Northeastern University
College of Engineering

Weekly STEM Newsletter 7 (May 1 - May 8, 2020)

Transportation Engineering

Introduction

When you think of transportation, you might picture taking the bus to school every morning or taking a drive in the family car. However, transportation is not only about cars but involves all types of transportation including planes, trucks, boats, trains, and much more. Transportation engineers are responsible for making sure each and every one of these can make it to their destination safely, quickly, and efficiently. Transportation engineering is a branch of civil engineering and tied closely to urban planning. Transportation engineers do not design and build vehicles - this is done by mechanical and electrical engineers. Instead, transportation engineers are responsible for planning and designing highways, roadways, airports, waterways, and pedestrian walkways - all the various paths and systems vehicles travel upon.

Go Boston 2030 is the City of Boston's comprehensive transportation plan for the future - how the city is improving transportation in the city to better meet the needs of its residents. As part of this initiative, the Boston Transportation Department released an interesting article titled "Boston Today" - which visualizes Boston's transportation system.

Northeastern Connections

At Northeastern, transportation engineering is offered in the College of Engineering as a concentration in civil engineering. That is, the students' take the required civil engineering curriculum, but choose to take transportation related technical electives and participate in the transportation capstone class.

Daniel Dulaski, a civil engineering professor at Northeastern whose research focuses on transportation safety and the influences of human factors in transportation design, is the

advisor for the senior transportation engineering capstone course. As part of the capstone course, he has helped students design innovative transportation solutions. For example, students in past years were tasked with finding a way to reduce pedestrian congestion in Boston's North End, which is caused by seasonal patterns. That is, at certain times during the year, more pedestrians tend to use sidewalks, causing them to become overcrowded. The students' solution was a portable sidewalk that could be placed easily during busy seasons, decongesting walkways for pedestrians. The portable sidewalk could then be removed when they are no longer needed. This year's transportation engineering capstone project posters can be found here.

Northeastern University also has transportation engineering clubs that students can participate in, such as NU American Society of Civil Engineers, NU Institute of Transportation Engineers, and Students for the Exploration and Development of Space. There are also clubs that focus on making vehicles, such as Paradigm Hyperloop, Baja SAE, and Concrete Canoe.

Do Now

Transportation engineering is, despite already being a subsection of civil engineering, itself quite a broad field of study. Transportation engineers do a huge variety of things. One such thing is designing streets to be safer for everyone - drivers, pedestrians, bicyclists, and even animals. In the process of designing streets, transportation engineers draw cross-sections of their streets to see how each aspect of their system works together. One tool in their arsenal is Streetmix, a free, online, street design tool that allows users to design their own streets, selecting a road width and adding or removing everything from light rail to wayfinding signs, adjusting the size of each feature to meet their specifications. This tool is great for preliminary design sketches of roadways and starting conversations about how we use our streets and how we can improve them. For this Do Now, there is no specific task: just try out this tool and play around. What is the coolest looking street you can design? Widest? Smallest? Biker-friendliest? Here's my street design: https://streetmix.net/-/1142913

Activity

These days, there are many, many ways for humans to move around. We can transport ourselves in cars and airplanes, perhaps to go to work or to go on vacation. But we can also transport goods or merchandise - sometimes known as cargo. We have created various ways of

transporting people and goods, for a variety of reasons, each specialized for a purpose.
These methods of transportation can be organized into four major categories:
1. *Ground transportation*: Includes any transportation method wherein the person or cargo is traveling on, under, or through the ground.
2. *Water Transportation*: similar to ground transportation, but instead is moving on, under, or through water.
3. *Air Transportation*: transportation through the atmosphere. The vehicle might start or end on the ground (to take on passengers for example), but is primarily in the air, minimizing the amount of time spent directly on the surface of the Earth.
4. *Space Transportation*: an up and coming transportation method, wherein the vehicle leaves the Earth's atmosphere and travels into space (as defined by the Kármán line).

For today's activity, we will be examining the history of transportation. But before we dive in though, as a challenge, try to write down as many different types of transportation as you can. We've compiled our own list (at the end of the newsletter) if you need some help: we really stretched our minds and were able to come up with 60 different types! How many can you get?

For our activity, we will be creating a transportation timeline - i.e. a historical timeline of when various transportation methods were discovered or invented. There are 2 different ways to play:
1. Using a 1-page (front/back) handout and write out your guesses (print and/or type in). This is a bit more difficult, as you have specific dates to work with and fill in.
(Activity and Answer Key)
2. Re-arraign a timeline, either by printing (uses a LOT of ink) or re-arraigning powerpoint slides. This is a bit easier, as there are no dates; you are just organizing them by when they were made.
(Activity and Answer Key)

Try your best! It is absolutely not easy - as many things were discovered at around the same time and you've probably never learned these things in school (or ever heard of some of these transportation methods). When you finish - think about what was most surprising? What did you get completely wrong? Why?

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 of your streetmix, your list of transportation methods, or your transportation timeline. Or instead -

draw a future transportation method - one that you've invented or thought of! Email us at stem@northeastern.edu.

Related links/Extensions

Water Transportation:

- Smithsonian's Interactive look at 50 largest shipping ports
- TED talk on the shipping industry
- 25 Mind Blowing Facts about the Shipping Industry
- Megastructures: China's Biggest Port (bit dated, but informative)
- Interview w/ a Shipping Industry Expert (also a bit dated, but informative)
- 30 Days Timelapse at Sea

Ground Transportation:

- Hyperloop Explained
- Boston: Vision Zero (Road Safety Project Map)
- 100 Years on the Lincoln Highway
- Transportation Video Games:
    - I Love Traffic (free)
    - Freeways ($4)
    - Mini Metro ($10)
- Boston Bike Pathway Map
- Walkability Score of your Neighborhood
- List of different types of highway interchanges (there's a LOT)

Air Transportation:

- Paper Airplane design activity
- How Air Traffic Control Works
- Inside Europe's Busiest ATC Center

COVID-19 Impacts on Transportation:

- How city transportation officials are responding
- Impact on commercial transportation

Our List of Types of Transportation:

Water Transportation (20): tugboat, fishing boat, dredger, fireship, crane ship, LNG tanker, oil tanker, bulk carrier, container ship, FPSO, cruise ship, research ship, ferry, hospital ship, military ship (aircraft carrier, destroyer, etc.), canoe, sailboat, liferaft, Venetian Gondola, speedboat

Ground Transportation (20): tram, subway, freight train, bus, moped, walking, biking, motorcycle, tanker truck, semi-trailer/truck, tractor, crawler transporter, wheelchair, hyperloop, hovercraft, skiing/snowboarding, skilift, snowmobile, bagger 288, pipeline

Air Transportation (17): fighter jet, helicopter, paraglider, parachute, blimp, cargo airplane (like the Beluga), commercial airplane (like Airbus A380), hot air balloon, general aviation (like Cessna 172), quadcopter, UAV (like MQ-9), missile (like AIM-9), shuttle carrier, ornithopter, ekranoplan, glider, gyrocopter

Space Transportation (3): spaceplane, ICBMs, launch vehicle (aka rocket, like the Saturn V)