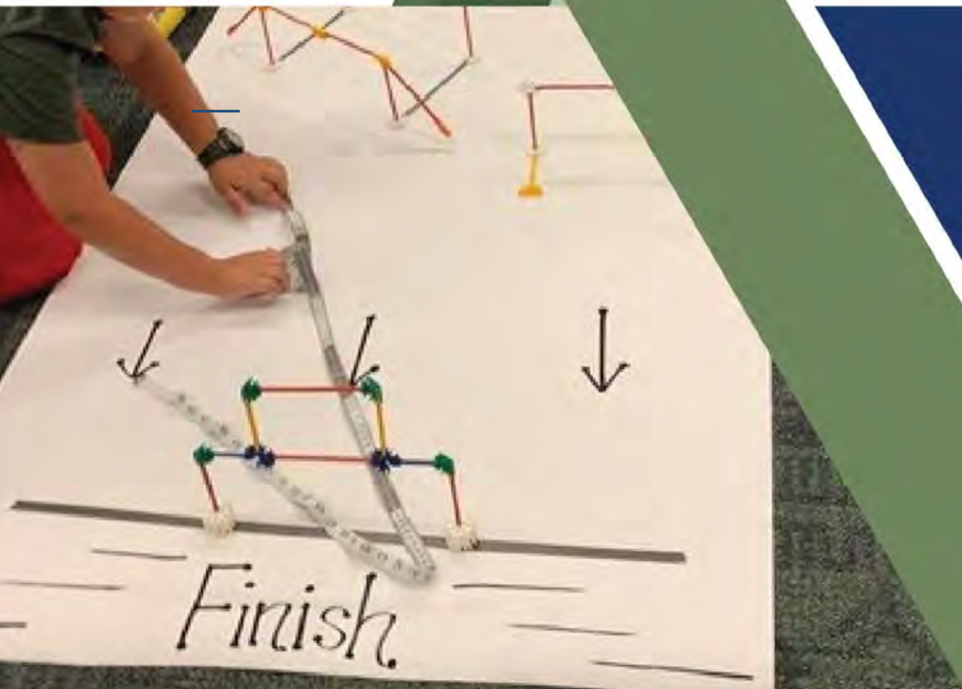

K-12 FINAL REPORT

Tennessee Technological University

December 2019

STEM in Motion at Tennessee Tech University

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STRIDE | Southeastern Transportation Research, Innovation, Development and Education Center

UF | Transportation Institute UNIVERSITY of FLORIDA

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16. Abstract

The purpose of this K-12 project, titled *STEM in Motion*, was to provide teachers with the tools and resources necessary to incorporate transportation topics into their middle school science and mathematics lessons. In addition to using a transportation focus to enhance science and math learning via tangible applications, this method attempted to introduce transportation-related career paths to students early on. This approach aimed to achieve the STRIDE goal to enhance the workforce development potential in the transportation field by introducing these topics to middle school students. The early introduction of such fields to students may increase the probability of more young people pursuing transportation as a career.

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DISCLAIMER

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1.0 Introduction

The purpose of this K-12 project, titled *STEM in Motion*, was to provide teachers with the tools and resources necessary to incorporate transportation topics into their middle school science and mathematics lessons. In addition to using a transportation focus to enhance science and math learning via tangible applications, this method attempted to introduce transportation-related career paths to students early on. This approach aimed to achieve the STRIDE goal to enhance the workforce development potential in the transportation field by introducing these topics to middle school students. The early introduction of such fields to students may increase the probability of more young people pursuing transportation as a career.

2.0 Educational Program

STEM in Motion was a middle school teacher workshop with the intent to provide middle school teachers with knowledge about how to incorporate transportation topics into their mathematics and science lessons. This workshop was developed through collaboration between the College of Engineering and the Oakley STEM Center at Tennessee Tech. The development also benefitted from several discussions with the STRIDE management to ensure an approach that was not duplicating other efforts.

The first two days of the workshop focused on training the participants on relevant transportation material. This approach enabled the team to exercise the delivery of this content with small groups of students. The participants were responsible for the development of their own lessons implementing transportation topics covered during the first two days of the program. The participants then came back on the third day to share their lessons and discuss any challenges or successes with the rest of the group. In our initial approach, we did not want to impose additional requirements for follow up reporting on the teachers. We felt this would have added to their workload and could have impacted their receptiveness to participate in the program.

3.0 Program Logistics

Workshop Dates:	June 25, 2019 (Full Day)
	June 26, 2019 (Full Day)
	August 24, 2019 (Half Day)
Workshop Location:	Oakley STEM Center at Tennessee Tech
Number of Participants:	16 Teachers
Participant Contact Hours:	18 hours and 30 minutes
TN Counties Served:	Putnam County
	Macon County
	Overton County
	Smith County
	Hamilton County
	Jackson County

4.0 Program Collaborators

The two and a half-day STEM in Motion workshop was facilitated through collaboration between the Tennessee Tech University College of Engineering, College of Education, and the Oakley STEM Center. Table 1 presents a summary of the roles of the collaborating units and Table 2 presents a summary of the individuals involved in the program and their associated roles.

TABLE 1 – PROGRAM COLLABORATORS

Group	Contribution
Millard Oakley STEM Center	Marketing and participant recruitment; Organized workshop including recruiting session facilitators, scheduling, and managing logistics
College of Engineering	Facilitated session on introducing transportation in the classroom; Facilitated session on the future of transportation
College of Education	Facilitated session on effective STEM practices; Facilitated discussion about Dream Big video; Co-facilitated crash prevention lesson; Facilitated session with Pro-Bots; Facilitated session with mouse trap cars and stopping distances on different surfaces; Facilitated session to analyze and compare example lessons and resources with what is known about effective STEM practices; Facilitated session program debrief and participant lesson share out; Assisted with session on introducing transportation in the classroom

TABLE 2 – PROGRAM FACILITATORS

Name	Position	Role
Carlos Galindo	Oakley STEM Center Outreach Coordinator	Marketing and participant recruitment
Lydia Johnson	College of Engineering Ph.D. Student	Facilitated session on introducing transportation in the classroom
Dr. Vahid Motevalli	Associate Dean for Research & Innovation; Professor of Mechanical Engineering	Facilitated session on the future of transportation
Dr. Jennifer Meadows	College of Education Assistant Professor	Facilitated session on effective STEM practices; Facilitated discussion about Dream Big video; Co-facilitated crash prevention lesson; Co-facilitated session with Pro-Bots; Co-facilitated session with mouse trap cars and stopping distances on different surfaces; Co-facilitated session to analyze and compare example lessons and resources with what is known about effective STEM practices; Co-facilitated session program debrief and participant lesson share out
Kelly Moore	College of Education Lecturer	Co-facilitated crash prevention lesson; Co-facilitated session with Pro-Bots; Co-facilitated session with mouse trap cars and stopping distances on different surfaces; Co-facilitated session to analyze and compare example lessons and resources with what is known about effective STEM practices; Co-facilitated session program debrief and participant lesson share out
Miguel Perez	College of Education Ph.D. Student	Assisted with session on introducing transportation in the classroom
Dr. Darek Potter	Millard Oakley STEM Center Director	Organized workshop including recruiting session facilitators, scheduling, and managing logistics

5.0 Program Discussion

This section provides both the originally anticipated agenda for each day of the workshop as well as a detailed discussion about actual workshop activities. The lessons/activities developed for the workshop are now available for use during student expeditions at the Oakley STEM Center. Future workshops and any outcomes communicated by the teachers will be made available through the Oakley STEM Center website and other modes of communication.

Workshop Day 1 Agenda (June 25, 2019)

<u>Original Planned Agenda</u>

8:30 – 9:00	Check-in (Continental breakfast provided)
9:00 – 9:30	Introductions / Program Outline / Participant Responsibilities
9:30 – 12:00	Effective STEM Practices (STEM Education Faculty – TTU College of Education)
12:00 – 13:00	Working Lunch (Skype Program – University of Florida)
13:00 – 14:00	Incorporating Transportation in the Classroom (Faculty – TTU College of Engineering)
14:00 – 15:00	Introduce Crash Prevention lesson by NanoSonics
15:00 – 16:00	Group discussion. Analyze and compare lesson to what we know about effective STEM Practices. Discuss potential lesson modifications

Workshop Day 1 Discussion

The first day of the workshop began with introductions, program outline, and overview of participant responsibilities by Dr. Darek Potter, Oakley STEM Center Director. Following this was a session about the future of transportation presented by Dr. Vahid Motevalli, Associate Dean for Research & Innovation and Professor of Mechanical Engineering. Participants were intrigued by his talk and asked many questions about topics such as flying cars and autonomous vehicles.

The next session was about effective STEM practices facilitated by Dr. Jennifer Meadows, College of Education Assistant Professor. In this session, participants explored habits of mind necessary for students to be successful in STEM education. This included examining the practices from each of the silos in STEM as well as English Language Arts (ELA)—a subject tested in every grade level among our participants. These siloed practices included:

- Science & Engineering: The Next Generation Science Standards (NGSS) are science content standards that set the expectation for what students should know and accomplish. The science and engineering practices dimension describes how scientists engage in investigating and building models and theories about the natural world; and how engineers incorporate key engineering practices as they design and build models and systems.

- Technology: The Association for Computing Machinery, Code.org, Computer Science Teachers Association, Cyber Innovation Center, and National Math and Science Initiative have collaborated with states, districts, and the computer science education community to develop conceptual guidelines for computer science education (K-12 Computer Science Framework Steering Committee, 2016). These guidelines include the seven technology (computational) practices. The guidelines are designed to transform computer science into a subject accessible for all.

- Engineering: Within the publication, *Engineering in K-12 Education: Understanding the Status and Improving the Prospects*, the Engineering Habits of Mind are described as skills needed for citizens in the 21st century (Katehi, Pearson, & Feder, 2009).

- Mathematics: The Common Core State Standards include the Standards for Mathematical Practice, which describe a variety of expertise that mathematics educators at all levels should seek to develop in their students.

