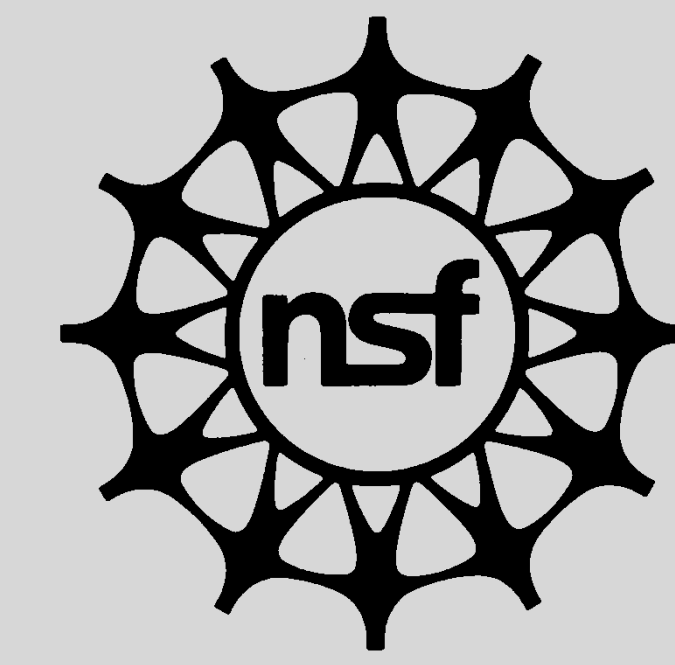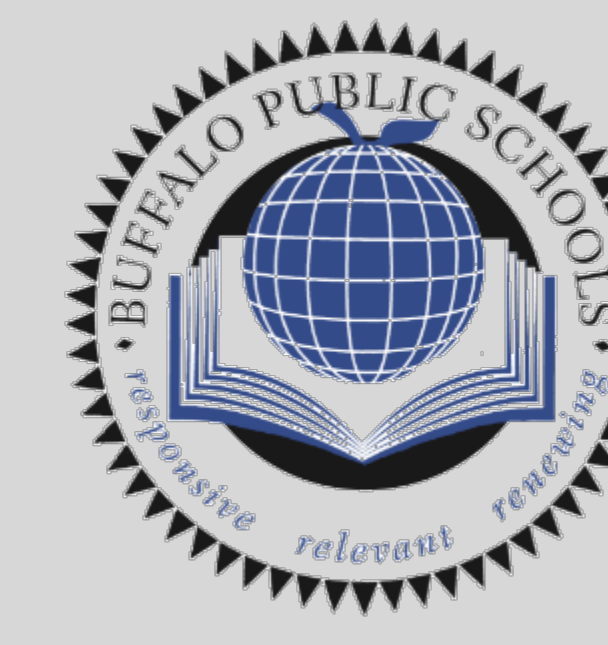# Considerations for ELLs in the STEM Classroom
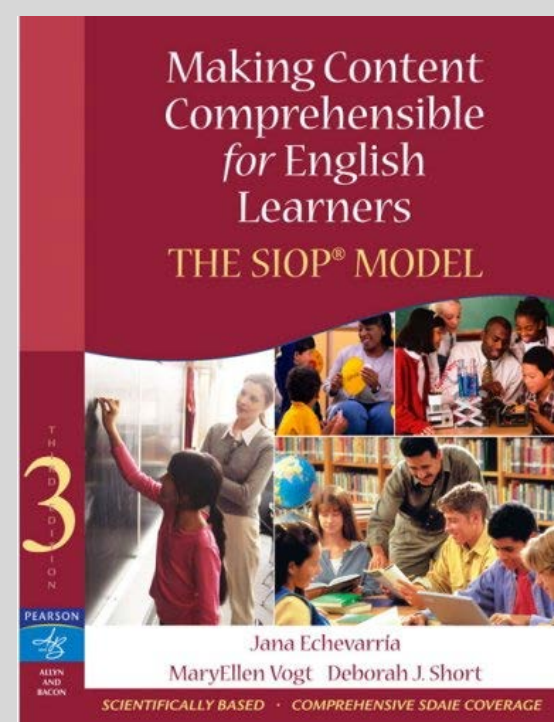
Lindsay Crimmins - Christina Contento – Kara Capozzi

Research Proposal

Our research and curriculum planning team created, adapted, and modified K-12 science units with special consideration for English language learners.

