How to Use Strategic Science Teaching

Conceptual Statement
These statements represent the California Science Standards re-stated to express the deep understanding of the content standards. They are stated in grade level language.

Essential Questions
These questions serve as doorways into focused yet lively discussion, inquiry and research. Essential Questions are designed to elicit a variety of plausible approaches to the more specific understandings of the lesson.

Conceptual Learning Sequence
The lesson provided represents only a portion of a unit of study in the content area. The lesson is planned as an introductory, embedded or culminating experience, within an expanded unit of study.

Student Outcomes
The learning experiences in the lesson will result in the student outcomes stated here that reflect both science learning and the use of a learning strategy that supports the use of literature and expository text.

Lesson Overview
This statement provides a sequential synopsis of the lesson. It identifies how students will use the specific literature selection with a "Learning Strategy" and a science investigation that will lead to the "Student Outcomes."

English Language Learners
The learning strategies for English Language Learners are identified by the hand icon and are explained within the lessons.

Literature in the Science Learning Cycle
The 5 E instructional model is used as a template for the holistic lesson design. Each lesson identifies where in the 5 E model or the Science Learning Cycle the literature selection is introduced and is emphasized and a science learning activity. Specific icons for each "E" in the Science Learning Cycle accompany this description.

Learning Strategy
Specific strategies from *Strategic Teaching and Learning*, (CDE, 2000) are identified for each lesson. The specific Learning Strategy is explained in the context of the lesson and is included in it's generic form in the appendix.

Literature Selection
Each book used as the basis for a Strategic Science Teaching lesson is annotated here. The book title is also found on the California Department of Education Recommended Readings in Science Related Literature list http://www.cde.gov

Grade 6

Title of Lesson:

Quake Safe Buildings

Conceptual Statement:

Human habitats can be changed due to earthquakes resulting from plate movements.

Essential Question:

How do movements of Earth's surface impact human and wildlife habitats?

Conceptual Learning Sequence:

This lesson is the culmination of a conceptual unit focusing on Earth's plates, the movement of those plates, and the effects of earthquakes on human environments. As the lesson unfolds, students discover how the motion of Earth and the structural design of a building can determine the ability of a building to withstand the powerful force of an earthquake.

Student Outcomes:

- Students review the natural phenomena of earthquakes and learn how the force released in an earthquake can cause structural damage to buildings.
- Students test various structural designs of building to determine "quake-safeness."
- Students use "Graphic Outlining" as they review the book *Earthquakes* by Seymour Simon.

Lesson Overview:

In this lesson, students read the book *Earthquakes* and use "Graphic Outlining," to graphically organize information on earthquakes and their consequences. The literature selection serves as a review as well as leading students to predict and discover new information about earthquake motion and its consequences. Students test various structural designs for a building.

English Language Learning:

English Language Development standards are referenced in the lesson where appropriate. The hand icon appears throughout the lesson when learning strategies and lesson components are identified as pathways for academic success and reflect critical developmental differences for students who are English language learners.

Literature in the Science Learning Cycle:

The book *Earthquakes* is utilized in the ENGAGE stage to connect to students' prior knowledge and in the EXPLORE stage to focus the students' investigation on structural stability as it relates to surface motion.

Learning Strategy:

Students use "Graphic Outlining" with *Earthquakes* to highlight the organizational pattern of the text. This strategy helps students organize what they read, leads them to predict what may come next, and integrate the new information they encounter. (See Appendix, pages 162-163).

Literature Selection:

Title: *Earthquakes*
Author: Simon, Seymour
Publisher: William Morrow, 1991 ISBN: 0688096336
Annotation: This book, from award-winning science writer Seymour Simon, examines the mysteries surrounding earthquakes. Why do they happen? Why are they more frequent in certain areas? What can people do to protect themselves and their property? Simon combines a detailed, clear text with actual photographs to provide some surprising answers.
Genre: Nonfiction

How to Use Strategic Science Teaching

Grade 6

California Content Standards:*

Science: Grade 6, Earth Science

Plate Tectonics and Earth's Structure

1. Plate tectonics accounts for important features of Earth's surface and major geologic events. As a basis for understanding this concept:
   - c. Students know lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to move ments in the mantle.
   - d. Students know that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface.
   - e. Students know major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions.
   - g. Students know how to determine the epicenter of an earthquake and know that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construc tion in the region.

2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:
   - d. Students know earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

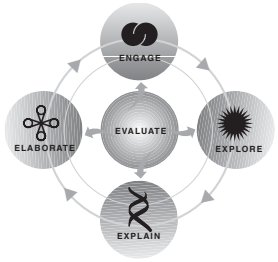
7. Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- a. Develop a hypothesis.
- b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
- c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
- d. Communicate the steps and results from an investigation in written reports and oral presentations.
- g. Interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions).

*Selected standards addressed within this lesson.

