2017 MONTANA SUMMER TRANSPORTATION INSTITUTE

Final Project Report

by

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of the

Western Transportation Institute
College of Engineering
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prepared for the

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16. Abstract The Western Transportation Institute (WTI) at Montana State University (MSU) hosted a Summer Transportation Institute (STI) for nineteen high school participants aimed at introducing pre-college youth to transportation modes, careers, and academic programs. The two-week residential camp was held on the MSU campus from July 16 to July 28, 2017. Participants lived on the MSU campus while participating in a multidisciplinary academic curriculum, which included guest speaker presentations, hands-on laboratories, team design-build projects, and field trips. During the evenings and weekend, STI students participated in educational, sports, and team-building activities. The 2017 STI program was comprised of rising tenth, eleventh, and twelfth grade students from across Montana.			
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PROGRAM ADMINISTRATION

1. Host Site: Western Transportation Institute, Montana State University
2. Address: PO Box 174250, Bozeman, MT 59717-4250
3. Project Director: Susan Gallagher
4. Length of Program: 2 weeks
5. Type of Program: Residential
6. Grade Level(s): Entering 10th, 11th, and 12th grades
7. Number of Students per Grade: 10^{th} grade (7), 11^{th} grade (5), 12^{th} grade (7)
8. Number of Student Applications Received: 31
9. Number of Students Selected for Program: 20
10. Number of Students to Complete Program: 19

ABSTRACT

The Western Transportation Institute (WTI) at Montana State University (MSU) hosted a Summer Transportation Institute (STI) for nineteen high school participants aimed at introducing pre-college youth to transportation modes, careers, and academic programs. The two-week residential camp was held on the MSU campus from July 16 to July 28, 2017. Participants lived on the MSU campus while participating in a multidisciplinary academic curriculum, which included guest speaker presentations, hands-on laboratories, team design-build projects, and field trips. During the evenings and weekend, STI students participated in educational, sports, and team-building activities. The 2017 STI program was comprised of rising tenth, eleventh, and twelfth grade students from across Montana.

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1 INTRODUCTION

The Summer Transportation Institute (STI) aims to address the nation's need for a diverse pool of transportation professionals by heightening pre-college student interest in transportation careers. Program activities are designed to enhance participants' problem-solving, communication, and critical thinking skills and to introduce them to the broad array of opportunities available in the transportation field. The Western Transportation Institute at Montana State University (MSU) hosted a two-week residential STI program for nineteen high school students from across Montana in July 2017. The camp participants lived on the MSU campus from July 16 to July 28 while participating in transportation-themed academic enhancement programs. The camp curriculum included presentations and activities related to various transportation modes, transportation planning, infrastructure design, and safety as well as a career and college preparatory component. The program benefited from partnerships with career professionals, who delivered guest presentations and hands-on activities that provided camp participants with insider perspectives on transportation career opportunities. Academic activities were enhanced by field trips and hands-on design/build activities.

2 COMMITTEE, PARTNERS, AND STAFF INFORMATION

2.1 Intermodal Advisory Committee

A project kick-off meeting was held on June 8, 2017 to discuss program planning, oversight, and management with the Montana Department of Transportation (MDT) and the U.S. Federal Highways Administration (FHWA). Patti Schwinden and Megan Handl of the MDT Civil Rights Division and Bob Seliskar of the FHWA Montana Division office attended. Discussion focused on scheduling and planning a comprehensive tour of MDT Headquarters in Helena, as well as opportunities for soliciting additional program sponsorships.

Additional representatives from government, industry, and academia make up an advisory board, which assists the STI program in developing a well-balanced curriculum, planning activities and field trips, obtaining technical expertise, and conducting strategic planning. Chad Welborn offered the MDT Design Unit's assistance with a crash attenuator activity as well as a presentation on Computer Aided Design. Transportation consultant and ITE member Danielle Scharf confirmed that the Montana Chapter of the Institute of Transportation Engineers (ITE) would once again provide financial support for the STI program. She also agreed to provide a guest presentation on a local arterial redesign project.

2.2 Partners/Sponsors

Several program partners contributed to the 2017 program. The MSU Department of Civil Engineering provided access to the bulk materials and structural testing laboratories and laboratory equipment as well as to the Tait Computer Laboratory. The Montana Department of Transportation organized tours, presentations, and lab/shop access to students during the field trip to MDT in Helena. Chad Welborn (MDT Design Unit) provided a guest presentation and demonstration of computer-aided design projects produced by student interns in the MDT Design Unit. Jeff Modrow, flight instructor from Summit Aviation, set up tours at the airport. Danielle Scharf of Sanderson Stewart, a private transportation consulting firm, presented information to

students about an arterial redesign project currently in the design phase in Bozeman. Kristi Dunks from the National Transportation Safety Board (NTSB) conducted a "crash scene investigation" activity and introduced careers at NTSB. Kyle Demars organized a tour of the MDT maintenance facilities in Bozeman. Leo Zwenke provided a tour of the gravel pit and asphalt and concrete mix plants at Knife River. Community contributions of this nature from local transportation professionals provide great value to the program by demonstrating real world career opportunities to the camp participants. Partners are listed in the Section I Attachment in Appendix A.

2.3 Program Staff

Full-time program staff included the Project Director, an Academic Program Coordinator, a Teaching Assistant, and two Residence Hall Advisors (RAs). Teaching staff were responsible for assisting with the development of classroom and hands-on activities, leading classroom activities, and assisting guest instructors with classroom management. The RAs were hired to supervise students during weekends and evenings and to plan and lead leadership, recreation, and team-building activities.

