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# Multilingual Learners as Scientists

*The synergy of NGSS and WIDA*

CESA2

# *Multilingual Learners as Scientists: The Synergy of NGSS and WIDA*

When we think of science, some people imagine a white-coated lecturer, or a silent lab technician. But look around you! Science is all around us. Science is on a medicine bottle, condensation on your window, dish soap bubbling up in hot water, oil splattering in a frying pan, dead logs in the woods full of critters forming an ecosystem, an ad on TV arguing the pros and cons of different sound systems, and so much more. You can find science in a fiction text about a child making a snowball and putting it in his pockets to save, where it melts, or in the silent French movie, *The Red Balloon*, where the boy's balloon lifts into the air, carried off by the wind.

The WIDA 2020 Standards set the stage for teachers to support MLLs in using language for different purposes within the disciplines, such as science, by adding the Key Language Uses (see chart on page 2) to each content area. We applaud this shift, because we feel that students will develop a versatility with using language, which was less overt in the earlier edition. The standards amplify the variety of ways disciplinary language can be used to engage in science stories (i.e narrative), to explain ideas, or present an argument – and many more opportunities beyond the "use academic language of science". While the new edition of the standards continues to focus on the language development, its focus is not on the production of language structures as the end, but a means to an end.

Here we present ideas for utilizing the NGSS crosscutting concepts, while paying attention to the key language uses from the WIDA 2020 Standards, through highlighting different modalities. We will explore one theoretical lesson for each of the four key language uses, provide ideas for the language domains (speaking, writing, listening, reading, representing and viewing), and present ideas using multiple modalities.

***Multimodality**, the use of multiple means of communication, is an essential way for all students to access and engage in the content areas. In addition to the use of spoken and written language, students also communicate through gestures, facial expressions, images, equations, maps, symbols, diagrams, charts, videos, graphs, computer-mediated content, and other means.*

*-WIDA Standards 2020, p. 19*

# Key Language Uses from the WIDA 2020 Standards
## (WIDA standards, 2020, p. 26-27)

| Key Language Use | Definition |
|---|---|
| **NARRATE** | Narrate highlights language to convey real or imaginary experiences through stories and histories. Narratives serve many purposes, including to instruct, entertain, teach, or support argumentation. |
| **INFORM** | Inform highlights language to provide factual information. As students convey information, they define, describe, compare, contrast, organize, categorize, or classify concepts, ideas, or phenomena. |
| **EXPLAIN** | Explain highlights language to give an account for how things work or why things happen. As students explain, they substantiate the inner workings of natural, man-made, and social phenomena. |
| **ARGUE** | Argue highlights language to justify claims using evidence and reasoning. Argue can be used to advance or defend an idea or solution, change the audience's point of view, bring about action, or accept a position or evaluation of an issue. |

# Key Language Use Example #1: Explain

**Kindergarten focus on speaking/listening using voice recording technology to conduct an investigation about forces.**

The Kindergarteners in Moreno's class are learning about how pushes can cause an object to move in the direction of the push. She wants the students to solve the problem of a robot that must get through the classroom door to the hallway. The robot goes toward the direction of the push, and then stops when it hits a barrier. The kindergartners need to send ideas to the teacher, figuring out how to solve the problem and explaining what they think the robot will do next, for each push.

To help multilingual students understand core concepts and the language needed to communicate those ideas, the teacher uses "message abundancy" (Gibbons, 2016), a way of representing the same message in multiple ways. This approach resembles a GPS where the following semiotic systems are used to convey the same message: color, voice, graphics, emphasis or highlighting of the main highway, and labels. Also, the message is conveyed in chunks, not all at once by giving just enough information needed at that time to be able to process it without being overwhelmed by it.

Another part of GPS communication is repetition of key ideas just in time when you need them. This approach does not simplify language or core concepts but amplifies them. Using micro-scaffolding (Daniels and Westerlund, 2018) (interactional in-the-moment response to student talk), the teacher asks students to elaborate on their ideas, provide language in the moment of need such as "if you push this.., this will move", "I think it will stop…", highlight verbs of movement "push, move, stop". This approach is in contrast to pre-teaching academic language before having an experience (Practice Brief 66).

As an example to solve this robot problem, one group discusses their ideas, supporting one another with gestures, objects, and translanguaging. They use the recording device

to explain their prediction if the robot gets pushed towards the bookshelf. “If you push the robot toward the books shelf, then he will stop when he reaches the corner of the bookshelf. He will have gotten closer to the door. I think he will stop there because there is nothing else between me and the bookshelf.”

As the students try out their prediction with the teacher, they keep track of their progress using numbers of “steps” on the recording device. The teacher plans to support the students, listening for just-in-time supports, when the need arises for the students to use push, directions as well as the reasons for their predictions (prediction with evidence). The NGSS and WIDA standards the students are working towards are specified in Table 2 below.

