

The Hot Wheels logo, featuring the words "HOT WHEELS" in a stylized, flame-like font. The letters are yellow with a red outline, set against a white background that tapers into a flame shape at the ends.The word "SPEEDOMETRY" in a bold, black, sans-serif font. To the right of the text is a stylized orange and black speedometer icon. The text is underlined with a thick orange line.

SPEEDOMETRY

UNDERSTANDING CAUSE AND EFFECT RELATIONSHIPS THROUGH FORCE AND MOTION

In this unit of study students will extend their understanding of the universal concept of relationships through a careful study of cause and effect relationships in the exploration of force and motion. Students will connect the attributes of objects, such as cars and trucks, to the push and pull actions that can cause an object to move in different ways, depending on its attributes and the forces used to cause movement. The study of movement, including the effects of forces on varied objects and situations will be taught through an integrated approach with authentic, real-world applications. The understanding of cause and effect relationships in science will be further integrated with social studies, English language arts, mathematics, and the arts, to help students gain a deeper understanding of the cross-cutting concept of cause and effect and see its application in the world around them.

The units are designed using an inquiry-based model that incorporates the 5E instructional model (Engage, Explore, Explain, Elaborate and Evaluate) to support student learning. The 5E model introduces critical learning processes that form an iterative process for on-going inquiry, discovery, reflection and learning. Though many units of study that follow a 5E model may use a linear format, this unit was developed with a new understanding of the 5Es as an on-going cyclical model whereby students are consistently reflecting on their learning and applying key concepts to diverse contexts. For example, students might Engage and Explore multiple times before Explaining and may again return to an Exploration prior to extending their learning to a new context. Evaluation will be on-going and embedded in most stages of the 5E as students are consistently demonstrating learning and teachers are consistently monitoring and adjusting instruction as needed. The 5Es integrate hands-on activities that help foster conceptual understanding and inspire students to explore further.

Each part of the unit will be organized around a dominant 5E progression, including a clearly identified process of Engage, Explore, Explain, Elaborate, and Evaluate, however, each lesson will also include subordinate processes. For example, in the Engage phase, there may be an Explain embedded. The dominant phase of the lesson is still intended to Engage students but the students will also experience an Explain and at times other subordinate 5E stages. This is creating the cyclical and on-going reflective nature of inquiry-based learning.





SPEEDOMETRY


UNDERSTANDING CAUSE AND EFFECT RELATIONSHIPS THROUGH FORCE AND MOTION

The 5E model further provides opportunities for all students to actively develop academic language through teacher support and modeling and student interaction with one another, content, and materials.

THINKING AND DOING APPROACH TO LANGUAGE DEVELOPMENT: SCIENCE AND ELD
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MANAGING AND MAXIMIZING LANGUAGE DEVELOPMENT: 5E PROCESS

PROCESS STEP	PURPOSE	MANAGING LANGUAGE OPPORTUNITIES
<p>Engage</p> 	<p>Schema activation Generating background knowledge Motivation Teacher modeling</p>	<ul style="list-style-type: none"> • Students talk from personal background and experience • Teacher facilitates, assesses, models language in her interactions
<p>Explore</p> 	<p>Common base of learning from discovery & interaction Experiential, hands-on</p>	<ul style="list-style-type: none"> • Students engaged in natural conversation • Teacher provides high degree of scaffolding for language use (probing questions, recasting responses, interactive) • Teacher facilitates, assesses, models language in her interactions
<p>Explain</p> 	<p>Teacher helps students to understand learning goal & correct misconceptions Students need to explain their understanding</p>	<ul style="list-style-type: none"> • Teacher provides explicit input & promotes explicit output of new language • Teacher provides explicit support for language use (vocabulary, questioning, text models, language frames, writing) • Teacher promotes word consciousness
<p>Elaborate</p> 	<p>Application of understanding of content objective in a new context</p>	<ul style="list-style-type: none"> • Students practice new understanding using language in a meaningful way (vocabulary, Questioning, text models, language frames, writing) • Teacher provides explicit support for language use

<i>PROCESS STEP</i>	<i>PURPOSE</i>	<i>MANAGING LANGUAGE OPPORTUNITIES</i>
Evaluate 	Assess students as they apply new understanding & abilities Students evaluate their own learning	<ul style="list-style-type: none"> • Review and self-evaluation • Provide opportunities for language consciousness

Estimated Instructional Time: A suggested time frame of 3 weeks is presented in the unit of study, however, flexibility is key for the success of the unit. Teachers should work at the appropriate pace for their class and differentiate as needed to maximize learning for all students.

The Science Behind This Unit: This unit explores forces (natural and man-made), pushes and pulls, and the relationship among the attributes of objects, forces, and pushes and pulls, which can change the way an object moves. The lessons will incorporate Hot Wheels cars (HW cars) and other accessible materials that students can manipulate and investigate for a hands-on learning experience.

In this unit students will observe, describe and investigate objects that we can push or pull to move. They will test how movement is impacted by external forces, such as terrain and weather, and man-made forces, such as attributes of cars, road conditions, and street signs.

Studying forces and motion by investigating pushes and pulls will help students understand cause and effect relationships. Studying forces and motion helps children explore how things interact with each other and understand the world around them. As a result of these experiences, students will be able to:

- Understand that pushes and pulls can have different strengths and directions
- Understand that objects can push one another and can change motion
- Explain that motion is a change of position
- Explain push and pull.

CREATING AN ENVIRONMENT FOR SUCCESS

Considerations for Diverse Learners: This unit incorporates many Universal Design for Learning principles and the 5E model of instruction. The UDL design principles ensure diverse points of engagement during learning and multiple ways that learners can demonstrate or communicate what they understand. The 5E Model (Engage, Explore, Explain, Elaborate and Evaluate) integrates hands-on activities that help foster conceptual understanding and inspire students to explore further. Learners are likely to find some phases more engaging or difficult than others depending on their comfort with the knowledge or processes required. We recommend that all children participate in each phase of learning as designed in order to deepen both their understanding of science content, and also their ability to use and communicate about using this knowledge in the world around them. If students have Individual Education Plans, please consult these documents for important modifications or accommodations that should be made for those students.

Strategies for Group Work: Throughout the unit students will work in cooperative groups. To increase group cohesion and engagement, you may want to name the groups after popular cars or allow students to create their own team names. You may also assign rotating jobs to each group member, such as timekeeper, recorder, reporter, go-getter.

Discussion:

There are many class discussions in this unit.

Some strategies to use in your classroom:

Think-Pair-Share: Students are given time to think or write their ideas, then share with a partner before sharing with the class. This gives students time to think of an answer and the support of their classmate's idea. This is particularly useful if you have English learners or students who are shy about talking.

Reporter: Each group can have an assigned reporter. After the group is given time to discuss, the reporter shares the group's ideas with the class. This job should be rotated so that everyone has an opportunity to be the reporter.

CREATING AN ENVIRONMENT FOR SUCCESS - CONTINUED

Notebooks: Students should have a place to take notes, record their data, and brainstorm their ideas throughout this process. You may want to provide the students with a blank notebook, or you can create a notebook using construction paper for the cover and stapled with kindergarten writing paper, where there is room for a picture and written text. Students can prepare their notebooks by decorating the cover page with drawings, clippings, words, or designs of their choosing to represent their understanding of science. You might prompt their designs by saying, “We are going to be scientists, and one thing that all scientists have as they explore the world around them is a place to record their thinking and learning. You will get to prepare your own science notebook that we will use throughout our unit of study. Decorate the cover any way you’d like as we prepare to explore the world of forces and motions.”

Academic Language: Explain to the students that they are going to be scientists and as scientists they will need to use written and oral language in many ways as they interact with materials and one another. They will need to use “academic language” when explaining their thinking throughout the unit. Each lesson will have relevant academic language provided with suggestions for appropriate times in the lesson to offer language support. At times academic language will be taught explicitly and at other times they will be provided language supports to interact successfully with their peers or to document their thinking in a written form. Students should be encouraged to use relevant academic language during experimentation and discussion. Some of the journal responses encourage the students to use specific academic language as well.

