These resources can be used with Grades K-5, Grades 6-8, and Grades 9-12. Websites and examples have been reviewed for appropriate use for English language learners and students who have been classified as Fluent English Proficient (FEP) Year 1 and Year 2.

English Language Development Strategies in *Science*

Group Work.

This could be through partners or cooperative groups. Group work provides frequent opportunities for students to communicate, to share observations and insights, test hypotheses, and jointly construct knowledge. In this method, students of different linguistic and educational backgrounds and different skill levels work together on a common task for a common goal in either the language or the content classroom. Depending on their language proficiency, students can be assigned various roles as facilitator, recorder, reporter, or illustrator. The teacher might consider heterogeneously grouping by language for some activities: students can learn both science and English from their peers. Group reports can be helpful as this provides frequent restating and expansion of important concepts.

Group work is recommended for successfully completing assignments which include problem solving tasks. A problem is presented. Initially, students work independently to find creative solutions to the problem. The students are then paired and instructed to try to convince each other of the practicability of the two solutions or to combine their solutions to make a better one. This pair is then grouped with another pair of students and they (the group of four) must decide on and present their best solution to the entire class.

Use of Graphic Organizers

Graphic organizers are an instructional tool that visually organizes and presents information so that it can be understood, remembered, and applied. Graphic organizers are used to help students place information in a comprehensible context and make connections between existing knowledge and new concepts to be learned. They enable students to organize information obtained from written or oral texts, develop reading strategies, increase retention, activate schema as a pre-reading or pre-listening activity, and organize ideas during the prewriting stage.

Graphic organizers can be useful to demonstrate a scientific process, experiment or model. They can also show main idea and details, facts, and/or arguments that support it. Graphic organizers help students to focus on a topic, review what they already know, organize their knowledge, and helps them monitor their growing comprehension of a given topic.

A sampling of graphic organizers and their use:

- Herringbone map - Use to prepare for a writing assignment, especially when writing about multiple ideas and attributes
- Flow charts - visually display a chain of instructions

- Cycle map – Use to show how items are related to one another in a repeating cycle

- Spider map - used to organize thoughts but also used effectively as a note-taking template

- KWHL Charts: What I already **K**now, What I **want** to find out, **H**ow I can learn more and What I have **l**earned – Use to organize what a student knows and what is learned about a topic before, during or after the research is done.

- THC Charts: What I **t**hink, **H**ow I will find out, and What I **c**onclude – Use to organize what a student knows and whey they want to learn about a topic before, during or after the research is done.

- Star Diagram – Many uses; basic brainstorming, organizing prior knowledge of a specific topic, or describing the who, what, when, where and why of a story.

- Vocabulary maps - Useful in helping students learn new vocabulary words. The new vocabulary word is written in the center and in each of the four corners, the student can write a variety of information. It could include a definition, a part of speech, a synonym, an antonym, a picture that illustrates the meaning of the word or write a sentence using the word.

- Fact/Opinion Chart – Two columns – one titled "Fact" and the other titled "Opinion." Students can listen to teacher statements and then determine which column to place the statement. Students can work in pairs or small groups and generate their own statements and determine whether it is a fact or opinion. Statement can be taken from literature text and used in the same manner.

Activation of Prior Knowledge

Connect learning objectives to the students' background experiences and knowledge. Students can be expected to share their prior knowledge through short verbal responses or by making a nonverbal choice from pictures or realia. This can be done by simply asking students what they already know about a subject. It can also be done through discussions, creating visuals like 'semantic webs', language experience stories, or free-writing on a topic. The key is to engage students in making connections between what they are learning in class and their own interests and experiences.

Also see "Use of Graphic Organizers."

Use of Academic Language Scaffolding

Language Scaffolding is a step-by-step process of building students' ability to complete tasks on their own. Students identify science vocabulary by participating in an introductory activity. Scaffolding consists of several strategies used in conjunction to "shelter" curriculum content for ELLs. These strategies include modeling the use of academic or technical language; contextualizing academic or technical language through the use of visuals, gestures, graphic

organizers, and demonstrations; and using hands-on learning activities that involve the use of academic or technical language.

Examples of Sentence Patterns in Scientific Discourse

Description: The _____ has _____ and _____.

Cite information: Here we see that _____.

Estimate: Looking at the _____, I think there are _____.

Retell: First, _____ next, _____ and then, _____.

Make Predictions: I think _____ will _____.

Give and Support Opinions: I think _____ is _____ because _____.

Cause and Effect: The _____ had _____, so _____.

Draw Conclusions: The _____ is _____ because _____.

Hypothesize: If _____ had _____, then _____ would have _____.

Persuade: As we just saw in the experiment, _____ does _____ because _____.

Example of a Student Choice Sentence Frame

Does the mass change during a chemical reaction?

Hypothesis: I think the mass will (circle one):

Increase decrease stay the same

Because: _____.

Context Clues through Visual Scaffolding

The teacher uses concurrent verbal explanation and physical demonstration of directions or concepts by using gestures, visuals, and demonstrations while giving directions. Gestures or actions in addition to graphs, visuals and other props can be used to communicate meanings. The teacher can display drawings or photographs while giving directions or to use as non-linguistic representation of science concepts. Students can respond by physically acting out or visually modeling their responses using gestures or realia.

