

Science - Frederick County Public Schools

Graduation Competencies and Performance Standards Overview

(Last Revised Fall 2022)

[Science CBE Verbs](#)

Discipline Specific Graduation Competency 1: Asking Questions and Defining Problems

Ask and refine questions in the areas of life, physical and earth/space science that lead to descriptions and explanations of how the natural and designed world works and which can be tested.

1A	Ask, clarify and revise questions from observations of varying phenomena (model, theory or results) to refine a model or explanation to determine testability and relevancy
1B	Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations

Discipline Specific Graduation Competency 2: Developing and Using Models

Use and construct models to represent ideas and explanations in life, physical and earth/space science.

2A	Develop, revise, and/or apply a model or multiple models based on evidence to illustrate and/or predict the relationships between systems or components of a system
2B	Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems

Discipline Specific Graduation Competency 3: Planning and Carrying Out Investigations

Plan and carry out life, physical and earth/space science investigations in the field or laboratory, working collaboratively as well as individually.

3A	Plan, conduct, and evaluate an investigation to produce data for building and revising models, supporting explanations for phenomena, or testing solutions to problems
3B	Identify and manipulate variables and collect data from a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success

Discipline Specific Graduation Competency 4: Analyzing and Interpreting Data

Use a range of tools (including tabulation, graphical interpretation, visualization & statistical analysis) to identify significant features & patterns in data in the areas of life, physical & earth/space science.

4A	Analyze data to identify design features or characteristics of the components of a proposed process or system using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution
4B	Apply concepts of statistics and probability including determining function fits to data, slope, intercept, and correlation coefficient for linear fits to scientific and engineering questions and problems, using digital tools when feasible
4C	Compare and contrast limitations of data analysis (measurement error, sample selection) as well as compare and contrast various types of data sets

Discipline Specific Graduation Competency 5: Using Mathematics and Computational Thinking

Use mathematics and computation to construct simulations, analyze data and recognize, express, and apply quantitative relationships of physical variables in life, physical and earth/space science.

5A	Create a computational model or simulation of a phenomenon, designed device, process, or system
5B	Use mathematical functions and representations to solve scientific problems, support explanations, or solve engineering problems.
5C	Apply ratios, rates, percentages, and unit conversions in the context of measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m ³ , acre-feet, etc.)

Discipline Specific Graduation Competency 6: Constructing Explanations and Designing Solutions

Construct explanations in life, physical and earth/space science and design solutions through engineering that are supported by sources of evidence consistent with scientific ideas, and theories.

6A	Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review)
6B	Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations

Discipline Specific Graduation Competency 7: Engaging in Argument from Evidence

Use argumentation (claim, evidence and reasoning) as the process by which explanations and solutions are reached in life, physical and earth/space science.

7A	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues
7B	Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations)

Discipline Specific Graduation Competency 8: Obtaining, Evaluating, and Communicating Information

Communicate clearly and persuasively the ideas and methods generated. Critiquing and communicating ideas-is a critical professional activity in the areas of life, physical and earth/space science.

8A	Communicate scientific and technical information about scientific phenomena, design and development, or proposed systems from multiple formats.
8B	Gather, read, and evaluate scientific and/or technical information from multiple sources, to determine the validity and reliability of the evidence and usefulness of each source

Graduation Competencies, Performance Standards and Scoring Criteria

Discipline Specific Graduation Competency 1: Asking Questions and Defining Problems

Ask and refine questions in the areas of life, physical and earth/space science that lead to descriptions and explanations of how the natural and designed world works and which can be tested

1A	Ask, clarify and revise questions from observations of varying phenomena (model, theory or results) to refine a model or explanation to determine testability and relevancy
1B	Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations

Performance Standards Scoring Criteria for Competency 1

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
1A Ask, clarify and revise questions from observations of varying phenomena (model, theory or results) to refine a model or explanation to determine testability and relevancy	I can ask closed questions based on observations.	I can ask open-ended questions based on observation.	I can ask relevant, testable questions to clarify relationships.	I can revise a relevant, testable question.
1B Define a design problem that involves the development of a process or system (with interacting components) and criteria/constraints that may include social, technical and/or environmental considerations	I can identify some parts of a problem that are part of a process or system.	I can define a problem that is part of a process or system.	I can define a design problem that is part of an interdependent process or systems with limited criteria/constraints.	I can define a design problem that involves the development of a process or system and criteria/constraints to explain social, technical and/or environmental considerations.

