Conducting a Case Study: Brooklyn Bridge Park

Description:

Students will be studying noise in Brooklyn Bridge Park. Students will collect quantitative data about the noise levels at different locations in the park. Students will analyze the data in a table and graph. Using the data, students will explore noise mitigation strategies.

Objectives:

- Collect and analyze quantitative sound data at Brooklyn Bridge Park
- Compare and contrast noise levels in the "sound shadow" and out of the "sound shadow"
- Study the impacts of sound mitigation strategies on noise levels

Vocabulary:

Berm, civics, mitigation, noise pollution, quantitative, sound shadow

Materials:

- Sound meter or smartphone applications (i.e., Arduino Science Journal, CDC NIOSH Sound Level Meter)
- Paper
- Writing Utensils
- "Brooklyn Bridge Park" worksheet
- Computers, laptops, or tablets with internet access
- Virtual Case Study: Brooklyn Bridge Park

Background Information:

Brooklyn Bridge Park first opened in 2010 at Pier 1, located along the East River in Brooklyn Heights. Construction continued over the next ten years to complete the 85-acre waterfront park. While the park is used by millions of visitors every year, a major concern for the park is the level of noise. Noise comes from nearby Furman Street, the Brooklyn Queens Expressway (BQE), and boat traffic along the East River. Noise from the surrounding area, especially from the BQE, is so intense that some areas experience noise above 80 decibels. Extended exposure to noise above 85 decibels can cause permanent damage to the ear.

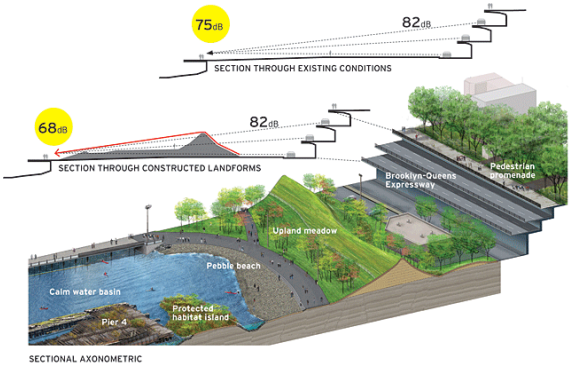
To combat noise pollution in the area, sound attenuation hills (berms) were created along Brooklyn Bridge Park. The three berms are 20 to 30-foot-high earthen hills that shield park goers from the roadway noise. The berms are covered in vegetation to help absorb and redirect noise from the highway. The berms can reduce noise pollution in the park up to 75%. A post on the Brooklyn Bridge Park's page claims, "Walking along the path and passing from the section unprotected by the wall to the place where it begins is the auditory equivalent of entering into cool shade after being exposed to the glaring sun."[1] The area protected by the berm is known as the "sound shadow." The berm may be an effective solution to redirect noise in Brooklyn Bridge Park, but it brings attention to a larger problem, which is how to combat noise pollution in other parts of the surrounding area, New York City, and other growing cities.

[1] Brooklyn Bridge Park

Method:

In the Classroom:

- Introduce students to the concept of noise pollution. Discuss different sources of noise pollution in their neighborhoods. What can our city do to help mitigate noise pollution?
- Familiarize students with Brooklyn Bridge Park by using the map on the park website. Have students make observations about the surrounding land and water such as major roads, ferry landings, construction, and housing.
- Use the online Case Study: Brooklyn Bridge Park to view the 12 different data collection locations used in this case study.
- Have students hypothesize about how these land and water features may impact the noise levels in Brooklyn Bridge Park using the first page of the following worksheet.
- Discuss noise mitigation strategies and explain why a berm was engineered in the park. Discuss how the design of the sound berm can reduce and redirect noise in the park. Refer to the following images.



Source: Brooklyn Bridge Development Corporation Rendering by Michael Van Valkenburgh Associates, Inc.

At Brooklyn Bridge Park:

- Plan a trip for your class to visit Brooklyn Bridge Park. If you are taking the 2, 3, 4, or 5 trains, exit at Borough Hall. If using the N, R, or W trains, exit at Court Street. From either station, exit and walk downhill along Joralemon Street. Continue along Joralemon Street towards Furman Street until you enter the park near Pier 5 (10-minute walk). From Pier 5, walk north with the waterfront on your left until you reach Pier 3.
- While taking a preliminary walk through the area, have students make predictions about the noisiest place(s) in the park. Some aspects that students should pay attention to include the number of people in the park, the proximity to major roadways and piers, and the amount of vegetation.
- Following the pre-investigation, split students into small groups of 2-3. Have students use a sound measuring device (either a cell-phone application or a sound meter) to begin the investigation. Make sure all students' sound measuring devices are calibrated.
    - If using the Arduino Science Journal app, press the plus button to create a new experiment. Then, press the edit button and select "Sensors." Scroll to the end and select the "Sound Intensity" option. Press "record" to record sound and "stop" to end the recording. Press the back arrow to see a snapshot of the recording.
    - If using the CDC NIOSH app, press the play button to start recording sound. Write down the LA_{eq} (Equivalent) which is the average of the sound every second. Make sure to save the recording by pressing

