APPENDIX A. Science Methods Course Matrix

Week	Class Topic(s) & Activities	ESTELL Comp/Category	Core Pedg Know & Skills	ESTELL Exemplar	Exemplar Justification	Core Readings
1	I. a.Orientation to syllabus and signature assignments b. ESTELL Pre-Survey II. Energy Game or Upside Water Cup			**Lead: Alberto or Alie**		
2	What Is Science? Science inquiry Inquiry Continuum (see reading)	Facilitating Collaborative Inquiry Promoting Science Talk Promoting Inquiry Skills	PCK: Understanding Levels of Inquiry CK:Devel'g Curric/Lesson Plans SMK: Surface tension ? Or nature of matter ?	"Milk Explosion" (Introduces topic of surface tension) or Buoyancy Or Sense of smell (nature of matter)	This investigation engages student teachers in inquiry at several different levels of teacher direction vs. student discovery, allowing them to develop an initial understanding of types of inquiry learning.	The Many Levels of Inquiry by Banchi & Bell from Science and Children (2008). Fathman & Crowther, 2006. Chapters 3 (Planning Science) & 7 (Designing Lessons)
3	Planning for Instruction Developing lesson plans (Prepare for SST/CAT=PACT)					
4	Learning Theories How Do Students Learn Science? -Learning Theory -Assessing initial ideas (Misconceptions)	Contextualizing Science Activity (Physical Environment & Ecology and Personal home/ community experiences) Directly connect to ESTELL components in general/theoretical frameworks in general	PCK: First hand Inquiry though contextualized instruction CK: National & State Stand' SMK: Constructivism (social vs. Indv) ESTELL framework	Lead: Meredith Schoolyard Investigation	This investigation engages students in first hand data collection in a real-world context which is both local and connected to personal/community experiences	(?) How children learn (Chapter 2). In Science for all children. 1977. (emailed by Alie) Trish short paper on ESTELL framework
5	Big Ideas in Science (and National & State Science Standards) Good place to stress need for multicultural science ed. As shown in the standards, NSTA					
6	More Scientific Inquiry	Promoting Complex Thinking -Scientific reasoning and understanding - Promoting Inquiry Skills	PCK: Inquiry focusing on scientific reasoning and understanding CK: Lesson planning—SST/CAT support SMK: animal diversity, adaptation	Lead: Isabel Skulls (Big Ideas: Structure & Scale, Diversity) Other possible extensions: Beaks/adaptation Owl pellets	This investigation focuses on developing students' scientific reasoning through collecting, analyzing and making sense of data and serves as an alternate example of scientific inquiry.	Stoll Dalton: Teaching Complex Thinking: Challenge students toward complexity. In S. Dalton, Pedagogy Matters: Standards for Effective Teaching Practice, CREDE (Just emailed to the group, in PDF, starting from p. 26-)

7	Student Assessment : -formative & summative -performance assessment	Literacy in science (authentic western/non-western) science literacy & vocabulary) (Great activity for also stressing contextualization)	PCK: Secondhand Inquiry through model building and text analysis Constructivism CK: more SST/CAT practice. Monitoring student's learning SMK: Sun-Earth-Moon Systems, Seasons	Lead: Isabel moon investigation (Private Universe) (Big Ideas: Systems, Interrela-tionships) [Starts with full moon]	This investigation confronts a persistent misconception among adults and children and provides insight into inquiry based primarily on second hand data sources/ modeling	1) Volkmann & Abell, 2003. Seamless Assessment. In Science & Children. (This was emailed to the group.) 2) Carr; Sexton; Lagunoff, 2006. Chap 6: Assessing ELLs. In Making Science Accessible to ELLs: A guidebook for teachers. (just emailed to the group)
8	Continue assessment (talk about various forms of assessment).	Literacy in science (authentic science literacy and vocabulary)	PCK: Secondhand Inquiry through model building and text analysis CK: more CAT practice. Monitoring student's learning	Lead: Isabel moon investigation (Private Universe) (Big Ideas: Systems, Interrelationships)	This investigation confronts a persistent misconception among adults and children and provides insight into inquiry based primarily on second hand data sources/ modeling	1) Brunsell & Marcks, 2007. Teaching for Conceptual Change in Space Science. In Science & Children. (This was emailed to the group.) 2) Freeman, G. & Taylor, V. (2006). Integrating science and literacy instruction: A framework for bridging the gap.
9	Planning for Diversity (ELL, SPED) -Teaching for Diversity -Cross-cultural science education	Scaffolding Language & Literacy in Science *a. Authentic Science Literacy* *b. Science Vocabulary*	PCK: ? CK: Adaptation of readily available materials to support inquiry & language development SMK: electricity & magnetism	Lead: Alie Electricity & Magnetism (Big Idea: Energy, transfer and conservation)	This investigation takes a set of activities similar to those found in texts student teachers are likely to find adopted in their schools and adapts them to make them inquiry-oriented and supportive of diverse learners	
10	Planning for Diversity (continues)	Scaffolding Language & Literacy in Science	PCK: ? CK: Adaptation of readily available science activities to support inquiry & language development SMK: electricity & magnetism	Lead: Alie Electricity & Magnetism (Big Idea: Energy, transfer and conservation)		

11	-Curriculum eval, eval of own lesson plans Critique of canned curriculum (e.g. FOSS and others)	ESTELL Framework - Students will check ESTELL components	Lead: Team Evaluating commonly found curric. materials Handout with questions to guide discussion		This investigation takes a set of activities similar to those found in texts student teachers are likely to find adopted in their schools and adapts them to make them inquiry-oriented and supportive of diverse learners	
12	Planning for Diversity (ELL, SPED) -Teaching for Diversity -Cross-cultural science education	Collaborative Inquiry (authority) Promoting Science Talk (academic science discourse) Contextualization	PCK: Scaffolding the language of science Peg Strat: SMK: animal diversity, anatomy, adaptations	Lead: Alberto Arthropod (Big Ideas: Diversity, Systems & Interrelationships)	This activity deals explicitly with making scientific language and content accessible to students through modeling, language supports, and facilitative use of technology	
13	Planning & Teaching for Diversity	All ESTELL components	Arthropods cont'd	Lead: Alberto		
14	Team Teaching or Workshop to help them with CAT and signature assignments	All ESTELL components	Weeks 14 and 15 are open for instructors to use as needed in their own contexts			
15	Learning Center Exhibition ESTELL Next steps or Other activity as needed					

ESTELL

Dialogic Activity in Science Instruction (EDAISI)

Teaching Examples and Guidelines

For Level 3 Teaching

EDAISI Instructional Practices

1. Facilitating Collaborative Inquiry
Collaboration
Authority

2. Promoting Science Talk
Academic Science Discourse
Instructional Conversation

3. Language in Science
Authentic Science Literacy
Science Vocabulary

4. Scaffolding & Development of Language in Science
Language Scaffolding (ELD)
Scaffolding Science Content (SDAIE)

5. Contextualizing Science Activity
Personal-Home-Community
Local-Ecological

6. Promoting Scientific Reasoning & Understanding through Inquiry
Scientific Reasoning & Understanding
Developing Inquiry Skills

Scoring Scale:
Level 0: Not Present • Level 1: Present • Level 2: Implementing • Level 3: Elaborating

Teaching Guidelines for Level 3

1.FACILITATING COLLABORATIVE INQUIRY

For **COLLABORATION**, the instructor:

- facilitates high collaboration between students (50%+) on the focal science activity
- makes explicit mention of roles and tasks
- groups students heterogeneously whenever needed
- rotates through 3 grouping sequences such whole group to small group and back to whole group OR whole group to stations to pairs OR small groups to pairs and back to small groups, etc.
- assures that all students are engaged including ELL and special need students

For **AUTHORITY**, the instructor:

- promotes an understanding of scientific authority as open and shared between the instructor and students
- promotes scientific knowledge as something that can be challenged
- designs activities where students generate science knowledge with instructional support

2. PROMOTING SCIENCE TALK

For **SCIENCE DISCOURSE**, the instructor:

- explicitly models, guides, and provides feedback on student use of discourse patterns such as:
    - ways of providing evidence
    - making explanations
    - expressing judgments
    - proposing methods of inquiry

For **INSTRUCTIONAL CONVERSATION**, the instructor:

- Uses mostly open-ended questions (indefinite, investigatory, & legitimate) to generate student talk on science topics
- Follows-up and promotes students to follow-up on science talk by connecting science talk
- May correct, reject, or accept student assertions/claims and encourages others to do the same

Teaching Guidelines for Level 3

3. LITERACY IN SCIENCE

For **AUTHENTIC SCIENCE LITERACY**, the instructor:

- guides & provides students with authentic science literacy tasks to support science learning
- provides instruction about their use and expectations of the literacy task
- provides feedback as to the use of those literacy practices
- provides materials necessary to conduct science literacy tasks
- provides explicit instruction provided about these literacy tools
- demonstrates how and why these tools are used by scientists
-

For **SCIENCE VOCABULARY**, the instructor:

- provides instructional attention to key terms that is substantive (e.g., student glossary, written on word wall, connected to what students already know)
- accurately uses at least 8+ different science terms, both inquiry terms (e.g., observe, predict, model) & key science terms (e.g., erosion, adaptation)
- checks for student accuracy in use of terms
- promotes student use of key words in writing or talk

4. SCAFFOLDING AND DEVELOPMENT OF LANGUAGE IN SCIENCE

For **ENGLISH LANGUAGE DEVELOPMENT**, the instructor:

- provides explicit attention to language structures for ELLs (e.g., figurative language, idioms) that is contextual, modeled with student opportunities to practice them
- provides students with feedback on their usage of developing language
- uses modified talk that considers student language proficiency, such as repetition, wait time, native language use, or written objectives/instructions, that facilitates student understanding of instruction

For **SPECIALLY DESIGNED ACADEMIC INSTRUCTION IN ENGLISH (SDAIE),** the instructor amplifies science content by:

- providing multi-sensory experience (gestures, manipulatives, etc.)
- visual representations (word wall, semantic map, technology, etc)
- scaffolds that are directly tied to the content objectives of the lesson

Teaching Guidelines for Level 3

5. CONTEXTUALIZING SCIENCE ACTIVITY

For **PERSONAL-HOME-COMMUNITY CONTEXTUALIZATION**, the instructor :

- incorporates, contrasts, & extends students' personal-home-community ideas to academic science concepts
- design scientific activities and/or inquiry projects that build on & include students' home, community or other socio-cultural understandings or multicultural contributions

For **PHYSICAL ENVIRONMENT-ECOLOGY**, the instructor:

- incorporates, contrasts, & extends student contributions/questions related to local physical, geographic, or ecological environment to large-scale/worldwide phenomena
- designs scientific activities that build on & include local, physical, geographic, and/or ecological phenomena

6. PROMOTING SCIENTIFIC REASONING

For **SCIENTIFIC REASONING & UNDERSTANDING**, the instructor:

- elicits & models activation of student prior knowledge about science topic
- makes clear the connection between student prior knowledge & science topic
- addresses discontinuities and connects science activity to science content objectives
- provides opportunities for student reflection of science learned outcomes

For **DEVELOPING INQUIRY SKILLS**, the instructor:

- provides feedback about student led inquiry
- facilitates student opportunities for sharing and evaluating each others inquiry (research design, findings, and implications of their investigations)

Level 3 ESTELL Practices

Example 1: Lesson- Biodiversity and Skulls Lab

1. FACILITATING COLLABORATIVE INQUIRY

- All students are involved in activity
- Students work in pairs, groups, and report in whole class setting
- Instructor reminds students of task/roles
- Students generate knowledge about teeth and form their own observational results
- Students assume authority in generating findings

2. SCIENCE TALK

- Instructor provides support in ways of making observations
- Students share results using observational guidelines
- Instructor rotates & monitors & probes thinking in each small group
- Instructor asks mostly open-ended questions
- Students have opportunities to engage each other and follow-up each others talk

3. LITERACY IN SCIENCE

- Students are engaged in writing/recording their observations into notebooks to classify types of teeth
- Instructor asks students about their observations and reminds students about scientific method
- Students use several inquiry and key terms reinforced orally, on the board, slides, and notebooks.