Discipline Specific Graduation Competency 2: Developing and Using Models

Use and construct models to represent ideas and explanations in life, physical and earth/space science

2A	Develop, revise, and/or apply a model or multiple models based on evidence to illustrate and/or predict the relationships between systems or components of a system
2B	Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems

Performance Standards Scoring Criteria for Competency 2

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
2A Develop, revise, and/or apply a model or multiple models based on evidence to illustrate and/or predict the relationships between systems or components of a system	I can use a model to illustrate the relationships between systems.	I can propose a model based on evidence to illustrate the relationships between systems or between components of a system.	I can develop a model or multiple models based on evidence to illustrate and/or predict the relationships between systems or between components of a system.	I can justify the use of a model or multiple models based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
2B Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems	I can use a model to generate data.	I can use a model to generate data and analyze it.	I can use a model to generate data and predict phenomena.	I can use data from a model to justify an explanation or prediction.

Discipline Specific Graduation Competency 3: Planning and Carrying Out Investigations

Plan and carry out life, physical and earth/space science investigations in the field or laboratory, working collaboratively as well as individually

3A	Plan, conduct, and evaluate an investigation to produce data for building and revising models, supporting explanations for phenomena, or testing solutions to problems
3B	Identify and manipulate variables and collect data from a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success

Performance Standards Scoring Criteria for Competency 3

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
3A Plan, conduct, and evaluate an investigation to produce data for building and revising models, supporting explanations for phenomena, or testing solutions to problems	I can plan an investigation.	I can plan an investigation and describe the data that will be collected.	I can plan and conduct an investigation to collect relevant data.	I can plan and conduct an investigation and then evaluate the design.
3B Identify and manipulate variables and collect data from a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success	I can collect and record data.	I can identify variables and collect/record data.	I can manipulate a variable and collect the resulting data.	I can analyze data to identify failure points or improve performance relative to criteria for success.

Discipline Specific Graduation Competency 4: Analyzing and Interpreting Data

Use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data in the areas of life, physical and earth/space science

4A	Analyze data to identify design features or characteristics of the components of a proposed process or system using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution
4B	Apply concepts of statistics and probability including determining function fits to data, slope, intercept, and correlation coefficient for linear fits to scientific and engineering questions and problems, using digital tools when feasible

Performance Standards Scoring Criteria for Competency 4

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
4A Analyze data to identify design features or characteristics of the components of a proposed process or system using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution	I can choose the appropriate tool, technologies, or models to communicate data.	I can use tools, technologies, or models to organize data.	I can use tools, technologies, or models to organize data to make valid and reliable scientific claims.	I can use a tool, technologies, or models to organize data and justify a scientific claim or determine an optimal design solution.
4B Apply concepts of statistics and probability including determining function fits to data and slope, intercept, and correlation coefficient for linear fits to scientific and engineering questions and problems, using digital tools when feasible	I can identify concepts of statistics and probability.	I can use statistics and probability concepts for analysis of data.	I can apply concepts of statistics and probability, such as: mean, median, mode, determining function fits to data and slope, intercept, and correlation coefficient for linear fits to scientific and engineering questions and problems.	I can evaluate the use and/or results of statistics and probability through error analysis to accurately show correlations to scientific and engineering questions and problems.

Discipline Specific Graduation Competency 5: Using Mathematics and Computational Thinking

Use mathematics and computation to construct simulations, analyze data and recognize, express, and apply quantitative relationships of physical variables in life, physical and earth/space science

5A	Create a computational model or simulation of a phenomenon, designed device, process, or system
5B	Use mathematical functions and representations to solve scientific problems, support explanations, or solve engineering problems.
5C	Apply ratios, rates, percentages, and unit conversions in the context of measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m ³ , acre-feet, etc.)

