ELLs and Science

Contents

ELLs and Science

If you think of yourself as a science teacher, keep in mind that when you have one or more ELL students in a class, you also become an English language teacher.

Learning the language of science and the vocabulary of science presents multiple challenges for ELLs. The language and concepts of science are often abstract. This level of abstraction goes beyond the understanding of individual vocabulary words. It is embedded in the basic syntax of sentences, the language functions connected to science, and the patterns of discourse of science.

One issue for ELL students is understanding polysemous words which are words with multiple meanings. These words may have everyday meanings and, at the same time, very specific meanings in science. A *class* of animals is not connected to a school. You do not sit at the periodic *table*. There are also words with very particular meanings in science that have very different definitions in other subject areas such as *power* (exponent of an expression in math, energy transferred per unit of time in physics), *replicate*, *translate,* and *conservative*.

One science teacher found that her students had difficulty classifying hair in one experiment because they did not understand the work "*shaft*" as it relates to hair. They were stuck because they only knew the colloquial use of shaft as in "to cheat."

One particular challenge of words with multiple meanings is function words. Function words are signal words that give information about rhetorical relationships such as cause/effect or logic. These are not specific to one subject's lexicon but are essential in understanding a subject. These are words such as: *therefore, also, initially, preceding*, and *while*. For example, the function word "*by*" can shift the meaning of a sentence, as in "*by 2008*" in a political science class, *"by photosynthesis"* in science, "*4 by 7*" for multiplying in mathematics and "*by the sea*" in a piece of literature.

Another challenge for students learning another language is that it is much easier for them to learn general categories such as *bird* and much more difficult for them to learn and recognize the specific examples in a category (e.g., *oriole*, a *robin* and a *finch* are all types of birds).

Examples of Language Difficulties

Everyday words that have a special meaning in science.

Words in Everyday Life (non technical)	Words in Science (technical)
table	periodic *table*
class	animal *class*
response	autonomic *response*
crest	*crest* of a wave
translation	*translation* in protein synthesis
work	*work (Physics)* force times the distance through which it acts
power	*power (Physics)* work done or energy transferred per unit of time
kingdom	animal *kingdom*

Sources:

Gomez and Mata, "Vocabulary Instruction for ELL Students in the Middle School Science Classroom," *Voices from the Middle*, Volume 13, No. 1 September 2005.)

John Carr, Ursula Sexton and Rachel Lagunoff, *Making Science Accessible to English Learners*, West Ed, 1999.

Sentences That May Have Syntactic Features Unknown to ELLs

Investigation and experimentation require particular discourse patterns that can be difficult for ELLs. These include language that is connected to relationships, causation, cause-effect, conditionals if…then, and frequent use of the passive tense. For example, the following passive sentences from a biology textbook do not follow the simplest subject-verb-object pattern of English. This limits the syntactic clues an ELL student can access when trying to decipher a sentence. Passive sentences often have implied subjects which must be inferred from the context.

Passive sentences:

1. The complex organic molecules have been digested and absorbed, leaving only water, cellulose and other undigestible substances behind.
2. Water is moved quickly across the large intestine wall.
3. These fragile new cells are covered by a tough root cap that protects the root.

Source

Kenneth Miller and Joseph Levine, *Biology*, Prentice Hall, 2003.

Cause-effect:

The fewer the number of hydrogens on a carbon-carbon bond, *the more* oxidized the bond. (cause-effect is implied in *the fewer* and *the more*)

Pronouns and indefinite words: The carbohydrate portion is on the exterior of the lipid bilayer, where *it* can hydrogen-bond with water.

Source

Antony Wilbraham, Dennis Staley, Michael Matta, Edward Waterman, *Chemistry*, Prentice Hall 2000.

Text Analysis

Look for the following in texts that may cause difficulty in understanding such as complex tenses. Use of complex tenses (simple present, past and future tenses are the easiest tenses to understand and rare in science texts). ELLs depend on redundancy, repetition of subjects and simple sentences. Look for texts that start with the concrete and move to the abstract. Check to see if the pictures, diagrams and captions are on the same page as the related text. The use of pronouns and indefinite words such as *it, there* and *that* make them difficult to understand especially at the beginning of a sentence.

Many science texts have multiple diagrams to help students understand key concepts. Unfortunately, the charts and visuals are often complex and require an understanding of key concepts and a great deal of text before they can be understood. They can be just as difficult to understand as the text they illustrate. Most charts and visuals lack simple explanations or keys for the colors and symbols used.

