“My role as a progressive teacher is not only that of teaching mathematics or biology but also of helping the students to recognize themselves as architects of their own cognition process” (Paulo-Freire, Pedagogy of Freedom)
Ice Breaker

Challenge:
In small groups (3-4) build a tower using the index cards.

Questions:
What skills were needed to complete the task?
What did you learn during the process?
Learning Goal

❖ Propose a curricular framework for the development of science curriculum for bilingual students using an inquiry model

• meets the academic, linguistic and developmental needs of bilingual students learning science content in a second language
Agenda

- What is inquiry based learning?
- Why inquiry based learning?
- How? Curricular Framework
- Examples
- Documentation & Assessment
- Resources
What is inquiry based learning?

❖ A pedagogy, a learning and teaching method that is student-centered and prioritizes student questions
❖ Constructivist learning theory, students construct knowledge and meaning from their experiences (Piaget, Vygotsky, Dewey)
❖ Focuses on investigating open ended questions or problems
❖ Supports students’ through the investigation process
❖ Can be implemented across all content areas (social studies, science, mathematics, language arts)
❖ It is not a linear process
Tell me and I’ll forget; show me and I may remember; involve me and I’ll understand
-Chinese proverb
Role of the Teacher

❖ Scaffold, model and helps students understand the problem, apply science knowledge, evaluate their designs, explain failures, and engage in revision (Barron, Cervetti, Darling-Hammond, Pearson, Schoenfeld, Stage, Tilson, Zimmerman, 2008)
Why inquiry?

❖ “Students who may struggle in traditional instructional settings have often been found to excel when they work in a Project Based Learning context, which better matches their learning style” (Boaler, 1997; Meyer, Turner, & Spencer, 1997; Rosenfeld & Rosenfeld, 1998)
❖ Students develop content knowledge and learn twenty-first century skills, such as the ability to work in teams, solve complex problems, and to apply knowledge gained through one lesson or task to other circumstances (Barron, Cervetti, Darling-Hammond, Pearson, Schoenfeld, Stage, Tilson, Zimmerman, 2008)
Why inquiry? (cont.)

- Supports young children to connect their experiences in ways leading to conceptual understanding (Hart, Burts & Charlesworth, 1997)

- Guided inquiry-based science is especially effective with young children by supporting them in learning the inquiry process (Samarapungavan et al., 2008)
Inquiry Models

❖ Project Based Learning-Students explore real-world problems and challenges, developing cross-curriculum skills while working in small collaborative groups

❖ Problem Based Learning-Students learn through the process of solving a problem. The approach is also inquiry-based when students are active in creating the problem.

❖ 5E Model is five steps in the sequence of teaching and learning in science instruction
Curricular Framework

For the development & review of curriculum:

❖ Educational Objectives
❖ Learning experiences
❖ Organization of the Learning Experiences
❖ Evaluation

Tyler’s principles of Curriculum and Instruction (Tyler, 1949)
Educational Objectives

- Standards aligned (NGSS, CCSS, ELD/ELA standards)
- Considers the linguistic needs of students and embeds language goals
- Considers the academic and developmental needs of the learners
- Student interest
Students who demonstrate understanding can:

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]

K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull. [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

**Science and Engineering Practices**
- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data
- Connections to the Nature of Science
- Scientific Investigations Use a Variety of Methods
- Establishing Engineering Design Criteria
- Developing and Using Models

**Disciplinary Core Ideas**
- PS2.A: Forces and Motion
  - Pushes and pulls can have different strengths and directions. (K-PS2-1), (K-PS2-2)
  - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1), (K-PS2-2)
- PS2.B: Types of Interactions
  - When objects touch or collide, they push on one another and can change motion. (K-PS2-1)
- PS3.C: Relationship Between Energy and Forces
  - A bigger push or pull makes things speed up or slow down more quickly. (secondary to K-PS2-1)
- ETS1.A: Defining Engineering Problems
  - A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (secondary to K-PS2-1)

