Academic Uses of English: A Focus on Science

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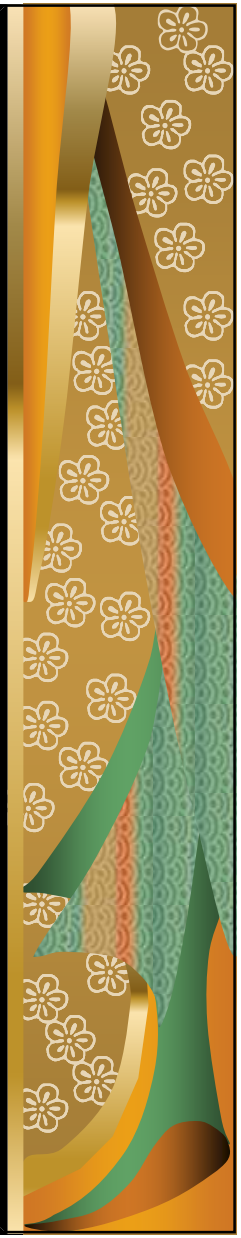
The Challenge

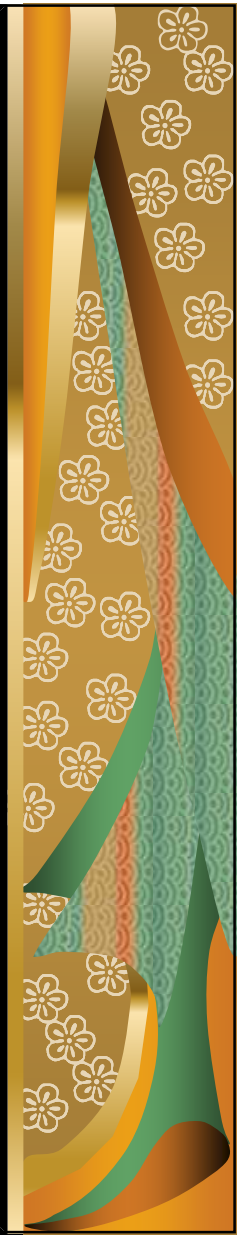
- Persistent gap in academic achievement between Caucasian students and those from culturally and linguistically diverse groups:
  - Many teachers are underprepared to make content comprehensible for ELLs.
  - Few teachers trained to teach initial literacy or content-area literacy to secondary ELLs.
  - ELLs are tested in mathematics and reading under No Child Left Behind; and in 2007-08, **tests in science** have been added to the battery of assessments they must take.

- Most ELLs need 4-7 years to learn English before they reach average academic performance levels.
- As ELLs, they are by definition not proficient
- But they are tested before they are proficient in English.

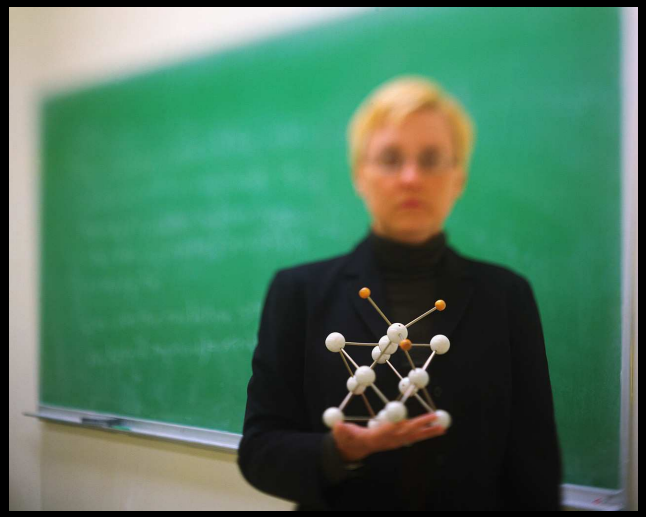


What Do Teachers Need To Help Close the Gap?

- Teachers need to incorporate both language and content objectives into their ESL and science lessons to promote academic literacy.
- Teachers need instructional strategies that can reduce the achievement gap between ELLs and native English-speaking students.



What is Sheltered Instruction?

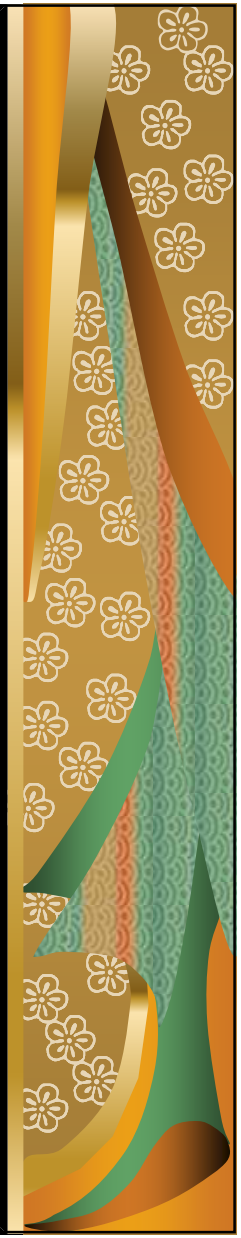


A means for making grade-level academic content (e.g., science, social studies, math) more accessible for English language learners while at the same time promoting their English language development.

