U.S. Department
of Transportation
Federal Railroad
Administration

Office of Research,
Development and Technology
Washington, DC 20590

Expanding Summer Youth Programs in Rail Through Virtual Learning and a National Campus Network – Phase III and Final Report

DOT/FRA/ORD-26/16

Final Report | August 2026

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
19 Aug. 2026	Technical Report	*08/2023-07/2024*

4. TITLE AND SUBTITLE

Expanding Summer Youth Programs in Rail Through Virtual Learning and a National Campus Network – Phase III and Final Report

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Pasi T. Lautala, https://orcid.org/0000-0001-5552-5590,
David Nelson, https://orcid.org/0000-0002-5082-6340
C. Tyler Dick, https://orcid.org/0000-0002-2527-1320
Bryan Schlake, https://orcid.org/0000-0002-6497-6833
Faeze Ghoshani, https://orcid.org/0000-0002-8972-6072

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931

8. PERFORMING ORGANIZATION REPORT NUMBER

If Any

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Department of Transportation
Federal Railroad Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
DOT/FRA/ORD-26/16

12. DISTRIBUTION/AVAILABILITY STATEMENT
This document is available to the public through the FRA website.

13. SUPPLEMENTARY NOTES
COR: Jason Wornoff, Ph.D.

14. ABSTRACT
FRA supported Michigan Technological University (Michigan Tech), in collaboration with Pennsylvania State University Altoona (Penn State Altoona) and the University of Illinois, Urbana-Champaign (UIUC), to establish Tracks to the Future: Railroad Transportation and Engineering, a summer program for high school students. Phase I of this program was offered in the summer of 2022 at Michigan Tech, Penn State Altoona, and UIUC. In Phase II (2023), the program expanded to three additional universities: University of South Carolina, University of New Mexico and California State University, Cal State Fresno. In Phase III the program added four more universities: University of District Columbia, University of Nebraska – Lincoln, North Dakota State University and Oregon State University. All cohorts used a hybrid format where students first spent two days participating in live remote sessions via Zoom and completing hands-on activities mailed to them prior to program start. Students then traveled to one of the host campuses for two days of on-campus activities and field visits. FRA funded the course development, the program fees for the students (including meals and housing), and field visit expenses at the host site. Rail industry companies provided limited travel support for students in need to reach the host site. The program reached over 300 registered students from 26 states over the three years studied. Pre- and post-program assessments showed an increase in student knowledge of railway topics, and the engineering belongingness surveys also showed the positive impact created by the program. With proper support, Tracks to the Future can continue to provide important outreach and education for pre-college students interested in rail.

15. SUBJECT TERMS
Railway engineering education, workforce development, online education, hybrid education

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE		66	19b. TELEPHONE NUMBER *(Include area code)*

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Acknowledgements

The research team thanks the industry sponsors who supported student travel, as well as all industry companies that hosted the various student groups for field visits. Hosts for field visits (all phases):

- Allegheny Portage Railroad Museum
- Amtrak
- B&O Railroad Museum
- BNSF Hobson Railyard
- California High Speed Rail Authority
- Canton Railroad
- Eagle Mine
- East Broad Top Railroad
- Escanaba & Lake Superior Railroad
- Knife River Corporation Railroad
- Lake Superior & Ishpeming Railroad
- Mineral Range Railroad
- Monticello Railway Museum
- Nebraska Department of Transportation
- Norfolk Southern Railway
- Pettibone
- Portland Bulk Terminal
- Railroaders Memorial Museum
- Rockhill Trolley Museum
- Sandia Peak Tramway
- South Carolina Railroad Museum

Industry companies/agencies sponsoring student travel:

- BNSF
- CN Railway
- ENSCO, Inc.
- GATX Corporation
- Genesee and Wyoming
- Hanson Professional Services, Inc.
- HDR
- Rail Pros
- SW Bridge Engineers, LLC
- Union Pacific Railroad
- Via Rail Engineering

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Executive Summary

FRA supported Michigan Technological University (Michigan Tech), in collaboration with Pennsylvania State University Altoona (Penn State Altoona) and the University of Illinois, Urbana-Champaign (UIUC), to establish a *Tracks to the Future: Railroad Transportation and Engineering* summer program for high school students. Phase I of this program was offered in the summer of 2022 at Michigan Tech, Penn State Altoona, and UIUC (Lautala et al., 2024). In Phase II (2023), the program expanded to three additional universities: University of South Carolina (USC), University of New Mexico (UNM) and California State University, Fresno (Cal State Fresno) (Lautala et al., pending). In Phase III (2024) the program added four more universities: University of District Columbia (UDC), University of Nebraska – Lincoln (UNL), North Dakota State University (NDSU) and Oregon State University (OSU).

All cohorts used a hybrid format where students first spent two days participating in live remote sessions via Zoom and completing hands-on activities mailed to them prior to program start. Students then traveled to one of the host campuses midweek for two days of on-campus activities and field visits. FRA funded the course development, the program fees for the students (including meals and housing), and field visit expenses at the host site. Rail industry companies provided limited travel support for students in need to reach the host site.

The program reached over 300 registered students from 26 states over the three years studied. The increasing number of host universities (3 in 2022 vs. 10 in 2024) provided an increase in annual student numbers, although participation in 2024 was approximately the same as in 2023. The majority of the students were rising high school juniors or seniors, with the rest comprised of rising freshman and sophomores.

As remote considerations during the COVID pandemic have become less important, researchers found the appetite for hybrid K-12 summer programs has waned, possibly explaining the lack of increase in Phase III participation numbers. Although feedback from students and parents was positive in all three years for the hybrid home-study portions, researchers recommend replacing the hybrid format with a full week on-campus experience. The hybrid materials may be repurposed as on-campus activities and/or used in shorter, home-based programs during the school year. These can even be extended from the typical high school student audience to younger stakeholders, such as middle school students.

Pre- and post-program assessments showed an increase in student knowledge of railway topics, and the engineering belongingness surveys also showed the positive impact created by the program.

Programs like Tracks to the Future allow students who are interested in rail transportation to further explore their interest. This program also allows those with limited but established curiosity on rail topics to validate their interest in a meaningful learning environment. With proper support, Tracks to the Future can continue to provide important outreach and education for pre-college students interested in rail.

1. Introduction

The Federal Railroad Administration (FRA) supported Michigan Technological University (Michigan Tech), in collaboration with Pennsylvania State University Altoona (Penn State Altoona) and the University of Illinois, Urbana-Champaign (UIUC), to establish Tracks to the Future: Railroad Transportation and Engineering, a summer program for high school students (Lautala et al, 2024). Phase II expanded the program to three additional universities: University of South Carolina (USC), University of New Mexico (UNM) and California State University, Fresno (Cal State Fresno) (Lautala et al., pending). In Phase III (2024) the program added four more universities: University of District Columbia (UDC), University of Nebraska – Lincoln (UNL), North Dakota State University (NDSU) and Oregon State University (OSU). All cohorts used a hybrid format where students first spent two days participating in live remote sessions via Zoom and completing hands-on activities mailed to them prior to program start. Students then traveled to one of the host campuses midweek for two days of on-campus activities and field visits. FRA funded the course development, the program fees for the students (including meals and housing), and field visit expenses at the host site. Rail industry companies provided limited travel support for students in need to reach the host site.

Although the team received a total of 168 applications, there were 19 duplicates, and 28 students withdrew their applications. A total of 122 students completed at least some portion of the program in Phase III.

1.1 Background

The rail industry has long acknowledged the challenge of replacing personnel approaching retirement age with new hires, many from college rail programs. Since students often arrive at universities and colleges with a predefined career in mind, it is critical for the rail industry to develop a pre-college program with a nationwide focus that can introduce students to the modern side of the industry, including critical safety aspects and the many high-tech applications and jobs available. Tracks to the Future can engage students before they determine their college careers and stimulate student interest in the rail industry.

Most pre-college experiences in railroading are focused on rail history and are sponsored by railroad museums or scenic railroads. There may be nationwide interest in rail transportation among students, but it is challenging to attract large groups of participants that share a specific geographic location. A nationwide university network that supports a hybrid program with combined virtual learning on rail transportation and site-specific campus visit for activities and field trips would be the most efficient approach to expand the reach of these pre-college rail industry programs.

1.2 Objectives

In Phase III, the team enhanced the program content by incorporating expertise and activities from other primary universities in the project (e.g., Penn State and UIUC). Phase III expanded the Phase II program from six universities to ten locations, increasing available seats to 200. As in 2022, researchers again tweaked the curriculum based on the lessons learned in the first two phases.

1.1 Overall Approach

The team took advantage of the diverse expertise of project leaders and developed a unified curriculum that introduced students to a variety of topics related to rail transportation and engineering. Researchers again used the Canvas learning management system and Zoom webinars as the main methods of delivery for the synchronous online portion of the program. A variety of instructional methods were used, including videos, team assignments, Kahoot! competitions to keep the online portion interesting, and a materials package mailed to all hybrid students for tabletop activities. The on-campus portion of the program included hands-on activities and competitions designed specifically for this program and included field visits to rail industry facilities. The team scaled up the program each year and minimized the amount of development needed at participating universities.

1.3 Scope

In Phase III, the team added four more hosts universities, training the new personnel to deliver the curriculum, and improved the registration and logistics process to smooth program operations. The team also changed some of the contractual structure to simplify the administration of the program. Researchers also expanded attempts to recruit industry participation and support for student travel, and were able to meet all identified travel needs.

1.4 Organization of the Report

This report briefly summarizes the preparations for, implementation of, and lessons learned from Phase III of the Tracks to the Future program. Section 2 presents the marketing efforts used to attract students to the program. Section 3 provides the demographic information of the student participants and Section 4 summarizes the curriculum and educational methods. Section 5 presents skills assessment results and lessons learned from the third year of implementation. Section 6 provides conclusions for the overall program and outlines proposed changes recommended for the future.

2. Program Preparations, Marketing, and Registration

In Phase III, the team fine-tuned the marketing strategy. However, as the registration period progressed, researchers found that even expanded marketing efforts failed to provide the desired outcome of a larger group of participants. The following sections provide a summary and timeline of marketing efforts, as well as discussion on registration coordination between the host universities.

2.1 Marketing Activities and Deadlines

The research team deployed systematic marketing efforts for Phase III soon after the end of Phase II. Table 1 provides a list of marketing activities and deadlines conducted as part of the program preparations. Marketing was done through multiple media, including a website, the summer youth program units within each host university, and specific targeted rail industry and stakeholder marketing through each university's rail transportation program and industry magazines. The team synchronized the marketing efforts with other summer youth programs at the host universities as much as possible.

Table 1. Marketing Activities

Item	Dates and Notes
Michigan Tech Summer Youth Programs website	January 2024
Michigan Tech website updated	January 2024
Rail industry magazine calendars	January 2024
Marketing Flyer completed	Email to contact list January 2024
UIUC marketing (with flyers)	February 2024 – approximately 300 locations
Email to list of railroad museums and tourist railroads (with flyers)	January 2024, follow up early April 2024
Email to Michigan Tech RTP contact lists (with flyers)	Late January-early February 2024, and ongoing through March
University partners marketing (email with flyers)	Late January-early February 2024, and ongoing through March

Marketing emails containing program flyers (Figure 1) were sent to approximately 25,000 email addresses through three rail programs and to more than 30,000 prospective students through Michigan Tech summer youth programs. Other host universities also sent the information to their own mailing lists. As an added effort, several host universities directly approached high schools in the region.

