Chapter 2
Transitional Kindergarten

2016 Science Framework

FOR CALIFORNIA PUBLIC SCHOOLS
Kindergarten Through Grade Twelve

Adopted by the California State Board of Education
November 2016

Published by the California Department of Education Sacramento, June 2018

To view the remaining sections of the 2016 California Science Framework on the CDE website, go to:
https://www.cde.ca.gov/ci/sc/cf/casciencefamework2016.asp

Items in this document that relate to crosscutting concepts are highlighted in green and followed by the abbreviation CCC in brackets, **[CCC]**, with a number corresponding to the concept. The same items that correspond to the science and engineering practices are highlighted in blue and followed by the abbreviation SEP in brackets, **[SEP]**, with a number corresponding to the practice.

The Web links in this document have been replaced with links that redirect the reader to a California Department of Education (CDE) Web page containing the actual Web addresses and short descriptions. Here the reader can access the Web page referenced in the text. This approach allows CDE to ensure the links remain current.

Transitional Kindergarten

This page intentionally blank.

Introduction to Transitional Kindergarten

Young children are natural explorers and builders; they are innately curious about the world, motivated to learn about it, and anxious to find ways to make it better. Early childhood educators are charged with helping direct that energy toward activities that cultivate curiosity, patience, perseverance, and a love of learning. The overall goal of the California Next Generation Science Standards (CA NGSS) in early childhood education is not to produce "little scientists" that act and talk like professionals, but instead put students on a track to become "big scientists." This process is gradual and the CA NGSS lay out a progression of practices and understandings that unfold in a developmentally appropriate manner. The CA NGSS define a set of **science and engineering practices (SEPs)**, **disciplinary core ideas (DCIs)**, and **crosscutting concepts (CCCs)** and describe how the implementation and expression of these ideas and activities change as students progress from kindergarten through high school (appendix 1 of this framework).

Recognizing the importance of early childhood education, California's *Education Code* Section 48000(d) defines transitional kindergarten (TK) as "the first year of a two-year kindergarten program that uses a modified kindergarten curriculum that is age and developmentally appropriate." The CA NGSS do not have grade-specific expectations for early childhood or TK, so this chapter outlines key elements of developmentally appropriate science at this level. As with all learning at this developmental level, teaching science in TK requires supporting children's development in language (including primary language and English for dual language/English learners), analysis and reasoning, symbolization or representation, and the emotional and social skills needed to learn and work with others.

Aligning Key Instructional Shifts of the CA NGSS with TK

Teaching science at the TK level should follow the same overarching principles of the CA NGSS outlined in the "Overview" chapter of this framework (chapter 1) where students engage in doing science, thinking about science, and understanding science. The *California Preschool Curriculum Framework* (*CA Preschool Framework*) (California Department of Education [CDE] 2012b) provides guidance to teachers on teaching strategies, setting up environments, and planning curriculum in a way that is also developmentally appropriate for science learning for TK students. However, the *CA Preschool Framework* predates the adoption of the CA NGSS. What needs to change? Chapter 1 of this framework describes three key instructional shifts in the CA NGSS, and these align closely with best practices of early childhood education in science from the *CA Preschool Framework*.

Phenomena-Driven Learning

Events in the natural and constructed world, or *phenomena*, are at the heart of instruction in the CA NGSS. Young children learn by directly experiencing these phenomena. Teachers can intentionally set up materials and learning environments that promote rich engagement and hands-on experiences. Learning through experience takes sustained engagement with the same ideas over weeks, months, and even years (National Research Council [NRC] 2007, 3); this means that students need ongoing access to the same set of materials and conversations rather than jumping from one idea to the next too quickly.

Science is driven by curiosity about the natural world, so a primary objective is to cultivate curiosity at the TK level. Teachers are essential for setting up the environment, scaffolding the exploration, and guiding language development around the phenomena. But teachers also play the role of "explorer in chief"; students **ask more questions [SEP-1]** and explore more boldly when their teacher demonstrates his or her own curiosity (Engel 2013).

One of the best ways to encourage engagement with phenomena and cultivate curiosity is to present anomalies, ask for explanation, and encourage informal learning through play (Gopnik 2012). Play not only allows for socio-emotional development, but it is also deeply cognitive and designed to help children learn. Outdoor play allows children to direct their own exploration and investigation while dramatic or pretend play is a method of processing and communicating information.

Coherent Instruction Across the Curriculum

Making discoveries through authentic exposure to rich real-world experiences in science and other domains such as language development, beginning early literacy, music, and

mathematics, prepares children in the TK classroom for the CA NGSS they will be mastering in kindergarten. TK is a particularly critical time for language development that sets the foundation for all future learning, including science and engineering. Science activities should therefore include scaffolding for language and vocabulary acquisition through rich discourse prompted by teacher questioning and through teacher-student and student-student interactions. Experiential learning in science is a key opportunity to learn new vocabulary because new words are needed to communicate about the explorations. The teacher or another child introduces words because they are relevant to the discourse. Repeated use of new words in relevant contexts underpins all language development for children of this age. Note that the emphasis in TK is not on science-specific terminology but rather the use of science as a platform to learn everyday and academic language.