4. SCAFFOLDING/DEVELOPMENT OF LANGUAGE IN SCIENCE

- Instructor points out modifications for ELL students
- Instructor uses multi-sensory and visual experiences including manipulating tools/drawing teeth and visuals

5. CONTEXTUALIZING SCIENCE ACTIVITY

- Instructor draws from familiar experiences in using students' own teeth
- Instructor contrasts/extends individual/group observations with larger concept of local habitats and animal diets

6. SCIENTIFIC REASONING AND UNDERSTANDING

- Students have opportunities to share & reflect on observations in whole class & in pairs
- Instructor provides explicit attention on inquiry cycle related to model lesson

Example 1: Description of Lesson

Activity before the elaborated Level 3 segment

Instructor starts the lesson by making class announcements and asks students for brief reactions about the ongoing Moon activity where students are making observational recordings at home. A few students share news and current events related to the moon. Next, the instructor reviews last week's lesson on biodiversity and then asks students about the benefits of such a lesson for all students and for ELLs. Following this sharing and review, students resume testing soil samples and taking notes to make a recommendation for a garden where students are working small groups. The instructor rotates through each small group. Most students ask questions to each other related to the procedures they are following for making observational notes of the chemical composition of the soil. The instructor reminds groups to come to a consensus on observations and on the recommendations for their site. The instructor then calls students back to a whole class arrangement and recalls how this kind of activity is productive for children and also notes the educational value of lab notebooks during science activities. The instructor then shares and reads sections of children's books related to bio-diversity and the environment. The instructor summarizes key points of the second story to students in a whole group setting. The instructor then resumes inquiry into the school site garden project. The instructor projects pictures of the campus where soil was collected. Student teams take turns and share their findings in the front of the class and present their ideas, recommending or not recommending a particular site area based on their observations. Students share results of soil composition, general description of site area, human impact, nitrogen levels, pH level, etc. Afterward, the instructor recaps and relates the lesson to how it can be implemented with children and possible next steps and real-world writing opportunities. Next the instructor re-introduces and discusses ESTELL teaching and contextualization as it relates to bio-diversity lesson. Students do a pair-share and examine the ESTELL lesson outline and discuss the connections to the lesson just completed. The instructor rotates through each group working on making these connections and addresses questions about ELL methods including differentiated instruction. The instructor then asks the whole class for any comments about ESTELL before introducing the concepts of levels of inquiry. One students asks about prior knowledge: "what do you do when there isn't any prior knowledge?" about particular concepts or themes. Students and instructor discuss this question. Next, the whole class continues discussing the levels of inquiry and ESTELL in a whole class format. The instructor begins the lesson by introducing the "5E's" of lesson planning based on the learning cycle. The 5E's include 1) Engage, 2) Explore, 3) Explain, 4) Elaborate/Expand, and 5) Evaluate. The instructor provides examples from her/his own teaching for each teaching step. There are question by students discussed as the instructor moves through each level and the teacher follows-up on connections between those questions. Class discussion ends with the "elaborate" step.

Elaborated Level 3 Teaching

The instructor then begins new a lab based on the "5E's". The instructor focuses on language development and ELL's in the modeling of the ensuing ESTELL lesson example called "Skull Lab". Students take out their lab books to work on this lab. The instructor asks student to pair-share their favorite food and think about the chewing action in mouths for each kind of food they eat. Students share in pairs. Then, the instructor models the lesson as if teaching children and models how children could report back certain chewing-related words from children and writes those words on board. The instructor explains then introduces the procedures for students used for investigating their own teeth and the diagramming their teeth. Students take turns drawing their teeth and recording their observation in their lab notebooks. The instructor rotates through groups and clarifies ways of examining theirs teeth and recording their own teeth as well as scientific observation method. The class reconvenes as a whole class where students share their observations again including the number, structure, and order of their own teeth. The instructor points out possible modifications for children when using this same lesson. The instructor says that she/he moves from "explore" to "explain" step of lesson the skulls lesson.

Level 3 ESTELL Practices

Example 2: Lesson-"Skulls Lesson"

1. FACILITATING COLLABORATIVE INQUIRY

- All students work in pairs
- Instructor rotates through groups and gives feedback on student observations
- Students make their own observations

2. SCIENCE TALK

- Students receive feedback on ways of providing evidence for matching skull parts
- Instructor uses mostly open-ended questions to promote science talk

3. LITERACY IN SCIENCE

- Students record their own observations and receive feedback on and use key terms

4. SCAFFOLDING/DEVELOPMENT OF LANGUAGE IN SCIENCE

- Students receive multi-sensory and visuals of science content in main activity

5. CONTEXTUALIZING SCIENCE ACTIVITY

- Some students connect to familiar understanding about living animals identified in skulls

6. SCIENTIFIC REASONING AND UNDERSTANDING

- Instructor and students engage in discussion where supporting evidence for types of food eaten by different animals given teeth structure are expressed and evaluated

Example 2: Description of Lesson

Before the Elaborated Level 3 Teaching

The instructor introduces the class agenda for the lesson including the ESTELL matrix for the skulls lesson, deconstruction of lesson planning activity, unit planning, and the final course assignment. The instructor asks students to take out their matrix and ask students to go back into small groups from before to review what was previously discussed among students. Students begin to share after a few minutes. The instructor asks students to share their comparisons from the biodiversity lesson and video they previously viewed and case study lesson they read on ELL's and asks how the schoolyard was contextualized. Several students share and discuss in a whole class setting. The instructor asks questions about teaching pedagogy in the readings/cases. Students continue sharing and discussing comparison of case studies on biodiversity while sitting in whole class structure. The instructor stresses parent expertise and then switches gears and starts the Skulls lesson and notes grouping structures important for children but not this class. Students count off and break into different groups of 1 through 8. The instructor then addresses groups and asks, "What do teeth do for you and other animals?" Students brainstorm ideas for a few minutes. The instructor then asks students to share what they came up with as the instructor writes ideas on the overhead projector. The instructor selects and rotates around the classroom. S/he notes what students could do and how do this activity with children (meta) including word wall. Finally, the instructor asks students to use mirror to draw picture of their teeth. S/he goes around helping groups understand instructions. The instructor rotates through different groups as students draw their teeth in pairs. The instructor and students engages in talk about what it means to draw teeth. The instructor asks, "think about how it would be if you were an elementary school kid?" Then, the instructor resumes whole class discussion by asking, "what did you learn about your teeth?" Students share observations. The instructor reviews terminology for teeth: incisors, canines, pre-molars/transitional teeth, etc, and their function and shows overhead diagram. The instructor asks students to try eating different foods and the action their teeth for the different food categories. Students go back to pair-share format on these observations.

Elaborated Level 3 Teaching

Students continue trying food and the instructor asks students about teeth used and type of teeth for different types of diets such as "what teeth did you use to eat the carrots?" The instructor turns to next activity. S/he passes out 3 skulls and asks students to record which types of eaters these animals are (e.g., herbivore, etc). The instructor rotates through each pair and asks questions. Students get back to a whole class discussion and report back to naming animals, type of food, and type of diets. The instructor and students engage in discussion where supporting evidence for types of food eaten by different animals given teeth structure are expressed. The instructor hands out pictures of skulls and asks students to describe how teeth are different and asks students to count their teeth handing out a data sheet. Students work in pairs on recording and matching teeth to animals. The instructor asks questions and gives feedback on scientific names for different animals. After six minutes, the instructor calls classroom back and asks groups what each group had identified (e.g., cow, raccoon, bird, bobcat, etc.). He/she asks students also which type of diet belongs to each skull. Students share. The instructor provides information on differences between animals and different diets. Some students connect to familiar understanding about living animals identified in skulls. S/he then goes on to connect how the activity can be adapted with children to draw from local resources and experiences.

After the Elaborated Level 3 Teaching

After break, a few students make announcements. The instructor begins again by noting that s/he will be talking about lesson planning for the next section and the logic behind the skulls lesson. The instructor describes how model lesson may accomplish each stage such as contextualization and eliciting, creating graphs, based on learning theory. The instructor also reviews other past lessons like parachute activity to connect examples and defines each stage of the 5E's (e.g. Engage, Explore, etc). Students volunteer questions about the cycle. The instructor then asks student to go back to the Skulls lesson and think about how the lesson incorporates the Five E's and have groups/pairs discuss how each step. The instructor engages pairs/groups with questions such as "you guys found most of the stages in there?" as they review ESTELL lesson outline. The instructor then goes back to whole class and asks what students found for each step and students respond and give examples for each step from the lesson. Students read from the lesson outline as they share back their comments. The instructor connects activity to final assignment/unit and resource for thinking about planning a lesson or integrating phases. The instructor then summarizes the 5 E model and turns each phase into a question…are there engaging activities?, etc. The instructor moves on to CAT activities and course projects and begins to review of final project and sections of the larger unit over next 5 weeks. The instructor lists required section for the final assignment. Students ask questions about the CAT and final assignment.

San Francisco State University
Department of Elementary Education
EED 679.09

Curriculum & Instruction in K-8 Science

Fall 2009

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Class Meeting Hours: Monday p.m., 1:10-3:55 p.m.
Classroom : 182 Burk Hall
Office Hours: by appointment

Course Description

This is a 3-credit course designed to provide Multiple Subject Credential candidates opportunities to learn and teach science through inquiry-based activities. Candidates will acquire an understanding of big ideas in physical, life, earth, and space sciences; develop science process skills; and learn how to plan and implement meaningful themes and lessons for K-8 diverse students. Throughout the course, we will be actively engaged in learning, planning, teaching, and assessing science lessons that are standards-based, inquiry-oriented, and designed to teach ***all*** students, particularly ELLs (English Language Learners). The primary goal of science education reform is to improve student learning of science and make content accessible to all students. The goals of this course are to explicitly model effective science teaching practices for ELLs and raise comfort level of teachers in science teaching and learning.

Conceptual Framework for this Course

EED 679 is a methods course that addresses workable science teaching practices to students in grades K-8. It focuses on a theoretical framework for science pedagogy, ESTELL (Effective Science Teaching for ELLs), which has been researched to improve the achievement of English Language Learners. **Please read the overview of ESTELL Framework posted on iLearn.** The course also emphasizes the 5-E Learning Cycle Model (Engagement, Exploration, Explanation, Extension, and Evaluation), which are established planning method in science education and consistent with contemporary theories about how individuals learn. The theoretical framework is based on the constructivist view of teaching and learning. In this context, students and teachers are actively involved in asking questions, making sense, and reflecting on information and experiences, and connecting classroom experiences to real world situations. The teacher's role is to provide instructional tools and opportunities for such exploration and to guide the students to make meaning of their experiences.