Echevarria, J., Vogt, M.E., & Short, D. (2008). *Making content comprehensible to English learners: The SIOP model.* Boston: Pearson/Allyn and Bacon.

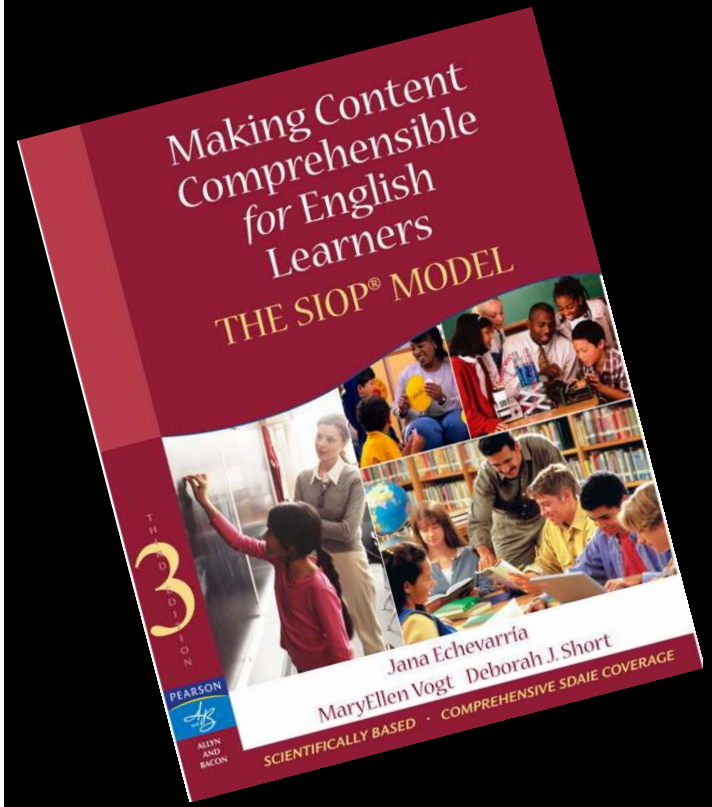
The Effects of Sheltered Instruction on the Achievement of LEP Students

- CREDE (Center for Research on Education, Diversity & Excellence)
- 7-year research study (1996-2003), funded by the US Dept. of Education
- Teacher-researcher collaboration for SIOP model development
- Field-testing of professional development model



The SIOP Model

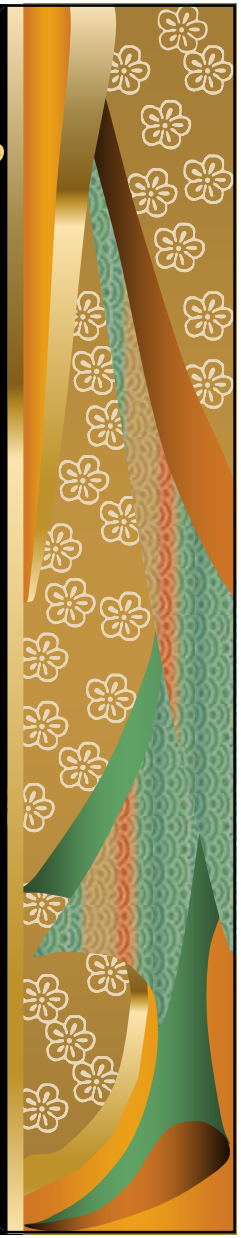
(Echevarria, Vogt, & Short, 2008)



- Preparation
- Building Background
- Comprehensible Input
- Strategies
- Interaction
- Practice & Application
- Lesson Delivery
- Review & Assessment

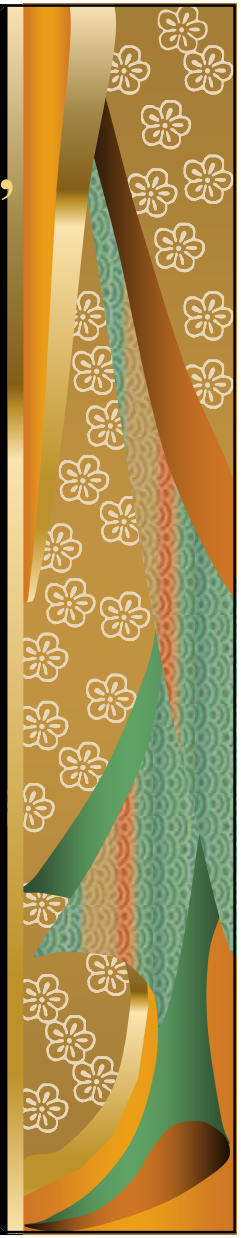
The SIOP Model (Echevarria, Vogt, & Short, 2004, 2008)

- **Preparation** – language and content objectives
- **Building Background** – vocabulary development, student connections
- **Comprehensible Input** – ESL techniques
- **Strategies** – metacognitive and cognitive strategies



