

Tables for Science

Key point for teachers of Science:

In the tables that appear below, the Framework offers useful conceptualizations of the language practices embedded within the CCSS and NGSS for science that span linguistic, discourse, interpersonal, sociocultural, strategic, and pragmatic competencies.

Table 5: Key Practices, Crosscutting Concepts and Disciplinary Core Ideas of the Science NGSS²⁸

This table summarizes key science and engineering practices.

| Scientific and Engineering Practices | Disciplinary Core Ideas |
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| <ol style="list-style-type: none"> 1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information | <p>Physical Sciences</p> <p>PS 1: Matter and its interactions</p> <p>PS 2: Motion and stability: Forces and interactions</p> <p>PS 3: Energy</p> <p>PS 4: Waves and their applications in technologies for information transfer</p> <p>Life Sciences</p> <p>LS 1: From molecules to organisms: Structures and processes</p> <p>LS 2: Ecosystems: Interactions, energy, and dynamics</p> <p>LS 3: Heredity: Inheritance and variation of traits</p> <p>LS 4: Biological Evolution: Unity and diversity</p> |
| Crosscutting Concepts | |
| <ol style="list-style-type: none"> 1. Patterns, similarity, and diversity 2. Cause and effect: Mechanism and explanation 3. Scale, proportion, and quantity 4. Systems and system models 5. Energy and matter: Flows, cycles, and conservation 6. Structure and function 7. Stability and change | <p>Earth and Space Sciences</p> <p>ESS 1: Earth’s place in the universe</p> <p>ESS 2: Earth’s systems</p> <p>ESS 3: Earth and human activity</p> <p>Engineering, Technology, and the Applications of Science</p> <p>ETS 1: Engineering design</p> <p>ETS 2: Links among engineering, technology, science, and society</p> |

²⁸ The Next Generation Science Standards are currently in draft format, but the basis of those standards is the National Research Council Framework, which enumerates these practices. A free copy of the NRC framework is available through www.nextgenscience.org.

Table 6: Key NGSS Science and Engineering Practices with Embedded Analytical Tasks and Receptive and Productive Language Functions

This table defines in detail these practices by outlining the language functions that ELLs need to engage with science and engineering content.

| Scientific Sense-Making and Language Use | |
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| Key NGSS Practice 1a: Ask questions (science) | |
| Analytical Tasks | <p>Frame questions conceptually to</p> <ul style="list-style-type: none"> • Achieve improved understanding of current topic • Elicit clarification of a statement just made by another • Elicit further details of models or explanations of others <p>Conceptually frame and refine questions that can be investigated by further observations or measurements</p> |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend and develop own understanding of a topic or another’s ideas, expressed orally or in writing • Comprehend questions and responses of others |
| Productive Language Functions | <p>Ask questions to</p> <ul style="list-style-type: none"> • Achieve improved understanding of current topic • Elicit clarification of a statement just made by another or further details of models or explanations of others • Propose investigations to be carried out through further observations or measurements |
| Key NGSS Practice 1b: Define the problem (engineering) | |
| Analytical Tasks | <ul style="list-style-type: none"> • Analyze the needs and constraints of the situation • Analyze what design criteria are needed |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend oral or written explanations of needs and constraints • Comprehend suggestions of others |
| Productive Language Functions | <p>Communicate (orally and in writing) ideas, concepts, and information related to formulation and expression of design criteria:</p> <ul style="list-style-type: none"> • Ask questions to elicit needs and constraints • Specify criteria using words and graphic representations • Describe design criteria and own analytic process orally or in writing |
| Key NGSS Practice 2: Develop models | |
| Analytical Tasks | <ul style="list-style-type: none"> • Develop and represent an explicit model of a phenomenon or system • Use a model to support an explanation of a phenomenon or system • Make revisions to a model based on either suggestions of others or conflicts between a model and observation |