Figure 1. Tracks to the Future 2024 Program Flyer

2.2 Registration and Selection Process

For Phase III, researchers continued to unify the registration process for all students as much as possible. All students were required to complete the application through a Michigan Tech

Google Form (Appendix A), regardless of the host site they chose. Students were asked to select their first, second, and third choice for the on-campus portion of the program. Researchers also asked if students could participate in Session 1, Session 2, or both, and asked if students would need financial support to travel to their campus choice.

Registration opened in January 2023 by contacting the waiting list from Phase II (including students who dropped out of the program in Phase II and students who used the early notification link on the website). General registration opened as the marketing program came online in early January.

The team received 134 applications by the preliminary deadline, and assigned all the applicants to one of their three choices. Since the PSU and UIUC cohorts were oversubscribed, some students were assigned to their second or third choice. Registration for the PSU and UIUC locations were then closed, but both locations agreed to take a few extra students.

Researchers continued to collect applications for locations that had not reached their 20-student cap, and eventually received a total of 168 applications. Eleven applications turned out to be duplicates and four students declined their initial assignment but reapplied to an open university slot. Two other students applied to locations that were filled and did not reapply for an open slot when offered. By the end of registration, a total of 159 slots were offered to students, although 41 students withdrew their applications before the start of the program. The program also was not offered at North Dakota State University when their cohort dwindled to one student.

Table 2 shows the offers and final cohorts for each location. The size of the final cohorts ranged from 5 to 25 students, although some of the students did not complete the full program.

Table 2. Seats Offered and Final Participants

University	Slots offered	Final Cohort
California State University – Fresno	20	17
Michigan Tech University	20	13
Oregon State University	8	6
Penn State University – Altoona	33	25
University of Illinois – Champaign/Urbana	28	22
University of South Carolina	12	9
University of the District of Columbia	19	15
University of New Mexico	7	6
North Dakota State University	4	0
University of Nebraska – Lincoln	8	5
Totals	159	118

3. Student Participation and Demographics

3.1 Summary of Participants

Table 3 provides a breakdown of students who confirmed their participation in the program, broken down between each cohort, grade level, gender, and minority status.

Table 3. Tracks to the Future – Phase III Student Demographics

	CA	IL	MI	PA	SC	NM	NE	OR	DC	Total
Total Students	17	22	13	25	9	6	5	6	15	118
12th Grade	6	6	4	8	2	0	2	3	3	34
11th Grade	4	3	2	5	4	2	0	3	6	29
10th Grade	5	7	3	6	3	2	2	0	3	31
9th Grade	2	6	4	1	0	2	1	0	3	19
Unknown				5						5
Gender										
Male	12	20	12	20	9	5	5	6	12	101
Female	5	2	1	3	0	1	0	0	3	15
Ethnic Background										
Caucasian	4	9	11	13	3	3	3	4	7	57
Latino	2	3	0	1	2	1	0	1	1	11
African American	1	4	0	8	2	0	1		1	17
Other Ethnic	10	5	0	3	1	2	1	1	5	28
Prefer Not To Say		1	1	0	1	0	0	0	1	4

Table 4 provides the student demographics across all three phases of the program. The total number of students doubled from Phase I to Phase II, which is consistent with the increase in host locations from three to six. However, Phase III did not attract more students, even though four more university host sites were available.

Table 4. Tracks to the Future Student Demographics 3-year Summary

	Year 1	Year 2	Year 3	Total
Total Students	66	122	118	306
12th Grade	24	41	34	99

11th Grade	31	32	29	92
10th Grade	7	27	31	65
9th Grade	3	21	19	43
Unknown			5	
Gender				
Male	62	98	101	261
Female	3	21	15	39
Ethnic Background				
Minority	23	63	60	146
Caucasian			57	
Latino			11	
African American			17	
Other Ethnic			28	
Prefer Not To Say			4	

3.1.1 Geographic distribution

Phase III of the program showed great geographic diversity, attracting students from 21 states and Canada (Table 5 and Figure 2). The highest number of participants came from California, Illinois, and New York. There were few participants from states west of the Mississippi, even after adding University of Nebraska – Lincoln, North Dakota State University, and Oregon State University as host locations. There were also very few participants from southeastern states. Future nationwide efforts might benefit from a more robust local marketing effort in the areas around campus locations.

Table 5. Student Demographics – Home State

Cohort/State Represented	Cal State-Fresno	Illinois	Mich Tech	Penn State-Altoona	South Carolina	New Mexico	Nebraska – Lincoln	Oregon State	DC	Total
AZ	1									1
CA	14						1	2		17
CO							1			1
FL					2					2
GA				1						1
IL		16	4		1	3	1	1		26
MA			1	1	1				1	4
MD				1	1	1			5	8
MI			6							6
MO		3								3
NE							1			1
NJ				2		1				3
NY	1			6				2	5	14
OH		1	1	3			1	1		7
PA				9					1	10
SC					1					1
TX	1				1	1				3
VA		1		1	2				2	6
WA								1		1
WI		1							1	2
ON-CA			1							1
TOTAL	17	22	13	24	9	6	5	7	15	118

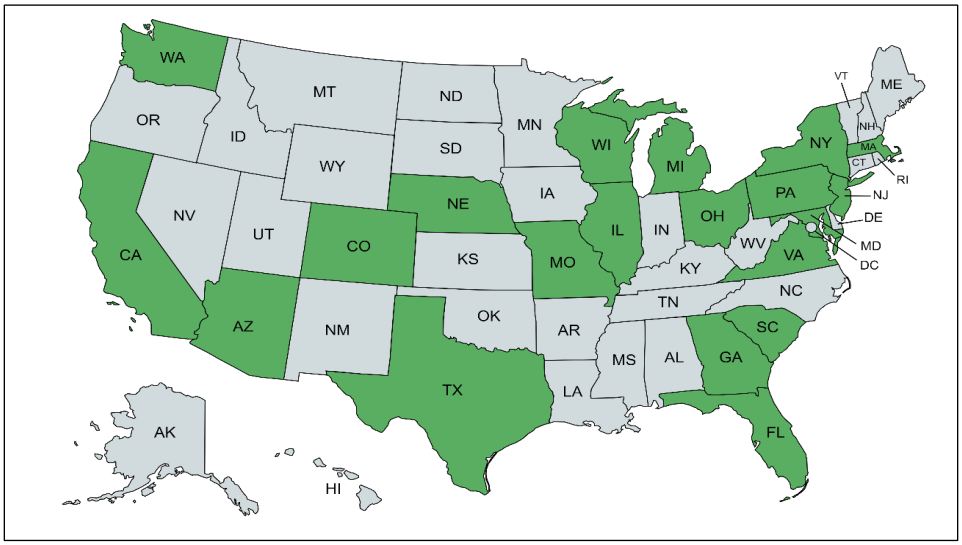

Figure 2. Phase III Student Demographics – Home Locations

Table 6 shows the demographics over all three years of the program. Most students came from Midwest and Eastern states, as well as California (in Phase II and III). Illinois had by far the strongest representation.

Table 6. Student Demographics – Home State 3-year Summary

Cohort/State Represented	Year 1	Year 2	Year 3	Total
AZ		1	1	2
CA		28	17	45
CO			1	1
CT	1			1
FL	2	1	2	5
GA	1	4	1	6
IL	21	23	26	70
IN	1			1
MA	2		4	6
MD	2	4	8	14
MI	10	6	6	22
MO		2	3	5
NC	2	2		4
NE			1	1
NJ	4	1	3	8
NM	1			1
NY	6	10	14	30
OH	1	1	7	9
PA	4	7	10	21
SC		2	1	3
TN		3		3
TX	2	3	3	8
VA	4	2	6	12
WA		4	1	5
WI	2		2	4
ON-CA			1	1
GTO-MX		1		1
TOTAL	66	105	118	289

4. Curriculum and Educational Methods

4.1 Virtual Learning – Hybrid Days 1 and 2

As in the first two phases, the hybrid sessions featured two days of synchronous virtual lessons conducted on the Zoom platform. The lesson materials were organized in Michigan Tech's Canvas learning management system (Figure 3). They included some traditional lecture material but mainly took advantage of various online tools for active learning (Menti,[1] Kahoot!,[2] and Google Sheets) and competitions to maintain student interest. The hybrid days also included hands-on activities with materials prepared by the program staff and mailed to the students ahead of class (Figure 4). A group of online internet search tasks were also used with results summarized in interactive Google Sheets. Table 7 presents the virtual activities topics, organized under four modules.

Figure 3. Tracks to the Future Home Page in Canvas

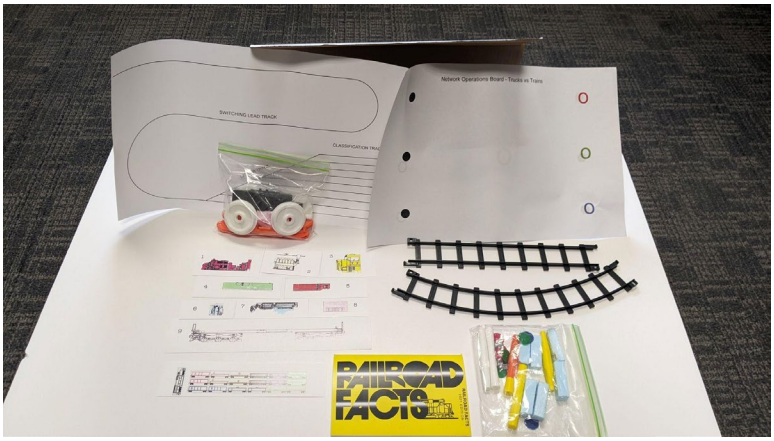

Figure 4. Contents of Mailed Activity Package

[1] Mentimeter is an online tool for creating interactive presentation content.

[2] Kahoot! is an on-line educational gaming system with instructor prepared questions. Students compete to answer questions quickly and correctly.

Table 7. Hybrid Program – Virtual Curriculum

Module	Content
Pre-course Assignments	• Pre-Knowledge Assessment • Engineering and Belongingness Pre-Survey

1. What is Rail Transportation?	• Industry Panel Discussion (T2F Travel Sponsors)
	• Intro and History of Rail
	  ○ Welcome and Rail Industry Jobs
	  ○ Transportation Modes
	  ○ Railroad History
	  ○ What is a Railroad?
	  ○ Modern Rail

2. Rolling Stock and Locomotives	• Locomotives PowerPoint
	  ○ Locomotive Puzzle Activity
	  ○ Wheel Dynamics Activity
	• Railcars PowerPoint
	  ○ Bogie Parts Activity
	• Braking and Train Energy Management PowerPoint

3. Freight Operations	• Freight Operations PowerPoint
	  ○ State-to-State Activity
	  ○ Trucks vs Trains Activity
	  ○ Yard and Terminal Scavenger Hunt Activity
	  ○ Classification Yard Sorting Game Activity

4. Passenger Rail	• Passenger Operations PowerPoint
	  ○ Let's Go for a Trip Activity
	• High Speed Rail PowerPoint
	  ○ Passenger Rail Options in Foreign Countries Activity
	  ○ HSR Corridors (China vs US)
	• Urban and Transit Rail PowerPoint
	  ○ US Commuter Rail System Activity

The hybrid curriculum included the same modules used in Phase I and II, but some activities were either dropped or modified to ensure timely completion and improve collaboration between students. The following includes brief introductions on the four modules completed as part of the hybrid portion of the program. See Appendix E for module details.

4.1.1 Module 0: Pre-Course Assignments

The opening module required student to complete two survey documents, the pre-skills knowledge assessment and the pre-belonginess survey. These documents allow team researchers to assess whether the material and activities provided in the program produce any change in student knowledge or attitude. The survey documents are included in Appendix B.

4.1.2 Module 1: What is Rail Transportation

This module introduced the rail industry. This material was presented synchronously using Zoom, PowerPoint slides, and Kahoot! competitions.

