

Engineering Design and Development (EDD)

Next Generation Science Standards

Component o

HS.ESS3.2 - Earth and Human Activity

Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS.ETS1.3 - Engineering Design

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

DCI - ETS1.A - Engineering Design - Defining and Delimiting Engineering Problems

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3)

DCI - ETS1.A - Engineering Design - Defining and Delimiting Engineering Problems

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering.

These global challenges also may have manifestations in local communities.
(HS-ETS1-1)

Science and Engineering Practice - Asking questions and defining problems

Evaluate a question to determine if it is testable and relevant.

Science and Engineering Practice - Planning and Carrying Out Investigations

Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.

Science and Engineering Practice - Planning and Carrying Out Investigations

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

Science and Engineering Practice - Planning and Carrying Out Investigations

Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.

Science and Engineering Practice - Constructing Explanations and Designing Solutions

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Science and Engineering Practice - Engaging in Argument from Evidence

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.

Science and Engineering Practice - Engaging in Argument from Evidence

Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Science and Engineering Practice - Engaging in Argument from Evidence

Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

Science and Engineering Practice - Engaging in Argument from Evidence

Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.

Science and Engineering Practice - Engaging in Argument from Evidence

Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.

Science and Engineering Practice - Engaging in Argument from Evidence

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).

Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

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Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. - Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Crosscutting Concepts - Systems and System Models

Systems can be designed to do specific tasks.

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Component 1

HS.ESS3.1 - Earth and Human Activity

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS.ESS3.2 - Earth and Human Activity

Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS.ESS3.5 - Earth and Human Activity

Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS.ETS1.3 - Engineering Design

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS.ETS1.4 - Engineering Design

Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

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Evaluate a question to determine if it is testable and relevant.

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Science and Engineering Practice - Asking questions and defining problems

Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

Science and Engineering Practice - Asking questions and defining problems

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.

Science and Engineering Practice - Developing and Using Models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

Science and Engineering Practice - Developing and Using Models

Design a test of a model to ascertain its reliability.

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Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

Science and Engineering Practice - Developing and Using Models

Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.

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Crosscutting Concepts - Patterns

Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Crosscutting Concepts - Patterns

Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Crosscutting Concepts - Patterns

Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced; thus requiring improved investigations and experiments.

Crosscutting Concepts - Patterns

Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.

Crosscutting Concepts - Patterns

Mathematical representations are needed to identify some patterns.

Crosscutting Concepts - Patterns

Empirical evidence is needed to identify patterns.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Systems can be designed to cause a desired effect.

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Changes in systems may have various causes that may not have equal effects.

Crosscutting Concepts - Systems and System Models

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Crosscutting Concepts - Stability and Change

Much of science deals with constructing explanations of how things change and how they remain stable.

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Component 2

HS.ESS3.3 - Earth and Human Activity

Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

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Science and Engineering Practice - Analyzing and Interpreting Data

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Science and Engineering Practice - Analyzing and Interpreting Data

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.

Science and Engineering Practice - Analyzing and Interpreting Data

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

Science and Engineering Practice - Analyzing and Interpreting Data

Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.

Science and Engineering Practice - Analyzing and Interpreting Data

Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

Science and Engineering Practice - Analyzing and Interpreting Data

Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model “makes sense” by comparing the outcomes with what is known about the real world.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m³, acre-feet, etc.)

Science and Engineering Practice - Constructing Explanations and Designing Solutions

Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

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Crosscutting Concepts - Scale, Proportion, and Quantity

In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

Crosscutting Concepts - Scale, Proportion, and Quantity

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Crosscutting Concepts - Scale, Proportion, and Quantity

Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.

Crosscutting Concepts - Scale, Proportion, and Quantity

Patterns observable at one scale may not be observable or exist at other scales.

Crosscutting Concepts - Scale, Proportion, and Quantity

Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Crosscutting Concepts - Scale, Proportion, and Quantity

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Crosscutting Concepts - Systems and System Models

Systems can be designed to do specific tasks.

Crosscutting Concepts - Energy and Matter: Flows, Cycles, and Conservation

Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

Crosscutting Concepts - Energy and Matter: Flows, Cycles, and Conservation

The total amount of energy and matter in closed systems is conserved.

Crosscutting Concepts - Energy and Matter: Flows, Cycles, and Conservation

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Crosscutting Concepts - Energy and Matter: Flows, Cycles, and Conservation

Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems.

Crosscutting Concepts - Energy and Matter: Flows, Cycles, and Conservation

Energy drives the cycling of matter within and between systems.

Crosscutting Concepts - Structure and Function

The way an object is shaped or structured determines many of its properties and functions.

Crosscutting Concepts - Structure and Function

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Crosscutting Concepts - Structure and Function

The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Crosscutting Concepts - Stability and Change

For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

Crosscutting Concepts - Stability and Change

Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Crosscutting Concepts - Stability and Change

Feedback (negative or positive) can stabilize or destabilize a system.