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| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend others’ oral and written descriptions, discussions, and justifications of models of phenomena or systems • Interpret the meaning of models presented in texts and diagrams |
| Productive Language Functions | <p>Communicate (orally and in writing) ideas, concepts, and information related to a phenomenon or system using a model developed for this purpose:</p> <ul style="list-style-type: none"> • Label diagrams of a model and make lists of parts • Describe a model using oral and/or written language as well as illustrations • Describe how a model relates to a phenomenon or system • Discuss limitations of a model • Ask questions about others’ models |
| Key NGSS Practice 3: Plan and carry out investigations | |
| Analytical Tasks | <ul style="list-style-type: none"> • Refine questions to be investigated • Analyze variables in situation and decide whether and how variables are to be controlled • Analyze resources needed • Plan observations or measurements and how to record them • Predict expected results based on proposed model and explanation (i.e., based on a hypothesis about the system) |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend descriptions of variables and resources • Comprehend suggestions of others for the plan • Comprehend alternate hypotheses and predictions suggested by others • Read and follow investigation plan |
| Productive Language Functions | <p>Communicate (orally and in writing) ideas, concepts, and information related to investigation tasks:</p> <ul style="list-style-type: none"> • Explain ideas for the task to others • Respond to others’ suggestions or questions about the plan • Produce a written plan for an investigation • Make predictions • Describe observations • Describe conditions and record measurements |
| Key NGSS Practice 4: Analyze and interpret data | |
| Analytical Tasks | <ul style="list-style-type: none"> • Decide on ways to organize and display data (e.g., graphs, charts, and timelines) • Recognize relationships between variables found in data, and where possible suggest mathematical expressions of them • Compare results obtained to predictions |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend suggestions of others and discussion of data • Interpret questions from others about the data |
| Productive Language Functions | <p>Communicate (orally and in writing) ideas, concepts, and information related to analysis:</p> <ul style="list-style-type: none"> • Create and label coherent representation of the data • Describe analysis and interpretations to others (orally or in writing) • Question others about their analysis |

| Key NGSS Practice 5: Use mathematics and computational thinking (linked to grade-level math standards) | |
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| Analytical Tasks | <ul style="list-style-type: none"> • Interpret and produce graphs of data • Relate mathematical symbols to physical quantities • Recognize where units of measure are needed • Recognize and apply mathematical relationships in interpreting phenomena • Recognize and apply algorithms for repeated computation (e.g., in data spreadsheet) • Employ computational tools appropriately |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend mathematical statements and arguments of others • Comprehend proposed algorithms for calculations • Comprehend discussions of use and purpose of computational tools |
| Productive Language Functions | <p>Communicate (orally and in writing) ideas, concepts, and information related to mathematical ideas and computational algorithms:</p> <ul style="list-style-type: none"> • Create and label coherent representation of data • Describe mathematical ideas in words as well as symbols • Describe and explain proposed algorithms for calculations |
| Key NGSS Practice 6: Construct explanations (science) and design solutions (engineering) | |
| Analytical Tasks | <ul style="list-style-type: none"> • Develop explanation or design • Analyze the match between explanation or model and a phenomenon or system • Revise explanation or design based on input of others or further observations • Analyze how well a solution meets design criteria |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend questions and critiques • Comprehend explanations offered by others • Comprehend explanations offered by texts • Coordinate texts and representations |
| Productive Language Functions | <p>Communicate (orally and in writing) ideas, concepts, and information related to a phenomenon or system (natural or designed):</p> <ul style="list-style-type: none"> • Provide information needed by listeners or readers • Respond to questions by amplifying explanation • Respond to critiques by countering with further explanation or by accepting as needing further thought • Critique or support explanations or designs offered by others |
| Key NGSS Practice 7: Engage in argument from evidence | |
| Analytical Tasks | <ul style="list-style-type: none"> • Distinguish between a claim and supporting evidence or explanation • Analyze whether evidence supports or contradicts a claim • Analyze how well a model and evidence are aligned • Construct an argument |
| Receptive Language Functions | <ul style="list-style-type: none"> • Comprehend arguments made by others orally • Comprehend arguments made by others in writing |

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| <p>Productive Language Functions</p> | <p>Communicate (orally and in writing) ideas, concepts, and information related to the formation, defense, and critique of arguments:</p> <ul style="list-style-type: none"> • Structure and order written or verbal arguments for a position • Select and present key evidence to support or refute claims • Question or critique arguments of others |
| <p>Key NGSS Practice 8: Obtain, evaluate, and communicate scientific information</p> | |
| <p>Analytical Tasks</p> | <ul style="list-style-type: none"> • Coordinate written, verbal, and diagrammatic inputs • Evaluate quality of an information source • Evaluate agreement/disagreement of multiple sources • Evaluate need for further information • Summarize main points of a text or oral discussion |
| <p>Receptive Language Functions</p> | <ul style="list-style-type: none"> • Read or listen to obtain scientific information from diverse sources including lab or equipment manuals, oral and written presentations of other students, Internet materials, textbooks, science-oriented trade books, and science press articles • Listen to and understand questions or ideas of others |
| <p>Productive Language Functions</p> | <p>Communicate (orally and in writing) ideas, concepts, and information related to scientific information:</p> <ul style="list-style-type: none"> • Present information, explanations, or arguments to others • Formulate clarification questions about scientific information • Provide summaries of information obtained appropriate a specific purpose or audience • Discuss the quality of scientific information obtained from text sources based on investigating the scientific reputation of the source, and comparing information from multiple sources |