4.1.3 Module 2: Rolling Stock and Locomotives

Module 2 focused on the rail cars and locomotives used across the rail industry. The presentation included PowerPoint slides in Zoom with embedded poll questions. It also featured two hands-on activities.

4.1.4 Module 3: Freight Operations

Organizers opened the second day of the home sessions with an introduction to Freight Operations. Instructors again used PowerPoint, with Kahoot! competitions interspersed throughout the presentation, as well as several videos and individual and group activities.

4.1.5 Module 4: Passenger Operations

Module 4 was conducted in three parts: Passenger Operations, High Speed Rail, and Urban Rail Transit. Each part included a PowerPoint presentation with embedded Kahoot! competitions, and a variety of student activities.

4.2 On-Campus Activities and Field Visits – Days 4 and 5

After virtual modules were completed, students spent Wednesday traveling to their host university for two days of on-campus activities and field visits. The schedule and program content of on-campus days were determined independently by each host university, but each school was provided with instructions for various activities that could be completed on these days. The following details Michigan Tech's example of on-campus activities, broken down to three morning and afternoon modules that each included different hands-on activities. Activities at other host universities followed a similar pattern.

4.2.1 Module 5: Morning Session

Small groups (i.e., 2-3 people) completed the on-campus activities and each group rotated between the three activity sites.

Trainz Simulator

Students partnered up to accomplish the tutorials included with the Trainz 2019 locomotive simulator, then spent some time operating trains in the simulator environment (time permitting) and reflecting on lessons learned from being a locomotive engineer (Figure 5). At Michigan Tech, many of the students returned to the computer lab in the evening on their own time to explore more of the Trainz environment.

Figure 5. Trainz Simulator

Wooden Track Operations

Students used Brio track pieces and rolling stock to illustrate rail operations in a game scenario. Starting with a single track with no sidings, students ran trains between two terminals. Each completed operation earned game money that the students then used to add infrastructure, including sidings, signals, and additional track.

Track Construction

Students built a model track section, including sub-ballast, ballast, ties, and rail. They received a firsthand feel for how adding ballast around the ties stabilized the structure laterally, longitudinally, and vertically (Figure 6).

Figure 6. Track Model Construction at Michigan Tech (left) and UIUC (right)

4.2.2 Module 6: Afternoon Session

The afternoon session concluded the classroom portion of the program with another round of hands-on activities.

Train Resistance and Car Weight and Size

This activity required students to work with a model rail car and a variety of different "load" materials (Figure 7). In the first part of the activity, students varied the weight of the load and measured the force required to move the car on a steel rail system and on a mat designed to simulate a rubber tire on pavement. In the second part, students used a variety of loads with different densities to illustrate how the volume of some materials can control the capacity of a rail car while the weight of other materials controls the capacity.

Mag-Lev

Students used magnets to illustrate the attraction and repulsion created between north and south poles, then built a mag-lev car to run on an inclined track. With two tracks available at both locations, races inevitably occurred!

Intermodal Operations

Students again used Brio track pieces and rolling stock, this time to illustrate the difference between truck only and combined truck and rail operations (Figure 8). Students moved

containers from a port location to an intermodal terminal using trucks on a highway, moving one container at a time, while a competing group loaded a train with containers double stacked.

Figure 7. Car Weight and Size

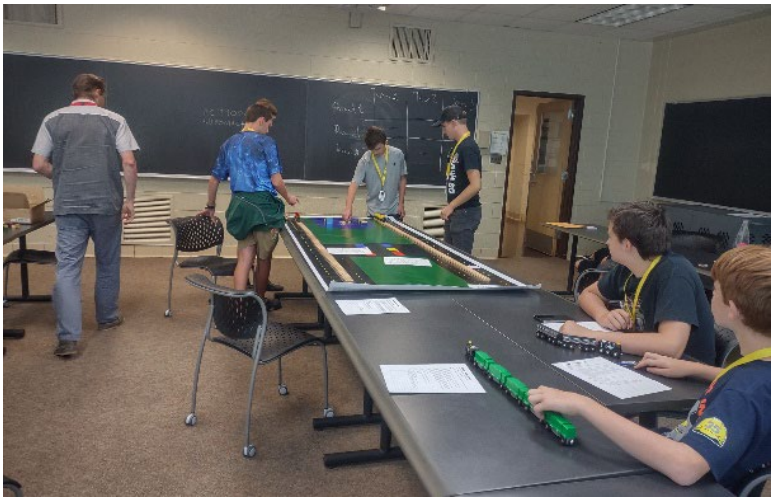

Figure 8. Intermodal Operations

4.3 Field Trips

Each university provided their own set of field trips as part of the on-campus portion of the program. The field trips by each host university are summarized below.

4.3.1 Michigan Tech

The Michigan Tech field trip started once more on Thursday evening with a bus ride from Houghton to Escanaba**.** Students spent the night in an Escanaba hotel, and then started the field trip schedule with a visit to the Escanaba and Lake Superior (E&LS) car repair shop **(**Figure 9**).** After a brief stop to see a steam locomotive housed at a CN Railway yard, the group traveled to Eagle Mills for a tour of the Lake Superior and Ishpeming (LS&I) Railroad facilities, including the car and locomotive shops, dispatch, a locomotive cab tour, and the loading area at the mine.

The group then visited the Eagle Mine Rail Copper/Nickel Concentrate Transload facility**.** Students also were able to watch the Mineral Range Railroad arrive to pick up a load of nickel and copper concentrate cars**.** The final stop on the way back to Houghton was at the Pettibone/Traverse Lift Company in Baraga for a tour of the shop with the lead design engineer for the Pettibone Speed Swing**.**

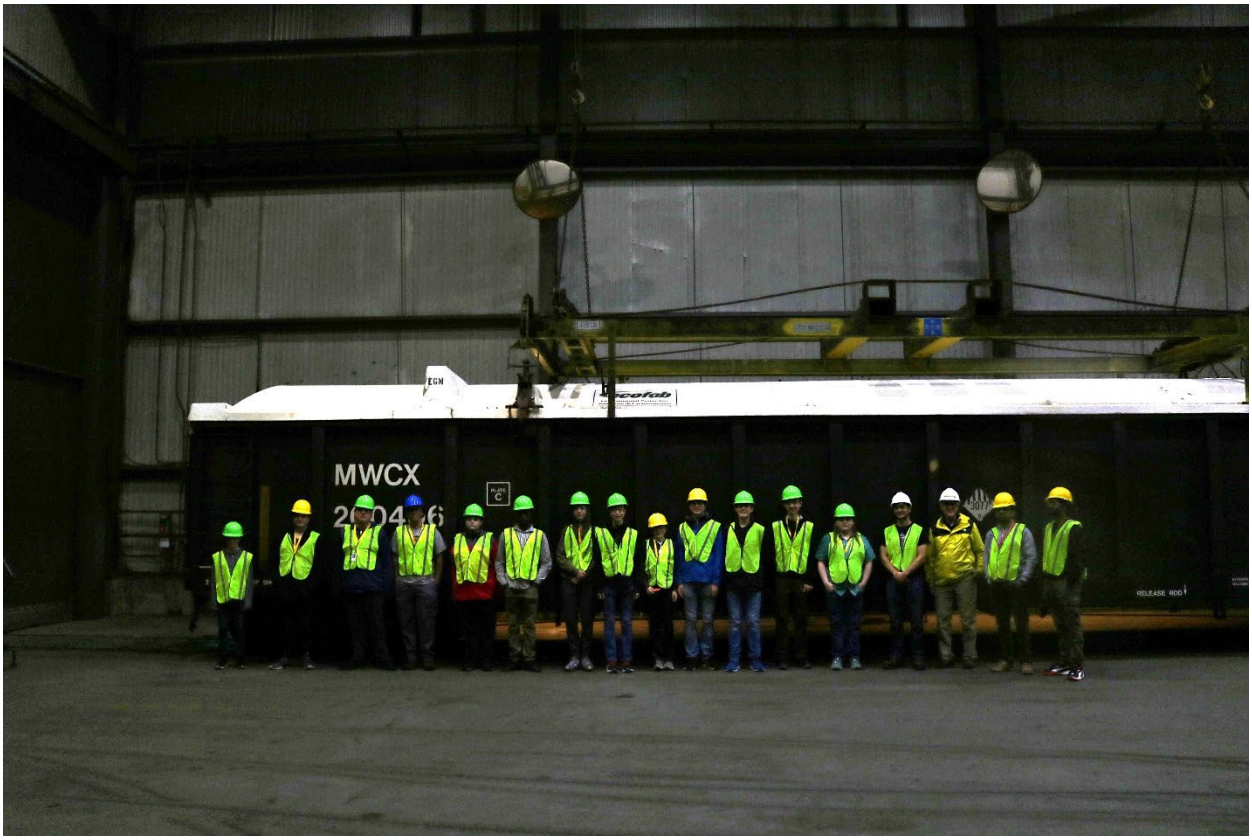

Figure 9. Michigan Tech Student Cohort at Escanaba and Lake Superior Railroad Car Shops

4.3.2 Penn State Altoona

Students came from across the US (PA, MD, NY, OH, GA, etc.) to participate in Penn State Altoona's in-person portion of the program (see Figure 10). On Wednesday afternoon, students enjoyed educational activities at the Railroaders Memorial Museum, including a tour of the PSU 2020 SD60i locomotive. On Friday, the group took field trips to the East Broad Top Railroad and Rockhill Trolley Museum where they learned about narrow gage railroad operations, steam locomotives, electrification, and aspects of railroad history.

Figure 10. Penn State Altoona Student Cohort

4.3.3 University of Illinois at Urbana-Champaign

The UIUC cohort field trip was held at the Monticello Railway Museum, located approximately 25 minutes west of campus. Students were able to tour a variety of railway facilities at this working railway museum, including rolling stock, track components, and an interlocking tower. The group were able to observe the process of building a train and ensuring the airline was complete and ready for departure, then experienced a train ride where students took turns riding in the locomotive and understanding the controls. The tour group then rode one of the museum's locomotives to the end of their branch line trackage, where the museum stores revenue service equipment for several railcar leasing firms. Near the end of the line, the students were able to observe an ongoing field experiment and even collect data from the locomotive as a "dynamic" test. The students then toured the museum grounds and enjoyed a pizza lunch near the location of a future roundhouse. The group remained enthusiastic and most importantly exhibited good railway safety awareness during the entire visit.

Figure 11. UIUC Student Cohort

4.3.4 University of South Carolina

The USC program included a field trip to the South Carolina Railroad Museum (SCRM) in Greensboro, SC. The SCRM was established in 1973 with a mission to preserve and interpret railroading in South Carolina. Program participants started the day with a hands-on experience preparing a train for departure and starting a locomotive, followed by a demonstration on configuring and operating the air-brake system of the train. The group then departed on an hour-long guided tour train ride on five miles of operating track to Rion Station. During the trip, the tour guide discussed the progress of the various restoration projects along the way while briefly introducing the history of each project. During the trip, the students had the opportunity to ride in the locomotive cab and observe the operations. At the Rion Station facility, the group attended a lecture presentation on the history of railroads in South Carolina. Upon their return, the group toured the many pieces of rolling stock donated to the museum by the Charleston chapter of the National Railway Historical Society. The equipment includes freight and passenger cars as well as a steam locomotive that once belonged to the Hampton and Branchville Railroad. The museum building exhibits a wide variety of equipment, displays, running scale model trains, and related items. At the end of the museum trip, the group returned to the USC campus and participated in a guided tour of the Swearingen Engineering Center and the Railway Infrastructure Testing Laboratories at USC.