Our curriculum attempted to bridge the gap between content and language instruction using "Best Practices" when teaching ELLs, incorporating hands on materials, emphasizing vocabulary, reading and writing daily, focusing on oral language production, and incorporating technology when possible.

Making Content Comprehensible for English Learners THE SIOP MODEL
Jana Echevarria, MaryEllen Vogt, Deborah J. Short

ELL Instructional Strategies

Flexible & Responsive Instruction
- Ask these questions while planning instruction

Select/create accommodations/differentiation activities/practices/strategies.

Content
How will you vary what students will learn and the materials that represent the content?

Process
How will you vary activities through which students make sense of key ideas using essential skills?

Product
How will you vary the way students demonstrate and extend what they understand and can do as a result of a span of learning?

Learning Environment
How will you vary the classroom conditions that set the climate, expectations for learning, and physical conditions?

Select/create corrective and enrichment activities/practices/strategies.

Correctives	Enrichments/Extensions
• re-teaching	• tutoring peers
• alternative textbooks	• developing practice exercises
• alternative materials	• developing related media materials
• workbooks and study guides	• completing special projects and experiments
• academic games	• developing games, problems, and contests
• learning kits	• using advanced computer-assisted/web-based lessons
• cooperative groups/teams	• locating background materials for future or current topics
• peer and individual tutoring	• developing additional formative assessments
• learning centers and laboratories	• planning to teach a mini-unit
• technology-assisted instruction (e.g., Podcasts, internet applications, video)	• creating bulletin boards and displays
	• applying knowledge to a new situation

SENTENCE STEMS
Sentence stems, such as "I think…" or "Today I learned…," support students as they write expository text and use content-area vocabulary from the word wall or word chart. These stems provide support without dictating student writing and allow for the development of student voice in science writing, which promotes ownership of the material.

LABELING DIAGRAMS AND ILLUSTRATIONS
As students add diagrams and illustrations to their science notebooks, they should be encouraged to label each one with correct scientific vocabulary, using the word wall or word chart as a reference. Doing so provides another opportunity to build relational and contextual knowledge of the words, and creates nonlinguistic representations – a research-based strategy. When these strategies are incorporated into a hands-on, inquiry-based science unit, they will promote rich, contextual vocabulary development – not just among English language learners but among all students.

Plants & Living Environment Relationships

The following unit plan for plants and living environment relationships is designed for elementary level students. The following instructional practices and leveled learning tasks are used to encourage and promote the academic vocabulary across grade levels and learning content.