The text itself is often complex and too dense syntactically for students to negotiate. Here is one excerpt from a biology text describing viral infections:

Viral Infection

Because viruses must bind precisely to protein on the cell surface and then use a host's genetic system, most viruses are highly specific to the cells they infect. Plant viruses do not infect animal cells; most animal viruses infect only certain species of animals; and bacterial viruses infect only certain types of bacteria.

Bacteriophages are viruses that infect bacteria. As examples of how viruses infect cells, we will look at two bacteriaophages known as T4 and lambda.

Source

Kenneth Miller and Joseph Levine, *Biology*, Prentice Hall, 2003

In addition to the content-specific vocabulary, the syntax of this passage is complex and difficult. The textbook writers are making an argument which is very abstract. Understanding the reasoning of this argument depends on understanding the syntactic cues which an ELL student would not be able to follow. In one long extended sentence, a student would need to follow the cues of "because" … "and then" to know that the end of the sentence is a concluding premise. If the student does not understand this sentence, it would be difficult to understand the proceeding sentence.

Here is another sample excerpt from the same text. This section is designed to make some connections to students' prior experience to give them a framework to understand the concept of the discovery of microorganisms.

Imagine living all your life as the only family on your street. Then, one morning, you open the front door and discover houses all around you. You see neighbors tending their gardens and children walking to school. Where did all the people come from? What if the answer turned out to be that they had always been there—you just hadn't seen them? In fact, they had lived on your street for years and years before your house was even built. How would your view of the world change? What would it be like to go, almost overnight, from thinking that you were the only folks on the block to just one family in a crowded community? A bit of a shock?

Humans once had just such a shock. Suddenly, the street was very crowded! Thanks to Roberto Hooke and Anton van Leeuwenhoek, the invention of the microscope opened our eye to the world around us.

Source

Kenneth Miller and Joseph Levine, *Biology*, Prentice Hall, 2003

There are assumptions in this analogy that would make it alienating to many students. Students who have not come from suburban communities or ever lived in houses are asked to imagine what it would feel like to go from living in the only house on their block to a street with multiple houses. This analogy for a shocking change in world view would be lost on students from urban communities and would also be alienating since it is so removed from their experiences.

Strategies for Teaching Content and Language in Science

STRATEGY: Semantic Feature Analysis or Features Matrix

Description

This chart includes a list of concepts about a topic or category and a list of features connected to that topic.

Students indicate which features are a component of each concept by writing a plus (+) or minus (-) in each column. Some teachers have students use the symbol (?) when they are unsure and use the features they are unsure about as a basis for discussion.

Procedures

There are many ways to use these charts. It is important to model the activity, allow for collaborative interactions, scaffold and require practice articulating the information orally and in writing, once the chart has been completed.

- Photocopy a grid onto an overhead transparency or draw a grid on a board of chart paper.
- Write the topic in the upper left hand column such as “chordates”.
- Elicit from the students the types of animals that belong to the phylum chordate.
- Elicit from the students the features or characteristics of animals in this phylum and write these in the far left column.
- Give students a blank grid and ask them to complete the grid individually. If an animal contains the characteristic, they put a (+). If the animal does not

contain the characteristic, they put a (-). If they are not sure, they put a (?). Model the first animal with the class. Encourage them to add features that the class may have forgotten.

- Have students share their matrix with a partner and discuss their answers.
- Have pairs share out and explain their decisions. Record the class's answers on your overhead transparency.
- As pairs share out, add any additional features they have identified.
- Help students make oral and written generalizations about the differences and similarities among chordates. Give them possible sentence frames:

Example

A(n) _____ (amphibian) lives on land, but a(n) _____

(invertebrate) does not.

Suggestion: Keep your overhead for future review and have students return to their Semantic Feature Analysis in future lessons.

Application

These charts work well as a pre- and post reading activity. They can create a connection between students' prior knowledge and concepts that are related. It allows students to visualize key concepts and their relationships, and it gives them a way to distinguish between similar concepts that are often confused. It is a way to graphically represent the similarities and differences of concepts related to a topic. These charts can frame collaborative discussions or serve as a prewriting activity where students form oral and written sentences about a topic.

Example:

Chordates	Invertebrates	Fish	Amphibians	Reptiles	Mammals	Birds
Central nervous system	+	+	+	+	+	+
Lives on land	-	-	+	+	+	+
Lays hard-shelled eggs	-	-	-	+	-	+
Gives live birth	-	-	-	-	+	+
Has a nerve cord at some stage	+	+	+	+	+	+
Has feathers	-	-	-	-	-	+
Is heterotrophic	+	+	+	+	+	-
Is ectothermic	+	+	+	+	-	-
Has hair	-	-	-	-	+	-
Has scales	-	+	-	+	-	-

Adapted from: *Content Area Graphic Organizers: Science*. Gina Hamilton, Walsh Publishing, 2005.