- English Language Arts: The Common Core State Standards for English Language Arts notes seven student capacities. As students advance through the grades and master the standards in reading, writing, speaking, listening, and language, they will be able to exhibit with increasing fullness and regularity these capacities of the literate individual.

Participants analyzed all of the practices of these STEM silos to create their own lists of what STEM practices are necessary for students to be successful in an integrated approach to STEM. In this session, we also looked at exceptional resources for use in the STEM classroom.

During a working lunch on day 1 of the workshop, participants watched Dream Big. After viewing this movie, participants discussed how this could be used in the STEM classroom. The discussion included how this movie could be used to motivate underrepresented groups in STEM.

Lydia Johnson, a Ph.D. student in the College of Engineering, facilitated a session on introducing transportation in the classroom. This session included the following topics:

- What is transportation?

- Why is transportation important?
- How do we transport things?
- How do you use transportation?
- What are possible jobs?
- How can “too much” transportation be bad?
- “We Need a Road” Activity

Kelly Moore, College of Education Lecturer, and Dr. Jennifer Meadows, College of Education Assistant Professor, co-facilitated a crash prevention lesson by NanoSonics.

The NanoSonics session focused on the following student learning objective: When you learn to drive you may learn the “3 second rule” that suggests you should leave about three seconds of time between you and the next vehicle. To accomplish this, pick a fixed object like a road sign, and count three seconds between when the car in front of you passes it and when you do.

- Why do you think the “3 second rule” is important?
- If you are traveling at a high rate of speed or if the roads are wet would the 3 second rule change?

We can determine why the 3 second rule is important by using some math.

Participants worked through the module that focused on this objective by using already recorded data. They also discussed how to help students collect this data on their own.

Kelly Moore, College of Education Lecturer, and Dr. Jennifer Meadows, College of Education Assistant Professor, co-facilitated a session to introduce Pro-Bots. These programmable vehicles were coded for speed and distance traveled to create specific patterns. Participants were challenged with creating a butterfly pattern using the Pro-bots.

Workshop Day 2 Agenda (June 26, 2019)

<u>Original Planned Agenda</u>

8:30 – 9:00	Check-in (Continental breakfast provided)
9:00 – 10:30	Introduce newly-developed and expandable lesson on vehicle stopping distances. Lesson topics include distance, velocity, acceleration, reaction times, driving distractions, friction, and how roadway conditions can impact stopping distances
10:30 – 11:30	Participants practice Stopping Distance lesson
11:30 – 12:00	Share-out on Stopping Distance lesson
12:00 – 13:00	Working Lunch (Skype Program – University of Florida, or faculty at Tennessee Tech University)
13:00 – 15:00	Participants present both Crash Prevention lesson and Stopping Distance lesson to small groups of students
15:00 – 16:00	Group discussion/brainstorm potential lessons for participant development
16:00 – 16:30	Program debrief and discuss next steps

Workshop Day 2 Discussion

The second day of the workshop began with a session on mouse trap cars, which was facilitated by Kelly Moore, College of Education Lecturer, and Dr. Jennifer Meadows, College of Education Assistant Professor. This session included brief instructions on how to make sudden-stopping mouse trap cars and how to use them to test stopping distances on various surfaces (sand, oil, and water). Participants created their own recording sheets to record data and then calculate how stopping distances were impacted due to the various surface changes. The different surfaces tested included oil, water, and sand. The participants noted that their students would be interested in such an activity as they could easily relate this to their own lives such as the car line at school, when riding with their parents, or even when playing near roadways.

The participants then had about 2 hours to work in groups to use what they had learned over the course of the workshop to develop their own lessons to be used with students later in the day (and in the classrooms). These lessons were tested and prepared during this time. After this collaboration and a working lunch, participants came back to together to share their lessons with the group. One group utilized the Pro-Bots to create a coding challenge for students. They were directed on how to code the robots and challenged to use what they know about distance and speed to draw either a snowman or a butterfly with the Pro-Bot. Another group also used the Pro-Bots. They designed an obstacle course with K-Nex. Students were given the challenge to again code the robots to successfully navigate the course. One group used the mouse trap cars and the lesson presented on stopping distances impacted by various surfaces. The participants made a chart for the students to record their data, asked students to collect data on various surfaces, and then discussed the impacts of each material on the stopping distances of the mouse trap cars through the use of the Claim-Evidence-Reasoning framework. The remaining group replicated the activity facilitated by Lydia Johnson, College of Engineering student. This activity challenged students to determine the most optimal route between a town and a new education center. Students were able to describe some factors engineers must consider during project planning; consider and evaluate multiple criteria; recognize that no design can meet everyone's need, but the most optimal design will be the best one given the circumstances; and understand that sustainability plays a role in transportation engineering. These objectives were accomplished as students first laid out a route between a city and new education center that is analyzed on the basis of cost alone. Students then revisited their designs and planned a road based on an expanded set of criteria.

Students rotated through four groups to participate in all of the lessons. After the lessons were completed, participants came back together to reflect on their experiences. The teachers all commented on the benefit of the opportunity to work together in both planning and implementing the lessons. The discussion turned to the participants creating their own individual lessons to be created for the follow up day of the workshop.

Workshop Day 3 Agenda (August 24, 2019)

<u>Original Planned Agenda</u>

8:30 – 9:00 Check-in (Continental breakfast provided)

9:00 – 11:00 Lesson share out. Teacher groups share their lessons and discuss challenges/successes

11:00 – 12:00 Program Debrief

Workshop Day 3 Discussion

The third day of the workshop involved all of the teacher participants sharing their developed lessons. Please refer to Appendix A for copies of the referenced lessons.

6.0 Program Evaluation

An evaluation survey was completed by all participants after day two of the workshop. Table 3 summarizes the results of the survey. As shown in Table 3, the results were overwhelmingly positive. Please refer to Appendix B for a compilation of the actual completed surveys.

TABLE 3 – PROGRAM EVALUATION SURVEY SUMMARY

	Survey Questions	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
		1	2	3	4	5
1	The objectives of the training were clearly defined.	0	0	0	2	14
2	Participation and Interaction were encouraged.	0	0	0	0	16
3	The topics covered were relevant to me.	0	0	0	4	12
4	The content was organized and easy to follow.	0	0	0	2	14
5	The materials distributed were helpful.	0	0	0	3	13
6	This training experience will be useful in my work.	0	0	0	4	12
7	The trainers were knowledgeable about the training topics	0	0	0	1	15
8	The trainers were well prepared.	0	0	0	2	14
9	The training objectives were met.	0	0	0	2	14
10	The time allotted for the training was sufficient.	0	0	0	2	14
11	The meeting room and facilities were adequate and comfortable.	0	0	0	0	16
12	I feel confident about checking out items at the STEM Center Lending Library.	0	0	0	3	13

References

K-12 Computer Science Framework Steering Committee. (2016). K-12 computer science framework.

Katehi, L., Pearson, G., & Feder, M. (2009). Engineering in the K-12 education. Understanding the states and improving the prospects (Vol. 16). Washington, DC: National Academic Press. Early Childhood Education and Practice.

Appendix A – Teacher Developed Lessons

Lesson Title: Friction and Distance

Standards Addressed:
__Science__ 4.PS3.1 teams will use evidence to explain the cause and effect relationship between the distance of an object and the surface. 4.ETS2.1 use appropriate tools and measurements to build a model. 4.ETS2.2 Determine the effectiveness of multiple solutions to design problems given the criteria and constraints.
__Math__: 4.MD.A.1 use measurements to determine the distance

Targeted Objectives:
Teams will create a clothespin car. The teams will test the distance of the car on a variety of simple made ramps. Each ramp will have a different surface. Teams will note the differences in height of ramp and material on ramp. Teams will distinguish which surface has the greatest friction and how their clothespin car reacts to surface.

Brief Description: Teams of three will make a clothespin car. Clothespin cars are simply made. Use the site WWW.Craftsbyamanda.com/clothespin-car/ . This activity should take no more than forty minutes. As soon as, cars are made teams will begin making ramps. Example ramps can be seen on www.science-sparks.com. Teams will only need one or two ramps and various materials to cover ramps. This activity should take no longer than twenty minutes. Teams should start predicting how each surface will react.

Materials Needed:
Clothespin cars: clothespins, bread ties, straws, buttons, same size, and white glue. Ramps: Textbooks, folders, notebooks, or binders. Materials of different texture to place on the ramps. Provide various classroom objects to prop up ramps. Measuring tape and timer for results.

Procedures:
__Introduction__ - I will introduce the lesson by having the students help me fill in a KWL chart. KWL chart is a chart that tells what they know, want to know, and what they learn about the topic. I will show a video clip after we complete the graphic organizer. I will use the clip from https://www.youtube.com>watch titled Physics- What is Friction?

__Body__ - First teacher needs to have materials pre-arranged for each team. Teacher will assign each team member a task to complete while in the group. The teams of three will complete the task. After the task is complete, the students should be able to try the ramps out. Once ramps have been made, teams should place material over them to cause friction. The goal is to see which ramp surface has the most or least friction. The teams will understand that friction can make you stop. Teams should measure from starting point on ramp to stopping point how far the car went from each surface.

__Closure__ - In closing, I will gather the students back to the KWL chart and we will complete graphic organizer with remaining information. I will have the students to make predictions as to why schools may close in the winter. Exit ticket will include defining Friction and distance traveled.

