model for your data).

Next, provide students with their data set (available in the handout at the end of this lesson) and give them time to graph their data and develop their linear models. This could be done on large dry erase boards or chart paper so that it can be displayed and presented to everyone. Ask students to determine, based on their models using evidence and reasoning, what would be the expected cost of water when they are adults at age 25, 35, 45, and 55. Regardless of their ages, each of these points in the future will require them to extrapolate a number of years into the future for their water data.

Last, have students present their findings in a poster presentation format where they can show their graph, mathematical model, and predictions of water utility bills at various points into the future. Facilitate a group discussion to help the group compare various costs in different cities and make connections between the methods by which they made their estimations of future water utility costs. Ask students to point to the city where they would want to live in the future, based on what they learned with this data, and invite a couple of volunteers to explain their rationale for why they chose to live in that certain city in the future.

***Teacher Notes:**

- All data is from the **IPUMS USA database**
- Not all years have data for each city
- 2020 data was not reliably available for any cities due to the COVID-19 pandemic.
- Use the Consumer Price Index (CPI) to adjust water/sewer costs for inflation
- To do so, the students should multiply the cost of water for a given year by the CPI for that year, then divide the result by the CPI for the year you want to adjust to.

LESSON CLOSURE

After the conclusion of all the activities, help students to make connections* between everything they did in the lesson and what they learned overall.

A. Compare and Connect

Initiate a discussion with students where you ask them to identify ways in which each activity connected to the other activities. This could be in terms of what was done, what was learned, or specific moments during the activities that corresponded with others.

Guide students to refer to each other's thinking by asking them to make connections between specific features of the activities and how they all connect to the big ideas of the lesson.

Make sure to invite students to connect other students' responses to their own ideas in the discussion.

B. Lesson Synthesis

Give students individual thinking and writing time in their notebooks to synthesize their learning, by jotting down their own reflections using the **Word, Phrase, Sentence Protocol.**

In the Word-Phrase-Sentence Protocol, students write:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson

Image Credit: Gary Abud, Jr.

C. Cool Down

After the individual synthesis is complete, students should share their synthesis with a partner.

After sharing their syntheses, have students complete a **3, 2, 1 Review** for the lesson with their partner, recording in their notebooks or, optionally, on exit ticket slips to submit, each of the following:

- **3 things** that they liked or learned
- **2 ideas** that make more sense now
- **1 question** that they were left with

Invite several students to share aloud what they wrote in either the synthesis or 3, 2, 1 Review.

Lastly, ask one student volunteer to summarize what has been heard from the students as a final summary of student learning.

**Optionally here, the teacher can revisit the learning objectives and make connections more explicit for students.*

Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.

NAME: _____

A Word, Phrase, Sentence Protocol

What is a **word** that you thought was most important from this lesson?

What is a **phrase** that you would like to remember from this lesson?

What is a **sentence** that sums up what you learned in this lesson?

3, 2, 1 Review Protocol

What are **3 things that you liked or learned** from this lesson's activities?

-
-
-

What are **2 ideas that make more sense** now to you?

-
-

What is **1 question that you were left with** after this lesson?

-

NAME: _____

4 Notes Summary Protocol

OOOH!

Something that was interesting to you

AAAH!

Something that became clearer; an "ah-ha" moment

HMMM...

Something that left you wanting to learn more

HUH?

Something you questioned or wondered

Sum It Up Statement:

Summarize your group discussion about your 4 Notes Summaries below:

NAME: _____

Think Pair Square Protocol

THINK

Write down your own individual ideas

PAIR

Summarize what you and your partner discussed

SQUARE

Summarize what your group discussed

Annual Water and Sewer Bill by City [Michigan]

Source: IPUMS USA Database—*Courtesy: Noah Attal, University of Michigan Earth and Environmental Studies Program in the Environment (PITE)*