Course Objectives

The course reflects a developmental approach to science instruction congruent with the CA Science Standards/Frameworks. By the end of this course, candidates will be able to:

- gain an understanding of science content & effective science instructional pedagogies for diverse learners, particularly ELLs;
- develop scientific attitudes and awareness of the nature of science and scientific investigations relevant to grades K-8 **(TPE 1A.13 –** Specific Pedagogical Skills, **4-** Making Content Accessible**)**;
- connect science educational theories to practice and demonstrate appropriate science assessment tools and instructional resources in their field placements **(TPE 2-**Monitoring Student Learning**, 3-** Interpretation and Use of Assessment**)**;
- demonstrate safety guidelines in science laboratories and explore classroom management systems in the teaching of standards-based inquiry science lessons **(TPE 5, 10-** Instructional Time**, 11-** Social Environment**);** and

- make conceptual connections across subject areas that are relevant to elementary school curricula, and to recognize that science is just as important as other disciplines in the elementary curriculum **(TPE 9, 10)**.

Required Websites:
CA State Board of Education. (2003). Sacramento: CA Department of Education. Online: http://www.cde.ca.gov/ci/ (CA Science Content Standards and Curriculum Frameworks)

Michaels, S., Shouse, A, & Schweingruber, H. (2007). Ready, Set, Science: Putting Research to Work in K-8 Science Classrooms. National Research Council, The National Academies Press. (ISBN: 10: 0-309-10614-1): http://www.nap.edu/catalog.php?record_id=11882

A Private Universe: http://www.learner.org/resources/series28.html
Annenberg / CPB Learner (Prof. Dev. For K-12 Teachers): http://www.learner.org/index.html

Optional Text:
Fathman, A. and Crowther, D. (2006). Science for English Language Learners: K-12 Classroom Strategies. Virginia: NSTA (National Science Teachers Association) Press. (ISBN: 10-0-87355-253-9)

Recommended References and Websites:
Carr, J., Sexton, U., & Lagunoff, R. (2007). Making Science Accessible to English Learners: A Guidebook for Teachers, 6-12. California: WestEd. (ISBN: 978-0-914409-40-3)

Freeman, G. and Taylor, V. (2006). Integrating Science and Literacy Instruction: A Framework for Bridging the Gap. Maryland: Rowman & Littlefield Education. (ISBN: 10-1578864038)

NSTA – National Science Teachers Association: http://www.nsta.org/ : Official Journal is: *Science and Children*

CA Academy of Sciences: http://www.calacademy.org/
The Exploratorium Institute for Inquiry: http://www.exploratorium.edu/IFI/index.html
NASA Homepage: http://www1.nasa.gov/home/
Project First: Eye on the Sky (UC Berkeley) – Astronomy for K-3 - http://www.eyeonthesky.org/

Environmental Education Websites:
Project WILD : http://www.projectwild.org/
Project WET (Water Education for Teachers): http://www.projectwet.org/
Project Learning Tree: http://www.plt.org/index.cfm

Skulls Unlimited International: http://www.skullsunlimited.com/
(Use the Search box to look for skulls of herbivores, omnivores, and carnivores)

Free Science Materials/Guidebooks, etc. for Teachers:
UCSF Science & Health Education Partnership at Daly Ralston Resource Center:
http://biochemistry.ucsf.edu/programs/sep/resources-daly-ralston-resource-center.html
SEPAL (at SFSU) – Science Education Partnership & Assessment Laboratory:
http://www.sfsu.edu/~sepal/index.html

Special Note for Students with Disabilities:
Students with disabilities who need reasonable modifications, special assistance, or accommodations in this course should promptly direct their request to the course instructor, and then contact the Disability Programs and Resource Center (DPRC) for further assistance. The DPRC is located in the Student Services Building, Room 110; phone: 338-2472 or email: dprc@sfsu.edu. Visit their website for more information: http://www.sfsu.edu/~dprc/

Cell Phones
Prior to the beginning of each class, please remember to turn off your cell phone, or place it in the" vibrate" or "ringer off" mode.

Computer Use During Class
You are welcome to use a laptop computer in class when working on class assignments, for example. However, you will need to save checking email or other personal computer use for time outside of class. Most students find it disruptive when they are focusing on class activities or listening to presentations and can hear keyboarding in the classroom. Your kind consideration is greatly appreciated by all!

Course Standards and Grading Policy

- For assignments/projects done in pairs (or small groups), both partners (or all members) receive the same grade.
- Grades will reflect students' contributions in class discussions, quality of presentation, ability to lead discussion groups, completion and quality of course assignments, and demonstration of professionalism during in-class activities/discussions.
- If you miss more than 2 classes, you will be expected to withdraw from the course.
- All assignments/projects are expected on their due dates. Late assignments/projects will be docked 2 points for each day past the due date that they are submitted.
- Excused absences are allowed only in extreme cases, and according to university policy.
- Tardiness (25-minute late): 3 times = 1 absence

Requirements	Tentative Points (100)	Due
Attendance Professionalism In-class activities/experiments	12 5 17	--
ICAR - Instructional Conversations about the Readings –Discussion Leader (Individual)	15	See sign-up sheet
Science Unit Plan (Group Project)	25	See sign-up sheet: Paper is due on the day of your presentation
SST – Subject-Specific Task: Task 1 Context for Learning Form only Task 2 Planning Commentary and 2 Lesson Plans	 5 15 6	December 7

Tentative Grading System **Pts:**

A	----------	95 - 100
A -	----------	90 - 94
B +	----------	85 - 89
B	----------	81 - 84
B -	----------	75 - 80
C +	----------	70 - 74
C	----------	65 - 69
C -	----------	60 - 64
F	----------	below 60

Course Requirements

1. Attendance (12 points) and **professionalism** (5 points)
If you need to miss a class, please contact me by phone or e-mail. If you are absent, you are responsible for asking another class member to fill you in on what you missed including getting handouts. If you miss more than 2 classes, you will be expected to withdraw from the course. For every absence, a point will be deducted from the final points earned. Science is a participatory experience and due to the nature of the class, attendance is crucial and will factor into the final grade.

As it pertains to this course, professionalism refers to your overall attitude and approach to learning and teaching. Dimensions of professionalism include, but are not limited to, the quality of contributions you make in class, the nature of your collaborative efforts with peers and instructor, and the enthusiasm / interest you convey with regard to your personal professional development. In other words, it involves arriving on time and actively participating in every class discussion and group work, being open to peers and instructor's feedback/suggestions, being flexible to classroom challenges, and respecting peers and instructor during class discussions and activities. If problems arise in whole class or group culture that make it uncomfortable or difficult for you to fully participate, and you feel you need support resolving the issue, please discuss this with me in person or via e-mail.

2. (ICAR) Instructional Conversations about Readings (10 pts.) and **Science Activity Demo** (5 pts.)
[ESTELL FRAMEWORK: Promoting Science Talk and Contextualizing Science Activity]

To distill the readings assigned for class, there will be a designated amount of time during class where groups will discuss and make sense of the readings. Each week, 4-5 students (discussion leaders) will be required to individually lead and facilitate discussion about the readings. You will be responsible to lead a small group discussion. As a facilitator, you will also incorporate a brief demonstration of a relevant science activity covered in the readings. This selected activity should be tied in to the main issues addressed in the assigned reading and should address appropriate ESTELL framework. The science activity demonstration hopes to present the practical application of a particular theme/concept in the reading. Each discussion leader is given 25-30 minutes to facilitate the discussion and science demo to a group of 7-8 peers.

An ICAR Evaluation Form is attached in the syllabus.
On the day of your presentation, you should bring to class a 2-3-page handout for each group member (7 copies). **Be sure to turn in a copy of your handout to the instructor.** The handout should address the following points:

- Authors' Message. Write down your version of the author's main message in 2-3 sentences.
- Definition of Terms. List words for which you are unsure and define them in your **own words** (include examples where appropriate).

- Integration of Material with other Knowledge. Make connections of the learning in the assignment to ideas/concepts acquired in previous meetings or other learning situations. How do these ideas parallel or contradict other theories or readings you have done? Do the readings address a particular ESTELL pedagogy? Explain your answer/give examples.
- Application of the Material. Make a conscious effort to assess the possible application and implications of the material to learning settings. How might the information in the readings help your teaching of science? What do you consider to be the value and relevance of the information presented to your current student teaching placement?
- Questions. List down questions you would ask the group to initiate science talk and to build on peers' responses to science activity demo.
- Include in the last page of the handout a description of the selected science activity: topic/title, book citation, grade level, materials, and procedures. Describe briefly why you have chosen this activity.

To the discussion leaders: allocate time for each of the above section, making sure that everyone in your small group is providing their interpretation of the assigned readings. Optional: Toward the end of your discussion: on poster paper, create a visual representation of what the group learned from discussing the readings and from the activity (i.e. concept mapping, pictograph, or any form of graphic organizer). This is to be shared to the whole class. If time permits, leave the last 3 minutes to discuss the effectiveness of the group, including if all participated, did the discussion get off task? What might you have done differently?

While there are discussion leaders, it **does not** mean that the rest of the class does not have to do the readings. You are still responsible for doing the readings and to come to class prepared to share 2 written questions or comments that you have about the readings.

3. Unit Plan (25 pts.)
[Integrated ESTELL pedagogy]

In groups of 4, prepare a thematically related science unit that explicitly states the science content standards, content objectives, science process skills (COMIC-E), relevant ESTELL framework, and assessment plan. Your group will choose a theme or "big idea" relevant to your grade level/s standards. The unit must constitute a minimum of four hands-on/inquiry-based science activities incorporating varying levels of inquiry. The 4 related activities should be in K-1, 2-3, 4-5 or 6-8 grade spans. Specific instructions will be provided in class. A Science Unit Rubric will be handed out in class for your reference.

While you might be inspired by some activities on the Internet or any other source, they must be referenced and modified to fit the ESTELL framework. Your group will be required to share an outline of the unit and demonstrate one of the lessons in class. Each group member is expected to participate equally in this project and presentation.

4. SST (Subject-Specific Task) (26 pts.). See the attached instructions and rubrics from PACT (Performance Assessment for CA Teachers).
[Planning Instruction to meet ESTELL FRAMEWORK: Scaffolding Language & Literacy in Science *and* Contextualizing Science Activity]
You may use the 2 related lessons from your unit plan. I encourage you to see me for consultation.

5. In-class activities. These are lessons or activities/experiments done in class. The lessons model the ESTELL framework. See syllabus for scheduled class activities.
[Each science lesson will model specific ESTELL pedagogy.]

Tentative Schedule and Assignments

(The Professor reserves the right to make changes in the schedule as necessary.)

D A T E	TOPIC / ASSIGNMENT
8/31	Overview: Course Syllabus and ESTELL Project ESTELL Pre-Survey for Student Teachers (45 minutes) In-class activity Sign-up for course projects/assignments

Assignment:

1. Download CA Science Content Standards and bring to class (your grade level standards only)
2. Read "The Nature of Science and Science Inquiry" article, pp. 21-29 only (PDF, iLearn)
3. Read "The Many Levels of Inquiry" by Banchi & Bell (PDF, iLearn)

9/7	No Class (Labor Day) Reminders: Reading assignment
9/14	What is Science? / Science Inquiry Continuum ICAR to be modeled using assigned readings - ESTELL: Promoting Science Talk In-class activity: Buoyancy Intro to Science Lesson Planning / Looking at CA Science Standards ESTELL Framework

Assignment:

1. Read "BSCS 5E Instructional Model," pp. 29-32. NSTA, 2007. (PDF, iLearn)
2. Read: (Optional Textbook) Chapter 7: Designing Lessons: Inquiry Approach to Science Using SIOP Model, pp. 95-106. Fathman & Crowther, Eds.