Sources:
www.Craftsbyamanda.com/clothespin-car/
www.science-sparks.com
https://www.youtube.com> **Physics- What is friction?**

Lesson Title: Transportation of the 19th Century Grade/Level: 8th Grade

Curriculum Standards
8.40 Analyze the development of roads, canals, railroads, and steamboats throughout the U.S., including the Erie Canal and the National Road.
Lesson Objective(s)
TLW Research the history of roads, canals, railroads, and steamboats. *TLW* Present the importance of roads, canals, railroads, and steamboats and how it still impacts us.
Assessment/Evaluation
Formative (Informal)*:* • Bell Ringer Paragraph: Students will write a paragraph over "What would happen if bikes, cars, trains, ships, planes, or any form of transportation was never invented?" • Notetaker: Students will use this notetaker during presentations. As the other students present the research they have collected students will answer questions on their notetaker. • Exit Ticket: Students will quickly write two or three sentences over what they next big mode of transportation will be and why they think that. Summative (Formal): • Presentation:
Instruction
Set/Motivator: 1. When students walk into class there will be a writing prompt on the board, "What would happen if bikes, cars, trains, ships, planes, or any form of transportation was never invented?" 2. Students will have five minutes to write a paragraph answering the prompt. 3. When students are finished, I will ask students to share what they wrote, creating a class discussion. 4. I will address the students by saying "If we did not have any forms of transportation, the only way we could get around would be walking. How many miles is your house away from school? How many miles is your house away from your favorite restaurant? Did you know it takes the average person 20 minutes to walk a mile? If you lived 5 miles away from the school it would take you 100 minutes to talk to school every day and do not forget you will have to walk back home after. Instructional Procedures/Learning Tasks: 1. In the early 19th century traveling was much more difficult and slower, children and poor adults walked everywhere, there were a few farmers that had horse and wagons. If you were wanting to pull heavy loads you had to use much slower oxen. But in the 1790s

started the Transportation Revolution that changed America and the way we travel for forever. The revolution introduced our country to roads, canals, railroads, and steamboats.

2. Today in class you are going to research these forms of transportation and popular routes. I will break you up into six different groups and you will create a slide show and present it to the class as they take notes in a notetaker. You will need to answer the following questions in your slide show:
   - What is it?
   - When was it invented?
   - Who invented it?
   - What was it used for?
   - Why is it important?
   - Cool Fact

   Students will have 30 minutes to research and create a presentation about their topic. Students will create their presentation using Google Slides. The topics for the groups are the following:
   - Roads
   - Railroads
   - Canals
   - Steamboats
   - Erie Canal
   - National Road
3. While students are working on their presentations, I will walk around the classroom making sure students are on task and assisting any students that need help.
3. When students are finished with their slide shows they will present it to the class. Students observing the presentation will be taking notes on a notetaker.

Closure:

1. Technology is advancing every day and we have come a long way from roads, canals, railroads, and steamboats. What do you think the next transport revolution will be? Let's watch this video and see some possible ideas. (https://youtu.be/bi9n5mUDYn8)
2. When the video is over have the students write which idea they think could be possible and why for an exit ticket.
3. When student have completed the exit ticket, they will turn in bell ringer, notetaker, and exit ticket to the appropriate basket.

Lesson Title: Raft Building

Standards Addressed:
6.ETS.1
6.SP.B4
6.SP.B5

Targeted Objectives: Students will design a raft, build it, and identify how many pennies can be placed in the raft in order for it to continue to float.

Brief Description: Students will have access to a variety of materials that can be used to design and build a raft. Students will work in groups in order to first design a raft that will float in a tub of water. Once the raft will float, the students will guess how many pennies they think their raft will hold before it sinks.

Materials Needed: 10 straws, tape, rubber bands, pennies, string, tub for water

Procedures:
Introduction- Students will be introduced to this activity by talking about canoeing, rafting, kayaking, or even floating on a tube or float in the water. Discuss what makes things float. Find out from students what they already know about this topic. Play a Kahoot to develop or reinforce background knowledge.
Body- Explain that the students will be working in groups or partners to design and build a raft that will float in a tub of water. Each group will be given 10 straws, tape, rubber bands, and string along with a handout for them to sketch and design their raft. Once they have planned and designed the raft, they will be ready to build it. Explain that changes may need to be made as they go through the design and building process. Give the groups time to build the rafts. Once the raft has been built, students will need to test their raft in the tub of water to see if it will float. If it doesn't float, they will go back and redesign and then test again. If the raft floats, they will be ready to see how many pennies their raft can hold before sinking. Before they test this, each group should guess how many they think it will hold. This information should be documented on the handout they are given. Students should graph their results.
Closure-The whole group will come back together to discuss what worked and didn't work as they designed and tested their rafts for whether they would float. We will also discuss how many pennies the rafts were able to hold before sinking. As an extension, we could discuss other materials that could be used to build the rafts or other materials that could be placed in the rafts. The students will also be asked to write about the successes and issues they had during all processes of this activity.

Sources: https://create.kahoot.it/details/5756aa2e-1c57-4757-a330-ce33b1edfc0b
file:///C:/Users/GinnieJackson/Downloads/STEMRaftChallenge.pdf

Lesson Title: Slope and Distance

Lesson Overview: Slope/ Rate of Change is a big concept in 8th grade. In order to help students better understand the concept, they need to be given hands on activities to connect the abstract concept with real world situations. In this lesson, the student will determine which ramp slope will allow a Hot Wheels Car to travel the longest distance.

Standards: 8.F.4 and 8.F.5

Materials:

- Hot Wheels Car
- Ramps made out of sturdy cardboard
- Various items to make the ramp adjust to differ heights
- Measuring Tape
- Recording sheet
- Pencil

Introduction: I will introduce the lesson by showing a video https://www.youtube.com/watch?v=0TbR22ot6As called the car and the ramp.

Lesson:

Throughout the room there will be five stations. At each station there will be a Hot Wheels Car and a ramp. The ramp's slope will be different for each station. In groups, the students will move to each station and conduct the following:

1. Find the slope of the ramp. This is done by using a tape measure and rise/run. (Remind the students that Rise is the vertical height from the floor to the top of the ramp. The Run is the horizontal distance under the ramp.)
2. Record the rise, run, and slope on the data sheet. Convert the slope into a decimal by dividing the rise by the run.
3. Starting at the top of the ramp, release the car and let travel down the ramp. When the car stops, measure the distance the car traveled and record on the data sheet. Repeat three times and then determine the average distance traveled.

When finished students will then use their data sheet to answer questions about slope and the outcome of each ramp.

Closing:

The students will have a whole group discussion based upon their data and written response. We will discuss how this affects us in everyday life.

Slope and Distance Data Sheet

	Rise Distance	Run Distance	Slope of Ramp	Trial 1 Distance	Trial 2 Distance	Trial 3 Distance	Average Distance
Station 1							
Station 2							
Station 3							
Station 4							
Station 5							

1. Which car traveled the greatest distance? Why?

2. As the slope of the ramp increases, what happens to the distance the car travels?

3. Was there anything that surprised you? Why or Why not?

4. How does slope affect us in everyday life?

Lesson Title: Cars and Fuel Efficiency

2 day lesson

Standards addressed: Ratios, proportions, unit rates

Introduction: Students will do research on different types of cars and build mouse trap cars to represent each type of car. They will look up combustion engines, power assist vehicles, dual mode vehicles and all electric cars. Choices will be given for what car models they may choose. They must choose one car.

Combustion- 1969 chevelle, 1970 charger

Power assist- 2016 ford f-150, 2014 mini cooper, and 2015 Jaguar F-type

Dual mode- (Hybrids) prius, fusion, G-max

All electric- Nissan leaf, BMW i-3, tesla model 3

Body: Day 1: as groups, students will build the mouse trap cars. Numbers will be assigned to the groups and weights will go with the numbers. After the cars are built and the weights are applied, they will be lined up and judged on distance. Some students may see the weights are being a disadvantage, which it should. After they are judged on distance a few times, we will all gather in the room and discuss why some had weight and some didn't. Talk about the different types of cars. Day 2: students will have chrome book and must look up fuel efficiency for the type of car they chose. They must find out how much gas mileage each gets per gallon (how long before you have to charge an electric car). Do you have to pay to drive an electric car (for charging)? If so how much and are their many charging stations in each city? How long must they charge? After the research is complete on fuel efficiency, students will be given locations to travel to and must calculate cost to get to this location by miles per gallon. More research must be done to get the driving distance. Plan for stops and fill ups

Closure: Students will be able to see the advantages and disadvantages of all types of cars. Lead a group discussion to point out the pros and cons of each. Do electric cars need oil changes? Discuss which is the best way to travel.

Targeted Objectives: advantages to the environment and wallet versus looks

Materials needed: Chrome book, sheet for gas mileage, calculator

Teacher cheat sheet

Car type	Gas mileage per gallon (how long before charge)	How large is the tank? How many gallons will it hold.	Cost of gasoline per gallon. Cost to fill it up. (stops to charge electric car/time)
1969 chevelle	8.9		
1970 charger	9.7		
2016 ford F-150	22		
2014 mini cooper	36		
2015 Jaguar F-type	24		
Toyota Prius	52		
Ford Fusion	42		
C-max	40		
Nissan Leaf	114		
BMW i-3	114		
Tesla model 3	132		

Possible destination and distance

Destination	Driving miles	Cost to get there
Cookeville to Destin	511.6	
Cookeville to Los Angeles	2089	
Cookeville to New York	818	
Cookeville to Las Vegas	1878	

Lesson Title: We have liftoff!

Standards Addressed:

Science - 2.PS3: Energy 1) Demonstrate how a stronger push or pull makes things go faster and how faster speeds during a collision can cause a bigger change in the shape of the colliding objects.

3.PS3: Energy 1) Recognize that energy is present when objects move; describe the effects of energy transfer from one object to another.

4.PS3: Energy 1) Use evidence to explain the cause and effect relationship between the speed of an object and the energy of an object. 2) Observe and explain the relationship between potential energy and kinetic energy.

5.PS2: Motion and Stability: Forces and Interactions 2) Make observations and measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Math - 2.MD.A.3 Estimate lengths using units of inches, feet, yards, centimeters, and meters.
4.MD.A.1 Measure and estimate to determine relative sizes of measurement units within a single system of measurement involving length, liquid volume, and mass/weight of objects using customary and metric units.

Targeted Objectives:

Students will consider propulsion of a rocket, and launch a rocket as thrust is created using a chemical reaction.

Brief Description:

Students will make a rocket that is based around a 35mm film container. They, with an adult's help, will place water into the container and a piece of an alka seltzer tablet. After placing the rocket onto a table, the rocket will blast off. Students will measure how high it is thrust into the air.