The SIOP Model (Echevarria, Vogt, & Short, 2004, 2008)

- **Interaction** – oral language
- **Practice & Application** – practice all 4 language skills
- **Lesson Delivery** – meet objectives
- **Review & Assessment** – review vocabulary and concepts

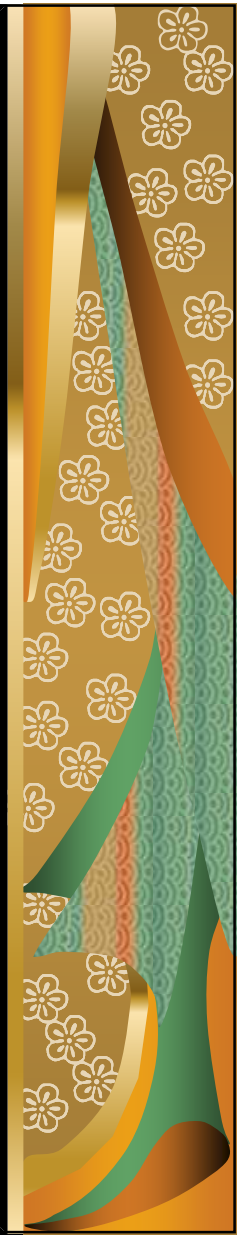


The SIOP Model

- Shares many features recommended for high quality instruction for all students, such as:
  - cooperative learning
  - strategies for reading comprehension
  - emphasis on the writing process
  - differentiated instruction.
- Accommodates the distinct second language development needs of ELLs.

The SIOP Model

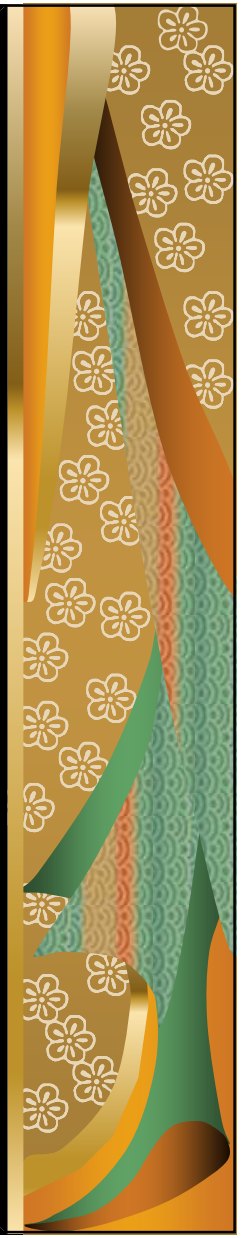
- Contains key features for the academic success of ELLs, such as the:
  - inclusion of language objectives in every lesson
  - development of background knowledge
  - acquisition of content-related vocabulary
  - emphasis on academic literacy practice.
- Allows for some variation in classroom implementation.



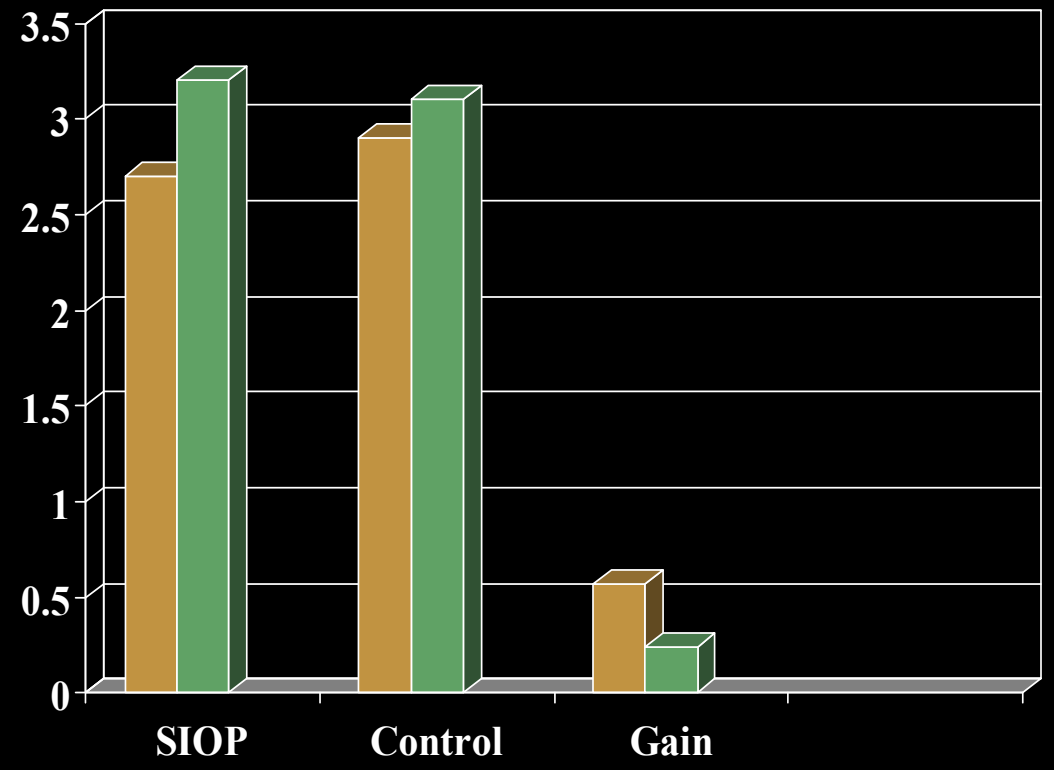
Major Research Finding

- 1998-99: Using a prompt requiring *expository writing,* ELLs in classes with SIOP-trained teachers outperformed and made greater overall gains on the IMAGE test* than ELLs in classes with non-SIOP-trained sheltered teachers (Echevarria, Short, & Powers, 2006).