As stated in the *California Preschool Learning Foundations* (CDE 2012a), "Language is a tool of communication used in all developmental domains. Children who are English learners need to be supported not only in activities focused on language and literacy, but across the entire curriculum." All children, particularly children at the *beginning* and *middle* levels of English-language acquisition, may show knowledge and skills in other domains such as science and engineering using their home language. Hands-on activities therefore support the growth of skills in these domains and should be designed so that they promote the language development of all students.

Learning Relevant to Student Experience and Community Needs

The CA NGSS brings two new opportunities to science learning that make it more relevant to science and the future needs of communities: engineering and environmental literacy. These elements were added to prepare students to be future citizens and leaders capable of making informed decisions to address key issues facing modern society. This broader goal is an endpoint that develops gradually over the entire TK–12 span. The child-centered, local focus of TK serves as an important first step on this progression.

California's Environmental Principles and Concepts (EP&Cs) are a fundamental component of the CA NGSS that stress human relationships with the natural world. Transitional kindergarten students begin building this relationship by spending time outdoors, and observing and appreciating the world around them (even when that world is entirely urban). A school with a creek has a clear advantage over an urban one at providing access to the natural world, but all California students should experience the world around them (whatever it may be). There are opportunities to make this happen in all school settings that build foundations of environmental literacy. In addition to observing all forms of life (ranging from weeds growing in

cracks to coyotes leaping schoolyard fences), students can experience patterns in weather, shadows and light, and feel the range of different materials that make up their environment.

Engineering concepts and practices at this early age are grounded in solving problems. One aspect of engineering involves physically creating things such as building structures with blocks, toy construction sets, or other three-dimensional construction materials and exploring the properties of materials. However, engineering is not only about physical solutions but includes developing processes and procedures that solve a range of real-world problems. Many of the problems students will face in the next generation are related to human-induced changes to the environment. Engineering can create solutions that reduce human impacts.

The California Preschool Learning Foundations and the CA NGSS

This section discusses learning progressions that bridge from the California Preschool Learning Foundations for science (CDE 2012a) to the CA NGSS for kindergarten. Students develop the interest, curiosity, language, and habits of mind needed to pursue science when TK teachers support students' development of both fundamental abilities for analysis and reasoning and for graphic and symbolic representation of their ideas.

Unlike preschool or kindergarten, TK does not have grade-specific content standards. The guidelines in this section reflect the range of abilities students may possess in the period between preschool and kindergarten, but are not specific to a grade-level standard. The Preschool Learning Foundations for science describe the behaviors and skills children typically exhibit "at around 48 months of age" and "at around 60 months of age" (CDE 2012a). Transitional kindergarten teachers commonly use these foundations to guide curriculum development, as children are not yet 60 months when they enter TK. Transitional kindergarten students are not expected to master the kindergarten standards until the end of kindergarten.

The California Preschool Learning Foundations were designed for all children, including dual language learners and children with disabilities. However, dual language learning children may understand more quickly through instruction in their home language, and children with disabilities or other special needs may require adaptations or modifications (CDE 2012a).

The California Preschool Learning Foundations for science are organized in four strands:

1. Scientific Inquiry
2. Physical Sciences
3. Life Sciences
4. Earth Sciences

Within these foundations, the Scientific Inquiry strand focuses on developing the skills and language of science. In the CA NGSS, similar skills are called **science and engineering practices (SEPs)**. One shift of the CA NGSS is that the SEPs are not separated from the other strands but are tools for acquiring understanding of core ideas within each discipline. The term *three-dimensional learning* in the CA NGSS refers to this integration of the science and engineering practices, disciplinary core ideas, and crosscutting concepts. The CA NGSS define **disciplinary core ideas (DCIs)** in physical, life, Earth and space sciences and engineering. Students engage in the science and engineering practices to understand the DCIs.The third dimension, **crosscutting concepts (CCCs)** help students explore connections across the four domains of science (physical science, life science, Earth and space science, and engineering design). These ideas, DCIs, SEPs, and CCCs, are fundamental ways of thinking about and asking questions that tie together all disciplines or strands of science. Even though the California Preschool Learning Foundations do not directly include CCCs, young children can explicitly consider the CCCs as they explore phenomena. For example, children can observe that sorting objects by color or size reveals an underlying set of **patterns [CCC-1]** in the classification of the objects. Or, children can do something to an object (pushing a ball on a table) and then observe what happens next (the ball may fall off the table). The understanding of this **cause and effect [CCC-2]** mechanism enables them to make predictions about future events.

The California Preschool Learning Foundations predate the adoption of the CA NGSS and therefore do not correlate directly to them. The tables in this chapter show one possible alignment between these two documents.

Science and Engineering Practices in TK

The SEPs, like all three dimensions of CA NGSS, build in complexity in an age-appropriate manner and look very different in TK–2 than they do in high school. Table 2.1 shows one way to interpret the SEPs for kindergarten through grade two. It serves as a simplified guide to the practices.