**Crosscutting Concepts**
- Cause and Effect
  - Simple tests can be designed to gather evidence to support or refute student ideas about causes. (K-PS2-1), (K-PS2-2)
Learning Experiences

- Experiential hands-on learning provides opportunities to develop content knowledge while also developing academic language in context (Amaral et al., 2002; Beltran et al., 2010; Cuevas et al., 2005; Lee et al., 2006)
- Hands on learning promotes 1:1 correspondence, attaching a name or description to what is seen and developing academic language (Beltran et al., 2010)
- Hands on experiences and purposefully-framed play increases young children’s understanding of science concepts (Pramling and Pramling Samuelsson, 2001)
Organization of Learning Experiences

❖ sequence, continuity and integration
❖ NGSS cross-cutting concepts
  1. Patterns
  2. Cause and effect
  3. Scale, proportion and quantity
  4. System and system models
  5. Energy and matter
  6. Structure and Function
  7. Stability and Change
Organization of Learning Experiences

❖ Universal Themes
  1. Interdependence
  2. Systems
  3. Patterns
  4. Change
  5. Power
  6. Structure

(Curriculum & Pedagogy, UCLA Lab School 2017)
The purpose of the 5E lesson plan model is twofold: to develop content knowledge while developing high levels of academic language (Beltran, Mora-Flores, Sarmiento, 2013).
5E model

5E Model is five steps in the sequence of teaching and learning in science instruction

1. Engage
2. Explore
3. Explain
4. Extend
5. Evaluate
Engage

❖ Introduce the topic, concept or idea
  • Picture or video clip
  • Performing an experiment
  • Posing a question (open-ended, researchable, hypothesis)

❖ Generate prior knowledge

❖ conduct a pre-assessment of language proficiency (observation and anecdotal records)
Simple Machines (Force & Motion)

- We experimented with concepts of push, pull and gravity through play
- We designed and build ramps
- Brainstormed words to describe how things move (empujar, jalar, rodar, gravedad etc..)
- We sketched and wrote our observations on our science journals
Explore

- Students investigate through experiments, observations and shared inquiry
- Simulation of an authentic investigation with tools and materials
- Exploratory stations
- Teacher guides inquiry process: probing, modeling, feedback, provides suggestions and models the use of academic language
Exploration through art

- We explored the force of push and pull as we tried to move paint to create art

Explain

- Students explain their learning (diagrams, charts, drawings, journal writing)
- Teacher guides students to find the answers to their questions and clarifies misconceptions (read alouds, demonstrations, pictorial input charts)
- Explicit vocabulary instruction of key academic terms and concepts, providing language frames (tiered vocabulary (basic, academic and content))
Extend

- Provides exploration and another opportunity for students to put learning into practice
- Task: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.
Inquiry is not a linear process

We developed new questions.....How do planes fly? How do trains work?

We engaged in a new inquiry cycle...
Goal of assessment is to ensure that language learning can be demonstrated along with content understanding.
Evaluation (cont.)

- multiple assessment measures ensure that second language learners are given multiple opportunities to demonstrate progress toward meeting content-related goals (Howard, Sugarman, Christian, Lindholm-Leary & Rogers, 2007)
  - Formative assessments: observations, scientific journals, oral and digital presentations
  - Performance assessments: evaluate students’ ability to carry out investigations, work collaboratively and communicate findings in alignment with the curriculum outcomes and content standards
  - Summative assessment: apply learning and supports in making connections between the learning experiences

- Teacher documentation and/or scripting student language/ responses
Documentation

❖ Making Learning Visible
❖ Students can clearly articulate and justify their learning process
❖ Students can document their learning in different forms including photographs, art work, journals, conversations and reflections

Curriculum & Pedagogy, UCLA Lab School 2017
Questions?

- Take aways
- Next steps for curriculum development and implementation....
- Challenges?
Resources

❖ 5E Model: https://bscs.org/bscs-5e-instructional-model

❖ Beltran, Mora-Flores & Sarmiento (2013) Science for English Language Learners


❖ Project Based Learning https://www.bie.org/about/what_pbl