Teaching Standards: See <u>Appendix 1</u> for teaching standards addressed in this unit.

<u>Synopsis:</u>

This unit is designed to grant students the necessary skills to access datasets in different formats, as well as using various forms of data assessment such as mean, median, standard deviation, and outliers to construct conclusions based on what the data is depicting. For this unit, I plan on integrating the conversation of health, and how statistical analysis can be used as a resource to examine the role social determinants play in the development of health disparities. Specifically, students will be assessing the prevalence of algae blooms amongst the Western, Eastern, and Piedmont regions of North Carolina, and how socioeconomic status, race, age, and region play a role in the development of asthma attacks. Not only will students understand the application of statistical analysis, but most importantly, the social implications of what the data represents and how this relates to students at the individual level.

I plan to teach this unit during the coming year to 65 students in Garinger High School Math 1

I permit for Charlotte Teachers Institute to publish my curriculum unit in print and online. I understand that I will be credited as the author of my work.

Statistical guide to preservation of Respiratory health

Mariam Mahgoub

Introduction:

Knowledge is power. There is immense power in being knowledgeable about your environment and how it afflicts or succors you. This knowledge cannot be acquired without one taking the initiative to seek out it. Working in the field of education, I carry the responsibility of advocating the importance of being your own advocate to my students, as well as being mindful about the world and knowing how to protect oneself. However, to instill this skill in your students, you must construct culturally relevant content. Students must be able to see how skills that are taught in math, English, and history class could be applied to their day to day life, which inevitably allows students to be critical thinkers; furthermore, more prepared for what they will face in the real world.

Specific skills that can be applied is knowledge and awareness about the quality of health in the community you reside in, and how there are social determining factors that could potentially afflict the health of members of that given community. Those who fall victim to health disparities come from marginalized communities. Social determinants such as education, food insecurity, environmental health, access to healthcare facilities, and employment can all play a leading role in the quality of health.

In our day and age, it is evident that there has been a rise in non-communicable diseases, and a decline in infectious diseases. Essentially, there has been increased access to vaccinations, which has led to a drop in infectious diseases. However, when examining non-communicable diseases, it is evident that the quality of one's environment or the choices at the individual level will lead to the development of the disease. For instance, heart disease, maternal mortality, and respiratory diseases such as asthma and COPD.

I will be focusing on addressing the impact that algae blooms in waterways within southeast North Carolina have on the incidence of asthma attacks. Additionally, students will use various forms of statistical analysis to interpret the social implications of what is discovered. Not to mention, students will use the knowledge acquired from the lessons learned on how they can preserve their health, and positively impact their community. Granting young children the power to preserve their health and the population's health will assure that they will be able to maintain or improve the quality of their life by being well aware of how social factors can affect their health and well being.

Rationale:

The purpose of this unit is to not only educate my students on how to go about statistical analysis but to also be well aware of the social implications of the data that is presented, especially when it comes to collecting data on social determinants of health and the effect that it may have on the population's health and rate of asthma attacks.

Within this unit, students will be presented data on a national basis of rates of asthma within the region of southeast North Carolina, particularly around the pig farms. Alongside assessing the prevalence of asthma and asthma attacks, my students will also assess data depicting the levels of algae blooms within the given region that's being studied. Additionally, students will also interpret data within their own community in Charlotte and what it may mean to them. Further gaining a better grasp on whether or not algae blooms are prevalent in Charlotte, and how this could potentially affect their respiratory health.

School Setting/Student Demographics:

Being that I will be focusing on the prevalence of algae blooms in southeast North Carolina and its impact on asthma. When it comes to health disparities, diseases that are both communicable and noncommunicable, it is evident that the underlying culprit is socio-economic status. The development of these diseases could be linked to sanitation, lack of access to adequate resources to maintain good health, and many more. Essentially, individuals living within low-income communities, are more likely to be more susceptible to contracting the said disease due to limited access to care.