Several full-time research staff from the Western Transportation Institute as well as faculty from multiple departments within the College of Engineering contributed to the development of the STI curriculum. All teaching and program staff are listed in the Section I Attachment in Appendix A. The STI topic presented by each instructor is given in parentheses after the person's title.

3 PROGRAM OBJECTIVES

The objectives of the MSU Summer Transportation Institute are to:

- Increase students' awareness of the significance of transportation in their daily lives;
- Expose high school students to the variety of transportation careers available and demonstrate how transportation professionals work to identify and solve real-world issues that have society-wide impacts;
- Increase students' understanding of the importance and need for creative and innovative transportation solutions;
- Develop communication and collaboration skills; and
- Provide college and career guidance.

The success of the program in meeting these objectives was evaluated based on: 1) an assessment of the program curriculum in covering all relevant topics; and 2) student responses on evaluations administered at the end of the program, which requested an overall assessment of all program aspects. Results from student evaluations are included in the *Evaluations* portion of this report.

4 MARKETING & STUDENT SELECTION PROCESS

Program announcements and applications were sent to principals, teachers, and guidance counselors at Montana high schools and via professional associations. Program materials were also posted on the WTI website. Students entering the 10^{th}, 11^{th}, or 12^{th} grade were encouraged

to apply for the program. For the first time, the program also entered into a memorandum of agreement with the state's Gear Up program. Gear Up is designed to support low-income and first-generation college students and supports liaisons across the state to work with students at high need schools. Additionally, the program supports a variety of academic summer enhancement programs across the state and encourages students from Gear Up schools to participate. The program included information on the 2017 Summer Transportation Institute in its brochure of summer opportunities that is distributed annually to Gear Up schools. Patti Schwinden of MDT Civil Rights Division also provided an in-person overview about the STI program to Gear Up liaisons during an annual meeting in Helena. Through this partnership, the program also committed to helping coordinate travel and to cover travel expenses for camp participants from Gear Up schools. As a result, two attendees from Browning, Montana received travel assistance from Gear Up to attend the STI.

Thirty-one applications were received and twenty applicants were accepted into the program. Twenty is the maximum number of students the program can accommodate under the current budget allocation. Nineteen students completed the program. One student accepted to the program was unable to attend at the last minute due to his involvement in a serious motorcycle accident. The Demographic Data Summary for 2017 STI participants is provided in Appendix B.

5 PROGRAM CURRICULUM

5.1 Academic Program

Transportation topics covered during the 2017 camp included traffic engineering, transportation planning, infrastructure design, advanced technologies, and safety. To underscore the multidisciplinary nature of transportation studies, faculty from a variety of College of Engineering Departments participated in curriculum development, including: Computer Science, Electrical and Computer Engineering, Mechanical Engineering, and Civil Engineering. STI participants additionally learned about career opportunities from professionals representing public and private sector transportation organizations as well as academia. Hands-on activities related to each topic helped to develop students' problem-solving skills and reinforced what they had learned. In addition to classroom activities, students participated in team design/build projects. Team design projects included designing different gear ratios on a mini-car to handle different tasks (e.g. climbing a hill or traveling quickly); designing and building a cost-effective crash attenuator; and designing and building gliders and a balsa wood bridge. The team projects served to build teamwork and communication skills while fostering creative problem solving.

Components of the academic program are outlined in detail below, and a daily schedule is provided in Appendix C.

<u>Traffic Engineering and Transportation Planning</u>
Danielle Scharf, Associate Principal and Bozeman Regional Director for engineering consulting firm Sanderson Stewart, provided data and technologies used to develop and present design alternatives for Kagy Boulevard. A major arterial redesign is being planned for Kagy Blvd. STI participants crossed Kagy each day when walking from the dormitories to the Western Transportation Institute building, and had the opportunity to observe construction work being done on an intermediary phase of the project.

Chad Welborn from the MDT Design Unit spoke with camp participants about the work of the unit and demonstrated some of the CAD products MSU student interns produced for MDT projects. Students learned about internship opportunities and the importance of gaining real world experience while in school.

Dr. Pat McGowen, a WTI research professor, discussed transportation planning and introduced the students to the traffic simulation programs Synchro and TrafficSim. Participants learned about carrying capacity, congestion, and forecasting. They then experienced being transportation engineers through a hands-on activity that explored the impact road design has on congestion. Participants used intersection counters to "map" a local intersection by counting the cars that were traveling certain directions. They then determined how the intersection would be able to handle forecasted traffic loads in the future using traffic simulation programs. Using the software, they explored various redesigns of the intersection to improve traffic movement.

Rebecca Gleason and Taylor Lonsdale, two Research Engineers at WTI, spoke to the group about active transportation and complete streets. After learning about how transportation planning and infrastructure impacts users beyond vehicles, the students completed a walking audit of local streets to determine comfort and usability for bicyclists and pedestrians.

Danae Giannetti from the MDT Design Unit discussed transportation planning issues with the camp participants and provided hands-on planning boards to teams of students. The participants placed roadway features on the boards (such as bridges, underpasses, roads, bike paths, sidewalks, etc.); and each board represented different environments (mountainous, rural, urban, etc.). Student teams then presented their designs to the other student groups for feedback and discussion.

Figure 1: Roadway Planning Activity

Automotive Design

Camp participants participated in a team design/build challenge focused on gear ratio design. They learned about torque and calculating gear ratios, and then they designed “mini electrical cars” capable of going fast, slow, or up an incline based on the gear ratio used.