Materials Needed:

35mm film canisters with caps
Rocket Template
Scissors
Tape
Alka seltzer tablets (broken into about ¼ tablets)
Water
Syringe
Goggles (to wear during flight testing)
Stop watch (to record flight length - from pop to landing)
Before time: Attach a tape measure to a wall vertically so rockets may lift off next to it and the height of the flight may be estimated.

Procedures:

Introduction - Show first 2 minutes of video of last liftoff of space shuttle. Ask students what happened to allow the rocket to liftoff. Allow responses. Guide students to realize the rocket had to have some type of fuel to thrust it into the atmosphere.

Body - Today we are going to use a different type of reaction to make a rocket liftoff.

1. Pass out rocket templates and film canisters. Students may use crayons or markers to decorate their rockets before attaching them to their canister. They will follow directions of Rocket Template page to put the rocket together. (Remind students that the canister must be able to open to receive the propellant. The lid must be on the bottom of the rocket.)
2. With younger students the adult should add water and alka-seltzer to the canister, shake it, and set down on the ground to watch it lift off.
   Older students may add 1 oz water (use the syringe to measure water) to the canister with ¼ tablet, replace lid, shake quickly, then set down and back up to watch liftoff.
3. Students should try to gauge how high each canister travels and keep record on a graph.

Trial Number	Height	Flight Length

4. Variables to change are the amount of water placed into the canister and amt of Alka-seltzer, as time allows.

Closure- What causes the rocket to lift off? *Chemical reaction between the alka-seltzer and water builds up pressure inside the canister and causes the lid to pop off while the rocket is propelled skyward.*

(If different quantities of water and/or alka-seltzer were used…) *Which combination of alka-seltzer and water worked the best? Compare graph information to interpret. Columns may be added as needed.*

What could we do to make the rocket liftoff even higher? *If we could increase the pressure inside the canister the rocket would fly higher. We could make this happen by increasing the amount of alka-seltzer inside the canister or taping the lid on so there is more time for pressure to build.*

Sources:
Video of last liftoff of space shuttle https://youtu.be/7XKBe2bqCVQ
Space craft template
NASA propulsion lessons
https://www.nasa.gov/sites/default/files/atoms/files/rockets_away_k-12.pdf
https://www.beano.com/posts/beano-makes-paper-rocket

Lesson Title: Engineering Ramps

Standards Addressed:
Science
5.ETS1: Engineering Design 1) Research, test, re-test, and communicate a design to solve a problem. 2) Plan and carry out tests on one or more elements of a prototype in which variables are controlled and failure points are considered to identify which elements need to be improved. Apply the results of tests to redesign the prototype. 3) Describe how failure provides valuable information toward finding a solution.

Targeted Objectives:
Determine the angle and material covering on a ramp that results in a vehicle's moving the fastest. Young kids learn by exploring, observing, and figuring out the way things work by experimenting, and exploring ramps and friction encourages this.

Brief Description:
Students will work in groups to figure out the angle and material covering on a ramp that will result in the vehicle moving the fastest.

Materials Needed:
Wood for ramps
Different toy cars
Materials to wrap ramps
Items to set up different angles for the ramps (books, chairs, tables, boxes, etc.)
Protractor
Yard stick

Procedures:
Introduction- Students will begin the lesson by watching a video of Victoria Schein is an automotive design engineer for Ford Motor Company in Dearborn, Michigan. She designs products that will be used in future Ford vehicles to keep drivers safe on the road. Students will then be told they will be engineering a ramp with different angles and materials to see which results in the fastest. They will first be asked to sketch a picture of what ramp and material they believe will be the fastest.
Body- Next students will be testing their prototype, they will then sketch and redesign their prototype at least three time to find which ramp and material result in the vehicle moving the fastest. They will be asked to measure the angles and the distance the car traveled.
Closure- In closing students will have exit ticket in which they must describe and sketch the ramp that allowed the car to move the fastest. They will also be asked to answer how failure in their prototypes allowed them to design a faster ramp.

Sources:
https://www.ite.org/pub/?id=0FBD0464-019D-BF13-61C4-FF5B270A4845
https://www.nbclearn.com/engineering/cuecard/117012

Lesson Title: Penny Cars: Does Weight Matter?

Standards Addressed:
Science-8PS2.4. Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
Math- 8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

Targeted Objectives:
Students will demonstrate and explain Newton's Second Law which states how changes in an object's motion depend on the sum of the external forces on the object and the mass of the object.

Students will also calculate, understand, explain, and graph the relationship of time, distance, speed, and mass.

Brief Description:
Students will conduct an experiment to determine the effect of mass on the distance that a student-made car will roll. Students will calculate the effect that mass has on the acceleration of the car based on the distance the car will roll. Students will then determine how far the car will roll if more mass is added. A graph will be plotted to analyze the data obtained to develop a conclusion.

Materials Needed:
30 Pennies Per Car
Masking tape
Meterstick or Measuring Tape
Small Car Ramps
Student-made Car (or TTU CD Rom Car)
Printer Paper
Optional: Textbooks for elevation

Procedures:
Introduction: Students will be introduced to Newton's Second Law of Motion prior to the experiment as the experiment will be reinforcing the content. They should be given an entrance ticket followed by a review that incorporates questions regarding speed, velocity, acceleration, and Newton's Second Law, which can be described with the formula F=ma. Students must also be reminded that gravity is a constant and will work on all cars the same (9.8 m/s/s).

Students should then watch the TED Ed video on Newton's Law's of Motion:
https://www.youtube.com/watch?v=kKKM8Y-u7ds

Body- Students will then explore Newton's Second Law of Motion by conducting an experiment with hand made cars. The students can make their own car ahead of time or use the hand made cars provided by TTU (the CD rom cars created for the friction activity during TTU's STEM in Motion Summer PD). The following procedure will be followed for the experiment:

1. Ask students to predict and hypothesize how the different masses will affect the distance that each car travels based on their knowledge of how mass affects force and acceleration. Record all information and data in the experiment handout or a science notebook.

Students should also determine the independent, dependent, and at least 3 constant variables for the experiment. (Example: independent variable: the distance the car traveled; dependent variable: number of pennies; constant variables: height of ramp, car being used, same person letting go of the car at the top of the ramp, etc.)

2. Students should gather materials and set up the experiment. If pre-elevated ramps are unavailable, use books to elevate the ramps (height will depend on the number of textbooks available and number of groups). Make sure the different groups use the same number of books (three is a good recommendation).

3. Students will conduct three trials to prove their hypothesis: one trial with no weights, one trial with fifteen weights, and one trial with thirty weights. To hold the pennies on the car, a small container that will fit on top of the car can be taped or the students can make origami boxes using this tutorial: https://www.youtube.com/watch?v=kFCR-0YyOEs
If students are working in groups, one individual can easily do this step. Tape will be used to attach the container or paper box to hold the weights to the top of the cars.

4. Student will begin each trial a total of three times and an average will be taken based on the three points of data. Students will measure the distance the car travels. Enforce to students to keep ramp angle, release height, etc. consistent as they should only be testing one variable at a time. Have students create a data table for recording their distances, as shown below.

5. Once students have completed the lab, they should place their materials away as they found them. They should then create a graph that represents the data obtained in their data tables. They should make a bar graph with the x axis representing the number of trials and the y axis representing the distance.

6. Ask students to answer the following questions in their science notebook:

- How does increasing mass (adding weights) affect the acceleration of the object?
- Explain your results in terms of Newton's Second Law (Acceleration= Force/Mass) and show work.

- How can this be applied to a real world situation where a cars mass can be a large contributing factor?
- Who would be interested in your findings? How might your data be of help to someone of interest?

Number of Pennies	**Distance (cm) Trial #1**	**Distance (cm) Trial #2**	**Distance (cm) Trial #3**	**Average Distance (cm)**
0				
15				
30				

Closure- After the students complete the lab, have a class discussion on how adding mass changed the acceleration of the car. Ask students to use their data to back up their arguments. If time permits, allow students to make predictions on how adding more pennies would affect the acceleration of the car.

Sources:
TED Ed Video of Newton's Laws: https://www.youtube.com/watch?v=kKKM8Y-u7ds
Origami Box Video: https://www.youtube.com/watch?v=kFCR-0YyOEs
Great website to explain motion, acceleration, and Newton's Laws: http://www.physics4kids.com/files/motion_intro.html

Lesson Title: Ultimate Airplane

Standards Addressed:
5. ETS1.1 Research, test, re-test, and communicate a design to solve a problem.
5.ETS2.1 Use appropriate measuring tools, simple hand tools, and fasteners to construct a prototype of a new or improved technology.

Targeted Objectives: Students should learn more about the scientific process through a fun experiment of making and flying a paper airplane.

Brief Description: The Engineering Design Process is used in this lesson. Each page of the student packet is labeled with the step of the process and a short description of what the step involves. In this STEM experience, your students will be exploring with paper airplanes, experimenting using different sizes, different kinds of paper, adding weight, and designing a final airplane by examining the data collected and using it to make the ultimate airplane. We used the PowerPoint as a guide for our lesson each day and to assist with questioning. This lesson can be condensed to fit your time frame.

Materials Needed:

Paper for making airplanes
Copies of the student lab packet
Masking tape or clear tape
Paper clips to use as weights
Measuring tools
Calculators

Procedures:
Refer to the Power Point Presentation for the Unit on the Ultimate Airplane Design. You may adjust to fit the needs of your students.
Day 1-Science inquiry and Scientific Method
Day 2-Technology, Tools, Microscope
Day 3-Customary vs International System of measurements (Length, mass, volume)
Day 4-Review with White board Practice
Day 5-

1. Teach Vocabulary

*Prototype-a model
*Research-activity that produces information or evidence
*Observe-watch and notice something carefully
*Hypothesis-statement of opinion that predicts the relationship between 2 variables
*Variables
Independent-the variable that changes
Dependent-the responding variable that is measured
Control-the variable that don't change
*Failure Point-point when an experiment stops working

2. Make airplanes and brainstorm variables using data sheet provided.

Day 6-Test your variables.
Day 7- Design the best plane based on data collected.
Day 8-Present findings if wish to teach Science Project Display Boards
Day 9-Review for test
Day 10-Test

Sources:

American Book Company: Grade 5 Science: Tennessee TN Ready standards review book

Lesson Title: Newton's Laws of Motions

Standards Addressed:

<u>Science</u>

- 5.PS2: Motion and Stability: Forces and Interactions
- Test the effects of balanced and unbalanced forces on the speed and direction of motion of objects.
- Make observations and measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- Explain that a force is a push or pull in a certain direction.
- Identify, diagram and explain the effects of balanced and net forces on motion.
- Demonstrate that forces can change the speed and direction of an object's motion.

