

Earth Science - Middle School

Eliciting Student Thinking

Population, Water Consumption and Water Levels

Scenario Guide
Activation Date:
Intensity Level: Low

Author(s)	Avatar(s) & Environment	Suggested Learner Audience
Simulations for Secondary Science Teachers Conference Yvonne Ayesiga Dr. Sara Flanagan Dr. Jamie Mikeska Dr. Michelle Schepakow Dr. Jennie Carr Mursion Jordan Don Lake Mead Assignment Paul Anderson, thewonderofscience.com ¹	Host Avatar(s) Nina/Michael Simulation Avatars Savannah, Dev, Ava, Jasmine, Ethan Environment [ML3z] Middle School Classroom	<ul style="list-style-type: none">Pre-service teachers
Delivery Mode(s) Available for Scheduling 1:1, Facilitated Group		
This scenario was created in partnership with AACTE and the convening, Enhancing Science Education through Virtual Reality: A Conference to Design Simulations that Enhance the Clinical Preparation of Secondary Science Teachers, is funded by the National Science Foundation (NSF) 20-572 Discovery Research PreK-12, award #2040747.		

Learner-Facing Vignette:

You are a middle school Earth Science teacher who is having students analyze data on increasing human population and its impact on Earth's natural resources. You are using the increasing population in Las Vegas and its effect on the water levels at Lake Mead. The students were given graphs as well as photos representing the changes in water levels, population and water consumptions (see supplemental materials). The students were then assigned the following assignment:

Is the growth of Las Vegas causing the drop in the water level of Lake Mead?
Claim

¹ Anderson, Paul. "Las Vegas and Lake Mead." *The Wonder of Science*, 19 1 2021, <https://thewonderofscience.com/msess34#assessments>.

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Evidence
Reasoning

The students were instructed to use the images and graphs (see supplemental materials) to make a claim, provide evidence and explain their reasoning. The students completed their assignment and have all their materials accessible on their tablet. You have not seen their completed work yet and instead want to elicit their answers and thinking on their constructed claims before collecting their work. The focus here is not necessarily to change their mind or correct any misconceptions but rather to get a clear understanding of how each student approached the assignment.

Outcome:

Your goal in this scenario is to elicit thinking from all students to get a clear understanding of how they constructed their claim, evidence and reasoning.

Strategies/Best practices to consider:

- Use probing questions to elicit student thinking on their claim and how the evidence they are using supports their claim
- Encourage students to evaluate the quality of their data and limitations in the data
- Encourage students to draw on outside knowledge to support or challenge their claims and evidence based reasoning

Information about Intensity Level: Low

Supplemental Materials:

This scenario is gearing toward practicing the following of the [Next Generation Science Standards 8 Practices of Science & Engineering](#):²

Analyzing and Interpreting Data
Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

² NSTA, and using information from Appendix F of the Next Generation Science Standards © 2011, 2012, 2013 Achieve, Inc. "Science and Engineering Practices." *National Science Teaching Association*, 2014, <https://ngss.nsta.org/practicesfull.aspx>. Accessed 10 8 2021.

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Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

Information for Course Instructor Scenario Selection:

This lesson utilizes the following Next Generation Science Standards listed below:³

ESS3.C: Human Impacts on Earth Systems

- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

Student Prior Knowledge

Students have an understanding of the definitions of claim, evidence and reasoning.

Claim: a statement that answers the question. It will usually only be one sentence in length. The claim does not include any explanation, reasoning, or evidence so it should not include any transition words such as “because.”

Evidence: the data used to support the claim. It can be either quantitative or qualitative depending on the question and/or lab. Students should only use data within their evidence that directly supports the claim.

Reasoning: The explanation of “why and how” the evidence supports the claim. It should include an explanation of the underlying science concept that produced the evidence or data.

Source⁴

Students have varying understandings and comfortability analyzing graphs.

³ Achieve. “Next Generation Science Standards.” *Next Gen Science*, 2013, <https://www.nextgenscience.org>. Accessed 10 July 2021.