Example:

Features Matrix					
(+) yes	(-) no				(?) not sure
Mechanical Model of Fluids Transport	Dump Model	Squirt Model	Siphon Model	Vacuum Model	Other _____
has ability to move "stuff"	+	-	+	+	
has continuous flow	-	-	+	?	
Circulates (back to start)	-	-	-	-	

Source

John Carr, Ursula Sexton, and Rachel Lagunoff. *Making Science Accessible to English Learners: A Guidebook for Teachers.* West Ed.

STRATEGY: *Comparison-Contrast Matrix*

Description

This strategy shows students how to create maps and graphic representations of rhetorical patterns used in text. This allows them to understand rhetorical structures in English such as cause-effect and comparison-contrast that often present difficulties for ELL students and allows them to read text with better comprehension.

A *comparison-contrast matrix* is a graphic organizer that helps students organize ideas from a text into similarities and differences. It can be used to compare and contrast two or more concepts, processes, or events. The reader lists the target concepts at the top of the matrix and the attributes, properties or characteristics along the left side.

This gives students a visualization of a common text pattern in science. It also allows them to understand the similarities and differences of key concepts and enhances their understanding of this text structure.

Procedures

Students read a passage individually and take notes. *(You can include some of the notes for students at the beginning level of proficiency.)*

- Have students share the notes with a partner and discuss their answers.
- The entire class shares out on an overhead transparency or LCD projector.
- Have students work with a partner on the key questions for this organizer.

Key questions connected with this frame:

- What items are being compared and contrasted?
- What categories of attributes can be used to compare and contrast the items?
- How are the items similar?
- How are the items different?
- What are the most important qualities or attributes that make the items similar?
- What are the most important qualities or attributes that make the items different?
- In terms of the qualities that are most important, are the items more alike or more different?

Discuss with whole class and have students reflect on the graphic organizer:

- How did using this organizer change the way you read this text?
- In what ways was it useful?

(Questions from Richard T. and Jo Anne L. Vacca. *Content Area Reading*. Harper-Collins Publishers, 1996)

Sample Matrix

	Fungi	**Algae**
Body Structure		
Food Source		
Method of Reproduction		
Living Environment		

Example:

	Meat-eating Marsupials	**Plant-eating Marsupials**
teeth	many sharp teeth	Large front teeth for shaped for nipping and cutting
feet	looks like a dog's or cat's foot	Second and third toes joined; big toe opposed

STRATEGY: *Reading Guides*

Description

Reading Guides help structure reader-text interactions. Students often struggle with what to focus on in a text. Guides provide support and direction for students and teach them how to learn with a text. The ultimate goal is to help students develop strategies to interact with and comprehend text independently.

ELL students often struggle with text because of the complex syntax and the abstract nature of academic information that is often not context-imbedded. The following strategies can be used to scaffold students' interaction with the text as they develop their English language proficiency.

Procedures

- Model this guide with a text on an overhead projector by "thinking aloud" telling the students your thinking as you go through a text.
- Have students complete the guide with the text you modeled.
- Have students try this strategy with a text at their independent reading level before having them try this on a more difficult text.

Application

Example:

Prereading Guide

Quick Look

1. *Write the selection title*_____
   _____
2. *List the subheadings.*_____
   _____
3. *What do the title and subheadings tell you about what you will read?*
   _____
   _____
4. *What do you know about the topic?*_____
   _____

Text Aids and Artwork

5. *List any vocabulary terms you find at the beginning of the selections or in bold or italic type in the text* _____
   _____

6. *Write any study questions you see at the beginning of the selection.*

_____

_____

7. *What does the artwork show? (include photos, charts, and diagrams)*

_____

_____

8. *What do the captions say about the artwork?*

_____

_____

The Text

9. *What do the first and last paragraphs tell you about the topic?*

_____

_____

10. *What do the topic sentences tell you about the topic?*

_____

_____

11. *How is the text organized?* _____

_____

Wrap-Up

12. *What do you think you will learn from your reading?*

_____

_____

Source

Globe Fearon Publishing

STRATEGY: *Semantic Map*

Description

Students generate a list of words connected to a topic. Then, they categorize these words which can be done collaboratively. The use of visuals helps reinforce word meanings.

Students need to actively engage in understanding words and making connections between concepts. Activities that involve categorizing build students' thinking. This strategy can be used to:

1) activate prior knowledge
2) build students' schema on a topic
3) develop and reinforce understand of concepts
4) expand students' vocabulary
5) understand the relationships among concepts

Procedures

1. Draw a large circle in the center of the map that will contain the question or concept that will be the main focus of the map. All the ideas for this map will be connected to this main concept, so it is generally bigger than all the other circles.

