In order to develop proficiency in the Standard for Mathematical Practice 3 (Construct Viable Arguments and Critique the Reasoning of Others) and Standard for Mathematical Practice 4 (Model with Mathematics), it is important to provide English Language Learners (ELLs) with two levels of access to the tasks: language access and content access.

Language Access

In the tasks presented, we can distinguish between the vocabulary and the language functions needed to provide entry points to the math content. These vocabulary words and language functions must be explicitly taught to ensure comprehension of the tasks. Some ways this can be done are by using the following approaches:

1. **Introduce the most essential vocabulary/language functions before beginning the tasks**. Select words and concepts that are essential in each task:

   Vocabulary Words:
   - Tier I (Nonacademic language)

     Mostly social language; terms used regularly in everyday situations (e.g., small, orange, clock)
   - Tier II (General academic language)

     Mostly academic language used regularly in school but not directly associated with mathematics (e.g., combine, describe, consequently), and academic language broadly associated with mathematics (e.g., number, angle, equation, average, product)
   - Tier III (Math technical language)

     Academic language associated with specific math topics (e.g., perfect numbers, supplementary angles, quadratic equations, mode, median)

   Language Functions:
   - Pronounce each word for students and have them repeat after you.
   - Introduce the vocabulary in a familiar and meaningful context and then again in a content-specific setting.
   - Math-specific examples include but are not limited to the following: explain, describe, inform, order, classify, analyze, infer, solve problems, define, generalize, interpret, hypothesize.

2. **Use visuals when introducing new words and concepts.**
   - Provide experiences that help demonstrate the meaning of the vocabulary words (e.g., realia, pictures, photographs, and graphic organizers).
   - Write key words on the board, and add gestures to help students interpret meaning.
   - Have students create their own visuals to aid in their learning. For example, assign a few content-specific vocabulary words to each student, and ask them to write student-friendly definitions and draw pictures to show what the words mean.

3. **Build background knowledge.**
   - Explicit links to previously taught lessons, tasks, or texts should be emphasized to activate prior knowledge.
   - Review relevant vocabulary that has already been introduced, and highlight familiar words that have a new meaning.
   - Access the knowledge that students bring from their native cultures.

4. **Promote oral language development through cooperative learning groups.**
   - ELLs need ample opportunities to speak English and authentic reasons to use academic language.
   - Working in small groups is especially beneficial because ELLs learn to negotiate the meanings of vocabulary words with their classmates.

5. **Native Language Support**
   - Full proficiency in the native language leads to higher academic gains in English. Because general structural and functional characteristics of languages transfer, allowing second language learners to access content in the native language provides them with a way to construct meaning in English.
   - In order to assist ELLs, the strategic use of the native language can be incorporated into English instruction as a support structure in order to clarify, build prior knowledge, extend comprehension, and bridge experiences. This can be integrated into a teacher's instructional practices through technology, human resources (e.g., paraprofessionals, peers, and parents), native language materials, and flexible grouping.

(The following suggested strategies should be considered when addressing the language demands of the tasks in this unit.)

6. **Possible Sentences**
   Moore, D.W., & Moore, S.A. (1986). "Possible sentences." In *Reading in the content areas: Improving classroom instruction*. Dubuque, IA: Kendall/Hunt.

Possible Sentences is a pre-reading strategy that focuses on vocabulary building and student prediction prior to reading. In this strategy, teachers write the key words and phrases of a selected text on the chalkboard. Students are asked to:

- Define all of the terms

- Group the terms into related pairs

- Write sentences using these word pairs

Steps to Possible Sentences

1) Prior to the reading assignment, list all essential vocabulary words in the task on the board.
2) Working in pairs, ask students to define the words and select pairs of related words from the list.
3) Ask students to write sentences using each of the word pairs that they might expect to appear in the task, given its title and topic.
4) Select several students to write their possible sentences on the board.
5) Engage the students in a discussion of the appropriateness of the word pairing and the plausibility of each sentence as a possible sentence in the selection.
6) Have students read the task and test the accuracy of their predictions. Sentences that are not accurate should be revised.
7) Poll the class for common accurate and inaccurate predictions. Discuss possible explanations for the success or failure of these predictions.
8) Introduce students to sentence frames which reinforce sentence structure while enabling ELLs to participate in classroom and/or group discussion.