Lesson at a Glance



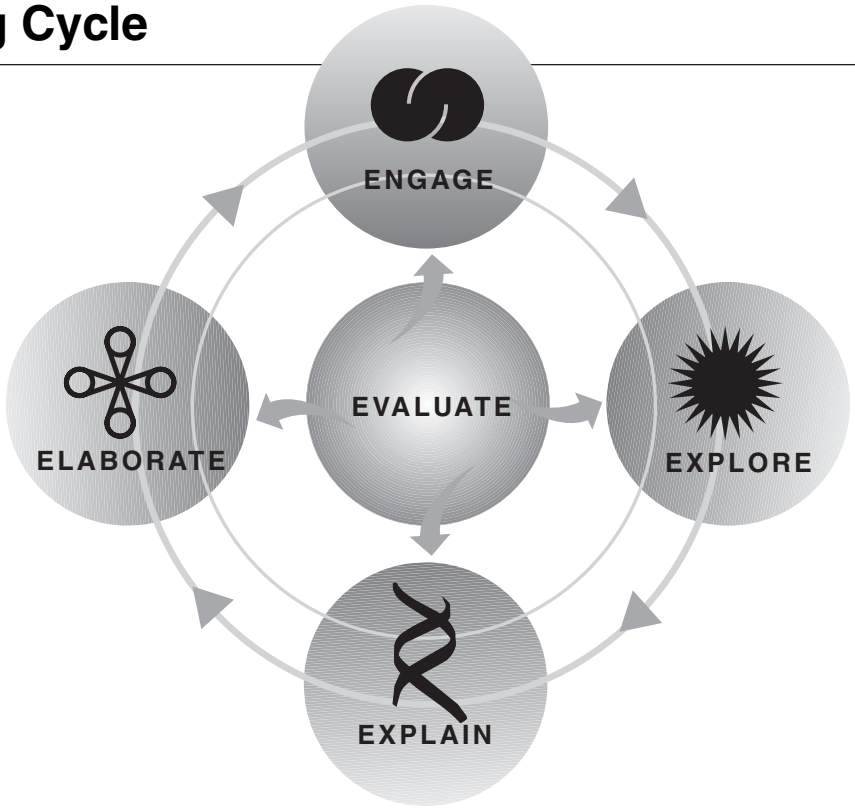
Science Learning Cycle	Objective Science Thinking Process	Suggested Time
ENGAGE	Students read *Earthquakes* to engage them in thinking about the causes of earthquakes. They graphically outline the literature selection, making connections to their prior knowledge. Communicating, Categorizing	30 minutes
EXPLORE	Students explore the literature selection for evidence of structural damage. They connect photos in the text to a teacher demonstration and the students' own investigation of structural design to determine "quake-safeness." Observing, Comparing, Analyzing	1 hour
EXPLAIN	Students whiteboard, relate their findings, and explain their data to the class while comparing information found in *Earthquakes*. Communicating, Relating, Contrasting	1 hour
EVALUATE	Students evaluate their understanding of force and structural design as they build models and test them for structural integrity. Students compare their findings to real scenarios. Teacher evaluates student understanding of student outcomes in this activity as well as throughout the lesson. Communicating, Inferring, Applying	2 hours
ELABORATE	Using a variety of resources, students research building destruction caused by earthquakes and relate the building design to "quake-safeness." Communicating, Inferring, Applying	1 hour

Science Standard
The Science Content Standards for California Public Schools, Kindergarten through Grade 12 (CDE, 2000) that are addressed in the lesson are specifically cited.

Lesson at a Glance
This visual overview of the Science Learning Cycle for the selected reading selection and science investigation not only prepares the teacher for the grade level lesson but also provides the teacher with a template that can be replicated to develop additional lessons.

Icons
Icons identify where the book (literature selection) or learning strategy is applied or where English Language Learners are supported in the cycle.

The Learning Cycle



Students come to our classroom with prior knowledge and experiences. Through their participation in active learning, student extend this knowledge, challenge their assumptions and conceptions, and build meaning out of their experiences. There are many instructional models that address the basis of learning.

In the scientific community, the instructional model known as the 5E's is commonly recognized as an excellent "learning cycle." This model aligns closely with the processes used in scientific and technological enterprises, and builds on the work of Karplus and Atkin. The model is supported by educational research on conceptual change; congruence with the general process of scientific inquiry and technological design; utility for designing and developing curriculum materials; and practical uses by science teachers (Bybee, 1997). The 5E Instructional Model can be used to help frame the sequence and organizations of lessons, units and programs. It can inform the many instantaneous instructional decisions a science teacher must make in teaching to meet student needs.

Each lesson in *Strategic Science Teaching* was developed using the 5E Instructional Model. In so doing, the authors of this document have emphasized science teaching that envisions students as both knowing and doing science. The model provides a framework for teachers to reflect on their own lesson designs and practices. It helps teachers refine or re-design their intended student outcomes and the related strategies/activities that support and maximize learning.

The model consists of five stages: **ENGAGE, EXPLORE, EXPLAIN, ELABORATE** and **EVALUATE**. These stages have specific functions that contribute to students' construction of a better understanding of scientific and technological knowledge, attitudes and skills. The actual application of each stage might not be as clear in a classroom setting as outlined below; still the model contributes to better, more consistent and coherent instruction. The 5E sequence includes:

ENGAGE: This stage initiates the learning task and is designed to make connections between past and present learning experiences. The teacher designs the ENGAGE stage to create interest, generate curiosity, raise questions and problems, and elicit student prior/current knowledge about the concept/topic.

EXPLORE: This stage provides the student with a common basis of experiences within which current concepts, processes and skills are identified and developed. The teacher designs activities that encourage students to think creatively within the limits of the activity; to propose preliminary predictions and hypotheses; to "puzzle" through problems; and to try alternatives to solve a problem.

EXPLAIN: In this stage, students have opportunities to demonstrate/explain their conceptual understanding, process skills or behaviors. Students question each other's explanations as well as interact with the teacher who directs student attention to specific aspects of the ENGAGE and EXPLORE experiences. The EXPLAIN stage provides a way or ordering and giving common language to the exploratory experiences.

ELABORATE: The teacher provides activities that challenge and extend the students' conceptual understanding and skills. Through new experiences, the students apply their learning to different experiences in order to develop deeper understanding, more information and necessary skills.

EVALUATE: While evaluation of learning goals is done throughout the 5E's, the EVALUATE stage provides a distinct opportunity to encourage students to assess their understanding and abilities. This stage also provides opportunities for teachers to evaluate student progress and look for evidence that students have changed or deepened their thinking.