Table 2.1. Age Appropriate Science and Engineering Practices

AS STATED IN STANDARDS	ADAPTED FOR TK–2
Asking questions (science)/Defining problems (engineering)	Wondering (science)/Deciding the "rules" (engineering)
Developing and using models	Drawing diagrams, building models, and discovering ways to think about 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)

Table 2.2 outlines connections between the scientific inquiry strand of the California Preschool Learning Foundations and the SEPs from the CA NGSS. The table illustrates what the SEPs might look like at the TK level. The table also includes ideas for how teachers can prompt or question children to further develop these practices in the context of children's spontaneous activities and observations. The descriptors for the kindergarten SEPs in table 2.2 come directly from appendix 1 of this framework for grade span K–2.

Two SEPs from the CA NGSS are not included in table 2.2 but are a part of TK instruction. There are many activities that can develop TK **mathematical thinking [SEP-5]**, including counting and measuring. For example, cooking (which is full of measurement) has been shown to be an effective strategy to improve science learning (Saçkes et al. 2011). The other CA NGSS SEP missing from the table is **developing models [SEP-2]**. Foundations

for modeling in TK include making representational drawings and diagrams (pictorial models). Making a drawing that represents a block structure a child has built as described above, or a chart that represents the growing of a plant week after week through a series of drawings of the plant at different stages are two examples. Students also develop internal mental models through play and interaction with the world. They actively apply these models to predicting outcomes. They slowly develop the language skills necessary to articulate their mental models (turning them into conceptual models that can be shared and refined as a community).

Disciplinary Core Ideas and Crosscutting Concepts in TK

Table 2.3 shows example connections between the California Preschool Learning Foundations for science and the DCIs in physical science, life science, and Earth and space science. Each foundation topic also includes a suggested link to an appropriate CCC. Teachers deepen and extend a child's thinking about the concept by using age-appropriate versions of the questions associated with each CCC presented in the overview chapter.

Other Resources

To ensure that TK meets the instructional and developmental needs of young learners, ongoing collaboration between instructional experts and curriculum developers at both the school and district levels is necessary to develop a coherent articulation across preschool to TK and to kindergarten.

The CDE has published a document, *The Alignment of the California Preschool Learning Foundations with Key Early Education Resources*[1] https://www.cde.ca.gov/ci/sc/cf/ch2.asp#link1 that connects the California Infant/Toddler Learning and Development Foundations, Head Start Child Development and Early Learning Framework, *California Preschool Learning Foundations (CDE 2012a)*, and the California Common Core State Standards. This resource and others presented in the *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve* and the *English Language Arts/English Language Development Framework for California Public Schools: Kindergarten Through Grade Twelve* provide additional opportunities to create a more interdisciplinary curriculum. The frameworks and other early childhood education resources can be downloaded from the California Department of Education Web site: https://www.cde.ca.gov/ci/sc/cf/ch2.asp#link2.

1. *The Alignment of the California Preschool Learning Foundations with Key Early Education Resources* predates the adoption of the CA NGSS. The standards listed in the alignment document are now-outdated standards from 1998.

Alignment Tables Linking California Preschool Learning Foundations to the CA NGSS

Table 2.2. Alignment of California Preschool Learning Foundations to the Science and Engineering Practices