Figure 12. University of South Carolina Student Cohort

4.3.5 California State University, Fresno

The in-person educational experience concluded with a field trip including a visit to the California High-Speed Rail Authority (CAHSRA) headquarters, formally the Union Pacific's depot in Fresno, CA. There the cohort was greeted by the Office of Communications and Outreach team, and toured three active CAHSRA construction sites: Fresno State/Underpass at Tulare St, Cedar/North Ave Viaduct, and San Joaquin River Viaduct.

Figure 13. University of California, Fresno, Student Cohort

4.3.6 University of the District of Columbia

UDC's field trip included riding the Washington Metro, visiting Amtrak at Union Station, and experiencing Amtrak trains and locomotives. Students rode an Amtrak train to Baltimore and a MARC train back to DC. In Baltimore, the cohort visited B&O Railroad Museum and Canton

Railroad, where they experienced short line operations, as well as visiting the locomotive shop to see and hear about the different power units used.

Figure 14. University of the District of Columbia Student Cohort

4.3.7 University of Nebraska – Lincoln

The University of Nebraska – Lincoln hosted a cohort of students from Illinois, Colorado, and Ohio. Day 1 on-campus activities started with a field trip to the BNSF Hobson Railyard in Lincoln, NE. The tour started with introductions and a safety briefing. Five BNSF employees shared their career paths and experiences with the students and discussed opportunities in the railroad industry, followed by Q&A. Afterward, the students visited the tower and saw how the yard operations are managed. Each staff member in the tower explained to the students their day-to-day responsibilities and demonstrated how they do their work. The tour concluded with a group photo overlooking the railyard. The students then visited the Nebraska Department of Transportation (NDOT) headquarters where they heard from the Highway Local Assistance Division Manager and Strategic Planning Division how NDOT works with short line and Class I railroads to improve safety and supply chains.

Figure 15. University of Nebraska – Lincoln Student Cohort

4.3.8 Oregon State University

Students visited the Portland Bulk Terminal and witnessed the intricacies of large-scale logistics and terminal operations. After receiving an instructive presentation from the port manager regarding train operations, students were able to observe the practical functioning of trains and visit the Bulk Cargo Terminals. The group then visited the Knife River Corporation Railroad in Salem, where they observed railroad management. Students at this facility had the opportunity to tour the train loading station located within the quarry site, which deepened their comprehension of the railway application in industry. The program included post-survey activities, which provided students with an opportunity to contemplate their experiences and collect feedback to enhance future endeavors.

Figure 16. Oregon State University Student Cohort

4.3.9 University of New Mexico

UNM students participated in building wireless sensors to measure vibrations in different transportation systems. They first measured train vibrations while traveling between Albuquerque and Santa Fe, and later applied the same technology to measure vibrations on the Sandia Peak Tramway, giving them the unique opportunity to compare data from both a railroad car and a tram car. One highlight of the visit was the use of LEWIS sensor technology on the Sandia Peak Tramway, where students measured vibrations on the "flying railroad," deepening their understanding of different modes of transportation and their environmental implications. Additionally, the students explored augmented reality applications for improving safety during field inspections. Smart Management of Infrastructure Laboratory (SMILab)[3] researchers mentored the group, introducing them to innovative research methods in science and technology.

[3] This program connects high school students with cutting-edge technologies, encouraging them to consider future careers in science and engineering at UNM.

Students were exposed to various advanced technologies, including robots, augmented and virtual reality (AR/VR), LEWIS sensor generations, drones, and the Vicon lab, demonstrating the practical applications of engineering in real-world contexts.

Figure 17. University of New Mexico student cohort

4.4 Student Assessments

Researchers assessed student knowledge improvements and changes in attitude about the rail industry during all three phases. The aggregate results of each assessment are included below.

4.4.1 Knowledge Assessment

The knowledge assessment documents remained the same for all three program phases and are included in Appendix B and Table 8. In each phase, the pre- and post-assessment form was the same, except for the introduction. Both assessments consisted of 19 questions with a variety of formats: true/false, multiple choice, and short answer. On questions where the students were asked to list as many items as they could, the team capped the scoring at 3 points each. Table 8 below shows the knowledge results for students in all three Phases. The PPI score is the percent of possible improvement and was calculated by subtracting the pre-score from the post-score and dividing the result by the difference between the pre-score and 100 percent.

Note that the team experienced problems collecting viable data in Phase II. Although nearly 80 percent of the students completed the pre-assessment, less than half completed the post-assessment. It appears that many of the students completing the post-assessment were rushed and did not complete all questions. For example, 10 of the 40 in the matched pair set scored lower on the post- than the pre-assessment, and three students who had perfect scores (e.g., named all 7 Class Is and 10 passenger systems in pre-assessment) did not name any on the post-assessment. This is reflected in the much higher range of scores during Phase II.

Overall, students showed improvement during the week, with similar results in all phases.

Table 8: Knowledge Assessment Scores

	Phase I				Phase II				Phase III			
Individual	**Pre-score**	**Post-score**	**Improvement**		**Pre-score**	**Post-score**	**Improvement**		**Pre-score**	**Post-score**	**Improvement**	
Mean Score	13.1	17.3	4.2		11.4	15.8	4.4		12.7	17	4.3	
Mean %	54.8	62.5	7.7		49.7	55.1	5.4		55.3	76.1	20.8	
Median Score	15.0	18.5	3.5		12.7	18.3	5.6		14.5	18.5	4	
Median %	62.5	80.4	17.9		61.2	79.7	18.5		63.0	80.4	17.4	
Score Range	19.0	17.0			22	22.7			21	19.33		
% Range	79.2	73.4			95.6	98.6			91.3	84		
	n=58	n-60			n=96	n=43			n=90	n=58		
Matched		**n= 58**		**PPI**		**n=40**		**PPI**		**n=49**		**PPI**
Mean Score	13.2	17.2	4.0		11.9	16	4.1		14.8	17.8	3	
Mean %	57.2	74.9	17.7	38.2	51.6	69.5	17.9	37.4	64.2	77.5	13.2	36.8
Median Score	15	18.5	3.5		13.2	18.5	5.3		15.7	18.7	3	
Median %	65.2	80.4	15.2	40	57.2	80.4	23.2	46.1	68.1	81.2	13.1	41.1
Score Range	19	17			19	22.3			16.7	19.3		
% Range	82.6	73.9			83%	97%			72.60	83.91		

4.4.2 Engineering Belongingness Survey

In Phase III, the team collected 86 pre-surveys and 59 post-surveys, from which 31 paired data sets were compiled. The results are shown in Table 9. The post scores were uniformly high with values of six or seven (Agree or Strongly Agree) in all cases except the last question, "Others ask me for help in rail transportation/engineering." None of the questions had a decrease in the median and 7 of 14 showed improvement in the paired data, while 5 out of 14 showed improvement with the full data set. A more complete examination of the results for all three phases is included in Appendix C, including mean and standard deviation values. Overall, the team saw similar trends in the responses across all three years of the program.

Table 9. Phase III Engineering Belongingness Survey

	Paired Data			Complete Dataset		
Median Values	**Post**	**Pre**	**Delta**	**Post**	**Pre**	**Delta**
A career in rail transportation/engineering will give me the kind of lifestyle I want.	7.0	6.0	1.0	6	6	0.0
A degree related to rail transportation/engineering will allow me to get a job where I can use my talents and creativity.	6.0	6.0	0.0	6	6	0.0
A degree in rail transportation/engineering will allow me to obtain a job that I like.	6.0	6.0	0.0	6	6	0.0
I can relate to people around me in this summer program.	7.0	6.0	**1.0**	6	6	0.0
I have a lot in common with the other students in this summer program.	6.0	5.0	**1.0**	6	5	**1.0**

	Paired Data			Complete Dataset		
Median Values	**Post**	**Pre**	**Delta**	**Post**	**Pre**	**Delta**
The other students in this summer program share my personal interests.	6.0	5.0	**1.0**	6	5	**1.0**
My parents see me as a rail transportation engineer.	6.0	5.0	**1.0**	6	5	**1.0**
My instructors see me as a rail transportation engineer.	6.0	5.0	**1.0**	6	4	**2.0**
My peers see me as a rail transportation engineer.	6.0	5.0	**1.0**	6	4	**2.0**
I am interested in learning more about rail transportation/engineering.	7.0	7.0	0.0	7	7	0.0
I enjoy learning rail transportation/engineering.	7.0	7.0	0.0	7	7	0.0
I find fulfillment doing rail transportation/engineering.	7.0	6.0	**1.0**	6	6	0.0
I am confident that I can understand rail transportation/engineering in this program.	6.0	6.0	0.0	6	6	0.0
I am confident that I can understand rail transportation/engineering outside of this program.	6.0	6.0	0.0	6	6	0.0
I understand concepts I have studied in rail transportation/engineering.	6.0	6.0	0.0	6	6	0.0
Others ask me for help in rail transportation/engineering.	4.0	4.0	0.0	4	4	0.0
Pre n = 86; Post n = 59; Paired n = 31 Scale 1-7 1 = Strongly Disagree 7 = Strongly Agree						

4.4.3 Program Survey and Student Feedback (Michigan Tech only)

Summer Youth Programs at Michigan Tech conducted a program survey to obtain student feedback on Tracks to the Future. The questions and related results for the Michigan Tech cohort are included in Appendix D, and in Table 10 and Table 11.

It is clear from the survey that students had a very positive experience with the program. When asked if they would recommend this course to others, 100 percent of students said yes, with most stating that it was fun. For their most memorable experiences, most students cited field trip activities, and when asked to share suggested improvements to the course, students listed either nothing or more hands-on activities.

Table 10. MTU Survey Yes/No Questions

	Was this your first summer at SYP?	Was your course experience different from your classroom experiences at home?	Before coming to SYP, did you plan to attend college?	Since attending SYP, have you gained confidence in your ability to be successful in a college atmosphere?	Based on your experience this summer, would you return next summer if possible?
% YES	88.88889	88.88888889	100	87.5	50
YES	8	8	8	7	4
NO	1	1	0	1	0
					4 (Too old)

Table 11. MTU Survey Rating Questions (5=Excellent/Agree, 1=Poor/Disagree)

	How inspired are you to learn more about your exploration after attending SYP?	How would you rate the experiments/ hands-on activities during your course?	How helpful was your instructor in explaining the material?	Did your instructor keep class interesting?	How would you rate your instructor(s) overall?
Average	3.75	4.67	4.33	4.11	4.78
5	1	6	3	2	7
4	5	3	6	6	2
3	1	0	0	1	0
2	1	0	0	0	0
1	0	0	0	0	0

5. Lessons Learned and Recommendations for Future

Each phase of the project was built on experiences from the previous phase. The lessons learned from Phases I and II are detailed in their corresponding final reports (Lautala et al., 2024; Lautala et al., pending). In this section, all three phases are collectively considered and the overall lessons learned throughout the three-year project life are summarized.

5.1 Marketing, Coordination, and Registrations

Researchers centralized the marketing and registration efforts to Michigan Tech to reduce confusion and potential changes in format. Partner universities assisted in distributing the marketing and coordinating university-specific logistics. While the final participation rate fell short of expectations, the team does not attribute this to lack of marketing. The following summarizes the lessons learned regarding marketing, coordination, and registrations:

- **Consistent deadlines**. Working with multiple universities can create confusion among participants. A single master schedule should guide the program.
- **Hard deadlines with high schools**. The team allowed a few last-minute changes to registrations, which made it difficult to make final plans for food, housing, travel, etc. It would be best to have a hard deadline and stick with it.
- **Administrative support.** For any university considering hosting Tracks to the Future, it's critical to find out in advance what level of support for the program is available in the university.
- **Post-surveys.** Despite best efforts, students continued to fall short on completing the post-surveys. Schedules didn't allow to gather them to a single location to complete the survey and despite providing access online, many students simply skipped at least some parts of the survey. The team recommends requiring the submittal of the post-survey to receive the completion certificate.
- **Subcontract process.** For grant funding, the creation of subcontracts takes several months. Universities and the granting agency need to ensure a long enough period for preparations, so funds are usable when program preparations on site begin in earnest.
- **Student financial aid and deposits.** Program fees covered from an external source increases the level of student interest to the program. However, in Phase III, an unprecedented number of students dropped out of the program. Some students canceled their participation at the last minute, creating confusion and even some financial losses to the program. In the future, a small, refundable deposit at the time of registration may be considered to increase retention. However, this must be balanced with student financial aid considerations, as these students may find a deposit burdensome.