Targeted Objectives:

To validate Newton's Laws of Motion

Brief Description:

In this experiment designed for use with PASCO Capstone software, students use this collection of equipment to discover or experimentally determine the first of Newton's Laws.

- Newton's First Law: Students examine an object's motion to see if it changes when forces are applied or not.
- Newton's Second Law - Students use the Smart Cart to discover the relationships between force, mass and acceleration
- Newton's Third Law - Using the force sensors from two Smart Carts, students prove that forces between objects are equal in magnitude yet opposite in direction. These experiments include both tug-of-war exercises and collisions between cars.

Materials Needed:

horizontal dynamic track, PASCO pass-cart, motion sensor connected to the Science Workshop Interface, lab stand, balance

Procedures:

Newton's Laws are the essential part of Dynamics—the area of physics that studies the cause of motion experienced by an object. The interaction between objects is measured by a physical quantity—force. A Force Is a vector quantity, and it can be presented as an arrow.

The arrow shows the direction in which the force is being applied, and the length of the arrow shows the magnitude (size) of the force. The two types of forces are contact forces and field forces. Examples of contact forces are friction force, normal force, and tension force. Examples of field forces are gravity force and electromagnetic force. Usually there is more than one force applied to an object.1To predict the type of motion an object will experience due to forces acting on it, a net force needs to be calculated.

A net force is the vector sum of all the forces that act on the object. Newton's First Law states that an object will be at rest or will maintain constant velocity motion until a nonzero net external force acts on it. In Other words, if the vector sum of all the forces applied to an object (or net force) is zero, the object stays at rest or is moving with constant velocity. The system of reference where this fact holds true is called an inertial system of reference. If the forces are not balanced (which means a net force does not equal zero), the object will move with constant acceleration, which will be directly proportional to the net force and inversely proportional to an object's mass.

Newton's Second Law of motion can be summarized by the following equation, a=ΣFm,(1)where ΣF represents a net external force acting on an object, m is the mass of the object moving under the influence of ΣF, and a is the acceleration of that object. ΣFandaare vector quantities while—mass—is a scalar quantity. If ΣF= 0, thena= 0, and the object moves at constant velocity as stated in Newton's First Law.If the mass is constant, then the acceleration is a linear function, ory=mx+b,(2)of the net force. After comparing equations (1) and (2), one can see that the slope of this linear graph equals the inverse value of the system mass. slope =1m(3)In this case, uncertainty in the experimental value of the system's mass can be found using the rules of error propagation 1 for=x n since slope =m−1.Δslopeslope=||||Δmm||||(4)

Newton's Third Law establishes the connection between the action-reaction pair of forces. If two objects collide with each other, then the force of the action will be equal to the force of reaction in magnitude but opposite in direction. Note that in this case, the action and reaction forces applied to the different objects cannot balance(cancel) each other even if they are equal in magnitude. In this lab, you will validate the first and second laws using a motion sensor and pass-cart(s) moving along a horizontal aluminum track.

Closure- Quiz

1. Who was the scientist who gave us the Laws of Motion?
2. How many Laws of Motion are there?
3. What is another name for the first law of motion?
4. Which law explains why we need to wear seatbelts?
5. Which law says that force is equal to mass times acceleration (F=MA)?
6. Which law says that heavier objects require more force than lighter objects to move or accelerate them?
7. Which law explains how rockets are launched into space?
8. Which law says that for every action there is an equal and opposite reaction?

Sources:
https://www.youtube.com/watch?v=aA_mqSzbkM0
https://www.youtube.com/watch?v=mn34mnnDnKU

Lesson Title: Critical Load

Lesson Overview:
This lesson will explore rate of change and the concepts of structural engineering. Students will learn how to calculate rate or change and how to measure the critical load, or maximum weight a structure can bear.

Lesson Synopsis:
Students will work in teams to design and build structures that must be transported on top of a pasco car for a specific distance. Students will learn about basic structures, how to reinforce, materials selection, and will be designing and building a prototype structure to hold increasingly greater weights. In addition, students will learn how to calculate rate of change by timing how long it takes to safely transport their structure for the predetermined distance. The goal is to be the fastest team to safely transport the "largest" structure.

Standards:
7.RP.A
7.RP.B

Materials:
- Pasco Cars (one of each team)
- Materials to build structures (cardboard, wood blocks, scotch tape, etc)
- Distance Markers (used when moving structure)
- Weights
- Pencil
- Student Resource Sheet (below)
- Student Worksheet (below)

Introduction:
The lesson will begin by letting students go to http://greatstructures.info/ and exploring different structures found all over the world.

Lesson:
1. Give each student the student reference sheet. These may be read in class or provided as reading material for the prior night's homework.
2. Provide each student team with materials and ask them to devise a structure that will hold the most weight. They are to plan out their structure, and build a prototype for testing. Allow 20 minutes for planning and execution.
3. Instructor places weights on each team's prototype increasing the weight until the structure fails. Students chart the maximum load each prototype successfully held (the amount just prior to failure)
4. If needed, students will make adjustments to structure. After making adjustments, students will place the highest amount of weight on their structure that they feel is possible.

5. Students will then place their structure on a Pasco car and push/pull the car a certain distance. Each team can push/pull at their own speed. Time will be kept for how long it takes to transport the structure.
6. Direct students on how to calculate rate of change. Have each team calculate unit rate for their structure.
7. As a class, discuss which team carried the most weight in the fastest amount of time. Lead a discussion as to which structure a company would purchase if the goal was to transport a structure the quickest? Heaviest? Both? If time didn't matter? Etc

Closing:
Have each team reflect on why they think their design did well or failed. Ask students how would they adjust the design if they could do it again?

Critical Load Student Resource: Civil Engineering Challenges

What Civil Engineers Do
Civil engineers are problem solvers, meeting the challenges of pollution, traffic congestion, drinking water and energy needs, urban redevelopment, and community planning. This activity focuses on the work of structural engineers who face the challenge of designing structures that support their own weight and the loads they carry, and that resist wind, temperature, earthquake, and many other forces.

Famous Building Failures
The John Hancock Tower in Boston, Massachusetts is said to have been "known more for its early engineering flaws than for its architectural achievement." Wind-induced swaying was so large, it was said to cause motion sickness for people on the upper-floors. This problem was solved by adding a pair of 300-ton dampers on the 58th floor. Another unrelated but serious problem was that 65 of its 10,344 floor-to-ceiling plate-glass windowpanes fell out of the building to the ground during construction -- luckily no injuries resulted to either workers or passersby! Another example is a library built at Syracuse University in the late 1970's was built without having taken into consideration the weight of the books!

Famous Structures
- The Stratosphere Tower in Las Vegas, Nevada, is the tallest free-standing tower (1,149 feet) in the United States, rising taller than Paris' Eiffel Tower, and the Tokyo Tower.
- The world's tallest bridge is in France and spans the Tarn valley. It is 2460m long and is supported by seven piers ranging from 77m to 244m in height.
- The Petronas Twin Towers in Kuala Lumpur, Malaysia, are the tallest office buildings in the world. They soar 451.9 metres from street level.
- The CN Tower in Toronto, Ontario, Canada has the title of "World's Tallest Building and Free-Standing Structure." It is 1,815' 5" or 553.33m tall.
- Canada also has the world's largest shopping and entertainment complex -- the West Edmonton Mall in Edmonton, Alberta. It spans 49 hectares (121 acres) and houses over 800 stores!

Efficiency Ratings and Critical Load

The efficiency rating measures the weight that will cause a structure to fail divided by the weight of the structure itself. The most efficient structures are strong and lightweight - a difficult combination to achieve. For example, roofers in areas which experience heavy snows must factor in the weight of a massive snowstorm into designing the strength of the roof. The weight at which a building or structure fails is called the "critical load."

Critical Load Student Worksheet: Measuring Critical Load

Step One:

As a team devise a structure that can be transported 6 feet without collapsing and carrying up to 5 pounds.

> **Question: 1.**
> What is your team's strategy or plan for construction?
>
> **Prediction: 1.**
> Predict the "critical load" of your structure as you have designed it.

Step Two:

As a team, build your structure (prototype) for testing.

Step Three:

Your instructor will test your structure, and determine at what weight your team's structure will fail by adding measurable weights (coins, sand, other materials) until it collapses. This is your structure's "critical load."

Questions:

1. What was your structure's "critical load?"
2. How close were you to your prediction from Step One?
3. What aspects of your design do you think helped/hindered its ability to hold more weight?
4. What was the highest critical load in your classroom?
5. What was the difference in the winner's design and yours? Or…if your team had the winning structure, what do you think set your structure apart from the rest?
6. What was the unit rate of the pasco car when moving your structure?
7. If you had to transport your structure 20 feet, how long would it take? 5 miles?
8. Suppose you are the owner of Verizon and you need a new structure to act as a call center to be delivered as quickly as possible. Which of your classmates structure would you choose and why?
9. Suppose you live in an area with strong winds and need a structure for an office building. Which of your classmates structures would you choose and why?

Lesson Title: Hovercraft Racers

Standards Addressed:
Science-
8.PS2: Motion and Stability: Forces and Interactions
2) Conduct an investigation to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.
3) Create a demonstration of an object in motion and describe the position, force, and direction of the object.
4) Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
5) Evaluate and interpret that for every force exerted on an object there is an equal force exerted in the opposite direction.

