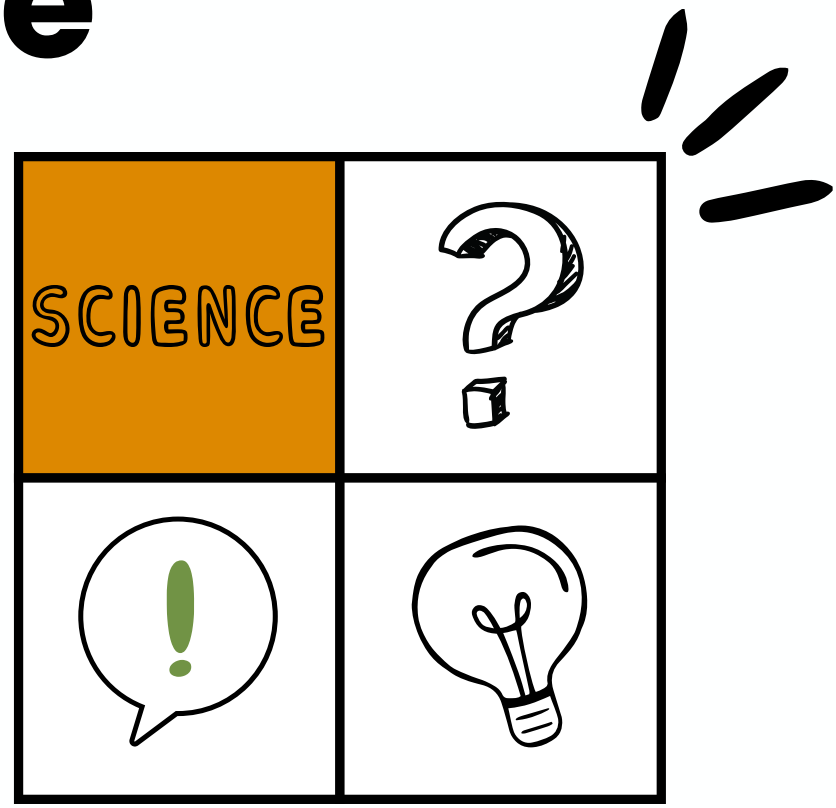
MELVA-S

Frayer Model Guide for Science



The University of Texas at Austin

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What is the MELVA-S project?

The MELVA-S Project (Measuring the Language and Vocabulary Acquisition in Science) is a research initiative led by Dr. Doris Luft Baker at the University of Texas at Austin. Funded by the Institute of Education Sciences (IES) from 2020 to 2025 (R305A200521), it aims to create and validate a new formative assessment system to measure science vocabulary growth for 2nd and 3rd grade students. Students orally respond to definition and sentence prompts for science vocabulary words, which are then transcribed and scored using natural language processing. These data provide information on student understanding of content that can be used to modify instruction. For more information about the project, visit our website: https://meadowscenter.org/project/melva-s/

Key Features:

- Utilizes advanced speech recognition and automated scoring technologies.
- Develops a dynamic, scalable assessment platform.
- Offers immediate feedback to educators for instructional improvement.
- It is available in Spanish and English, providing unique insights for multilingual students.

The MELVA-S Project also enhances science learning by offering additional resources for teachers, including a **science dictionary** and the following adaptation of the **Frayer Model** developed by Baker's research team.

The MELVA-S Frayer Model

Science education can be challenging for teachers as it requires knowledge of both content and effective pedagogies to support student achievement (Toplis, 2015). Moreover, language comprehension plays a critical role in science instruction, requiring teachers to support science vocabulary development (National Science Board, 2023; Baker et al., 2021). This is especially important for emergent bilingual students, who must simultaneously develop proficiency in a new language while learning academic content (Lee, 2005).

Vocabulary and background knowledge are crucial to participate in science activities such as asking questions, analyzing data, and sharing conclusions. However, according to Baker et al. (2019, 2025), students who struggle academically often do not receive the necessary support to improve their vocabulary knowledge and language proficiency. This suggests that academic vocabulary instruction is frequently overlooked in schools (Baker et al., 2025). Therefore, introducing explicit vocabulary instruction in early grades is crucial, as it supports word automaticity, which contributes to both oral reading fluency and reading comprehension in later grades (Baker et al., 2015; 2019). These are key skills that help students access content across subject areas such as science. Considering this, teaching vocabulary effectively and efficiently is essential (Baker et al., 2015).