Working at Garinger High School, the school population has shifted dramatically over the course of the last few years. Looking at the student demographic breakdown, black students make up 42%, Hispanics 44%, Asian 8%, White 4%, two or more races 2%, American Indian .2%, and Hawaiian Native .01%.[1] As you can see, the majority of the students who make up Garinger's population are Black and Hispanic, which are the two populations that have the highest rates of infant mortality in the United States. Alongside the students' racial demographics, when it comes to socioeconomic status, data has shown that nearly 99% of the student population is economically disadvantaged and 99% of the students are on a free lunch program, meaning they most likely suffer from food insecurity.[2]

Unit Goals:

The goal of this unit is for me to introduce to my students the importance of being well informed about your health and the social determining factors that can afflict your health, specifically the quality of the water you drink. I want my students to be well informed about how one's socioeconomic status can also be a determining factor in the quality and level of access to good health and resources. This is not to say that individuals who come from a low socioeconomic status are 'stuck', but rather the knowledge that is gained through this unit will allow students to see the importance of being knowledgeable about the social implications of algae blooms, which could further inflict on their respiratory health. I want my students to be socially and politically aware of the world they live in so that in the future, they can make a lasting impact in their communities for the better. Listed below are the standards my students and I will be focusing on within this unit when addressing the health and social impact of algae blooms on the waterways of southeast North Carolina.

NC.M1.S-ID.1 *Use technology to represent data with plots on the real number line (histograms, and box plots).*

NC.M1.S-ID.2 *Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. Interpret differences in shape, center, and spread in the context of the data sets.*

NC.M1.S-ID.3 *Examine the effects of extreme data points (outliers) on shape, center, and/or spread.*

Content Research:

During and after the industrial revolution, the developed world has been in this constant battle of trying to maintain the levels of supply and demand. As we progress and grow within our

[1] "How Does Garinger High Rank Among America's Best High Schools?" U.S. News & World Report. U.S. News & World Report. Accessed November 30, 2020. https://www.usnews.com/education/best-high-schools/north-carolina/districts/charlotte-mecklenburg-schools/garinger-high-144883.

[2] "How Does Garinger High Rank Among America's Best High Schools?" U.S. News & World Report. U.S. News & World Report. Accessed November 30, 2020. https://www.usnews.com/education/best-high-schools/north-carolina/districts/charlotte-mecklenburg-schools/garinger-high-144883.

population, this leads to the constant need for mass production. Especially within food supply, a country must be producing an adequate quantity of food to support its population. Furthermore, when looking at the imp; an act that mass production and the industrial revolution has had, it is evident that the field of agriculture has been significantly impacted. As a result, there has been a significant increase in the levels of phosphorus and nitrogen in the fertilizer.[3] With this increase in nutrients, it provides an adequate environment for the crops to grow. However, when it comes to aquatic and human life, it has negatively impacted both.[4] As water runoff from farms makes its way to waterways, high levels of phosphorus and nitrogen are dumped into the waterways. As the concentration of phosphorus and nitrogen increases, it will eventually lead to the development of algae blooms.[5] Algae blooms can be very hazardous towards aquatic life because it makes it difficult for fish to find food, further leading to the development of 'dead zones' within waterways.[6] 'Dead zones' make it difficult for fish to not only find food, which could lead to death or fish migrating to another waterway but also fish have difficulties when breathing because the algae bloom is so thick that it gives the fish limited access to oxygen.[7]

Aside from aquatic life, when it comes to algae blooms, this could lead to drinking water contamination, causing water-borne infectious diseases. Alongside the development of infectious diseases, research has made it evident that algae blooms can play a role in the triggering of asthma attacks or the development of asthma-like symptoms.[8] Individuals who have asthma have very sensitive airways, meaning when foreign chemicals or particles pass through the airway will

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[3] "Phosphorus and Water." science for a changing world. USGS. Accessed November 30, 2020. https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0.