* Illinois Measure of Annual Growth in English



1998-99 Pre/Post Writing Skills Scores on the IMAGE Test

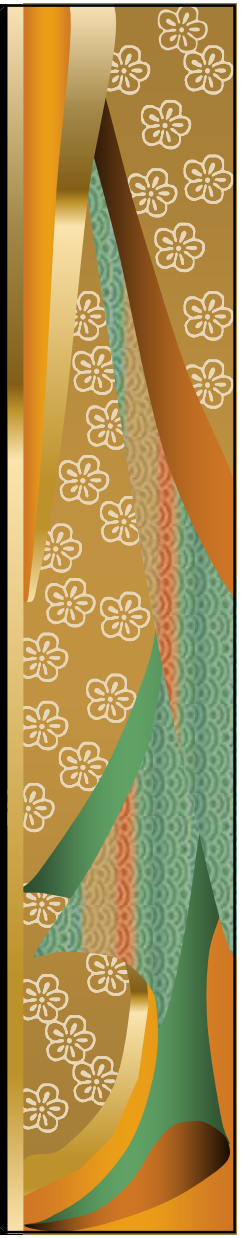


SIOP Research Reference

CREATE
Center for Research on the Educational Achievement and Teaching of English Language Learners

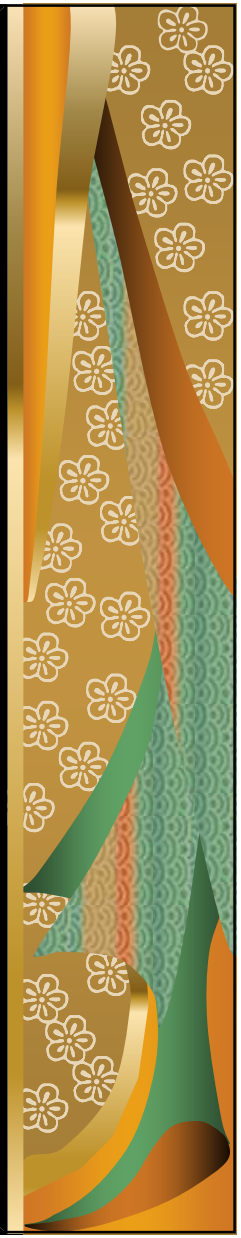
SIOP Science Research Project

The Impact of the SIOP Model on Middle School Science and Language Learning



The Impact of the SIOP Model on Middle School Science and Language Learning

- A 5-year study (2005-2010) conducted by Center for Applied Linguistics, California State University, Long Beach, and University of Houston supported by IES, U.S. Dept. of Ed.
- Uses a randomized experimental design to investigate the impact of the SIOP Model on student academic achievement in middle school science.
- SIOP professional development, lesson plans, and science language assessments.



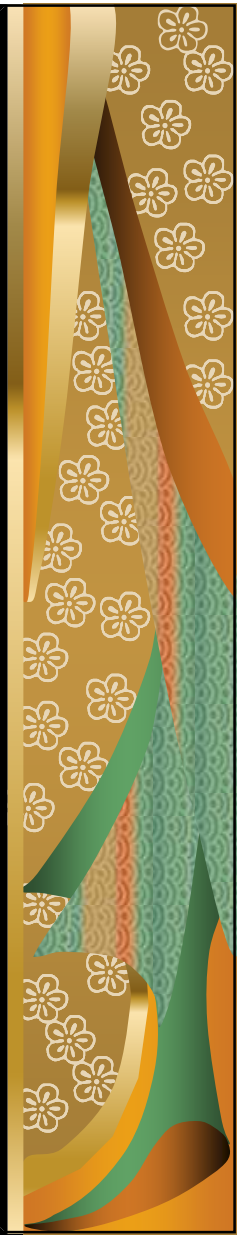
Research Questions

1. What are the effects of the SIOP Model of sheltered instruction on academic language and concept comprehension among English language learners in middle school science classrooms?

2. What are the effects of an integrated SIOP Model of sheltered instruction on academic language and concept comprehension among English language learners in middle school science classrooms?

Hypotheses

- Students of teachers trained in the SIOP Model will outperform students of teachers not trained in the model on measures of Grade 7 science content and scientific language.
- Teachers who receive SIOP training in the model plus project-developed SIOP science curriculum units will implement the model to a higher degree than teachers who receive training alone.
- The students of teachers with SIOP training + SIOP science lessons will perform better than students of teachers with training alone.