Transportation Structures and Materials

Civil Engineering Professor Damon Fick introduced students to bridge design and demonstrated a number of basic mechanics principles using foam, balsa wood, and reinforced and unreinforced concrete beams. Students were then guided in using design software to build and test a bridge virtually. Students also worked in teams of two to design and build a small scale, balsa wood truss bridge. The teams competed in a formal competition, during which loads were added to the bridges until they failed.

Students learned about the importance of soils as foundations for structures, including roadways, then demonstrated their acquired knowledge of soil properties in a laboratory competition. Student teams designed and built small scale, reinforced soil towers. The walls were subjected to increasing loads until they collapsed. WTI Research Engineer, Michelle Akin, led the geotechnical engineering activity.

Civil Engineering Professor Mike Berry introduced students to the various components that make up concrete and concepts behind concrete mix design. Samples of cast and cured concrete were subjected to material property testing using compression equipment in the lab. The compression tests demonstrated the differences in concrete strength that result from different design mixes.

The speaker I found most interesting was Mike Berry. I am very interested in becoming a civil engineer, specifically a structural engineer, so it was great to meet one and learn what he does. Mr. Berry brought such a great personality to the classroom and really inspired me to want to be a structural engineer.

The students were shown additional laboratory strength tests conducted on a variety of different material types. Mechanical Engineering researchers demonstrated laboratory equipment that calculates the force required to break different materials, and discussed the importance of knowing the strength and properties of materials used in infrastructure.

Figure 2: Field Trip to Knife River gravel mines

Finally, students toured the gravel pit and asphalt and concrete mix plants at Knife River, a construction firm located in Belgrade, Montana. Leo Zwenke of Knife River discussed how gravel is mined and sorted for infrastructure projects, and described the process for mixing and testing asphalt and concrete at the site.

Aviation

The students visited the Gallatin Field Airport and toured the air traffic control tower, the fire and rescue area, and the airplane maintenance hangars. They also had the opportunity to meet with flight instructors at Summit Aviation, who described the process for obtaining a pilot's license as well as the variety of aviation careers available.

I enjoyed the gliders and the balsa bridges the most. We were able to develop unique and intricate designs on our own and test them out.

Students also participated in a hands-on glider design/build challenge. Working in teams of two, they designed and tested gliders using different wing placement and nose weight. Final glider designs were reviewed and tested in a competition.

Transportation Safety

Kristi Dunks, a crash scene investigator for the National Transportation Safety Board, led a simulated crash scene investigation with the students. She described the investigative process and had participants divide into teams to investigate a fictional accident between a vehicle and pedestrian. Students studied the crash scene and documented skid marks and vehicle damage, and gathered data on the weather and other possible contributing factors. They separately interviewed the vehicle driver and passenger as well as the pedestrian involved. The group then regathered to share its findings, formulate a theory on the cause of the accident, and make recommendations for preventing future accidents of this kind. Finally, Kristi provided different examples of crash sites an investigator might be asked to study and described the range of potential investigative duties while on site.

Camp participants also learned how roadside design impacts safety. For example, they learned about crash attenuators and how they are designed to mitigate roadside hazards. They then formed engineering teams and were challenged to design and build a crash attenuator as economically as possible out of provided materials (plastic bags, cotton balls, straws, etc.). The attenuators were tested using a ramp, a toy truck, and an egg (as passenger). Teams were allowed two trials to build the most cost efficient and effective crash attenuator possible.

Transportation Technologies

Craig Shankwitz, a researcher at the Western Transportation Institute, presented an overview to camp participants on the future of transportation technologies, especially in the area of autonomous and connected vehicles. Rob Maher, Department Head in the MSU Electrical and Computer Engineering (ECE) Department, demonstrated technologies similar to those used in autonomous and semi-autonomous vehicles, using robots with embedded sensors that are designed and programmed by ECE students. To learn more about programming, the STI students

participated in a coding exercise led by graduate students from the MSU Department of Computer Science.

Transportation and the Environment

Students learned how hydrology relates to roads during an interactive session with Civil Engineering Professor Katey Plymesser in the hydraulics lab. They learned about the importance of culvert design for fish passage as well as some basic hydrology concepts. WTI Research Scientist Rob Ament introduced camp participants to international work currently being undertaken in the field of road ecology. Students learned how wildlife crossing structures can protect both passengers and wildlife by reducing animal-vehicle collisions. Finally, to expose students to unique research capabilities at MSU and transportation-related research for cold climates, the students toured the Civil Engineering Department's Subzero Laboratory.

Field Trips

Field trips supplemented classroom and laboratory activities, providing students with an opportunity to meet and speak with practicing transportation professionals. Students participated in several field trips during the program. In addition to the field trips to the Gallatin airport and to Knife River (both described above), camp participants also visited the MDT Maintenance facilities in Bozeman. Maintenance Chief Kyle Demars introduced careers in road maintenance and allowed the students to experience sitting in some of the equipment (snow plows, etc.) used by maintenance staff.

The group also traveled to Helena to tour the headquarters of the Montana Department of Transportation (MDT). They were welcomed to MDT by Montana Governor Bullock, who provided opening remarks and hosted a Q & A session with the students. MDT and FHWA Division staff also welcomed the group and shared information about career opportunities within the different divisions at MDT. Students met additional MDT staff while touring the sign shop, equipment and vehicle maintenance shops, and other labs. They learned about the motor carrier and enforcement division and had the opportunity to experience how important Americans with Disabilities Act (ADA) design is for people with disabilities in an exercise using "visual impairment devices" and wheelchairs.

Following the tour of MDT, the students took a ferry ride on the Missouri River through the Gates of the Mountain and learned about the history of water transportation in the area. By a fortunate coincidence, their ferry captain for the ride just happened to be Governor Steve Bullock.

