Northeastern University
College of Engineering

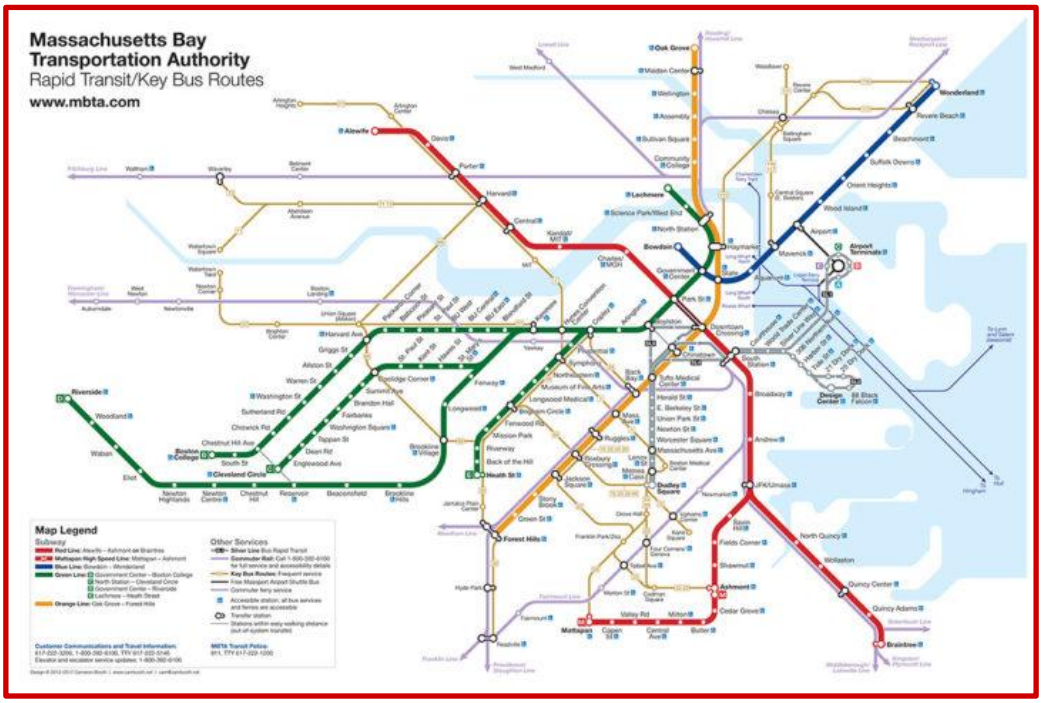
Weekly STEM Newsletter - Week 31 (MARCH 15 - MARCH 22, 2021)

The MBTA!

Introduction

I'm sure you've heard about the MBTA - the bus, train, and ferry that can take you to different parts of the city through red, orange, green, and blue lines. But did you know that Boston is the birthplace of public transit in America? To fully grasp what that means, here's a brief history of the MBTA. When people first immigrated to Boston in the 1600s, the Ferry was the main way to get around. In the 1700s, people started using the Stagecoach, a four-wheeled vehicle that was pulled by horses, as well as the Omnibus, a larger stagecoach that had multiple stops on predetermined routes. Between 1850 and 1880, Boston had the first horsecar on rails. During 1887, the horsecar had spread to more than 20 companies, providing this service all around Boston (8 thousand horses were needed!). Cable car lines, inspired by Washington D.C., were introduced in the 1880s. These cars could move without the need for horses! After that, the 1890s had the creation of BERy, Boston Elevated Railway Company, a streetcar and rapid transit railroad. It became Boston's primary mass transit provider. North America's first subway tunnel also opened in the 1890s in Boston known as the Tremont Street subway. It connects the Government Center, Park Street, and Boylston stations (it's still in use today!). Unfortunately, BERy faced financial struggles in the early 1900s, so the General Court of Massachusetts passed the Public Control Act which set fares to cover the costs of the public transit and increased taxes for the towns that were served by BERy. Then in 1947, the MTA was formed (Metropolitan Transit Authority) to absorb BERy. As time passed by, Boston grew and grew, and so did the number of people using the MTA. After urban planners, community leaders, and legislators conducted a study on the transit needs of Massachusetts, they decided to integrate the existing railroads of greater Boston into one system: The Massachusetts Bay Transportation Authority (the MBTA!). Now, the MBTA is the "largest public transit system in the country, serving nearly 200 cities and towns and over 1 million daily riders on the subway, bus, ferry, and Commuter Rail".

Due to COVID-19 changes to service and operations have been made to protect the health and safety of those who rely on public transit. As of recent the following changes have been made - all riders and employees must wear face coverings while riding the T, bus operators have the option to bypass a stop if they think the bus is too crowded to safely accommodate more riders, and MBTA buses, subways and commuter rails are cleaned periodically for safety health measures. There are various projects being completed across the city that will enhance the experience of MBTA users. For example, the Silver Line is being extended into Everett and beyond to provide more access to job opportunities and resources in the greater Boston area since more people are commuting due to COVID-19. Likewise, the Green Line D track and signal are being replaced to improve reliability and the overall quality of service of the Green Line. Lastly, as part of an $8 billion, 5-year program, the red line is gradually being rebuilt with new red line vehicles, signal upgrades, and a new test track. It's important to stay knowledgeable on MBTA projects if you use public transportation and to see how construction may impact your travel time.