⁴ ModelTeaching. “Claim-Evidence-Reasoning (CER).” *Model Teaching*, 19 Jan 2019, <https://www.modelteaching.com/education-articles/writing-instruction/claim-evidence-reasoning-cer>.

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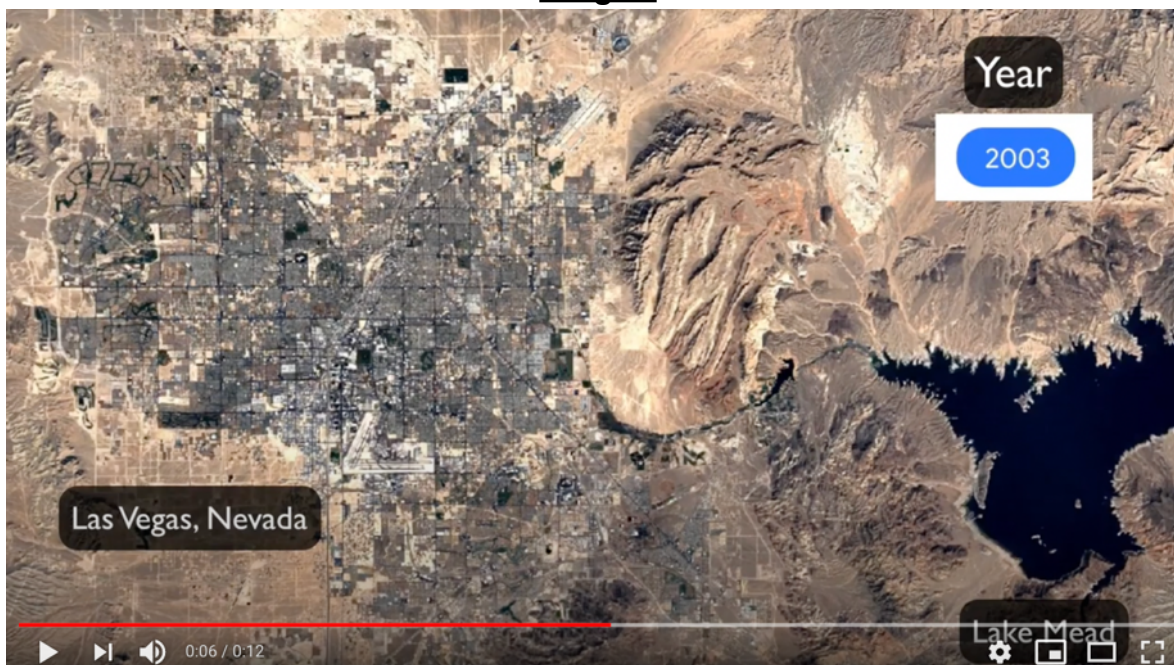
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Data for Assignment ⁵

Image 1



Image 2



⁵ Anderson, Paul. "Las Vegas and Lake Mead." *The Wonder of Science*, 19 1 2021, <https://thewonderofscience.com/msess34#assessments>.