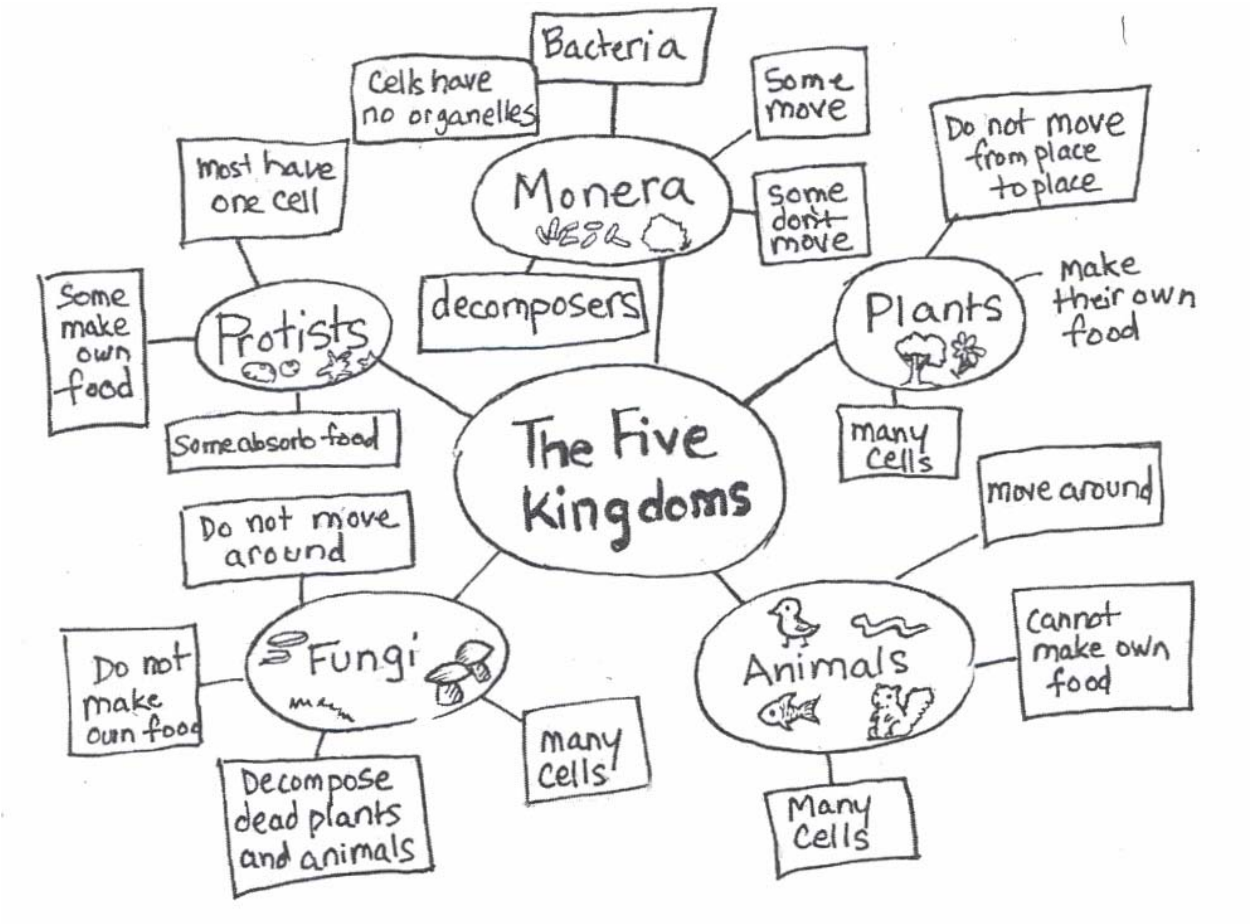
2. Elicit from the students the ideas that help to clarify or explain the concept. These ideas can come from brainstorming, asking key questions, or having them investigate a topic cooperatively with a text. You can write these ideas on the board or an overhead for future use. Help the students categorize these ideas.

3. Students can generate details, inferences and generalizations about these categories.

4. Create the map with the students. The categories are directly related to the main idea so these are written in smaller circles at the end of the spoke that comes from the center circle.

5. The details, inferences and generalizations create a third layer and are connected to the outer circles with spokes. These are often written in a different shapes, such as a rectangle and in a different color to make the relationships between ideas clear.

6. The class can discuss the map and make changes based on the discussion. They can add, omit or modify the map. This discussion helps clarify the relationships between the concepts. It also allows the teacher to assess the students' understanding of the topic and plan for future instruction.