There are specific strategies to support vocabulary instruction. First, Baker et al. (2021) emphasized the importance of including content and language objectives to ensure students are exposed to vocabulary essential for specific content areas such as science.

Next, research highlights how beneficial it can be to utilize students' home languages when teaching vocabulary, such as in translanguaging activities that encourage students to mix languages and modes to communicate meaning (Suárez, 2020). This is necessary to encourage all students in the classroom to use their assets to communicate with others (Baker et al., 2022; Cárdenas-Hagan et al., 2007). Students also benefit from deep vocabulary instruction, where they are exposed to multiple examples of word meanings in different contexts (Baker et al., 2015; Cena et al., 2013; Coyne et al., 2010). All of these evidence-based strategies come together through the MELVA-S Frayer Model, which we describe below.

The MELVA-S project created an adapted version of the Frayer Model, originally developed by Frayer and colleagues (1969) at the University of Wisconsin, and has been found to boost students' vocabulary acquisition (Atienzo, 2024; Riksadianti, 2021; Panjaitan & Sihotang, 2020). The original Frayer model contained four squares to make sense of words: 1) word definitions, 2) characteristics, 3) examples, and 4) non-examples. The MELVA-S Frayer Model uses recent evidence on how to support depth of vocabulary knowledge, such as incorporating multimodality and differentiation options, to modify this model specifically for science. In our version, the **first** square is designated for the word's definition, the **second** for an example sentence, the **third** can be tailored to support student needs, and the **fourth** square is reserved for visual representations.

The next section introduces the MELVA-S Frayer Model layout and provides a completed example. Following that, we provide guidance on completing each of the four squares. Finally, we present a detailed lesson plan to support gradual release of responsibility during science instruction.

The MELVA-S Frayer Model Template & Example

Definition:

Sentence:

Alternative Definitions:

Definition: To have a strong effect on.

Sentence: Recycling has a positive impact on our planet.

impact/impacto

Alternative Definitions: The strong influence of a person, a thing, or an action on something; to hit.

Square 1: The Definition

In the first square, co-write a definition of the vocabulary word together. We find that providing more teacher guidance at this stage is recommended. Having a definition ready to share with students is important. The MELVA-S Dictionary is available to support you at this stage.

Teacher Prompts:

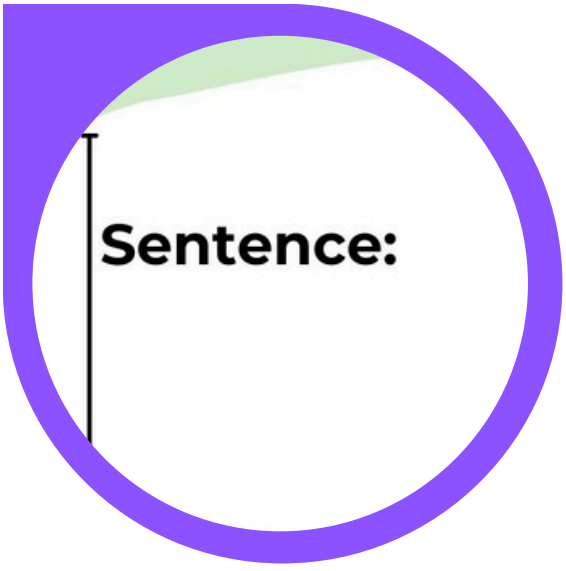
- _ _ _ _ _ means [insert definition or create together based on prepared materials].
- Have you heard this word before? Where?

Square 2: Write a Sentence

Knowing the definition of a word and being able to apply it in science conversations or settings are two distinct skills. Students need opportunities to use vocabulary in various contexts to support deep science learning. Seeing multiple examples of how a word can be used is important to this process (Young, 2005). To deepen students' understanding of terminology, encourage them to create sentences using key vocabulary words within this square. Discuss how the word is used in science, as well as any alternative definitions.

Possible sentence supports:

- Provide sentence stems to guide students. For example: "One example of extreme weather is _ _ _ _ _ _. It is extreme because_ _ _ _ _ _ _ _."
- Write the sentence together.
- Provide a scenario in which they would use the word.
- Show a picture and have students write a sentence using the vocabulary term to describe it.



