Science

The National Research Council's (NRC) *National science education* standards state that:

> the commitment to science for all implies inclusion of those who traditionally have not received encouragement and opportunity to pursue science -- women and girls, students of color, students with disabilities, and students with limited English proficiency.
> (NRC, 1996)

Vocabulary

Both fluent English speakers and English language learners will encounter new and unfamiliar vocabulary as they move through their science education. Unlike their English speaking peers, however, English learners are also constantly learning vocabulary in all of their school subjects as well as in their daily lives.

There are a number of ways in which teachers can make the massive vocabulary-learning process required of English learners easier.

- Use classroom routines to present vocabulary. You might spend two or three minutes at the beginning of a class highlighting scientific vocabulary that students will need in the class. Use the same type of language each time—for instance "Here are some key words." By making the presentation of vocabulary a routine event, students are not faced with the extra task of working out what kind of instruction is going on.
- Exploit cognates. Cognates are words which sound similar across languages because they have common origins. Much of the scientific vocabulary of English comes from words with Latin origins (like *experiment*, *observe*, *precipitation*); these words are likely to have cognates in languages descended from Latin (including Spanish, French, and Portuguese).

Talking Science

Communication is a vital part of the scientific discovery process. Students working in small hands-on groups in the science classroom use back-and-forth communication to make meaning out of their observations and discoveries. Teachers should ensure that English language learners are not excluded from this crucial learning experience.

- Make sure that instructions are clear to everyone in the group, perhaps by providing them in written as well as oral form, so that ELLs have time to digest the content.
- Allow speakers of the same language to work together and to discuss scientific concepts in their native language before they communicate them in English.
- If groups are multilingual, teachers can assign roles to each member of the group, and construct roles with more or greater linguistic demands to suit their diverse students. For instance, a student with limited English might be assigned to connect key concepts to new vocabulary; a more proficient student might be responsible for taking observation notes.
- When calling on students, give them a moment or two to jot down ideas before they speak in front of the class. This allows students to marshall their thoughts and gives them time to think about the language that they will need to express their ideas.

Excerpted from Ballantyne, K.G., Sanderman, A.R., Levy, J. (2008). *Educating English language learners: Building teacher capacity*. Washington, DC: National Clearinghouse for English Language Acquisition. Available at http://www.ncela.gwu.edu/practice/mainstream_teachers.htm.

Writing Science

English language learners may understand the concepts of science very well, but unless they have the tools to communicate their understanding, teachers have no way of assessing their comprehension (and may underestimate it). Teachers can help ELLs by providing varying degrees of scaffolding. Of particular use to ELLs are partial "sentence chunks" that scaffold the types of sentences students should use to communicate their scientific knowledge. Sentence chunks allow students to express their scientific learning without being hindered by lack of language skills—they also model the types of scientific language students can use in the future. As students become more proficient, less scaffolding is required.

<table>
<tr><th colspan="2">LABORATORY REPORT</th></tr>
<tr><td colspan="2">Title
Relationship between _____ and _____</td></tr>
<tr><td colspan="2">Background
This experiment investigates _____.
This experiment tests the hypothesis that _____.
Based on _____ I predict that _____.</td></tr>
<tr><td>Equipment
(Ensure students have the vocabulary to list the equipment.)</td><td>Procedure
(Provide examples of verbs that students will need to list the procedure. For instance, you might include a list of verbs such as add, pour, fill, heat, distill, decant.)</td></tr>
<tr><td colspan="2">Observations
At the beginning of the experiment, the _____ was _____. After _____, the _____ became _____.</td></tr>
<tr><td colspan="2">Conclusion
Adding _____ to _____ causes _____.</td></tr>
</table>

Example of a laboratory report with partial sentence chunks.

Instructional Congruence

Instructional congruence refers to "the process of merging academic disciplines with students' linguistic and cultural experiences to make the academic content accessible, meaningful, and relevant for all students" (Lee, 2004, p. 72). Instructional congruence can refer to both ways of talking and thinking about scientific inquiry as well as ways of presenting scientific topics.

Students from diverse cultural backgrounds may have ways of approaching inquiry that differ from Western norms. They may come from cultures where it is considered inappropriate to question authorities such as teachers and textbooks. Students from different cultural backgrounds may also differ in terms of their comfort levels with working collaboratively or individually. The presentation of topics in traditional science lessons may also miss chances to connect to students' background knowledge.

Teachers can modify instruction so that it values students' cultural norms while simultaneously facilitating scientific inquiry. In designing a unit on weather for a multi-year professional development program, a research team built elements into the unit designed to be convergent with students' learning. In this case, the students were mostly Hispanic students from the Caribbean and Central and South America.

The unit:

- used both metric and traditional units of measure;
- incorporated weather conditions familiar to students, such as hurricanes and other tropical weather patterns;
- used inexpensive household supplies for hands-on activities so that students could replicate the activities at home with their families;
- allowed students to work collaboratively or individually depending on their comfort level with these patterns;
- integrated science standards with both TESOL and English language arts standards to encourage English language development in social settings, in the academic content, and in socially and culturally appropriate ways.

To Learn More About Teaching Science to English Language Learners

Web Resources

Anstrom, K. (1998). *Preparing secondary education teachers to work with English language learners: Science*. NCBE Resource Collection Series, No. 11. Available from http://www.ncela.gwu.edu/pubs/resource/ells/science.htm

Dobb, F. (2004). *Essential elements of effective science instruction for English learners*. Los Angeles, CA: California Science Project. Available from http://csmp.ucop.edu/downloads/csp/essential_elements_2.pdf

Gomez, K. & Madda, C. (1995). Vocabulary Instruction for ELL Latino Students in the Middle School Science Classroom. *Voices from the Middle*, 13(1), 42-47. Available from http://elearning.ncte.org/section/content/Default.asp?WCI=pgDisplay&WCU=CRSCNT&ENTRY_ID=B1585EDDA5D74E0381945A054587AC58

Jarrett, D. (1999). *The inclusive classroom: Teaching mathematics and science to English language learners*. Portland, OR: Northwest Regional Educational Laboratory. Available from http://www.nwrel.org/msec/images/resources/justgood/11.99.pdf

Print Resources

Carr, J., Sexton, U., & Lagunoff, R. (2006). *Making Science Accessible to English Learners: A Guidebook for Teachers*. San Francisco, CA: WestEd.

Fathman, A.K. & Crowther, D.T. (2006). *Science for English language learners: K–12 classroom strategies*. Arlington, VA: National Science Teachers' Association Press.

The weather unit described above is taken from Lee, O. (2004). Teacher change in beliefs and practices in science and literacy instruction with English language learners. *Journal of Research in Science Teaching, 41*(1), 65-93.