9/21	Planning for Instruction / Developing Lesson Plan 5-E Learning Cycle Model (LCM) / Science Inquiry Discussion Leaders **(ICAR) –** Chapter 7 and NSTA articles In-class Activity: Properties of Matter ESTELL: Promoting Inquiry Skills

Assignment:

1. Read "Schoolyard Inquiry for English Language Learners," pp. 47-51, by Westervelt. Science Teacher. (PDF, iLearn)
2. Read: (Optional Textbook) Chapter 2: Learners, Programs and Teaching Practices, pp. 9-18. Fathman & Crowther, Eds.

9/28	Learning Theories: How Do Students Learn Science? ESTELL: Contextualizing Science Activity In-Class Activity: Schoolyard Investigation Discussion leaders **(ICAR)** – Westervelt and Chapter 2 articles

Assignment:

1. Read "Four Strands of Science Learning," (Chapter 2) by Michaels, et.al. (PDF, iLearn)
2. Read "Outdoor Classrooms – Planning Makes Perfect," pp. 44-48, by Haines. Science and Children. (PDF, iLearn)

10/5 Big Ideas in Science (National and State Science Standards)
In-Class Activity: Continuation of Schoolyard Investigation
Planning & Designing Scientific Investigation / COMIC-E science processes
Discussion leaders **(ICAR)** – Michaels and Haines articles

Assignment:
1. Read: "Sheltered Instruction Techniques for ELLs," pp.34-38, by Pray & Monhardt. Science and Children. (PDF, iLearn)
2. Read: (Optional Textbook) Chapter 4: Strategies for Teaching Science to English Learners, pp. 37-59. Fathman & Crowther.

10/12 Planning and Teaching for Diversity / Cross-cultural Science
In-Class activity: Arthropod
Discussion leaders **(ICAR)** – Pray and Fathman articles
Revisit ESTELL Framework and Unit Planning

Assignment:
1. Read: "Integrating Oral Communication and Science Instruction," by Freeman, G. & Taylor, V. In Integrating science and literacy instruction: A framework for bridging the gap.
2. Read "Science Conversations for Young Learners," pp. 43-45, by Sander & Nelson. Science and Children. (PDF, iLearn)

10/19 Promoting Complex Thinking and Inquiry Skills
Promoting Science Talk
In-Class activity: Investigating Skulls of Herbivores, Omnivores & Carnivores
Discussion leaders **(ICAR)** – Freeman & Sander articles

Assignment:
1. Read: Carr; Sexton; Lagunoff. 2007. "Scaffolding Science Learning" (Chapter 5, pp. 55-75). In Making Science Accessible to English Learners. (PDF, iLearn)
2. Read: "The Science Representation Continuum," pp. 52-55, by Olson, J. Science and Children. (PDF, iLearn)

10/26 No Class (Campus Closure: Furlough Day)
Reminders: Work on your SST (Science-Specific Task) or Science Unit

11/2 No Class (Quita Furlough Day)
Reminders: Assigned Readings/ICAR: Carr & Olson articles

11/9 Student Assessment in Science / Scaffolding Language & Literacy in Science
In-Class activity: Electricity
Discussion leaders **(ICAR)** – Carr & Olson articles

Assignment:
1. Bring a science textbook, science kit, or other science resource being used in your respective field placements. Bring the accompanying teacher's manual if available.

[Examples: FOSS, GEMS, AIMS, Delta Science Modules, etc.]
2. Read "Criteria for Selecting Inquiry-Centered Science Curriculum Materials," pp. 63-75. In Science for All Children.

11/16 Forms of Assessment in Science
In-class activity: Science Curriculum Evaluation
Scientific Investigation Presentation (2 groups)

Assignment:
1. "Seamless Assessment," pp. 41-45, by Volkmann & Abell. Science & Children. (PDF, iLearn)
2. Read (Optional Textbook) Chapter 5: Strategies for Assessing Science and Language Learning, pp. 61-75. Fathman & Crowther.

11/23 – 11/27 Fall Recess (No Classes)

Reminders: a) Work on your SST or Unit Plans, b) Visit this website and view the video segment: A Private Universe: Seasons & Phases of the Moon -- http://www.learner.org/resources/series28.html (scroll down the page and click the icon: **VoD**)

11/30 In-Class activity: Sun-Earth-Moon Investigation
Private Universe (Video Segment)
Discussion leaders **(ICAR)** – Volkmann and Fathman articles
Scientific Investigation Presentation (2 groups)

Assignment:
1. Read: "Teaching for Conceptual Change in Space Science," pp. 20-23, by Brunsell & Marcks (PDF, iLearn)
2. Read: "More than a Human Endeavor: Teaching the Nature of Science," pp. 43-47, by Olson, J. Science and Children. (PDF, iLearn)

12/7 Continue Moon Investigation
Misconceptions (or Alternative Frameworks) in Science
Whole Class Discussion & Application– Brunsell and Olson articles
Sharing Science Unit Plans (2 groups)
Due: SST (Task 1 Form and Task 2)

12/14 **Sharing: Science Unit Plans (2 groups)**
Assessment and Reflection
Post-Survey for Student Teachers: ESTELL Project

Suggested Science Lesson Plan Format

Lesson Title:
Grades:
Big Ideas/Unifying Themes:
Process Skills:
Vocabulary:

Intended Learning Outcomes: At the end of this lesson, students should be able to:
Three types:

1. Content knowledge (content specific knowledge described in the curriculum).

2. Skills and processes (COMIC-E, investigative skills, use of equipment, etc.).

3. Socially/Culturally relevant / Critical thinking (attitudes, social relevance, social action)

Instructional Resources / Materials / Technology - What materials will the teacher and the students need to make this a successful science lesson? Include examples of science content-based children's literature/picture books and relevant websites. Discuss appropriate technology integration to enhance and extend science concepts and processes.

CA Frameworks/Standards:

Lesson Development (or Procedures):

- This section details, in a step-by-step manner, the sequence of teaching that is planned in the lesson. Follow the **5-E Learning Cycle Model in Science Inquiry (Engagement, Exploration, Explanation, Evaluation, Extension)** in introducing and presenting the science concepts, processes, and application to real life situations.

- Include what you will say to move the children from one phase of the lesson to the next. If you intend, for example, to have them deepen their understanding through discussion and hands-on activities, you must include the prompts (questions) to scaffold the discussion.

- Identify and describe briefly the level/s of inquiry addressed in the lesson or sequence of activities (i.e. Structured Inquiry, Guided, Open/Full Inquiry).

- Include Assessment Plan (i.e. KWL, concept mapping, rubrics, journals, student demonstrations, quiz, worksheets, direct student observations, etc.).

Approx. Time	LESSON DEVELOPMENT (Content)	ESTELL Framework
5-10 min.	I. Introduction [Engagement: Attention-Activator, Brainstorming, or Discrepant Event/Demo]	
25-35 min.	II. Development [Exploration & Explanation: Hands-on Minds-on Activity or Learning Centers, Interactive Mini-lecture/PowerPoint Presentation	
10-15 min.	III. Closure / Evaluation [Review of information & experiences, Question & Answer session, Demo if needed, Homework] IV. Extension [Application]	

Instructional Conversations about the Readings (ICAR) and Science Activity Demo

Evaluation Form

NAME: _____ DATE: _____

I. Readings (Facilitation)

Demonstrates organizational skills in presenting the material; encourages science talk or dialogue to involve peers in sustained discussion; and engages members to come up with visual representation / summary of what the group learned:

5 4 3 2 1

The 2-page handout clearly synthesizes the authors' message, definition of terms, integration of material with other knowledge, application of the material, and relevant questions. A brief description of the accompanying science activity for demonstration is presented:

5 4 3 2 1

II. Science Activity Demo/Overview

The selected activity connects with the readings; effective use of materials/manipulatives to convey science concepts/principles; effective time management; clear contextualization of activity, and discusses pedagogies for ELLs:

5 4 3 2 1

TOTAL POINTS: 15 =

Additional Comments:

SAN DIEGO STATE UNIVERSITY
DEPARTMENT OF POLICY STUDIES IN LANGUAGE AND CROSS-CULTURAL EDUCATION
PLC 912: TEACHING SCIENCE FOR UNDERSTANDING TO BILINGUAL K-6 STUDENTS

Fall 2010-ESTELL

Professor, Science Education.
Office: BAM 225
Telephone: 594 – 2687 (office)
e-mail:arodrigu@mail.sdsu.edu (best way to contact me)

Office hours: Wednesdays before and after class or by appointment.

Meeting times: **Thursdays: 4:00 PM – 6:40 PM**

Site: CVLCC

Goals of the course:

One of the principal goals of this course is to provide you with opportunities to enhance your pedagogical knowledge and skills so that you can successfully complete your student teaching placement in bilingual school contexts. Hence, learning to teach science in this class will involve conceptualizing science as a verb and not as a noun. To make the distinction more clear, I prefer to use the term multicultural science education instead of science education when referring to the teaching and learning of science. I define multicultural science education as the process of actively engaging students in collaborative inquiry about what scientific theories, concepts, laws, and terms mean to them, and about what kind of impact science has on their immediate social world.

As you will find out, we will cover a wide variety of topics that should help you grow not only as an innovative and engaging teacher, but also as a science teacher who is concerned with making science education accessible to all students. Therefore, throughout the course, we will explore the role of the science teacher as an agent of social change. That is, an individual who actively contributes toward establishing a pluralist society by making the classroom one of the most important settings where gender equity, anti discriminatory principles and multicultural understanding are modeled and practiced.

Some specific objectives of the course:

At the end of this course, you should be able to:

1. List and contrast current models of science teaching and learning.

3. Demonstrate competence in the use of various learner-centered pedagogical strategies for bilingual students.

4. Develop collaborative, inquiry-based, bilingual, learner-centered unit plans.

5. Demonstrate competence in assessing student learning and in developing plans of action to meet students' needs.

6. Implement pro-active strategies to establish a safe classroom environment in which all students are encouraged to participate and express their views.

7. Demonstrate competence in the use of instructional technologies to enhance student learning.

8. Explain how his/her personal philosophy of teaching and learning contrasts with the College of Education's conceptual framework and with the State of California's Teacher Performance Expectations (TPE).

9. Demonstrate competence in teaching science in Spanish and/or in other predominant language in our local school districts.

Course Objectives Related to the PACT Task Assessment:

As you may be aware, you are also now required to complete additional requirements for certification by the California Commission on Teacher Credentialing (CCTC). This course will help you prepare for the **PACT Task Assessment** for science in the area of **planning** (CAT). In fact, the major assignment I have always used for this course is almost the same as what you are being expected to complete for the CAT. Thus, I have made some modifications of the major or signature assignment of the course to best assist in meeting the CAT requirements. More information can be found in the document that describes all assignments for the course.

Textbooks:

Required textbooks

"Science Education as a Pathway to Teaching Language Literacy." Edited by Alberto J. Rodriguez (2010). Sense Publishers (available at **KB Books**, SDSU 5187 College Avenue, 619-287-2665)

The following selected readings are posted on Blackboard (see timeline below for details).

Required Reading Assignments

Banchi, H., & Bell, R. (2008). The many levels of inquiry. *Science and Children.* October, 26-29.

Baumgarten, A. & Bacher, M. (2006). Planning science and English instruction: One teacher's experience. In In A. K. Fathman & D. T. Crowther (Eds). *Science for English Language Learners: K-12 Classroom Strategies*. Arlington: NSTA Press.

Brunsell, E., & Marcks, J. (2007) Teaching for conceptual change in space science. *Science Scope*. 1-4

Carr, J. (2007). Assessing English learners. In J. Carr, Ursula Sexton, & Rachel Lagunoff (Eds). *Making science accessible to English language learners: A guidebook for teachers*. San Francisco: WestEd.