CREATING AN ENVIRONMENT FOR SUCCESS - CONTINUED

Core academic language functions, forms and vocabulary that will be presented throughout the unit will include but is not limited to:

ACADEMIC LANGUAGE BANK	
<i>LANGUAGE FUNCTION/FORMS</i>	
<p>Cause and Effect</p> <p>The...are...</p> <p>The...,... because...</p> <p>...because...</p> <p>..., so...</p> <p>Because...,...</p> <p>Since...,...</p> <p>As a result of..., ...</p> <p>...which lead to...</p> <p>Due to the fact that...,...</p> <p>...caused...</p>	<p>Drawing Conclusions</p> <p>...is/are...</p> <p>...is not/are not...</p> <p>...can...</p> <p>...can't...</p> <p>I know...because...</p> <p>Because of..., I can conclude...</p> <p>As a result of...,...</p> <p>I've noticed..., therefore,...</p> <p>Based on..., I can conclude that...</p> <p>Since..., I know...</p> <p>Considering that...is...we can conclude that...</p>
<i>VOCABULARY</i>	
<p>Tier 2 (General Academic Vocabulary)</p> <p>Force</p> <p>Cause</p> <p>Effect</p>	<p>Tier 3 (Discipline-Specific Vocabulary)</p> <p>Push</p> <p>Pull</p>

CREATING AN ENVIRONMENT FOR SUCCESS - CONTINUED

Cause - a person or thing that acts, happens, or exists in such a way that some specific thing happens as a result; the producer of an effect. The reason or motive for some human action

Effect - something that is produced by an agency or cause; result; consequence

Force - strength or power exerted upon an object; power to influence, effect or control

Push - to press upon or against with force to move it away; to move in a particular way by exerting force

Pull - to draw or haul towards oneself or itself, in a particular direction, or into a particular position; to draw or tug at with a force

Tier 2: Academic Vocabulary Expansion

Cause (n): reason, root, origin, basis, grounds; (v): make happen, bring about, set off, trigger

Effect (n): result, consequence, outcome, conclusion, influence, impact; (v): bring about

A classroom chart with the core academic language can be prepared prior to starting the unit of study and made available to students throughout the lesson by displaying it in the classroom. Because of students' on-going and diverse literacy development in kindergarten, pictorial representations of core concepts can be added to the chart to support student access to the charts.

The unit is further designed with the understanding that written language can be represented in diverse ways. Students will be encouraged to use developmentally appropriate written language, such as the use of drawings, labeling, dictation, pictorial representations, and standard written text. The lessons provide examples of visual representations of vocabulary and other core concepts and content throughout the unit.

Considerations for English Language Learners

The unit of study includes integrated English language development (ELD). Standards for developing English will be embedded in all lessons, explicitly and implicitly. The use of the ELD standards will guide language integration, and the English Language Arts standards will further extend students' application of language. All lessons are designed using the 5E processes, which align to supporting English language learners through hands-on, minds-on authentic experiences. Based on the work of various educators and researchers in the

CREATING AN ENVIRONMENT FOR SUCCESS - CONTINUED

area of bilingual education, including seminal works by Jim Cummins, Kenji Hakuta, Diane August and Timothy Shanahan, this unit is grounded in the belief that language development happens best through rich, contextualized experiences where students are able to draw on prior knowledge and early language experiences to learn a new language.

There are ample opportunities for ELs to learn the concepts and content through a variety of methods, materials, and experiences. The careful attention to academic language in all lessons provided will further support ELs in accessing content and articulating their thinking.

Teachers should be mindful of students' varying stages of English language development to modify instruction accordingly. Nationally, the development of English has been conceptualized into three to five identifiable markers of language progression. For example, California's English language development (ELD) standards have shifted from five levels to three (Emerging, Expanding, and Bridging) with specific characteristics and supports for students at each level. An explanation of the ELD levels is provided in the appendix. The proficiency level descriptors are provided as an example of what is available in states across the country to help teachers understand the diversity of English learners and how to support them at different levels of English language development.

These tools can help teachers modify instruction to support ELs at all levels of ELD.

Considerations for Gifted Students

Setting the stage - Surface implications:

Hard floors create the most significant speed and distance changes for students to observe and measure. With carpeting, increase the height of the ramps in order to create a noticeable difference in students' recorded data. Students can increase height by using more books to elevate the ramps, holding ramps at determined heights on yardsticks, or using clamps to attach ramps to chairs or tables. Students and teachers should feel encouraged to use any materials available that can create varied textures, heights, movements, and obstacles to allow for optimal experimentation.

CREATING AN ENVIRONMENT FOR SUCCESS - CONTINUED

Observe students while they work and provide criteria-based feedback (formative assessment):

As students work in groups use the Group Discussion Observation Guide to record what you see students doing and hear students saying. At the end of each class period give examples of times you saw groups meeting or on their way to meeting the descriptions. Depending on your students' proficiency levels, as well as the time of school year you are implementing the curriculum, the journal responses may need to be modified. If your students are not ready to write a sentence, you can write the academic vocabulary word(s) on the board for them to copy in the journal. You may also have a student dictate his/her response as part of a shared writing activity or allow students to illustrate their work through pictures, diagrams, or other visual representations in their own journals.

Suggestions for assessment are included at the end of each lesson and assessment tools are included in the appendix. Teachers may choose to use these opportunities for assessment in the ways that work best for them and their students.



STANDARDS ALIGNMENT AND CONNECTIONS

These learning activities support students in the development of capacities described across several key frameworks for standards based instruction. Teachers can observe student performance related to the following standards from the *California Department of Education Key STEM Content and Process Standards, Next Generation Science Standards (NGSS), Common Core State Standards for Literacy and Mathematics (CCSS), History/Social Science standards, Visual and Performing Arts standards and the English Language Development standards.*



COMMON CORE, ENGLISH LANGUAGE ARTS (CCSS)

SPEAKING AND LISTENING

CCSS. ELA-LITERACY. SL.K.1	Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
CCSS. ELA-LITERACY. SL.K.1.A	Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
CCSS. ELA-LITERACY. SL.K.1.B	Continue a conversation through multiple exchanges.
CCSS. ELA-LITERACY. SL.K.3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
CCSS. ELA-LITERACY. SL.K.4	Describe familiar people, places, things, and events and, with prompting and support, provide additional detail.

STANDARDS ALIGNMENT AND CONNECTIONS - CONTINUED

COMMON CORE, ENGLISH LANGUAGE ARTS (CCSS)

WRITING

CCSS. ELA-LITERACY. W.K.2	Use a combination of drawing, dictating, and writing to compose informative/ explanatory texts in which they name what they are writing about and supply some information about the topic.
CCSS. ELA-LITERACY. W.K.8	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

LANGUAGE

CCSS. ELA-LITERACY. L.K.5	With guidance and support from adults, explore word relationships and nuances in word meanings.
CCSS. ELA-LITERACY. L.K.5.A	Sort common objects into categories (e.g., shapes, foods) to gain a sense of the concepts the categories represent.
CCSS. ELA-LITERACY. L.K.5.C	Identify real-life connections between words and their use (e.g., note places at school that are colorful).

ENGLISH LANGUAGE DEVELOPMENT STANDARDS

<i>ELD STANDARD</i>	<i>EMERGING (EM)</i>	<i>EXPANDING (EX)</i>	<i>BRIDGING (BR)</i>
ELD. P1.K1	1. Exchanging information and ideas: Contribute to conversations and express ideas by asking and answering yes-no and wh-questions and responding using gestures, words, and simple phrases.	1. Exchanging information and ideas: Contribute to class, group, and partner discussions by listening attentively, following turn-taking rules, and asking and answering questions.	1. Exchanging information and ideas: Contribute to class, group, and partner discussions by listening attentively, following turn-taking rules, and asking and answering questions.

STANDARDS ALIGNMENT AND CONNECTIONS - CONTINUED

ENGLISH LANGUAGE DEVELOPMENT STANDARDS			
<i>ELD STANDARD</i>	<i>EMERGING (EM)</i>	<i>EXPANDING (EX)</i>	<i>BRIDGING (BR)</i>
ELD. P1.K3	3. Offering opinions: Offer opinions and ideas in conversations using a small set of learned phrases (e.g., I think X), as well as open responses.	3. Offering opinions: Offer opinions in conversations using an expanded set of learned phrases (e.g., I think/don't think X. I agree with X), as well as open responses, in order to gain and/or hold the floor	3. Offering opinions: Offer opinions in conversations using an expanded set of learned phrases (e.g., I think/don't think X. I agree with X, but . . .), as well as open responses, in order to gain and/or hold the floor or add information to an idea.
ELD. P1.K6	6. Reading/viewing closely: Describe ideas, phenomena (e.g., parts of a plant), and text elements (e.g., characters) based on understanding of a select set of grade-level texts and viewing of multimedia, with substantial support.	6. Reading/viewing closely: Describe ideas, phenomena (e.g., how butterflies eat), and text elements (e.g., setting, characters) in greater detail based on understanding of a variety of grade-level texts and viewing of multimedia, with moderate support.	6. Reading/viewing closely: Describe ideas, phenomena (e.g., insect metamorphosis), and text elements (e.g., major events, characters, setting) using key details based on understanding of a variety of grade-level texts and viewing of multimedia, with light support.
ELD. P1.K10	10. Composing/Writing: Draw, dictate, and write to compose very short literary texts (e.g., story) and informational texts (e.g., a description of a dog), using familiar vocabulary collaboratively in shared language activities with an adult (e.g., joint construction of texts), with peers, and sometimes independently.	10. Composing/Writing: Draw, dictate, and write to compose short literary texts (e.g., story) and informational texts (e.g., a description of dogs), collaboratively with an adult (e.g., joint construction of texts), with peers, and with increasing independence.	10. Composing/Writing: Draw, dictate, and write to compose longer literary texts (e.g., story) and informational texts (e.g., an information report on dogs), collaboratively with an adult (e.g., joint construction of texts), with peers, and independently using appropriate text organization.

