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.
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.
## MANAGING AND MAXIMIZING LANGUAGE DEVELOPMENT: 5E PROCESS

<table>
<thead>
<tr>
<th>PROCESS STEP</th>
<th>PURPOSE</th>
<th>MANAGING LANGUAGE OPPORTUNITIES</th>
</tr>
</thead>
</table>
| **Engage**   | Schema activation  
Generating background knowledge  
Motivation  
Teacher modeling | • Students talk from personal background and experience  
• Teacher facilitates, assesses, models language in her interactions |
| **Explore**   | Common base of learning from discovery & interaction  
Experiential, hands-on | • 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 |
| **Explain**   | Teacher helps students to understand learning goal & correct misconceptions  
Students need to explain their understanding | • 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 |
| **Elaborate** | Application of understanding of content objective in a new context | • Students practice new understanding using language in a meaningful way (vocabulary, Questioning, text models, language frames, writing)  
• Teacher provides explicit support for language use |
<table>
<thead>
<tr>
<th>PROCESS STEP</th>
<th>PURPOSE</th>
<th>MANAGING LANGUAGE OPPORTUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate</td>
<td>Assess students as they apply new understanding &amp; abilities Students evaluate their own learning</td>
<td>• Review and self-evaluation • Provide opportunities for language consciousness</td>
</tr>
</tbody>
</table>

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

### ACADEMIC LANGUAGE BANK

**LANGUAGE FUNCTION/FORMS**

<table>
<thead>
<tr>
<th><strong>Cause and Effect</strong></th>
<th><strong>Drawing Conclusions</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The...are...</td>
<td>...is/are...</td>
</tr>
<tr>
<td>The...,... because...</td>
<td>...is not/are not...</td>
</tr>
<tr>
<td>...because...</td>
<td>...can...</td>
</tr>
<tr>
<td>..., so...</td>
<td>...can’t...</td>
</tr>
<tr>
<td>Because...,...</td>
<td>I know...because...</td>
</tr>
<tr>
<td>Since...,...</td>
<td>Because of..., I can conclude...</td>
</tr>
<tr>
<td>As a result of...,...</td>
<td>As a result of...,...</td>
</tr>
<tr>
<td>...which lead to...</td>
<td>I’ve noticed..., therefore,...</td>
</tr>
<tr>
<td>Due to the fact that...,...</td>
<td>Based on..., I can conclude that...</td>
</tr>
<tr>
<td>...caused...</td>
<td>Since..., I know...</td>
</tr>
<tr>
<td></td>
<td>Considering that...is...we can conclude that...</td>
</tr>
</tbody>
</table>

**VOCABULARY**

<table>
<thead>
<tr>
<th>Tier 2 (General Academic Vocabulary)</th>
<th>Tier 3 (Discipline-Specific Vocabulary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force</td>
<td>Push</td>
</tr>
<tr>
<td>Cause</td>
<td>Pull</td>
</tr>
<tr>
<td>Effect</td>
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</tbody>
</table>
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 English language performance standards for English Language Learners (ELLs). Standards for ELLs will be embedded in all lessons, explicitly and implicitly. The use of the English Language Performance 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 ELLs through hands-on, minds-on authentic experiences. Based on the work of various educators
and researchers in the 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 ELLs 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 ELLs in accessing content and articulating their thinking.

Teachers should be mindful of students’ varying stages of English language development to modify instruction accordingly. The proficiency level descriptors for the state of Texas are provided in the Appendix. These tools can help teachers modify instruction to support ELLs at all levels of English language development.

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.
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.
These learning activities support students in the development of capacities described in the Texas Essential Knowledge and Skills (TEKS).