Square 3: Teacher's Choice

In this square, we encourage teachers to consider students' background knowledge and needs when choosing an activity that will best support their vocabulary growth. We expand on some examples below:

- Encourage emergent bilingual students to write the word's definition or use it in a sentence in their home language. Translanguaging, or combining English and other languages, can support science learning (Suárez, 2020).
- Analyze the parts of the word (prefix, suffix, root).
- Use the word in another context and/or explore alternative definitions.
- Include synonyms and/or antonyms of the key vocabulary term.
- Find an example of the word being used in a book or online text. Have students copy the sentence and the source.
- Have students work in pairs to dictate what the other says in response to a prompt. (i.e., "Use analyze in a sentence that involves dinosaurs").

Square 4: Visual Representation

Science is multimodal (Suárez, 2020; Townsend, 2018). We should encourage students to draw on their full linguistic repertoires (verbal, written, and visual) to represent their understanding. With this in mind, we encourage students to include an image in the fourth square. Some suggestions to support this include:

- Having students draw an image.
- Providing a teacher-prepared image to glue in the square.
- Allowing students to search for an image to represent the key term when completing the Frayer Model digitally.
- Having students take a picture of an image with a camera, then attach or upload it to the square.
- Encouraging students to search for images in books, magazines, flyers, and mail inserts, then cut them out to add to the square.

MELVA-S Lesson Plan Example

EARTH SCIENCE – THE SUN, EARTH, AND MOON	
Lesson 1: The relation among the Sun, Earth, and Moon Grade Level: 2nd Duration: 10 minutes	
OBJECTIVES	
Primary Objective:	
Students will define and use one key vocabulary word (*System*, Orbit, or Space) using the Frayer Model in a quick structured activity. • **TEKS:** (9) (A) construct models and explain the orbits of the Sun, Earth, and Moon in relation to each other. • **NGSS:** Earth and Space Science (ESS1: Earth's Place in the Universe, ESS2: Earth's Systems)	
Vocabulary:	
English	System - A group of things that interact with each other to work as a whole. Orbit - The invisible path something takes as it moves around a bigger object like the Earth going around the Sun. Space - The amount of space between things.
Spanish	Sistema - Un grupo de cosas que interactúan entre sí para formar algo completo. Órbita – El camino invisible que sigue un objeto cuando gira alrededor de otro más grande, como la Tierra alrededor del Sol. Espacio – La distancia que hay entre dos cosas.
I DO (teacher models 2 minutes)	• Display an image of the Sun, Earth, and Moon. • Choose one vocabulary word (Orbit, System, or Space) and complete a Frayer Model on the board. **Example for Orbit:** Definition: The invisible path something takes as it moves around a bigger object like the Earth going around the Sun. Examples: "Planets orbit stars. The Moon orbits the Earth." Non-examples: "A rock sitting on the ground is not in orbit." Ask: *Can you think of something else that orbits?*
WE DO (guided practice 3 minutes)	• Students complete a Frayer Model for another word (System or Space) together. • Ask students to suggest examples and non-examples.
YOU DO (Independent practice 3 minutes)	Students write a sentence using the word in a new context (e.g., *Our school is a system because we all work together*).
QUICK REFLECTION (closure 2 minutes)	• Ask: *What was one new word you learned today? How could you use it outside of science?* • Optional: Have a few students share their work.
DIFFERENTIATION IDEAS	For bilingual students: Allow/encourage them to write definitions or sentences in their home language.

As seen in the sample, vocabulary instruction does not require extensive time. Regardless of the lesson's length, explicitly teaching word definitions is essential to supporting students in developing their academic vocabulary (Cena et al., 2012).