STANDARDS ALIGNMENT AND CONNECTIONS - CONTINUED

ENGLISH LANGUAGE DEVELOPMENT STANDARDS

ELD STANDARD	EMERGING (EM)	EXPANDING (EX)	BRIDGING (BR)
ELD. P1.K.11	11. Supporting opinions: Offer opinions and provide good reasons (e.g., My favorite book is X because X.) referring to the text or to relevant background knowledge.	11. Supporting opinions: Offer opinions and provide good reasons and some textual evidence or relevant background knowledge (e.g., paraphrased examples from text or knowledge of content).	11. Supporting opinions: Offer opinions and provide good reasons with detailed textual evidence or relevant background knowledge (e.g., specific examples from text or knowledge of content).



NEXT GENERATION SCIENCE STANDARDS (NGSS)

K-PS2- 1.	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. <i>[Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]</i>
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STANDARDS ALIGNMENT AND CONNECTIONS - CONTINUED

NEXT GENERATION SCIENCE STANDARDS (NGSS)

K-PS2- 2.

Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

SCIENCE AND ENGINEERING PRACTICES

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- With guidance, plan and conduct an investigation in collaboration with peers. (K-PS2-1)

Analyzing and Interpreting Data

Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Analyze data from tests of an object or tool to determine if it works as intended. (K-PS2-2)

Connections to the Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world. (K-PS2-1)

STANDARDS ALIGNMENT AND CONNECTIONS - CONTINUED

DISCIPLINARY CORE IDEAS

PS2.A: Forces and Motion

- Pushes and pulls can have different strengths and directions. (K-PS2-1),(K- PS2-2)
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1),(K-PS2- 2)

PS2.B: Types of Interactions

- When objects touch or collide, they push on one another and can change motion. (K-PS2-1)

PS3.C: Relationship Between Energy and Forces

- A bigger push or pull makes things speed up or slow down more quickly. (secondary to K-PS2-1)

ETS1.A: Defining Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (secondary to K-PS2-2)

CROSSCUTTING CONCEPTS

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (K-PS2- 1),(K-PS2-2)

HISTORY SOCIAL SCIENCE STANDARDS

HSS.K.4

Students compare and contrast the locations of people, places, and environments and describe their characteristics.

HSS.K.5

Determine the relative locations of objects using the terms near/far, left/right, and behind/in front

STANDARDS ALIGNMENT AND CONNECTIONS - CONTINUED

VISUAL AND PERFORMING ARTS	
<i>DANCE</i>	
1.3	Comprehension and Analysis of Dance Elements 1.3 Understand and respond to a wide range of opposites (e.g., high/low, forward/backward, wiggle/freeze).
1.4	Perform simple movements in response to oral instructions (e.g., walk, turn, reach).
<i>THEATER</i>	
5.1	Dramatize information from other content areas. Use movement and voice, for example, to reinforce vocabulary, such as fast, slow, in, on, through, over, under.
<i>VISUAL ARTS</i>	
5.2	Look at and draw something used every day (e.g., scissors, toothbrush, fork) and describe how the object is used.

COMMON CORE, MATHEMATICS	
CCSS. MATH.CONTENT. K.MD.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
CCSS. MATH.CONTENT. K.MD.A.2	Directly compare two objects with a measurable attribute in common, to see which object has “more of”/”less of” the attribute, and describe the difference. <i>For example, directly compare the heights of two children and describe one child as taller/shorter.</i>

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UNIVERSAL CONCEPT: RELATIONSHIPS (CAUSE AND EFFECT)

PART 1: PUSH/PULL

Overview: The relationship between the attributes of an object on push and pull

The Science Behind the Lesson: A force is a push or pull upon an object resulting from the interaction of one object on another. Whenever there is an interaction between two objects, there is a force that has been exerted upon each of the objects. The type of force can determine the speed, distance and direction in which an object will move. As part of this lesson sequence students should understand that force can come from the pushing, to exert force by moving an object forward or away from you, or by pulling, to exert force by moving an object towards you or in the same direction you are moving in. Students will understand that the way in which they push or pull something can differ depending on how they interact with the object. Words describing movements will help students explain how they are exerting a force on an object (i.e. fast, slow, hard, soft, straight, curved). Understanding movement as the effect of push and pull forces helps students see the concept of cause and effect relationships in science.

DOMINANT STANDARDS

K-PS2-1.	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
CCSS. ELA-LITERACY. L.K.5	With guidance and support from adults, explore word relationships and nuances in word meanings.
CCSS. ELA-LITERACY. L.K.5.A	Sort common objects into categories (e.g., shapes, foods) to gain a sense of the concepts the categories represent.
CCSS. ELA-LITERACY. L.K.5.C	Identify real-life connections between words and their use (e.g., note places at school that are colorful).
CCSS. ELA-LITERACY. SL.K.1	Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.

DOMINANT STANDARDS

CCSS. ELA-LITERACY. SL.K.1.A	Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
CCSS. ELA-LITERACY. SL.K.1.B	Continue a conversation through multiple exchanges.
CCSS. ELA-LITERACY. SL.K.3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
CCSS. ELA-LITERACY. W.K.2	Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.

SUBORDINATE STANDARD

CCSS.MATH. CONTENT. K.MD.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
CCSS.MATH. CONTENT. K.MD.A.2	Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.

INTEGRATED ELD STANDARD

<i>ELD STANDARD</i>	<i>EMERGING (EM)</i>	<i>EXPANDING (EX)</i>	<i>BRIDGING (BR)</i>
ELD. P1.K.3	3. Offering opinions: Offer opinions and ideas in conversations using a small set of learned phrases (e.g., I think X), as well as open responses.	3. Offering opinions: Offer opinions in conversations using an expanded set of learned phrases (e.g., I think/don't think X. I agree with X), as well as open responses, in order to gain and/or hold the floor.	3. Offering opinions: Offer opinions in conversations using an expanded set of learned phrases (e.g., I think/don't think X. I agree with X, but . . .), as well as open responses, in order to gain and/or hold the floor or add information to an idea.

ENGLISH LANGUAGE DEVELOPMENT STANDARDS

<i>ELD STANDARD</i>	<i>EMERGING (EM)</i>	<i>EXPANDING (EX)</i>	<i>BRIDGING (BR)</i>
ELD. P1.K.11	11. Supporting opinions: Offer opinions and provide good reasons (e.g., My favorite book is X because X.) referring to the text or to relevant background knowledge.	11. Supporting opinions: Offer opinions and provide good reasons and some textual evidence or relevant background knowledge (e.g., paraphrased examples from text or knowledge of content).	11. Supporting opinions: Offer opinions and provide good reasons with detailed textual evidence or relevant background knowledge (e.g., specific examples from text or knowledge of content).

Essential Questions: What is force? What causes an object to move? What causes an object to move differently (fast, slow, straight, curved)?

ENGAGE

EXPERIENCE #1



Teacher: The purpose of this activity is to present students with the opportunity to initially play with the cars as they become instructional tools for teaching and learning. Students will be able to explore attributes of the cars and to initiate questions that can serve as the basis of inquiry throughout the unit: Push/pull.

Questions to be addressed to the students to stimulate inquiry and discussion are sometimes embedded in the text of the experiences.

Assessment: Students will formulate a question to stimulate inquiry resulting from the play with the cars. The students' questions can be recorded in their **Science Notebooks**.

Experience:

1. Place all the cars on a surface available to the students. This can be on the rug or placed in the center of small groups of student desks. This can be called the “exploration space.”

2. Invite the students to explore the characteristics of the cars (size, shape, color, and features). Provide students with an opportunity to “play” with the cars for a few minutes.

What do you notice about the cars? How are they alike or different?

3. Collect the cars to prepare students for a demonstration. Let them know they will return to their cars after the demonstration.

4. Inform students that they are to follow the teacher's directions regarding the numbers, color, and/or size of cars to select and move the cars in a self-directed manner.

- Demonstrate for students the following procedure: I will choose two of the same color cars and push one car with the other car. What made the car move? How did the color of the cars affect how they moved?
- Allow students to share their ideas about how the car was able to move.

ENGAGE

EXPERIENCE #1 - CONTINUED



5. Have students form small groups and return to their exploration spaces with access to the cars. Provide students with the following chart of possible combinations of cars to use in the action(s) they design.