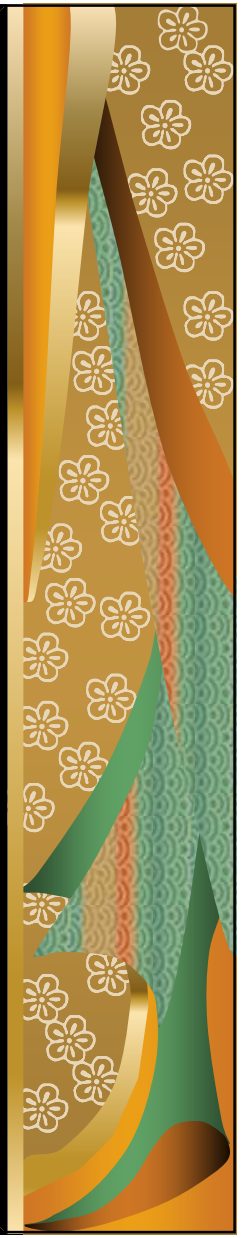
CREATE SIOP Science Study

Year 1: Pilot study

- Approximately 120 students participated in two districts, Arlington, Virginia and Long Beach, California.
- Pilot designed to:
  1) develop and refine Grade 7 science curriculum lessons that incorporate the SIOP Model features, and
  2) field-test academic science language assessments.

Science Language and Literacy Skills in SIOP Lessons

- Preview, scan, and identify the main ideas in reading passages
- Identify unknown vocabulary words important to understanding a passage
- Define and correctly use new science vocabulary
- Classify or categorize concepts and terms
- Form and write a hypothesis
- Describe and sequence steps in a process
- Summarize findings orally or in writing



Biome Lesson 1

SIOP LESSON PLAN

SUBJECT: Life Science
UNIT FOCUS: Biome

Lesson # 1 **Length of lesson 1 day**

STANDARD(S): Virginia Standards of Learning. Life Science **10)** The students will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem.

LESSON TOPIC: Living Things and the Environment

OBJECTIVES: *write on board*

Language Students will

- Define new vocabulary visually and in writing

Content Students will

- Identify and categorize the biotic and abiotic factors in an ecosystem
- Compare and contrast ecosystems, populations, and communities
- Investigate how an organism's habitat is affected by abiotic and biotic factors

KEY VOCABULARY: ecosystem, biotic factors, abiotic factors

MATERIALS: index cards, poster paper

PREPARATION:

1) Post four pieces of poster paper in the corners of the room. Label **hot**, **cold**, **dry**, and **wet**.
2) Ask students to bring in, or have, index cards to make vocabulary cards for each of the key vocabulary terms

MOTIVATION:

**Post, read, and explain the content and language objectives of this lesson to the students.
"Let's look at our language objectives for today. Students will (read language objectives above). Now let's look at our content objectives for today. Students will (read content objectives above)" Explain the objectives.

Warm Up/Building Background (15 minutes)

- Tell the students to choose a corner and list things found in those environments on the poster paper. Then ask the groups to categorize the things as living or non-living (students could do this by highlighting living things with one color and nonliving things with a different color). Groups select a presenter and that student shares the group's poster. Expand the topic by asking the groups to think and discuss the following questions:
  - What are some areas or regions (in the U.S. or elsewhere) with these characteristics? Have you ever lived in one of these areas?
  - What do these environments have in common? What environments are the most different? Explain.
  - What are some ways you adapt to your environment (jump in the pool when it is hot, turn on the heat in the winter, etc.)
  - What environment is the best to live in? How did you come to this decision?

  Ask groups to share their responses with the whole class and record some of the answers for the class to see.
- Tell the students we are going to learn two new words for "living" and "non-living" today. Introduce *biotic* and *abiotic*.
- Explain, "With each of our key vocabulary words for this chapter, we will be making vocabulary cards that will help us study." Model a vocabulary card--write the word on the front side, write a definition in your own words, draw a picture, and use the word in a sentence on the back. Students develop a vocabulary card for *biotic* and *abiotic*. Write the new words on the board or add to a Word Wall.

PRESENTATION: (10 minutes)

- Read the introductory passage on pp. 16-17 to the students. Check for comprehension throughout and discuss any unknown words.

PRACTICE/APPLICATION (10 minutes)

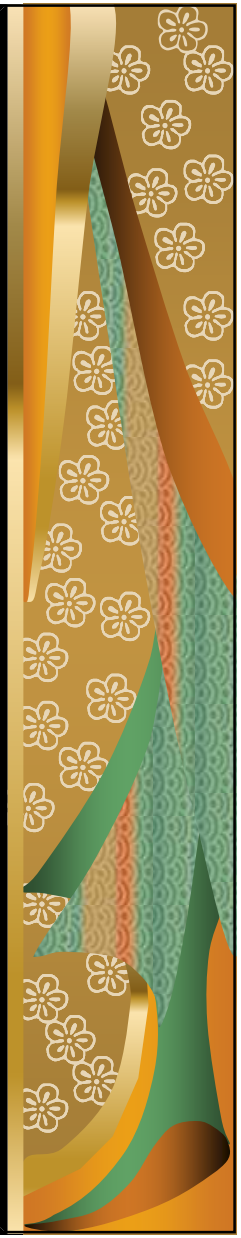
- Emphasize that all the biotic and abiotic factors that interact in an area form an ecosystem and ask the students to help you make a word web for ecosystem (you may want to help the students get started by asking questions like, "Ok, what was the name of the ecosystem of these prairie dogs?" and "What is the name of the ecosystem where we live?"). Leave the web on the board or overhead for the students to refer to later in the lesson.
- Develop vocabulary card for *ecosystem*. Write the new word on the board or add to a Word Wall.