5.2 Curriculum

The hybrid curriculum evolved throughout the project. Overall, comments on the virtual sessions were positive each year. Several parents noted that they were impressed with how engaged their students were with the online portion of the program, as several of them had traditionally struggled with remote education activities. Nevertheless, it was clear that the main attraction of

the program are the on-site visits. The following summarizes the lessons learned for continuing curriculum development:

- **Content aligned with time**. The amount of materials was reduced to allow more time for each activity, which made teaching more manageable. In future, content should be aligned with available time.
- **Google Docs and permissions issues**. All interactive work was done through Google Docs. This worked well and allowed instructors to monitor student group progress during the assignments.
- **Breaks for instructors.** With the increased number of cohorts, the workload for instructors increased. In days where the same module is taught twice, a break between sessions is necessary.
- **Zoom logistics.** Students had numerous questions about logistics during the hybrid sessions, but coordinators at the host universities were not always available to respond to the questions. Time should be set aside for logistics questions and the host university coordinator should be present at those times.

5.3 Program Future

Programs like Tracks to the Future allow students interested in rail transportation to further explore the sector. While the first three years of the program were a great success, the student/parent appetite for hybrid programs began fading in 2024. For this reason, recommendations for the future somewhat differ from the format used over the last three years. The main observations and suggestions are as follows:

- **Full on-campus format**. The on-campus activities were consistently rated as highlights in the student/parent feedback and the immersed environment helps students build belongingness with the program and their colleagues. The hybrid format should be replaced with a full week of on-campus experience.
- **Hybrid materials in shorter "explorations."** Even if the summer program is conducted fully on campus, the hybrid materials developed in the program can still be used. Some of the materials (e.g., train puzzle and HSR travel exploration) could easily be done as part of the on-campus program, but the greater value may be in using these materials to conduct additional explorations throughout the school year. These shorter, synchronous educational programs can be run on weekday nights or weekends during the regular school year. The activities can even extend from the typical high school student audience to younger stakeholders, such as middle school students. With all materials (and recordings that show example delivery) in the Rail Learning System (RLS) web service hosted by Michigan Tech, any interested educational institutions can take advantage of the materials.
- **Program costs and sponsors**. These types of programs see an increase in participation if at least a portion of program costs are not the responsibility of students/parents, especially if they must travel long distances to reach the host location. Based on the experience at Michigan Tech, covering the whole program cost doubles the participation when compared to a scenario where 50 percent of the cost is covered. It is unlikely that there is continuous federal grant available for the program, but there is interest within the

industry to help secure at least partial funding for program operations. Even direct travel support for students has been proven attractive to industry, although the implementation logistics have been challenging. Overall, to reach the full potential of the program, at least half of the program cost should be covered by external sources.

6. Conclusion

The goal of the Tracks to the Future program was to establish a pre-college program with a nationwide focus that introduces students to the modern side of the rail industry, including critical safety aspects and the many high-tech applications and jobs that are available. An existing K-12 summer youth program developed at Michigan Tech was converted to a hybrid program and expanded to ten host universities across the United States. The program was completed by more than 289 students from 25 states over the first three years. Most students were rising high school juniors and seniors.

Based on feedback and observations, the program was a success. Increasing the interactivity of hybrid content helped to keep students interested. Nevertheless, the on-campus portion was considered the highlight of the program. Pre-, and post-assessments in railway knowledge and engineering belongingness both showed improvement among the students after program completion. Due to reduced interest in the hybrid program, the team recommends the full week program be converted back to an all on-campus format. However, the hybrid modules can be used in the on-campus program and/or for shorter programs during the academic year, as all materials are freely available for use by interested stakeholders in Michigan Tech's RLS web service. It's also important to have funding available to reduce the financial burden for students. Researchers saw over 50 percent increase in student participation when the program fee was covered in full as compared to half.

While there is no direct method to track the long-term impacts of the program, Tracks to the Future offers an excellent platform for continuing growth of K-12 education and exposure to rail topics. With proper support, Tracks to the Future can continue to provide important outreach and education for pre-college students interested in rail.

7. References

Federal Railroad Administration, Railroad Industry Modal Profile, An Outline of the Railroad Industry Workforce Trends, Challenges, and Opportunities, 2011, https://railroads.dot.gov/elibrary/railroad-industry-modal-profile-outline-railroad-industry-workforce-trends-challenges-and , Accessed Sept. 13, 2020

Federal Railroad Administration, Railroad Industry Modal Profile, An Outline of the Railroad Industry Workforce Trends, Challenges, and Opportunities - Update, 2016, https://railroads.dot.gov/elibrary/railroad-industry-modal-profile Accessed Sept. 13, 2020

Lautala, P., Nelson, D., Dick, C.T., Schlake, B., & Ghoshani, F. (2024). Expanding Summer Youth Programs in Rail through Virtual Learning and a National Campus Network – Phase I Report. Federal Railroad Administration.

Lautala, P., Nelson, D., Dick, C.T., Schlake, B., & Ghoshani, F. (pending publication). Expanding Summer Youth Programs in Rail through Virtual Learning and a National Campus Network – Phase II Report. Federal Railroad Administration.

Appendix A.
Registration Forms and Documents

Tracks to the Future 2023 - Registration

Thank you for your interest for the 2023 Tracks to the Future Program!
The program is currently overbooked, and we are putting some students on a waiting list. If you would like us to add you to the list, please provide the contact information, as well as your preferred location information as accurately as possible. However, there are no guarantees you will be included this year. We will use our waiting list to give students preferential booking for next summer.
We're looking forward to meeting all the 2023 cohorts this summer!
If you need more detailed information on the program, please visit http://rail.mtu.edu/event/tracks-future-session-1.

* Indicates required question

1. Email *

2. Student First Name *

3. Student Last Name *

4. Student E-mail Address *

5. Parent First Name *

6. Parent Last Name *

7. Parent E-mail *

8. Parent Phone Number

9. Student Mailing Address *

10. Student Home City *

11. Student Home State

12. Student Zip Code *

13. Student Grade, Fall 2023 *

Mark only one oval.

- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 12

14. Student Gender *

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Other: _____

15. Student Preferred Pronouns

_____

16. Ethnic Background *

Mark only one oval.

- ◯ Caucasian
- ◯ African American
- ◯ Native American
- ◯ Latino
- ◯ Other
- ◯ Prefer not to say

17. If Other, describe your ethnic background

18. Student's School Name *

19. School Address *

20. Please provide a short narrative (a few sentences or a paragraph) describing why you would like to attend this railway education program *

21. Please rank the Sessions and Cohorts (sites) you would like to participate in (you have to rank all six). Remember, Mon-Tue of the week are remote via Zoom, Wed. is travel day to host site, and Thu-Fri are at the host site. If the session you choose as first is oversubscribed we will try to assign your second choice. Use the next question to indicate if there are any cohorts you can't, or won't attend. *

Mark only one oval per row.

	First	Second	Third	Fourth	Fifth	Sixth
Session 1, June 19-23, Michigan Technological University, Houghton MI	◯	◯	◯	◯	◯	◯
Session 1, June 19-23, Fresno State University, Fresno CA	◯	◯	◯	◯	◯	◯
Session 1, June 19-23, University of South Carolina, Columbia SC	◯	◯	◯	◯	◯	◯
Session 2, July 17-21, Penn State University, Altoona PA	◯	◯	◯	◯	◯	◯
Session 2, July 17-21, University of Illinois, Champaign/Urbana IL	◯	◯	◯	◯	◯	◯
Session 2, July 17-21, University of New Mexico, Albuquerque NM	◯	◯	◯	◯	◯	◯

22. The previous question required you to rank all the session options and locations. Are there any locations you would not, or could not attend?
Remember Session 1 is **June 19 - July 23**, and Session 2 is **July 17 - July 21**

Check all that apply.

- [ ] Session 1, Michigan Tech, Houghton, MI
- [ ] Session 1, Fresno State University, Fresno, CA
- [ ] Session 1, University of South Carolina, Columbia, SC
- [ ] Session 2, Penn State, Altoona, PA
- [ ] Session 2, University of Illinois, Champaign, IL
- [ ] Session 2, University of New Mexico, Albuquerque, NM

23. In 2022 we had some industry companies that provided financial support to student families who could not afford to send a student. If financial support for the travel to your location where available would you need that support to be able to attend this year's program?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

24. Let us know, if you have any other questions

Tracks To The Future: Railroad Transportation and Engineering

For: All students grades 8-11

Dates: June 26-July 1, 2022 (On-Campus)

Applications are now closed. Please check back in Winter 2022 for information about the 2023 cohort.

Railroads, the high tech and environmentally sensitive transportation mode! Don't believe us? Come and learn why railroads remain the most energy-efficient mode of transportation and what forms modern railroad track, equipment, and communications/control systems might take. Learn how rail compares with other modes and leads the charge in reducing transportation greenhouse gas emissions! Find out ow it all works through classroom sessions, hands-on activities and field visits to railroad facilities.

Note: Live-in participants only. This exploration will travel to various locations throughout Michigan's Upper Peninsula during the week, and may include an overnight stay in Escanaba, MI.

How to Apply

1. Complete the online SYP application here selecting "Tracks to the Future: Railroad Transportation and Engineering" (CRN 51204) as your program of choice.
   a. When prompted for deposit, click "Mail-In Deposit". Program fees will not be applied until selection decisions are made (within 3 weeks of the deadlines).

2. Provide supplemental documents *either* through our Summer Youth Programs Scholarship Application or by emailing documents to syp@mtu.edu.

Summer Youth Programs Scholarship Application

Thank you for your interest in one of our scholarship programs! Please use the form below to indicate your preference of programs for consideration and to upload your supplemental documents.

The deadline for document submission to be considered for our scholarship programs is Sunday April 10, 2022 at 5pm. For early decision, please submit all documentation by Tuesday March 1, 2022 at 5pm.

All documentation submitted for scholarship consideration should be accompanied by a completed online application available at: www.mtu.edu/syp

dannelso@mtu.edu Switch account

The name and photo associated with your Google account will be recorded when you upload files and submit this form. Only the email you enter is part of your response.

* Required

Email *

Your email

Next

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Clear form

Tracks to the Future: Railroad Transportation and Engineering Hybrid Program Application

Thank you for your interest in one of our scholarship programs! Please use the form below to indicate your preference of programs for consideration and to upload your supplemental documents.

The deadline for document submission to be considered for our scholarship programs is April 10, 2022 at 5pm.

Selected applicants will be contacted by their host site to complete registration paperwork.

dannelso@mtu.edu (not shared) Switch account

Next

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Clear form

Appendix B.
Pre- and Post-Knowledge Assessments

Let's see what you already know about rail …. Name _____

Instructions: Answer the following questions to the best of your ability, however, please do not guess at an answer. If you really don't know, answer I Don't Know (IDK). If you think you have an answer, but aren't positive, go ahead and give it your best shot! Some of the multiple-choice questions have more than one correct answer, in those cases choose all the correct ones.