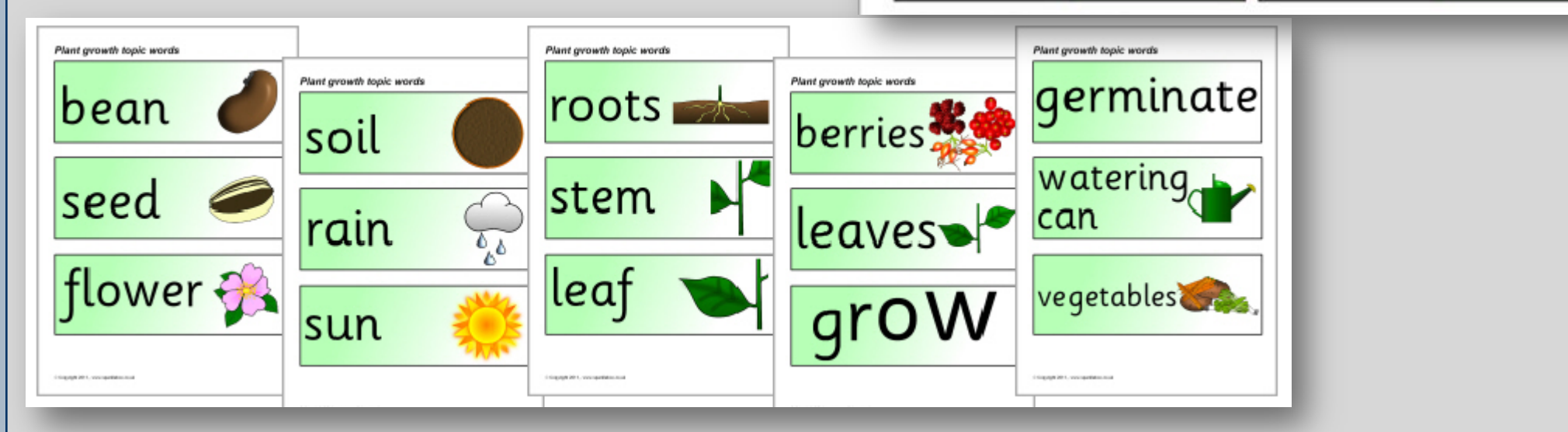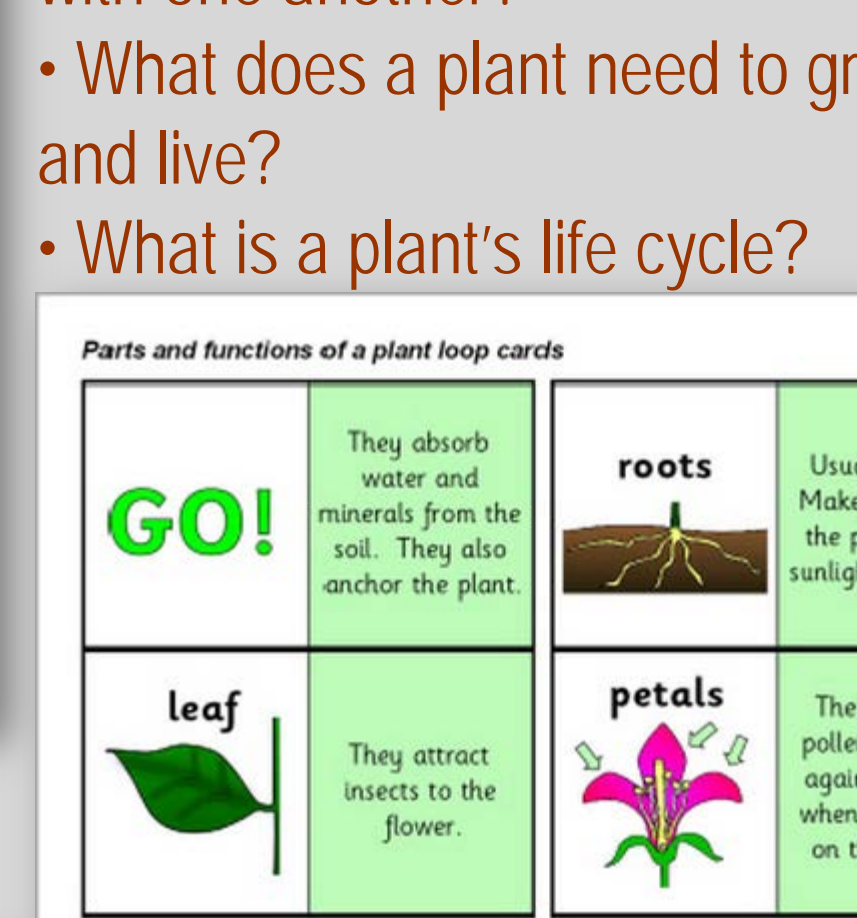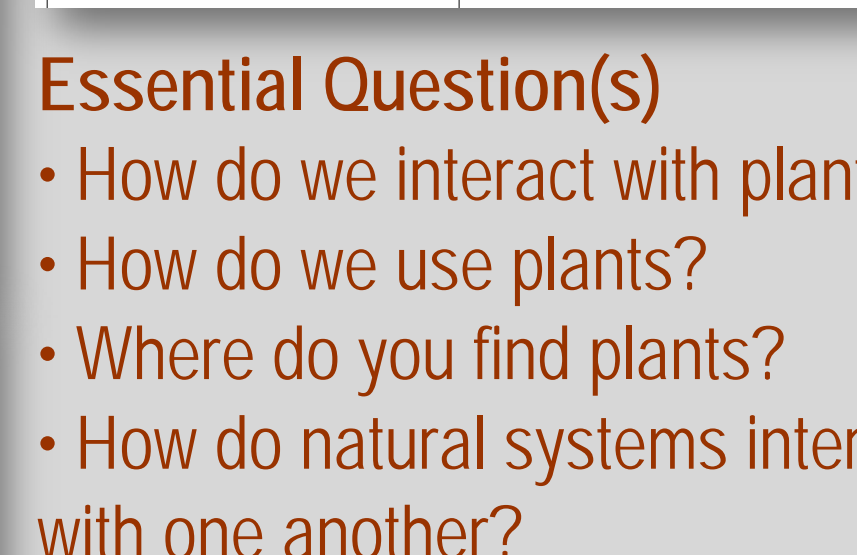