REVIEW/ASSESSMENT: (5 minutes)

- Students write two things they learned in the lesson and one question they still have on the Exit Sheet for today's lesson.
- Review objectives. "Let's see if we met our language objectives for today. Students will (read language objectives above). Now let's see if we met our content objectives for today. Students will (read content objectives above)." Discuss if met or not and why/how.

Science Language Assessments

- Aligned to national science and TESOL standards.
- Test items informed by the World-class Instructional Design and Assessment (WIDA) English Language Proficiency *Access for ELLs*® test.
- Test tasks adapted from research by the National Center for Research on Evaluation, Standards, and Student Testing (CRESST).



Key Features of Science Language Assessments

- Assessment of reading and writing ability
- Graphic support and bolded key words
- Text elaboration and simplification
- Items range in levels of difficulty
- Short and extended written responses
- Knowledge of the language of science necessary to answer test items

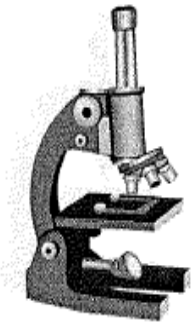
Cell Structure and Function

Part I. Read the passage below and then answer the questions.

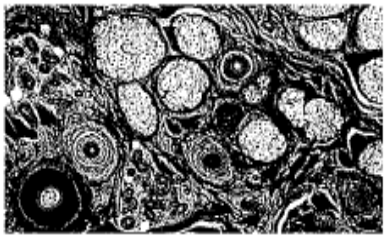
Cells are the basic units of structure and function in living things. We know about them because after the **microscope** was invented in 1590, scientists could see cells. **Cell theory** explains the relationship between cells and living things. Cell theory tells us the following:

a) All living things are made of cells.
b) Cells are the basic unit of structure and function in living things.
c) All cells are produced from other cells.

Cell theory applies to all living things, from the simplest to the most complex organism.



Microscope

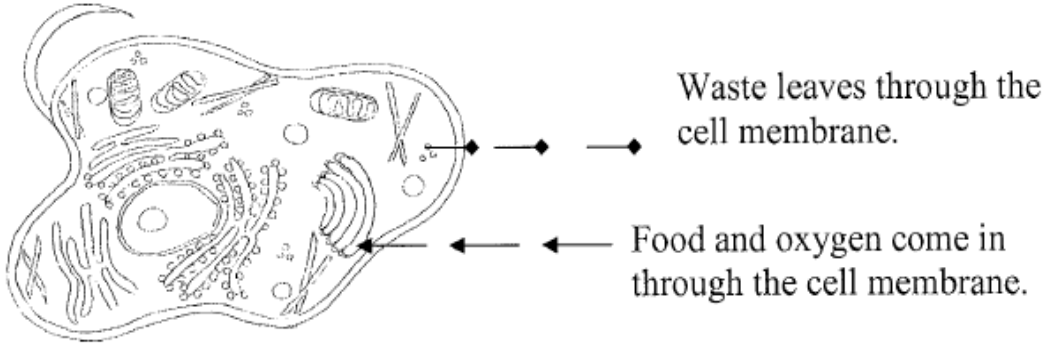


Skin Cells

(Source: http://www.dorlingkindersley-uk.co.uk/static/cs/uk/11/clipart/humanbody/img/image_body004.jpg)
(Source: http://www.celltechpersonalcare.com/skintelligence/skin_health.jsp)

Animal cells have many parts with different jobs. The most important part of an animal cell is the **nucleus**. It acts as a cell's 'brain' or 'control center,' because the nucleus directs all of the cell's activities. The nucleus is surrounded by a **nuclear membrane**. The nuclear membrane has many pores, which are tiny openings. The membrane protects the nucleus by allowing only certain materials to pass in and out through the pores. **Chromatin** are inside the nucleus. They are strands of genetic material that contain the instructions to direct the functions of a cell. The nucleus also contains the **nucleolus**. The nucleolus produces **ribosomes**.

Another part of an animal cell is the **cell membrane**. It surrounds an animal cell. The membrane also has many pores to control what passes in and out of the cell. The cell membrane lets **oxygen** and food into the cell and lets harmful waste products out.