<table>
<thead>
<tr>
<th>TEKS §110.11. ENGLISH LANGUAGE ARTS AND READING</th>
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<tbody>
<tr>
<td>(21)</td>
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<td>(23)</td>
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<td>(15)</td>
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</table>
### TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) ALIGNMENT AND CONNECTIONS

#### TEKS §110.11. ENGLISH LANGUAGE ARTS AND READING

<table>
<thead>
<tr>
<th></th>
<th>Reading/Vocabulary Development. Students understand new vocabulary and use it correctly when reading and writing. Students are expected to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5)</td>
<td>(A) identify and use words that name actions, directions, positions, sequences, and locations;</td>
</tr>
<tr>
<td></td>
<td>(C) identify and sort pictures of objects into conceptual categories (e.g., colors, shapes, textures)</td>
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#### TEXAS ADMINISTRATIVE CODE §74.4. ENGLISH LANGUAGE PROFICIENCY STANDARDS

<table>
<thead>
<tr>
<th></th>
<th>Cross-curricular second language acquisition/listening.</th>
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<tbody>
<tr>
<td>(2)</td>
<td>(C) learn new language structures, expressions, and basic and academic vocabulary heard during classroom instruction and interactions;</td>
</tr>
<tr>
<td></td>
<td>(D) monitor understanding of spoken language during classroom instruction and interactions and seek clarification as needed;</td>
</tr>
<tr>
<td></td>
<td>(E) use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language;</td>
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<tr>
<td></td>
<td>(G) understand the general meaning, main points, and important details of spoken language ranging from situations in which topics, language, and contexts are familiar to unfamiliar;</td>
</tr>
<tr>
<td></td>
<td>(H) understand implicit ideas and information in increasingly complex spoken language commensurate with grade-level learning expectations; and</td>
</tr>
<tr>
<td></td>
<td>(I) demonstrate listening comprehension of increasingly complex spoken English by following directions, retelling or summarizing spoken messages, responding to questions and requests, collaborating with peers, and taking notes commensurate with content and grade-level needs.</td>
</tr>
</tbody>
</table>
TEXAS ADMINISTRATIVE CODE §74.4.
ENGLISH LANGUAGE PROFICIENCY STANDARDS

(3) Cross-curricular second language acquisition/speaking.
(B) expand and internalize initial English vocabulary by learning and using high-frequency English words necessary for identifying and describing people, places, and objects, by retelling simple stories and basic information represented or supported by pictures, and by learning and using routine language needed for classroom communication;
(D) speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency;
(E) share information in cooperative learning interactions;
(H) narrate, describe, and explain with increasing specificity and detail as more English is acquired;

(5) Cross-curricular second language acquisition/writing.
(B) write using newly acquired basic vocabulary and content-based grade-level vocabulary
(G) narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired.

TEKS §112.11. SCIENCE

(2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to:
(B) plan and conduct simple descriptive investigations such as ways objects move

(6) Force, motion, and energy. The student knows that energy, force, and motion are related and are a part of their everyday life.
### TEKS §113.11. SOCIAL STUDIES

| (4) | Geography. The student understands the concept of location. The student is expected to:  
(A) use terms, including over, under, near, far, left, and right, to describe relative location; |
| (5) | Geography. The student understands physical and human characteristics of place. The student is expected to:  
(A) identify the physical characteristics of place such as landforms, bodies of water, natural resources, and weather; and  
(B) identify how the human characteristics of place such as ways of earning a living, shelter, clothing, food, and activities are based upon geographic location. |
| (15) | Social studies skills. The student communicates in oral and visual forms. The student is expected to:  
(A) express ideas orally based on knowledge and experiences; and  
(B) create and interpret visuals, including pictures and maps. |

### TEKS §117.104. THEATRE

| (3) | Creative expression: production. The student applies design, directing, and theatre production concepts and skills. The student is expected to:  
(A) create playing space using common objects such as tables or chairs; |
<table>
<thead>
<tr>
<th>TEKS §111.2. MATHEMATICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(7) Geometry and measurement. The student applies mathematical process standards to directly compare measurable attributes. The student is expected to: (A) give an example of a measurable attribute of a given object, including length, capacity, and weight; and (B) compare two objects with a common measurable attribute to see which object has more of/less of the attribute and describe the difference.</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS

PART 1: PUSH/PULL  20 - 45
PART 2: FORCE AND MOVEMENT  46 - 59
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 with 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

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>(2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to: (B) plan and conduct simple descriptive investigations such as ways objects move</td>
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<td>(6) Force, motion, and energy. The student knows that energy, force, and motion are related and are a part of their everyday life.</td>
</tr>
<tr>
<td>Standard</td>
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</tr>
<tr>
<td>(21)</td>
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<td>(22)</td>
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<tr>
<td>(23)</td>
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</tbody>
</table>
### Cross-curricular second language acquisition/listening.