Figure 3: Students meet Montana Governor Bullock (center) on Gates of the Mountain ferry field trip

5.2 Enhancement Program

The enhancement program was designed to prepare students for college and to promote career self-awareness. The desired outcomes for the enhancement program were for students to: 1) better understand the steps necessary to enter college; 2) better understand what college majors are available and coursework requirements for those majors; 3) develop employability tools; and 4) better understand potential career paths.

A representative from the MSU Admissions Office spoke with STI participants about college entrance exams, college preparatory coursework, choosing an academic major, obtaining financial aid, and academic support services available for college students. Students also took the on-line "Strong Interest Inventory," a test designed to highlight a person's strengths and interests in relation to potential career fields. A representative from the MSU Career Services Office met with students to distribute and discuss the results of the Strong Interest Inventory and to help students put the information into context. The presentation emphasized the importance of developing employability skills, including good resumes and interviewing skills.

5.3 Sports and Recreation Program

The objectives of planned weekend and evening activities were to provide students additional experience working in teams and to promote a spirit of collegiality and good sportsmanship among the STI participants. Each evening, the Resident Advisors (RAs) organized ice-breakers, team-building activities, and team sports. Activities were varied to cater to the range of interests within the group. Activities included: frisbee, soccer, swimming, and park outings. Students visited the Museum of the Rockies, the planetarium, Lewis and Clark Caverns, a local farmer's market, and a free community music event.

Jon and Kaylyn [the RAs] were very good and planned many fun things after classes.

5.4 Orientation and Closing Awards Program

STI participants arrived on campus on Sunday, July 16 and moved into their dormitory rooms with the assistance of the RAs and teaching staff. After the new arrivals were situated, an orientation was held for the students and parents. The Academic Program Coordinator introduced all staff members and provided an overview of planned STI activities. STI rules, regulations, and expectations were reviewed in detail as well as consequences for non-compliance. The following day, students received an orientation to the academic program and participated in a tour of the Montana State University campus.

Family members of STI participants as well as STI instructors and partners were invited to the STI Closing Ceremony held on Friday, July 28. The participants compiled a slideshow presentation of their STI experience to present to their parents. Each student received a certificate of completion from STI staff. Design-build teams received special recognition for successful design and construction of balsa bridges, gliders, and crash attenuators.

6 EVALUATIONS

An end of program survey was administered to participants to gauge how students' attitudes toward college and career choices, engineering, and MSU may have been changed by the program. The survey also evaluated the success of the program in meeting its objectives to: 1) increase participants' awareness of the significance of transportation; 2) expose participants to the variety of transportation careers available; 3) improve participants' understanding of the society-wide impacts made by transportation professionals; 4) increase students' understanding of the need for innovation in transportation; and 5) improve student confidence in career and college planning.

All nineteen participants completed the overall program evaluation. Student evaluation scores show that most participants felt they learned more about careers in transportation. Slightly more than half reported feeling more confident about making college and career choices as well as more confident about handling college coursework. Eleven out of nineteen reported increased interest in exploring transportation-related careers and/or post-secondary education after high school. Most participants also reported that after the camp they: 1) now better understand how

transportation professionals identify and solve problems that impact them in everyday life (18 out of 19 respondents); 2) better understand how important innovation is for transportation (15 out of 19 respondents); and 3) have better developed problem-solving skills (12 out of 19 respondents).

Table 1 below provides a breakdown of student responses to end of program evaluation questions.

What I learned and experienced at this camp will help me make decisions about my major, my choice of college, and even my career eventually.

Table 1: End of Program Survey Summary

	Number of Responses				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
STI Participant Goals					
1. I was able to meet other students with interests similar to mine.	10	6	2	1	
2. I was able to design and build projects.	12	7			
3. I was able to learn more about careers in transportation.	14	4	1		
4. I had fun while attending STI.	8	9	2		
5. STI helped me prepare for college.	4	7	7	1	
6. I was able to learn more about engineering.	10	6	3		
7. I would recommend the STI to other students.	7	8	3	1	
8. I was able to learn more about Montana State University.	7	11	1		
9. Before the STI, I was interested in majoring in engineering.	8	4	6	1	
10. After the STI I would consider majoring in engineering.	6	7	4	2	
11. Before the STI, I was interested in attending MSU.	1	9	3	5	1
12. After the STI, I would consider attending MSU.	2	13	3	1	
13. The camp helped me to understand better the importance of college preparatory class work.	2	9	4	4	
14. I feel more confident now about making future college and career choices.	2	8	7	2	
15. I feel better able to work on a team project.	4	7	7	1	
16. I feel more confident that I can handle college courses.	1	9	7	2	
17. I am more interested in exploring transportation-related careers/post-secondary education after high school	2	9	4	2	2

	Number of Responses				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Speakers					
1. Camp presenters were knowledgeable and answered participants' questions.	10	8	1		
2. I enjoyed the camp guest speakers & presenters.	4	11	3	1	
3. I learned about the importance of different modes of transportation.	8	9	1	1	
4. I understand better how transportation professionals identify and solve problems that impact me in everyday life.	8	10	1		
5. I understand better how important innovation is for transportation.	7	8	3	1	
6. Camp presentations and activities helped me to develop my problem-solving skills.	6	6	6		1

List a few things you learned about transportation that you didn't know prior to coming to camp.

Through this camp, I learned several things about transportation. I learned how transportation engineers predict traffic flow and got a better look at the preparation it takes for analyzing and planning a major traffic construction project. I also learned about culverts, overpasses and underpasses for wild animal crossings, and bridge design to name a few.