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE AND ENGINEERING PRACTICES
1.0 Observation and Investigation		
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.1 Demonstrate curiosity and raise simple questions about objects and events in their environment.	**1.1 Demonstrate curiosity and increased ability to raise questions about objects and events in their environment.**	**SEP-1 Asking questions and defining problems** • Ask questions based on observations to find more information about the natural and/or designed world(s).
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Wondering why the toy car does not roll down the ramp, picks up the car and discovers that it is missing one wheel. • Sees a snail and wonders, *Why is it hiding inside? When is it coming out?*	• When playing in the block area creates a sloped ramp with blocks and rolls different toy cars down the ramp. Checks which car goes the farthest when rolling down the ramp. • While sorting different rocks, picks up one of the rocks and washes it with soap and water. Then gets the magnifying glass to observe it more closely.	• Respond to student questions with questioning to prompt further investigation or analysis of the problem. • Provide opportunities and materials for students to follow up on their questions and interests about natural or engineered phenomena. • Choose and read aloud books and stories that follow up on student questions and interests.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.2 Observe objects and events in the environment and describe them.	**1.2 Observe objects and events in the environment and describe them in greater detail.**	**SEP-3 Planning and carrying out investigations** • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. **SEP-4 Analyzing and interpreting data** • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions. **SEP-6 Constructing explanations and designing solutions** • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. **SEP-8 Obtaining, evaluating, and communicating information** • Describe how specific images (e.g., a diagram showing how a machine works) support a scientific or engineering idea. • Use information from observations to construct an evidence-based account. • Communicate information in oral form using models and drawings that provide detail.
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• A child with a visual impairment touches the bark of a tree and communicates, "It feels a little scratchy when I touch the bark." • Tastes a piece of red apple and a piece of green apple and describes what they taste like.	• While exploring a rain stick, shakes it and listens to the sound it makes. Children share their observations: "I can hear something inside, like beans or small rocks"; "It sounds like rain"; "It looks like a long stick"; "It is made of wood"; "It has a drawing on it with many colors." • Observes the caterpillar (or picture of a caterpillar) closely and draws a picture of a caterpillar. Communicates, "It has stripes-yellow, white, and black-like a pattern."	• Provide opportunities to observe natural and engineered phenomena indoors and out. • Encourage students to record observations through drawings and verbally. • Ask questions that encourage further observations and introduce words and language needed for the situation. • Make class charts recording important words or ideas that students introduced in their observations with accompanying pictures.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.3 Begin to identify and use, with adult support, some observation and measurement tools.	**1.3 Identify and use a greater variety of observation and measurement tools. May spontaneously use an appropriate tool, though may still need adult support.**	**SEP-1 Asking questions and defining problems** • Define a simple problem that can be solved through the development of a new or improved object or tool.
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• While exploring, studying, or examining leaves, uses a magnifying glass, with the teacher's assistance, to observe a leaf closely. • Using a measuring cup, helps the teacher measure two cups of flour during a cooking activity.	• Uses age-appropriate tools to pick up and group together small things found in soil. • While preparing dough, child uses a measuring cup to pour one cup of flour.	• Pose design problems in the context of building and sandbox play activity, e.g., "How could you make your block building more stable?" • Introduce simple tools for measurement, observation, or manipulation of materials and encourage children to use them in activities such as cooking or sorting.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.4 Compare and contrast objects and events and begin to describe similarities and differences.	**1.4 Compare and contrast objects and events and describe similarities and differences in greater detail.**	**SEP-3 Planning and carrying out investigations** • Make observations (firsthand or from media) and/or measurements to collect data that can be used to make comparisons. **SEP-4 Analyzing and interpreting data** • Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Compares a hummingbird egg to a chicken egg (while observing pictures or actual objects) and describes their similarities: "They are round and white and look the same." • Using different senses, observes a watermelon, contrasts the inside and outside, and communicates, "The outside is green and hard, and the inside is red and soft."	• Observes and describes what the sky looks like on a foggy day and how it is different on a sunny day. • Compares creases in the palm of his hand to a leaf and communicates, "They both have stripes all over. Some lines are tiny, and some are long, like this one."	• Provide opportunities to observe natural phenomena over an extended period of time. • Encourage students to record observations through drawings and verbally, and discuss those observations. • Ask questions that encourage further observations and introduce words and language needed for the situation. • Make class charts recording important words or ideas that students introduced in their observations with accompanying pictures.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.5 Make predictions and check them, with adult support, through concrete experiences.	**1.5 Demonstrates an increased ability to make predictions and check them (e.g., may make more complex predictions, offer ways to test predictions, and discuss why predictions were correct or incorrect).**	**SEP-3 Planning and carrying out investigations** • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. • Make predictions based on prior experiences. **SEP-4 Analyzing and interpreting data** • Compare predictions (based on prior experiences) to what occurred (observable events).
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• After making a prediction about which block is heavier, uses the balance scale to test her prediction. • Looks through the window on a windy day and predicts, "More leaves will fall down."	• Brings an object to the water table and predicts whether it will sink or float. Then puts the object in water and observes what happens. Comments to his friend, "Yes, I knew it! It is floating." • In response to the question, "What do you think will happen if water is added to the flour?" Predicts, "The flour will feel sticky and will not look like flour any more. The water and the flour will mix together." Another child suggests, "Let's pour some water and see what happens."	• Ask questions that prompt comparisons or predictions. • When students offers predictions, ask them to explain why that is their expectation. • Carry out investigations to follow up on predictions. • Foster discussion of results, both when the outcome is as expected and when it is not, fostering further questions and observations or revised predictions for a new but related situation.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.6 Make inferences and form generalizations based on evidence.	**1.6 Demonstrate an increased ability to make inferences and generalizations based on evidence.**	**SEP-6 Constructing explanations and designing solutions** • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. **SEP-7 Engaging in argument from evidence** • Identify arguments that are supported by evidence. • Construct an argument with evidence to support a claim.
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Notices that a plant is wilted and says that it needs some water. • Looks outside the window and observes the trees moving. Infers that it is windy outside: "Look at the trees; it is windy!"	• Observes a picture of an unfamiliar animal. Notices the wings and communicates, "It is a bird. I know it because it has wings." • Observes a picture of a child dressed in a jacket, a scarf, mittens and a hat and communicates that it must have been very cold outside.	• Encourage children to discuss and elaborate on observations and conclusions. • Ask questions to elicit analysis and reasoning and to encourage students to provide evidence from observation to support conclusions (or claims). • Encourage student group talk to arrive at a common understanding or explanation of a phenomenon.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
2.0 Documentation and Communication		
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.1 Record observations or findings in various ways, with adult assistance, including pictures, words (dictated to adults), charts, journals, models, and photos.	**2.1 Record information more regularly and in greater detail in various ways, with adult assistance, including pictures, words (dictated to adults), charts, journals, models, photos, or by tallying and graphing information.**	**SEP-2 Developing and using models** • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). **SEP-4 Analyzing and interpreting data** • Record information (observations, thoughts, and ideas). • Use and share pictures, drawings, and/or writings of observations. **SEP-8 Obtaining, evaluating, and communicating information** • Obtain information using various texts, text features, and other media that will be useful in answering scientific questions and/or supporting a scientific claim.
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• "Records" in her journal what the pumpkin looks like on the inside and draws an orange oval with many dots on the inside. The teacher writes down the child's observation: it is soft inside and has lots of seeds. • In collaboration with friends, creates a collage with rocks and leaves collected during a walk around the yard or neighborhood and refers to it when describing the items collected on their walk.	• Collects information by using tally marks to find out how many children have pets and how many do not have pets. • After coming back from a walk in the neighborhood, creates with other children a model of the building they have observed using different materials such as boxes of different sizes, paper rolls, and plastic bottles.	• Encourage drawing activity to represent observations and ideas. • Ask students to make a diagram showing how they built a block structure. • Encourage children to build patterns or structures following a design diagram. • Develop simple charts or bar graphs to record student observations and have children discuss them. • Ask children to suggest how the teacher should represent information or observations that they are gathering.