1. **(C)** Learn new language structures, expressions, and basic and academic vocabulary heard during classroom instruction and interactions;
2. **(D)** Monitor understanding of spoken language during classroom instruction and interactions and seek clarification as needed;
3. **(E)** Use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language;
4. **(G)** Understand the general meaning, main points, and important details of spoken language ranging from situations in which topics, language, and contexts are familiar to unfamiliar;
5. **(H)** Understand implicit ideas and information in increasingly complex spoken language commensurate with grade-level learning expectations; and
6. **(I)** Demonstrate listening comprehension of increasingly complex spoken English by following directions, retelling or summarizing spoken messages, responding to questions and requests, collaborating with peers, and taking notes commensurate with content and grade-level needs.

### Cross-curricular second language acquisition/speaking.

1. **(B)** Expand and internalize initial English vocabulary by learning and using high-frequency English words necessary for identifying and describing people, places, and objects, by retelling simple stories and basic information represented or supported by pictures, and by learning and using routine language needed for classroom communication;
2. **(D)** Speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency;
3. **(E)** Share information in cooperative learning interactions;
4. **(H)** Narrate, describe, and explain with increasing specificity and detail as more English is acquired;
### DOMINANT STANDARDS

**TEXAS ADMINISTRATIVE CODE §74.4. ENGLISH LANGUAGE PROFICIENCY STANDARDS**

| (5) | Cross-curricular second language acquisition/writing.  
(B) write using newly acquired basic vocabulary and content-based grade-level vocabulary  
(G) narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired. |

### SUBORDINATE STANDARD

**TEKS §111.2. MATHEMATICS**

| (7) | Geometry and measurement. The student applies mathematical process standards to directly compare measurable attributes. The student is expected to:  
(A) give an example of a measurable attribute of a given object, including length, capacity, and weight; and  
(B) compare two objects with a common measurable attribute to see which object has more of/less of the attribute and describe the difference. |

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

<table>
<thead>
<tr>
<th>NUMBER OF CARS</th>
<th>CAR COLOR</th>
<th>CAR SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>same</td>
<td>same</td>
</tr>
<tr>
<td>2</td>
<td>same</td>
<td>different</td>
</tr>
<tr>
<td>3</td>
<td>different</td>
<td>different</td>
</tr>
</tbody>
</table>

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.
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?*
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.

<table>
<thead>
<tr>
<th>shove</th>
<th>poke</th>
<th>tug</th>
<th>pinch</th>
</tr>
</thead>
<tbody>
<tr>
<td>jerk</td>
<td>nudge</td>
<td>press</td>
<td>pluck</td>
</tr>
<tr>
<td>drag</td>
<td>prod</td>
<td>yank</td>
<td>tag</td>
</tr>
</tbody>
</table>

2. Construct a chart with the students to facilitate understanding of synonyms related to the concepts of push and pull.
3. 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.

4. 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.”

5. 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.

<table>
<thead>
<tr>
<th>PUSH</th>
<th>PULL</th>
</tr>
</thead>
<tbody>
<tr>
<td>shove</td>
<td>tug</td>
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<tr>
<td>prod</td>
<td>drag</td>
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</table>
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.
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.

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).
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?
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.
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?

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.
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

<table>
<thead>
<tr>
<th>At Home</th>
<th>At School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push</td>
<td>Push</td>
</tr>
<tr>
<td>Pull</td>
<td>Pull</td>
</tr>
<tr>
<td>Push</td>
<td>Pull</td>
</tr>
<tr>
<td>Push</td>
<td>Pull</td>
</tr>
</tbody>
</table>

3. Refer to the completed chart to ask these questions:
   a. What are the differences between push and pull?
   b. What are you doing when you push something? Let’s do the motion together (demonstrate in the air, pushing something away from you).
   c. What action are you performing when you pull something? Let’s do the motion together (demonstrate in the air, pulling something towards you).
   d. 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?
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 something at home and school when it is pushed and/or pulled.

