



Comparison The Quality of Drinking Water between Three Boroughs: Queens, Brooklyn, Manhattan



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INTRODUCTION

Water is important for humans. It is used for every activity in life and it is required for life itself. Living organisms have 60 to 70 percent of their weight water. Also, water is needed in agriculture and industry. The presence of toxic chemicals and biological agents that exceed what is naturally found in the water may pose a threat to human health and/or the environment. Any amount of those chemicals pollutes the water, regardless of the harm they may pose to human health and the environment. The most common pollution indicators in drinking water are Chlorine; iron; copper; pH, and the hardness which is measured by the amount of calcium and magnesium in water. These factors are naturally found in the water in very small amounts; however, having large amounts can be harmful and possibly fatal. The goal of this experiment is to test the water contaminants of three boroughs in NYC based on the parameters of chlorine, Iron, copper, pH, hardness, phosphate, coliform bacteria and lead. We aim to detect any pollutants from these water sample in order to prevent any disease caused by polluted water.

QUESTION/PROBLEM

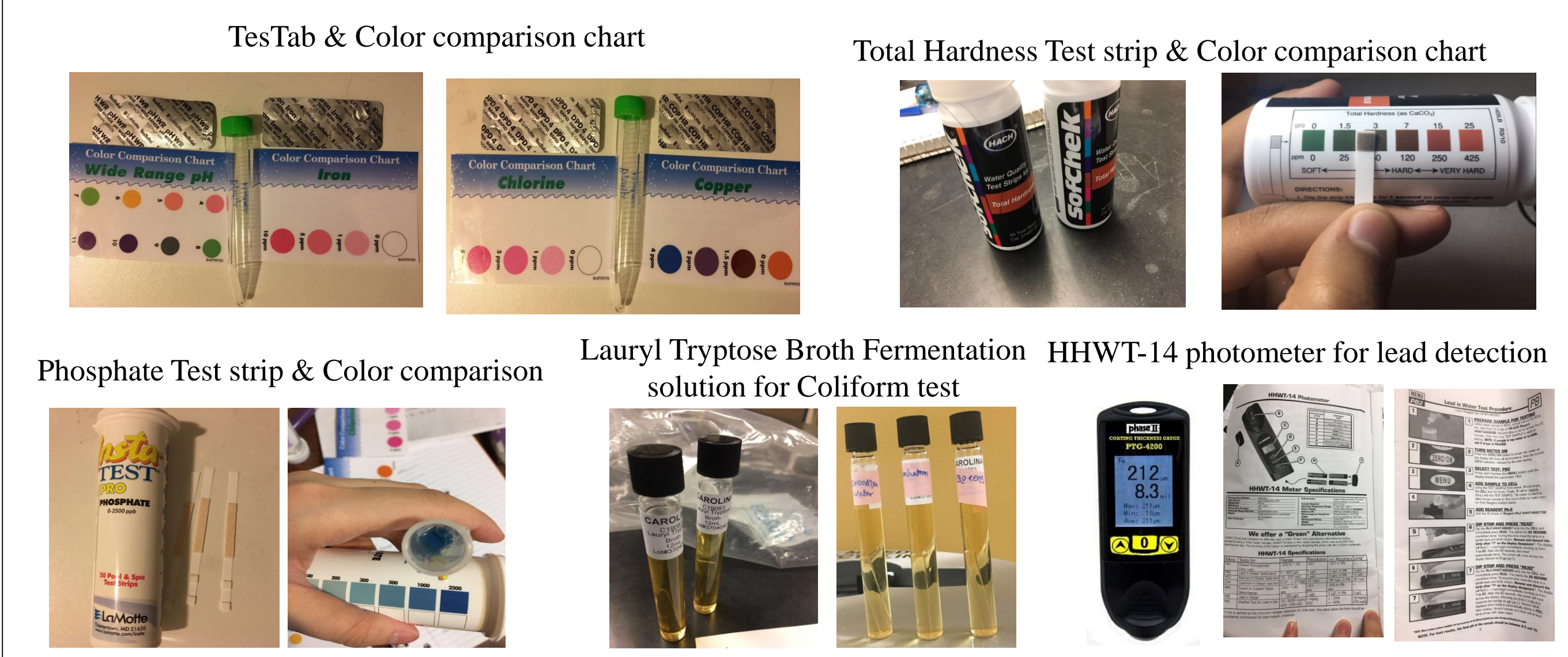
In most cases, water can get polluted once it flows into the pipes to different houses, buildings and locations. Thus, the most common variables influence the water quality can be the age of the pipes, water transport, or the ways of how water preserved.