Image 3

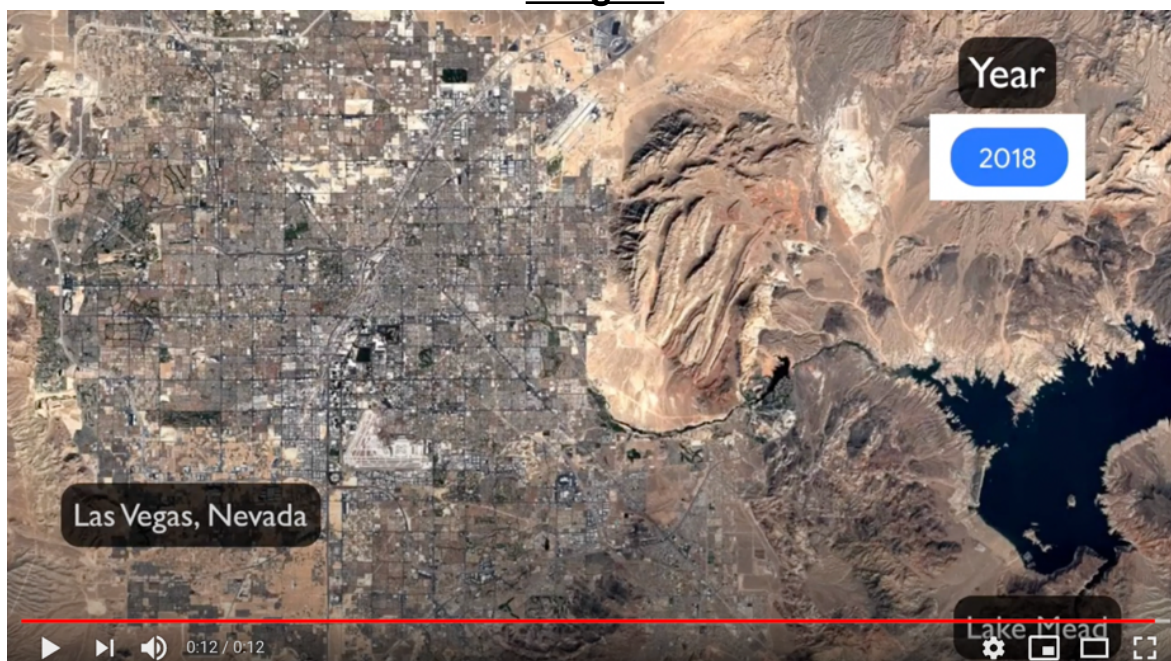
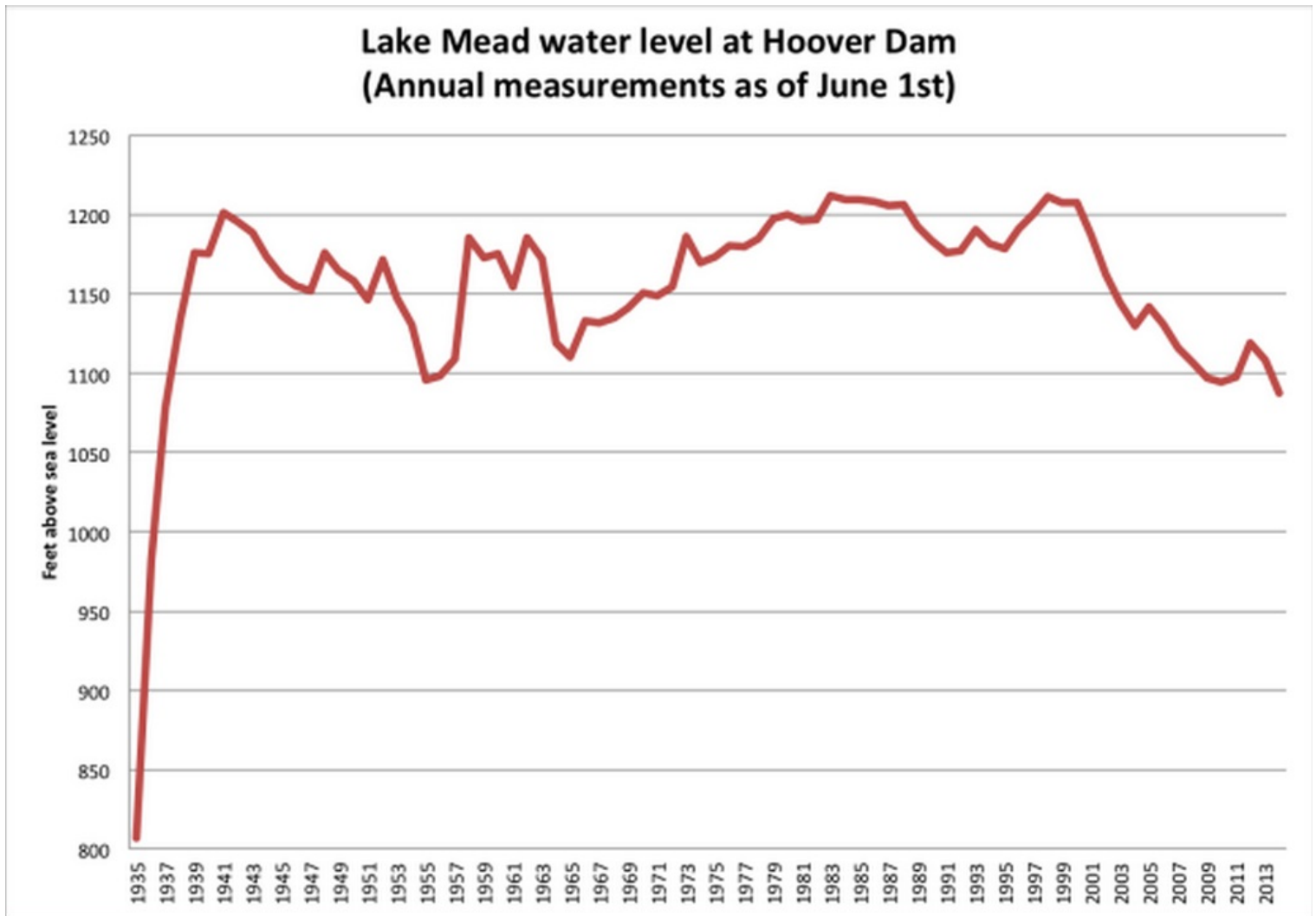