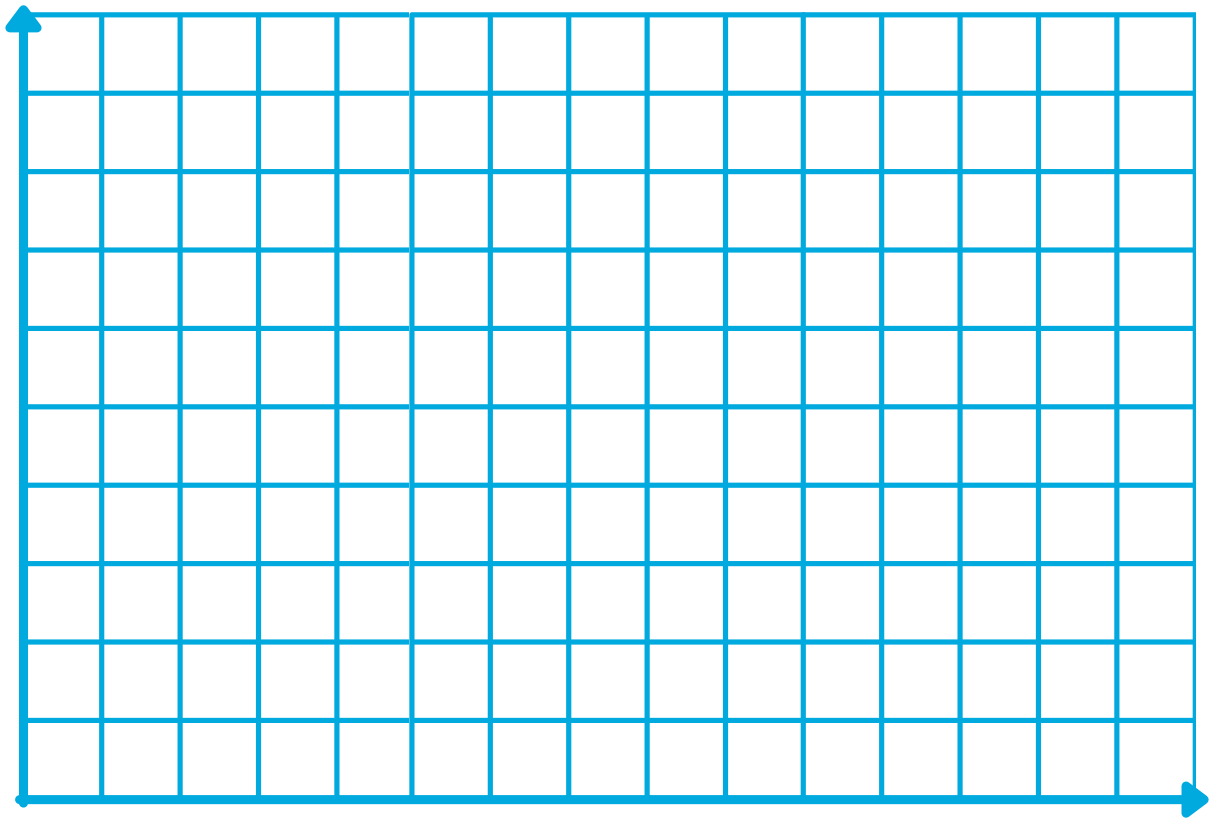
Year	Consumer Price Index (CPI)	Michigan (State Average)	Ann Arbor, MI	Detroit, MI	Flint, MI	Grand Rapids, MI	Sterling Heights, MI	Warren, MI	Lansing, MI	Livonia, MI
1960	29.6	$48		$46	$74	$34		$41		
1970	39	$50								
1980	82	$113	$120	$100	$112	$106	$126		$97	$120
1990	130.7	$263	$270	$293	$369	$247	$232	$189	$263	$249
2000	172.2	$343								
2001	177.1	$352								
2002	179.9	$371								
2003	184	$384								
2004	188.9	$401								
2005	195.3	$425	$336	$566	$532	$441	$320	$303	$470	$454
2006	201.6	$455	$399	$644	$560	$475	$342	$305	$507	$414
2007	207.3	$466	$444	$642	$535	$466	$371	$311	$537	$423
2008	215.33	$487	$491	$680	$537	$541	$364	$316	$501	$435
2009	214.53	$501	$514	$666	$547	$585	$360	$327	$562	$461
2010	218.05	$511	$452	$679	$550	$562	$403	$391	$550	$458
2011	224.93	$542	$481	$751	$706	$585	$415	$380	$551	$419
2012	229.59	$561	$517	$744	$896	$599	$457	$427		
2013	232.95	$588	$491	$790	$1,113	$606	$486	$419		
2014	236.73	$587	$482	$786	$1,147	$566	$419	$451		
2015	237.01	$602	$507	$863	$1,345	$566	$505	$448		
2016	240	$617	$483	$871	$1,177	$582	$519	$432		
2017	245.12	$642	$558	$905	$1,017	$579	$602	$472		
2018	251.1	$651	$567	$875	$1,091	$614	$625	$509		
2019	255.65	$646	$627	$837	$1,135	$591	$627	$528		

NOTE:

- Not all years have data for each city, and no city data was available for 2020
- Use the Consumer Price Index (CPI) to adjust water/sewer costs for inflation by multiplying the cost of water for a given year by the CPI for that year. then, divide that result by the CPI for the year you want to adjust to (example: adjust 1960 costs to 2018 standard.