SCIENTIFIC INQUIRY STRAND		CA NGSS SCIENCE & ENGINEERING PRACTICES
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.2 Share findings and explanations, which may be correct or incorrect, with or without adult prompting.	**2.2 Share findings and explanations, which may be correct or incorrect, more spontaneously and with greater detail.**	**SEP-4 Analyzing and interpreting data** • Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems. • Compare predictions (based on prior experiences) to what occurred (observable events). **SEP-6 Constructing explanations and designing solutions** • Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. **SEP-7 Engaging in argument from evidence** • Distinguish between opinions and evidence in one's own explanations. • Listen actively to arguments to indicate agreement or disagreement based on evidence, and/or to retell the main points of the argument. **SEP-8 Obtaining, evaluating, and communicating information** • Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Records the growth of a plant in the garden, and communicates, "The plant grew from a seed, just like the flower in the story." • When asked, "What happened to the water?" Explains, "It is hard now because we put it in the freezer."	• When asked whether a puppet can eat, explains, "A puppet cannot eat because it does not have a real mouth. You can draw him a mouth, but it is not real like this." (points to own mouth). • When talking with children about why some things slid faster and others slower when letting go of them at the top of the slide, children come up with different explanations: "It got stuck because it is heavy," "It is slippery," "It is bumpy," "It has wheels."	• Prompt analysis and reasoning from evidence through questioning strategies. • Provide opportunities and encouragement for students to respond to the ideas of others with questions or elaborations.

Table 2.3. Connections Between the California Preschool Learning Foundations Science Domain Strands and the CA NGSS

PHYSICAL SCIENCE STRAND		PHYSICAL SCIENCE – CA NGSS
1.0 Properties and Characteristics of Nonliving Objects and Materials		
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.1 Observe, investigate, and identify the characteristics and physical properties of objects and of solid and nonsolid materials (size, weight, shape, color, texture, and sound).	**1.1 Demonstrate increased ability to observe, investigate, and describe in greater detail the characteristics and physical properties (size, weight, shape, color, texture, and sound) of objects and of solid and nonsolid materials.**	**Support for K-PS3-1** Make observations to determine the effect of sunlight on Earth's surface. **[Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.]** **(PS3.B - Sunlight warms Earth's surface.)** **Support for K-2-ETS1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem. **Patterns [CCC-1]** **Scale, Proportion, and Quantity [CCC-3]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Holds a wood block and a foam block. Refers to the wood block when asked which one is heavier. • Tries to push a toy car through a maze and realizes that the car is too big and cannot go through. Gets a smaller car and tries again.	• Uses a balance scale to find out which of two balls is heavier. • During a cooking activity, explores sugar, flour, salt, powdered gelatin, or cornstarch by using the senses (touch, smell, taste). Children communicate their observations: "All of them are white," "The flour is very soft," "The sugar looks more like salt, but it tastes sweet."	• Set up opportunities for students to investigate, record, and discuss the effects and patterns of sun and shade in the playground. • Prompt discussion, observation, and analysis of the relationship of shape to use for tools and other objects used in everyday activities in the classroom (including body parts, art tools, cooking tools, etc.)