Echevarria, J. & Colburn, A. (2006). Designing lessons: Inquiry approach to science using the SIOP model. In A. K. Fathman & D. T. Crowther (Eds). *Science for English Language Learners: K-12 Classroom Strategies*. Arlington: NSTA Press.

Freeman, G. & Taylor, V. (2006). Integrating language literacy and science instruction: A framework for bridging the gap. Rowman & Littlefield Education.

Huerta-Macias, A. (1998). Learning for Latinos: The sociocultural perspectives. In Gonzalez, M. L., Huerta-Macias, A, & Tinajero, J. (Eds). *Educating Latino children: A guide to successful practice*. Lancaster: Technical Publishing Co.

Medina-Jerez, W., Clark, D. B., Medina, A. & Ramirez-Marin, F. (2007) Science for ELL: Rethinking our approach. *The Science Teacher*. March, 52-56.

Moscovici, H. & Nelson, T. (1998) Shifting from activity mania. *Science and Children*. January 14-40.

NSTA Position Statement: Multicultural Science Education. http://www.nsta.org/about/positions/multicultural.aspx

Rodriguez, A. J. (2004). *Turning despondency into hope: Charting new paths to improve students' achievement and participation in science*. North Carolina: SERVE www.serve.org

Rodriguez, A. J. (1999). Making ethnicity invisible in the name of equity: Standard contradictions in the National Science education Standards. Multicultural Perspectives 1 (2), 3-7.

Rodriguez, A. J. (1998). Strategies for counterresistance: Toward sociotransformative constructivism and learning to teach science for diversity and understanding. *Journal of Research in Science Teaching*. 35 (6) 589-622.

Rosebery, Ann S. & Warren, Beth W. Teaching science to English Language Learners: Building on students' strengths. Arlington: NSTA Press.

Scott, J. (1993). *Science & Language Links: Classroom Implications.* Portsmouth, NH: Heinemann

Stoddart, T. (2010). Effective Science Teaching for English Language Learners: ESTELL Handbook.

Westerverlt, M. (2007) Schoolyard inquiry for English language learners. *The Science Teacher .* March, 47-51.

Recommended textbooks

"Science for English Learners: K-12 Classroom Strategies" by Anna K. Fathman and David T. Crowther (Eds). Published by the National Science Teachers Association. 2006.

"Science Education and Student Diversity: Synthesis and Research Agenda" by Okhee Lee and Aurolyn Luykx. Published by Cambridge. 2006.

"Teaching Science for Understanding: A Human Constructivist View" by Joel J.Mintzes, James H. Wandersee, & Joseph d. Novak. Published by Academic Press. 1997.

"Science in the Multicultural Classroom: A Guide to Teaching and Learning" by Robertta H. Barba. Published by Allyn & Bacon, 1998, 2nd edition.

"The National Science Education Standards" The National Research Council. 1996.

"Science Education for a Pluralist Society" by Michael Reiss. Published by the Open University Press, 1993.

"Constructing Science in Middle and Secondary School Classrooms" by Dale R. Baker and Michael D. Piburn

"The Content of Science: A Constructivist Approach to its Teaching and Learning" Edited by Peter Fensham, Richard Gunstone and Richard White. Published by Falmer Press, 1994

Additional references:

I will make articles and other materials available throughout the course as needed in order to meet specific interests. You will also be expected to have access to good science textbooks for your collaborative projects.

Students should have access to science textbooks in Spanish.

Evaluation Overview

As mentioned above, learning about multicultural science education involves hands-on and minds-on activities, discussion, and asking a lot of questions; hence, you are required to attend **all** classes, to actively interact with your peers, and to complete all the assignments. (Remember that one of the objectives of this class is to provide you with opportunities to practice what you are learning about teaching science).

Each of the assignments and/or projects listed below will be explained in more detail in class. You will also find a description for each assignment and/or project in your course packet. You are encouraged to read these ahead of time. I welcome your questions any time.

Your final grade will be determined by your performance on two broad areas:

Participation & Professional Behavior

- Active participation in class, attendance, and professional behavior 10%
- One-page written reactions to readings (RR) & leading paper-discussions 15%
- Written critique of another team's lesson plans (ECB work, see collaborative project in assignment handout) 5%

Participation total 30%

Major Projects (see packet for details on these assignments)

- Collaborative Curriculum Project **40%**
- Team Teaching **10%**
- Learning center & write up **20%**

Major Projects Total 70%

Grading: A =100-95 ; A- = 94-90; B+ = 89-85
B = 84-80; B- = 79-75; C+ = 74-70
C = 69-65 ; C- = 64-60; D+ = 59-55

IMPORTANT NOTES:

- Part of your preparation as a teacher includes following a professional code of behavior and responsibility. Therefore, you are expected to treat all members of the class and your instructor with respect. In order to demonstrate your abilities and desire to become an effective science teacher, you must actively

participate in class and display the kind of professional behavior and positive attitude you are expected to enact as a teacher graduating from our program.

- Keeping this in mind then, students who are tardy more than twice or miss one class without a medical, family emergency, or religious excuse will loose five points from their grade for each instance. If you miss more than two classes without a medical, family emergency, or religious excuse, you will be not be able to complete this course successfully. Therefore, I might request that your admission to the program be reviewed. You are required to call me as soon as possible if you think you will not be able to attend class to discuss make up work.
- Due to the nature of the assignments and projects in this course, all deadlines are firm. Of course, if you have any special circumstances, feel free to discuss these in advance. I will do whatever I can to assist you, but I cannot help if I do not know your situation. Your success in the class is very important to me.
- If any of the activities planned for class are in conflict with your religious beliefs, personal situations, and/or disabilities, feel free to discuss this in confidence with your instructor as soon as possible. You may also contact: The Office for Services for Students with Disabilities at 4-6473.
- This is a required course and we only have one semester to cover many topics; therefore, all assignments must be completed within the semester unless you have made arrangements in advance with your instructor. Note that you need to successfully complete this course to receive your teacher's certification.

College of Education's Conceptual Framework

You will notice that all aspects of this course are congruent with the College of Education's Goals, the State of California Teacher Professional Preparation Standards, and the National and State Science Education Standards. To make this connection more explicit, each seminar indicated in the course timeline (below) shows the relevant connection to the State of California's Teacher Performance Expectations (TPE). You are encouraged to refer to your Student Teaching Handbook for a full a description of each TPE.

You are my first priority, and I am committed to assisting you become an effective, caring and well-prepared science teacher. Feel free to ask questions any time. I check my e-mail often, and this is the easiest way to contact me. I would be glad to meet with you wherever is convenient for you if your schedule does not allow you to meet with me before or after class.

We need more dedicated and enthusiastic teachers who are committed to improving the science education opportunities available to all students. We are counting on you.

Have an intellectually stimulating and rewarding term!

TENTATIVE TIMELINE

Class Date	Class Topics & Activities	Assignments Due	TPE
Wk1. Aug. 25	Orientation: Syllabus and Signature Assignments Science content: Energy in an ecosystem/ El Juego de la Energia		# 1,6,7 ,8,9, 10,12
Wk2. Sep. 02	A. Science & the Inquiry Continuum B. Curriculum Development: B.1. Writing Inclusive, Inquiry-Based & Socially Relevant Science Lessons for CAT/PACT B.2 Critique of Lessons Plans Science content: Surface tension/ Milk explosion ESTELL Category: ➢ Collaborative Inquiry ➢ Science Talk	Bachi & Bell (2008) Baumngarten & Bacher, (2006), Chap. 3 Chapt. 1. Gee in Rodriguez (2010)	#1,2, 4,5, 6,7, 8,9 10,11 ,14, 15,16
Wk3. Sept. 09	Models of Teaching & Learning – Part I Individual constructivism, situated cognition, social constructivism & sociotransformative constructivism.	ESTELL Handbook (2009) Moscovici & Holmlund-Nelson (1998)	#1,2, 4,5,6 7,8,9 10,11 ,14, 15,16

	Science content: Biodiversity/School Garden ESTELL Category: Contextualizing Science Activity (Physical Environment & Ecology and Personal home/ community experiences).		
Class Date	**Class Topics & Activities**	**Assignments Due**	**TPE**
Wk4. Sept. 16	A. Models of Teaching & Learning -- Part II B. Using Instructional Technologies with ELL's Science content: Biodiversity/School Garden ESTELL Category: Contextualizing Science Activity (Physical Environment & Ecology and Personal home/ community experiences).	**Reading Reaction #1** (Westervelt, 2007); Rodriguez (2000) Rodriguez (Journal of Research in Science Teaching, 1998)	#1,2, 4,5,6 7,8,9 10,11 ,14, 15,16
Wk5. Sept. 23	Models of Teaching & Learning -- Part III Exploring the Meaning of "Social" in Social Constructivism Science content: Animal diversity / Skulls ESTELL Category: ➢ Collaborative Inquiry	Chapt. 6- Crowther in Rodriguez (2010) Revisit Rodriguez (1998, 2000) **CCP Proposal due**	#1,2, 4,5,6 7,8,9 10,11 ,14, 15,16

	➢ Scientific reasoning and understanding.		
Class Date	**Class Topics & Activities**	**Assignments Due**	**TPE**
Wk6. Sept. 30	Connecting Multicultural Science Education and Models of Teaching & Learning with the Bilingual Learner Science content: Earth's Moon Language & Literacy in Science ➢ *Authentic (Western/Non-Western) Science Literacy* Scientific reasoning and understanding. ➢ *Science Vocabulary*	**Reading Reaction #2** Brunsell & Marcks, 2007. Chapt. 2- Rodriguez & Zozakiewicz in Rodriguez (2010) NSTA Mission Statement on Multi. Science Education.	#1,2, 4,5,6 7,8,9 10,11 ,14, 15,16
Wk7. Oct. 07	Using Alternate/ Performance Assessment Science content: Earth's Moon ESTELL Category: Language & Literacy in Science ➢ *Authentic (Western/Non-Western) Science Literacy* Scientific reasoning and understanding. ➢ *Science Vocabulary*	**Reading Reaction Paper # 3**. Chapt. 5 - Cleveland et al in Rodriguez (2010); Rodriguez (2004-Monograph). Carr (2006).	#2, 4,5,7 11,12 ,13,1 415,1 6

Class Date	**Class Topics & Activities**	**Assignments Due**	**TPE**
Wk8. Oct. 14	Lesson Planning for Cross-Cultural Education/Critiquing Canned (Commercial) Curriculum <u>Science content</u>: Electricity <u>ESTELL Category</u>: Scaffolding Language & Literacy in Science	**Reading Reaction Paper # 4** Rodriguez (1999)	#2,3 4,5,7 8,9, 10,13
Wk9. Oct. 21	Collaborative Curriculum Project Workshop	Bring one completed lesson from CCP for feedback. Bring other resources and be prepared to work with team members.	#9, 10,13 14,15 16
Wk10 Oct. 28	Model building & Planning for Cross-Cultural Education - Part I <u>Science content</u>: Arthropods <u>ESTELL Category</u>: Collaborative Inquiry Science Talk Contextualization	**Learning Center Proposal** Revisit ESTELL Handbook – Review all categories.	#9, 10,13 14,15 16

Wk11. Nov. 04	Model building & Planning for Cross-Cultural Education - Part II <u>Science content</u>: Arthropods <u>ESTELL Category</u>: Collaborative Inquiry Science Talk Contextualization	Revisit ESTELL Handbook – Review all categories.	#9, 10,13
Class Date	**Class Topics & Activities**	**Assignments Due**	**TPE**
Wk12 Nov. 11	Veteran's Day Memorial – No Classes		
Wk13 Nov. 18	Team Teaching I	Bring materials & copies of activities **ECB Critiques Due**	#9, 10,13
Wk14 Nov. 25	**<u>Harvest Holiday</u>** **<u>No Classes</u>**	**CCP Due Wed. Nov 24 for those who are done**	
Wk15 Dec. 02	Team Teaching II		#9, 10,13
Wk16 Dec. 08	Learning Center Exhibition	**Bring completed LC's with enough materials for several student groups.** **Learning Center write up.**	#2,4 7,8,9 10,13

BIODIVERSITY IN THE SCHOOLYARD

DR. MEREDITH HOULE

This series of lessons demonstrates some ways you could leverage the outdoor spaces around your school (even in a highly urbanized schoolyard) to study a variety of scientific phenomena. The focus here is on identifying characteristics of the schoolyard ecosystem to decide where to place a wildlife habitat/native plants garden.