- Choose books whose pictures can help to tell the story. Illustrations can become an effective tool for generating interest, expanding vocabulary, and providing opportunities for simple discussion. The use of pictures and labels ease the language transition.

- Songs and games provide opportunities for children to hear and reproduce the language naturally. Teacher-led songs without the use of a cassette make it easier for students to understand the words. The use of sentence strips with some or all of the verbiage assists students by connecting spoken to written language. • Realia, Manipulatives, and Materials. Science lessons for ELL students should include activity-based lessons with all students having hands on access to materials. Using concrete objects in the classroom creates cognitive connections with vocabulary, stimulates conversation, and builds background knowledge. The use of realia gives students the opportunity to use all of their senses to learn about a subject. Laboratory equipment, measurement tools, rocks, plants, or any real object that relates to the language objective of a lesson can be used as realia. When real objects are not available, photographs, illustrations, and artwork make effective substitutes for realia.

Realia, Manipulatives, and Materials

Science lessons for ELL students should include activity-based lessons with all students having hands on access to materials. Using concrete objects in the classroom creates cognitive connections with vocabulary, stimulates conversation, and builds background knowledge. The use of realia gives students the opportunity to use all of their senses to learn about a subject. Laboratory equipment, measurement tools, rocks, plants, or any real object that relates to the language objective of a lesson can be used as realia. When real objects are not available, photographs, illustrations, and artwork make effective substitutes for realia.

Teachers use manipulatives while simultaneously modeling the connecting academic language. Students use manipulatives for a variety of reasons: to represent real objects or complex interactions, manipulate objects to demonstrate and/or to explain concepts to others.

<u>Examples of using Manipulatives with Science Content</u>

- Human body models
- Realia for experiments
- Styrofoam balls and toothpicks for construction
- Magnets, batteries, iron filings

Task-based or Experiential Learning
This provides appropriate contexts for developing thinking and study skills as well as language and academic concepts for students of different levels of language proficiency. Students learn by carrying out specific tasks or projects: for example, "doing science" and not just reading about it.

Leveled Questions

The teacher adapts the level of questions asked to the English Learners' language acquisition stage. Alternatively, the teacher can differentiate student responses, based on language proficiency. Adjusting questioning strategies to the language level of the student may include the teacher using gestures, visuals, and slowing the speech rate. The student may be allowed to respond to a question by pointing to a visual, giving a one-word response or a complete sentence or explanation with confidence.

Multiple Intelligence Strategies

The teacher employs instructional techniques that address the multiple intelligences present in each student. Teachers use a myriad of multiple instructional strategies to target the varied intelligences of English Learners. This method allows the student to actively use his own personal strengths in order to gain confidence in his abilities.
Gardner's Multiple Intelligence Strategies

1. Verbal-linguistic intelligence and learning processes, focusing on speaking, reading, and writing;

2. Logical-mathematical intelligence, focusing on teaching of logic, mathematical processes, working with numbers, and sequencing;

3. Kinesthetic intelligence, focusing on drama, creative movement, dance, manipulatives, classroom games, physical education, and exercise;

4. Visual-spatial intelligence, focusing on pictorial representation, flow charts, visualization, board and card games, architecture and the visual arts;

5. Musical intelligence, focusing on singing, musical notation, curriculum songs, and musical instruments;

6. Interpersonal intelligence, focusing on positive interpersonal environments, conflict management, learning through service, appreciating differences, multiple perspectives, problem-solving, and multicultural education;

7. Intrapersonal intelligence, focusing on self-esteem, goal setting, thinking skills, emotional expression, and self-directed learning.

Bloom's Taxonomy Strategies

Keep in mind Benjamin Bloom's six classification levels when using questioning strategies with your students. Note that in the 1990's, Lorin Anderson (a former student of Bloom's) headed a new group of cognitive psychologists and updated the taxonomy reflecting relevance to 21st century work. Verbs now describe the different levels of the taxonomy instead of nouns.

1. Remembering/knowledge**:** Can the student recall or remember the information? Define, duplicate, list, memorize, recall, repeat, reproduce state

2. Understanding/comprehension**:** Can the student explain ideas or concepts? Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate, and paraphrase.

3. Applying/Application: Can the student use the information in a new way? Choose, demonstrate, dramatize, employ, illustrate, interpret, operate, schedule, sketch, solve, use, write.

4. Analyzing/Analysis: Can the student distinguish between the different parts? Appraise, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, and test.

5. Evaluating/Synthesis (used to be at the top of the pyramid but is now second from the top): Can the student justify a stand or decision? Appraise, argue, defend, judge, select, support, value, evaluate

6. Evaluating/Synthesis (used to be at the top of the pyramid but is now second from the top): Can the student justify a stand or decision? Appraise, argue, defend, judge, select, support, value, evaluate

7. Creating/Evaluation (used to be second from the top but is now on the top of the pyramid: Can the student create new product or point of view? Assemble, construct, create, design, develop, formulate, and write.

Assessing All Students' Performance and Understanding

Teachers should use authentic forms of assessment. They should observe students in the process of accomplishing academic tasks. How students use materials can be one indicator of their involvement and understanding of content. When questioning students, teachers need to provide adequate wait time. Teachers should give serious consideration to performance-based assessments for formal evaluation. Individual student interviews may reveal a variety of beneficial information. Teachers should also consider accepting drawings as indicators of learning within a science journal.