# Key Language Use Example #2: Inform

**Fourth grade focuses on reading and writing using email to analyze data about shadows at different places on the planet.**

In the fourth grade, students are testing out shadows in two different parts of the world, emailing a “pen-pal” 4th grade class in Argentina. They want to test the length and direction of the shadows at noon, and use evidence to engage in scientific argument with one another about the reason for the early (or late) sunrise and sundown. Each student performs an investigation, measuring the data and figuring out when the sun rises and goes down. They use email to check if the information is different in the other hemisphere in South America. Each class keeps track of the data collected on a line graph.

The teacher supports newcomers by helping them insert a picture of classmates’ shadows at 9am, 12pm, and 3pm, and adding labels to send the other students data about what they discover

in an email. One student, who speaks Wolof as her first language, moves between independent and scaffolded sensemaking with the teacher and others. She uses the labels “sun”, “shadow”, “sunrise”, and “sundown” in her picture in her email and the words “high sun = short shadow”. When she receives the same kind of information back from Argentina, she will have enough information to figure out if shadows are the same or different around the planet.

The NGSS and WIDA standards they are working towards are specified in the table on page 5.

# Key Language Use Example #3: Narrate and Explain

**Eighth graders focus on images and spoken words in photographs to model transfer of energy at the particle level.**

Eighth graders in Veguilla’s dual language classroom are going to narrate a story about the energy that they used during the day, using images taken from their phone. Each student will put together a presentation that focuses on a few hours in their day (could be at school), and how energy was transferred to accomplish tasks.

Veguilla’s goal for students is to bring in details to tell a story about how the energy was transferred, using the images to sequentially talk through

# NGSS and WIDA Standards Referenced in the Kindergarten Lesson

| NGSS Standard | WIDA Standards |
|---|---|
| **K-PS 2-1**<br>Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. (Note: This lesson integrates Practice 5: Using Mathematics and Computational Thinking.) | **ELD-SC.K.Explain.Expressive**<br>Construct scientific explanations that:<br>• Describe information from observations about a phenomenon<br>• Relate how a series of events causes something to happen<br>• Compare multiple solutions to a problem<br><br>**ELD-SC.K.Explain.Interpretive**<br>Interpret scientific explanations by:<br>• Defining investigable questions or simple design problems based on observations and data about a phenomenon<br>• Using information from observations to find patterns and to explain how or why a phenomenon occurs |

# NGSS and WIDA Standards Referenced in the Fourth Grade Lesson

| NGSS Standard | WIDA Standards |
|---|---|
| **5-ESS1-2**<br>Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. | **ELD-SI.4-12.Inform**<br>• Define and classify facts and interpretations; determine what is known vs. unknown<br>• Report on explicit and inferred characteristics, patterns, or behavior<br>• Describe the parts and wholes of a system<br>• Sort, clarify, and summarize relationships<br>• Summarize most important aspects of information |

their day. The familiar events will serve as the phenomena to model during the course of the week. This day, to engage in the phenomenon, the teacher is prompting students to use energy-related language as needed.

The teacher is ready to support ideas, rather than pre-loading vocabulary. She anticipated the need for "stored energy, spring energy, energy of motion" and causal language "when I did this… this happened" and "as I was doing this, I noticed this…", and "transferring", which she writes down on the board. She asks students to point out what they heard, smelled, felt, and saw during the energy transfer events. One eighth grader, Ajay who is level 4, says, "When I got on the school bus, and moved up the stairs, I dropped my backpack. I was transferring stored energy to energy of motion. I heard the bang of the backpack on the stairs." Another student, also level 4, says, "The toast popped up in the morning, transferring spring energy to energy of motion….and I smelled the toast."

The teacher accepted the not-quite-perfect use of sentences; she first paid close attention to the language of ideas (Bunch & Martin, 2021), and not the grammatical accuracy of complex sentences, which is more appropriate to some summative writing tasks. She asked the students to show the images and describe the evidence that energy was being transferred. The rest of the class suggested more interesting details that could be added. They asked questions about each story: "How were you feeling when the bus rolled up?"; "Were you in a hurry to get your toast, why?". In addition to *Narrate*, students also explain the relationship of cause and effect in energy transfer. In this way, she blends two Key Language Uses naturally, not just recounting events but explaining the underlying forces involved in the energy transfer.

This lesson applies learning toward the performance expectations, in the NGSS and WIDA Standards as specified in the table on page 7.

# Key Language Use Example #4: Argue

**Tenth graders focuses on representing and writing using modeling to represent biotic factors in a local ecosystem.**

In tenth grade, students, with a variety of English language proficiency levels, form a lab table group. They are collaborating to use math and graphs to mathematically model the local ecosystem's carrying capacity for deer. The teacher has the students act out carrying capacity using modified movement in the game *Oh Deer!* for added fun and multimodality, and then mathematically model factors (food availability, deer population, shelter, predation level) using a graph, keeping in mind that a certain percentage of the deer population decreases due to natural pressures. The students will support the graph by writing a title and the evidence that backs up the graph – relational ideas, and numbers from the *Oh Deer!* game they played. One group writes, "The numbers in *Oh Deer!* went from 9 to 20, then 50, then 10, then 8. I show the carry capacity (for deer) as < than 50." The teacher will support the students plugging in some numbers over the next few lessons, and consider the wolf as a factor in population dynamics. To support this learning, she slows down and models for students how to explain data on the graph using oral language before sending students into groups to practice that skill on their own. As the students practice, the teacher reformulates students' responses to teach the language of evidence intentionally not assuming that just because they figured out the evidence, they know how to explain it orally or in writing. To support the writing, the teacher supports students by jointly constructing possible responses to support their explanations with evidence.

