TLPL 688 Fall 2019, Spring 2019, Summer 2019
Designing High-Quality Learning Experiences: Transdisciplinary STEM Lesson

Name: Maddie Chervenak School:Thurgood Marshall Elementary School
Grade Level/Subject: 4th Grade Phenomenon/Topic:

Lesson Snapshot	
Title	Bumper Cars
NGSS Performance Expectation	**4-PS3-1**. Use evidence to construct an explanation relating the speed of an object to the energy of that object. **4-PS3-3.** Ask questions and predict outcomes about the changes in energy that occur when objects collide. **3-5-ETS1-3.** Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
Disciplinary Core Ideas	**ETS1.B: Developing Possible Solutions** ● Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2) ● At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2) ● Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3) **ETS1.C: Optimizing the Design Solution** ● Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)
Disciplinary Practices	**Science and Engineering:** ● **Planning and carrying out investigations** ○ Use evidence (e.g., measurements, observations, patterns) to construct an explanation. ● **Asking Questions and Defining Problems** ○ Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
Crosscutting Concepts	**Cause and effect** ● Energy can be transferred in various ways and between objects.

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	Energy and Matter ● Energy can be transferred in various ways and between objects.
Maryland College and Career Ready Standards. Mathematics	**Mathematics -** ● M4: Angle measure and plane figures
Maryland College and Career Ready Standards. ELA/Literacy	**ELA/Literacy** ● W3.7 Conduct short research projects that build knowledge about a topic. (3-PS2-1) ● W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1
Maryland STEM Standards of Practice	1. Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content 2. Integrate Science, Technology, Engineering, and Mathematics Content 3. Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics 4. Engage in Inquiry 5. Engage in Logical Reasoning 6. Collaborate as a STEM Team 7. Apply Technology Strategically

Overview

This is a summary of what students will learn in the lesson and/or unit. It explains the academic focus and real-world connection (phenomena under study).

Over 10 days, student teams will design and test a better bumper car that is functional, fun, and safe. Students will be posed with this question, "how can you make a bumper car that is safe and fast?" Students will start by making a diagram of an initial design for a bumper car, they then will test their car to see how safe their car is and if the car is fast. Finally, they will evaluate their car to see if it is safer and faster than other cars in the class.

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Driving Question:
A broad, open-ended, life-relevant question that ties the identified performance expectations to the phenomena under study. It helps to initiate and focus inquiry.

How can we use what we know about what happens when objects collide to design a bumper car that is fun, functional and safe?

Suggested Student Outcomes
The specific student outcomes for the lesson and/or unit. They describe the transferable knowledge and skills that students should understand and be able to do when the unit is completed. What will the students understand better as a result of this lesson?

Students will design a bumper car.
Students will build a model of their bumper car.
Students will test their cars to determine what happens when two cars collide.
Students will explain what happens when two objects collide.

Interdisciplinary Connections
How do the core ideas, concepts, and practices of multiple disciplines come together to support student understanding?

Students will use science, technology, engineering, and mathematics to develop a model to observe and measure what happens when two objects collide.

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Enduring Understandings/ Key Ideas:
Students will develop an understanding that air is made up of particles that are too small to be seen and that air is matter.

5 E Components	General Description	MSDE STEM S.O.P (check all that apply)
Engage Did you design an activity that allows students to: ☐ Activate and apply prior knowledge and understandings? ☐ Ask questions? ☐ Identify problems to be solved, conflicts to be resolved, decisions to be made?	(Day 1) 1. Starting questions/Discussion: - What is energy? - What is a collision? - What happens when two objects collide? 2. Before we watch a video on bumper cars, I want you to close your eyes and image bumper cars. - What does it look like? - What does it sound like? 2. Watch video on Bumper Cars: https://www.youtube.com/watch?v=7MJ4vJmjdUs - Thinks abouts as they watch: - What do you notice? - What do you wonder? - Compare your own image and to the video. What is similar? What is different? 3. Students will be posed a question: - What do you think would happen if the bumper cars collided fast? 4. Have students watch a video on the fastest bumper car. - https://youtu.be/8tCZN0G3BpQ - Think abouts as they watch the video:	□ Learn and Apply STEM Content □ Integrate STEM Content □ Interpret and Communicate Information from STEM disciplines □ Engage in Inquiry □ Engage in Logical Reasoning □ Collaborate as a STEM Team □ Apply Technology Strategically

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	- What do you think would happen if the bumper cars collided fast?	