1. Where was the final spike for the transcontinental railroad driven?

A) Promontory, UT	B) San Francisco, CA
C) Omaha, NB	D) New York, NY
E) I Don't Know	

2. List as many large (Class 1) freight railroads in the US as you can? _____
3. List as many passenger rail/transit systems in the US as you can (up to 10)? _____
4. What is the most common freight car in the US today?

A) tank car	B) covered hopper
C) box car	D) flat car
E) I Don't Know	

5. How is a typical modern freight locomotive powered in the US?

A) Nuclear power turns an alternator to create electricity	B) Coal burns to heat water to steam
C) A diesel engine turns an alternator to create electricity	D) A gasoline engine drives a mechanical transmission
E) I Don't Know	

6. Railroad wheels are shaped like:

A) Flat cylinders	B) Cones
C) I Don't Know	

7. How is a typical bogie set held together?

A) Welding	B) Gravity
C) High strength bolts	D) Super glue
E) I Don't Know	

8. The average freight rail shipment in the US moves _____ miles.
9. The typical US Class 1 railroad freight train is _____ cars long
10. Most freight cars move directly from origin to destination on a single freight train. T/F/IDK
11. Amtrak owns all the rail lines it operates on. T/F/IDK
12. Most passenger trains in the North America operate at speeds over 100 mph T/F/IDK
13. Rubber truck tires have more resistance than steel train wheels. T/F/IDK
14. What does the ballast do in a track system?

A) Holds the track down to the ground	B) Keeps the ties from moving longitudinally
C) Provides vertical support underneath the sleepers	D) Provides drainage through the system
E) I Don't Know	

15. Diesel engines drive the wheels that make the maglev move forward. T/F/IDK
16. If you have a freight car with a nominal capacity of 110,000 pounds what is the maximum gross rail load?

A) 220,000 pounds	B) 263,000 pounds
C) 286,000 pounds	D) 315,000 pounds
E) I Don't Know	

17. Trains are very efficient, so it doesn't take a lot of accelerating force or braking effort to start and stop them. T/F/IDK
18. The number of trains per day that can travel across a single-track corridor is primarily dependent on siding length and location. T/F/IDK
19. Trucks are more effective for long-haul and high-volume transportation than rail T/F/IDK

Let's see what you learned about rail …. Name _____

Instructions: Answer the following questions to the best of your ability, however, please do not guess at an answer. If you really don't know, answer I Don't Know (IDK). If you think you have an answer, but aren't positive, go ahead and give it your best shot! Some of the multiple-choice questions have more than one correct answer, in those cases choose all the correct ones.

1. Where was the final spike for the transcontinental railroad driven?

A) Promontory, UT	B) San Francisco, CA
C) Omaha, NB	D) New York, NY
E) I Don't Know	

2. List as many large (Class 1) freight railroads in the US as you can? _____
3. List as many passenger rail/transit systems in the US as you can (up to 10)? _____
4. What is the most common freight car in the US today?

A) tank car	B) covered hopper
C) box car	D) flat car
E) I Don't Know	

5. How is a typical modern freight locomotive powered in the US?

A) Nuclear power turns an alternator to create electricity	B) Coal burns to heat water to steam
C) A diesel engine turns an alternator to create electricity	D) A gasoline engine drives a mechanical transmission
E) I Don't Know	

6. Railroad wheels are shaped like:

A) Flat cylinders	B) Cones
C) I Don't Know	

7. How is a typical bogie set held together?

A) Welding	B) Gravity
C) High strength bolts	D) Super glue
E) I Don't Know	

8. The average freight rail shipment in the US moves _____ miles.
9. The typical US Class 1 railroad freight train is _____ cars long
10. Most freight cars move directly from origin to destination on a single freight train. T/F/IDK
11. Amtrak owns all the rail lines it operates on. T/F/IDK

Appendix C.
Pre- and Post-Survey Engineering Belongingness and Results

Belongingness & Identity Pre Survey

The following survey consists of 16 multiple choice questions. Circle the best answer for each.

1. A career in rail transportation/engineering will give me the kind of lifestyle I want.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

2. A degree related to rail transportation/engineering will allow me to get a job where I can use my talents and creativity.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

3. A degree in rail transportation/engineering will allow me to obtain a job that I like.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

4. I can relate to people around me in this summer program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

5. I have a lot in common with the other students in this summer program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

6. The other students in this summer program share my personal interests.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

7. My parents see me as a rail transportation engineer.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

8. My instructors see me as a rail transportation engineer.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

9. My peers see me as a rail transportation engineer.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

10. I am interested in learning more about rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

11. I enjoy learning about rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

12. I find fulfillment doing rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

13. I am confident that I can understand rail transportation/engineering in this program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

14. I am confident that I can understand rail transportation/engineering outside of this program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

15. I understand concepts I have studied in rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

16. Others ask me for help in rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

Belongingness & Identity Post Survey

The following survey consists of 16 multiple choice questions. Circle the best answer for each.

1. A career in rail transportation/engineering will give me the kind of lifestyle I want.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

2. A degree related to rail transportation/engineering will allow me to get a job where I can use my talents and creativity.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

3. A degree in rail transportation/engineering will allow me to obtain a job that I like.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

4. I can relate to people around me in this summer program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

5. I have a lot in common with the other students in this summer program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

6. The other students in this summer program share my personal interests.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

7. My parents see me as a rail transportation engineer.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

8. My instructors see me as a rail transportation engineer.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

9. My peers see me as a rail transportation engineer.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

10. I am interested in learning more about rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

11. I enjoy learning about rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

12. I find fulfillment doing rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

13. I am confident that I can understand rail transportation/engineering in this program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

14. I am confident that I can understand rail transportation/engineering outside of this program.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

15. I understand concepts I have studied in rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

16. Others ask me for help in rail transportation/engineering.

1–Strongly Disagree 2–Disagree 3–Somewhat Disagree 4–Neutral 5–Somewhat Agree 6–Agree 7–Strongly Agree

2024 Engineering and Belongingness Survey Results

	All Available Records						Matched Pairs					
	Post Mean	Pre Mean	Delta	Post Median	Pre Median	Delta	Post Mean	Pre Mean	Delta	Post Median	Pre Median	Delta
A career in rail transportation/engineering will give me the kind of lifestyle I want.	6.0	5.5	0.5	6	6	0.0	6.3	6.0	0.4	7.0	6.0	1.0
A degree related to rail transportation/engineering will allow me to get a job where I can use my talents and creativity.	6.0	5.6	0.4	6	6	0.0	6.4	6.0	0.4	6.0	6.0	0.0
A degree in rail transportation/ engineering will allow me to obtain a job that I like.	6.0	5.8	0.2	6	6	0.0	6.3	6.4	-0.1	6.0	6.0	0.0
I can relate to people around me in this summer program.	5.8	5.3	0.5	6	6	0.0	6.2	5.6	0.6	7.0	6.0	1.0
I have a lot in common with the other students in this summer program.	5.6	5.0	0.6	6	5	1.0	6.1	5.4	0.7	6.0	5.0	1.0
The other students in this summer program share my personal interests.	5.5	5.3	0.3	6	5	1.0	6.0	5.4	0.6	6.0	5.0	1.0
My parents see me as a rail transportation engineer.	5.3	4.9	0.4	6	5	1.0	6.0	5.5	0.5	6.0	5.0	1.0
My instructors see me as a rail transportation engineer.	5.3	4.6	0.7	6	4	2.0	5.7	5.0	0.7	6.0	5.0	1.0
My peers see me as a rail transportation engineer.	5.1	4.5	0.5	6	4	2.0	5.6	4.9	0.7	6.0	5.0	1.0
I am interested in learning more about rail transportation/engineering.	6.3	6.5	-0.2	7	7	0.0	6.6	6.8	-0.2	7.0	7.0	0.0
I enjoy learning rail about transportation/engineering.	6.4	6.3	0.1	7	7	0.0	6.6	6.7	-0.1	7.0	7.0	0.0
I find fulfillment doing rail transportation/engineering.	6.2	5.8	0.4	6	6	0.0	6.5	6.3	0.2	7.0	6.0	1.0
I am confident that I can understand rail transportation/engineering in this program.	6.0	5.9	0.1	6	6	0.0	6.2	6.3	-0.1	6.0	6.0	0.0
I am confident that I can understand rail transportation/engineering outside of this program.	5.9	5.7	0.2	6	6	0.0	6.2	6.0	0.1	6.0	6.0	0.0
I understand concepts I have studied in rail transportation/engineering.	5.9	5.5	0.4	6	6	0.0	6.3	5.9	0.4	6.0	6.0	0.0
Others ask me for help in rail transportation/engineering.	4.4	4.2	0.2	4	4	0.0	4.7	4.5	0.2	4.0	4.0	0.0
Scale 1-7 1 = Strongly Disagree 7 = Strongly Agree												
Pre-Survey n = 52 Post Survey n = 32												
23 Matched Pairs												

2023 Engineering and Belongingness Survey Results

	All Available Records						Matched Pairs					
	Post Mean	Pre Mean	Delta	Post Median	Pre Median	Delta	Post Mean	Pre Mean	Delta	Post Median	Pre Median	Delta
A career in rail transportation/engineering will give me the kind of lifestyle I want.	5.3	4.0	1.3	6	4	2	5.4	3.9	1.5	6.0	4.0	2.0
A degree related to rail transportation/engineering will allow me to get a job where I can use my talents and creativity.	5.7	4.1	1.6	6	4	2	5.8	4.1	1.8	6.0	5.0	1.0
A degree in rail transportation/ engineering will allow me to obtain a job that I like.	5.3	5.2	0.1	6	5	1	5.6	5.2	0.6	6.0	5.0	1.0
I can relate to people around me in this summer program.	5.5	4.9	0.6	6	5	1	5.7	5.0	1.0	6.0	5.0	1.0
I have a lot in common with the other students in this summer program.	5.1	4.7	0.4	6	4	2	5.3	4.7	0.8	6.0	4.5	1.5
The other students in this summer program share my personal interests.	4.9	4.8	0.1	5	5	0	5.0	4.7	0.5	6.0	4.5	1.5
My parents see me as a rail transportation engineer.	4.8	4.9	-0.1	6	5	1	5.1	5.0	0.3	6.0	5.0	1.0
My instructors see me as a rail transportation engineer.	4.9	4.5	0.4	5	4	1	5.1	4.6	0.7	5.0	4.0	1.0
My peers see me as a rail transportation engineer.	4.6	4.3	0.3	5	4	1	4.9	4.5	0.7	5.0	4.5	0.5
I am interested in learning more about rail transportation/engineering.	5.3	5.9	-0.6	6	6	0	5.5	6.0	-0.2	6.0	7.0	-1.0
I enjoy learning rail about transportation/engineering.	5.7	5.9	-0.2	6	7	-1	5.9	6.0	0.2	6.0	7.0	-1.0
I find fulfillment doing rail transportation/engineering.	5.3	5.3	0.0	6	6	0	5.4	5.4	0.3	6.0	6.0	0.0
I am confident that I can understand rail transportation/engineering in this program.	5.7	5.9	-0.3	6	6	0	6.0	6.0	0.3	6.0	6.0	0
I am confident that I can understand rail transportation/engineering outside of this program.	5.4	5.8	-0.4	6	6	0	5.6	5.9	0.0	6.0	6.0	0
I understand concepts I have studied in rail transportation/engineering.	5.4	5.2	0.2	6	5	1	5.6	5.4	0.4	6.0	6.0	0
Others ask me for help in rail transportation/engineering.	3.7	4.1	-0.4	4	4	0	4.1	4.1	0.2	5.0	4.0	1
Scale 1-7 1 = Strongly Disagree 7 = Strongly Agree												
Pre-Survey n = 52 Post Survey n = 32												
23 Matched Pairs												