Note regarding prior knowledge: This lesson does assume some prior knowledge about plants. In particular that plants require certain nutrients in the soil, as well as sunlight and water for growth.

Day 1:
Students are introduced the overall problem and project – CA is a biodiversity hotspot but that diversity is threatened by habitat loss among other factors. The project will be to create a wildlife garden to increase the biodiversity on their schoolyard. Prior to beginning the project, students complete a short pre-assessment about their understanding of biodiversity and discuss what is biodiversity. By the end of day 1, students have chosen two or three potential locations for their wildlife habitat.

Day 2:
Students collect field data on their two sites to determine which site would make the best wildlife habitat. This data collection may be done in the field or based on soil samples and digital photos taken by the students or instructor between sessions. Using the data collected, they construct a scientific argument on where their wildlife garden should be sited.

Additional Websites for Reference

National Wildlife Federation's Schoolyard Habitat Project,
http://www.nwf.org/gardenforwildlife/

Michigan State University's Environmental Literacy Project,
http://edr1.educ.msu.edu/EnvironmentalLit/index.htm

School Garden Wizard
http://www.schoolgardenwizard.org/

California Native Plant Society's Education Program
http://www.cnps.org/cnps/education/

Learning Outcomes

By the end of this lesson, the students should be able to:

- Define biodiversity and describe why it is important
- Design an investigation to compare the biodiversity at two sites
- Use evidence collected to make a recommendation
- Describe some ways to improve local biodiversity
- Provide an example of how people from different cultures used knowledge of biodiversity in agriculture.

Standards:

- CA, Gr.2/2d. Students know there is variation among individuals of one kind within a population.
- CA, Gr.2/2e. Students know light, gravity, touch, or environmental stress can affect the germination, growth, and development of plants.
- CA, Gr. 3/3c. Students know living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
- CA, Gr. 3/3d. Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.
- CA, Gr.4/3b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
- CA, Gr.6/5c. Students know populations of organisms can be categorized by the functions they serve in an ecosystem.
- CA, Gr.6/5d. Students know different kinds of organisms may play similar ecological roles in similar biomes.
- CA, Gr.6/5e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

BIODIVERSITY VOCABULARY

ENGLISH	SPANISH	ENGLISH	SPANISH
Biodiversity	Biodiversidad	Community	Comunidad
Organism	Organismo	Interdependence	Interdependencia
Population	Poblacion	Phosphorous	Fosforo
Natural selection	Seleccion natural	Nitrogen	Nitrogeno
Endemic species	Species endemicas	Potassium	Potasio
Biological hot spot	Area biologica importante	Biotic	Biotico
Biomes	Biomas	Abiotic	Abiotico
Habitat	Habitat		

Materials

- Data Sheet
- Microsoft Excel, Google Spreadsheets or other software for analyzing data **OR** graph paper
- PowerPoint OR chart paper (for presentations)
- Copies of data (either available digitally, paper or posted on board)
- 1 long piece of string tied to make a large circle (approx 3 m, but should be standardized across all groups) OR hoola hoop
- magnifying glass
- ruler
- Trowel
- Paper Plates or white napkins
- thermometer
- soil test kit (such as http://www.acornnaturalists.com/store/NITROGEN-PHOSPHOROUS-POTASSIUM-NPK-SOIL-TEST-KIT-P2095C0.aspx)
- Jelly Jar or 1 liter bottle (at least one per site)
- science notebook or investigation sheet
- pen or pencil
- map of schoolyard

Day 1. Introducing Biodiversity

Time	Lesson Content/ Instructional Move	ESTELL Framework
15 min	I. Introduction a. Assessing prior knowledge [Quiz] • In pairs (mixed ability) students complete pretest questions drawn from MSUs *Environmental Science Literacy* project. (See Handout #1) • *Differentiated instruction:* Provide a vocabulary list and individual support to ELLs. b. Discuss Reponses/Review Biodiversity [Whole Class Discussion] • Review responses to get a sense of where students are in their understanding of biodiversity (considering across levels, e.g., organism (genetic), population (natural selection), community (assembly, interdependence) • Differentiated instruction: Post vocabulary table as a vocabulary wall and cross check terms used by students o Why is biodiversity important in the food webs? (Irish potato blight vs. Peruvian potato farming)	Contextualizing Science Activity
		Language &

5 min	II. Development a. Defining Biodiversity [Think-Pair-Share] • In pairs (same as above) students come up with a definition of what is biodiversity and why it is important • Have students share some of their definitions as a class • Remind them, they can revise and expand their definitions over time	Literacy in Science
5 min	b. Introduce Problem/Project [Powerpoint/Mini-Lecture] • California is biological hotspot, high biodiversity and high number of endemic species • CA's diversity is threatened by habitat loss due to agriculture and development, as well as other factors such as air pollution, water issues, …. • As a class, we will design a wildlife habitat on our schoolyard to help improve the biodiversity of our schoolyard. First we need to figure out where the best place would be.	Contextualizing Science Activity
30-40 min	c. Picking Potential Sites Step 1: Deciding how to Decide [Whole Class Brainstorm/concept map] • Ask students: What criteria should we use to decide where we should put our site o *Possible responses include access to water (hoses), proximity to human contact, proximity to the classroom window for observations, current biodiversity of the site, available space, soil quality, available sunlight, etc.* o Separate the criteria into two lists (data currently available from experience or maps and data they will need to collect in the field) Step 2: Picking potential sites (round 1) [Small group Discussion, heterogeneous groupings] • In small groups, have students rank or tier the available data criteria based on their perceived importance • Handout copies of a map of the schoolyard the students use the criteria to pick one or two potential sites • (*Note if green space is very limited, these "sites" could be container gardens) Step 3: Decide on Potential Sites [Whole Class Discussion] • Project image of schoolyard, have groups share where and why they chose a given site(s) • As a class decide on two (maximum three) potential sites Step 4: Discuss data collection [Whole Class Discussion] (collect some ecological data (abiotic & biotic) • Biotic data may include biodiversity of plants, insects • Abiotic data may include soil quality (composition,	Scientific Reasoning & understanding through inquiry Science Talk Collaborative Inquiry

	moisture), amount of shade/sun, etc Step : Plan for next class: • In groups (same as above), develop and write out a plan to collect data, including: Where? What data? Assign roles and responsibilities (e.g., Sara will be responsible for plant biodiversity, Tom for soil quality, etc.)	
5 min	III. Closure: Quick write: What factor do you think will be most important in choosing a school garden site and why? Sentence frame: I think _____ will be most important because_____.If time, discuss opinions.	Language & Literacy in Science

Day 2: Collecting Data and Picking a Site

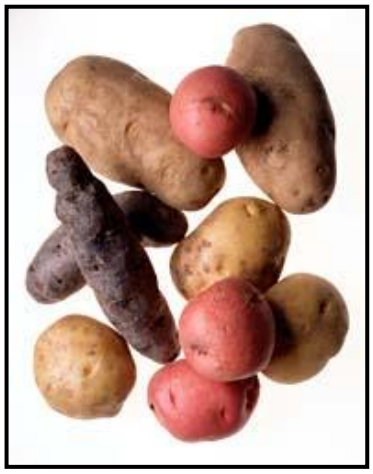
Time	Lesson Content/ Instructional Move	ESTELL Framework
5 min	I. Tie-in/Orientation [Review, Q&A] a. Review last class/Set-up Field Data collection • Project image of schoolyard with the two "potential" sites for the wildlife habitat highlighted. • Assign groups (same as last class) to one of the two sites. • Review data collection (note, instructor may need to revise based on desired data collected) • Remind students to assign roles within groups to be efficient as we will have limited time in the field.	
30 min	II. Development a. Collect Data in the field [Investigation & data gathering] In heterogeneous groups as above students complete Handout #2 (see attached)	
15 min	b. Sharing Data [Analyzing data] • Return to classroom, and create large tables on the board • Have students record their summary data on the board OR have students enter into a shared Google spreadsheet OR Microsoft Excel • Compile and average data for each factor at each site	
30 min	c. Analyzing and Making Sense of Data [Analyzing data/Developing arguments] • In the same groups, have students complete the handout *Using Evidence to Choose a Site for our Wildlife Garden* including writing an argument (See Handout #3) • Emphasize that an argument needs to contain a claim, evidence & reasoning. • As a class, share and discuss which site people picked and their evidence and reasoning for these sites. Encourage students to use visuals images of the sight, and graphic representations of their data.	Scientific Reasoning & Understanding through Inquiry Collaborative Inquiry
10 min	d. Next Steps [brainstorm, whole class] • Discuss as a class what the next steps might be if you were going to continue the project.	Collaborative Inquiry
15 min	III. Closure [Integrating literacy/Writing persuasive arguments] (see Handout #4) b. Have students draft a letter to the principal or school board which includes: • Why increasing biodiversity is important	Language & Literacy in Science

	(environmentally, socially, culturally); • How your garden could increase biodiversity in your schoolyard; • Evidence for where you school garden should be located (see argument you wrote above); • Steps that will need to be taken for your garden to become a reality.	

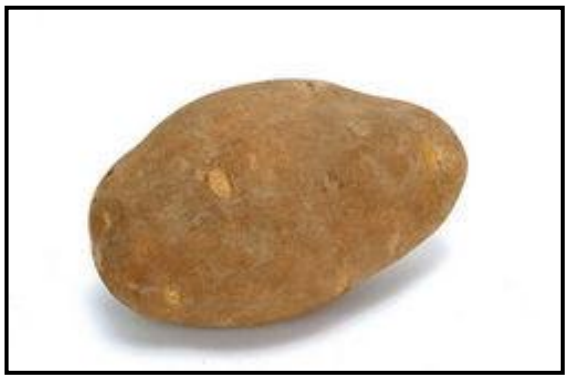
Handout #1 Biodiversity Prior Knowledge Assessment

Problem 1. Potatoes

When Europeans first came to Peru, they found that the Peruvians were growing a crop that they had never seen before: potatoes. Each Peruvian field contained many types of potatoes, as shown in the picture on the left. The Europeans worked hard to improve Peruvian potatoes. Eventually they developed potatoes like the one on the right—all bigger and providing more food than Peruvian potatoes.



Peruvian fields (Picture A)



European fields (Picture B)

1a. What do you think the Europeans did to get their big, uniform potatoes from smaller, more variable Peruvian potatoes?

1b In the mid 1800's, the potato blight killed most of the potato crop in Ireland, a European country, resulting in starvation and the death of about one million people. How was this related to their decision to plant only one type of potato?