<table>
<thead>
<tr>
<th>PUSH AND PULL: CAUSE</th>
<th>EFFECT</th>
<th>BECAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I pushed the teacher’s chair at school.</td>
<td>It moved</td>
<td>\textit{It moved because I pushed it hard.}</td>
</tr>
</tbody>
</table>
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.
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.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rug</td>
<td>Slow, Rough, Bumpy</td>
</tr>
</tbody>
</table>
**WHAT HAPPENED**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The [blank]</td>
<td>was pulled over a</td>
</tr>
<tr>
<td>[blank]</td>
<td>and it went [blank]</td>
</tr>
<tr>
<td>Because</td>
<td>[blank]</td>
</tr>
</tbody>
</table>
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.
Why did it take more time to go across the rug?

Do different cars go differently over the rug?

Why is it harder to go over the rug?

Why did it go slow?

The car traveled bumpy over the rug

Why did it take more time to go across the rug?
**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.
### EXPERIENCE #7 - CONTINUED

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>CARS</th>
<th>RESULTS</th>
<th>FORCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball</td>
<td>Heavy/Light</td>
<td>Fast/Slow</td>
<td>Push/Pull</td>
</tr>
<tr>
<td>String</td>
<td>Long/Short</td>
<td>Easy/Hard</td>
<td>Push/Pull</td>
</tr>
<tr>
<td>Rope</td>
<td>Big/Small</td>
<td>Smooth/Bumpy</td>
<td>Push/Pull</td>
</tr>
<tr>
<td>Ribbon</td>
<td></td>
<td>Soft/Hard</td>
<td>Push/Pull</td>
</tr>
</tbody>
</table>

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.”
**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.
   - Discuss how the “world of work” is defined by many people doing different types of work.
   - 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.
   - Group the students in teams.
   - 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.
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
4. Discuss the meaning of the key words. Present these questions (in any order) to the students to complete the frame:
   a. What type of force occurred?
   b. What was the motion?
   c. What was the cause?
   d. 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:
   a. Hot Wheels needed to go up a hill but could not go up the hill.
   b. 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**

<table>
<thead>
<tr>
<th>TEKS §112.11. SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Scientific investigation and reasoning. The student develops abilities to ask questions and seek answers in classroom and outdoor investigations. The student is expected to: (B) plan and conduct simple descriptive investigations such as ways objects move</td>
</tr>
<tr>
<td>(6) Force, motion, and energy. The student knows that energy, force, and motion are related and are a part of their everyday life.</td>
</tr>
</tbody>
</table>
### DOMINANT STANDARDS

**TEKS §110.11. ENGLISH LANGUAGE ARTS AND READING**

| (5)  | Reading/Vocabulary Development. Students understand new vocabulary and use it correctly when reading and writing. Students are expected to:
|      | (A) identify and use words that name actions, directions, positions, sequences, and locations;
|      | (C) identify and sort pictures of objects into conceptual categories (e.g., colors, shapes, textures) |
| (15) | Writing/Expository and Procedural Texts. Students write expository and procedural or work-related texts to communicate ideas and information to specific audiences for specific purposes. Students are expected to dictate or write information for lists, captions, or invitations. |

### SUBORDINATE STANDARD

**TEKS §110.11. ENGLISH LANGUAGE ARTS AND READING**

| (21)  | Listening and Speaking/Listening. Students use comprehension skills to listen attentively to others in formal and informal settings. Students continue to apply earlier standards with greater complexity. Students are expected to:
|       | (A) listen attentively by facing speakers and asking questions to clarify information; and
<p>|       | (B) follow oral directions that involve a short related sequence of actions. |
| (22)  | Listening and Speaking/Speaking. Students speak clearly and to the point, using the conventions of language. Students continue to apply earlier standards with greater complexity. Students are expected to share information and ideas by speaking audibly and clearly using the conventions of language. |</p>
<table>
<thead>
<tr>
<th>SUBORDINATE STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEKS §110.11. ENGLISH LANGUAGE ARTS AND READING</strong></td>
</tr>
<tr>
<td><strong>(23)</strong> Listening and Speaking/Teamwork. Students work productively with others in teams. Students continue to apply earlier standards with greater complexity. Students are expected to follow agreed-upon rules for discussion, including taking turns and speaking one at a time.</td>
</tr>
</tbody>
</table>