Before this camp, I didn't realize all the working parts behind our state's transportation. I learned how there are tons of working parts to keep the roads in great condition and making travel better and more efficient for the public.

I never understood the amount of planning that goes into roads. I learned about the technologies that help keep the roads safe.

I learned about complete streets and how nice they are to have even though they are difficult and expensive to build. I also learned about how roads/highways are designed and how long it takes to design a road before you can begin to build it.

I didn't know how many careers were related to transportation.

I learned about wildlife crossings, what goes into road maintenance, how signs are made, and the engineering in bridges.

I didn't know how many different subjects listed under "transportation." I also didn't know how it affects every little thing around city areas to rural towns.

I learned more about how a highway was made, including software and cost. I did not know how long it took for a road construction project to finish.

How many factors go into designing and constructing roadways; how different materials are tested; how complex the software is.

I didn't know about snow science.

I learned all about how roads are mapped out and designed. I also learned more about bridges and how they work.

I learned that being an engineer is very fun.

I learned about how many different parts were included in the department of transportation. I also learned about the process of having an idea turn into reality. I also learned that everything is super expensive in transportation.

What were the most interesting aspects of your field trips?

The most interesting aspects were touring the buildings, like the MDT HQ in Helena and the local MDT center here in Bozeman.

Being able to get into plow trucks at MDT mechanics shop.

Meeting the governor, seeing the inside of the air traffic control tower.

Getting to travel and meet those that work at transportation jobs and getting to learn about their jobs. Like getting to go to MDT headquarters and learn about all the different jobs that allow us to use roads and sidewalks.

I liked looking at machinery. I liked the behind-the-scenes look at how things work.

The most interesting aspects of my field trips were the interaction with other campers and the cool phenomena we witnessed. I had a great time going and seeing the Lewis and Clark caverns and the planetarium show and I enjoyed getting to know other campers and just having fun together on the field trips.

The most interesting aspect was going to the airport.

A majority of the field trips were engaging and a great break from the classroom.

I liked visiting the quarry as well as Lewis and Clark caverns. Driving out to Helena was very interesting, especially their sign building room and ironworks with how they modified snowmobiles.

The most interesting thing on the field trips was when Governor Bullock was the captain on our boat. It was also very interesting to learn about aviation at the airport.

I really enjoyed the field trips because we were able to go to public places and view all the behind the scenes. I really enjoyed learning about things I would question when just seeing them in my everyday life, such as, the airport, the Knife River plant, etc.

Which design/build activities did you enjoy most and why?

I enjoyed all of them, but I would say the gliders and crash attenuators. These were the best because our design visually and noticeably impacted their performance. I saw how our designs affected forces that acted on both the trucks and gliders, such as impact, collision, speed, deceleration, lift, drag and weight.

I enjoyed the gliders because we had the chance to test the gliders in the gym and also brought imagination and crafts to the planes that everyone enjoyed.

The design/build activity I enjoyed the most was the balsa bridges. I am very interested in structural engineering and I think bridge design is so cool. Because of this, I really enjoyed getting to design and build our own bridges out of balsa wood.

I enjoyed the crash attenuators the most. It was the most fun because it was fun to design ways to keep the egg from breaking.

My favorite activity was the bridge simulators that gave us the opportunity to build our own designs and see how they worked.

Crash attenuators (sending toy trucks down steep ramps and into a cinder block is fun).
Gliders (we could really be creative about the design and decoration).

My favorite activity was building the gliders because it was simple, fun, and could be really rewarding. The balsa bridge took a really long time to build and it was fun/sad seeing it snapped in half.

Please comment on the guest speakers and daytime activities. Which activities or speakers did you find the most interesting and why?

The guest speakers and the activities they gave us were fun because they first gave us a brief background on what they do and then let us do similar activities that relate to their jobs. I liked

the structural engineering project because we got to work with groups and figure out how to build a safe road for all the people using it, including bikes etc. but also keep it at a low cost.

I liked the career planning activity; it was interesting to see how well I knew myself. I also liked the speaker on the self-driving cars, as it is an interesting idea.

I liked the speaker on culverts because she had that cool machine that you could control the water flow and slope. I also liked the speaker on bridges because I learned a bit and got to use a fun program, bridge builder.

Most interesting was the materials lab (pulling apart the metals and polymers). Breaking things and using lab equipment is fun.

One speaker I found interesting was Danielle Scharf for the Kagy redesign; she gave a lot of interesting and good information on the project.

My favorite speakers were the ones that talked about civil engineering (the guy who broke steel with us) and the guy who talked about roadway logistics. They were both very informing and engaging.

I really enjoyed Dr. Berry's talk. He made his talk interesting and fun.

I found that all the guest speakers were interesting because their jobs seemed fun and I never knew they existed.

I really enjoyed when the speakers talked, but then involved us in an activity that applied what we had just talked about. Especially with Dr. Berry, when we crushed cement and rebar.

There were a lot of guest speakers and it is hard to remember each one individually, but what I do remember about them as a whole is that they knew what they were talking about. Some of the speakers had us do stuff (e.g. investigate a crash scene) which made it more memorable and fun.

How do you think you will apply what you learned at camp over the next few years?

I plan to continue my studies and I plan to go to college for robotic or structural engineering. This camp helped me explore more of the hobbies I was already highly involved in.

It will definitely help me pick and choose a job easier.

I will never look at a sidewalk in the same way.

I will use what I learned to help make college and career choices.

I will apply what I learned every time I go to do something involving design and/or transportation.