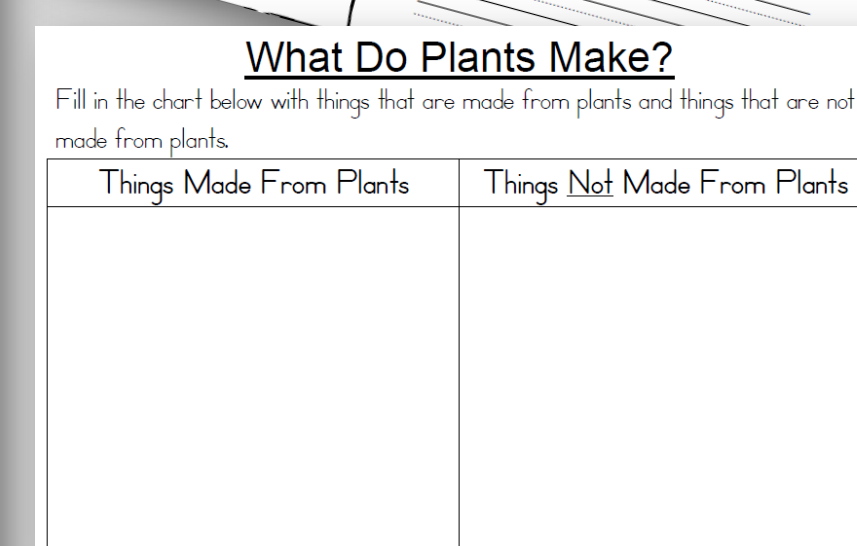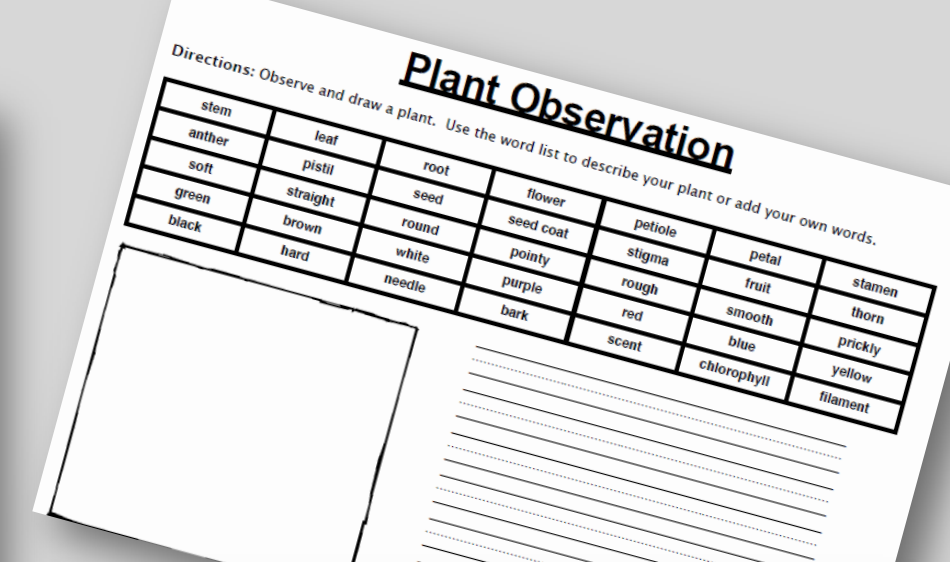Language and content objectives within this unit include:

- Define and use unit vocabulary.
- Identify and use science equipment.
- Match pictures to science vocabulary terms.
- Interpreting charts, and graphs.
- Participate in group discussion.
- Summarize/paraphrase was is heard, read, and viewed.
- Restate and carry out multi-step oral instructions.
- Interact with partners and small groups about content and skills.
- Ask relevant questions.

Unit Components

- High focus on vocabulary instruction through visuals
- Lessons and experiments based on questions from life experiences
- Planned activities to engage and encourage use of academic language within the classroom in all four modalities

Science Tools & Process (Ongoing - Weekly)

Unit Vocabulary/ Concepts/Topics

[K] Science Process Skills
experiment, investigate, measure, observe, procedure, scientist
[K] Measurements & Tools
estimate, explore, measure*, ruler
[K] Living Environment
plants, grow, different, same, water, sun, flower
[1] Science Process Skills
experiment*, investigate*, measure*, observe*, procedure*, scientist*, predict, record, compare
[1] Measurements & Tools
estimate*, explore*, measure*, ruler*, graduated cylinder, hand lens
[1] Living Environment
plants*, living*, grow*, different*, water*, sun*, flower*, roots, stem, seed, similar, soil, living, nonliving, forest, air, size, shape, sand, rock, mixture, life cycle
[2] Science Process Skills
experiment*, investigate*, measure*, observe*, procedure*, scientist*, predict*, record*, compare*, changes
[2] Measurements & Tools
estimate*, explore*, measure*, ruler*, graduated cylinder*, hand lens*
[2] Living Environment
plants*, living*, grow*, different*, water*, sun*, similar*, soil*, living*, nonliving*, forest*, air*, size*, shape*, sand* rock*, mixture*, life cycle*, precipitation, absorb
[3] Science Process Skills
experiment*, investigate*, measure*, observe*, procedure*, scientist*, predict*, record*, compare*, changes*, purpose, conclusion
[3] Measurements & Tools
estimate*, explore*, measure*, ruler*, graduated cylinder*, hand lens*
[3] Living Environment
plants*, living*, grow*, different*, water*, sun*, similar*, soil*, living*, nonliving*, forest*, air*, size*, shape*, sand*, rock*, mixture*, life cycle*, precipitation*, absorb*, pollen, pollination, desert, rainforest

Plant Observation

What Do Plants Make?
Fill in the chart below with things that are made from plants and things that are not made from plants.

Things Made From Plants	Things Not Made From Plants

Essential Question(s)
- How do we interact with plants?
- How do we use plants?
- Where do you find plants?
- How do natural systems interact with one another?
- What does a plant need to grow and live?
- What is a plant's life cycle?

Parts and functions of a plant loop cards

GO! — roots — Usually green. Makes food for the plant from sunlight and CO2
leaf — petals — They release pollen to brush against insects when they land on the flower.
They absorb water and minerals from the soil. They also anchor the plant.
They attract insects to the flower.

bean — soil — roots — berries — germinate
seed — rain — stem — leaves — watering can
flower — sun — leaf — vegetables — grOW

Diffusion & Osmosis Unit – High School

The following unit plan for diffusion and osmosis is for a high school Biology classroom. The following instructional techniques are utilized to promote a high level of academic language acquisition while learning content.

- Language and content objectives for each lesson

Content Objective: SWBAT compare and contrast the properties of the cell membrane by completing an experiment with bubbles.
Language Objective: SWBAT talk and write about the cell membrane by using the sentence starters The cell membrane is similar to the bubble because… and The cell membrane is different from the bubble because…

Content Objective: SWBAT explain the difference between active and passive transportation
Language Objective: SWBAT write 3 complete sentences to describe cellular transportation using the frame. "This is _____ transportation. The _____ is moving from _____ concentration to _____ concentration. This needs / does not need _____"

- Non-linguistic representation of information

Directions: Draw your own cell and materials moving into the cell using active transport
Step 1: Make a key. What material is moving into or out of the cell?
Step 2: Draw the materials inside and outside of the cell.
Step 3: Draw an arrow (→) to show a material moving because of active transport
Step 4: Write two sentences to explain your picture

Active Transport
Key

Lab Report Questions
5. Draw a picture of the gummy from yesterday in water and after adding distilled water and salt water.

Cup 1 — Before (Yesterday) — After Distilled Water (Today)
Cup 2 — Before (Yesterday) — After Salt Water (Today)
Volume: Volume: Volume: Volume:
Mass: Mass: Mass: Mass:

- Label the contents and note the colors present in both the beaker and the cell of the "Final State" diagram below.

- Access to science and academic vocabulary

enlarge to get bigger ★→★
Shrink to get smaller

Tier 2	Tier 3
concentration	cell membrane
transportation	selective permeable
enlarge	solution
salt	active transportation
shrink	passive transportation
cell	diffusion
materials/substance	osmosis

(1) Tier 2 Vocabulary
molecule - the smallest unit of a material or substance
material / substance - a solid, liquid, or gas used for doing or making something (difference between substance and molecule - water bottle, drop of water, molecule of water)
shrink - to get smaller
enlarge - to get bigger
transport - to move
concentration - a amount/number of something

- Teaching academic skills such as reading expository text and note-taking

Teacher's Two Column Notes (Interactive Reader p. 43-44, 46-49)
Tr. Cell Membrane and Cellular Transportation