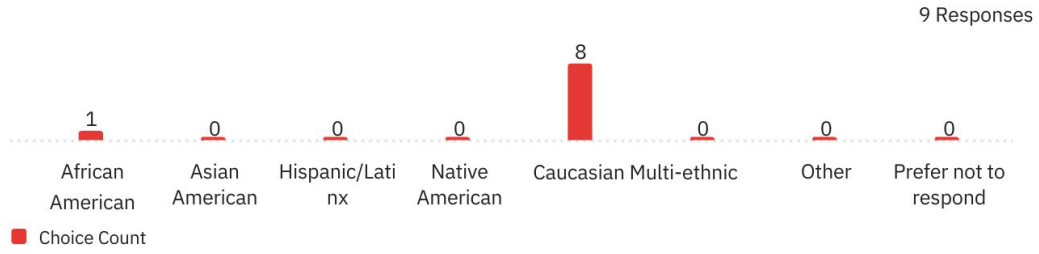
2022 Engineering and Belongingness Survey Results Results

	All Available Records							Matched Pairs					
	Post Mean	Pre Mean	Delta	Post Median	Pre Median	Delta		Post Mean	Pre Mean	Delta	Post Median	Pre Median	Delta
A career in rail transportation/engineering will give me the kind of lifestyle I want.	5.7	5.7	0.0	6	5	1		5.7	5.7	0.0	6	5	1
A degree related to rail transportation/engineering will allow me to get a job where I can use my talents and creativity.	5.7	5.7	0.0	6	5	1		5.7	5.7	0.0	6	5	1
A degree in rail transportation/ engineering will allow me to obtain a job that I like.	5.7	5.7	0.0	6	6	0		5.7	5.7	0.0	6	6	0
I can relate to people around me in this summer program.	5.7	5.7	0.0	6	6	0		5.7	5.7	0.0	6	6	0
I have a lot in common with the other students in this summer program.	5.7	5.6	0.0	6	5	1		5.7	5.6	0.0	6	5	1
The other students in this summer program share my personal interests.	5.7	5.7	0.0	6	5	1		5.7	5.7	0.0	6	5	1
My parents see me as a rail transportation engineer.	5.7	5.7	0.0	6	5	1		5.7	5.7	0.0	6	5	1
My instructors see me as a rail transportation engineer.	5.8	5.8	0.1	6	5	1		5.8	5.8	0.1	6	5	1
My peers see me as a rail transportation engineer.	5.9	5.8	0.1	5	5	0		5.9	5.8	0.1	5	5	0
I am interested in learning more about rail transportation/engineering.	5.9	6.0	-0.1	7	7	0		5.9	6.0	-0.1	7	7	0
I enjoy learning rail about transportation/engineering.	5.8	5.9	-0.1	7	7	0		5.8	5.9	-0.1	7	7	0
I find fulfillment doing rail transportation/engineering.	5.7	5.8	0.0	6	6	0		5.7	5.8	0.0	6	6	0
I am confident that I can understand rail transportation/engineering in this program.	5.6	5.7	-0.1	6	6	0		5.6	5.7	-0.1	6	6	0
I am confident that I can understand rail transportation/engineering outside of this program.	5.4	5.5	-0.1	6	6	0		5.4	5.5	-0.1	6	6	0
I understand concepts I have studied in rail transportation/engineering.	5.2	5.3	-0.1	6	6	0		5.2	5.2	-0.1	6	6	0
Others ask me for help in rail transportation/engineering.	4.6	4.6	0.0	5	4	1		4.6	4.6	0.0	5	4	1
Scale 1-7 1 = Strongly Disagree 7 = Strongly Agree													
Pre-Survey n = 52 Post Survey n = 32													
23 Matched Pairs													

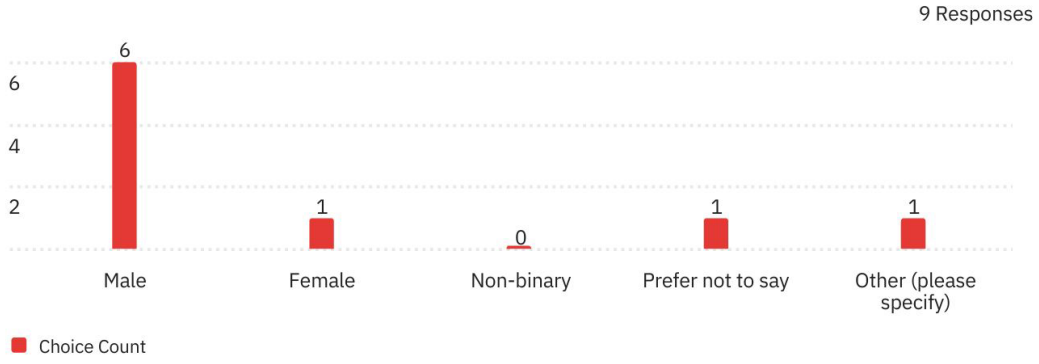
Appendix D.
Program Feedback Survey and Student Comments (Michigan Tech)

Tracks to the Future: June 23 - 28, 2024 1

Q6 - What is your ethnicity? - Selected Choice



Q3 - What is your gender? - Selected Choice



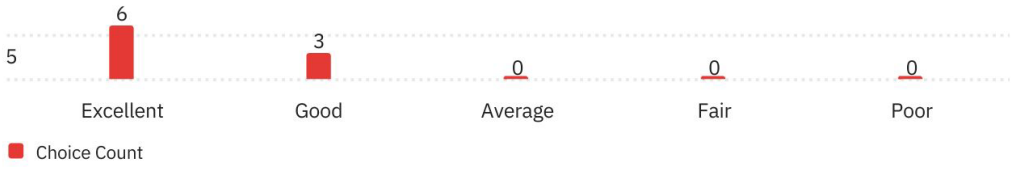
Q7 - Was this your first summer at SYP?

Q10 - Was your course experience different from your classroom experiences at home?

9 Responses

Q12 - How would you rate the experiments/hands-on activities during your course?

9 Responses



Q21 - How helpful was your instructor in explaining the material?

9 Responses

Q17-18 - Would you recommend this course to others? Why or why not?

9 Responses

Would you recommend this course to others? Why or why not?
Yes unique experiences
Yes Fun and informational / free

yes it was a great way to learn more about an industry I didn't know a lot about

yes if you like trains its fun

Yes It really helped me was really helpful and interesting fields.

yes it was fun

yes i learned a lot, and i think others can too

yes as it shown

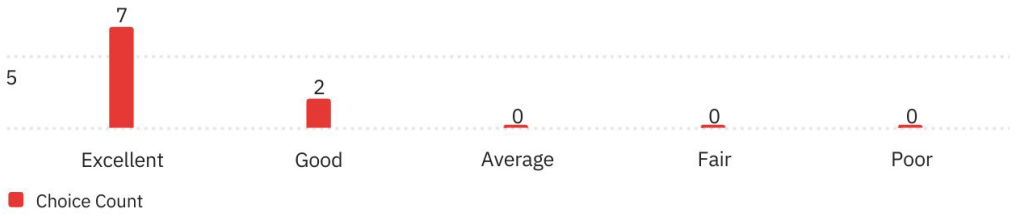
Yes Super fun and free

Q23 - Did your instructor keep class interesting?

9 Responses

Q24 - How would your rate your instructor(s) overall?

9 Responses



Q51 - Before coming to SYP, did you plan to attend college?

8 Responses

Q31 - Now that you've attended SYP, are you more likely to attend college?

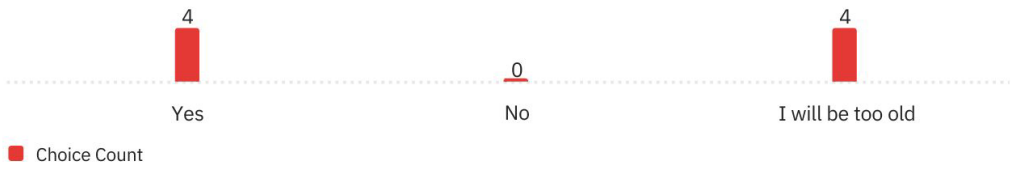
No data found - your filters may be too exclusive!

Q34 - Since attending SYP, have you gained confidence in your ability to be successful in a college atmosphere?

8 Responses

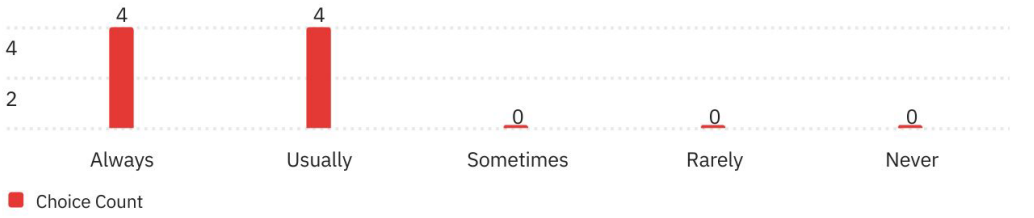
Q29 - Based on your experience this summer, would you return again next summer if possible?

8 Responses



Q50 - Were the counselors available when you needed them?

8 Responses



Q26 - Were the SYP staff/counselors were approachable and easy to talk to?

8 Responses

Q52 - We often share quotes from student experiences with our donors for continued scholarship support. What would you tell them about your time at SYP?

5 Responses

We often share quotes from student experiences with our donors for continued scholarship support. What would you tell them about your time at SYP?

Excellent program, great people.

It was fun.

it was fun!

it was great

An amazing experiance

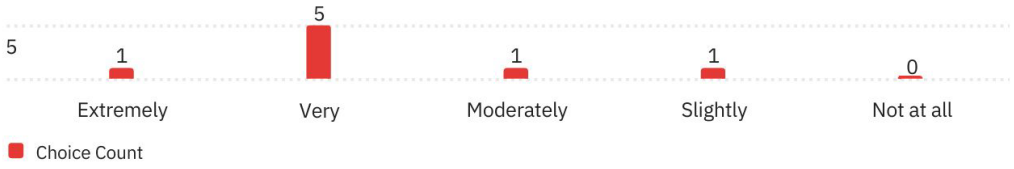
Q48 - What improvements would you like to see in this course?

6 Responses

What improvements would you like to see in this course?
I think the canoe was well done and interesting
More building a railway shuttle
none
more interactive activities
IDK
nothing

Q19 - How inspired are you to learn more about your exploration after attending SYP?

8 Responses



Q36 - Has participating in this program positively influenced your thinking about attending Michigan Tech?

8 Responses

Q51 - Before coming to SYP, did you plan to attend college?

8 Responses

Q43 - What was your most memorable experience at SYP?

7 Responses

What was your most memorable experience at SYP?
Touring Eagle Mine
Doing tracks to the future
climbing on a train
Have fun with my friends.
cabafso6
recreation activities
train rev

Q47 - What are your top 3 career choices right now?

8 Responses

What are your top 3 career choices right now?
engineer Rail dispatch Railcar design
Electrical engineer railcar repair locomotive engineer
I am not sure at this time
aerospace engineer, electrical engineer, civil engineer
Astronaut biologist engineer

engineer, conductor, ?

something in law, some kind of engineer, scientist

Dispatcher engineer Vet

Appendix D.
Training Modules Detail

Module 0: Pre-Course Assignments

The opening module required student to complete two survey documents, the pre-skills knowledge assessment and the pre-belonginess survey. These documents were intended to allow researchers to assess whether the material and activities provided in the program produced any change in student knowledge or attitude. The survey documents are included in Appendix B.