Sequence of Instruction

Sequence	Lesson Activities	Teacher Prompts
Direct Instruction "I do"	Define the vocabulary word together with a pre-crafted definition, such as those in the MELVA-S teacher dictionary. This can help prevent misconceptions.	Let's look at the definition of _ _ _ _ together. Has anyone heard of the word _ _ _ _? Where have you heard it? Can you think of an example of _ _ _ _ _?
Guided Instruction "We do"	Write a sentence together using the vocabulary word within a science context. ·Students can then either copy a variation of your sentence or generate their own. Next, either (a) choose a differentiated option to do with students for the 3rd square (i.e., defining the word in their home language, looking at prefixes/suffixes) OR (b) illustrate the word with students in the fourth square. Students will complete the remaining square independently.	Now, let's use _ _ _ _ in a sentence. How would we use this word in science? 3rd square prompt examples: Does the word _ _ _ _ _ have another meaning? Have you heard it in another context? How do you say _ _ _ _ _ in your native language?
Independent Instruction "You do"	Students complete the final square on their own. Share your work with the class or partner.	Let's share our ideas! (Choose a sharing format) • Find a partner and share your work. • Does anyone volunteer to come to the front of the class to share your work? • We are going to do a gallery walk. Display your Frayer Model(s) where other students can see them. Come form a line to view everyone's finished work.

Melva-S Frayer Model: Final Thoughts

According to Oakhill (2020), when discussing vocabulary, we should prioritize depth (i.e., students' deep understanding and ability to define words) over breadth (i.e., the number of words students know superficially). Deep vocabulary knowledge facilitates stronger connections between a word's meaning and conceptual understanding, particularly in content areas such as science, and supports students in making inferences during reading. Similarly, Li et al. (2021) and Baker et al. (2015) emphasized that deep vocabulary knowledge is a strong predictor of reading comprehension. This means that vocabulary instruction is essential for language acquisition in both foreign and native languages (Baker et al., 2022; Li et al., 2021).

THE NEXT PAGE INCLUDES FINAL TAKEAWAYS FOR EFFECTIVE SCIENCE VOCABULARY INSTRUCTION.

Vocabulary Instruction Checklist

- PRESENT DEFINITIONS FOR THE WORDS: STUDENTS NEED TO UNDERSTAND THE MEANING OF THE TARGETED WORD.
- OFFER SEVERAL EXAMPLES USING THE WORDS: STUDENTS NEED TO KNOW HOW TO USE THE TARGETED WORD IN CONTEXT.
- INTRODUCE ALTERNATIVE DEFINITIONS: IF THE TARGETED WORD HAS ALTERNATIVES, SHARE THOSE DEFINITIONS WITH STUDENTS.
- DEMONSTRATE SEVERAL EXAMPLES OF ALTERNATIVE DEFINITIONS: THIS HELPS STUDENTS FURTHER EXPAND THEIR VOCABULARY AND LEARN HOW TO USE THE TARGETED WORD IN CONTEXTS UNRELATED TO THE SUBJECT AREA.

MELVA-S Science Dictionary

To implement these strategies, MELVA-S also developed a science dictionary to enhance the accessibility and engagement of science instruction for both teachers and students. See the sample below.

English Word	Definition	Example Sentence	Spanish Word	Definition	Example Sentence	Image
Landform	A natural formation of the Earth's surface like a mountain, a hill, a lake or a valley.	The island and the volcano are both examples of landforms.	**Accidente geográfico**	Una formación natural de la superficie terrestre, como una montaña, una colina, un lago o un valle.	La isla y el volcán son ambos ejemplos de accidentes geográficos.	

Providing student-friendly definitions empowers learners to build their vocabulary and deepen their understanding, enabling them to use new words confidently in diverse settings. However, as Baker et al. (2015) noted, it is important for students not only to recognize and understand word meanings but also to use them accurately. Thus, creating learning opportunities for students to demonstrate and analyze their understanding of words is essential (Baker et al., 2015).

Note. The full version of this resource is available on the Meadows Center for Preventing Educational Risk (MCPER) website: https://meadowscenter.org/resource/melva-s-science-dictionary/.
The dictionary is a compilation of all scientific terms extracted from the MELVA-S and MITOS projects led by Dr. Doris Luft Baker. For more information about the MITOS project: https://meadowscenter.org/project/mitos/.

Concluding Thoughts

As highlighted by Baker et al. (2025), equipping students with the skills to master academic language and vocabulary is crucial for understanding, explaining, and discussing academic content such as science. Coyne et al. (2022) confirm that targeted, extended vocabulary instruction significantly benefits students. With this in mind, MELVA-S seeks to support science learning for ALL learners. By providing vocabulary support to students in the early grades (Baker et al., 2015; Cena et al., 2012), we can improve their future access to STEM fields. Thank you for investing in these key skills!

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