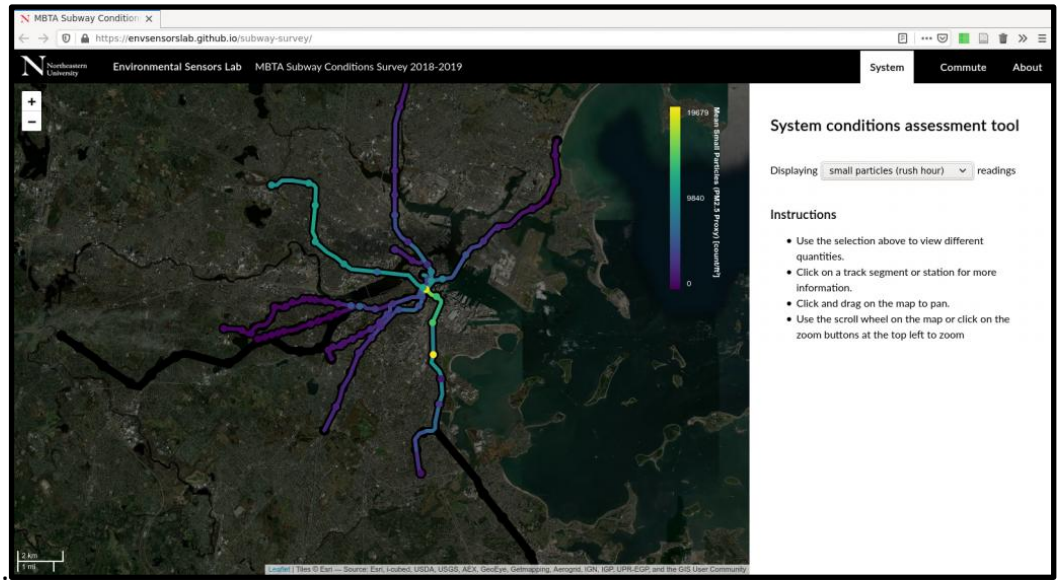


Northeastern Connections

Faculty Connection

Every day, thousands of people including Northeastern students and staff commute to, from, and around campus using the MBTA system. To better understand the conditions that these commuters experience on a daily basis, Northeastern's Environmental Sensors Lab conducted a

snapshot survey with hundreds of hours ridden on the T. Conducted in mid-2018 and late 2019, this experiment sought to see the conditional differences between the routes and whether or not there was a correlation between certain conditions. The team collected data from most of the MBTA Subway lines and focused on particle matter, noise, temperature, humidity, lightness, and vibration levels. They had two trials - the first collecting data on all the components above and the second focusing on particle matter during rush hour and less busy times. This data is linked to a map with the corresponding routes and can be viewed here as shown in the image below.



Student Connection

At Northeastern University, the College of Engineering has several student-run clubs and organizations, including the Northeastern University Institute of Transportation Engineers (NUITE). The goal of NUITE is to help students interact with a larger engineering community in order to have a better understanding of transportation systems engineering.

Northeastern's chapter of the Institute of Transportation Engineers organizes events such as seminars, conferences, and field trips that take advantage of the resources offered at Northeastern as well as in Boston. This organization aims to give its members interactions with ongoing research and projects locally and nationally.

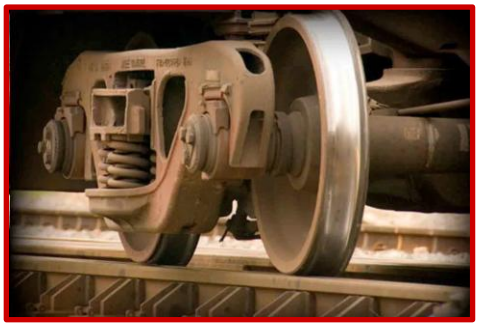
As seen in the picture above, members of NUITE have gone to Boston Logan Airport to see how the runway was being rehabilitated as planes took off and landed. They have also taken tours of the Massachusetts Bay Transportation Authority (MBTA) and historic bike paths.

Do Now

Now that you have an understanding of how civil engineers developed the MBTA, what other skills do you think a civil engineer needs? Outside of the day-to-day complicated equations and formulas, there are a variety of other necessary skills. Civil engineers are incredibly creative and must have adequate written and oral communication skills. Engineers generally must be well-rounded thinkers in order to be able to think outside of the box.

In this Do Now, write a poem about the Massachusetts Bay Transportation Authority (MBTA). This poem can be of any style you would like (haiku, rhyme, sonnet, etc.). In fact, did you know that the name for Charlie Cards was inspired by the song "Charlie on the MTA"? It was written in 1949 as a campaign song for Mayoral candidate Walter A. O'Brien, Jr. about a man called Charlie who got stuck on an endless train ride. Do any extra research on the MBTA if needed to help you write your poem! You can also check out this other song for some inspiration: The MBTA Song.