<p>| <strong>TEXAS ADMINISTRATIVE CODE §74.4. ENGLISH LANGUAGE PROFICIENCY STANDARDS</strong> |
| <strong>(2)</strong> Cross-curricular second language acquisition/listening. |
| (C) learn new language structures, expressions, and basic and academic vocabulary heard during classroom instruction and interactions; |
| (D) monitor understanding of spoken language during classroom instruction and interactions and seek clarification as needed; |
| (E) use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language; |
| (G) understand the general meaning, main points, and important details of spoken language ranging from situations in which topics, language, and contexts are familiar to unfamiliar; |
| (H) understand implicit ideas and information in increasingly complex spoken language commensurate with grade-level learning expectations; and |
| (I) demonstrate listening comprehension of increasingly complex spoken English by following directions, retelling or summarizing spoken messages, responding to questions and requests, collaborating with peers, and taking notes commensurate with content and grade-level needs. |</p>
<table>
<thead>
<tr>
<th>SUBORDINATE STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEXAS ADMINISTRATIVE CODE §74.4. ENGLISH LANGUAGE PROFICIENCY STANDARDS</td>
</tr>
</tbody>
</table>
| (3) Cross-curricular second language acquisition/speaking.  
  (B) expand and internalize initial English vocabulary by learning and using high-frequency English words necessary for identifying and describing people, places, and objects, by retelling simple stories and basic information represented or supported by pictures, and by learning and using routine language needed for classroom communication;  
  (D) speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency;  
  (E) share information in cooperative learning interactions;  
  (H) narrate, describe, and explain with increasing specificity and detail as more English is acquired; |
| (5) Cross-curricular second language acquisition/writing.  
  (B) write using newly acquired basic vocabulary and content-based grade-level vocabulary  
  (G) narrate, describe, and explain with increasing specificity and detail to fulfill content area writing needs as more English is acquired. |
| TEKS §117.104. THEATRE |
| (3) Creative expression: production. The student applies design, directing, and theatre production concepts and skills. The student is expected to:  
  (A) create playing space using common objects such as tables or chairs; |
| TEKS §113.11. SOCIAL STUDIES |
| (4) Geography. The student understands the concept of location. The student is expected to:  
  (A) use terms, including over, under, near, far, left, and right, to describe relative location; |
### SUBORDINATE STANDARD

<table>
<thead>
<tr>
<th>TEKS §113.11. SOCIAL STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5) Geography. The student understands physical and human characteristics of place. The student is expected to: (A) identify the physical characteristics of place such as landforms, bodies of water, natural resources, and weather; and (B) identify how the human characteristics of place such as ways of earning a living, shelter, clothing, food, and activities are based upon geographic location.</td>
</tr>
<tr>
<td>(15) Social studies skills. The student communicates in oral and visual forms. The student is expected to: (A) express ideas orally based on knowledge and experiences; and (B) create and interpret visuals, including pictures and maps.</td>
</tr>
</tbody>
</table>

**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?
**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.

<table>
<thead>
<tr>
<th><strong>DRIVING TEST SCHEDULE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day/Time</strong></td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
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
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*. 
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).
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.

<table>
<thead>
<tr>
<th>DRIVING CONDITIONS</th>
<th>CAUSE AND EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight road</td>
<td></td>
</tr>
<tr>
<td>Bumpy road</td>
<td></td>
</tr>
<tr>
<td>Curvy road</td>
<td></td>
</tr>
<tr>
<td>Hilly road</td>
<td></td>
</tr>
</tbody>
</table>

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...

<table>
<thead>
<tr>
<th>WEATHER CONDITION</th>
<th>EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icy</td>
<td>Very Slippery</td>
</tr>
</tbody>
</table>
   | 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.
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)
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.
## OUR BRIDGES

<table>
<thead>
<tr>
<th>Name of Student’s Bridge</th>
<th>Building Material Used</th>
<th>Speed</th>
<th>Distance</th>
<th>Time</th>
<th>Cause and Effect Relationship</th>
<th>Conclusion</th>
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d) Proficiency level descriptors.
(1) Listening, Kindergarten-Grade 12. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in listening. The following proficiency level descriptors for listening are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction.