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Explore Did you design an activity that allows students to: ☐ Actively explore new concepts through hands-on learning experiences? ☐ Ask questions and define issues or problems related to the phenomena under study? ☐ Engage in disciplinary practices to learn, and apply disciplinary core ideas and crosscutting concepts when exploring the phenomena? ☐ Demonstrate refinement of everyday thinking around core ideas and concepts? ☐ Select and employ tools (including technology) that are relevant to answering the driving question?	(Day 2) Students will use an online platform to test what they think will happen when two objects collide. - https://phet.colorado.edu/en/simulation/collision-lab - Questions: - Students design their bumper car that they think will be fast and safe using the criteria and constraints. ● ***Criteria:*** This can be a dream bumper car, but should include some elements that students predict will make it safer. ● ***Constraints:*** You may use only the materials provided for you: rubber bands, cardboard, straws, CDs or DVDs, Masking or other heavy tape, scissors, Optional: Milk or juice cartons.	□ Learn and Apply STEM Content □ Integrate STEM Content □ Interpret and Communicate Information from STEM disciplines □ Engage in Inquiry □ Engage in Logical Reasoning □ Collaborate as a STEM Team □ Apply Technology Strategically

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		(check all that apply)
Explain Did you design an activity that allows students to: ☐ Analyze data/information and draw conclusions? ☐ Communicate understandings and possible solutions? ☐ Construct explanations and design solutions? ☐ Demonstrate critical thinking and reasoning? ☐ use technology appropriately for analysis and communication?	(Day 3) After students have created their diagram, they are to share their designs with another team. Students ask the following questions after reviewing the other teams design: - Why did you choose those specific materials? - Why did you leave others out? - What design elements did you include that will help keep passengers safe?	□ Learn and Apply STEM Content □ Integrate STEM Content □ Interpret and Communicate Information from STEM disciplines □ Engage in Inquiry □ Engage in Logical Reasoning □ Collaborate as a STEM Team □ Apply Technology Strategically

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Extension / Elaboration Did you design an activity that allows students to: ☐ Modify/refine procedures, prototypes, models, solutions, arguments, essays, etc.? ☐ Challenge and/or deepen their understandings of the core ideas and concepts related to the phenomena under study? ☐ Demonstrate critical thinking and reasoning? ☐ Make connections to other real-world applications of the knowledge constructed in the activity?	(Day 4-7) Students will build their bumper car using the materials given and the criteria and constraints. (This took students 3-5 days to complete) - ***Criteria:*** This can be a dream bumper car, but should include some elements that students predict will make it safer. - ***Constraints:*** You may use only the materials provided for you: rubber bands, cardboard, straws, CDs or DVDs, Masking or other heavy tape, scissors, Optional: Milk or juice cartons - **Materials:** ● CDs or DVDs ● Straws ● Masking or other heavy tape ● Skewers ● Styrofoam or pieces of sponges ● Rubber bands ● Cardboard ● Milk or juice cartons (optional) ● Scissors	□ Learn and Apply STEM Content □ Integrate STEM Content □ Interpret and Communicate Information from STEM disciplines □ Engage in Inquiry □ Engage in Logical Reasoning □ Collaborate as a STEM Team □ Apply Technology Strategically

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Evaluation
 	
Did you design an activity that allows students to:
 	
☐ Assess and/or justify their own understandings?
 	
☐ Demonstrate an understanding of concepts through performance-based tasks?
 	
☐ Participate in peer reviews and/or offer feedback to each other?
 	
☐ Demonstrate critical thinking and reasoning?
 	
☐ Reflect on answers or solutions to the complex question, global issue, challenge or real-world problem?
	(Day 8)
	Students will test their cars and evaluate how safe and fast their car was compared to other students.
	- Students will use their Crash Test Observations Recording Sheet to record how their car did after every test.
	  - Place the car on a smooth flat surface facing a stationary test wall.
	  - Place a tomato inside the car. This will be the passenger.
	  - This will show if the car is safe or not due to the look and feel of the tomato after all the tests are complete.
	  - Use masking tape to mark the cars' starting point (~1 ½ feet away from the test wall)
	  - Using a broom, push the car against the wall in one swift motion.
	  - Have students record the tomato's appearance and feel on the recording sheet.
	
	(Day 9)
	After the tests are complete and the students have recorded their observations.
	- Students should consider the following questions:
	  - How did the amount of energy affect your car in a collision?
	  - Describe the energy's path during your collision tests.
	  - How safe is your car?
	  - What evidence do you have to support that?
	  - Can you think of a way to make your car safer?
		□ Learn and Apply STEM Content
		
		□ Integrate STEM Content
		
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