PHYSICAL SCIENCE STRAND		PHYSICAL SCIENCE – CA NGSS
2.0 Changes in Nonliving Objects and Materials		**K-PS2 Motion and Stability: Forces and Interactions**
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.1 Demonstrate awareness that objects and materials can change, explore and describe changes in objects and materials (rearrangement of parts; change in color, shape, texture, temperature).	**2.1 Demonstrate an increased awareness that objects and materials can change in various ways. Explore and describe in greater detail changes in objects and materials (rearrangement of parts; change in color, shape, texture, form, and temperature).**	**Support for K-PS3-1** Make observations to determine the effect of sunlight on Earth's surface. **[Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.]** **PS3.B – Sunlight warms Earth's surface.** **Energy and Matter [CCC-5]** **Stability and Change [CCC-7]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Participates in making guacamole and demonstrates how teacher can make it soft by pressing and mixing the avocado with a fork. • While playing with blue and yellow soft clay, observes that the mixture became green and communicates, "Hey, teacher, I made green." • Notices that the ice in the cup melted into water. Puts his fingers in the water, and gestures to the teacher to come over and feel the water.	• While making lemonade, mixes water with lemon juice and makes a prediction about how it is going to taste. • After putting different colored crayons on a piece of aluminum foil and placing it in the sun, the teacher asked, "What do you think might happen?" Children predict, "It will get burned," "It will get hot, and then they will mix." • Records in her journal how the ice in the bowl melted: "I touched it with my finger, and it was very cold and very hard." The teacher asks, "What happened to the ice after lunch was over?" The child describes her drawing: "The ice was very small, and there was water in the bowl." The teacher writes the child's words down and rephrases the child's description: "Yes, the ice has melted."	• Provide opportunities to observe and discuss changes in matter (ice melting, cake cooking, etc.). • Prompt individual and group efforts to discuss and record what occurred.

PHYSICAL SCIENCE STRAND		PHYSICAL SCIENCE – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.2 Observe and describe the motion of objects (in terms of speed, direction, the ways things move), and explore the effect of own actions (e.g., pushing, pulling, rolling, dropping) on making objects move.	**2.2 Demonstrate an increased ability to observe and describe in greater detail the motion of objects (in terms of speed, direction, ways things move), and to explore the effect of own actions on the motion of objects, including changes in speed and direction.**	**K-PS2-1.** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. **[Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.]** **K-PS2-2.** Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* **[Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.]** **Patterns [CCC-1]** **Scale, Proportion, and Quantity [CCC-3]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Blows through a straw on a ping pong ball and discovers it makes the ball move. • A child with a new wheelchair demonstrates to her peers how she uses the ramp to go up and down instead of using the stairs.	• Places two toy cars at the top of a ramp and releases them at the same time. Observes which one reaches the bottom first. • A child in a new wheelchair discovers that it is more difficult to move on carpet than on the floor and that he cannot roll on sand: "If I roll into the sand, I'll get stuck."	• Prompt analysis of situations where a push or a pull can change motion (e.g., pushing a swing, pulling a cart). • Prompt discussion and observations about how a rolling ball or a toy car stops on different surfaces. Lead children to discuss what is the same and what is different in each test (e.g., whether you can give the same push and see different outcomes and of how outcomes change with type or slope of surface).

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

LIFE SCIENCE STRAND		LIFE SCIENCE – CA NGSS
1.0 Properties and Characteristics of Living Things		
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.1 Identify characteristics of a variety of animals and plants, including appearance (inside and outside) and behavior, and begin to categorize them.	**1.1 Identify characteristics of a greater variety of animals and plants, and demonstrate an increased ability to categorize them.**	**Support for K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive. **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** **Patterns [CCC-1]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Looks at an informational book and identifies which animals can fly. • Observes a cactus and tells a friend, "They have needles. I got poked once."	• When talking about plant roots that we eat, one child says, "potatoes," another says, "taros," and another says, "yams." • Observes plants and identifies the different parts (e.g., root, stem, buds, leaves).	• Have children grow plants and small animals in the classroom and observe and record observations about them. • Prompt discussion of plant and animal needs for growth and health. • Prompt discussion of human food needs and health.

LIFE SCIENCE STRAND		LIFE SCIENCE – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.2 Begin to indicate knowledge of body parts and processes (e.g., eating, sleeping, breathing, walking) in humans and other animals.	**1.2 Indicate greater knowledge of body parts and processes (e.g., eating, sleeping, breathing, walking) in humans and other animals.**	**Support for K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive. **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** **Patterns [CCC-1]** **Structure and Function [CCC-6]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• After running, touches his chest to feel his heart beating. • Makes the connection between facial parts and senses (eyes for vision, ears for hearing). For example, covers her eyes and says, "Now I can't see."	• Explains, "We can walk with our legs and birds fly with their wings." • Participates in discussion about the outside and inside of the body. Touches his arms and communicates, "I can feel my skin, and inside my body I can feel my muscles and bones."	• Prompt observation and discussion of how humans and animals use their body parts to meet their needs.

LIFE SCIENCE STRAND		LIFE SCIENCE – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.3 Identify the habitats of people and familiar animals and plants in the environment and begin to realize that living things have habitats in different environments.	**1.3 Recognize that living things have habitats in different environments suited to their unique needs.**	**K-ESS2-2.** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. **[Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]** **K-ESS3-1.** Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. **[Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]** **Systems and System Models [CCC-4]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• A child holds a worm and says, "Where is the dirt? I want to put him back." • While looking at a picture book of different animals, child demonstrates with his body how the fish and the dolphins swim in the ocean.	• Participates in building a nest. Using tweezers collects twigs and leaves in the yard: "Just like birds use their beaks." • Sorts photos of animals according to those living in water, those living on land, and those who can live in both the water and on the land.	• Provide opportunities to vary conditions for plants being grown and support children to observe and discuss differences in conditions and in outcomes for the plants.