(A) Beginning. Beginning ELLs have little or no ability to understand spoken English in academic and social settings. These students:
   (i) struggle to understand simple conversations and simple discussions even when the topics are familiar and the speaker uses linguistic supports such as visuals, slower speech and other verbal cues, and gestures;
   (ii) struggle to identify and distinguish individual words and phrases during social and instructional interactions that have not been intentionally modified for ELLs; and
   (iii) may not seek clarification in English when failing to comprehend the English they hear; frequently remain silent, watching others for cues.

(B) Intermediate. Intermediate ELLs have the ability to understand simple, high-frequency spoken English used in routine academic and social settings. These students:
   (i) usually understand simple or routine directions, as well as short, simple conversations and short, simple discussions on familiar topics; when topics are unfamiliar, require extensive linguistic supports and adaptations such as visuals, slower speech and other verbal cues, simplified language, gestures, and preteaching to preview or build topic-related vocabulary;
   (ii) often identify and distinguish key words and phrases necessary to understand the general meaning during social and basic instructional interactions that have not been intentionally modified for ELLs; and
   (iii) have the ability to seek clarification in English when failing to comprehend the English they hear by requiring/requesting the speaker to repeat, slow down, or rephrase speech.
(C) Advanced. Advanced ELLs have the ability to understand, with second language acquisition support, grade-appropriate spoken English used in academic and social settings. These students:
   (i) usually understand longer, more elaborated directions, conversations, and discussions on familiar and some unfamiliar topics, but sometimes need processing time and sometimes depend on visuals, verbal cues, and gestures to support understanding;
   (ii) understand most main points, most important details, and some implicit information during social and basic instructional interactions that have not been intentionally modified for ELLs; and
   (iii) occasionally require/request the speaker to repeat, slow down, or rephrase to clarify the meaning of the English they hear.

(D) Advanced high. Advanced high ELLs have the ability to understand, with minimal second language acquisition support, grade-appropriate spoken English used in academic and social settings. These students:
   (i) understand longer, elaborated directions, conversations, and discussions on familiar and unfamiliar topics with occasional need for processing time and with little dependence on visuals, verbal cues, and gestures; some exceptions when complex academic or highly specialized language is used;
   (ii) understand main points, important details, and implicit information at a level nearly comparable to native English-speaking peers during social and instructional interactions; and
   (iii) rarely require/request the speaker to repeat, slow down, or rephrase to clarify the meaning of the English they hear.

(2) Speaking, Kindergarten-Grade 12. ELLs may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in speaking. The following proficiency level descriptors for speaking are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction.

(A) Beginning. Beginning ELLs have little or no ability to speak English in academic and social settings. These students:
(i) mainly speak using single words and short phrases consisting of recently practiced, memorized, or highly familiar material to get immediate needs met; may be hesitant to speak and often give up in their attempts to communicate; 
(ii) speak using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts; 
(iii) lack the knowledge of English grammar necessary to connect ideas and speak in sentences; can sometimes produce sentences using recently practiced, memorized, or highly familiar material; 
(iv) exhibit second language acquisition errors that may hinder overall communication, particularly when trying to convey information beyond memorized, practiced, or highly familiar material; and 
(v) typically use pronunciation that significantly inhibits communication.

(B) Intermediate. Intermediate ELLs have the ability to speak in a simple manner using English commonly heard in routine academic and social settings. These students: 
(i) are able to express simple, original messages, speak using sentences, and participate in short conversations and classroom interactions; may hesitate frequently and for long periods to think about how to communicate desired meaning; 
(ii) speak simply using basic vocabulary needed in everyday social interactions and routine academic contexts; rarely have vocabulary to speak in detail; 
(iii) exhibit an emerging awareness of English grammar and speak using mostly simple sentence structures and simple tenses; are most comfortable speaking in present tense; 
(iv) exhibit second language acquisition errors that may hinder overall communication when trying to use complex or less familiar English; and 
(v) use pronunciation that can usually be understood by people accustomed to interacting with ELLs.
(C) Advanced. Advanced ELLs have the ability to speak using grade-appropriate English, with second language acquisition support, in academic and social settings. These students:

