P SELL
An NSF Funded Program

Promoting Science among English Language Learners

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Targeted Areas

- Science focus
- Integration with
  - English language and literacy
  - Mathematics

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Science

- Science content knowledge
- Science inquiry to promote science understanding
  - hands-on and minds-on (reasoning and application)
  - gradual shift from teacher-directed to student-initiated inquiry

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Inquiry Framework

1. Questioning 	**State the problem** ▪ What do I want to find out? (written in the form of a question) **Make a hypothesis** ▪ What do I think will happen? (explain your reasoning)
2. Planning 	**Make a plan by asking these questions (think, talk, write)** ▪ What materials will I need? ▪ What procedures or steps will I take to collect information? ▪ How will I observe and record results?
3. Implementing 	**Gather the materials** ▪ What materials do I need to implement my plan? **Follow the procedures** ▪ What steps do I need to take to implement my plan? **Observe and record the results** ▪ What happens after I implement my plan? ▪ What do I observe? ▪ How do I display my results? (graph, chart, table)
4. Concluding 	**Draw a conclusion** ▪ What did I find out? Check the most correct statement based on your data. ▪ Was my hypothesis correct or incorrect? (explain your reasoning)
5. Reporting 	**Share your results (informal)** ▪ What do you want to tell others about the activity? **Produce a report (formal)** ▪ What is the answer to the problem?

Inquiry Matrix

Inquiry levels	Questioning	Planning	Implementing	Concluding	Reporting
0	Teacher	Teacher	Teacher	Teacher	Teacher
1	Teacher	Teacher	*Students*	Teacher	*Students*
2	Teacher	Teacher	*Students*	*Students/ Teacher*	*Students*
3	Teacher	*Students/ Teacher*	*Students*	*Students*	*Students*
4	*Students/ Teacher*	*Students*	*Students*	*Students*	*Students*
5	*Students*	*Students*	*Students*	*Students*	*Students*

English Language & Literacy

- Literacy strategies for all students
- ESOL strategies
- Linguistic scaffolding
- Home language
- Home and community culture

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Literacy Strategies for All Students

Incorporate reading and writing strategies

- Activate prior knowledge
- Promote comprehension of expository science texts
- Promote scientific genres of writing
- Connect science process skills (e.g., describe, explain, predict, conclude, report) to language functions (e.g., explain, compare, contrast)
- Use graphic organizers (e.g., concept map, word wall, Venn diagram, KWL)

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ESOL Strategies

Use language support strategies

- Use a small number of key terms in multiple contexts
- Promote hands-on inquiry
- Use realia (real objects or events)
- Encourage multiple modes of representations (gestural, oral, pictorial, graphic, textual)
- Use graphic devices (graphs, charts, tables, drawings, pictures)
- Promote precision in observing and describing objects and events through attention to positional words (above/below, inside/outside), comparative terms (e.g., hot, hotter, hottest), and affixes (e.g., *in*crease or *de*crease)

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Linguistic Scaffolding

Reduce language load while maintaining the rigor of science content and process

- Adjust language load for students at varying levels of English proficiency
- Use language that matches students' communicative competence in length, complexity, and abstraction
- Communicate at or slightly above students' level of communicative competence (i.e., comprehensible input)
- Build students' understanding and discourse skills (e.g., from "it is foggy" to "water vapor condenses into little water drops")

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Home Language

Use home language support

- Present science terms in multiple languages in the beginning of each lesson
- Use cognates (and highlight false cognates) in home language
- Allow code-switching
- Allow ELLs to discuss the lesson in class using their home language
- Encourage bilingual students to assist less English proficient students in their home language
- Allow ELLs to write about activities in home language

Home Culture

Incorporate the ways students' cultural experiences influence science instruction

- Build on students' lived experiences at home and in the community (i.e., funds of knowledge)
- Explore culturally-based ways students communicate and interact in their home and community (i.e., cultural congruence)
- Use students' cultural artifacts, culturally relevant examples, and community resources
- Use texts with content that is familiar to ELLs

Mathematics

- Measurement and instruments
- Recording and display of data using graphs, charts, tables, and drawings
- Analysis and interpretation of data

Research Synthesis

Lee, O. (2005). Science education and English language learners: Synthesis and research agenda. *Review of Educational Research, 75*(4), 491-530.

Big Ideas

Based on your experience and expertise, think about effective science instruction for ELLs.

- What do ELLs bring to the science classroom?
- What are effective classroom practices in teaching science for ELLs?

What ELLs Bring to Science

- ELLs bring to the science classroom cultural and linguistic experiences that can be used as intellectual resources.
- At the same time, ELLs bring cultural norms and practices that are sometimes discontinuous or in conflict with norms and practices of science.

Effective Classroom Practices

- Articulate ELLs' linguistic and cultural experiences with science disciplines:

  - when continuous, capitalize on students' thinking and knowledge as points of contact

  - when discontinuous, make norms and practices of science explicit and visible

Effective Classroom Practices (continued)

- Provide all students with academically rigorous curriculum.
- Engage students in hands-on, inquiry-based instruction to promote scientific understanding, inquiry, and discourse.
- Be aware of ELLs' differing needs when deciding how much explicit instruction to provide and how to guide students for their own learning.

Equitable Learning Opportunities

1. Value and respect ELLs' experiences from home and community
2. Articulate ELLs' linguistic and cultural knowledge with science disciplines
3. Provide academically rigorous curriculum and instruction
4. Offer educational resources