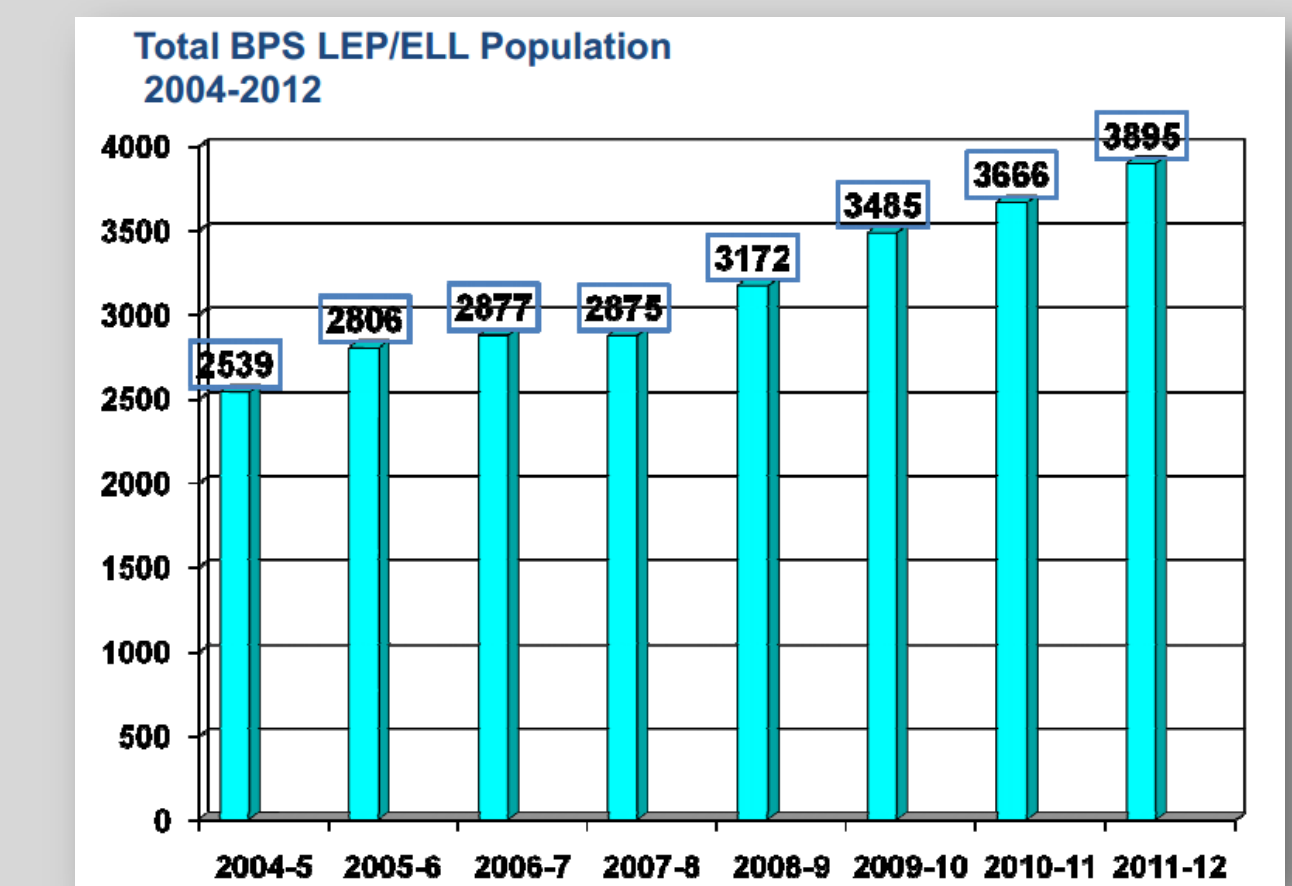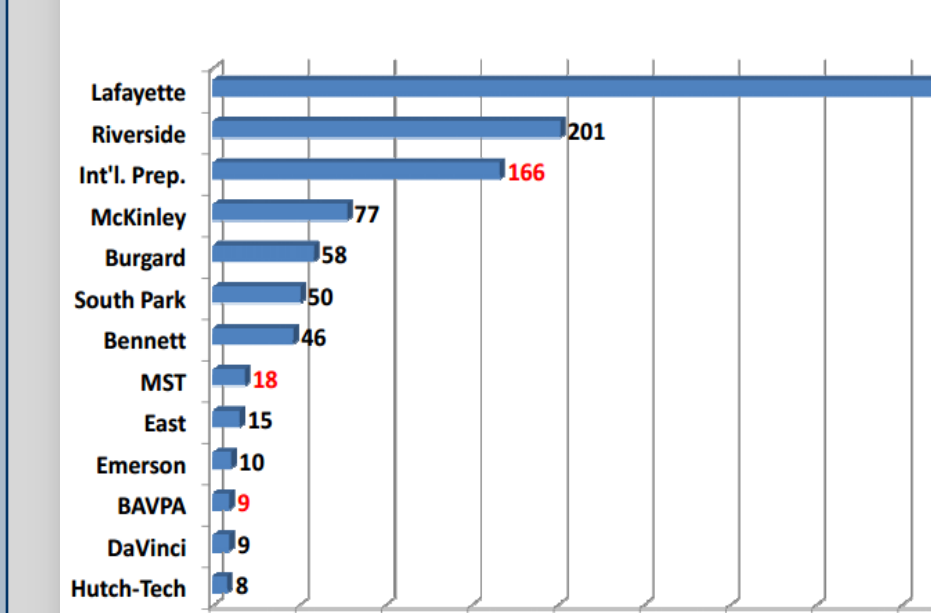| *structure (p. 43)	- the layer - separates the inside from the outside of a cell phospholipid - (phosphate group, lipid (fat) group - interact with water
*function (p. 44 top)	- selectively permeable - allows some materials to cross it, not all materials can cross
*passive transport (p. 46)	- movement without energy - concentration - amount of molecules (materials?) - diffusion - high concentration to low concentration - no energy needed - osmosis - only water
*solutions (p. 46 - 47)	- high concentration of salt, low concentration of water, the cell shrinks - high concentration of water, low concentration of other materials, the cell enlarges
*active transport (p. 49)	- uses energy - low concentration to high concentration