[4] "Phosphorus and Water." science for a changing world. USGS. Accessed November 30, 2020. https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0.

[5] "Phosphorus and Water." science for a changing world. USGS. Accessed November 30, 2020. https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0.

[6] "Phosphorus and Water." science for a changing world. USGS. Accessed November 30, 2020. https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0.

[7] "Phosphorus and Water." science for a changing world. USGS. Accessed November 30, 2020. https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0.

[8] "Current Algae Blooms Bring Risk to Asthma Sufferers." Southwest Florida's Health and Wellness Magazine. Accessed November 30, 2020. https://www.swfhealthandwellness.com/current-algae-blooms-bring-risk-asthma-sufferers/.

react by becoming inflamed, further shrinking the pathway.[9] This can be quite detrimental if asthma attacks reoccur frequently, leading to the development of Chronic Obstructive Pulmonary Disease (COPD).[10]

In southeast North Carolina, it is evident that algae blooms are highly concentrated, which can potentially impact the quality of respiratory health, specifically for individuals who are diagnosed with asthma. Currently, in southeast North Carolina, there are high levels of algae blooms that are heavily concentrated within that region. Knowing that algae blooms are an indication of high levels of phosphorus and nitrogen in waterways, I began to research the number of farms within that region that may have played a significant role in the development of algae blooms. From my research, I came across hog farms. Starting in the year 1999, North Carolina was hit by Hurricane Floyd, which had caused significant damage to the coast.[11]Flooding broke through lagoons of animal waste within industrial hog farms, which caused the rural counties to have an excess of 'toxic flooding' filled with animal waste.[12]Additionally, the storm drowned nearly two million chickens and turkeys and 110,000 hogs.[13] Not to mention, the storm also carried the waste of animals into the waterways, leading to an excess of environmental hazards.[14]

After this horrific event during the year 2016, another disaster struck, hurricane Mattews. When Matthews hit North Carolina, the same thing took place. The storm led to excess flooding of farms, which led to feces runoff, causing contaminants to flow into waterways, further developing environmental hazards.[15] This repeated pattern of environmental hazards being linked to the development of algae blooms is affiliated with two concerns, excess use of

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[9] "Current Algae Blooms Bring Risk to Asthma Sufferers." Southwest Florida's Health and Wellness Magazine. Accessed November 30, 2020. https://www.swfhealthandwellness.com/current-algae-blooms-bring-risk-asthma-sufferers/.

[10] "Current Algae Blooms Bring Risk to Asthma Sufferers." Southwest Florida's Health and Wellness Magazine. Accessed November 30, 2020. https://www.swfhealthandwellness.com/current-algae-blooms-bring-risk-asthma-sufferers/.

[11] Moon, Emily. "North Carolina's Hog Waste Problem Has a Long History. Why Wasn't It Solved in Time for Hurricane Florence?" Pacific Standard, September 14, 2018. https://psmag.com/environment/why-wasnt-north-carolinas-hog-waste-problem-solved-before-hurricane-florence.

[12] Moon, Emily. "North Carolina's Hog Waste Problem Has a Long History. Why Wasn't It Solved in Time for Hurricane Florence?" Pacific Standard, September 14, 2018. https://psmag.com/environment/why-wasnt-north-carolinas-hog-waste-problem-solved-before-hurricane-florence.

[13] Moon, Emily. "North Carolina's Hog Waste Problem Has a Long History. Why Wasn't It Solved in Time for Hurricane Florence?" Pacific Standard, September 14, 2018. https://psmag.com/environment/why-wasnt-north-carolinas-hog-waste-problem-solved-before-hurricane-florence.

[14] Moon, Emily. "North Carolina's Hog Waste Problem Has a Long History. Why Wasn't It Solved in Time for Hurricane Florence?" Pacific Standard, September 14, 2018. https://psmag.com/environment/why-wasnt-north-carolinas-hog-waste-problem-solved-before-hurricane-florence.