(i) are able to participate comfortably in most conversations and academic discussions on familiar topics, with some pauses to restate, repeat, or search for words and phrases to clarify meaning;
(ii) discuss familiar academic topics using content-based terms and common abstract vocabulary; can usually speak in some detail on familiar topics;
(iii) have a grasp of basic grammar features, including a basic ability to narrate and describe in present, past, and future tenses; have an emerging ability to use complex sentences and complex grammar features;
(iv) make errors that interfere somewhat with communication when using complex grammar structures, long sentences, and less familiar words and expressions; and
(v) may mispronounce words, but use pronunciation that can usually be understood by people not accustomed to interacting with ELLs.

(D) Advanced high. Advanced high ELLs have the ability to speak using grade-appropriate English, with minimal second language acquisition support, in academic and social settings. These students:

(i) are able to participate in extended discussions on a variety of social and grade-appropriate academic topics with only occasional disruptions, hesitations, or pauses;
(ii) communicate effectively using abstract and content-based vocabulary during classroom instructional tasks, with some exceptions when low-frequency or academically demanding vocabulary is needed; use many of the same idioms and colloquialisms as their native English-speaking peers;
(iii) can use English grammar structures and complex sentences to narrate and describe at a level nearly comparable to native English-speaking peers;
(iv) make few second language acquisition errors that interfere with overall communication; and
(v) may mispronounce words, but rarely use pronunciation that interferes with overall communication.
(5) Writing, Kindergarten-Grade 1. ELLs in Kindergarten and Grade 1 may be at the beginning, intermediate, advanced, or advanced high stage of English language acquisition in writing. The following proficiency level descriptors for writing are sufficient to describe the overall English language proficiency levels of ELLs in this language domain in order to linguistically accommodate their instruction and should take into account developmental stages of emergent writers.

(A) Beginning. Beginning ELLs have little or no ability to use the English language to build foundational writing skills. These students:

(i) are unable to use English to explain self-generated writing such as stories they have created or other personal expressions, including emergent forms of writing (pictures, letter-like forms, mock words, scribbling, etc.);
(ii) know too little English to participate meaningfully in grade-appropriate shared writing activities using the English language;
(iii) cannot express themselves meaningfully in self-generated, connected written text in English beyond the level of high-frequency, concrete words, phrases, or short sentences that have been recently practiced and/or memorized; and
(iv) may demonstrate little or no awareness of English print conventions.

(B) Intermediate. Intermediate ELLs have a limited ability to use the English language to build foundational writing skills. These students:

(i) know enough English to explain briefly and simply self-generated writing, including emergent forms of writing, as long as the topic is highly familiar and concrete and requires very high-frequency English;
(ii) can participate meaningfully in grade-appropriate shared writing activities using the English language only when the writing topic is highly familiar and concrete and requires very high-frequency English;
(iii) express themselves meaningfully in self-generated, connected written text in English when their writing is limited to short sentences featuring simple, concrete English used frequently in class; and
(iv) frequently exhibit features of their primary language when writing in English such as primary language words, spelling patterns, word order, and literal translating.
(C) Advanced. Advanced ELLs have the ability to use the English language to build, with second language acquisition support, foundational writing skills. These students:
   (i) use predominantly grade-appropriate English to explain, in some detail, most self-generated writing, including emergent forms of writing;
   (ii) can participate meaningfully, with second language acquisition support, in most grade-appropriate shared writing activities using the English language;
   (iii) although second language acquisition support is needed, have an emerging ability to express themselves in self-generated, connected written text in English in a grade-appropriate manner; and
   (iv) occasionally exhibit second language acquisition errors when writing in English.

(D) Advanced high. Advanced high ELLs have the ability to use the English language to build, with minimal second language acquisition support, foundational writing skills. These students:
   (i) use English at a level of complexity and detail nearly comparable to that of native English-speaking peers when explaining self-generated writing, including emergent forms of writing;
   (ii) can participate meaningfully in most grade-appropriate shared writing activities using the English language; and
   (iii) although minimal second language acquisition support may be needed, express themselves in self-generated, connected written text in English in a manner nearly comparable to their native English-speaking peers.