Introduction to Kindergarten Through Grade Two

Students in kindergarten through fifth grade begin to develop an understanding of the four disciplinary core ideas: physical sciences; life sciences; Earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them.

The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain more complex phenomena in the four disciplines as they progress to middle school and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

— NGSS Lead States, *Next Generation Science Standards for States By States*.

When children arrive on the first day of school in kindergarten, they are already scientists and engineers. Children are naturally curious about the world, motivated to learn about it, and anxious to find ways to make it better. Early elementary teachers cultivate this curiosity and give students foundations for implementing the **science and engineering practices (SEP)** in later grades. The SEPs, like all three dimensions of the California Next Generation Science Standards (CA NGSS), build in complexity in an age-appropriate manner and look very different in K–2 than they do in high school. Appendixes E, F and G of the national version of the Next Generation Science Standards (NGSS) outline these progressions for each dimension and table 3.1 shows one way to interpret the SEPs for grades K–2. Children use these practices to understand everyday life events (*phenomena*), and CA NGSS-aligned instruction should begin with and be based around these real-world experiences. In particular, K–2 instruction focuses on recognizing **patterns [CCC-1]** in what students observe. Under the learning progressions in the CA NGSS, these patterns will be explained in later years, leaving early elementary students to focus on exuberant exploration with their senses and early attempts at making sense of what they discover.

The CA NGSS do not specify which phenomena to explore or the order in which to address topics because phenomena need to be relevant to the students that live in each community and should flow in an authentic manner. This chapter illustrates one possible set of phenomena that will help students achieve the CA NGSS performance expectations (PEs). The phenomena chosen for this statewide document will not be ideal for every classroom in a state as large and diverse as California. Teachers are therefore encouraged to select phenomena that will engage their students and use this chapter's examples as inspiration for designing their own instructional sequence.

In this framework, overarching phenomena that frame entire sequences of instruction are called *anchoring phenomena* while smaller and more focused phenomena are called *investigative phenomena*. While all phenomena ideally should be relevant to students' lives, cultures, and experiences, sometimes instruction draws attention to specific events that occur as *everyday phenomena*. Some phenomena introduce challenges that require engineering solutions, and in these cases it makes sense to focus on the anchor, investigative, or everyday problem rather than the phenomenon itself.

In this chapter's examples, each year is divided into instructional segments (IS) centered on questions about observations of a specific anchoring phenomenon. Different phenomena require different amounts of investigation to explore and understand, so each instructional segment should take a different fraction of the school year. As students achieve the performance expectations within the instructional segment, they uncover **disciplinary core ideas (DCIs)** from the different disciplines of science (physical science, life science, and Earth and space science) and engineering. Students engage in multiple practices in each instructional segment, not only those explicitly indicated in the performance expectations. Students also focus on one or two **crosscutting concepts (CCCs)** as tools to make sense of their observations and investigations; the CCCs are recurring themes in all disciplines of science and engineering and help tie these seemingly disparate fields together.

The SEPs, DCIs, and CCCs grow in sophistication and complexity throughout the K–12 sequence. While this chapter calls out examples of the three dimensions in the text using color-coding, each element should be interpreted with this grade-appropriate complexity in mind (appendix 1 of this framework clarifies the expectations at each grade span in the developmental progression).

Table 3-1. Age Appropriate Science and Engineering Practices

AS STATED IN STANDARDS	ADAPTED FOR K–2
Asking questions (science)/Defining problems (engineering)	Wondering (science)/Deciding the "rules" (engineering)
Developing and using models	Drawing diagrams and building models to represent how things work.
Planning and carrying out investigations	Doing "exploriments"
Analyzing and interpreting data	Comparing and looking for patterns
Using mathematical and computational thinking	Counting and measuring
Constructing explanations (science)/ Designing solutions (engineering)	Describing what happened (science)/ Tinkering (engineering)
Engaging in argument from evidence	"I think ____ because I see or know ____."
Obtaining, evaluating, and communicating information	Writing, drawing, or talking (acting out) about what we know, read, and understand about new discoveries (things) (ELA connections)

How can science fit into an early elementary teacher's busy agenda? This document explicitly illustrates strategic connections across the disciplines (mathematics, English language arts, history/social science, arts, and health). While these integrations are crucial, specific time must be devoted to science itself as students directly engage in the SEPs to explore their world. The common experiences students share provide a platform that supports language development and motivates mathematics, accelerating progress in those fields rather than detracting from them.

As teachers design their own instructional segments, they should consider the amount of observable data students need to collect across a certain time period in order to observe relevant **patterns [CCC-1]** from the data. For example, IS4 in kindergarten focuses on weather and climate investigations. To be successful, weather observation should be carried out over different times during the year to allow for some variability in weather conditions. To broaden the scope of data, teachers can creatively engage families and expanded-learning programs to build upon classroom learning experiences.