LIFE SCIENCE STRAND		LIFE SCIENCE – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.4 Indicate knowledge of the difference between animate objects (animals, people) and inanimate objects. For example, expect animate objects to initiate movement and to have different insides than inanimate objects.	**1.4 Indicate knowledge of the difference between animate and inanimate objects, providing greater detail, and recognize that living things (humans, animals, and plants) undergo biological processes such as growth, illness, healing, and dying.**	**Support for K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive. **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** **Patterns [CCC-1]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Communicates, "My puppy is going to get big, but this one (showing toy) won't." • While in the yard, points to a lady bug and tells his friend, "It is a real one! Look, it's moving."	• Communicates, "I had a goldfish, but one day it got very sick and died." • While playing in the yard, a child hits a bush and a flower falls off. The child communicates, "It will grow again."	• Uses stories and activities to prompt discussion of patterns and differences between living and non living things, and between real and imagined abilities of objects and animals. • Expands on children's interest in babies (animal or human), and observations of family members as well as of the plants and animals in the classroom to prompt analysis of general features of life cycles.

LIFE SCIENCE STRAND		LIFE SCIENCE – CA NGSS
2.0 Changes in Living Things		**K-LS2**
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.1 Observe and explore growth and changes in humans, animals, and plants and demonstrate an understanding that living things change over time in size and in other capacities as they grow.	**2.1 Observe and explore growth and changes in humans, animals, and plants and demonstrate an increased understanding that living things change as they grow and go through transformations related to the life cycle (for example, from a caterpillar to butterfly).**	**Support for K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive. **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** **Structure and Function [CCC-6]** **Stability and Change [CCC-7]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Observes the beans she is growing and makes a prediction about how tall they will grow. • While singing and acting out a song about "growth," pretends she is a plant and demonstrates with her body how the little seed grew into a seedling and the seedling grew into a tree.	• Observes tadpoles closely and communicates, "They are so much bigger now. Later, the legs will come out. They will be frogs." • Looks at the picture book *The Tiny Seed* and retells the story in his home language and some English, referring to pictures and describing how the seed grew into a plant. • Observes how a caterpillar makes a chrysalis and then emerges as a butterfly.	• Support student to develop ways to represent change over time for a single organism observed in the classroom. • Prompt discussion of patterns of change in the life of a particular type of plant or animal or of a human. Encourage students to analyze the similarities and differences between various species' life cycles.

LIFE SCIENCE STRAND		LIFE SCIENCE – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.2 Recognize that animals and plants require care and begin to associate feeding and watering with the growth of humans, animals, and plants.	**2.2 Develop a greater understanding of the basic needs of humans, animals, and plants (e.g., food, water, sunshine, shelter).**	**K-LS1-1.** Use observations to describe patterns of what plants and animals (including humans) need to survive. **[Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]** **Patterns [CCC-1]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Observes different types of seeds and with the help of the teacher plants them in dirt and waters them. • While working in the garden, notices the dry soil and tries to water the flowers. • Communicates, "My baby sister was very little, but now she is big because she eats cereal."	• In an experiment with plants, children describe their observations: "The plants near the window grew, but the plants with no light became yellow." • Feeds the class pet fish, with adult assistance, and explains, "We give them special food just for fish but not too much."	• Prompt discussion of animal needs and of human needs and wants (distinguishing a need from a desire).

EARTH SCIENCES STRAND		EARTH AND SPACE SCIENCES – CA NGSS
1.0 Properties and Characteristics of Earth Materials and Objects		
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
1.1 Investigate characteristics (size, weight, shape, color, texture) of earth materials such as sand, rocks, soil, water, and air.	**1.1 Demonstrate increased ability to investigate and compare characteristics (size, weight, shape, color, texture) of earth materials such sand, rocks, soil, water, and air.**	**Support for K-PS3-1.** Make observations to determine the effect of sunlight on Earth's surface. **[Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.]** **PS3.B – Sunlight warms Earth's surface.** **Patterns [CCC-1]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Explains that sand and water are needed to make a sand castle. • Plays with rocks and discovers that she can use a rock to draw on a sidewalk.	• In explorations of air, observes a kite flying and communicates, "The wind blows really hard and the kite goes high into the clouds."	• Prompt observation and analysis of how sunlight and shade have different effects on different surfaces. • Use discussion of observations of varied materials to help students develop rich descriptive language and terminology to describe matter properties