Image 4



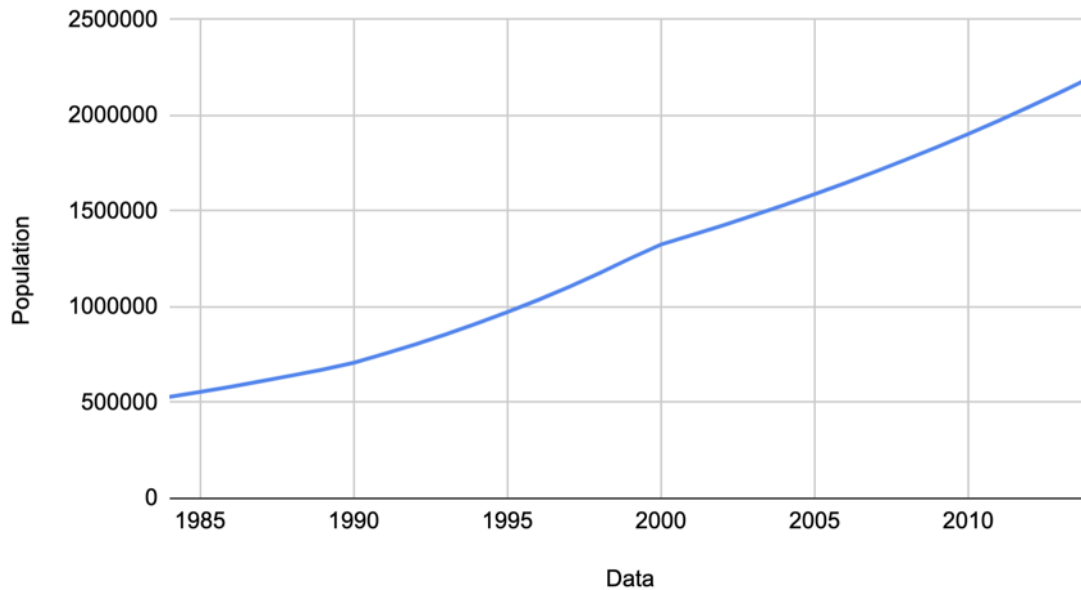
Lake Mead water surface elevation has dropped over 143 feet.