Handout #2: Data Collection

Materials:

- 1 long piece of string
- magnifying glass
- ruler
- Trowel
- Paper Plates or white napkins
- thermometer
- soil test kit (such as http://www.acornnaturalists.com/store/NITROGEN-PHOSPHOROUS-POTASSIUM-NPK-SOIL-TEST-KIT-P2095C0.aspx)
- Jelly Jar or 1 liter bottle (at least one per site)
- science notebook or investigation sheet
- pen or pencil
- map of schoolyard
-

Activity:

1. Read through the handout and review assigned jobs from previous class
2. Using the map, find the potential site you were assigned
3. Find a space, and spread your long piece on the ground in a circle
4. Mark the location of your quadrat on the map
5. Based on your assigned roles, collect data as described below

Observations:

Sketch your entire area in the square below

Part 1. Bi

1. COUNT how many different kinds of plants do you see? _____

DRAW and DESCRIBE some of the plants found in your quadrat.

2. COUNT how many different kinds of insects do you see? _____
[*Remember, look in the air, on the leaves and stems of plants, and on the ground (under rocks or in the surface of the soil]*

DRAW and DESCRIBE some insects.

Part 2. Abiotic Measure: Soil Quality

1. Inspect Soil

- Take a trowel of soil and dump it onto a white plate or napkin.
- Using the magnifying glass, and your fingers inspect it.

2. DRAW and DESCRIBE the soil below:

Draw:

Describe: (what color is it? What is the texture like? What does it smell like?)

3. FEEL your soil.
Circle the closest response: VERY WET DAMP DRY

4. SOIL COMPOSITION TEST. Fill the jar/bottle approximately 2/3 with soil. Fill with water and shake vigorously for 1-2 minutes. (This test can take up to 24 hours (for the soil to settle), you may want to do this ahead of time and have available for observation) Measure the width of each band of soil particulates that settle out.

Soil Type	Band width (cm)	Percent Composition
Sand		
Silt		
Clay		
Organic matter		

SOIL NUTRIENT TESTS. Take three samples of soil from your square. Nitrogen, Phosphorus and Potassium are all nutrients (food sources) that need to be in the soil for plants to grow.

Follow the direction for the test kit and record your results below.

TEST	Sample 1	Sample 2	Sample 3	Average
Nitrogen				
Phosphorus				
Potassium				

Why do you think you are asked to take **3** samples?

Part 3. Abiotic: Sunlight and Temperature

SUNLIGHT

1. How much sunlight does your square have right now: [Circle the Closest Answer]

   Full Shade Mostly Shade Half Shade/Half Sun Mostly Sun Full Sun

2. Based on the location of buildings and Trees around your square, do you think your square _____?

   - gets full sun for part of the day? YES/NO (circle)
   - is fully shaded for part of the day? YES/NO (circle)

TEMPERATURE

3. For three locations in your square, take the temperature just above the soil (1 inch) and just below the soil surface.

[To take the soil temperature, carefully insert the tip of the thermometer into the soil approximately one inch. You may need to use the trowel to loosen the soil but be careful to not disturb the soil too much or your temperature reading will not be accurate.]

Location	Sample 1	Sample 2	Sample 3	Average
Air Temperature				
Soil Temperature				

Part 4. Evidence of Human Impact

What evidence do you see of people impact the site? This might include sprinklers, trash, trampling/walking through, gardening, etc.

For each item, indicate whether you think this has a high, moderate, low or no impact on the living things in your site. For example, a walkway might be evidence of human impact. The impact of this walkway might be *High* if it looks like the soil is very compacted and the walkway is used frequently, *Moderate* if it looks like it is occasionally used, and *Low* if it runs right next to your quadrat (circle) but it is unlikely or only rarely that people walk off the path into your quadrat (circle)

Evidence of Human Impact	Impact Level (circle)			
1.	HIGH	MODERATE	LOW	NONE
2.	HIGH	MODERATE	LOW	NONE
3.	HIGH	MODERATE	LOW	NONE
4.	HIGH	MODERATE	LOW	NONE
5.	HIGH	MODERATE	LOW	NONE
6.	HIGH	MODERATE	LOW	NONE
7.	HIGH	MODERATE	LOW	NONE
8.	HIGH	MODERATE	LOW	NONE
9.	HIGH	MODERATE	LOW	NONE
10.	HIGH	MODERATE	LOW	NONE

Handout #3 Data Analysis

Using Evidence to Choose a Site for our Wildlife Garden

1. Compare the data for the two sites

a. On what measures are the sites most similar?

b. On what measures are the sites most different?

2. Based on these data, as a group, write an argument as to why you think these data suggest you should choose a Site A or B.

Claim (State which site you feel should be chosen for your schoolyard wildlife habitat):

Evidence (What evidence do you have from your observations of the site and the data you collected support your claim? Include at one piece of evidence from each type of data collected (e.g. biotic, abiotic: soil, abiotic: sunlight & temperature, human impact). OR at least two p

Reasoning (Why is this evidence relevant? How would this evidence suggest that this site would make a good site for a wildlife habitat to increase biodiversity in your schoolyard?)

Next Steps

List the steps you would need to take to create a wildlife garden in your schoolyard. What additional information would you need? How would you go about collecting it?

Handout #4: Letter to Principal or School Board.

Write a letter to the principal or school board. This letter should include:

- Why increasing biodiversity is important (environmentally, socially, culturally);
- How your garden could increase biodiversity in your schoolyard;
- Evidence for where you school garden should be located (see argument you wrote above);
- Steps that will need to be taken for your garden to become a reality.

What can we Learn About Animals by Looking at Their Skulls?

Dr. Isabel Quita, SFSU

Methods Instructor's Page

This page is to be used in conjunction with the Animal Skulls Lessons. Below, some suggestions and more information are provided for teachers and/or student teachers interested in conducting these lessons in their classrooms. Included in this page are useful background information and resources as teachers facilitate inquiry activities for the target grade level/s students.

Overview of Lessons:

Based on the structure and design of an animal's skull and teeth, students can infer many of its dietary and social patterns. Skulls provide rich information: identification of the species, animal's eating preferences, gender, size and much more. In fact, after skulls investigation, students can write or tell their own authentic stories behind each animal skull, with proper science language & literacy and visual scaffolding. The guided inquiries are designed using the 5E learning cycle model to provide a student-centered and planned sequence of instruction (engagement, exploration, explanation, evaluation, and extension).

Differentiated Instruction for target grade level/s students

Science inquiry engages students in meaningful learning. Inquiry process is characterized by interactive, student-centered activities focused on questioning, exploring, posing explanations, arguing from evidence/data, and assessment throughout the learning cycle. Explicit modeling of relevant ESTELL practices and constant use of the following strategies are evident in this mini-unit:

1. Use flexible grouping and small group instruction on a regular basis. Frequent regrouping is encouraged based on the complexity of the content, student interest, student learning styles, and other classroom needs.
2. Have a variety of physical models, visuals, informational texts, non-fiction readers, and other resources available for student use. Supporting materials (i.e. written descriptions and graphic images) for investigation should be readily available. A student with above or below grade-level reading ability will benefit from studying informational texts at the appropriate level.
3. Engage students in culturally inclusive activities (i.e. Bringing in a variety of cultural food, demonstrating uses of different teeth structure, valuing dental/health hygiene).
4. Differentiate assessment tools: verbal & written presentations, use of science notebooks, journals, forms of graphic organizers, etc.

Note to Methods Instructors: The series of activities is intended for elementary students grades 1-4, with appropriate modifications in the presentation of materials, teaching strategies, grouping & management systems, and assessment plans. The presentation of concepts and activities are modeled after the 5E Learning Cycle Model (Engagement, Exploration, Explanation, Evaluation, and Extension Phases of Inquiry). Credential candidates will perform the activities and after each activity, discussions will cover how specific ESTELL practices are explicitly demonstrated. Also, the Inquiry Continuum (structured, guided, and open inquiry) and other pedagogical strategies will be addressed.

[More engaging visuals/photos/diagrams are presented in the PowerPoint slides.]

Day 1: Describing the Types of Teeth and Their Uses
[Modified from CA Academy of Sciences, Skulls of Herbivore/Omnivore/Carnivore Kit]

Activity 1- What do teeth do for you and for other animals?

Objective: This activity is designed to engage students in thinking about the many different things animals can do with their teeth.

Instructions: Arrange students in mixed groups of 4-5 according to language ability. On a piece of paper, write down as many teeth-related verbs as you can think of in one minute (i.e. chew, bite, grind). You are free to list responses in different languages with translations. One student in the group is the recorder. When time is up, have the recorder give the paper to another student in the group to read the list aloud to the whole class. One student will come to the word wall and generate a class list on poster paper, successively adding all the words that were not mentioned by previous groups. One of the students in the group may act out/role play the verbs. The class list will be posted on the word wall.

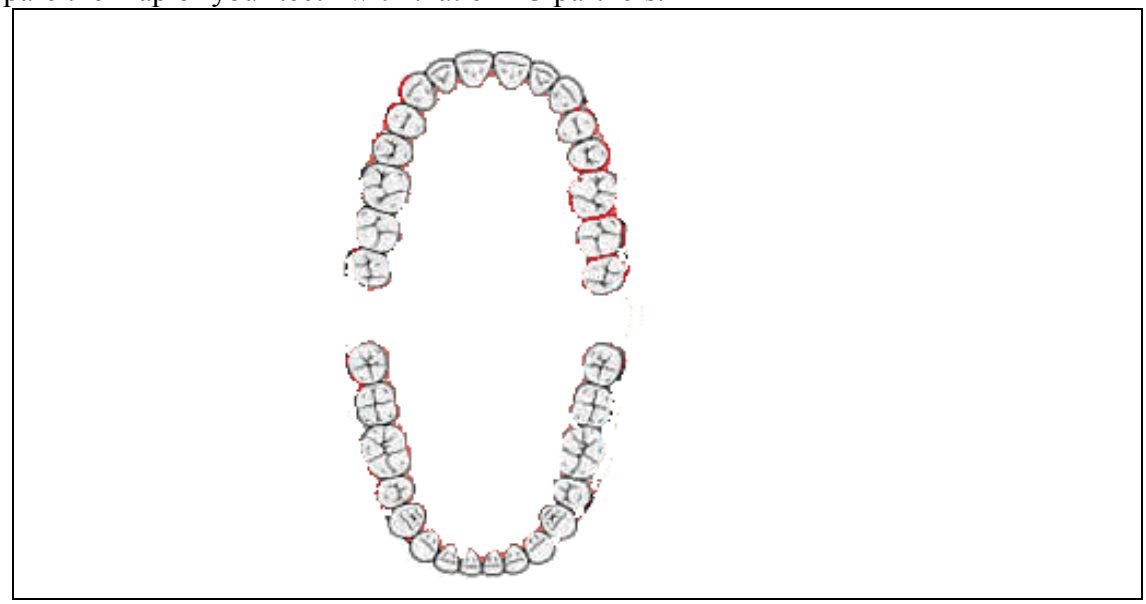
Possible answers:

bite, break, browse, chatter, chew, chip, chomp, chow, click, clip, crack, crunch, crush, cut, dig, display, divide, gnash, gnaw, grasp, grate, graze, grind, grip, kill, masticate, mush, nibble, nip, pierce, pinch, pull, puncture, rip, root, seize, separate, sever, shear, shred, slice, smoosh, snip, squeeze, stab, strip, tear, ---- and more!

Activity 2: Investigating your Teeth
Note: Be sure to wash your hands thoroughly before this activity.