Cell Membrane at Work

(Source: http://www.biologycorner.com)

II. Match the organelles with their functions. Write the letter of the organelle next to its function.

A. Endoplasmic Reticulum
B. Vacuoles
C. Nuclear membrane
D. Lysosomes
E. Golgi bodies

____ They receive, put together, and distribute materials within the cell.

____ They stock food, water, and waste products.

____ They break down food, recycle waste, and old cell parts.

____ They transport materials within the cell.

III. Complete each sentence with one of the words in the list. Use each word only once.

nucleus	cell membrane	chromatin
mitochondria	nucleolus	ribosomes

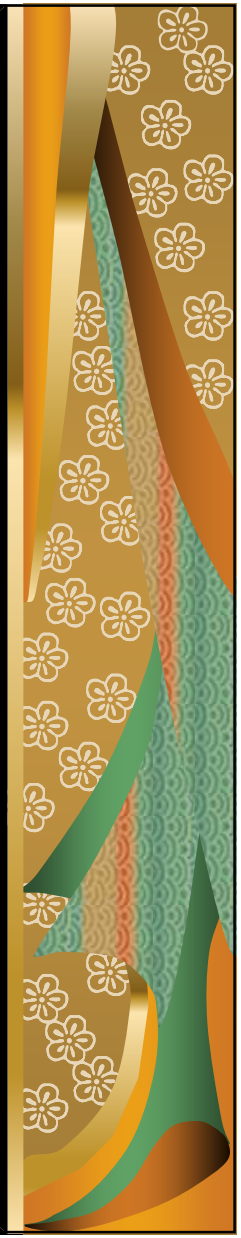
1. The _____ is the part in the nucleus where proteins are produced.
2. The _____ controls all the activities of the cell.
3. _____ produce most of the cell's energy.

VIII. Write an answer to the following question.

Mark has blue eyes, but both his biological parents have brown eyes. Based on all the information you read about genetics, explain how this can happen. Write as much as you can. Use scientific terms.

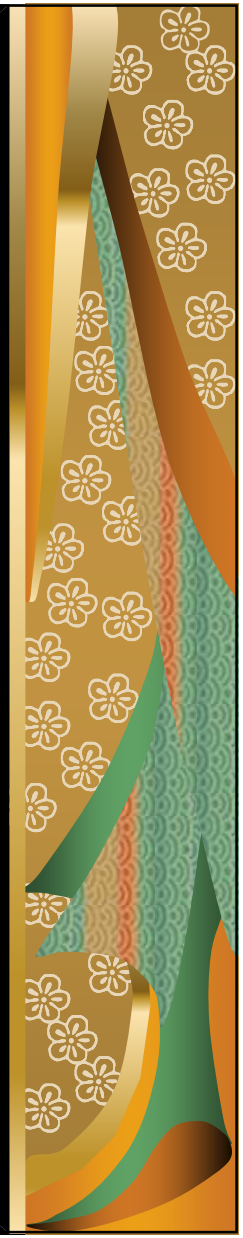
Writing Rubric - IMAGE

- A five point scale that assesses student writing in five categories:
  - language production
  - focus
  - support/elaboration
  - organization
  - mechanics
- Inter-rater reliability established between 2 raters.



Year 2 SIOP Science Study

- Experimental Design
- 8 Middle Schools
  - 5 SIOP
  - 3 comparison
- 7th grade science classes
- SIOP teachers received 2 ½ day training and lesson plans for 4 units
- Students were administered pre and post assessments

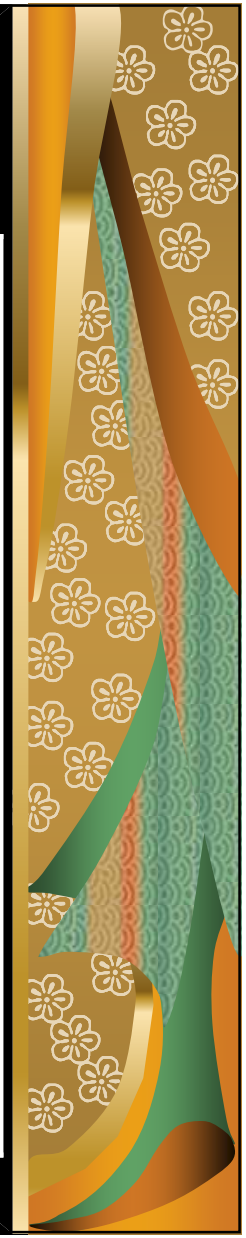


Project Activities

- Develop SIOP science units for Grade 7 (Cell Structure/Function, Cell Division, Photosynthesis/Respiration, and Genetics)
- Develop science language assessments
- Train intervention teachers
- Provide coaching to intervention teachers
- Compare data with control teachers