Source:

Ann K. Fathman and David T. Crowther, *Science for English Language Learners: K-12 Classroom Strategies.* National Science Teachers Association Press. 2006

Strategies to Teach Content and Language Using Students' Prior Knowledge and Culture

STRATEGY: *Anticipation Guide*

Description

An anticipation guide is a series of statements students read and respond to before reading a text, viewing a video or listening to a presentation. It is a way to activate and assess thoughts and prior knowledge about a topic. These statements often challenge or elicit students' misconceptions or preconceived ideas about a topic.

This activity is particularly useful for ELL students. It allows for cooperative exploration of a topic before studying material. It allows for a rich discussion where students can make predictions and expectations about reading or listening before taking in new information. It also helps teachers identify student ideas or misconceptions about a topic that may connect to a different culture or different experiences. It is one way for a teacher to understand their students' paradigms for how the world works.

Procedure

For Set Up:

1. Analyze the material to be read (or listened to). Identify the key ideas and details. Think about the major concepts (implicit and explicit) that you want to focus on.
2. Keep in mind student experiences and beliefs in reading may challenge or support (what students may know or believe about the topic).
3. Write (3-5)short, clear, declarative statements that connect to the key ideas of a reading.
4. Put the statements in a form that will encourage predictions.

For Instruction:

1. Give each ELL student a copy of the guide and have him or her respond individually. (You can also project the guide on an overhead or LCD projector.)

2. Have students work with a partner to share answers and give reasons for their responses.
3. Responses and reasons can be shared in a whole-class discussion. As students make connections to the topic, the teacher needs to stay open to multiple responses.
4. Students read the text and then revisit the statements and compare their answers with the information in the text.

Application

PREDICTION GUIDE

Directions: Read each statement. Start with the "Me" column and place a "+" if you agree or a "o" if you disagree with the statement. Then read the textbook and decide whether or not the author agrees with the statement. Again use a "+" or a "o". Change all "o" statements so they agree with the textbook, and write the page number of where you found the information.

ME	Author	Statements

Chart format from Sally Berman, *Catch Them Thinking in Science.* Skylight Publishing Inc.

Example

PREDICTION GUIDE

Directions: Read each statement. Start with the "Me" column and place a "+" if you agree or an "o" if you disagree with the statement. Then read the textbook and decide whether or not the author agrees with the statement. Again use a "+" or a "o". Change all "o' statements so they agree with the textbook, and write the page number of the page where you found the information.

ME	Author	Statements
		The moon has no atmosphere.
		Most of the moon's craters are very old.
		Surface temperatures on the moon do not get very high or very low.
		We see both sides of the moon from Earth.
		We would weigh just as much on the moon as we do on Earth.
		Moon rocks are light in color.
		Most of the moon's surface is covered with a fine dust.
		Shooting stars rarely hit the moon.
		The moon's gravity does not affect the Earth.
		During the eclipse, the Earth blocks sunlight from reaching the moon.

Example:

ANTICIPATION GUIDE FOR CLICHÉS ABOUT THE WEATHER

Directions: Put a check (√) under ***likely***, if you feel the weather saying has any scientific basis. Put a check (√) under ***unlikely***, if you feel that it has no scientific basis. Be ready to explain your choice.

LIKELY	*UNLIKELY*	*STATEMENT*
		Red sky at night, sailors delight; red sky at morning, sailors take warning.
		If you see a sunspot, there is going to be bad weather.
		When the leaves turn under, it is going to storm.
		If you see a hornet's nest high in a tree, a harsh winter is coming.
		Aching bones mean a cold and rainy forecast.
		If a groundhog sees his shadow, there will be six more weeks of winter.
		Rain before seven, sun by eleven.
		If a cow lies down in a pasture, it is going to rain soon.
		Sea gull, sea gull, sitting on the sand. It's never good weather while you're on land.

Source
Richard T. Vacca and Jo Anne. L. Vacca, *Content Areas Reading*, Harper Collins