- Two of the same color and size
- Two of the same color but different sizes
- Three different colors and sizes

<i>NUMBER OF CARS</i>	<i>CAR COLOR</i>	<i>CAR SIZE</i>
2	same	same
2	same	different
3	different	different

6. Tell each group that they are to use the chart to select cars and that they will use the cars selected to move in any way they choose. This gives students a chance to play with the cars, while making note of the different attributes of the cars and their actions.

7. After allowing the students to play based on the cars' attributes, ask students to pose a question about the actions they performed. Prompt students' formation of questions with key words: *Remember, when you form a question you want to use words such as How, Why, When, Can, Does, Do, Could to begin your questions.*

**ASKING QUESTIONS ABOUT CARS****How** _____ ?**Why** _____ ?**When** _____ ?**Can** _____ ?**Does** _____ ?**Do** _____ ?**Could** _____ ?

8. Record the students' questions on a chart that will serve as an inquiry reference throughout the unit. Following is an example of questions generated by students.

- *Does the size of the car make it go fast or slow?*
- *Does the color of the car make it go fast or slow?*

ENGAGE

EXPERIENCE #2



Teacher: The purpose of this learning experience is to introduce vocabulary describing the actions of push/pull. Allow students to become familiar with the cars and the vocabulary through purposeful interactions and play.

Assessment: Students will develop some alternative vocabulary (synonyms) that describe “push and pull.”

Students can select a “favorite” push/pull synonym to record in their **Science Notebooks**.

They can draw a sketch of the movement to help them remember the synonyms.

Provide sketching symbols such as arrows to show the movement depicted by the synonym.

E.g. Shove → → →

Experience:

1. Prepare the set of Push/Pull vocabulary squares by writing each word on a 3x5 note card or small sheet of paper. Review each word individually by pronouncing it clearly for students. Repeat and explain to students which words are synonyms for push and which are synonyms for pull.

shove	poke	tug	pinch
jerk	nudge	press	pluck
drag	prod	yank	tag

2. Construct a chart with the students to facilitate understanding of synonyms related to the concepts of push and pull.



<i>SYNONYMS</i>	
PUSH	PULL
shove	tug
prod	drag
_____	_____
_____	_____
_____	_____
_____	_____

- Place all the cards in random order on a space accessible to the students. This can be on the class rug or at students' desks. Students need enough room to move the cars again.
- Explain to students that they are going to use "new words" to move the car they select and will be able to describe the results of their actions by using the vocabulary words provided for push and pull: *"You are going to get a chance to move the cars again, but this time you will use new words to describe the force you are using to move the cars."*
- Follow this sequence of activities to conduct the learning experiences:
 - Have students alone or with a peer select both a "vocabulary square" and a car.
 - Read and define the word on the "vocabulary square."
 - Allow student(s) to enact the action with the car defined by the word on the "vocabulary square."
 - Repeat the activity in this learning experience several times so all students have the opportunity to participate.



ENGAGE

EXPERIENCE #2 - CONTINUED

6. Culminate the experience by having students work with a partner to sort their individual “vocabulary squares” into two groups.

a. Group A – PUSH

b. Group B – PULL

Allow students to glue the vocabulary squares into their **Science Notebook** on separate pages, one for Push words and another for Pull words.



ENGAGE

EXPERIENCE #3



Teacher: The purpose of this learning experience is to introduce the science concept of push/pull connected to social studies (history and economics).

This learning experience provides an interdisciplinary perspective about the science concept: push/pull.

Note: The presentation and subsequent discussion for each set of pictures can take place within a single day or over several days of instruction.

Assessment: Students should be able to use the visual clues in the pictures to verify the application of push/ pull in historical and economic contexts.

Students can enter in their **Science Notebooks** a sample or collection of responses in words or pictures to the learning experience:

- Prove or disprove the statement: Pushing and pulling have been important to people and work over time.
- Interview a family member to identify an example of push/pull in history or work. Draw or find a picture in a newspaper, magazine, or on the internet that illustrates the example, and enter it in the **Science Notebook**.
- Research through picture books examples of a historic or industrial example of push/pull. For example, *And Everyone Shouted, Pull*, by Claire Llewellyn

Experience:

1. Prepare the two sets of pictures for presentation (technologically or virtually).





ENGAGE

EXPERIENCE #3 - CONTINUED

2. Consider the following pattern to present, and discuss the pictures:

- Present the picture
- Introduce new vocabulary such as carriage, buggy, etc.
- Ask questions about the action depicted in the picture.
- Encourage discussion

3. Use the following questions to accompany the presentation of each of the pictures.

- *What do you think is happening in the pictures?*
- *What type of action is shown in the picture (push or pull)?*
- *Why is the action necessary or important?*
- *What clues in the picture indicate or show the time that the action is taking place?*

4. Present the set of pictures illustrating the concepts of push/pull in economic (industrial) settings.



5. Following the pattern of presentation: present the picture, state the question, and conduct a discussion using the questions as a guide.

- What push/pull work are the workers doing?
- Why are the actions of push/pull important to getting the work done?
- What other work is done in places where things are made or where things are used that rely on push/pull?



ENGAGE

EXPERIENCE #3 - CONTINUED

6. Culminate the presentation and discussion of the pictures of historic and industrial examples of push/pull with a generalization such as the following: *Pushing and pulling have been important to help people live and work over time.*

7. In their **Science Notebook**, students should label one page “Push” and another page “Pull”. Provide students with sets of their own picture cards used for the lesson (see appendix). Instruct students to cut and glue the pictures on the appropriate page based on whether the picture depicts a push or a pull force.

ENGAGE

EXPERIENCE #4



Teacher: The purpose of the learning experience is to relate the concepts of push/pull to everyday activities at home and at school. This learning experience facilitates the relationship between science and the real world and changes the often-held belief that science only exists in books and in a classroom.

Assessment: Students should be able to recognize the concepts of push/pull in multiple environments.



The Cause/Effects/Because chart (p. 24) completed by the class can be used as an assessment of the group's understanding of push/pull and cause and effect.

Experience:

1. Display a chart with the labels Home and School (see appendix). Elicit from the students activities that are performed at home and at school. Record students' responses under the appropriate picture: Home or School.

What kinds of things do you do at home?

What kinds of things do you do at school?

<i>HOME</i>	<i>SCHOOL</i>
	



2. Introduce a second chart that articulates the concept of push/pull under each picture: Home and School. Using the chart completed in step #1 ask students to determine if the activities under each picture (Home and School) require a push or pull force. Record their ideas on the chart.

ENGAGE

EXPERIENCE #4 - CONTINUED



Note: Note that some of the items, such as “eating,” listed under home might require discussions to determine if it is distinctively labeled as push or pull. Keep in mind the push moves something away from you, a pull brings it towards you. Some activities may involve both types of forces.

PUSH AND PULL			
At Home		At School	
			
Push	Pull	Push	Pull

3. Refer to the completed chart to ask these questions:

- What are the differences between push and pull?*
- What are you doing when you push something? Let's do the motion together (demonstrate in the air, pushing something away from you).*
- What action are you performing when you pull something? Let's do the motion together (demonstrate in the air, pulling something towards you).*
- Let's talk about some of the actions that might require more force, a stronger push or pull. Look at the chart, which ones require more force? Which require less force?*



ENGAGE

EXPERIENCE #4 - CONTINUED

4. Introduce the concepts of cause and effect related to the push/pull examples listed on the Home/School chart. Ask students to select an example on the Home/School chart to describe its cause and effect relationship to push/pull and the reason (“because”) the push/pull action took place. Note the steps in the learning experience:

- a. *Solicit examples of push/pull and ask the students to describe the effect(s) of some thing at home and school when it is pushed and/or pulled.*

<i>PUSH AND PULL: CAUSE</i>	<i>EFFECT</i>	<i>BECAUSE</i>
<i>I pushed the teacher’s chair at school.</i>	<i>It moved</i>	<i>It moved because I pushed it hard.</i>

EXPLORE/EXPLAIN

EXPERIENCE #5 EFFECTS OF PUSH/PULL ON DIFFERENT SURFACES



Teacher: The purpose of this learning experience is to

- (a) facilitate understanding of the effects of push/pull with the Hot Wheels under various conditions, and
- (b) develop the reason and structure of a problem to explore.

Students will work in groups to learn and practice the concepts of collaboration and teamwork.

Assessment: Students will learn to work in teams.

Students will learn to define a problem as evidenced by the submission of the work completed either in the team or individually.

Teachers will have multiple opportunities to listen and observe how students are making sense of push and pull forces and the effects of different pushes against the cars.

Experience:

1. Collect at least five of each of the following items and place them in sets on a paper plate or in a paper bag. The items are intended to represent different surfaces. Those items listed are suggested but the activity can be done with any other available materials. You will need five sets to use with a class of 20 to form groups of 4. If you have larger class sizes, prepare more materials in order to maintain the group size between 3-4 students.
 - a. Sand paper
 - b. Piece of cloth
 - c. Cardboard squares/construction paper (something with a semi-smooth surface)
 - d. Tin foil
 - e. Rug sample or swatch

EXPLORE/EXPLAIN

EXPERIENCE #5 EFFECTS OF PUSH/PULL ON DIFFERENT SURFACES - CONTINUED



2. Organize the students randomly into five teams of 3-4 students. Discuss the purpose of a team and the rules such as sharing, respect for differences of opinion and action that represent teamwork or collaboration.