Biology Interactive Reader
3.4 Diffusion and Osmosis

Buffalo Public School ELL Demographics

Total BPS LEP/ELL Population 2004-2012

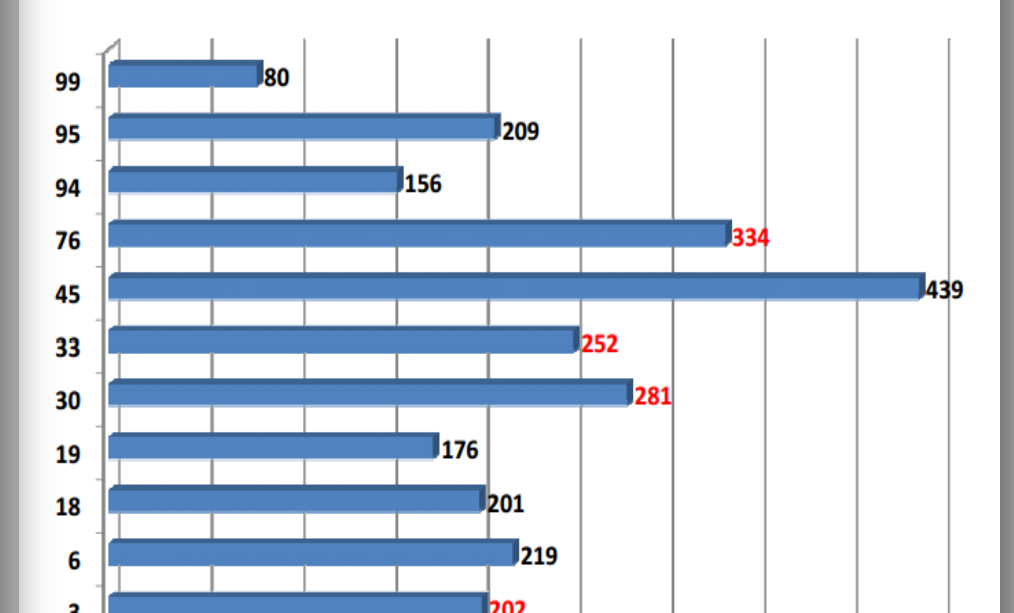| 2004-5	2005-6	2006-7	2007-8	2008-9	2009-10	2010-11	2011-12
2639	2806	2977	2875	3172	3485	3666	3896