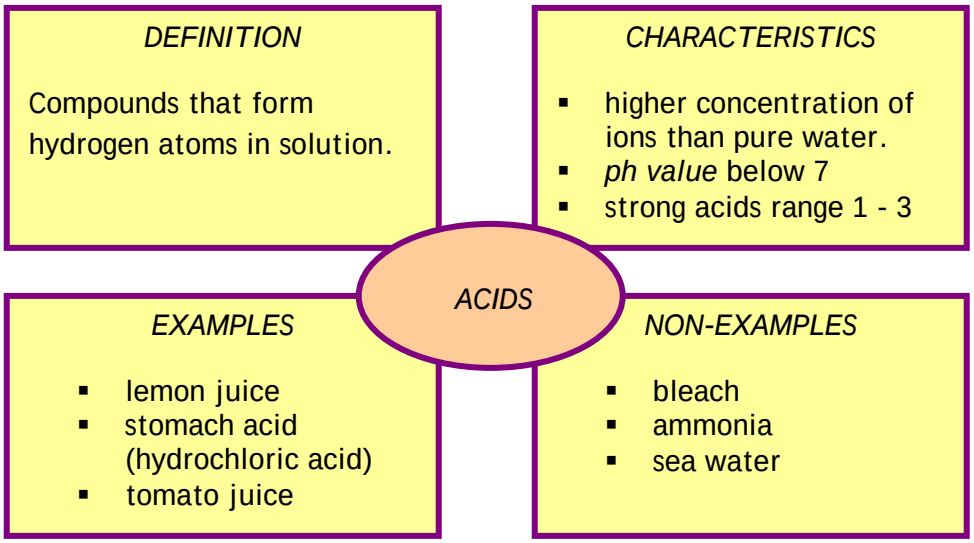
STRATEGY: *Frayer Model Map*

Description

A four-square graphic organizer that helps students visualize how a concept relates to other ideas. This allows students to organize their inquiry about a new vocabulary term and helps improve their comprehension of a new concept.
Each box requires a different type of thinking about a concept. In one box, students must define the concept, in another box identify its essential characteristics, and in the last two boxes come up with examples of the concept and contrast it with non-examples of the concept. This process can be a preparation activity for creating analogies or connecting a concept to synonyms and antonyms.

This strategy is useful for assessing and activating prior knowledge about a concept. It allows teachers to identify student misconceptions about a topic. It also provides a structure for students to work cooperatively with reference materials to explore a new concept.

Example:



Procedures

1. Have students work in groups or pairs to complete the graphic organizer from prior knowledge.
2. Students can add to their charts using reference materials.
3. Each group presents its findings to the class and the class can take notes on a Frayer organizer.

4. The organizer can be revisited later in the unit as a post-reading activity, after an experiment, or as a review activity at the end of a unit.

Strategies for Assessing ELLs' Knowledge of Content and Language in Science

STRATEGY: *Vocabulary Self-rating*

Description

These are strategies for students to assess what they know and understand about key vocabulary words and concepts. These can be used before, during and after explicit instruction.

Activities like these make explicit to student what words they know and what they need to learn. It allows students to take responsibility for their own learning by helping them monitor their own learning. It also provides teachers with information about what students understand regarding the vocabulary they are learning and modify instruction.

Procedures

1. The teacher reads the word aloud and students rate their understanding of the word. This lets students know what they need to learn and lets the teacher know which words to focus on.
2. Students rate the words after explicit vocabulary instruction. This allows students to see what they have learned and teachers to see what still needs to be emphasized.
3. Students rate the word after content area instruction. This lets students know what they have learned and measure their own growth. This also lets teachers know what they need to reteach in terms of vocabulary and also in terms of the related content.

Application

(See table below)

VOCABULARY SELF-RATING			
Name: _____			
Lesson Topic: _____			
(+) I am sure I know it (-) I am sure I don't know it. (?) I'm not sure			
Word (form)	*Before Lesson*	*After Vocabulary Instruction*	*After Content Instruction*
organ (n)			
amylase (n)			
enzyme (n)			
absorb (v)			
diffuse (v)			

Source

John Carr, Ursula Sexton and Rachel Lagunoff, *Making Science Accessible to English Learners*, West Ed, 1999.

STRATEGY: *Learning Logs*

Description

Learning logs are journals that have students participate in their own learning. They are used as a tool to help students learn by having them focus on information, compare it, find patterns, ask questions, predict, summarize, shift perspectives, activate prior knowledge and reflect on what they learned. They can be used at all points of a lesson such as assessing what students already know when they begin a unit of study, having them write questions about what they are learning mid-way through a lesson and reflecting on what they have learned at the end of an activity.

These journals are particularly valuable for content-area learning. They encourage students to think about their own learning and allow teachers to see what students understand or do not understand. Because students are encouraged to use their own words and not worry about spelling and grammar, they use writing as a tool to learn and are not required to produce a finished, formal product. When used for students to write summaries of what they learned, students can articulate what they understand, what they are confused about, evaluate their own performance and understand their own learning styles.

When used as a final activity for assessment students can respond to a set of questions, freewrite about key words related to a topic, explain how they performed an operation, state the most important points for a class discussion, describe where they became confused about a difficult activity, lab experiment, reading, or process. These responses are a source of data for the teacher about what students understand and don't understand as well as what they are experiencing as learners. It gives the teacher ideas about what to plan next.