[15] Moon, Emily. "North Carolina's Hog Waste Problem Has a Long History. Why Wasn't It Solved in Time for Hurricane Florence?" Pacific Standard, September 14, 2018. https://psmag.com/environment/why-wasnt-north-carolinas-hog-waste-problem-solved-before-hurricane-florence.

phosphorus and nitrogen as a method of growing crops, and effective infrastructure implemented within farms to assure limited amounts of runoff water from farms to waterways nearby.

The prevalence of algae blooms is highly concentrated specifically within the region of Sanford county and Jacksonville.[16]Amongst both of those locations, it is evident that there is a large population of hog farms, due to excess runoff of phosphorus and nitrogen from animal feces, this has led to the development of excess algae blooms, which is not only classified as an environmental hazard, but also a health hazards, specifically to individuals who are diagnosed with asthma.[17]

As previously mentioned, individuals who are diagnosed with asthma are more susceptible to asthma attacks when their sensitive airways are triggered by foreign particles or toxins. According to the North Carolina Medicine Journal, the national prevalence of adults diagnosed with asthma is 7.6% and 8.4% for children.[18] In fact, the prevalence of asthma amongst children is 2% more in North Carolina, in comparison to the national average.[19]Especially amongst minorities, it is evident that the prevalence of asthma is significantly higher amongst black and non-Hispanic ranking at 13.4% and Hispanic-Puerto Rican ranking at 13.7%.[20] Working at Garinger High School, the majority of my students identify as Black or Hispanic, meaning they fall under the demographic of individuals who are more vulnerable to being diagnosed with asthma.

Additionally, alongside the algae bloom, socio-economic status plays a leading role in the development of asthma or frequency of asthma attacks, such as exposure to polluted air and lack of access to healthcare (asthma medication).[21] In addition to one's socioeconomic status, studies have shown that during the year 2014, the rate of asthma attacks was at an all-time high within the Eastern region, followed by the Piedmont region, and finally the Western region.[22] This is

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[16] Raleigh, and Rose. "Study Finds Hog Farm Waste in NC Waters, but Significance Is Disputed." news observer. Raleigh News & Observer. Accessed November 30, 2020. https://www.newsobserver.com/news/technology/article32817855.html.

[17] Raleigh, and Rose. "Study Finds Hog Farm Waste in NC Waters, but Significance Is Disputed." news observer. Raleigh News & Observer. Accessed November 30, 2020. https://www.newsobserver.com/news/technology/article32817855.html.

[18] Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

[19] Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

[20] Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

[21] Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

[22] Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

quite concerning being that Charlotte is located in the Eastern part of North Carolina. Finally, the final factor that was assessed was urbanicity, which depicted that nearly 70% of asthma-related emergencies took place amongst rural and suburban communities. [23] Amongst rural communities, farms are quite prevalent, as well as algae blooms, leading to the potential for aquatic life and humans to be exposed to toxins released from the algae blooms.

Eastern North Carolina is disproportionately affected by health disparities due to social determinants, such as housing conditions. Similar to algae blooms, asthma attacks are triggered by exposure to toxins, whether that is from algae blooms, toxins from their homes, living near factories, or areas that experience a lot of CO_2 emissions.

Coming from a background in public health, and hearing from my student numerous times that mathematics is not useful, is what motivated me to want to integrate this conversation of algae blooms into the classroom and the impact that this has on one's respiratory health. The most impact you can have with your students in the classroom is making the content culturally relevant, but most importantly, demonstrate to your students how what they are learning can directly impact their livelihood. Introducing the conversation of public health in terms of access and social determinants of health, grants students with immense knowledge and power over preserving their health, especially being that individuals who are more susceptible to health disparities are minorities.