Use a small mirror and look at your teeth. Count your teeth using your tongue or clean fingers. How many teeth do you have? _____

Does this diagram have more teeth than you do? Cross out any teeth that you are missing. (Option: Color the incisors blue, the canines red, and the pre-molars and molars green.)
Compare the map of your teeth with that of 2-3 partners.



Describe your **incisors** or front most teeth:

Describe your **canines** or the teeth in front of the jaws:

Describe your **premolars** or the teeth located between the canines and molars:

Describe your **molars** or the back most teeth in the jaw:

NOTE:
Guide questions to promote science talk:

a) How many teeth do you have?

b) What are the different types of teeth? How are they similar and different?

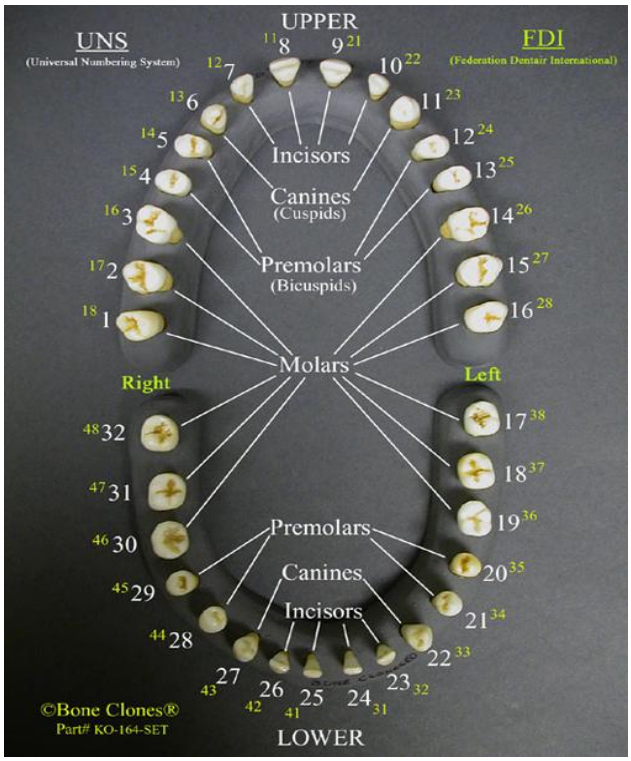
c) Compare the map/diagram of your teeth with that of your partner's.

d) How should we take care of our teeth?

Background Information
Human Teeth:
Incisor (I): the front most teeth in the jaw, shovel shaped, used for cutting or slicing food. These teeth are also called *anterior* teeth.
Canine (C): the pointed teeth in front of the jaws used for piercing and tearing food
Premolars (P): teeth located between the canines and molars, used for chewing
Molars (M): the back most teeth in the jaw, also called *posterior* teeth; used for mastication to ensure your food passes properly down your throat and into your stomach. Molars have a large flat chewing surface that can break down food easily.

Adults have 32 permanent teeth: 8 incisors, 4 canines, 8 pre-molars, 12 molars.
Young children (age 5) who have all their baby teeth have 20 teeth: 8 incisors, 4 canines, 8 molars.
Between ages 6-8, the first permanent molars are added.
Between ages 11-13, the second permanent molars are added.
Between ages 16-22, the third permanent molars are added.

Human Adult Teeth



Activity 3: Explore the Functions of your Teeth
How do you eat your food?

Note to Instructors: This activity can be made more culturally inclusive by bringing foods from various cultures—include sweets to stress care later during the class discussion.

1. Review the types of teeth & their uses: incisors, canines, premolars and molars.
2. Table group: write down the different types of food your teacher has given you. Circle the teeth you use to eat each one.

Food: Carrots
Incisors
Canines
Premolars and molars

Food: Beef Jerky or Dried Mango
Incisors
Canines
Premolars and molars

Food: Different kinds of Nuts
Incisors
Canines
Premolars and molars

Food: Banana
Incisors
Canines
Premolars and molars

a) For each type of tooth describe how that tooth helps you to eat the food. You may refer to the list of verbs (action words) posted on the word wall.

Incisors: The front most teeth in the jaw are used for
chopping food, cutting, slicing food _____.

Canines: The pointed teeth in front of the jaws are used for
tearing, piercing food, _ _____.

Premolars: Teeth located between the canines and molars are used for
chewing, mastication of food, crushing _____.

Molars: The back most teeth in the jaw are used for
grinding, mastication of food to ensure food passes properly down the throat.

b) Continue to discuss with your peers ways on how to take care of your teeth.



Day 2: Examining Models of Animal Skulls

Activity 4: Investigating Skulls
What Can We Learn From Skulls?

Each group will be given a numbered skull. Observe closely any significant features (i.e. its teeth, eye socket, etc.) and share with your group members.

1. Fill out the chart below:

Skull #	**√ Type of Teeth**	**Functions of teeth / Food this animal used to eat**	What is your guess of which animal this might be?
	Incisor = **Canine =** **Pre/Molar =**		
	Incisor = **Canine =** **Pre/Molar =**		
	Incisor = **Canine =** **Pre/Molar =**		

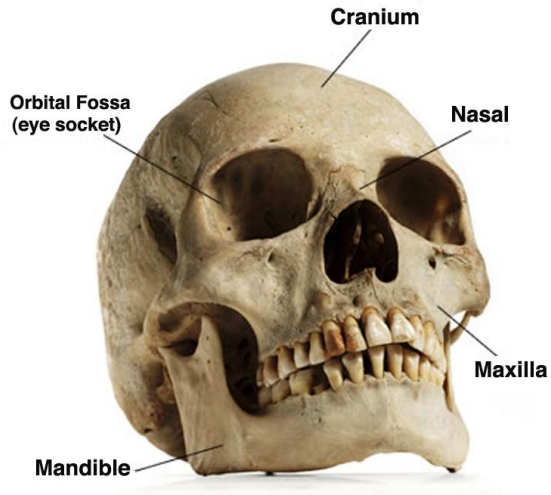
2. Based on the information you have, which type of animal do you think it is? (An Herbivore, Omnivore, or Carnivore?)

3. What other questions do you have about this animal?

Possible Answers:

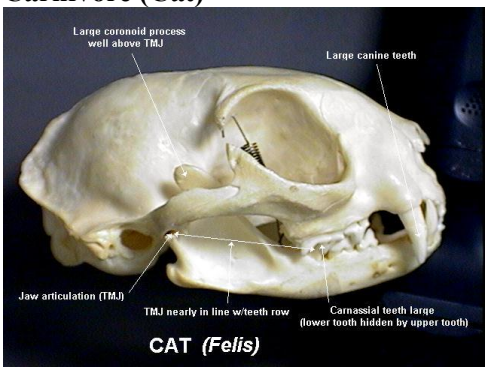
A. Herbivores: porcupine, rabbit, sheep, deer, beaver, koala
B. Omnivore: baboon, raccoon, bear, opossum, peccary (a kind of pig), skunk
C. Carnivore: bobcat, coyote, dog, cat, tiger, gray fox

Human Adult Skull

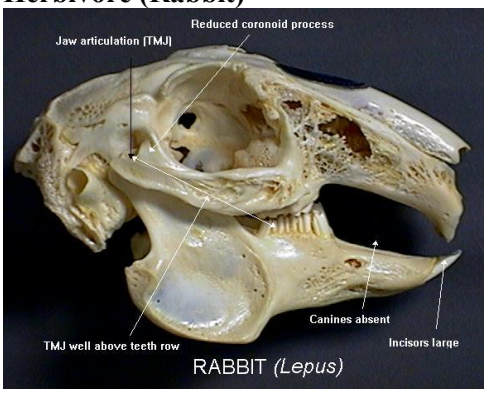


SAMPLE SKULL PHOTOS for Activity 4 (These skulls will be numbered, no labels attached.)

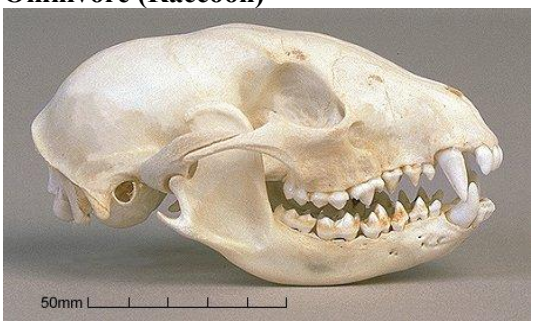
Carnivore (Cat)



Herbivore (Rabbit)

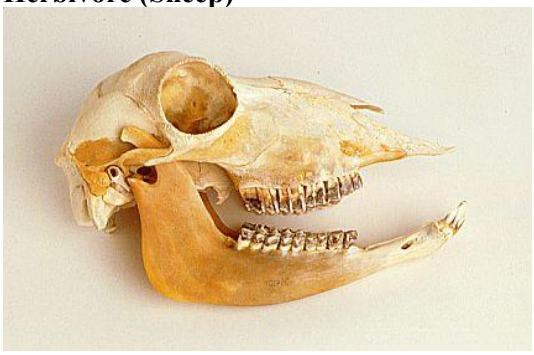


Omnivore (Raccoon)



Carnivore (Tiger)

Herbivore (Sheep)



Omnivore (Bear)

Option: For open inquiry, at the start of the unit, each table group will develop a research question about skulls. To be able to answer the research question, students will gather data and information through research (i.e. Web-based materials/sources, expert interviews, visit to CA Academy of Sciences or virtual museums with skulls gallery photos, textbooks/curriculum materials with similar themes). Students share to the class (through display boards) their research findings and other information related to their research questions.

Sample research questions framed by fifth graders:

- How can we tell, by looking at a skull, what or who the ancestors might be?
- How can you tell if it is a herbivore, carnivore, or omnivore by examining the skull?
- Why do animal babies have soft spots?
- How can you tell if it is a male or female by looking at the skull?

Closure and Reflections for Credential Students:

- Review the Intended Learning Outcomes and briefly discuss how they were covered.
- Reflect on assessment plan, management systems, groupings, ESTELL framework/pedagogy
- Review the levels of inquiry demonstrated
- Discuss the relevance of these big ideas: animal structure & function, biodiversity, etc. – Why is this theme important? How was this lesson culturally inclusive, student centered?
- Deconstruct lesson plans

Online Resources:

CA Academy of Sciences: Skulls -- http://www.calacademy.org/exhibits/skulls/
This website explores more fully rotatable skulls, presents skull facts with images, and describes skulls in culture.
Virtual shapes of teeth -- http://www.toothclub.gov.hk/en/en_teens_02_01_03.html
Skulls Unlimited International -- http://www.skullsunlimited.com/

Children's Literature/Non-fiction Readers:

Brown, Harry. (1997). "Which?" Guide to Children's Health. ISBN: 0852026552.

Collard, S. (2008). Teeth. Charlesbridge Publishing. (ISBN: 10:1580891217). – Grades K-3.

Curry, Don. (2005). Take Care of Your Teeth. ISBN: 10: 0516279157. Reading level: Ages 4-8.

Goulding, Sylvia. Taking Care of Your Teeth (Healthy Kids). ISBN: 1842343165.

Kalman, Bobbie's Series (2007)—Reading Level, Ages 4-8:

What is a Carnivore? (Science Big Ideas). Crabtree Publishing. ISBN-10: 0778732940;

What is a Herbivore? ISBN: 10: 0778732959; What is an Omnivore? ISBN: 10:0778732967

Lynch, W. (2001). Whose Teeth are These (Whose? Animal Series). ISBN: 10:1552852040. Reading level: Ages 4-8.

Pallotta, Jerry. (2002). The Skull Alphabet Book. Charlesbridge Publishing Inc. ISBN-10: 0881069159