Graph 1



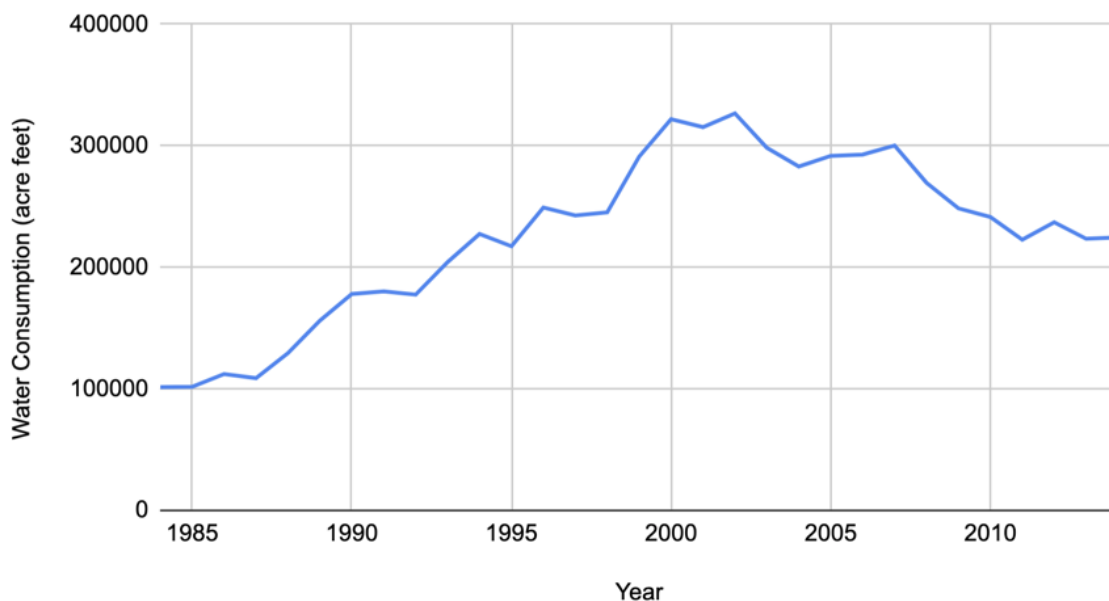
Graph 2

Las Vegas Population (1984-2014)



Graph 3

Las Vegas Water Consumption (1984-2014)



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Background (Internal, not Learner-Facing)

Review Time	Delivery Mode(s)
Advanced Mursion Bank: up to 1 hour and 15 mins 1 hour rehearsal with trainer bill to Trainee directly to Client	1:1, Facilitated Group
Scenario Specific Content Intensity Level: <ul style="list-style-type: none">Low: In a low intensity, the students exhibit mostly on task behavior with a few instances of off task behavior. Most students are engaged and off-task behavior is likely a result of over-participation or excitement over the subject matter. Off-task behavior can be redirected at the first attempt by the Learner. Host Specific Inquiries: <ul style="list-style-type: none">N/A	

What is this scenario intended to address?

This scenario is intended to get Science teacher candidates the opportunity to practice asking probing questions and eliciting responses.

Simulation Specialist Goal:

To provide an authentic and engaging experience of a middle school classroom with 5 diverse student perspectives.

Avatar's perspective:

NOTE: If asked directly what their claim/evidence/reasoning is, each student can simply read what they wrote for each box without offering any deeper insight. The student explanation is how they might generally describe their thinking if the learner does not ask specific probing questions. A big part of the questioning will likely revolve around analyzing the different graphs more closely and critically. The students can further analyze correctly or incorrectly, depending on how clear the learner is on their questioning. There are quite a few images and graphs to refer to, which can be overwhelming. As the avatar, feel free to say "wait hold on, let me find that" as if they are scrolling on their tablet to find the information and give you time to locate the appropriate material. We suggest having two tabs open or information in front of you - one with the avatar perspectives accessible and a second with the [images and graphs](#) accessible to quickly switch between the two.

Quick Links to Avatar Perspectives

[SAVANNAH](#)
[DEV](#)
[AVA](#)
[JASMINE](#)
[ETHAN](#)

Savannah

Is the growth of Las Vegas causing the drop in the level of Lake Mead?

Claim

Population does impact the water levels at Lake Mead.

Evidence

The Population graph (Graph 2) says that the population is increasing. In the pictures (Image 1-4), you can see that as the city gets bigger (bigger population), the levels at Lake Mead are decreasing.

Reasoning

I looked at the population graph and it shows population increasing over the years. The pictures also show that over the years as the city gets bigger, the lake is getting smaller which means that water levels are decreasing.

Misconception: Misunderstanding Vocabulary and Ignoring some of the data.