Procedures

A. At the end of a lesson, leave 5 minutes for students to add an entry to their log.
B. Choose a question or a set of questions that will help students reflect on what they learned and how they learned.

Application

Here are some possible questions at the end of a lesson:

1. What did I learn today?
2. What did I understand about the work we did in class today?
3. What didn't I understand?
4. At what point in the lesson did I get confused?
5. What helped me to learn in today's class?
6. What do I want to know more about?
7. What questions do I still have about this topic?
8. How did I learn from the discussion or lesson?

Mini Lesson Plan

Lesson on Understanding Water Systems

From: Maureen Sims, Jane Hill, Catherine Little, Jane Sims, Toronto School Board, Toronto, Canada

Source

Anne K. Fathman and David T. Crowther, ed., *Science for English Language Learners: K-12 Classroom Strategies,* NSTA press, 2006.

Topic

Understanding water systems: pollution and conservation

Context

This lesson was prepared for an eighth-grade class of 33 students. Eight members of the class were native speaker of English; five others had been in Canada for several years. Twenty-two students were English language learns at varying stages of proficiency. They spoke Spanish, Tagalog, Korean and Arabic. Several students had arrived within the last month, others over the last two or three years.

Standards and Objectives

- Examine how humans use resources from the Earth's different water systems and identify the factors involved in managing these resources for sustainability. The Ontario Curriculum: Science and Technology. Earth and Space Systems: Grade 8 –Water Systems. Ministry of Education and Training.
- Participate in social and academic discussions using short phrases and short sentences. (Stage 2) *The Ontario Curriculum: English as a Second Language and English Literacy Development. A Resource Guide 2001.*
- Make notes in some detail on familiar topics (Stage 3) *The Ontario Curriculum: English as a Second Language and English Literacy Development. A Resource Guide. 2001.*

Background

This is an early lesson in a unit on water systems. The students have just completed an interview with an adult using questions such as these: "When you were young, where did your water supply come from? How did the water come to your house? How did your family make sure your drinking water was safe? How did your family conserve water? How did weather affect the water supply? How was

wastewater dealt with? What responsibility did the local government have in regulating water supplies?"

Students have been instructed to bring notes in their native language or English.

Materials

Chart paper	magic markers
Paper for making posters	colored pencils, pastels

Activities

Engagement

Check the notes students have taken on their interviews and then ask them to do a prediction exercise. Distribute a sheet with five questions, such as:

How many of us do you think interviewed?:

	Predictions	Number of Interviews
a person over 60 years old		
someone who got water from a well		
someone who often swam in a river		
someone who sometimes boiled water		
someone who got water from a lake		

First, have students predict how frequently they think each of these interviews would occur. Ask students to raise their hands so the class can compare their estimates with the actual figures.

Exploration

Divide students into groups of four students. Have them first talk about interesting facts they discovered during their interviews. Listen carefully and note examples of pollution and conservation.

Explanation

Use the examples you have noted to introduce the terms *pollution* and *conservation*. Two topics to explore are the effects of too much rain and of the expansion of deserts. In this group, students from Egypt were familiar with the gradual expansion of the Sahara desert and the Filipino students with how flooding contaminates water systems.

Distribute chart paper and markers. Ask each group to use the information from their interviews to complete a chart with examples to support each of these statements:

- Water can be conserved in a number of ways.
- Water pollution has a number of causes.

Elaboration

Have students work in pairs to make a poster about water sustainability using the ideas they have generated. Each poster must have a title, an important fact and an illustration.

Evaluation

As students finish their posters, select two or three students to tape the completed work in the hallway, group similar themes together.

Finish the class with a gallery walk during which students walk around the room and look at the poster. They can complete a chart with questions like these:

- How many posters show the same strategies for conserving water and curbing pollution as your group identified?
- List ideas which are different from yours.
- In what way do you think you waste water? How can you change that?

In a gallery walk, students circulate in groups to view and discuss work. Give each group a set amount of time for each theme, and have them rotate clockwise.

For homework, have students use the charts to write a short paragraph using the points developed in their charts as examples to support the statements used as topic sentences.

In cooperation with their ESL teachers, some of the students will use the information gathered in their interviews for a writing exercise. A useful model could be a UNICEF publication, "A Life Like Mine: How Children Live Around the World." 2002. Dorling Kindersley Publishing, London.

Summary

This lesson is an example of how English learners can use knowledge about their community to gain a broader perspective in an integrated classroom

RESOURCES

Articles on Science Education and ELLs

Karen A Carrier, "Supporting Science Learning through Science Literacy Objectives for English Learners" *Science Activities;* Vol. 42, No. 2; Summer 2005. Pages 5-11.