The ELL population in Buffalo Public Schools continues to show yearly growth. With over 70 different languages spoken, and now over 4,000 ESL students, BPS is a highly diverse district. Many of the English Language Learners are SIFE. A Student With Interrupted Formal Education may have never attended school in their home country. These students come to Buffalo with limited literacy skills due to their educational background. It is crucial for BPS teachers to accommodate learners of diverse backgrounds in science in order to provide hands-on and real-world experiential learning.
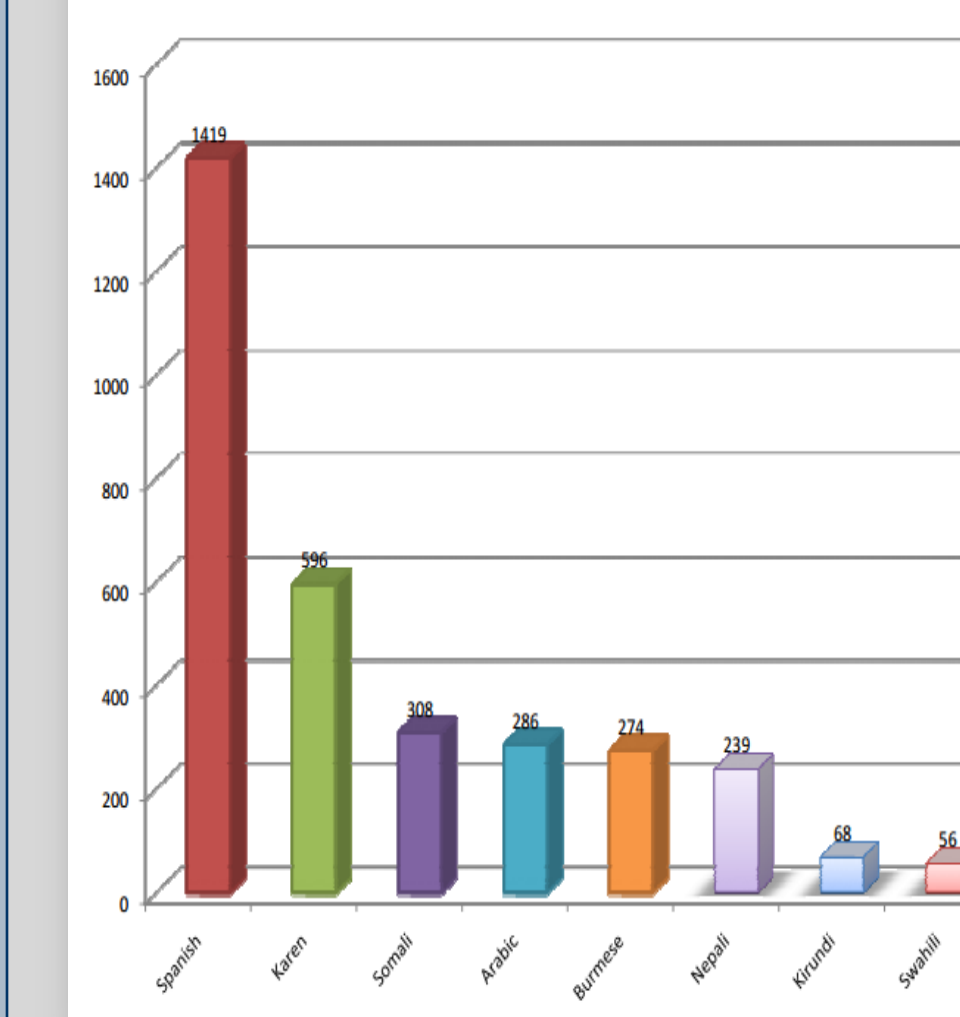
LEP/ELL STUDENTS IN BPS HIGH SCHOOLS
Lafayette, Riverside, Int'l. Prep., McKinley, Burgard, South Park, Bennett, MST, East, Emerson, BAVPA, DaVinci, Hutch-Tech

LEP/ELL STUDENTS IN BPS ELEMENTARY SCHOOLS

BPS LEP/ELL TOP 10 LANGUAGES 2011-2012

Buffalo's ESL population represents various high incidence languages, and is not only limited to Spanish speakers. These include many African and Asian languages, such as Karen, Somali, Arabic, Burmese, Nepali, Kirundi, Swahili, and Vietnamese.

References / Acknowledgements

Biology: interactive reader. S.I.: Mcdougal Littell Houghton, 2013.
Echevarria, Jana, MaryEllen Vogt, and Deborah Short. *Making content comprehensible for English learners: the SIOP model.* 2nd ed. Boston: Allyn and Bacon, 2004.

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