Targeted Objectives:
*Understand that a force is a push or a pull that acts upon an object as a result of its interaction with another object.
*Understand that forces result from interactions.
*Understand that some forces result from contact interactions (normal, frictional, tensional, and applied forces) and other forces are the result of action-at-a-distance interactions (gravitational, electrical, and magnetic forces).
*Understand that for every action, there is an equal and opposite reaction.
*Understand that friction slows moving objects, but also allows them to be controlled.
*Predict characteristics of surfaces that might influence the amount of friction.

Materials Needed:
-1 compact disc (CD)
-1 plastic bottle with a cap (such as a Coke bottle, ~16 oz. size)
-1 balloon
-knife (to cut the top off the plastic bottle)
-drill (to put holes in the bottle cap)
-hot-glue gun (to be shared among groups)

Procedures:
Introduction- Discuss with students the concepts of Newton's 3rd Law and discuss how friction is related to Newton's Law . Ask what happens when you roll an object across the ground over grass vs. the sidewalk. Which is easier to ride your bike on? Why?
View the introductory video over hovercrafts and how they work. Students will also view the powerpoint about Newton's 3rd Law.
https://rcschools.edlioschool.com/apps/pages/index.jsp?uREC_ID=611944&type=d&pREC_ID=1638968
https://www.youtube.com/watch?v=Q-zGaZX1O5A

Body- Allow students to create and conduct experiments with the hovercrafts. Students will experiment with hovercrafts that have varying number of holes in them. Students will also experiment with their hovercrafts on different surfaces. As students are conducting their experiments, they will take notes on the performance of their hovercraft with varying holes and on different surfaces. Later students will discuss the movement of their hovercraft.

Closure- Students will have a whole class discussion based upon the evidence from their experiments and should be able to explain Newton's 3rd Law. Students will also visit the website below and complete the assessment to check for understanding.
https://www.rcschools.net/apps/pages/index.jsp?uREC_ID=611944&type=d&pREC_ID=1638968

Sources:

http://teachers.egfi-k12.org/hovercraft-racers/
https://www.rcschools.net/apps/pages/index.jsp?uREC_ID=611944&type=d&pREC_ID=1638968
https://www.youtube.com/watch?v=Q-zGaZX1O5A

Lesson Title: Day Five – I'm outta here….

It's been four long days and you have had enough. You look around you and all you see is hot steamy jungle, hot dry desert, crazy insects, and more poisonous snakes than you can count! It's time to get out of here any way you can! You gather up your remaining supplies and decide that you are going to build a raft to escape the island. You'd rather take your chances on the open seas than stay on this beach another day! You start to glance around your camp, taking in all the things you have available and an idea starts to form in your head……

<u>Directions:</u>

Using the materials that are available to you, construct a floating raft that can help you to sail across the ocean to safety. The craft must be able to float, have a means of propulsion (A sail of some kind), and hold up a set weight without sinking. Keep this in mind as you build.

You have:

80' of wood	1 popsicle stick = 5 feet
80' of rope	1 inch of floss = 5 feet of rope
8' by 8' of tarp	1 inch of paper = 1 foot of tarp
1 gallon of tree sap	1 glue stick = 1 gallon of tree sap

Lesson Title: "The Night Worker"

Standards Addressed:

Science-

- K.ETS1: Engineering Design 1) Ask and answer questions about the scientific world and gather information using the senses. 2) Describe objects accurately by drawing and/or labeling pictures.
- 1.ETS1: Engineering Design 1) Solve scientific problems by asking testable questions, making short-term and long-term observations, and gathering information.
- 2.ETS1: Engineering Design 1) Define a simple problem that can be solved through the development of a new or improved object or tool by asking questions, making observations, and gather accurate information about a situation people want to change. 2) Develop a simple sketch, drawing, or physical model that communicates solutions to others. 4) Compare and contrast solutions to a design problem by using evidence to point out strengths and weaknesses of the design.
- 2.ETS2: Links Among Engineering, Technology, Science, and Society 1) Use appropriate tools to make observations, record data, and refine design ideas. 2) Predict and explain how human life and the natural world would be different without current technologies.
- 3.ETS1: Engineering Design 1) Design a solution to a real-world problem that includes specified criteria for constraints. 2) Apply evidence or research to support a design solution.
- 3.ETS2: Links Among Engineering, Technology, Science, and Society 1) Identify and demonstrate how technology can be used for different purposes.
- 4.ETS2: Links Among Engineering, Technology, Science, and Society 1) Use appropriate tools and measurements to build a model. 2) Determine the effectiveness of multiple solutions to a design problem given the criteria and the constraints. 3) Explain how engineers have improved existing technologies to increase their benefits, to decrease known risks, and to meet societal demands.

Math-

- K.G.A.1 Describe objects in the environment using names of shapes. Describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, between, and next to.

(Many ELA standards also apply)

In Context Vocabulary-

- Engineer-someone who designs and tells people how to use machines
- Machinery-lots of machines that do different jobs
- Excavator-a machine used for digging
- Survey (this word appears twice in the story)-looking over an area of land
- "Stars shine like beacons"-we do not need to teach similes to our preschool children but it's nice for them to hear examples in stories and conversations, upper elementary should be able to identify and explain

- Mammoth-gigantic

Targeted Objectives:

- Introduce/Enforce the meaning of *engineers* and their role in the making of roads
- Construct models of roads with different surfaces using different tools(technology) and test said roads
- Make observations and draw conclusions on which surface types are more suitable and why roads are a necessity
- Describe how roads have changed based on societal need over the years

Brief Description: The teacher will engage students by introducing ***The Night Worker***. The book will be an interactive read aloud focusing on the job of the engineer in the picture book. After completion of the book reading and book talk, students will use dirt, gravel, hot wheels, etc. to construct road surfaces and designs. They are encouraged and reminded throughout the process to observe which surfaces are more desirable and which pieces of technology would be best for creating the best roadways.

Materials Needed:

- "The Night Worker" by Kate Banks (picture book)
- Dirt, gravel, grass surface, concrete surface, blacktop surface, etc.
- Hotwheels cars, miniature construction machinery (Tonka Toys)
- Paper and pencil for data collection

Procedures:

Introduction-

- Group discussion about engineers, roads, the need for both, what is needed to construct a road, book predictictions

Body-

- "The Night Worker" read aloud, book discussion
- Introduce items students will use to design roads, test road surfaces, see how technology is needed for each type of road surface, collect data

Closure-

- Share data findings (which surface is more desirable, how has technology had to change over time to ensure roadway desirability)

Sources:

https://www.coloring.ws/construction1.htm (for younger elementary students)
https://www.tn.gov/content/dam/tn/education/standards/math/ (math standards)
https://www.tn.gov/education/instruction/academic-standards/science-standards.html (science)
https://www.shopbecker.com/beckers-book-corner/the-night-worker/book-prompts/ (vocabulary definitions)

Lesson Title: BB8 on the Move

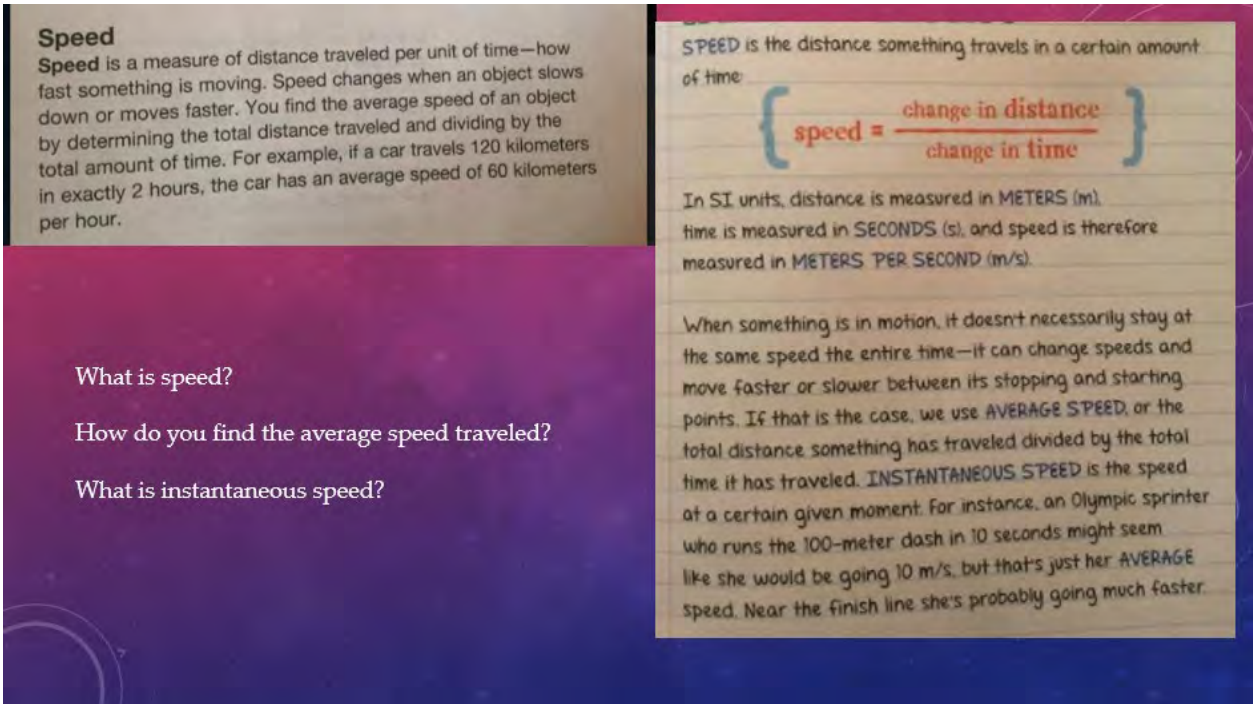
Standards Addressed:
Science-8PS2.3: Create a demonstration of an object in motion and describe the position, force, and direction of the object.
Math- 8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.