- a. Consider informing students where in the application of science that teams have and continue to work collaboratively: NASA, chemists working on a new formula, game designers, etc.

3. Introduce students to the materials in the bags or on plates and the Hot Wheels. Place the materials on a large sheet of paper (chart paper/newsprint). Inform students that they will be “playing” with the materials placed on the large piece of paper to determine what they can discover about the movement of the cars from their play experience. Tell students that their task as they play is to see how the cars move when interacting with the different materials (i.e. How did it move across the sand paper? How were you able to make it move?)

- a. Allocate a specific time period for the play and inform students of the time restriction for the activity. Move from team to team to listen and initiate questions regarding their explorations.

What did you notice about the cars when you tried to make them move across (each of the items in the bag)? What caused...to happen? What happened when you used the [an item in the bag] and the car? What did you have to do to make it move?

4. Ask the students to join another team of four to share their explorations. Use the following questions to stimulate the discussion with the larger group of students.

Share with other teams what you did with your materials.

- a. How did the car react to different types of materials?
- b. What made the cars move fast/slow?

5. Ask students to share what they discovered in their teams or small groups. Record the students' ideas on a large chart paper.

EXPLORE/EXPLAIN



EXPERIENCE #5 EFFECTS OF PUSH/PULL ON DIFFERENT SURFACES - CONTINUED

<i>MATERIAL</i>	<i>EFFECT</i>
Rug	Slow, Rough, Bumpy

6. Ask each student in the group to select one of the smaller pieces of material used with the cars. Each student will place their piece of material in their **Science Notebook** and list words in their notebook that represent how the material impacted the movement of the car. For example, if they placed the construction paper in their notebook, they might write the words, fast, easy, smooth. Students can select words from the chart recorded in step #5.

7. Provide students with another opportunity to describe their experience with their Hot Wheels car and its travel over different materials by introducing the What Happened open-ended sentence frame.

8. Discuss how and why selected words can be used to complete an idea, sentence, or thought.

9. Practice completing a What Happened sentence frame with the students.

10. Instruct students to reassemble in their teams to complete a What Happened sentence frame that restates their experience pushing/pulling their Hot Wheel over different materials.

11. Direct students to paste their What Happened sentence frame into their **Science Notebooks**.

EXPLORE/EXPLAIN



EXPERIENCE #5 EFFECTS OF PUSH/PULL ON DIFFERENT SURFACES - CONTINUED

WHAT HAPPENED

The _____ was pulled over a

_____ and it went _____

Because _____

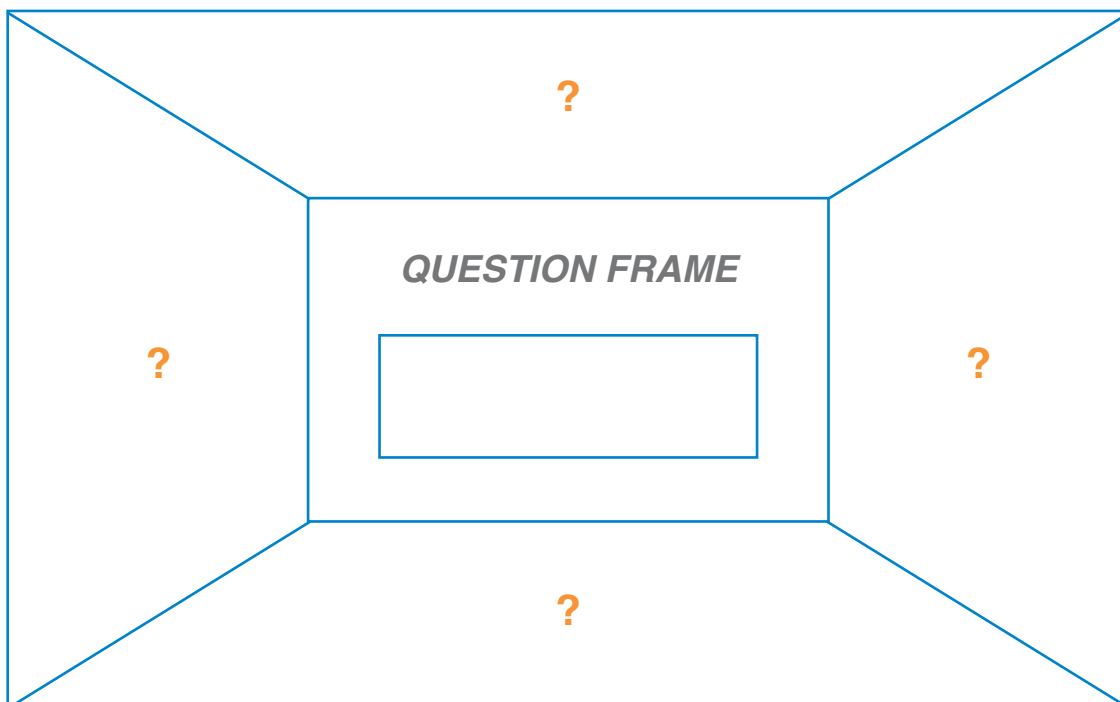
EXPLORE/EXPLAIN

EXPERIENCE #6

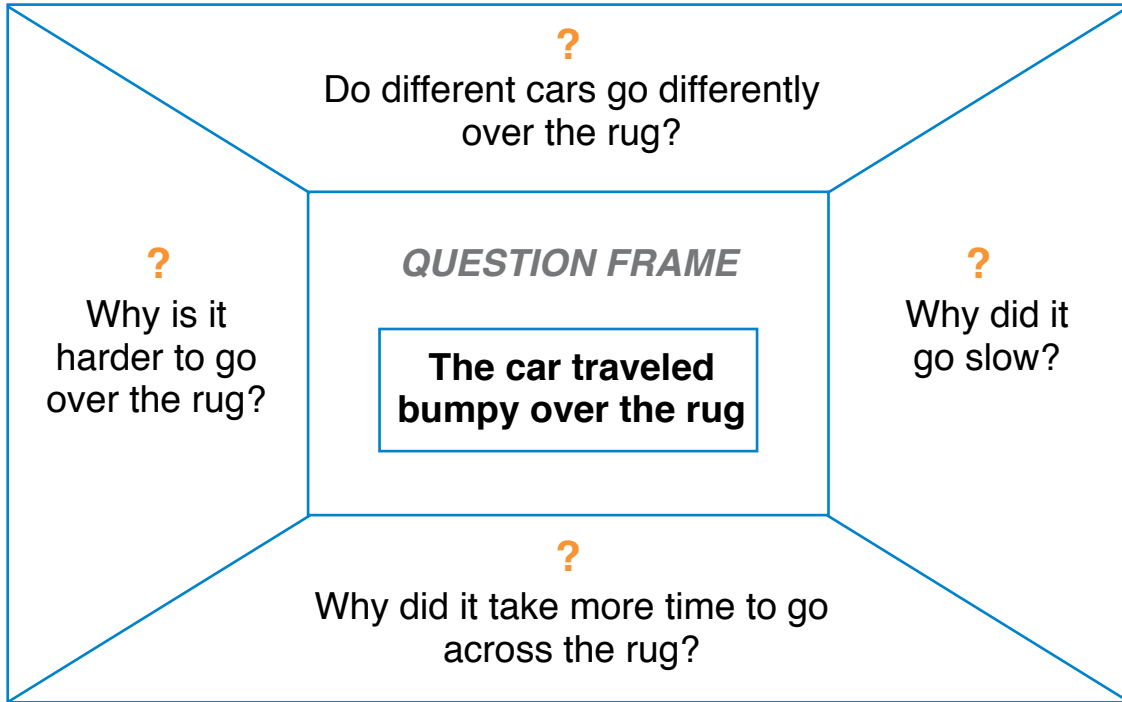


Experience:

1. Explain to students the role and importance of questioning in science.
2. Solicit examples of important questions that have affected the understanding of science (examples: How far away is the moon? What makes the kite stay up in the sky?, etc.).
3. Review with students the learning experience related to varied materials and what happened when the cars traveled over the surfaces of different materials.
4. Ask students to form questions from something they experienced with their Hot Wheels and the different materials. For example: Why did it go slower over the bumpy pieces of rug?
5. Instruct students to enter a question from their experience with different materials and the Hot Wheels in their **Science Notebooks**.
6. Consider using the Question Frame to articulate questions generated by the cars traveling over different surfaces. Note the examples on the following Question Frame Chart.