The teacher is very deliberate at showing students how natural language, symbolic language, and graphing work together because she is aware that it is a complex task to navigate all those semiotic systems.

## NGSS and WIDA Standards Referenced in the Eighth Grade Lesson

| NGSS Standard | WIDA Standards |
|---|---|
| **MS-PS3-2**<br>Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.<br><br>**MS-PS1-4**<br>Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.<br><br>Specifically moves understanding toward the Crosscutting concept<br><br>**PS3.C: Relationship Between Energy and Forces**<br>When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. | **ELD-SI.4-12.Narrate**<br>• Share ideas about one's own and others' lived experiences and previous learning<br>• Connect stories with images and representations to add meaning<br>• Identify and raise questions about what might be unexplained, missing, or left unsaid<br>• Recount and restate ideas to sustain and move dialogue forward<br>• Create closure, recap, and offer next steps<br><br>**ELD-SC.6-8.Explain.Expressive**<br>Construct scientific explanations that<br>• Describe valid and reliable evidence from sources about a phenomenon<br>• Establish neutral or objective stance in how results are communicated<br>• Develop reasoning to show relationships among independent and dependent variables in models and simple systems<br>• Summarize patterns in evidence, making trade-offs, revising, and retesting |

## NGSS and WIDA Standards Referenced in the Tenth Grade Lesson

| NGSS Standard | WIDA Standards |
|---|---|
| **HS-LS2-1**<br>Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.<br><br>**With the application of the Crosscutting concepts**<br><br>**Stability and Change**<br>Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2- 6),(HS-LS2-7) | **ELD-SI.4-12.Argue**<br>• Generate questions about different perspectives<br>• Support or challenge an opinion, premise, or<br>• interpretation<br>• Clarify and elaborate ideas based on feedback<br>• Evaluate changes in thinking, identifying trade- offs<br>• Refine claims and reasoning based on new information or evidence<br><br>**ELD-MA.9-12.Argue.Expressive**<br>Construct mathematics arguments that<br>• Create precise conjecture, using definitions, previously established results, and stated assumptions<br>• Generalize logical relationships across cases<br>• Justify (and refute) conclusions with evidence and mathematical principles<br>• Evaluate and extend others' arguments |

# CONCLUSION

In these four lessons, we demonstrated how to use NGSS three dimensional performance expectations, expanded with application of the Cross-cutting concepts, and the Key Language Uses from the WIDA standards. The WIDA Standards Language Expectations referenced in the lessons provided a focus on "doings" and not on language structures decontextualized and removed from the function they serve. These Language Expectations provide a powerful entry point for the lesson or unit focus. Together, NGSS and WIDA create a powerful synergy that can be a catalyst for ensuring that all students, including MLs, have access to rigorous and exciting phenomenon-based learning of science.

# ABOUT THE AUTHORS:

**Dr. Ruslana A. Westerlund** is a CESA 2 consultant at the Language and Culture Center specializing in disciplinary literacy for multilingual students. Her expertise is in Systemic Functional Linguistics, a theory of language used in the WIDA 2020 Standards. She consults with districts to build teacher capacity around supporting reasoning, reading, and writing in discipline-specific ways. Prior to coming to CESA 2, Ruslana was a researcher at WIDA (2013- 2021) where she contributed to the development of the most recent edition of the WIDA Standards as well as the Framework for Equitable Instruction, a resource for content teachers to support multilingual students. She loves science, especially the science of fermentation in sourdough bread, kimchi, and kombucha which she makes at home. She is also an author of a memoir *From Borsch to Burgers: A Cross-cultural Memoir* where she chronicles her journey from Ukraine to the United States and the negotiation of her ever-evolving transcultural identity.

**Dr. Emily Adah Miller** is the co-PI for Multiple Literacies in Project-based Learning. She is a lead writer for the Diversity and Equity Team on the Next Generation Science Standards, a member of the NGSS writing team, and writer of multiple peer-reviewed research articles. She is an author of the best-selling teacher practice book, NGSS for All, and practice book Crosscutting Concepts, both with NSTA Press and Okhee Lee. Before academia, Emily taught in multiple grades Pk-9th, as an ESL and Bilingual Resource science specialist in Wisconsin at Title I schools. She served as an associate researcher on an NSF Teacher Professional Development grant with the Wisconsin Center for Educational Research where she collaborated with WIDA to design Discourse Tools aligned with the ELPD Framework, and co-chaired the adoption of the new ELD standards in Wisconsin. Emily's research interests are examining sensemaking practices for underrepresented students in PBL science contexts, and how teachers can build on these opportunities to support their students.

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**Resources for Further Learning:**


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