NAME: _____ DATE: _____

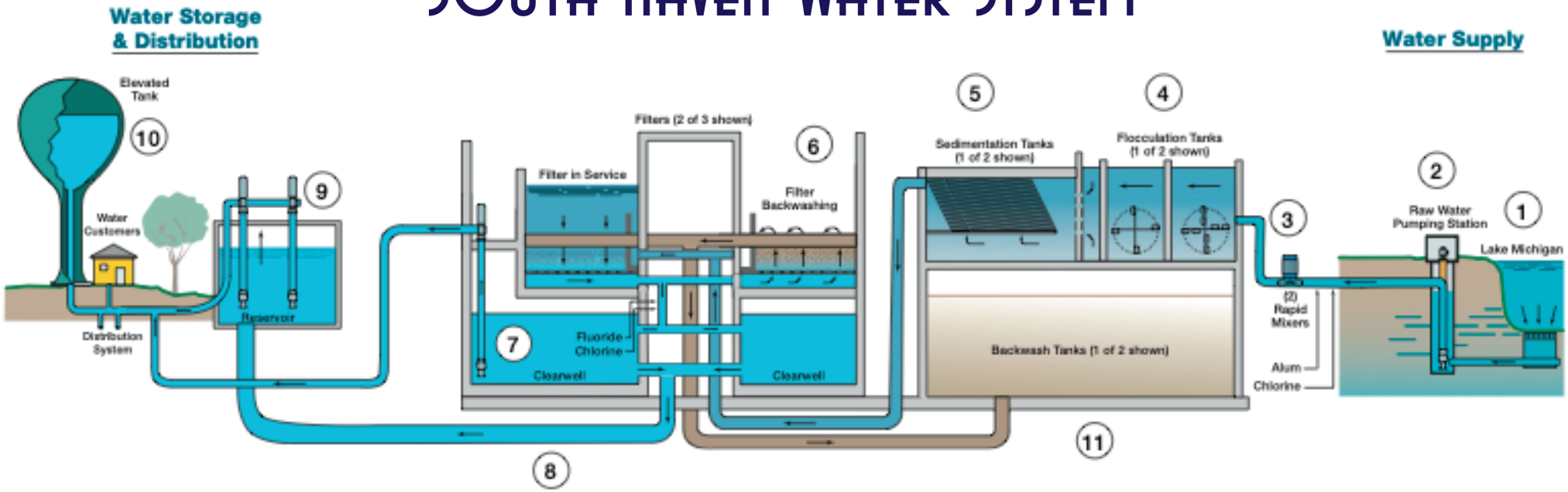
Mathematical Modeling of the Cost of Water



Directions:

1. Label each axis of the graph with a quantity and unit, e.g., time (years) or cost ($).
2. Scale each of your axes according to the range of data that is contained in the data table.
3. Plot the data from the table for your given city's water utility bill costs over time.
4. Find and draw a line of best fit over your data points once you have graphed them.
5. Calculate the slope of the best fit line.
6. Determine the y-intercept value of the best fit line.
7. Write an equation in point-slope form (y=mx+b) for your best fit line
8. Give your graph a title

South Haven Water System



1. Raw water is drawn through steel cribs in Lake Michigan.
2. The raw water pump station houses three pumps which transfer the raw water to the water treatment plant.
3. The in-line rapid mixers quickly and uniformly mix treatment chemicals into the raw water.
4. The flocculation tanks increase the size of the destabilized particles in the water. The particles stick together and form larger particles called floc which can be settled out of the water.
5. The plate settlers remove large particles. The stainless steel plates improve the efficiency of the gravity process by providing more surface area for particles to settle on.
6. The filter media consists of 15 inches of sand and 15 inches of anthracite coal. The water is filtered to remove solid particles remaining after the sedimentation tanks.
7. Just before leaving the plant, small amounts of fluoride for dental protection and sodium hypochlorite (chlorine) for disinfection are added to the filtered water.
8. Treated water is stored in the plant in two clearwell tanks which are connected to the finished water reservoir on site. The clearwells are equipped with high service pumps providing water to the distribution system and backwash pumps for cleaning filters.
9. The reservoir provides contact time for disinfection and also provides storage to help manage water production needs.
10. The distribution system storage tanks provide stable system pressure and storage for fire protection and other emergencies.
11. The filter backwash wastewater is collected in holding tanks located under the flocculation/sedimentation tanks. The cleanest portion of the filter wash water, called filter-to-waste, is routed to a recycle tank and can be sent to the head of the plant for retreatment and reuse.

Source: The City of South Haven, MI Department of Public Works