the download button. Students should take note of the L_{max} in the observation notes section of their worksheet.
    - *While both applications can be used, the Arduino Science Journal is more student friendly, while the NIOSH application provides the most accurate data.
- Using the worksheet, have students use their sound measuring devices to determine the sound levels at each of the 12 locations marked on the Case Study: Brooklyn Bridge Park.
- Record the decibel level in the table on the worksheet. In order to get the most accurate reading, make sure everyone is quiet when taking sound recordings. Take a reading for one minute, and record the minimum, maximum, and average sound level readings from each of the locations on your worksheet.
- After sound data has been collected at all 12 locations, have students share their data and observations. Which locations had the highest sound levels? Which locations had the lowest sound levels? Why?
- As a class, return to Pier 3 where most of the berm is located. In a group discussion, talk about how the design of the berm helps to mitigate noise. Point out features such as the vegetation and granite base. Also, consider the importance of parks and natural areas for dense, urban areas like New York City.

For Groups Unable to Visit the Park:

- Have students use the virtual Case Study: Brooklyn Bridge Park to further explore the case study locations in Brooklyn Bridge Park. Have students observe any features they can gather from the photographs and satellite imagery.
- Using the Case Study: Brooklyn Bridge Park, have students record the data in the table on their worksheet.
    - Note: The data was collected on July 19, 2019, between 12:00PM and 1:00PM using a cellphone microphone and the Arduino Science Journal application.
- Use graph paper or Excel spreadsheets to visualize the data in a graph. On the X-axis is the location # and on the Y-axis is the decibel level. Ask students to think about the best way to display the data such as using a bar graph, line graph, or box-and-whisker diagram.
    - When graphing, be sure to mention that decibels follow a logarithmic scale. For example, a sound at 40dB is twice as loud as a sound at 30dB. Use Khan Academy's Logarithmic Scale video for more information.

Discussion:

- What is the relative sound level in the "sound shadow?" What is the sound level out of the "sound shadow?"
- How does time of day, time of year, and amount of people influence the sound level recorded in the park? What else might influence sound levels in the park?
- How does the design of a berm decrease noise pollution in the park?
- What other mitigation strategies can reduce noise in Brooklyn Bridge Park?
- What are the challenges Brooklyn Bridge Park may face when mitigating noise for the other areas of the park?
    - Why can't Brooklyn Bridge Park build a berm around the entire park?
- Were the results consistent with your hypothesis?
- Why are New York City parks important places for humans and wildlife? How can noise in the park affect visitors?
- Are there any outliers in the data you collected? What do you think could have caused this?

Extension:

- Explore other areas of the park that are not included in the map, such as the other two berms near Piers 2 and 5. Do noise levels differ in these areas? Why?
- Compare the data students collected to the data collected by DEP.
    - Is there a difference between the sound data collected by students and the sound data recorded by DEP? Why?
- Compare the sound level readings from different sound meters. Have some students test different sound meters to compare their effectiveness. Refer to DEP's Understanding the Effectiveness of Different Sound Devices lesson.
    - Are there any differences in the data collected? If so, why?
- Have students brainstorm new mitigation strategies that could be used in Brooklyn Bridge Park and other parts of NYC.
- Further explore Brooklyn Bridge Park with your students, including the interactive sound features on Pier 3. Use DEP's Mapping Sound and Noise lesson to create a sound map while visiting Brooklyn Bridge Park.
- Try conducting a "soundwalk" of Brooklyn Bridge Park. Use Antonella Radicchi's article for a guide to sound walking.
- Try the activity in a park near your school. How do the natural elements alone help to absorb noise from the surrounding area? Make observations and collect sound data.

NYC Department of Environmental Protection
educationoffice@dep.nyc.gov
For more information visit www.nyc.gov/dep

Name: _____ Date: _____

Case Study: Brooklyn Bridge Park

Directions: Before exploring how the features of the park help mitigate noise, include your hypothesis below. Then, record any observations about the area. Using the map below and your sound meter or phone app, record the minimum, maximum, and average sound level readings at each of the locations.

Hypothesis:

_____

_____

_____

Observational Notes:

Case Study: Brooklyn Bridge Park

MAP KEY
Green – Locations Inside Berm
Red – Locations Outside Berm

Location	Noise Level	Observation Notes
Location 1		
Location 2		
Location 3		
Location 4		
Location 5		
Location 6		
Location 7		
Location 8		
Location 9		
Location 10		
Location 11		
Location 12		