Helping Students Become Science Language Learners with the 5E Model

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by Jodi Marchesso

In the Pasadena Unified School District (PUSD), we are working to prepare students to be critical thinkers, creative problem-solvers, and strong communicators—the leaders of tomorrow. Science is a core part of that.

When students are learning science, they are actually learning a new language. They are learning to understand, spell, read, and write words that they will not see in any other content area. That's why I call all of my students "science language learners." In PUSD, 18 percent of students are English language learners (ELLs) as well, which means they have the added challenge of trying to learn science content concepts, vocabulary, and English simultaneously.

So how can we engage native English speakers and ELLs in meaningful science learning while helping them reach the performance expectations in the California Next Generation Science Standards (CA NGSS)? One highly effective way is through the 5E (Engage, Explore, Explain, Elaborate, and Evaluate) model of instruction.

Students come to the classroom with different backgrounds, experiences, and preconceptions about how the world works. So, teachers will begin a lesson or unit by activating students' prior knowledge while igniting their interest in a new topic. For example, a teacher might have each corner of the room labeled strongly agree, agree, disagree, and strongly disagree. The teacher then presents a statement, such as "Genetically Modified Organisms should be banned," and asks students to choose a corner of the room and discuss with their classmates why they chose that corner. This particular activity helps students create connections to their previous knowledge and provides the teacher with the opportunity to hear what their students already think about the topic. Other ways that a teacher might engage students with a topic is to introduce a scientific phenomenon through a hands-on demonstration or video and ask questions to access that prior knowledge and identify misconceptions. We also use KWL charts so students can write about what they already know, what they want to know, and ultimately what they learned.

We use a digital science curriculum called STEMscopes California as our core science resource in kindergarten through 12th grade. After we develop the initial context for the lesson, students explore the topic through hands-on, inquiry-based investigations. As students dive into the online investigations and hands-on exploration kits, they construct their own contexts and meanings for the scientific phenomena and concepts they're exploring. This helps them retain more knowledge and develop a deeper understanding of the world around them. It is important to note that students should be given the opportunity to take part in activities and experiments *before* giving them new vocabulary or asking them to read science text. This is helpful for all learners, including ELLs, because it allows them to have experiences that they can then attach to the vocabulary so that deeper learning occurs.

Next, we ask students to explain the new concepts and skills they learned during the explore phase. Giving students the opportunity to verbalize their understanding and demonstrate what they've learned to the teacher and their peers helps them synthesize their new knowledge. The teacher can guide discussions by asking questions and inviting other students to share. As students listen to each other's explanations, they can compare them with their own, discuss or debate ideas, and revise their ideas based on their current understanding. Afterward, teachers can introduce formal terms, definitions, and explanations for concepts, processes, skills, or behaviors and provide informational text to help students connect informal language to formal language and make sense of the content.

In addition to discussions, presentations, and written assignments, our teachers use interactive notebooks to organize and assess student learning. The right side of

the spiral notebook is for writing down information given by the teacher, e.g., notes, vocabulary, video notes, or labs. The left side shows the student's understanding of the information from the right side, e.g., brainstorming, reflections, drawings, figures, or worksheets. The notebooks enable students to think, record, and reflect as scientists while enhancing their writing skills and encouraging creativity. They also give ELLs a chance to process their ideas about science while practicing writing in English. In addition, the notebooks help teachers see each student's progression of learning so they can evaluate changes in their thinking over time and see if misconceptions were resolved.

When students elaborate, they are challenged to deepen their conceptual understanding and hone their skills by applying what they've learned to new, but related, experiences. Teachers can have students elaborate through debates, extended inquiry investigations, problem-based learning, and citizen science.

One important way students elaborate in PUSD is by participating in the Innovation Exposition, which is PUSD's alternative to a science fair. I got the idea for the Innovation Exposition from a CSTA conference where I heard an educator from Placer County talk about their annual STEM Expo. PUSD's Innovation Exposition enables all students in grades K-8 to think critically and explore their interests and talents. Students can choose to submit a project in one of six categories: Invention, Environmental Innovation, Science Fiction, Scientific Inquiry, Creativity with 3D Printing, or Reverse Engineering. At the annual event in May, students in grades K-3 showcase their work, while students in grades 4–8 can choose to have their work evaluated and judged by local STEM professionals.

During the evaluation phase, students' knowledge is assessed to inform teachers of their progress toward mastery. In PUSD, we encourage teachers to integrate informal and formal assessments throughout each of the other four phases so they can gauge students' progress and modify their instruction as they go. This is particularly helpful for ELLs because it allows teachers to see if they are grasping concepts, even if they struggle with the English language. Our teachers use multiple informal assessments such as student conferencing, exit tickets, and interactive notebooks. Our summative assessments consist of multiple choice questions, open-ended response questions, claim–evidence–reasoning, and performance tasks to assess student learning.

In science, we are all language teachers and all students are language learners. Thus, it is important to monitor students' grasp of the language throughout the process, not just at the end of a unit. With the 5E model, we can give students who are native English speakers and students who are ELLs meaningful opportunities

to learn science by doing, reading, writing, representing, and presenting their ideas—just like scientists do. We are also helping them develop 21st-century skills such as communication, collaboration, critical thinking, problem-solving, and creativity. This aligns the classroom with the real-world application of science by ensuring that students achieve the essentials necessary for professional success and personal achievement.

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http://www.classroomscience.org/helping-students-become-science-language-learners-with-the-5e-model