Activity

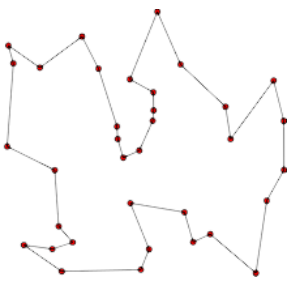


Have you ever thought about train wheels? If you look at the picture, they seem to look exactly as expected, but how do they stay on track if not bound to it? For this activity, you're going to try mimicking different possible shapes for the wheels and even rolling them to mimic the behavior of wheels on a train track.

Materials Needed:

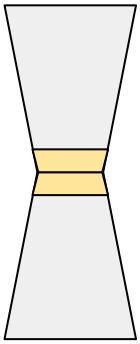
You can use any materials you want but here are some suggestions:

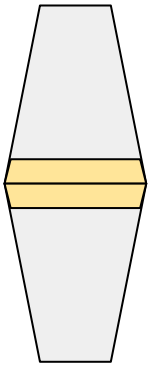
- At least four disposable cups of the same size (plastic, paper, or styrofoam works)
- Two long rulers or yardsticks of the same length
- Tape
- Shoebox (or box of a similar size) or a stack of books

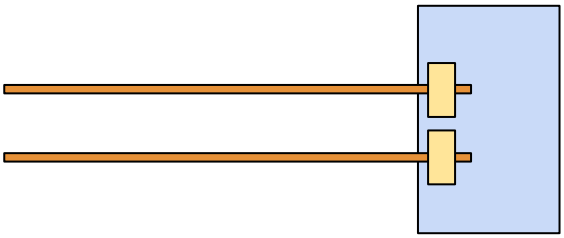


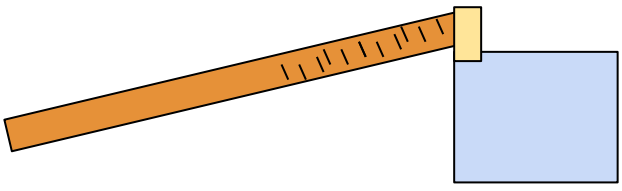
Steps:

- You're going to have to find a flat workplace to do this activity. You will need to find a place you can stick some of your items to (an uncarpeted floor or table should do it)
- Tape two cups from their base, then tape two different cups around their tops as seen on the diagrams on the right.
- Set up your area. You should tape your rulers vertically on your box (or stack of books) around 5 inches apart (or at a width that is smaller than the height of the cups that are stuck together. You should have an incline. Refer to the diagram below.
- Place one of your cups at the top and release it and watch it go down the incline
- Try this with your other cup (different shape)
- Repeat this several times for both cups
- Now try doing this again but place your cups off-center. Place it a bit more to the right then try placing it a little more to the left. Repeat this several times and try it with both shapes.
- You can find video instructions here for this activity. (Click here for the source of the activity)



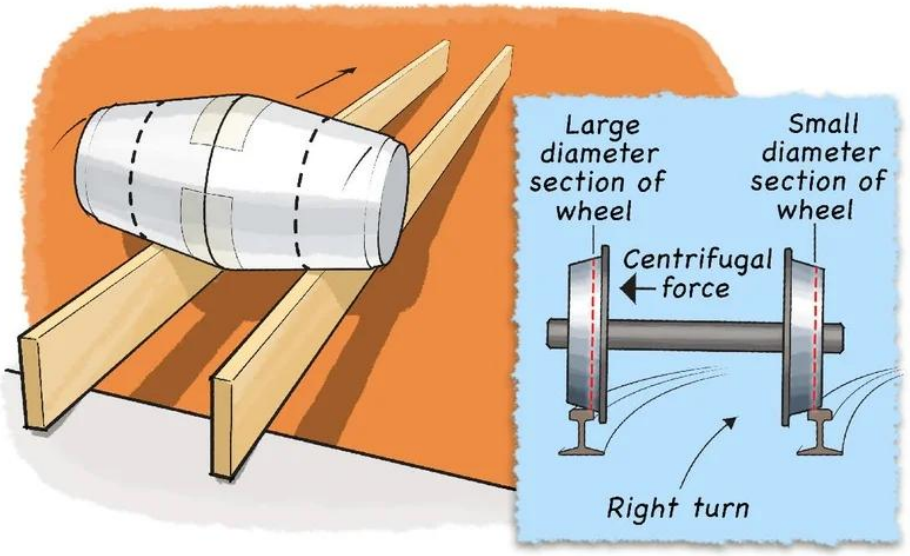






Discussion Questions:

- What were the results of the activity? What did you observe?
- Which shape works better as wheels?
- Study the diagram below. What is centrifugal force?



Share Your Results

We'd love to know how the activity and/or the "do now" turned out! What worked and what didn't work? Please share with us something you learned and/or send us pictures! Email us at stem@northeastern.edu.

Related links/Extensions

- MBTA - Massachusetts Bay Transportation Authority
- The History of the T
- Understanding Environmental Conditions in the MBTA – Northeastern Environmental Sensors Lab
- MBTA Subway Conditions Survey 2018-2019