Performance Standards Scoring Criteria for Competency 5

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
5A Create a computational model or simulation of a phenomenon, designed device, process, or system	I can identify and describe the components of a computational model	I can create a computational model that contains representations of relevant components	I can create a computational model that models each component and its simplified mathematical relationship to other components.	I can identify and describe the limitations of the computational model, based on the assumptions that were made in creating the algebraic descriptions of the model.
5B Use mathematical functions and representations to solve scientific problems, support explanations, or solve engineering problems.	I can identify simple mathematical representations to describe and/or support scientific conclusions and design solutions.	I can identify and use mathematical representations of phenomena or design solutions.	I can identify, use, and accurately solve mathematical representations of phenomena or design solutions with units .	I can accurately apply mathematical representations of phenomena or design solutions to support claims and/or explanations to solve scientific and engineering problems.

Discipline Specific Graduation Competency 6: Constructing Explanations and Designing Solutions

Construct explanations in life, physical and earth/space science and design solutions through engineering that are supported by multiple sources of evidence consistent with scientific ideas, principles, and theories

6A	Construct and revise an explanation or argument based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review)
6B	Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations

Performance Standards Scoring Criteria for Competency 6

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
6A Construct and revise an explanation or argument based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review)	I can make a claim or provide some valid and reliable scientific evidence that implies a connection to scientific theories and laws that describe the natural world.	I can make a relevant claim with some valid and reliable scientific evidence and imply a connection to scientific theories and laws that describe the natural world.	I can explain a relevant claim based on multiple pieces of evidence that makes a connection to scientific theories and laws that describe the natural world.	I can justify a relevant and thorough claim based on multiple pieces of evidence that effectively connect to scientific theories and laws that describe the natural world.
6B Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations	I can design a valid solution to a complex real-world problem.	I can design a valid solution to a complex real-world problem then describe appropriate criteria and constraints for the solution to the problem.	I can evaluate a valid solution to a complex real-world problem based on scientific knowledge and evidence, then describe appropriate criteria and constraints for the solution to the problem.	I can refine a solution based on scientific knowledge, evidence, criteria and constraints in order to optimize the solution.

Discipline Specific Graduation Competency 7: Engaging in Argument from Evidence

Use argumentation as the process by which explanations and solutions are reached in life, physical and earth/space science

7A	Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues
7B	Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations)

Performance Standards Scoring Criteria for Competency 7

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
7A Compare and evaluate competing arguments, counterclaims, or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues	I can identify reasoning or supporting evidence of an argument for a currently accepted claim or solution.	I can explain reasoning and supporting evidence of an argument for a currently accepted claim or solution.	I can explain the merits and limitations of an argument or solution based on scientific knowledge, evidence, criteria and constraints.	I can evaluate the merits and limitations of an argument or solution based on scientific knowledge, evidence, criteria and constraints.
7B Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations)	I can propose a solution to a real world problem	I can propose a reasonable solution to a real world problem	I can compare competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).	I can evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

Discipline Specific Graduation Competency 8: Obtaining, Evaluating, and Communicating Information

Communicate clearly and persuasively the ideas and methods generated. Critiquing and communicating ideas individually and in groups is a critical professional activity in the areas of life, physical and earth/space science

8A	Communicate scientific and technical information about scientific phenomena, design and development, or proposed systems from multiple formats.
8B	Gather, read, and evaluate scientific and/or technical information from multiple sources, to determine the validity and reliability of the evidence and usefulness of each source

Performance Standards Scoring Criteria for Competency 8

Performance Standards	1 - Emergent	2 - Approaching	3 - Proficient	4 - Exemplary
8A Communicate scientific and technical information about scientific phenomena, design and development, or proposed systems from multiple formats.	I can identify scientific and technical information about phenomena, design and development, or proposed systems from multiple formats.	I can describe scientific and technical information about phenomena, design and development, or proposed systems from multiple formats..	I can explain scientific and technical information about phenomena, design and development, or proposed systems from multiple formats.	I can apply scientific and technical information about phenomena, design and development, or proposed systems from multiple formats.
8B Gather, read, and evaluate scientific and/or technical information from multiple sources, to determine the validity and reliability of the evidence and usefulness of each source	I can identify scientific or technical information related to the claims from multiple sources.	I can describe key pieces of evidence to determine the validity or reliability of each claim.	I can compare the validity and reliability of multiple claims.	I can evaluate the validity and reliability of multiple claims in order to choose the best interpretation of the evidence.