Module 1: What is Rail Transportation

This module introduced the rail industry. This material was presented synchronously using Zoom, PowerPoint slides, and Kahoot! competitions.

Part 1 – Industry Panel Discussion, Welcome and Rail Industry Jobs

Program started with moderated industry panel discussion between representatives from Diamond level industry sponsors, followed by student and instructor introductions, and finished with a short PowerPoint slide presentation focusing on industry jobs and the railroad programs at each university.

Part 2 – Transportation Modes and Railroad History

The second part started with discussion of transportation in general and introduced the different modes for both freight and passenger operations. Instructors started a Kahoot! competition during the second presentation.

The second presentation covered the history of rail, from beginnings in the early 1800's, through the golden years in the late 1800's, the death spiral in the mid 1900's, and the Staggers Act of 1980. Instructors again used Kahoot! questions to maintain student interest and engagement.

Part 3 – Railroad System Components Freight and Passenger Rail Transportation Today

The first presentation provided a macro level overview of a railroad and what is required to operate one. The discussion included use of word clouds to brainstorm different components of the system, locomotives, railcars, crew, passengers, cargo, fuel, and all the paperwork required to keep track of the commodities moved. The slides used a passenger train example to focus the discussion.

Instructors concluded the introductory module with a final PowerPoint presentation with embedded Kahoot! competitions to look at how railroads have progressed since the Staggers Act. Topics covered included the rail consolidations that led to today's Class 1 railroads, the short line railroads that support them, the commodities the railroads move, and the infrastructure involved. The morning sessions ended with an introduction to the different types of passenger rail operations, both in the US and around the world.

Module 2: Rolling Stock and Locomotives

Module 2 focused on the rail cars and locomotives used across the rail industry. The presentation centered on PowerPoint presentations in Zoom with embedded poll questions. It also featured two hands-on activities.

Part 1 – Locomotives

Instructors used a PowerPoint presentation to focus student discussion. This section also featured a Wheel Dynamics activity, using 3D printed "cylinders" with different profiles to illustrate the wheel shape used on modern railcars and locomotives. Students rolled the cylinders down a curved track they assembled at home, and noted which shapes managed to stay on track. The student cohort reconvened for a short discussion of their findings.

Part 2 – Railcars

This session again included a PowerPoint presentation, this time to discuss the parts of a typical car and the markings on its sides. Instructors presented an interactive quiz on car parts, used a Menti WordCloud to discover what kinds of cars students were already familiar with, and discussed the various types of cars and where they were used. The session ended with a discussion of railcar loading and a Kahoot! competition on railcar information.

Part 3 – Train Energy Management

This session opened with a Kahoot! on braking and train energy management. Instructors followed with a PowerPoint presentation covering the history of rail brakes and how they evolved to today's standards. A YouTube video of Wabtec's Trip Optimizer system was used to illustrate train handling concepts. This session ended with a presentation about alternative power systems for locomotives.

Module 3: Freight Operations

Instructors opened the second day of the home sessions with an introduction to Freight Operations. This session again used PowerPoint, with Kahoot! competitions interspersed throughout the presentation, as well as several videos and individual and group activities.

Part 1 – State to State Freight Movements

This group activity used Zoom breakout rooms. Students researched commodity flows between state pairs and reported back to the larger group at the end of the activity.

Part 2 – Network Operations, Trucks vs Trains

An individual guided activity introduced network operations using materials included in the lesson kit.

Part 3 – Freight Rail Terminals

The final part of the freight operations module included two activities. The first was a small group activity where students explored a variety of freight rail yards and then compared them with the rest of the students in the main classroom. Then students used a freight yard diagram and a set of paper cars and locomotives to "sort" rail cars using the Basic Sorting Process. The instructor also demonstrated Geometric and Triangular sorting using the same tools, allowing students to follow along on their own freight yards (provided as part of the student package).

Module 4: Passenger Operations

Module 4 was conducted in three parts: Passenger Operations, High Speed Rail, and Urban Rail Transit. Each part used a PowerPoint presentation with embedded Kahoot! competitions. Instructors also included a variety of student activities, as detailed below.

Part 1 – Intercity Rail

This session included a brief discussion of current Amtrak operations and the shared track concept. The session ended with a small group activity where students investigated the time and cost to complete a journey between a US city pair using four different passenger modes. Students returned to the large group to discuss their findings.

Part 2 – High Speed Rail (HSR)

This session introduced high speed rail with a discussion of systems in operation around the world, highlighting that the US is significantly behind in HSR development. Instructors also discussed the "sweet spot" for HSR operations distance, and how the distance between many US city pairs makes HSR more difficult to implement.

The session included two student activities. The first activity asked students to work in small groups and research the operating characteristics of five different rail corridors, each around 200 miles long. Characteristics included the number of daily service options, the time required to complete the route, and the cost to do so. As the students discovered various parts of the puzzle, they entered the values in a shared Google Docs sheet. The activity wrapped up with a guided discussion illustrating the differences.

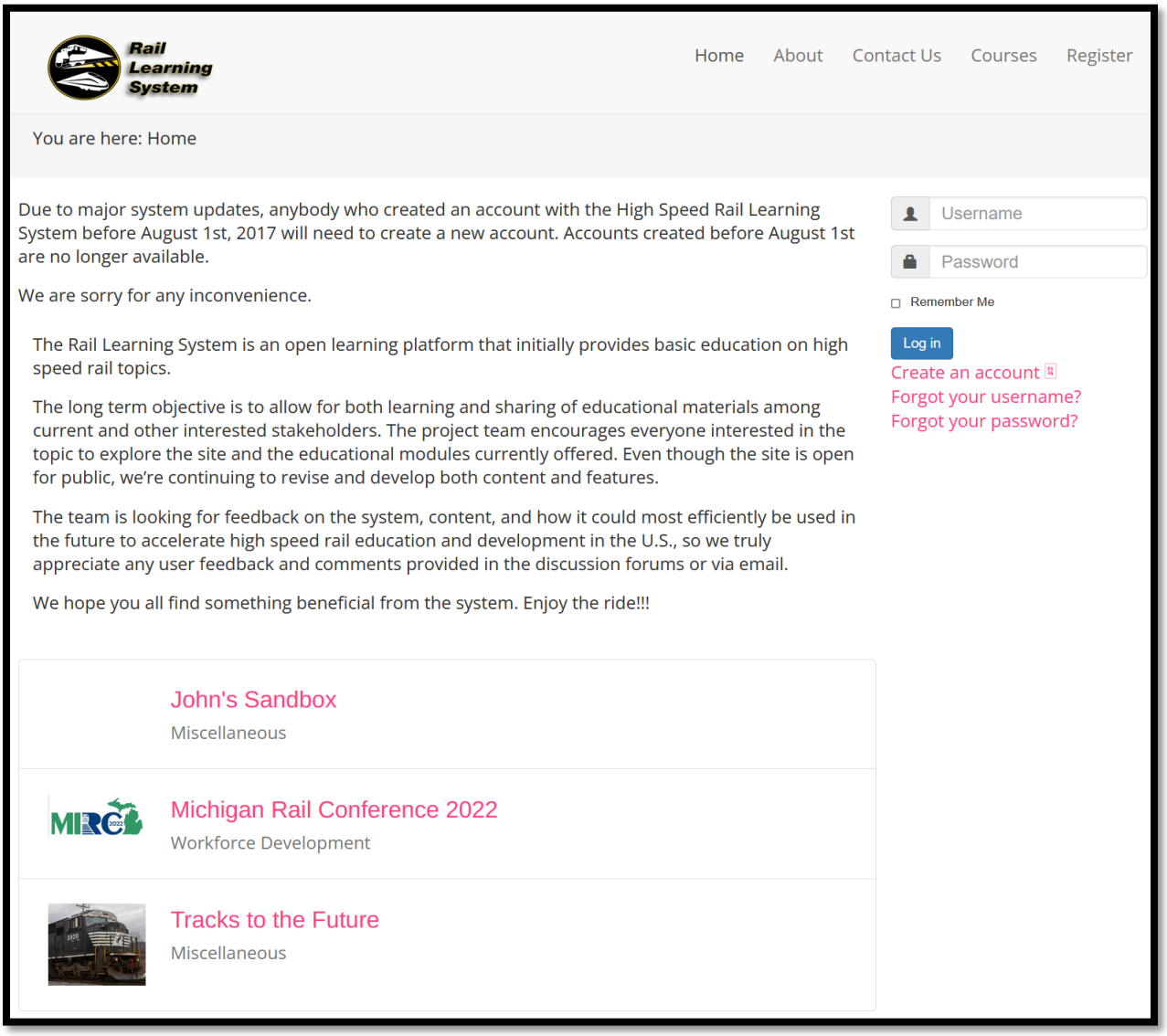
The second activity required students to work in small groups to compare a potential highspeed corridor in the US with an existing one in China. The activity pointed out that the corridors have similar distance and population characteristics, illustrating the idea that there are some areas in the US where HSR might make sense.

Part 3 – Urban Rail Transit

The final virtual session illustrated the different types of urban rail systems currently operating in the US and where those systems are found. The session wrapped up with a final student activity where students used internet resources to research the characteristics of an assigned transit system. Students returned to the full group session to compare results.

Appendix E.
Sharing Educational Materials

To make all materials developed and used in the program easily available for other universities and agencies interested in offering educational opportunities for interested students, the team has created a Tracks to the Future repository under the Rail Learning System (RLS) web service hosted by Michigan Technological University. The materials can be accessed from the home page by any registered stakeholder at any time. Registration is free.



The RLS site is structured in a similar manner to the program. From the landing page, stakeholders can first access all the materials available for the four hybrid modules, including slides, online activity sheets, and recordings of one of the 2024 cohorts to see how each module was taught by the team in the virtual environment. While there are no recordings for the on-campus modules, guidelines for conducting such activities are provided in the RLS.

Module 1. What is Rail Transportation

This section will introduce you to the transportation modes, rail industry jobs and development of rail transportation in the US (and somewhat beyond).

Module Topics

- Rail Industry Jobs/Careers and Railroad Engineering Programs
- Transportation Modes
- Rail Transportation History
- Rail System Components
- Freight and Passenger Rail Transportation in the U.S. Today

Learning Activities

- Kahoot "Knowledge" Competition for Module 1
- Word Clouds Activities
- Freight Transportation Modes
- Passenger Transportation Modes
  - What makes a railroad?
  - What makes a passenger train?
  - What are the Class 1 railroads in North America?

Learning Content

Part 1 - Rail Careers/Jobs and Transportation Modes

Presentation on Rail Jobs/Careers & Univ. Transportation Rail Programs

Download - 0 Tracks To Future Welcome and Rail Jobs-Programs

Transportation Modes

Download - 1 Tracks to Future Modes

Part 2 - Railroad History and System Components

Railroad History

Download - 3 Tracks to Future What is Railroad

Rail System Components

Download - 4 Tracks to Future Railroads Today

Part 3 - Freight and Passenger Rail Transportation Today

Freight/Passenger Railroads Today

Download - 2 Tracks to Future RR History

- Kahoot "Knowledge" Competition for Module 1
- Word Clouds Activities
- Freight Transportation Modes
- Passenger Transportation Modes
  - What makes a railroad?
  - What makes a passenger train?
  - What are the Class 1 railroads in North America?

Abbreviations and Acronyms

ACRONYM	DEFINITION
AREMA	American Railway Engineering and Maintenance of Way Association
FRA	Federal Railroad Administration
HSR	High Speed Rail
NRC	National Railroad Construction and Maintenance Association
NS	Norfolk Southern
PSU	Penn State University
SYP	Summer Youth Program
RLS	Rail Learning System
UIUC	University of Illinois, Urbana-Champaign