EXPLORE/EXPLAIN
EXPERIENCE #6 - CONTINUED





ELABORATE/EXTEND

EXPERIENCE #7

Teacher: The purposes of this activity are to provide a variety of materials that affect pushing and pulling and to build access and utilization of vocabulary related to pushing and pulling.

This activity also introduces how the properties of the Hot Wheels can/cannot affect the actions push and pull.

Assessment: Students will complete the chart. The chart can be used as an informal assessment of the knowledge students have acquired about the relationships between the application of push/pull with different materials and their reactions on different cars: fast, slow, etc.

Experience:

1. Collect a variety of materials inclusive of rubber and cotton balls, different-sized wooden blocks, sugar cubes, ribbon, string, and rope.
2. Display the collection of Hot Wheels. Ask each child or team of children to select two Hot Wheels that differ in size, weight, and color.
3. Demonstrate and explain that the students will use the materials, such as balls, string, rope, and ribbon to determine the cause and effect relationships of these materials on their reactions to the movements of the cars.
4. Introduce the chart to the students that facilitates their understanding of how the properties of the Hot Wheels such as size and weight affect push/pull with different materials (balls, string, etc.).
5. Demonstrate how students can circle their responses in each category to show the causes and effects of the actions: push/pull.



ELABORATE/EXTEND

EXPERIENCE #7 - CONTINUED

<i>MATERIALS</i>	<i>CARS</i>	<i>RESULTS</i>	<i>FORCE</i>
Ball	Heavy/Light	Fast/Slow	Push/Pull
String	Long/Short	Easy/Hard	Push/Pull
Rope	Big/Small	Smooth/Bumpy	Push/Pull
Ribbon		Soft/Hard	Push/Pull

Note the examples of a student response. “I used a **short rope** (material) to **pull** a **small** (car) with the (results) that the car traveled **slow**.”

<i>MATERIALS</i>	<i>CARS</i>	<i>RESULTS</i>	<i>FORCE</i>
Ball	Heavy/Light	Fast/Slow	Push/Pull
String	Long/Short	Easy/Hard	Push/Pull
Rope	Big/Small	Smooth/Bumpy	Push/Pull
Ribbon		Soft/Hard	Push/Pull



EVALUATE

EXPERIENCE #8

Teacher: The objective of this learning experience is to introduce students to disciplines (engineering) as a formal way to name and describe the work of different types of scientists. This learning experience (the language of the discipline) can also introduce young students to the concepts of careers in science and the work done in different areas of science.

Assessment: Students will be able to use the language of the discipline in context to describe the causes and effects of applying different forces on different sizes of Hot Wheels.

Students will be able to discuss the concepts of a discipline and disciplinarian and insert their frame into their **Science Notebooks**.

Experience:

1. Discuss how people at the school (teacher principal, nurse, custodian, etc.) all assume different roles and types of work.
 - a. Discuss how the “world of work” is defined by many people doing different types of work.
 - b. Introduce students to the picture of an engineer and the work engineers do. Descriptors of the people and their work can be addressed simply. For example, “an engineer solves problems with machines.”



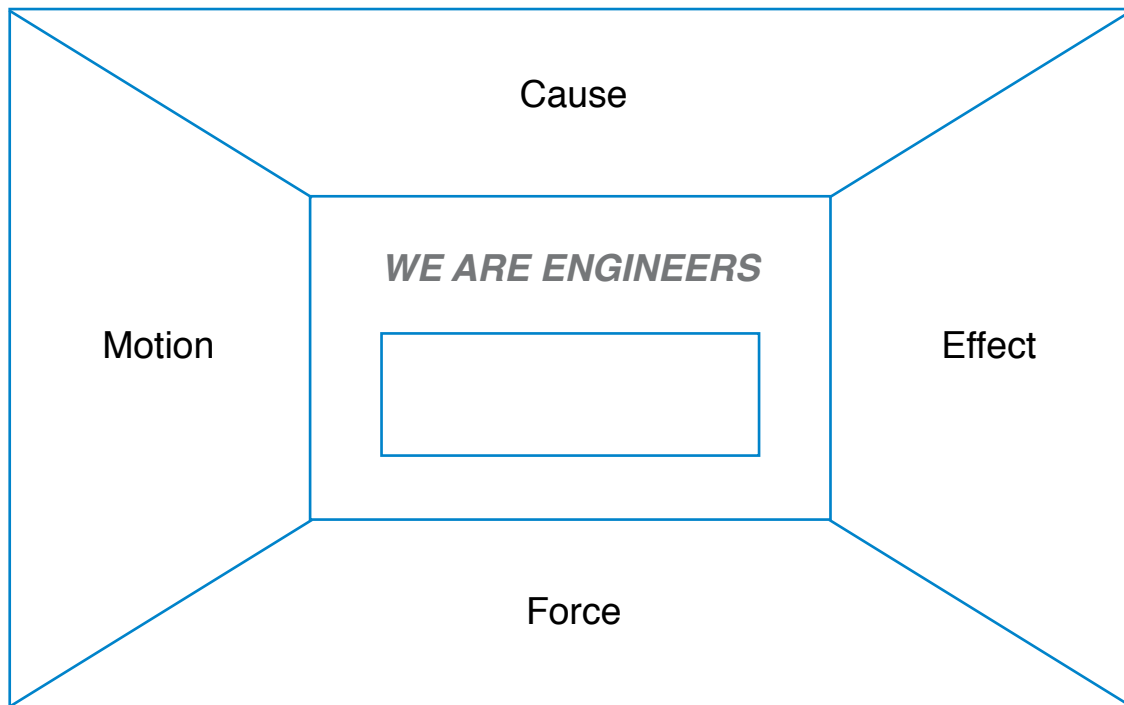
2. Create a set of role-playing frames.
 - a. Group the students in teams.
 - b. Instruct the students to use the key words on the chart to describe the **causes** and **effects** and **motion** and **force** of the actions of the selected disciplinarians.



EVALUATE

EXPERIENCE #8 - CONTINUED

3. Present the frame to the students. Introduce the vocabulary surrounding the frame: Cause, Effect, Force, Motion. Discuss the work of the disciplinarian in relationship to the words of the frame – an Engineer: a person who builds and solves problems with machines.



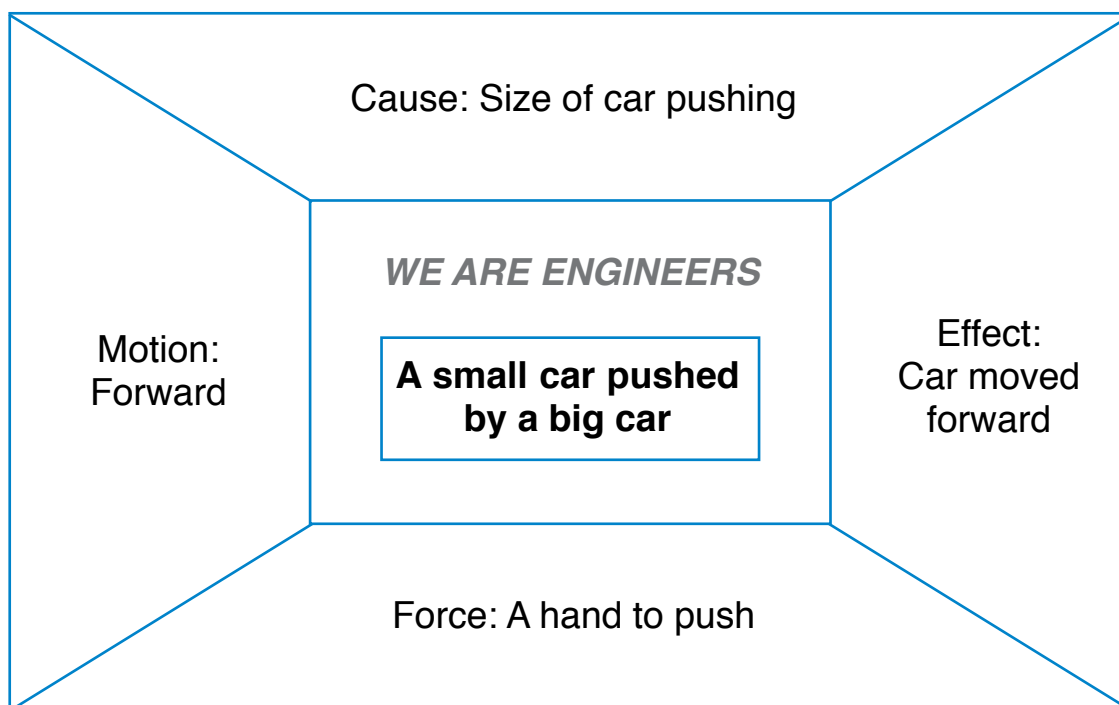
- a. Complete the centerpiece of the frame with a specific Hot Wheels action:
 - i. A small car pushed by a big car
 - ii. A big car pulling a small car
 - iii. Two cars pushed by one car
- b. Read the action to the students.