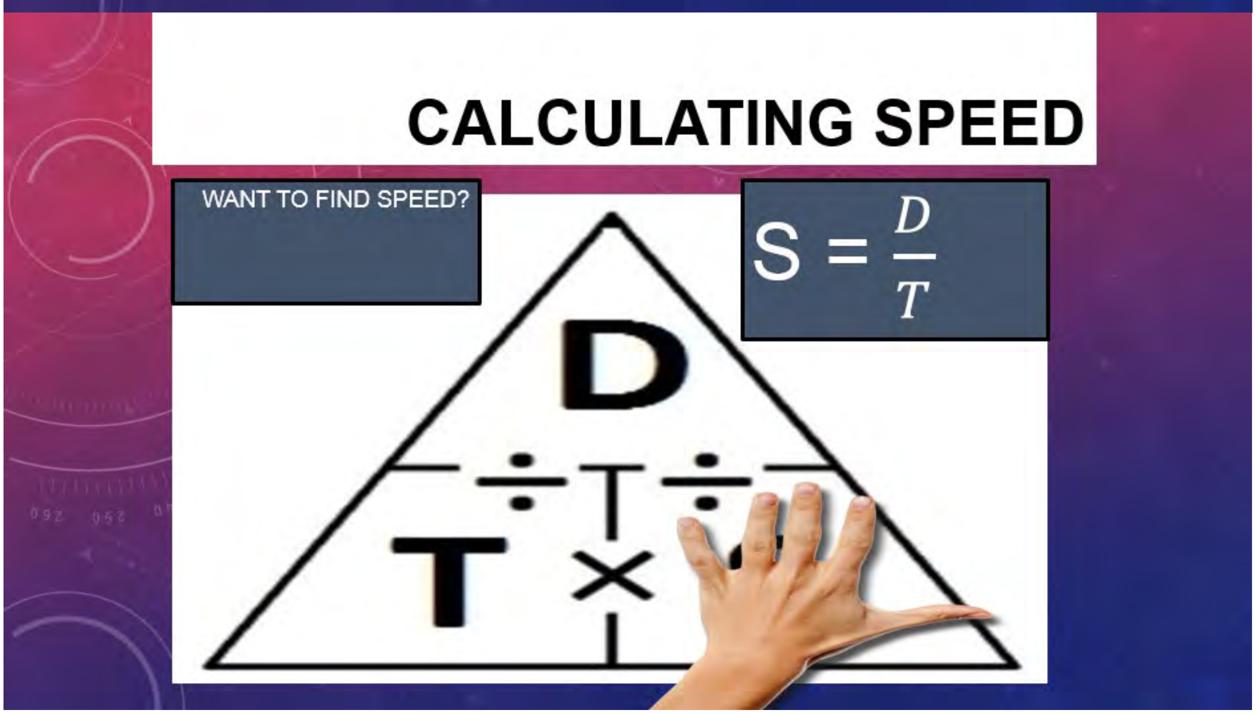
Targeted Objectives:
Students will calculate, understand, and explain the relationship of time, distance, and speed.

Brief Description: Newton's First Law deals with objects in motion staying in motion. In order to understand objects in motion, one must understand how to calculate average speed. In this activity, students will use a robot operated with a phone app to find speed when they already know distance and by recording time.

Materials Needed: Stopwatch, BB8 sphero (charged), tape of some color (could be painter's tape or just white?) Tape will be used on the ground as a track for BB8 to follow. A tape measure (the sewing kind is better than the handyman kind). A phone or iPad with the BB8 sphero app downloaded onto it.
Pen, graph paper, and trial record page to record the trials.

Procedures:
Introduction- Watch the video What is Speed safeshare video
Then, if they aren't sure how to calculate the average speed, the teacher can go over the concept using the PPT included in this folder. (see example slides below)





<u>Body</u>-
Students will calculate average speed.

1. Students will be placed in groups of 2-3 and given a roll of tape, a stopwatch, a BB8 Sphero (charged), an ipad or phone with the sphero app downloaded, a tape measure, a pen/pencil and a copy of the following recording paper.

Trial Number	Time Traveled	Distance Traveled

2. Pairs will put tape on the ground/floor in a path that they would like to have BB8 follow.
3. Once they have that down, they will take the tape measure and record the length of the path. (This will be the distance traveled for all of the trials.) They will record this on their paper.
4. The students will then place BB8 at one end and use the app to steer him to the end of the tape. (this will be for practice)
5. The students will practice on how to use the stopwatch.
6. The students will then take turns operating BB8 and the stopwatch. One will move BB8 along the tape to the end while the other measures the time elapsed. Then the partners will switch.
7. As students finish each trial they will record the time that it takes to travel the path.
8. Students will then take the times they recorded and plot them on the Y axis of the graph paper. The X axis will be for each trial.
9. Students will discuss what they notice about their results with the other pairs.

Closure- Questions to consider

1. Why is it important to find the average speed? *Speed is rarely constant due to the forces on earth. Due to the fluctuations, scientists typically find the average speed.*
2. Which variable was placed on the Y-axis of your graph? *The dependent variable, which is the one that changes or 'depends' on what is done to it.*
3. Which variable was placed on the X-axis? *The independent variable, which represents each trial/traveling down the path. This is why line graphs show "change over time."*
4. What would happen to your average if one of your trials was exceptionally different than the other trials? *It could skew the average to make someone think that BB8 on average was much slower or much faster than he was.*
5. What industries would this apply to? Do you think companies might inflate or deflate data? Why or why not?
6. Why do you think it is important to make sure your records are accurate? *Answers will vary*

Follow-up: Once you have finished this lesson, a good follow up is to continue graphing motion. I have included a ppt in this folder that uses Phet's Moving Man to continue to develop motion graphing skills. https://phet.colorado.edu/en/simulation/moving-man
The PPT is labeled PS2.3: Graphing Motion

Sources:
What is Speed Safeshare Video
Getting Started with BB8 Sphero Tutorial

Lesson Title: CD CAR

Lesson Overview: engineering and design often require applying principles of a specific design to another purpose. Students will learn how Karl Benz applied the concepts of the bicycle to combustion to invent the first self-powered automobile used for personal travel

Standards: 8.F.4 and 8.F.5 8.PS2

Materials:

- paper
- cardboard tubing
- straws
- string, yarn, or twine
- 4 CDs
- Paper plates
- Paper bowls
- Plastic spoons
- ramp

Introduction: I will introduce the lesson by showing a video http://vimeo.com/268983353 over the invention of the Dynashere

Activity Procedure

1. Ask students to think about these questions: who invented the wheel? When was it invented? How has the wheel changed the way we live?
2. Distribute the activity sheets. Students will read and highlight information and write responses. After students have responded to the first three questions, review and discuss their responses
3. Students will watch the video "Who invented the wheel" and discuss the key ideas such as rotary motion, water wheels, and pulleys
4. Introduce the term combustion. Discuss its process and how it takes place when oxygen, heat, and a fuel source react with each other
5. After students learn about the steam engine introduce Karl Benz 3 wheeled tricycle to the class.
6. After the students are exposed to all content divide your students up into teams. Review area and circumference of circles and review the team challenge, answering any questions the students have.
7. Once all questions have been answered direct the students to move on to the activity. Students will first begin with the assembly of their CD car
8. Upon completion of the car they will move the to the ramp with their CD cars for the challenge
9. After the students complete the challenge have them complete their activity sheet

Closing:
The students will have a whole group discussion based upon their data and written response. We will discuss how this affects us in everyday life.

Resources:
http://vimeo.com/26898353
http://www.history.com/shows/modern-marvels/videoes/who-invented-the-wheel#who-invented-the-wheel
http://www.howstuffworks.com/engine.htm
http://www.pitarta.com/discover/5wh/online.asap?story=28
http://vimeo.com/26894196

Appendix B – Program Evaluation Surveys

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

Learning with students to practice with.

14. What aspects of the training could be improved?

None - liked it ALL

15. How do you hope to change your practice as a result of this training?

More hands-on engagement and real-world problem solving for my students.

16. What additional STEM focused trainings would you like to have in the future?

More use of the STEM library items (Like practice)
And maybe grade-level examples aligned w/ standards.

17. Please share other comments or expand on previous responses here:

Thank you SO MUCH for this opportunity!

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	○	○	○	○	○
2. Participation and interaction were encouraged.	○	○	○	○	○
3. The topics covered were relevant to me.	○	○	○	○	○
4. The content was organized and easy to follow.	○	○	○	○	○
5. The materials distributed were helpful.	○	○	○	○	○
6. This training experience will be useful in my work.	○	○	○	○	○
7. The trainers were knowledgeable about the training topics.	○	○	○	○	○
8. The trainers were well prepared.	○	○	○	○	○
9. The training objectives were met.	○	○	○	○	○
10. The time allotted for the training was sufficient.	○	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	○	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	○	○	○	○	○

(*More questions on back →*)

13. What did you like most about this training?

Very Active and "hands on".

14. What aspects of the training could be improved?

Maybe a few more lessons on force, motion, speed, etc.

15. How do you hope to change your practice as a result of this training?

I will use the robot cars for sure this fall.

16. What additional STEM focused trainings would you like to have in the future?

Anything! Love getting new info for my "tool box".

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓				
2. Participation and interaction were encouraged.	✓				
3. The topics covered were relevant to me.	✓				
4. The content was organized and easy to follow.	✓				
5. The materials distributed were helpful.	✓				
6. This training experience will be useful in my work.	✓				
7. The trainers were knowledgeable about the training topics.	✓				
8. The trainers were well prepared.	✓				
9. The training objectives were met.	✓				
10. The time allotted for the training was sufficient.	✓				
11. The meeting room and facilities were adequate and comfortable.	✓				
12. I feel confident about checking out items at the STEM Center Lending Library.	✓				

(More questions on back →)

13. What did you like most about this training?

Our participation is helpful to the STEM center. Great to be a contributor.

14. What aspects of the training could be improved?

Even though the info was excellent, Dr. Montevelli's & Lydia's(?) ppt were a little deeper than necessary.

15. How do you hope to change your practice as a result of this training?

I will include technologies I can check out from the lending lab.

16. What additional STEM focused trainings would you like to have in the future?

Love being included!