7. **The Frayer Model**

Frayer, D., Frederick, W. C., and Klausmeier, H. J. (1969). *A Schema for testing the level of cognitive mastery*. Madison, WI: Wisconsin Center for Education Research.
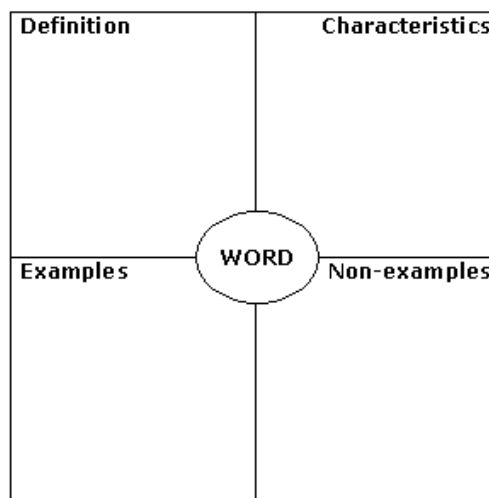
The Frayer Model is a graphic organizer used for word analysis and vocabulary building. It assists students in thinking about and describing the meaning of a word or concept by:

- Defining the term

- Describing its essential characteristics

- Providing examples of the idea

- Offering non-examples of the idea

Steps to the Frayer Model

1) Explain the Frayer Model graphic organizer to the class. Use a common word to demonstrate the various components of the form. Model the type and quality of desired answers when giving this example.

2) Select a list of key concepts from the task. Write this list on the chalkboard and review it with the class before students read the task.

3) Divide the class into student pairs. Assign each pair one of the key concepts and have them read the task carefully to define this concept. Have these groups complete the four-square organizer for this concept.

4) Ask the student pairs to share their conclusions with the entire class. Use these presentations to review the entire list of key concepts.

Frayer Model

Definition	Characteristics
Examples	Non-examples

WORD

8. **Semantic Webbing**

Maddux, C. D., Johnson, D. L., & Willis, J. W. (1997). *Educational computing: Learning with tomorrow's technologies*. Boston: Allyn & Bacon.

Semantic Webbing builds a graphical representation of students' knowledge and perspectives about the key themes of a task before and after the learning experience. Semantic Webbing achieves three goals:

- Activating students' prior knowledge and experience
- Helping students organize both their prior knowledge and new information
- Allowing students to discover relationships between their prior and new knowledge

Steps to Semantic Webbing

1) Write a key word or phrase from the task on the board.

2) Have students think of as many words as they know that relate to this key idea. Write these words on the side on the chalkboard.

3) Ask students to group these words into logical categories and label each category with a descriptive title.

4) Encourage students to discuss/debate the choice of the category for each word.

5) Write the students' conclusions (the categories and their component words) on the chalkboard.

6) Have the students read the task in pairs and repeat the process above.

7) When they finish reading, have students add new words and categories related to the key idea.

Native Language Support: Full proficiency in the native language leads to higher academic gains in English. Because general structural and functional characteristics of language transfer, allowing second language learners to access content in the native language provides them with a way to construct meaning in English. In order to assist ELLs, the strategic use of the native language can be incorporated into English instruction as a support structure to clarify, to build prior knowledge, to extend comprehension, and to bridge experiences. This can be integrated into a teacher's instructional practice through the following: technology, human resources (e.g., paraprofessionals, peers, and parents), native language materials, and flexible grouping.