I think that it could help open more career options for me. I will be more aware of options that I have for the future.

I think that over the next few years, what I have learned at camp will make a difference in my college education. I have definitely been inspired to become an engineer, and possibly go to MSU.

It has helped me learn more about what field of engineering I want to do. The camp helped me learn about the distinctions between civil and mechanical engineering. I am now excited to pursue mechanical engineering.

I have a better idea of what I want to major in. I am more aware of transportation safety issues (don't crowd the plow, etc.). I will use my knowledge to help with school projects and reports.

I think that I learned a ton about what it's like to be an engineer and now I know which type of engineering I like most; this will help me pick a major.

I think I will apply by being a better student and getting to know more about building things.

I definitely know that I'm not so interested in Civil Engineering and won't pursue it. I will be able to take these teamwork skills and living on a campus for two weeks and be able to use it through my college life.

I might go for a minor in one of these careers.

Once I go to college I may learn to be a engineer.

Please share any additional comments about camp organization, staff, or activities.

The camp was the most exciting and funnest camp I've been to! The staff were always friendly and funny with us.

Everything was great. Overall the staff was fantastic and Joel, John and Kaylyn were great leaders and mentors and it was amazing to be able to spend time with them.

I had a great time at camp and have no complaints!

Fewer speakers/activities that are only powerpoints. Add more hands-on activities such as the ones we did.

A little more down time from 7 to 10. There was always activity, so just make a little bit of time to just hang out.

Were you interested in transportation careers before attending camp? Are you more interested in exploring careers in transportation now?

I wasn't really interested in transportation-related careers before. I am definitely more interested in exploring careers in transportation, like structural engineering or roadway design, or the electronic side of transportation.

No, I wasn't. And yes, I'll look more into engineering now because some field of engineering were pretty interesting and the presenters also looked like whatever field of engineering they were in, that they loved their job which made it look interesting.

I was somewhat interested. Now I am more interested.

Before this camp I had never considered a career in transportation. After this camp I am definitely more interested in at least looking at jobs/careers in transportation.

My career assessment showed that engineering might not be my best career path.

I was not before, but I would now consider being a pilot.

I wasn't interested that much before the camp. I'm not really interested after the camp either. I found that it just wasn't a good fit for me and didn't interest me.

I was very interested in transportation before the camp and now I am more knowledgeable about it. I am still interested in transportation.

I was interested in becoming a civil engineer, a structural engineer specifically, before attending camp. That being said, meeting Mike Berry and getting to design our own bridges, both on the computer and during the balsa bridge project has inspired me more to be a civil engineer.

Yes, and I am a lot more interested now.

I wasn't interested in transportation careers before, but now I am interested in some of them.

7 SENIOR SURVEY DATA

Each year, the project director mails out a survey to past STI participants following the completion of their final year of high school. The survey is designed to obtain information on how the camp impacted their career and college choices after high school. Data from forty-six respondents is included in the 2009-2016 annual reports. One program alumnus from the 2014 program contacted the Program Director this year and reported that he had enrolled in an Environmental Engineering program at Montana Tech. He additionally stated:

The WTI summer camp got me thinking about going to school for hydrology and an environmental based major. It was a useful tool for my career exploration and I am grateful that I attended.

An additional eleven senior surveys were distributed to 2017 high school graduates via email. To date, two responses has been received from the recent graduates surveyed. One reported that she is currently attending a two-year program in Interior Design and a four-year program in Business Management at MSU Gallatin College and MSU respectively. While the STI did not impact her decision to attend college, it did help in choosing a major and in preparing for college entrance. In comments on how the Summer Transportation Institute affected choices made after high school, the respondent commented:

During WTI camp last year I got to learn about various types of engineering and transportation jobs. I found out that I did not want to become an engineer, which I had been considering, but I didn't really have any knowledge about the real-world applications of it. The one thing I did learn about and get to experience that inspired me was flying. I want to become a private pilot. Getting to fly at Summit Aviation was a great experience, one that I think should continue to be in the program because it is very fun and educational.

However, although becoming a pilot is an option in college, I decided to pursue that later on in life. Instead I decided to go with two of my other passions: design and business. I am studying an Associates in Interior Design and a Bachelors in Business Management.

Getting to spend two weeks on campus helped prepare me for college life, familiarized me with campus (which was very, very helpful!) and gave me a heads-up as to how a college class is. Camp did not affect my decision to attend college, or where, because I was planning on going to college, and at MSU, but it definitely helped me to choose my major and my direction of study. I think that continuing this camp would be great! It gave us 2016 campers a lot of helpful knowledge and experiences, and I believe it would do so for others as well.

The second respondent is currently enrolled in a four-year Mechanical Engineering program at MSU. He reported that the STI experience did impact his decision to attend college by showing him that MSU was a good fit. He commented, "After the STI program, I felt reassured that my choice to pursue a degree in mechanical engineering was the right one. I also gained a better understanding of the MSU campus which lead to me deciding to go to college there."

A follow-up letter will be sent to the other nine 2017 graduates who have not yet responded to the emailed survey, and any new data received will be incorporated into future project reports.

8 RECOMMENDATIONS

The 2017 program continued to benefit from collaborations with public and private sector industry representatives who contributed new curriculum modules and field trip experiences. The program will continue to actively seek partnerships of this kind in future years. The program will also continue to provide participants with a multidisciplinary perspective on transportation-related applications by seeking out collaborators from a variety of academic disciplines. Finally, the partnership with the Montana Gear Up program was successful in facilitating better outreach and support to students from underserved schools and should be continued in future years.