Student did not understand the vocabulary on the Water Level (Graph 1 - Sea Level) and Water Consumption (Graph 3 - acre) graphs, so they did not use these graphs and instead focused on what they did understand. This student focused on the population graph (Graph 2) which shows population increasing and used the pictures to further support their claim.

Student Explanation

- *I think that population is impacting the water levels because the screenshots of the picture show the city getting bigger and the lake getting smaller so there isn't as much water.*
- *Graph 2 proves population has been increasing a lot and evenly since 1985.*

Possible Questions and Responses

- Why didn't you use the other two graphs?
 - *I didn't understand them. I don't know what "ac-re" means or "above sea level" so I didn't get what those graphs mean*
- What do you know about the word acre?
 - *I don't know. I've never heard of it before.*
- Sea Level?
 - *Does it mean where the sea starts?*

Dev

Is the growth of Las Vegas causing the drop in the level of Lake Mead?

Claim

Population does not have an impact on Lake Mead water levels.

Evidence

Population graph (Graph 2) steadily increases while water levels (Graph 2) and water consumption (Graph 3) varies.

Reasoning

The pictures show the city getting bigger while water levels at the lake are dropping. The graphs of population show that too, but the water levels vary over the years, decreasing toward the end of the graph. But the water consumption graph is decreasing after 2000 while the population is still increasing and water levels are still decreasing. So, the population is not affecting water levels at Lake Mead.

Mistake: Focusing on some data points and ignoring others.

Student sees that while the population is increasing, in the water consumption graph (Graph 3) it appears that water consumption increases and then decreases after 2000. However, the water in the lake varies a lot, therefore this student concluded there is no relation between the population and water levels. This student disregards the pictures because they could be taken at different times of the year or at different angles.

Student Explanation

- *Population does not affect water levels at Lake Mead.*
- *The water consumption graph (Graph 3) shows that the population is actually using less water after 2000 while the water levels continue to decrease so whatever the population does must not affect the water.*
- *The water levels are also kinda all over the place over the years, so they must not be related.*
- *And the pictures, maybe they are taken at different times of the year or at different angles or something? The pictures don't really prove anything.*
- *So the population can't be affecting it, especially if they are decreasing their water consumption and the water levels are still falling.*

Possible Questions and Responses

- Take a closer look at graph 3 (water consumption), what is happening from 1985 through 2000?
 - *It's mostly increasing.*
- Why might water consumption, which had been steadily increasing over the years, suddenly start to decrease in 2000?
 - *Maybe people learned how to conserve water better?*
- What do you think is causing the water levels to vary at different points in time?
 - *Changes in how rainfalls?*

Ava

Is the growth of Las Vegas causing the drop in the level of Lake Mead?

Claim

Population increase can be one factor that causes the drop of water level.

Evidence

Population (Graph 2) increases, and so does water consumption (Graph 3) until 2000. After 2000, water consumption (Graph 3) decreases but the water levels (Graph 1) continue to decrease as well. So the water levels are affected by water consumption, but they must be affected by something else too.

Reasoning

The graphs and pictures prove that the population affects it, but it's not enough information because even as the population consumes less water, the water levels keep falling. The population is probably one thing affecting the water levels but it

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can't be the only thing. Maybe there is more evaporation. Maybe other towns are pulling from the lake.

Correct: Student accurately analyzed the data and drew the conclusion that other factors could be contributing to the change in water levels.

Student Explanation

- *I think the population is affecting the water levels but there has to be other things as well like global warming, maybe more evaporation or another town is also taking from the water. There's other big cities in Nevada, right?*
- *Population increases, and so does water consumption until 2000. After 2000, water consumption decreased but the water levels continue to decrease as well. So the population does affect the lake, but the water levels must be affected by something else too.*

Possible Questions and Responses

- What other factors could be contributing to the change in water levels besides population growth?
 - *Maybe changes in the weather? Global warming causes droughts.*
- How do you know that the population affects the water levels in Lake Mead?
 - *Vegas has to be pulling from the lake for water, so it has to affect the lake somehow! Unless they get water from somewhere else?*
- What is shown in the four images? How does that support or refute your claim?
 - *I see that the city is getting way bigger and the lake is getting way smaller. Which is the same thing most of the graphs are showing.*

Jasmine

Is the growth of Las Vegas causing the drop in the level of Lake Mead?