This article explores how having science teachers write science literacy objectives helps ELL students develop literacy in science.

Lola Berber-Jiménez, Jose Montelongo, Anita C Hernandez, Roberta Herter, David Hosking. "Helping Students Write Better Conclusions, *The Science Teacher:* Vol. 75, No. 3, March 2008, pages 56-61.

The authors describe how to use sentence completion tasks to teach students how to write conclusions in lab reports. This writing helps students learn the language of science.

Greg Corder, "Supporting English Language Learners' Reading in the Science Classroom" Science Scope; Vol. 31, No. 1; September 2007. Pages 38-41.

This article describes a number of specific techniques to support the development of reading skills in ELL students.

Kimberly Gomez and Christina Madda, "Vocabulary Instruction for ELL Latino Students in the Middle School Science Classroom**"** *Voices From the Middle:* Vol. 13, No. 1, September 2005. Pages 42-47.

This article looks at the strategies used by one reflective science teacher of ELLs to examine how purposeful design of lessons to support ELLs impacts their learning in science.

Alicia M. Honnert and Sarah E. Bozan, "Summary Frames: Language Acquisition for Special Education and ELL Students" *Science Activities*: Vol. 42, No. 2, Pages 19-29.

This article discusses how teaching summarization as a reading strategy increases students' abilities to acquire and use information and to better comprehend science concepts.

Suzanne Keenan, "Reaching English Language Learners: Strategies for Teaching Science in Diverse Classrooms" *Science and Children:* Vol. 42, No. 2, Pages 49-51.

This paper focuses on specific methods and strategies that enhance the teaching of science to ELL students.

Felicia Lincoln and Caroline Beller, "English Language Learners in the Science Classroom" *Science Scope; Vol. 28 No. 1, September 2004. Pages 28-31.*

The authors delineate teaching strategies for differentiating instruction for ELL students in science classes.

Websites

Language Professional Organizations and Resources

Teachers of English to Speakers of Other Languages
www.tesol.org/s_tesol/index.asp

National Association of Bilingual Education
www.nabe.org

National Association of Applied Linguistics (AAAL)
www.aaal.org

International Reading Association (IRA)
www.reading.org

National Council of Teachers of English (NCTE)
www.ncte.org

Center for Applied Linguistics
www.cal.org

National Clearinghouse for English Language Acquisition
www.ncela.gwaa.edu

U.S. Department of Education's Office of English Language Acquisition Enhancement, and Academic Achievement for Limited English Proficient Students (OELA)
www.ed.gov/about/offices/list/oela/index.html

Online Directory of ESL Resources
www.cal.org/resources/update.html

Center for Research on Education, Diversity & Excellence Publications and Products
www.cal.org/crede/pubs

CREDE's Five Standards of Effective Pedagogy
www.crede.org/standards/standads.html

Sheltered Instruction Observation Protocol Web Site
www.siopinstitute.net

Center for Equity and Excellence in Education Test Database
http://ceee.gwu.edu/standards_assessments/EAC/HOME/htm

National Center for Research on Evaluation and Testing (CRESST)
www.cresst.org.index5htm

National Literacy Panel on Language Minority Children and Youth (NLP)
www.ed.gov/offices/ORI/AtRisk/nlp.html

Science Education Professional Organizations and Resources

Association of Presidential Awardees in Science Teaching (APAST)
http://apast.enc.org/index2htm

Association of Science Materials Centers (ASMC)
www.kitsupport.org

Association for Multicultural Science Education (AMSE)
http://amse,edhost.org

Association for Science Teacher Education (ASTE) Formerly, The Association for the Education of Teachers of Science (AETS):
http://theaste.org

Council for Elementary Science Education International (CESI)
http://unr.edu/homepage/crowther/cesi.html and http://CESIscience.org

Council of State Science Supervisors (CSSS)
http://csss.emc.org

National Association for Research in Science Teaching (NARST)
www.educ.sfu.ca:16080/narstsite

National Marine Educators Association (NMEA)
www.marine-ed.org

National Middle Level Science Teachers' Association (NMLSTA)
www.nmlsta.org

National Science Education Leadership Association (NSTA)
www.nsta.org

School Science and Mathematics Association (SSMA)
www.ssma.org

Science Education for Students with Disabilities (SESD)
www.sesd.info

Society for College Science Teachers (SCST)
www.scst.suu.edu

Source

Anne K. Fathman and David T. Crowther, ed., *Science for English Language Learners: K-12 Classroom Strategies,* NSTA press, 2006.