4. Instruct students that they will read and use the words around the frame to Think Like an Engineer to explain the action in the center of the frame using the key words:

- a. Cause
- b. Effect
- c. Force
- d. Motion

EVALUATE

EXPERIENCE #8 - CONTINUED



4. Discuss the meaning of the key words. Present these questions (in any order) to the students to complete the frame:

- What type of force occurred?
- What was the motion?
- What was the cause?
- What was the effect?

5. Create and use these other actions within the frame to reinforce Thinking Like an Engineer, and complete additional frames. Note these suggestions for problems:

- Hot Wheels needed to go up a hill but could not go up the hill.
- Hot Wheels ran out of gas.

UNIVERSAL CONCEPT: RELATIONSHIPS (CAUSE AND EFFECT)

PART 2: FORCE AND MOVEMENT

Overview: In this lesson sequence students will continue to explore the concepts of force and motion, extending their understanding beyond push and pull. Students will understand that there are other forces, such as natural and man-made forces, that can impact the movement of an object.

The Science Behind the Lesson: Students have understood force as a tangible, visible and physical experience that causes an object to move. They focused on push and pull forces that move objects away from them or draw them towards them. In this unit, students need to understand that forces can be natural or man-made and affect objects in diverse ways. Natural forces enact forces, pushes and pulls, on objects that cause diverse reactions. For example, weather can cause an object to slow down if conditions are too dangerous for the object to move quickly. The wind is a natural force in nature that can push and pull objects such as leaves to move in opposing directions. Other forces can be man-made, also having a great impact on objects. Road signs and road conditions cause drivers to move their cars in different directions and at different speeds. These forces work in tandem with other push and pull movements. Students will see how push and pull is not such a simple, predictable movement, but that there are other interactions/forces that impact movement that can work sequentially or simultaneously.

DOMINANT STANDARDS

K-PS2-2.

Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.*

WRITING

**CCSS.
ELA-LITERACY.
W.K.2**

Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.

**CCSS.
ELA-LITERACY.
W.K.8**

With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

UNIVERSAL CONCEPT: RELATIONSHIPS (CAUSE AND EFFECT)

PART 2: FORCE AND MOVEMENT - CONTINUED

SUBORDINATE STANDARD	
CCSS. ELA-LITERACY. SL.K.1	Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
CCSS. ELA-LITERACY. SL.K.1.A	Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
CCSS. ELA-LITERACY. SL.K.1.B	Continue a conversation through multiple exchanges.
CCSS. ELA-LITERACY. SL.K.3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
CCSS. ELA-LITERACY. SL.K.4	Describe familiar people, places, things, and events and, with prompting and support, provide additional detail.
CCSS. ELA-LITERACY. L.K.5	With guidance and support from adults, explore word relationships and nuances in word meanings.
CCSS. ELA-LITERACY. L.K.5.A	Sort common objects into categories (e.g., shapes, foods) to gain a sense of the concepts the categories represent.
CCSS. ELA-LITERACY. L.K.5.C	Identify real-life connections between words and their use (e.g., note places at school that are colorful).

UNIVERSAL CONCEPT: RELATIONSHIPS (CAUSE AND EFFECT)

PART 2: FORCE AND MOVEMENT - CONTINUED

INTEGRATED ELD STANDARD			
ELD STANDARD	EMERGING (EM)	EXPANDING (EX)	BRIDGING (BR)
ELD. P1.K.3	3. Offering opinions: Offer opinions and ideas in conversations using a small set of learned phrases (e.g., I think X), as well as open responses.	3. Offering opinions: Offer opinions in conversations using an expanded set of learned phrases (e.g., I think/don't think X. I agree with X), as well as open responses, in order to gain and/or hold the floor.	3. Offering opinions: Offer opinions in conversations using an expanded set of learned phrases (e.g., I think/don't think X. I agree with X, but . . .), as well as open responses, in order to gain and/or hold the floor or add information to an idea.
ELD. P1.K.10	10. Composing/Writing: Draw, dictate, and write to compose very short literary texts (e.g., story) and informational texts (e.g., a description of a dog), using familiar vocabulary collaboratively in shared language activities with an adult (e.g., joint construction of texts), with peers, and sometimes independently.	10. Composing/Writing: Draw, dictate, and write to compose short literary texts (e.g., story) and informational texts (e.g., a description of dogs), collaboratively with an adult (e.g., joint construction of texts), with peers, and with increasing independence.	10. Composing/Writing: Draw, dictate, and write to compose longer literary texts (e.g., story) and informational texts (e.g., an information report on dogs), collaboratively with an adult (e.g., joint construction of texts), with peers, and independently using appropriate text organization.
ELD. P1.K.11	11. Supporting opinions: Offer opinions and provide good reasons (e.g., My favorite book is X because X.) referring to the text or to relevant background knowledge.	11. Supporting opinions: Offer opinions and provide good reasons and some textual evidence or relevant background knowledge (e.g., paraphrased examples from text or knowledge of content).	11. Supporting opinions: Offer opinions and provide good reasons with detailed textual evidence or relevant background knowledge (e.g., specific examples from text or knowledge of content).

UNIVERSAL CONCEPT: RELATIONSHIPS (CAUSE AND EFFECT)

PART 2: FORCE AND MOVEMENT - CONTINUED

Essential Questions: What causes an object to move? What are the different forces that can be exerted on an object? Which forces do we find in nature and which are person-made? What are the cause and effect relationships found in our environment to help us understand force and motion?



ENGAGE

EXPERIENCE #1 DEPARTMENT OF MOTOR VEHICLES



Teacher: The purpose of this learning experience is to introduce students to the reasons for and the types of forces that can impact movement. They have been focusing on physical movement, through push and pull. This experience illustrates other forces that impact movement, such as rules, regulations, and signs governing driving. In addition, students will be introduced to the academic language associated with the rules and regulations for driving.

Assessment: Students will be able to read and respond to the importance of signage when driving.

Experience:

1. Show and discuss a collection of artifacts related to motor vehicles:

- a. Driving license
- b. Motor Vehicle Code
- c. Drivers written test items

2. Introduce the academic language appropriate to the discussion such as: safety, vehicle, caution, license, hazards, signs, etc.



3. Create a mock DMV for students to obtain their driver's license.

- a. Invite students to “make an appointment” to get their driver's license by signing the “driving test schedule.” Pass the schedule around and have students select an appointment and sign up on the schedule.

<i>DRIVING TEST SCHEDULE</i>	
Day/Time	Name

ENGAGE

EXPERIENCE #1 DEPARTMENT OF MOTOR VEHICLES



Note: the experience of obtaining a driver's license reinforces the importance of data identifying the individual. It also is a symbol that represents that the driver knows and understands the rules and regulations of driving on the road. Explain to students that when they drive on the road, they are responsible for following rules and signs that will impact the movement of the car. Sometimes they will be asked to stop, go, yield, go faster, go slower, etc. They will understand that movement can be impacted by external forces.

b. The development of a driver's license can be facilitated by giving each student a small index card to draw a self-portrait.

4. Show the students the road signs (next page). Discuss each sign and what it means. If they do not recognize the sign be sure to explain its purpose in a given context.

5. Provide each student with a copy of the road signs hand-out and 6 popsicle sticks or tongue depressors. Ask students to cut each sign out and glue each one to a popsicle stick or tongue depressor:

- a. Stop
- b. Traffic Light
- c. Railroad crossing
- d. Pedestrian crossing
- e. Rock fall
- f. Curvy Road





ENGAGE

EXPERIENCE #1 DEPARTMENT OF MOTOR VEHICLES

6. Instruct students to share with a partner (pair share) sitting next to them their signs and what they mean. Consider developing sentence frame charts to stimulate discussion.

This is a ...it means...

The...sign...makes you...

The...sign...is for you to...

When you see a ...you should...

7. Have students walk around the room sharing with different partners their signs and what they mean.

8. Show students how to place their signs in their **Science Notebook**.

ENGAGE



EXPERIENCE #2 DEPARTMENT OF MOTOR VEHICLES, CONTINUED

1. Make large replicas of the same signs students used in the previous learning experience and place the signs around the classroom to resemble mock roads.
 - a. Distribute Hot Wheels to the students, one for each student.
 - b. Instruct students to drive around the room and obey the signage now that they have received their driving license and they know what the signs mean. Remind students that their movements will be impacted by two things: a push or pull caused by them exerting force on the car so that it moves, and the external “force” of the signs which impact how and when they move.
2. Summarize the students’ experiences. Discuss and list the causes and effects of signage when driving.
3. Ask students for other types of signs that they think might be important when they drive (Example: Do Not Race sign).

EXPLORE/EXPLAIN

EXPERIENCE #1



Teacher: The purpose of the learning experience is for students to acquire understanding of how and why different conditions and materials affect speed.