Instructional Implementation:

Teaching Strategies

My first approach to introducing the curriculum to my students, I want to take the first day to simply discuss with my students their understanding of health, as well as things within their environment that could potentially impact their health, positively or negatively. I want students to first grasp the big picture of health, before focusing on a specific sector of health. Once students can understand the importance of health and factors that can potentially impact one's health, students will have a better grasp as to why what they are being introduced to is affiliated with their day to day life.

In addition to introducing the 'big picture' of health, another quite efficient strategy is the use of visuals. I will introduce to my students' images of various factors amongst our environment that could potentially impact our health. For instance, showing students a picture of a neighborhood that suffers from food deserts, and a neighborhood that has access to healthy foods, and allow my students to make the connections on their own, as to what is presented in the image could potentially impact their health positively or negatively. As a result, students will begin to also gain a better grasp of social determinants of health, alongside health disparities amongst communities that present limiting access to healthy food and living conditions.

Classroom Lessons: Below is a brief breakdown of the social component of the content that students will be introduced to within this given unit.

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[23] Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

Lesson 1:

The first lesson will entail the conversation of health, 'what is good health?' and 'what impacts one's health?' Through this dialogue, I will integrate the strategy of 'big picture' and visually present to my students conflicting impacts that depict social determinants that have both a positive and negative impact on one's health. As previously mentioned, introducing an image that depicts a neighborhood with food deserts, such as a corner store being someone's main access to food, and another neighborhood has access to a grocery store with healthy food.

Lesson 2:

The second lesson will entail the prevalence of asthma within North Carolina based on one's racial identity and region (Eastern, Western, or Piedmont). Students will learn about how minorities are more susceptible to contracting asthma, and how social determinants, such as the prevalence of algae blooms and inadequate access to clean air can deteriorate one's respiratory health. This lesson will challenge students to recognize the long term health impact that exposure to polluted air can have on one's respiratory health.

Lesson 3:

The third and final lesson will focus on implementing a resolution. The dialogue amongst my students will focus on how they can take initiative in finding small changes in their lifestyle to preserve their health so that they are not susceptible to the development of asthma. For those who are diagnosed with asthma, students will be informed that they can adequately take their medication to assure if they are exposed to polluted air that triggers an asthma attack, that they have access to their inhaler and that they are regularly taking any necessary medication to limit the incidence of asthma attacks.

Learning Experience

Lesson 1:

The objective of lesson one is...

NC.M1.S-ID.1 *Use technology to represent data with plots on the real number line (histograms, and box plots).*

Followed by the introduction to health, students will present numerous datasets, such as tables depicting the prevalence of grocery stores amongst different area codes in Charlotte, this will allow students to see how zip codes that are low-income are disproportionately disadvantaged when it comes to access to grocery stores. Alongside this dataset, students will also be introduced to other data sets that show the demographic of individuals who live in particular zip codes as well as diseases that are more prevalent amongst specific regions in Charlotte. Once again, by accessing different datasets and plotting the points into Desmos, students will be able to see graphically how certain demographics are more susceptible to health disparities, due to their level of access.

Once students have been able to access the datasets as a class, students will continue to conduct their own assessment of datasets that align to social determinants of health and provide a

mathematical interpretation and analysis of the data distribution. Additionally, students will be required to provide a one-page explanation of the social implication of what they discovered.

Lesson 2:

The objective of lesson two is...

NC.M1.S-ID.2 *Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. Interpret differences in shape, center, and spread in the context of the data sets.*

Once students have been introduced to the prevalence of asthma and the role algae blooms play in the development of respiratory inflammation, students will be provided datasets that depict the prevalence of algae blooms by regions in North Carolina, the prevalence of asthma attacks by region, race, and age. From these datasets, students will be looking at the prevalence of each component throughout the course of the last 10 years, and provide the mean, median, and standard deviation. Through the use of the Desmos platform, will allow students to not only assess the improvement or deterioration of health throughout the course of the years but also gain a better grasp of the correlation between algae blooms and asthma attacks or respiratory inflammation. After conducting their own mathematical assessment of the datasets provided, students once again will provide a one-page description as to why what they discovered is important and relevant.