Content Access

When engaging ELL students in cognitively demanding tasks, teachers should consider which concepts the ELLs are likely to encounter when accessing mathematics and which of these pose the most challenges. Teachers should consider what the student is required to know as well as be able to do. What is the mathematics in the task? What prior knowledge is required in order for ELL students to proceed? In order to activate prior knowledge and prepare English Language Learners (ELLs) for the demands of the tasks in the lesson, we suggest that they engage in a different but similar task prior to working on the selected performance assessment tasks, such as the following:

1. **Use of Manipulatives**
   Provide ELL students with manipulatives when appropriate. While there are different types of manipulatives available commercially, teacher-made materials are recommended and encouraged. Manipulatives are always appropriate when introducing a concept regardless of the grade.

2. **Graphic Organizers**
   Graphic organizers, such as Venn diagrams, Frayer Models, charts and/or tables, help ELLs understand relationships, recognize common attributes, and make associations with the concepts being discussed.

3. **Use of Technology**
   Technology must be integrated whenever possible. Teachers should make calculators available for ELLs in regular, daily instruction to expand their conceptual understanding and prepare ELLs for upcoming

assessments. Various software and internet-based programs can also be very beneficial, many of which are available in the ELLs' native languages. Use of technology develops and reinforces basic skills.

4. **Differentiated Instruction**

   While all students can benefit from differentiated instruction, it is crucial for teachers to identify the different learning modalities of their ELLs. Teachers and ELLs are collaborators in the learning process. Teachers must adjust content, process, and product in response to the readiness, interests, and learning profiles of their students. In order to create and promote the appropriate climate for ELLs to succeed, teachers need to know, engage, and assess the learner.

5. **Assessment for Learning (AfL)**

   Whenever ELL students are engaged in tasks for the purpose of formative assessments, the strategies of Assessment for Learning (AfL) are highly recommended. AfL consists of five key strategies for effective formative assessment:

   1) Clarifying, sharing and understanding goals for learning and criteria for success with learners
   2) Engineer effective classroom discussions, questions, activities, and tasks that elicit evidence of students' learning
   3) Providing feedback that moves learning forward
   4) Activating students as owners of their own learning
   5) Activating students as learning resources for one another

Scaffolding: A Tool to Accessibility

In order to be successful members of a rigorous academic environment, ELLs need scaffolds to help them access curriculum. These scaffolds are temporary, and the process of constructing them and then removing them when they are no longer needed is what makes them a valuable tool in the education of ELLs. The original definition of scaffolding comes from Jerome Bruner (1983), who defines scaffolding as "a process of setting up the situation to make the child's entry easy and successful, and then gradually pulling back and handing the role to the child as he becomes skilled enough to manage it."

The scaffolds used in this unit are placed purposefully to teach specific skills and language. Once students learn these skills and gain the needed linguistic and content knowledge, these scaffolds are no longer needed. Nevertheless, each child moves along his/her own continuum, and while one child may no longer need the scaffolds, some students may still depend on them. Thus, constant evaluation of the process is an inevitable step in assuring that scaffolds are used successfully.

The scaffolding types necessary for ELLs are modeling, activating and bridging prior knowledge and/or experiences, text representation, metacognitive development, contextualization, and building schema[1]:

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[1] Walqui, A., *Scaffolding Instruction for English Language Learners: A Conceptual Framework*, retrieved from http://www.educacion.gob.es/exterior/centros/losangeles/es/series/201003-Scaffolding-Walqui.pdf.

- Modeling: finished products of prior students' work, teacher-created samples, sentence starters, writing frameworks, shared writing, etc.

- Activating and bridging prior knowledge and/or experiences: using graphic organizers, such as anticipatory guides, extended anticipatory guide, semantic maps, interviews, picture walk discussion protocols, think-pair-share, KWL, etc.

- Text representation: transforming a piece of writing into a pictorial representation, changing one genre into another, etc.

- Metacognitive development: self-assessment, think-aloud, asking clarifying questions, using a rubric for self evaluation, etc.

- Contextualization: metaphors, realia, pictures, audio and video clips, newspapers, magazines, etc.

- Building schema: bridging prior knowledge and experience to new concepts and ideas, etc.

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