Crosscutting Concepts - Stability and Change

Systems can be designed for greater or lesser stability.

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Component 3

HS.PS3.3 - Energy

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS.ESS3.3 - Earth and Human Activity

Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS.ESS3.4 - Earth and Human Activity

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

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Science and Engineering Practice - Planning and Carrying Out Investigations

Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.

Science and Engineering Practice - Planning and Carrying Out Investigations

Select appropriate tools to collect, record, analyze, and evaluate data. Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.

Science and Engineering Practice - Analyzing and Interpreting Data

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Science and Engineering Practice - Analyzing and Interpreting Data

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.

Science and Engineering Practice - Analyzing and Interpreting Data

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

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Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.

Science and Engineering Practice - Analyzing and Interpreting Data

Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

Science and Engineering Practice - Analyzing and Interpreting Data

Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Use simple limit cases to test mathematical expressions, computer programs, algorithms, or simulations of a process or system to see if a model “makes sense” by comparing the outcomes with what is known about the real world.

Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m³, acre-feet, etc.)

Science and Engineering Practice - Constructing Explanations and Designing Solutions

Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

Science and Engineering Practice - Constructing Explanations and Designing Solutions

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) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

Science and Engineering Practice - Constructing Explanations and Designing Solutions

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Science and Engineering Practice - Engaging in Argument from Evidence

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.

Science and Engineering Practice - Engaging in Argument from Evidence

Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

Science and Engineering Practice - Engaging in Argument from Evidence

Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

Science and Engineering Practice - Engaging in Argument from Evidence

Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.

Science and Engineering Practice - Engaging in Argument from Evidence

Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.

Science and Engineering Practice - Engaging in Argument from Evidence

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).

Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.

Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.

Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

Crosscutting Concepts - Patterns

Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Crosscutting Concepts - Patterns

Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Crosscutting Concepts - Patterns

Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced; thus requiring improved investigations and experiments.

Crosscutting Concepts - Patterns

Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.

Crosscutting Concepts - Patterns

Mathematical representations are needed to identify some patterns.

Crosscutting Concepts - Patterns

Empirical evidence is needed to identify patterns.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Systems can be designed to cause a desired effect.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Changes in systems may have various causes that may not have equal effects.

Crosscutting Concepts - Scale, Proportion, and Quantity

In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

Crosscutting Concepts - Scale, Proportion, and Quantity

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

Crosscutting Concepts - Scale, Proportion, and Quantity

Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly.

Crosscutting Concepts - Scale, Proportion, and Quantity

Patterns observable at one scale may not be observable or exist at other scales.

Crosscutting Concepts - Scale, Proportion, and Quantity

Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Crosscutting Concepts - Scale, Proportion, and Quantity

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Crosscutting Concepts - Systems and System Models

A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

Crosscutting Concepts - Systems and System Models

Systems can be designed to do specific tasks.

Crosscutting Concepts - Systems and System Models

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

Crosscutting Concepts - Systems and System Models

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Crosscutting Concepts - Systems and System Models

Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

Engineering Design and Development (EDD)

Next Generation Science Standards

Component 4

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS.ETS1.3 - Engineering Design

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

DCI - ETS1.A - Engineering Design - Defining and Delimiting Engineering Problems

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3)

DCI - ETS1.A - Engineering Design - Defining and Delimiting Engineering Problems

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering.

These global challenges also may have manifestations in local communities.
(HS-ETS1-1)

Science and Engineering Practice - Asking questions and defining problems

Evaluate a question to determine if it is testable and relevant.

Science and Engineering Practice - Asking questions and defining problems

Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Science and Engineering Practice - Asking questions and defining problems

Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

Science and Engineering Practice - Asking questions and defining problems

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.

Science and Engineering Practice - Developing and Using Models

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

Science and Engineering Practice - Developing and Using Models

Design a test of a model to ascertain its reliability.

Science and Engineering Practice - Developing and Using Models

Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

Science and Engineering Practice - Developing and Using Models

Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.

Science and Engineering Practice - Developing and Using Models

Develop a complex model that allows for manipulation and testing of a proposed process or system.

Science and Engineering Practice - Developing and Using Models

Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

Science and Engineering Practice - Planning and Carrying Out Investigations

Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.

Science and Engineering Practice - Planning and Carrying Out Investigations

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

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Science and Engineering Practice - Analyzing and Interpreting Data

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.

Science and Engineering Practice - Analyzing and Interpreting Data

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

Science and Engineering Practice - Analyzing and Interpreting Data

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Science and Engineering Practice - Engaging in Argument from Evidence

Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.

Science and Engineering Practice - Engaging in Argument from Evidence

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).

Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

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Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

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Crosscutting Concepts - Cause and Effect: Mechanism and Prediction

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Engineering Design and Development (EDD)

Next Generation Science Standards

Component 5

HS.ETS1.1 - Engineering Design

Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS.ETS1.3 - Engineering Design

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

DCI - ETS1.A - Engineering Design - Defining and Delimiting Engineering Problems

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3)

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