EARTH SCIENCES STRAND		EARTH AND SPACE SCIENCES – CA NGSS
2.0 Changes in the Earth		**K-ESS2 Earth's Systems**
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.1 Observe and describe natural objects in the sky (sun, moon, stars, clouds) and how they appear to move and change.	**2.1 Demonstrate an increased ability to observe and describe natural objects in the sky; begin to notice how they appear to move and change.**	**Support for K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.]** **Patterns [CCC-1]** **Stability and Change [CCC-7]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Records his observation of the sky by drawing a picture. Refers to his drawing and indicates or points to, the sun and the clouds. • Gestures toward the sky and communicates in the home language, "Last night I looked at the sky and I saw the moon."	• Communicates, "When I looked at the sky with my dad, I saw the moon and it was round and big. I saw the stars, too." • Communicates, "Sometimes when I look at the sky at night, I see only the moon, and sometimes I see the moon and the stars."	• Provide a rich environment with multiple opportunities for children to become interested in, observe, and describe phenomena in the natural world. • Prompt student discourse and communication about their observations.

EARTH SCIENCES STRAND		EARTH AND SPACE SCIENCES – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.2 Notice and describe changes in weather.	**2.2 Demonstrate an increased ability to observe, describe, and discuss changes in weather.**	**K-ESS2-1.** Use and share observations of local weather conditions to describe patterns over time. **[Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.]** **Patterns [CCC-1]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• A child who is hearing impaired looks through the window and communicates in sign language, "It is raining." • Communicates, "It is windy. The wind is blowing my hair."	• Observes the weather and makes a prediction, "The sky is gray. I think it is going to rain." • Observes the chart with the daily recordings of the weather and communicates, "This week, it was sunny every day."	• Prompt observations, records, and discussions of weather.

EARTH SCIENCES STRAND		EARTH AND SPACE SCIENCES – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.3 Begin to notice the effects of weather and seasonal changes on their own lives and on plants and animals.	**2.3 Demonstrate an increased ability to notice and describe the effects of weather and seasonal changes on their own lives and on plants and animals.**	**Support for K-ESS3-2.** Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* **[Clarification Statement: Emphasis is on local forms of severe weather.]** **Support for K-PS3-1.** Make observations to determine the effect of sunlight on Earth's surface. **[Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.]** **Patterns [CCC-1]** **Stability and Change [CCC-7]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• In the dramatic play area, pretends it is a rainy day, puts on boots and a coat, and carries an umbrella. • While playing outside on a sunny day, touches the slide and communicates, "The sun makes it hot, very hot."	• On arrival in the morning, communicates, "It was so foggy. We couldn't see through the window." • Communicates, "In the winter I wear a jacket and in the summer when it is hot, I wear shorts."	• When students make spontaneous observations or ask questions about the weather or other natural events, provide opportunities for elaborations, and follow up with opportunities to investigate and discuss the phenomena further through activities or stories.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

EARTH SCIENCES STRAND		EARTH AND SPACE SCIENCES – CA NGSS
At around 48 months of age	*At around 60 months of age*	*By the end of kindergarten*
2.4 Develop awareness of the importance of caring for and respecting the environment, and participate in activities related to its care.	**2.4 Demonstrate an increased awareness and the ability to discuss in simple terms how to care for the environment, and participate in activities related to its care.**	**K-ESS3-3.** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.* **[Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]** **Systems and System Models [CCC-4]**
Example Student Actions	**Example Student Actions**	**Teacher Actions That Can Elicit Student Actions**
• Helps the teacher to sort recyclable items such as papers, bottles, and cans. • Turns off the faucet after washing his hands.	• Uses recycling bins more independently. May remind another child to put a paper towel in the blue recycling box. • Reminds a friend to turn off the faucet, "so we do not waste water."	• Use the classroom, outside play areas, and nearby parks as places where students observe, discuss, and make decisions about actions to maintain a healthy and attractive environment for themselves and for others. • Engage students in discussions of the resources they use and where they come from.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

References

California Department of Education (CDE). 2012a. *California Preschool Learning Foundations*. Sacramento: California Department of Education. https://www.cde.ca.gov/ci/sc/cf/ch2.asp#link3

———. 2012b. *California Preschool Curriculum Frameworks*. Sacramento: California Department of Education. https://www.cde.ca.gov/ci/sc/cf/ch2.asp#link4

Engel, Susan. 2013. "The Case for Curiosity." *Educational Leadership* 70 (5): 36–40. https://www.cde ca.gov/ci/sc/cf/ch2.asp#link5

Gopnik, Alison. 2012. "Scientific Thinking in Young Children: Theoretical Advances, Empirical Research, and Policy Implications." *Science* 337 (6102): 1623–1627.

National Research Council (NRC). 2007. *Taking Science to School: Learning and Teaching Science in Grades K–8*. Washington, DC: The National Academies Press.

Saçkes, Mesut, Kathy Cabe Trundle, Randy L. Bell, and Ann A. O'Connell. 2011. "The Influence of Early Science Experience in Kindergarten on Children's Immediate and Later Science Achievement: Evidence from the Early Childhood Longitudinal Study." *Journal of Research in Science Teaching* 48 (2): 217–235. https://www.cde.ca.gov/ci/sc/cf/ch2.asp#link6