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workship
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	○	✓	○	○	○

(More questions on back →)

13. What did you like most about this training?

Well-planned, usable examples, the Food!

14. What aspects of the training could be improved?

More lesson Plan examples (hard copies)

15. How do you hope to change your practice as a result of this training?

Continue improving my hands-on teaching through technology

16. What additional STEM focused trainings would you like to have in the future?

STEM in biology

17. Please share other comments or expand on previous responses here:

Best training I've had so far.

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

Real life experiences to use in the classroom

14. What aspects of the training could be improved?

N/A

15. How do you hope to change your practice as a result of this training?

Use more models

16. What additional STEM focused trainings would you like to have in the future?

Aligned to standards that can be easily pulled during units

17. Please share other comments or expand on previous responses here:

Very well planned out and a great experience

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workship
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(*More questions on back →*)

13. What did you like most about this training?

I liked the hands on activities!

14. What aspects of the training could be improved?

15. How do you hope to change your practice as a result of this training?

I feel that I have gained alot of Knowledge and will be able to give students background Knowledge!

16. What additional STEM focused trainings would you like to have in the future?

Any! I feel that this training has been awesome and I would like more!

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workship
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	○	●	○	○	○
2. Participation and interaction were encouraged.	●	○	○	○	○
3. The topics covered were relevant to me.	○	●	○	○	○
4. The content was organized and easy to follow.	●	○	○	○	○
5. The materials distributed were helpful.	○	●	○	○	○
6. This training experience will be useful in my work.	○	●	○	○	○
7. The trainers were knowledgeable about the training topics.	●	○	○	○	○
8. The trainers were well prepared.	●	○	○	○	○
9. The training objectives were met.	●	○	○	○	○
10. The time allotted for the training was sufficient.	●	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	●	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	●	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

This training was relevANT. The STAFF is obviously very Knowledgable and helpful.

14. What aspects of the training could be improved?

N/A

15. How do you hope to change your practice as a result of this training?

Several resources were introduced that can be helpful.

16. What additional STEM focused trainings would you like to have in the future?

Students really enjoy building things. hands on robotics.

17. Please share other comments or expand on previous responses here:

Great Job! Would gladly come back.

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workship
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(*More questions on back →*)

13. What did you like most about this training?

Friendly
Great ideas
Learned tons
Sharing time/ Learning from others

14. What aspects of the training could be improved?

More trainings during summer; hard to do during school year

15. How do you hope to change your practice as a result of this training?

More hands-on learning opportunities

16. What additional STEM focused trainings would you like to have in the future?

More 4-5 standards covered

17. Please share other comments or expand on previous responses here:

I always love these trainings!

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop

June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	●	○	○	○	~~●~~
2. Participation and interaction were encouraged.	●	○	○	○	○
3. The topics covered were relevant to me.	●	○	○	○	○
4. The content was organized and easy to follow.	●	○	○	○	○
5. The materials distributed were helpful.	●	○	○	○	○
6. This training experience will be useful in my work.	●	○	○	○	○
7. The trainers were knowledgeable about the training topics.	●	○	○	○	○
8. The trainers were well prepared.	●	○	○	○	○
9. The training objectives were met.	●	○	○	○	○
10. The time allotted for the training was sufficient.	●	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	●	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	●	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

The students coming over and all the hands on activities

14. What aspects of the training could be improved?

Great!

15. How do you hope to change your practice as a result of this training?

Hopefully I won't be as intimidated of new technology.

16. What additional STEM focused trainings would you like to have in the future?

any I loved it! Would love to see more elementary STEM

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
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2. Participation and interaction were encouraged.					
3. The topics covered were relevant to me.					
4. The content was organized and easy to follow.					
5. The materials distributed were helpful.					
6. This training experience will be useful in my work.					
7. The trainers were knowledgeable about the training topics.					
8. The trainers were well prepared.					
9. The training objectives were met.					
10. The time allotted for the training was sufficient.					
11. The meeting room and facilities were adequate and comfortable.					
12. I feel confident about checking out items at the STEM Center Lending Library.					

(More questions on back →)

13. What did you like most about this training?

the hands-on activites

14. What aspects of the training could be improved?

None! Everything was great!

15. How do you hope to change your practice as a result of this training?

incorporate more STEM activities within my lessons

16. What additional STEM focused trainings would you like to have in the future?

elementary friendly

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	○	✓	○	○	○
4. The content was organized and easy to follow.	○	✓	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	○	✓	○	○	○
7. The trainers were knowledgeable about the training topics.	○	✓	○	○	○
8. The trainers were well prepared.	○	✓	○	○	○
9. The training objectives were met.	○	✓	○	○	○
10. The time allotted for the training was sufficient.	○	✓	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	○	✓	○	○	○

(*More questions on back →*)

13. What did you like most about this training?

I REALLY ENJOYED THE HANDS ON EXPERIENCE. IT WAS EASIER FOR ME TO LEARN ABOUT THE TOPIC + THEN COMPLETE AN ACTIVITY RELATED TO IT TO REINFORCE THE CONTENT.

14. What aspects of the training could be improved?

NONE!

15. How do you hope to change your practice as a result of this training?

I'LL DEFINITELY BE ~~COMPLETING~~ CREATING MORE HANDS ON ACTIVITIES RELATED TO TECH | STEM

16. What additional STEM focused trainings would you like to have in the future?

ENVIRONMENTAL STEM!

17. Please share other comments or expand on previous responses here:

I REALLY FEEL LIKE THIS WAS A FULFILLING EXPERIENCE AS A SCIENCE TEACHER. I'M ALWAYS UP FOR LEARNING NEW IDEAS IN REGARDS TO THE CLASSROOM/TEACHING.

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workship
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	○	●	○	○	○
2. Participation and interaction were encouraged.	●	○	○	○	○
3. The topics covered were relevant to me.	○	●	○	○	○
4. The content was organized and easy to follow.	○	●	○	○	○
5. The materials distributed were helpful.	○	●	○	○	○
6. This training experience will be useful in my work.	○	●	○	○	○
7. The trainers were knowledgeable about the training topics.	●	○	○	○	○
8. The trainers were well prepared.	●	○	○	○	○
9. The training objectives were met.	●	○	○	○	○
10. The time allotted for the training was sufficient.	●	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	●	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	●	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

The hands on and working with peers.

14. What aspects of the training could be improved?

N/A

15. How do you hope to change your practice as a result of this training?

to incorporate more transportaion lessons.

16. What additional STEM focused trainings would you like to have in the future?

Any I love all of the Stem training

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workship
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

The interaction with the Summer Camp students was a nice change of pace

14. What aspects of the training could be improved?

Overall I thought this was Very beneficial

15. How do you hope to change your practice as a result of this training?

Involve more math based components to my stem Activities

16. What additional STEM focused trainings would you like to have in the future?

I think having a Stem training that focused on low cost Activities could benifit our teachers in the upper Cumberland (some teachers have problems comming up with money)

17. Please share other comments or expand on previous responses here:

NA

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(*More questions on back →*)

13. What did you like most about this training?

I enjoyed hands-on activities + working with the students who were brought in.

14. What aspects of the training could be improved?

N/A

15. How do you hope to change your practice as a result of this training?

I hope to have activities that relate to transportation in the real world for my students.

16. What additional STEM focused trainings would you like to have in the future?

N/A

17. Please share other comments or expand on previous responses here:

I enjoyed this training. It was very helpful + enjoyable.

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	●	○	○	○	○
2. Participation and interaction were encouraged.	●	○	○	○	○
3. The topics covered were relevant to me.	●	○	○	○	○
4. The content was organized and easy to follow.	●	○	○	○	○
5. The materials distributed were helpful.	●	○	○	○	○
6. This training experience will be useful in my work.	●	○	○	○	○
7. The trainers were knowledgeable about the training topics.	●	○	○	○	○
8. The trainers were well prepared.	●	○	○	○	○
9. The training objectives were met.	●	○	○	○	○
10. The time allotted for the training was sufficient.	●	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	●	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	●	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

The activities mentioned are appropriate for middle school classrooms. Also, I loved getting to work with the SAC Students. This was the first time in a workshop like this that Students have been present.

14. What aspects of the training could be improved?

15. How do you hope to change your practice as a result of this training?

I am more aware of best practices for all subject areas. This was nice to know!

16. What additional STEM focused trainings would you like to have in the future?

Cost-effective activities

17. Please share other comments or expand on previous responses here:

Thank you for your feedback!

Workshop Evaluation Form

STRIDE STEM in Motion Workshop
June 25-26, 2019

Instructions: Please indicate your level of agreement with the statements listed below in #1-12.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The objectives of the training were clearly defined.	✓	○	○	○	○
2. Participation and interaction were encouraged.	✓	○	○	○	○
3. The topics covered were relevant to me.	✓	○	○	○	○
4. The content was organized and easy to follow.	✓	○	○	○	○
5. The materials distributed were helpful.	✓	○	○	○	○
6. This training experience will be useful in my work.	✓	○	○	○	○
7. The trainers were knowledgeable about the training topics.	✓	○	○	○	○
8. The trainers were well prepared.	✓	○	○	○	○
9. The training objectives were met.	✓	○	○	○	○
10. The time allotted for the training was sufficient.	✓	○	○	○	○
11. The meeting room and facilities were adequate and comfortable.	✓	○	○	○	○
12. I feel confident about checking out items at the STEM Center Lending Library.	✓	○	○	○	○

(More questions on back →)

13. What did you like most about this training?

I loved that this training brought in students for us to "try the activities on!" This ~~AA~~ will make it more likely that I will use these activities in my own classroom.

14. What aspects of the training could be improved?

) I thought everything was great... no need for improvement.

15. How do you hope to change your practice as a result of this training?

I hope to use more hands-on activities instead of just note-taking.

16. What additional STEM focused trainings would you like to have in the future?

More activities like we did w/ this training.

17. Please share other comments or expand on previous responses here:

I enjoyed the staff, the food, bringing the students in, and the pleasant atmosphere

Thank you for your feedback!