Assessment: Students will be able to dictate a cause/effect or stimulus/response or outcome from their experiences of driving under different road and/or weather conditions.





Experience:

1. Distribute the Hot Wheels to students to demonstrate and practice the effects of speed under different conditions:

- a. Steep road
- b. Curvy road
- c. Straight road

Note: these types of roads can be made using the plastic loops in the Hot Wheels kit and cut outs of roads made from cardboard.

2. Complete the chart with the students noting the causes and effects of speed under the named conditions.

<i>DRIVING CONDITIONS</i>	<i>CAUSE AND EFFECTS</i>
Straight road 	
Bumpy road 	
Curvy road 	
Hilly road 	

- a. Add conditions that affect driving to the chart as teacher or students identify such conditions.

EXPLORE/EXPLAIN

EXPERIENCE #2



1. Provide students with a series of weather conditions to investigate their effects on movement (speed) and forces when driving. Reexamine previous discussions about how different forces can affect a variety of movements, beyond pushing and pulling.

2. Display pictures depicting different weather conditions on large pieces of paper. Ask students to share with a partner what they see and what they know about the different weather pictures posted. Provide the following sentence frames to guide their pair share.

I see...It can make things....

That picture shows...

<i>WEATHER CONDITION</i>	<i>EFFECT</i>
Icy	Very Slippery
Rain	Wet Slippery

3. Review each picture of the different weather conditions with the class to describe effects of the elements related to the conditions. Chart the students' responses.

4. Instruct students that they will be driving a selected How Wheel under different weather conditions to determine the anticipated effects of the weather on the force and movement of the car. Students will explain what happens to their car as it moves across different road conditions. Demonstrate to the students that they can pantomime the movement of the car under the depicted weather conditions.

EXPLORE/EXPLAIN

EXPERIENCE #2



5. Discuss the multiple words and phrases that can express the same idea.
6. Introduce and practice examples of the multiple meanings to describe cause and effect:
 - a. Stimulus/response
 - b. Action/consequences
 - c. Situation/results.
7. Apply students' findings from the learning experiences regarding the effects of driving conditions on movement and force using the language of stimulus/response rather than cause and effect.
8. Have students select a road condition and draw a picture of it in their **Science Notebook** with a sketch of their car. Ask students to write words that describe the road condition. They can use the chart in step #3 for help.



ELABORATE/EXTEND

EXPERIENCE #3

Teacher: One specific purpose of the learning experience is to comprehend the need and use of bridges to facilitate driving. In addition, students can acquire understanding of the structures that facilitate people's movement on roads.

A second objective of the learning experience is to consider and apply engineering skills to construct a bridge or some other structure relevant to facilitate driving on the road.

Assessment: Students will be able to construct a bridge from raw materials (an inventive, maker activity).

Students will be able to describe the cause/ effect relationship between push on the bridge and speed, distance, and time. They will record their observations on a class chart.

Ask students to sketch a replica of their bridge in their **Science Notebook**.

Experience:

1. Show students pictures of various bridges:

- a. Tapan Zee bridge (New York)
- b. Golden Gate bridge (San Francisco)
- c. Los Angeles bridge (Los Angeles)
- d. Bay Bridge (Oakland)

2. Discuss the purposes and functions of bridges.

3. Provide students with a collection of raw materials:

- Square or round empty boxes
- Cups
- Sugar cubes
- Graham crackers
- Licorice sticks
- Brads, rope, glue (other materials that can be used to construct a bridge)



ELABORATE/EXTEND

EXPERIENCE #3

4. Introduce students to the skills of creativity thinking (Eberle, R):

- Substitute
- Combine
- Add-to
- Minimize/maximize
- Elaborate
- Redesign

5. Instruct students to select the raw materials needed to “engineer” a bridge for Hot Wheels to travel.

6. Conduct an opportunity for the students to share their bridges.

- a. Summarize the common features and materials used in the construction of the various bridges.

7. Instruct students to select a Hot Wheel for the purpose of “driving” it over the various student-built bridges.

- a. Inform students that they are to push the Hot Wheel over the bridge, identify the time required for their Hot Wheel to travel the bridge using a timer available for the class and measure the distance traveled by the Hot Wheel with string or rope.

8. Facilitate the completion of the chart with the entire class.

ELABORATE/EXTEND

EXPERIENCE #3



OUR BRIDGES

Name of Student's Bridge	Building Material Used	Speed	Distance	Time	Cause and Effect Relationship	Conclusion

Student Capacities	ELD Proficiency Level Continuum				Lifelong Language Learning		
	Emerging	Expanding	Bridging				
<p>Native Language</p> <p>English learners come to school possessing a wide range of competencies in their native language appropriate to their age. They may have varying levels of literacy in their native language, depending on their prior experiences in the home, community, and school. As learners of English as a new language, they gain metacognitive awareness of what language is and how it is used and apply this awareness in their language learning strategies, including drawing upon knowledge of their native language.</p>	<p>English learners enter the Emerging level having limited receptive and productive English skills.</p> <p>As they progress through the Emerging level, they start to respond to more varied communication tasks using learned words and phrases with increasing ease.</p>	<p>Upon exit from the Emerging level, students have basic English communication skills in social and academic contexts.</p>	<p>As English learners progress through the Expanding level, they move from being able to refashion learned phrases and sentences in English to meet their immediate communication and learning needs toward being able to increasingly engage in using the English language in more complex, cognitively demanding situations.</p>	<p>Upon exit from the Expanding level, students can use English to learn and communicate about a range of topics and academic content areas.</p>	<p>As English learners progress through the Bridging level, they move from being able to communicate in ways that are appropriate to different tasks, purposes, and audiences in a variety of social and academic contexts toward being able to refine and enhance their English language competencies in a broader range of contexts.</p>	<p>Upon exit from the Bridging level, students can communicate effectively with various audiences on a wide range of familiar and new topics to meet academic demands in a variety of disciplines.</p>	<p>Students who have reached “proficiency” in the English language (as determined by state and/or local criteria) continue to build increasing breadth, depth, and complexity in comprehending and communicating in English in a wide variety of contexts.</p>
<p>High-Level Thinking with Linguistic Support</p> <p>English learners possess cognitive abilities appropriate to their age and experience. In order to communicate about their thinking as they learn English, they may need varying linguistic support, depending on the linguistic and cognitive demand of the task.</p>	<p>General Extent of Support</p>				<p>Occasional</p> <p>Students who have exited the Bridging level benefit from occasional linguistic support in their ongoing learning of English.</p>		
<p>Substantial</p> <p>Students at the early stages of the Emerging level can engage in complex, cognitively demanding social and academic activities requiring language when provided substantial linguistic support; as they develop more familiarity and ease with understanding and using English, support may be moderate or light for familiar tasks or topics.</p>	<p>Moderate</p> <p>Students at the early stages of the Expanding level can engage in complex, cognitively demanding social and academic activities requiring language when provided moderate linguistic support; as they develop increasing ease with understanding and using English in a variety of contexts, support may be light for familiar tasks or topics.</p>	<p>Light</p> <p>Students at the early stages of the Bridging level can engage in complex, cognitively demanding social and academic activities requiring language when provided light linguistic support; as they develop increasing ease with understanding and using highly technical English, support may not be necessary for familiar tasks or topics using everyday English.</p>					

Mode of Communication	ELD Proficiency Level Continuum	
	→ Bridging →	
	At the <i>early stages</i> of the Bridging level, students are able to perform the following tasks:	Upon <i>exit</i> from the Bridging level, students are able to perform the following tasks:
Collaborative	<ul style="list-style-type: none"> ● Express increasingly complex feelings, needs, ideas, and opinions in a variety of settings; respond to questions using extended and more elaborate discourse. ● Initiate and sustain dialogue on a variety of grade-level academic and social topics. 	<ul style="list-style-type: none"> ● Participate fully in all collaborative conversations in all content areas at grade level, with occasional support as necessary. ● Participate fully in both academic and non-academic settings requiring English.
Interpretive	<ul style="list-style-type: none"> ● Comprehend concrete and many abstract topics and begin to recognize language subtleties in a variety of communication settings. ● Read increasingly complex text at grade level. ● Read technical text supported by pictures or graphics. 	<ul style="list-style-type: none"> ● Comprehend concrete and abstract topics and recognize language subtleties in a variety of communication settings. ● Read, with limited comprehension difficulty, a variety of grade-level and technical texts in all content areas.
Productive	<ul style="list-style-type: none"> ● Produce, initiate, and sustain interactions with increasing awareness of tailoring language to specific purposes and audiences. ● Write and express ideas to meet increasingly complex academic demands for specific purposes and audiences. 	<ul style="list-style-type: none"> ● Produce, initiate, and sustain extended interactions tailored to specific purposes and audiences. ● Write and express ideas to meet a variety of social needs and academic demands for specific purposes and audiences.