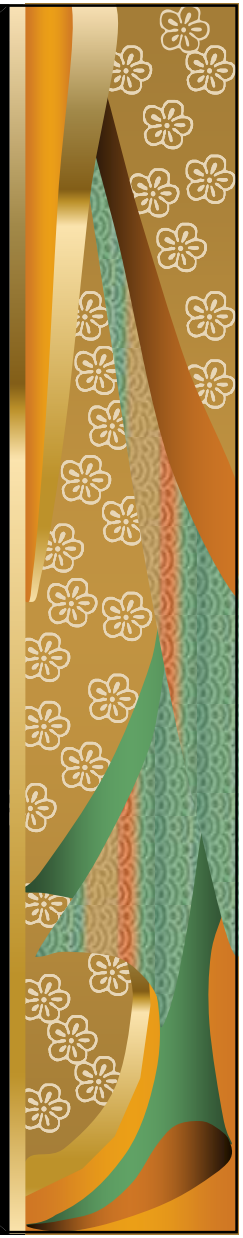
Year 2 Student Participants

	SIOP Classes	Control Classes	Totals
ELL	105	112	217
FEP (≤ 3 years)	212	121	333
FEP (> 3 years)	89	20	119
English only	243	109	352
Totals	649	372	1021



Preliminary Results (without essays)

- For 3 of the 4 measures students in SIOP group significantly out-performed students in comparison group (Photosynthesis mean score for both pre and post for both groups was very low.)
  - Differences among designated group
    - On two of the measure specifically the students in the FEP groups outperformed the students in the other groups within the SIOP group



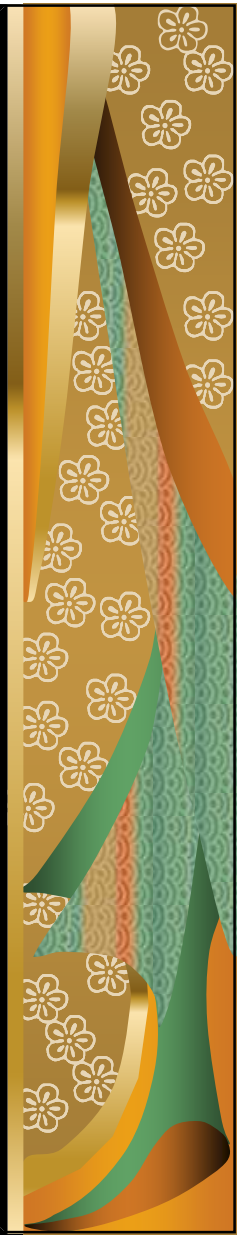
Year 3

- 12 schools will participate as Treatment 1, Treatment 2, or Control sites.

  - Treatment 1 teachers will receive SIOP training, SIOP lessons, and coaching.

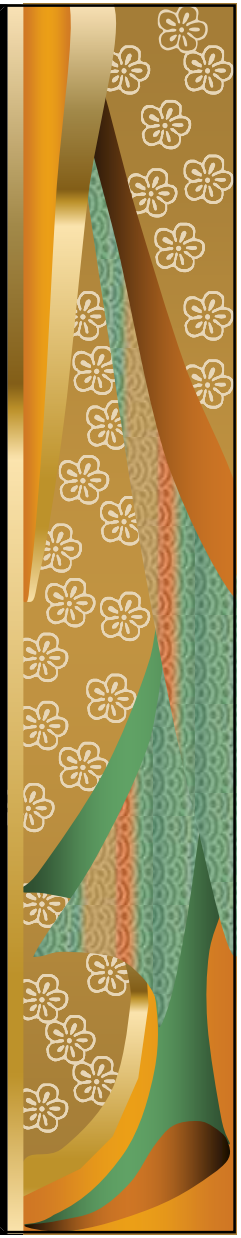
  - Treatment 2 teachers will receive SIOP training and coaching.

- Control teachers conduct business as usual with data collection.



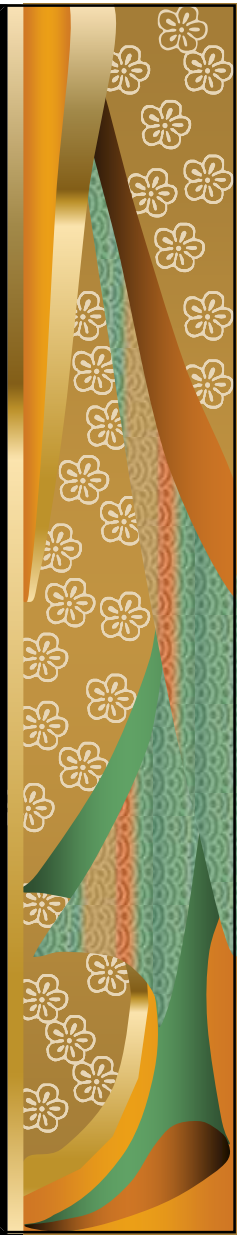
Years 4-5

- Data gathered from Years 1-3 will be combined with the research findings from other CREATE research studies and will tested as a school reform intervention for ELLs.



Summary: What Teachers Can Do

- Develop knowledge of scientific terms and other academic vocabulary
- Build and activate background, being sensitive to different cultural beliefs and ways of knowing
- Promote academic discussion in class
- Teach comprehension strategies for expository text
- Engage students in scientific writing
- Assess both science language and content knowledge



For more information

On the SIOP Model, see www.cal.org/siop and www.siopinstitute.net

On the SIOP science research project, see www.cal.org/projects/create.html