9 APPENDIX A: SECTION 1 ATTACHMENTS

NATIONAL SUMMER TRANSPORTATION INSTITUTE PROGRAM - ANNUAL REPORT

SECTION I: INTER-MODAL ADVISORY COMMITTEE (IAC)

State: Montana	
Fiscal Year: 2017	**Host Site: Montana State University**

Name:	Chad Welborn
Title:	Design Supervisor
Organization:	MDT Design Unit

Name:	Patti Schwinden
Title:	Division Chief
Organization:	Montana Department of Transportation, Civil Rights

Name:	Scott Keller
Title:	Adjunct Instructor
Organization:	MSU Civil Engineering Department

Name:	Bob Seliskar
Title:	Program Management Analyst & Civil Rights Specialist
Organization:	Federal Highway Administration, Montana Division

Name:	Danielle Scharf
Title:	Associate/Senior Engineer
Organization:	Sanderson Stewart

SECTION I: PARTNERS/SPONSORS

State: Montana	
Fiscal Year: 2017	**Host Site: Montana State University**

Name:	Jeff Modrow
Title:	Flight Instructor
Organization:	Summit Aviation
Role/Contribution:	Airport tour arrangements

Name:	Leo Zwenke
Title:	Manager
Organization:	Knife River
Role/Contribution:	Asphalt & Concrete mix plant and gravel pit tour

Name:	Montana ITE Chapter
Title:	
Organization:	
Role/Contribution:	$400 program sponsorship
Name:	Kyle Demars
Title:	Maintenance Division Chief - Bozeman
Organization:	Montana Department of Transportation
Role/Contribution:	MDT Maintenance tour

Name:	Danielle Scharf, PE
Title:	Engineer
Organization:	Sanderson Stewart
Role/Contribution:	Transportation Engineering presentation
Name:	Chad Welborn & Danae Giannetti
Title:	Design Unit Supervisor, Engineer
Organization:	MDT Design Unit
Role/Contribution:	CAD presentation; Design Unit overview & crash attenuator assistance; transportation planning boards

SECTION I: SUMMER TRANSPORTATION INSTITUTE PROGRAM STAFF

State: Montana Fiscal Year: 2017	**Host Site: MSU Western Transportation Institute**

Name:	Dr. Katey Plymesser
Position Title:	Assistant Professor, Civil Engineering (hydrology lab)
Affiliation:	Civil Engineering, Montana State University

Name:	Dr. Mike Berry
Position Title:	Professor (Infrastructure materials)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Dr. Patrick McGowen
Position Title:	Research Professor (Transportation Engineering)
Affiliation:	Western Transportation Institute, Montana State University

Name:	Michelle Akin
Position Title:	Research Engineer (Geotechnical Engineering)
Affiliation:	Western Transportation Institute, Montana State University

Name:	Dr. Damon Fick
Position Title:	Professor (Structures/Bridge design)
Affiliation:	Civil Engineering Department, Montana State University

Name:	Rob Ament
Position Title:	Program Manager (Road Ecology)
Affiliation:	Western Transportation Institute, Montana State University

Name:	Dr. Rob Maher
Position Title:	Department Head (robotics)
Affiliation:	Electrical Engineering Department, Montana State University

Name:	Rebecca Gleason
Position Title:	Research Associate (Livability/Active Transportation)
Affiliation:	Western Transportation Institute

Name:	Dr. Craig Shankwitz
Position Title:	Research Engineer (Autonomous & Connected Vehicles)
Affiliation:	Western Transportation Institute

NATIONAL SUMMER TRANSPORTATION INSTITUTE PROGRAM - ANNUAL REPORT

SECTION I: SUMMER TRANSPORTATION INSTITUTE PROGRAM STAFF

State: Montana	
Fiscal Year: 2017	**Host Site: MSU Western Transportation Institute**
Name:	Susan Gallagher
Position Title:	STI Project Director
Affiliation:	Western Transportation Institute

Name:	LeeAnn Swain
Position Title:	STI Academic Program Coordinator
Affiliation:	Western Transportation Institute

Name:	Joel Seeley
Position Title:	STI Teaching Assistant
Affiliation:	Western Transportation Institute

Name:	Jonathan Santos
Position Title:	Residence Hall Advisor (STI)
Affiliation:	Western Transportation Institute

Name:	Kaylyn Myers
Position Title:	Residence Hall Advisor (STI)
Affiliation:	Western Transportation Institute

10 APPENDIX B: DEMOGRAPHIC SUMMARY REPORT

FY 2017

National Summer Transportation Institute Program - Demographics Data Sheet

State:	Montana	Project Director:	Susan Gallagher
		Program Dates:	July 16-28, 2017
Host Site:	Western Transportation Institute	Program Length:	2 weeks

Select Grade Level		**Applicant Data**	
High School	X	Number of Applications Received:	31
Middle School		Number of Participants Selected:	20
Select Program Classification		Number of Participants that Completed the Program:	19
Residential	X	**Geographic Representation of participants**	
Non-Residential		Number of Cities: 11	Number of Counties: 11	Number of States: 1

	Race/Ethnicity							**Gender**		**Disability**	**Grade Level**					
	African American	Caucasian	Hispanic American	Native American	Asian American	Pacific Islander	Other	Male	Female	Targeted Disabilities*	7	8	9	10	11	12
Number Of Participants:	1	14	2	3	1	1		15	4					7	5	7