Lesson 3:

NC.M1.S-ID.3 *Examine the effects of extreme data points (outliers) on shape, center, and/or spread.*

The third and final lesson entails addressing resolutions, and with addressing resolutions, students will use the datasets mentioned from lesson two, to identify outliers, factors that do not have a significant impact on one's health. By identifying the outliers, will allow for students to find what determinants of health are highly prevalent and play a leading role in the development of asthma attacks, allowing them to provide a constructive action plan as to what initiative can be taken to assure that they do not become susceptible to experiencing asthma attacks.

Appendix 1: Implementing Teaching Standards for North Carolina Standard Course of Study

Extended Essential Standards

High School Mathematics

Math 1

Presented below are the three objectives for this given unit.

NC.M1.S-ID.1 *Use technology to represent data with plots on the real number line (histograms, and box plots).*
NC.M1.S-ID.2 *Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. Interpret differences in shape, center, and spread in the context of the data sets.*
NC.M1.S-ID.3 *Examine the effects of extreme data points (outliers) on shape, center, and/or spread.*

       This unit works towards challenging students to use technology to assess data in different formations, such as graphs, datasets, histograms, and box plots. Additionally, students are expected to use various forms of data analysis for the data provided, such as assess standard deviation, mean, and median, as well as outliers. By the same token, my lesson plans not only to fulfill the integration of various forms of datasets, as well as data assessment, but the social implication of the data presented. Students are challenged each day to assess the data from a mathematical standpoint, and then provide a one-page explanation of the social implication and importance of the information discovered. This allows students to see how mathematics can be used beyond the classroom, especially as a resource to allow one to be more well informed on what is taking place within their community and how to utilize the data discovered to their best interest.
Appendix 2: Teacher and Student Materials

https://www.desmos.com/calculator

Canvas discussion board

Powerpoint Presentation: Datasets presented the whole group

Canvas Classwork as independent practice on data analysis

https://www.youtube.com/watch?v=XOIFIN-LJRw (video gives students a introduction into the concept of health disparities, students may watch his on their own time to gain a better grasp of what health disparities essentially means and how to identify it)

Bibliography

"Current Algae Blooms Bring Risk to Asthma Sufferers." Southwest Florida's Health and Wellness Magazine. Accessed November 30, 2020. https://www.swfhealthandwellness.com/current-algae-blooms-bring-risk-asthma-sufferers/.

Dieu, Holly, Gregory D. Kearney, Hui Bian, Katherine Jones, and Arjun Mohan. "Asthma-Related Emergency Department Visits in North Carolina, 2010–2014." *North Carolina Medical Journal* 79, no. 2 (n.d.): 81–86.

How Does Garinger High Rank Among America's Best High Schools?" U.S. News & World Report. U.S. News & World Report. Accessed November 30, 2020. https://www.usnews.com/education/best-high-schools/north-carolina/districts/charlotte-mecklenburg-schools/garinger-high-144883.

Moon, Emily. "North Carolina's Hog Waste Problem Has a Long History. Why Wasn't It Solved in Time for Hurricane Florence?" Pacific Standard, September 14, 2018. https://psmag.com/environment/why-wasnt-north-carolinas-hog-waste-problem-solved-before-hurricane-florence.

Phosphorus and Water." science for a changing world. USGS. Accessed November 30, 2020. https://www.usgs.gov/special-topic/water-science-school/science/phosphorus-and-water?qt-science_center_objects=0.

Raleigh, and Rose. "Study Finds Hog Farm Waste in NC Waters, but Significance Is Disputed." news observer. Raleigh News & Observer. Accessed November 30, 2020. https://www.newsobserver.com/news/technology/article32817855.html.