Claim

Population increases are causing the drop in the level of Lake Mead

Evidence

Population graph (Graph 2) increases from 1985 to 2010.
Water level graph (Graph 1) is decreasing from 1985 to 2010
Water consumption graph (Graph 3) is increasing, and even though it started to decrease starting in 2000, it's still much higher than it was before.

Reasoning

The graphs and photos show the population going up while water levels go down. The water consumption graph (Graph 1) shows that water consumption in the city is increasing and even though it starts to decrease in 2000, it's still much higher than before and so it is still high enough to keep the water levels dropping.

Correct: Student analyzed the data correctly and scientifically supported their claim.

Student Explanation

- *Yes, the growth of Las Vegas is affecting the water*

Possible Questions and Responses

- What about the years that the water level rises

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levels at the dam.

- The population graph (2) and water consumption graph (3) both start at 1985 but the water level graph (1) starts at 1935 so you can only pay attention to after 1985 which shows it is decreasing.
- Water consumption goes up and even though it starts to go down in 2000, it must not be enough to reverse or pause the water levels dropping, it's still much higher than it was back in 1985.
- So like, maybe the city is trying to help the situation with like, a Green Initiative but they aren't doing enough to help water levels.

around 1999?

- I'm not sure. Water consumption went down a little around that year so it does affect the water levels but maybe not all the time?...I'd have to go back and really compare each year.
- According to Graph 1, how did the water level in Lake Mead change from 1985 to 2013?
 - It goes down and up but overall its kind of just going down.
- What about the images?
 - We don't get to see the years in between, so maybe there were periods of time when the levels were rising but it fell again.
- What, if any, other factors could be affecting the water levels at Lake Mead?
 - Global Warming, maybe? The weather in Vegas could be changing so maybe it doesn't rain as much.

Ethan

Is the growth of Las Vegas causing the drop in the level of Lake Mead?

Claim

No Las Vegas didn't cause the drop in the lake.

Evidence

The population graph (Graph 2) goes up the whole time, but the graph of the lake (Graph 1) keeps going up and down and up and down.

Reasoning

If the people in Las Vegas were using up all the water in the lake, the graph of the lake (Graph 1) would go down instead of up and down.

Misconception: misreading graphs

In the Water Levels Graph (Graph 1), this student was focusing on the shape of the graph and not paying attention to the years on the X-axis. They did not realize the graph begins in 1935 while the Las Vegas Population and Water Consumption Level graphs begin in 1985. So they drew their conclusion without fully understanding how to read and properly compare the graphs. This student only paid attention to how the graph looked at first glance.

Student Explanation

- Nah, I don't think that the city causes the drop in the

Possible Questions and Responses

- Did you make sure the dates of the graphs lined up to

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<p>water levels.</p> <ul style="list-style-type: none">• <i>The population graph (Graph 2) goes up the whole time, and water consumption (Graph 3) goes up the whole time and then kinda goes down but the water levels graph (Graph 1) is kind of all over the place.</i>• <i>If the population was affecting it, then the water levels graph (Graph 1) would just go down like the population graph (Graph 2)</i>	<p>properly compare?</p> <ul style="list-style-type: none">○ <i>Oh - ok, to be honest I did NOT look at the numbers. (Ethan can take time to re-analyze)</i>○ <i>In that case, since 1985 the water levels went up a little but then went down a lot. So maybe it is causing the change</i>
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ADDITIONAL QUESTIONING:

Any of the students can answer these questions.

What other factors could affect the water level of the lake besides the population in Las Vegas?

- *Rain and snow could increase the levels again and refill the lake.*
- *Isn't a drought when theres not enough rainwater? Doesn't global warming cause droughts?*

How could we learn more about what is really happening to the lake? What additional data might we need?

- *We could look for graphs that show rain for the same years as the graphs we have.*
- *We need a map to see what other towns are near Las Vegas and check their population and water use.*
- *We could find out what happened in 2000 that made everyone stop using so much water. Was a law passed?*