HYPOTHESIS

We assume that if one of the three borough contains more pollutants than others two, then it may indicate that there has been some problems presented in its pipes, water transportation, or the ways of how its water preserved.

METHODS

- **Chlorine test:** chlorine PD #4R TesTab
- **Iron Test:** Iron TesTab
- **Copper test:** copper HR TesTab
- **pH Test:** pH wide range TesTab
- **Hardness test:** total hardness test strip
- **Phosphate Test:** Phosphate Test strip
- **Coliform bacteria test:** adding Lauryl Tryptose Broth Fermentation solution to each water samples
- **Lead Test:** We will use the special equipment "HHWT-14 photometer" to test the lead level in these water samples. Photometer is a special instrument used to detect the liquid properties.

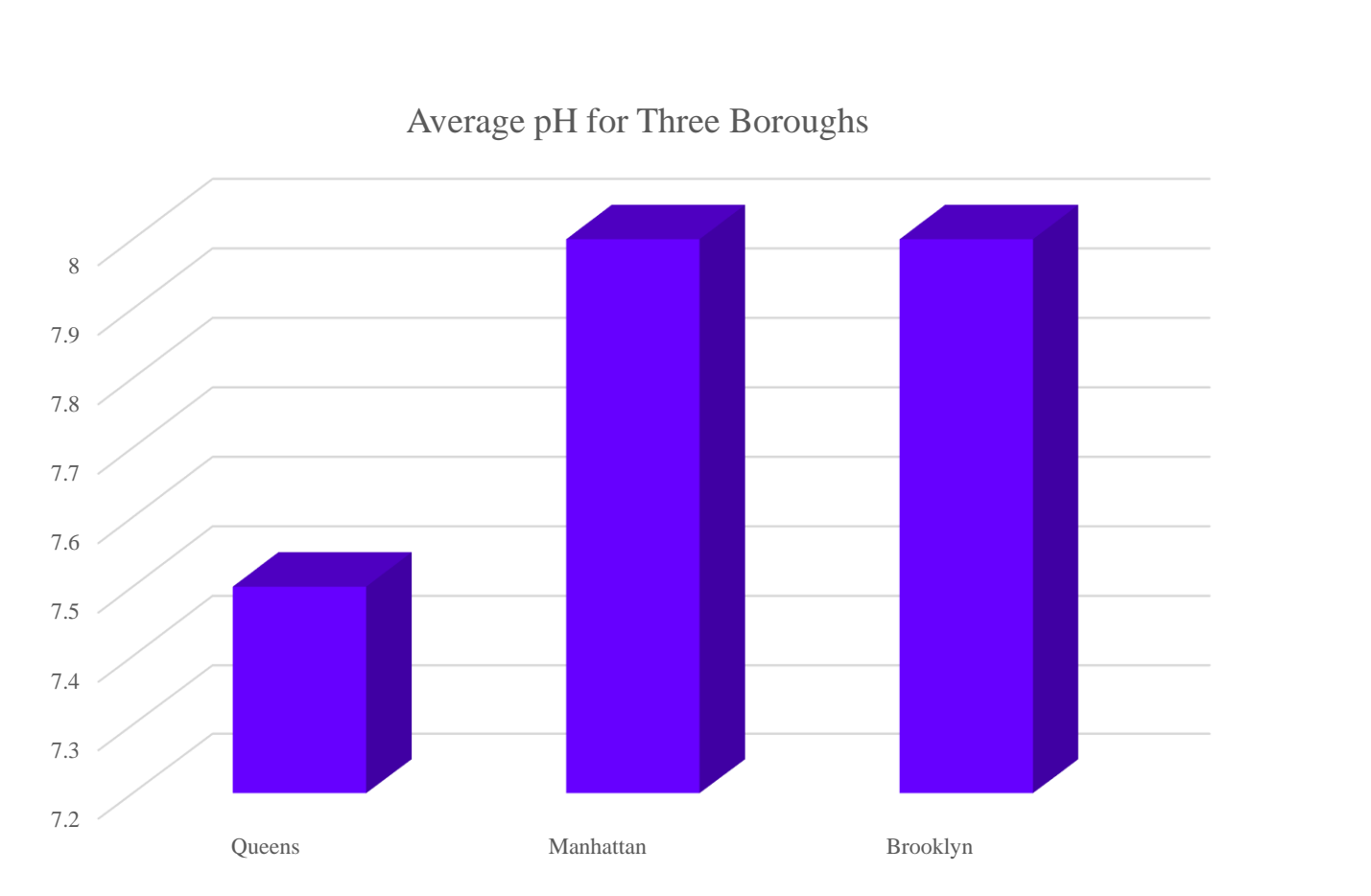
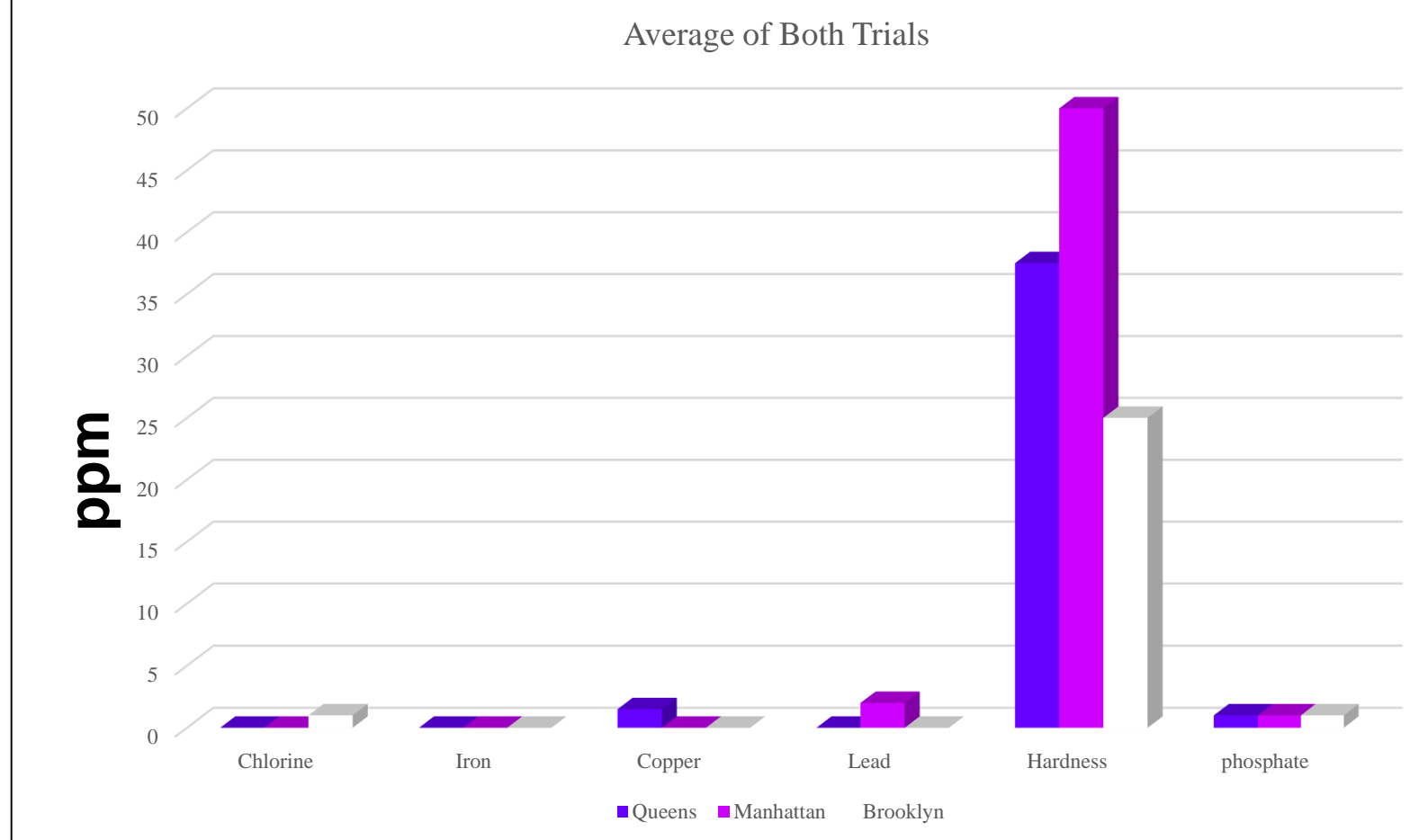