Provide Type(s) of *Targeted Disabilities: N/A

Schools Represented	
Name/City/State	Name/City/State
Big Sky High School/Missoula/MT	Skyview High School/Billings/MT
Hellgate High School/Missoula/MT	Lustre Christian High School/Wolf Point/MT
Shepherd High School/Shepherd/MT	
Sunland Christian/Helena/MT	
Stillwater High School/Lakeside/MT	
Billings High School/Billings/MT	
Browning High School/Browning/MT	
Custer County High/Miles City/MT	
Colstrip High School/Colstrip/MT	
Hamilton High School/Hamilton/MT	
Homeschool/Clancy/MT	

11 APPENDIX C: STI SCHEDULE

2017 Summer Transportation Institute at Montana State University

Week 1: July 17 – July 23

Monday, July 17	Thursday, July 20
9-9:30am: STI Orientation (STI Staff) [WTI Classroom, Rm 333] **9:30am-11:30am:** CSI Jr. (Crash Scene Investigators with NTSB) (Kristi Dunks) [WTI classroom] **Noon-1pm:** Lunch (Miller Dining Hall) **1:00-2:00pm:** Intro to CE (Anders Larson) [Cobleigh Hall, 202] **2-4:00pm:** Structures & West Point Bridge Design (Damon Fick, CE) [Cobleigh 202 & Tait Computer Lab]	6:30am: Breakfast and pick up sack lunches 6:45am: Depart for Tour of Montana Department of Transportation Headquarters (Helena) 8:30-9am: Welcome, Governor Bullock (MDT Commission Room) 9-11 am: Tours of MDT shops/labs (Sign Shop, Equipment Shop, Geotech Lab, Materials Lab) 11am-12pm: ADA exercise 12-12:30pm: MDT Division Presentations/ Overview (MDT Commission Room) 2pm-4pm: Gates of the Mountain ferry ride
Tuesday, July 18	Friday, July 21
9am-10am: College 101 (Admissions Counselor, Elicia Palmer) [WTI Classroom] **10am -10:40am:** Balsa Bridge team work **10:50am-noon:** Campus Tour (SUB-2nd floor Admissions office) **Noon-1pm**: Lunch **1-2pm**: ECE Robots (Rob Maher) [CB 608] **2-3pm:** Coding project (Computer Science) [Barnard, room 254] **3pm-5pm:** Crash Attenuators [CB202]	**8:30am-9am**: Strong Interest Inventory- [CB Tait Computer Lab] **9am-noon**: Intersection counting and traffic simulation study (Pat McGowen, WTI) [Tait Lab] **Noon-1pm**: Lunch (Miller Dining Hall) **1-3pm**: Bike/Ped transportation and Complete Streets [WTI Classroom] (Taylor & Rebecca) **3-4:30pm**: Transportation Planning activity boards (Danae Giannetti)
Wednesday, July 19	Saturday/Sunday July 22-23
8:30am-10:30am: Balsa bridge project [WTI Classroom, Rm 333] **10:30-11am:** Kagy redesign (Danielle Scharf, Sanderson Stewart) **11am-11:30:** MDT Design Unit/CAD demo (Chad Welborn, MDT) **Noon-1pm:** Lunch [Miller Dining Hall] **1-2pm:** Hydrology/Hydraulics (Plymesser) [CB 103, Hydraulics Lab) **2-4pm:** Concrete introduction and lab; concrete testing (Mike Berry, CE) [CB202/Bulk materials lab]	**Sports and Enhancement Activities** Saturday - Lewis and Clark Caverns- (8:00am departure from Miller; pick up sack lunches). Check in at 10am. 10:15am-12:15pm: Cave tour Sack lunches/picnic/hike Sunday – Museum of the Rockies

Week 2: July 24 – July 28

Monday, July 24	Thursday, July 27
9-11am: Soil Reinforcement and Retaining Walls (Michelle Akin) [CB 202/209] **11am-noon:** SubZero lab tour **Noon-1pm:** Lunch (Miller Dining Hall) **1-3:30pm:** Gear Ratios and Mini Car Project (Joel Seeley) [WTI classroom] **3:30-5pm**: Balsa bridges	**8:30am-9:15am**: Connected Vehicles (Shankwitz) [WTI classroom] **9:15-10:15am**: Road Ecology (Rob Ament) **10:15am-noon**: Test balsa bridges (CFT2 lab) **Noon-1pm:** Lunch (Miller Dining Hall) **1-2pm:** Final evaluations; transportation knowledge post-test (Jeopardy) [WTI classroom] **2-4pm:** Closing ceremony preparation
Tuesday, July 25	Friday, July 28
8:15am: Depart for Gallatin Field Airport [from Miller; pick up sack lunches] **9am-noon**: Field trip to Gallatin Field Airport and tour with Summit Aviation (Jeff Modrow) **Noon-1pm**: Lunch (Belgrade Park) **1pm-2pm**: Knife River tour (asphalt & concrete mix plant/gravel pit) **2:30-3:30pm:** MDT Maintenance tour (Kyle Demars) **4pm-5pm**: Glider team design/build project [WTI classroom]	**Morning:** Packing and Dorm Check Out [parent pick up from dorms by 10am – participants and families meet at WTI at 11am for Closing Ceremony] **11am-Noon:** Camp farewell lunch and presentations (for all families) [WTI Classroom, Room 333]
Wednesday, July 26	
9am-10:30am: Complete balsa bridges & gliders (prep for competitions) **10:30am-12pm:** Career Planning (Cathy Nolan, Career Services) [WTI classroom, Rm 333] **12-1pm:** Lunch (Miller Dining Hall) 1-2pm: Materials Testing (Maddy, ME) [Barnard Hall, 008F] **2-4pm**: Final glider team prep/presentations and flight tests (Romney gym)	