Algebra 1 Lesson Plan

Student Population: 9th Grade Algebra 1 Students

Class Period: 85 minute block schedule period

Classroom Objectives:

- Students will understand the purpose of utilizing CMS to simulate and understand complex processes.
- Students will understand the various components that comprise a system and its necessary parameters through discussions of water networks and similar complex systems.
- Students will harness their critical thinking abilities to make decisions regarding actions necessary to protect consumers on a water network.
- Students will solve linear equations and linear systems of equations in context.

Common Core State Standards for Mathematics (CCSSM):

- CCSS.MATH.CONTENT.8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
- CCSS.MATH.CONTENT.HSA.CED.A.3: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.
- CCSS.MATH.CONTENT.HSG.MG.A.3: Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
- CCSS.MATH.CONTENT.HSF.LE.B.5: Interpret the parameters in a linear or exponential function in terms of a context.
- CCSS.MATH.CONTENT.HSA.REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
- CCSS.MATH.CONTENT.HSS.ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Warm-Up: 5 Minutes	Students will be shown the water network grid and asked to postulate with their groups what it may represent. After 2 minutes of think time with their groups, three students will be randomly chosen to share what ideas their group came up with.

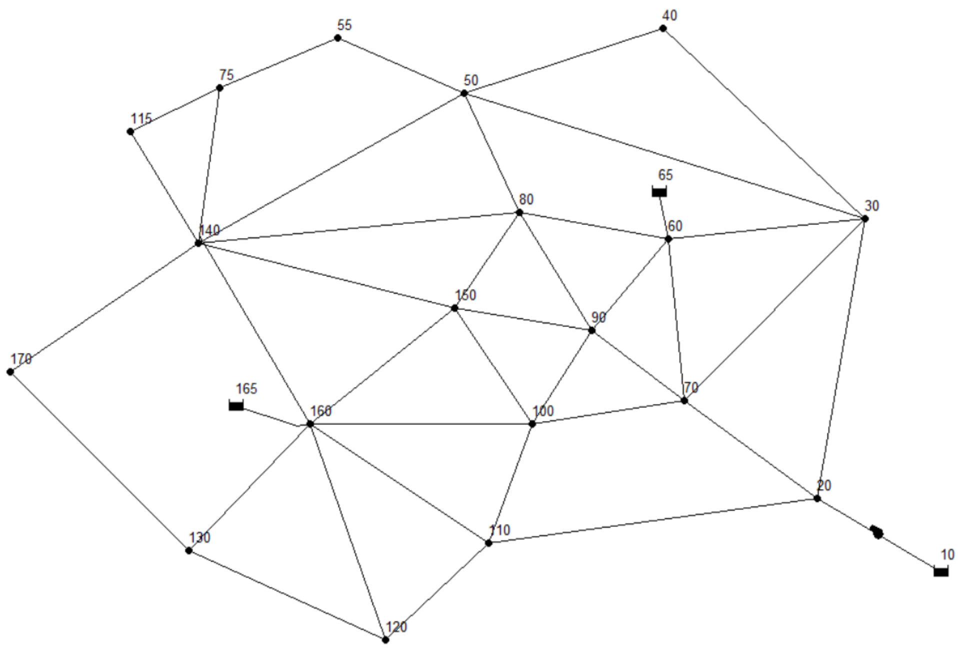
Engager: 10 Minutes	Students will be informed on various statistics regarding Chicago's Water Network and asked to brainstorm individually what different factors could impact the water quality in a water network. After 2 minutes of think time, students will share in their groups for 2 minutes before three students are randomly selected to share. Students will then be introduced to the idea of a contaminant entering the system.
Activity: 35 Minutes	Students will work with their groups to complete the worksheet (on the next page of this document). After 25 minutes are up, students will be randomly called to write their answers and explanations on the board. Then, other students will be called randomly to explain verbally to the class how each student found their answer and why it is correct. Students will be notified ahead of time that they may be chosen to share.
Exploration: 25 Minutes	Students will be randomly split into six groups and then assigned to specific stations. There will be three total stations and students will have roughly 8 minutes at each station. One station will involve the use of Python, one station will involve the use of Desmos modeling, and one station will be an additional review of solving linear equations and systems of linear equations in context.
Wrap-Up: 10 Minutes	Students will work individually on an exit ticket to assess their learning on the activity both in and out of context.

Algebra 1 Name: ________________________

Save the Arlington Heights Water Network! Date: _____________ Pd: __

A dangerous contaminant has entered the Arlington Height's Water Network due to trash leakage above a faulty pipe.

This chemical can be lethal in doses above 50 mg. Solve the following equations to determine which neighborhoods (labeled on the graph with numbers) are in danger, and which pipes need to be closed!



You are welcome to split up the work among your group, but be sure to check each other's work.

Once you have identified which neighborhoods are over the concentration limit, circle where you believe the contaminant source to be and draw an "X" through the pipes that you would recommend closing.

20) $\square + 20 = 63$	30) $3\square - 4 = 65$	40) $4(\square - 3) = 60$	50) $\frac{\square}{3} + 7 = 24$	55) $9\square + 2 = 2\square + 372$
60) $\square - 5 = 54$	70) $10\square = 390$	75) $\square - 12 = 50$	80) $5\square = 250$	90) $6\square + 4 = 40$
100) $9\square - 3\square = 36$	110) $\frac{\square}{5} = 9.6$	115) $8\square + 12 = 452$	120) $\frac{3\square+5}{7} = 5$	130) $\frac{3\square}{4} = 24$
140) $\frac{\square}{2} + 5 = 35$	150) $6\square + 4 = 40$	160.) $5(\square + 3) = 90$	170) $2(\square + 5) + 8 = \square + 64$	

Flushing Out the Contaminant

Now that we have identified the source of the contaminant, we can work on flushing it out of the system!

Suppose that at the time of contamination, there is 32 mg of contaminant at neighborhood 130. If the contaminant is flowing in at a rate of 10 mg/hour, write an equation to model this situation in terms of *h* hours and *c* contamination.

1. Linear Equation: ____

Now suppose that a hydrant was placed at this node to flush out the contaminant at a rate of 15 mg/hour. Rewrite your equation from #1 using this information.

2. Linear Equation: ____

We would like to solve the system such that $c = 0$. Solve this system using substitution and explain what it means in context.

3. Solution: _____________________
4. Meaning in Context:____
   ____.

Adjusting Parameters!

Suppose that we are able to adjust the scenario in specific ways. Circle if the amount of contaminant would increase, decrease, or stay the same, giving a written explanation for why. Be prepared to share your answers and justifications with the class!

Parameter Change:	**Effect on Contaminant Concentration:**			**Justification:**
More hydrants are added.	Increase?	Decrease?	Stay the Same?	_______________________
Detection occurs at a later time.	Increase?	Decrease?	Stay the Same?	_______________________
There are more neighborhoods.	Increase?	Decrease?	Stay the Same?	_______________________
The demand for water is higher.	Increase?	Decrease?	Stay the Same?	_______________________
There are fewer pipes.	Increase?	Decrease?	Stay the Same?	_______________________
There is more chlorine in the system.	Increase?	Decrease?	Stay the Same?	_______________________