RESULTS

First experiment 11/16/2017					Second experiment 11/20/2017				
Factors	3 Boroughs (experimental group)			Distilled water (control group)	Factors	3 Boroughs (experimental group)			Distilled water (control group)
	Queens	Manhattan	Brooklyn			Queens	Manhattan	Brooklyn	
chlorine	0ppm/clear	0ppm/clear	1ppm/light pink	0ppm	0ppm/clear	0ppm/clear	1ppm/light pink	0ppm	
Iron	0ppm/clear	0ppm/clear	0ppm/clear	0ppm	0ppm/clear	0ppm/clear	0ppm/clear	0ppm	
Copper	1.5ppm/dark brown	0ppm/light orange	0ppm/light orange	0ppm	1.5ppm/dark brown	0ppm/light orange	0ppm/light orange	0ppm	
pH	7 with the pH tab/light green, 7.5 with the paper test	8/dark green	8/dark green	7/light green	8 with the pH tab/dark green, 7.5 with the paper test	8/dark green	8/dark green	7/light green	
Hardness	25ppm/dark green	50ppm/brown	25ppm/Green	no hardness	50ppm/brown	50ppm/brown	25ppm/Green	no hardness	
Phosphate	1000ppb	1000ppb	1000ppb	0ppb	1000ppb	1000ppb	1000ppb	0ppb	
Coliform bacteria	no bubble	no bubble	no bubble	no bubble	no bubble	no bubble	no bubble	no bubble	
Lead	0mg	2mg	0mg	0mg	0mg	2mg	0mg	0mg	

Table 1. Results for the first trial

Table 2. Results for second trial



Graph 1. Comparing the different results between three boroughs for chlorine Iron, copper, Lead, phosphate, and Hardness in ppm. (Notes: for phosphate, 1000ppb=1ppm, for lead, 1mg/L=1ppm)

Graph 2. Comparing the different results between three boroughs for pH

Parameters	Chlorine	Iron	Copper	pH	Hardness	phosphate	Coliform bacteria	lead
EPA Standard	0.75ppm	0.1ppm	0.3-0.6ppm	7-9.1	0-60 ppm (Soft) 60-120 ppm (Medium) 120-180 ppm (Hard)	3 mg/L	0	0

Table 3: Different parameters with EPA standard

Factors	Distilled water	Queens			Manhattan			Brooklyn		
		low	Normal	High	low	Normal	High	low	Normal	High
chlorine	0 ppm		✓			✓			✓	
Iron	0 ppm			✓		✓			✓	
Copper	0 ppm			✓		✓			✓	
pH	7			✓		✓			✓	
Hardness	50 ppm			✓		✓			✓	
Phosphate	500 ppb			✓		✓			✓	
Coliform bacteria	0			✓		✓			✓	
Lead	0			✓			✓			✓

Table 4. Overall Summary: comparing the results with three boroughs

DISCUSSION

- **Chlorine test:** Queens and Manhattan water samples contain 0 ppm of chlorine, while Brooklyn water samples contain 1 ppm.
- **Phosphate test:** the phosphate level of all three boroughs reaches to 1000 ppb (1000 ppb = 1 ppm), which is within the acceptable range of EPA standard.
- **Hardness test:** hardness is a measure of amounts of calcium and magnesium in water; In our case, the hardness level of all three boroughs is in the range of 25 ppm to 50 ppm, which is relatively soft.
- **Iron and copper test:** all three boroughs have the normal level of iron, Brooklyn and Manhattan both have ideal level of copper, however, Queens contains 1.5 ppm of copper, which is 0.2 ppm higher than the EPA acceptable level.
- **pH test:** pH is a measure of how acidic or basic the water is, all three boroughs have the normal pH range which is between 7.0-9.1.
- **Coliform test:** the presence of coliform bacteria may indicate that our drinking water has risks of causing disease. In both trials, we did not see any bubble appear, so there is no coliform bacteria existed in NYC water supply system.
- **Lead test:** Manhattan water sample contains excessive level of lead

CONCLUSIONS AND FUTURE STUDY

- Overall, we can conclude:
- Brooklyn has the best water quality and safety compared to the two other boroughs since all eight measured parameters were in the normal range;
 - Queens water sample has relatively low level of chlorine and slightly high level of copper; Manhattan has the poorest water safety since it has the excessive lead level which is harmful to health.

Therefore, we suggest that EPA should monitor the drinking water in Manhattan frequently in order to make sure the levels of lead meet EPA's standard. More samples should be collected from old houses in Manhattan to make sure drinking water is lead free at this area.

REFERENCES

United States Environmental Protection Agency. January 19, 2017. <https://www.epa.gov/dwstandardsregulations/secondarydrinking-water-standards-guidance-nuisance-chemicals>. EPA chlorine level in drinking water: <http://www.waterandhealth.org/chlorine-in-tap-water-is-safe-to-drink/> Laskey, Jen. "The Health Benefits of Water". February 16,2015, <https://www.everydayhealth.com/water-health/water-body-health.aspx>

ACKNOWLEDGMENTS

The completion of this study could not have been possible without the helps from professor Maria Entezari. This work was supported by PSCUNY award## 67489-00 47 granted to Dr. Maria Entezari and NIH Bridges award#