

High-Level Description: Developing focused, answerable inquiry and research questions.

0	No evidence of developing inquiry or research questions that support understanding of a given topic.	1	Questions are relevant to a specific topic.	2	Questions are relevant to a specific topic <b>and are based on the described problem or situation.</b>	3	Questions are relevant to a specific topic, <b>are testable or researchable, and build on prior knowledge about the topic.</b>	4	Questions are relevant to a specific topic, are testable or researchable, and build on <b>disciplinary</b> knowledge about the topic.	5	Questions are <b>valid, testable, or researchable, and based on observed patterns and/or research.</b>	6	Questions are <b>valid, focused, testable or researchable, and based on observed patterns, current research, and/or a specific model or theory.</b>	7	Questions are <b>valid, precise, testable or researchable, and based on observable patterns, specific evidence from current research, and/or a specific model or theory, and push standard thinking on a given topic or in a particular discipline.</b>	8	Questions are <b>valid, precise, testable or researchable, based on patterns/ observations, specific evidence from current research and/or a specific model or theory, and push standard thinking on a given topic or in a particular discipline.</b>
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**High-Level Description: Defining the criteria and constraints for addressing a real-world problem through engineering design.**

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No evidence of defining a design problem.	Begins to define a simple design problem with incomplete description of criteria or constraints.	<b>Definition of a simple design problem is mostly complete.</b> Representation of criteria for success and constraints is <b>general</b> .	Definition of a simple design problem is <b>complete</b> . <b>Includes several criteria and practical constraints (e.g., materials, time, or cost).</b>	Definition of <b>the problem</b> or design statement is complete. <b>Identifies relevant criteria and constraints.</b>	Definition of the problem or design statement is complete <b>and includes rationale</b> . Addresses <b>multiple criteria and constraints relevant to the problem</b> .	Definition of the problem or design statement is complete and includes rationale. Addresses multiple criteria and constraints, <b>including one or more social, technical or scientific</b> constraints relevant to the problem.	Definition of the problem or design statement is <b>thorough</b> and includes rationale. <b>Fully</b> addresses criteria and <b>important</b> social, technical and/or scientific constraints relevant to the problem.	Definition of the problem or design statement is thorough, <b>precise</b> , and includes rationale. Fully addresses <b>all</b> criteria and the <b>complex interactions among</b> important social, technical, and scientific factors relevant to the problem. <b>When relevant, addresses unknowns and raises relevant questions to more clearly define the problem.</b>

High-Level Description: Developing hypotheses and predictions related to the inquiry or research question, or to the investigation.

0	No evidence of hypothesis or prediction.	1	Makes a prediction that is partially relevant to the inquiry question with little or no reasoning.	2	Makes a prediction <b>related</b> to the inquiry question. <b>Supports reasoning for prediction with prior observations or experiences.</b>	3	Makes a <b>reasonable</b> prediction related to the inquiry question <b>that involves changing a variable.</b> <b>Begins to explain reasoning for prediction by relating it to prior knowledge such as cause and effect relationships.</b>	4	Makes a reasonable prediction related to the inquiry question that involves changing a variable. <b>Hypothesis relates to prior research about the topic.</b>	5	<b>Constructs a testable hypothesis about the investigated question, with a basic description of the variables.</b> Hypothesis relates to <b>observation, research, or scientific principle.</b>	6	Constructs a <b>clear, testable</b> hypothesis about the investigated question, with <b>an accurate definition of the independent and dependent variables.</b> Hypothesis <b>is based on observation, research, scientific principle, model, or theory.</b>	7	Constructs a <b>precise, testable</b> hypothesis about the investigated question, with an accurate definition <b>and explanation of the relationship</b> between independent and dependent variables. Hypothesis is based on observation, research, scientific principle, or theory.	8	Constructs a precise, testable, <b>and insightful</b> hypothesis about the investigated question, with accurate definition and <b>thorough</b> explanation of the relationship between independent and dependent variables. Hypothesis is based on observation, research, scientific principle, model, or theory.
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**High-Level Description: Planning and carrying out investigations that provide evidence to support explanations, design solutions, and/or models.**

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No evidence of procedures to investigate a question or test a model or design/solution.	Identifies a general approach to investigate a question or test a design with minimal description of procedures.	Provides a set of procedures that is <b>partially aligned to the objectives of the inquiry/design criteria.</b> <b>Lists some tools/instruments and types of observations/measurements to be gathered.</b>	Provides a set of procedures that is aligned to the objectives of the inquiry/design criteria <b>and is likely to produce some evidence/data relevant to the purpose.</b> <b>Lists tools/instruments and types of observations/measurements to be gathered.</b> <b>Includes controls when relevant.</b>	Provides a set of procedures that is aligned to the objectives of the inquiry/design criteria and is likely to produce some evidence/data relevant to the purpose. <b>Lists tools/instruments and types of observations/measurements to be gathered.</b> <b>Considers the amount of data needed to answer the inquiry question/evaluate the design and includes controls when relevant.</b>	Provides an <b>orderly, mostly replicable</b> set of procedures that is likely to produce evidence that is aligned with the objectives of the inquiry/design criteria. <b>Describes tools/instruments and types of observations/measurements to be gathered.</b> <b>Considers the amount of measurements/data needed to answer the inquiry question or evaluate the design with accuracy and includes controls when relevant.</b>	Provides a <b>clear and orderly,</b> replicable set of procedures that <b>will</b> produce relevant and sufficient evidence aligned to the objectives of the inquiry/design criteria <b>and/or to test a model.</b> <b>Describes tools/instruments and types/amount of measurements/data to be gathered needed to produce reliable measurements and describes the role of controls when relevant.</b>	Provides a <b>detailed, clear,</b> and replicable set of procedures that will produce relevant and sufficient evidence aligned to the objectives of the inquiry/design criteria and/or to test a model. <b>Describes tools/instruments and the types/amount of measurements/data needed to produce reliable measurements and describes the role of controls when relevant.</b> <b>Identifies some possible contingencies.</b>	Provides a detailed, clear, and replicable set of procedures that will produce sufficient and <b>accurate evidence precisely matched</b> to the objectives of the inquiry/design criteria and to test <b>and revise</b> a model. <b>Describes tools/instruments and the types/amount of measurements/data needed to produce reliable measurements, and limitations of the data.</b> <b>Describes the role of controls when relevant.</b> <b>Includes contingency plans to address failure points or when a redesign may be needed.</b>

High-Level Description: Organizing and representing information (e.g., numerical and visual data).

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0	No evidence of organizing information.							
1	Attempts to organize information into a structure. The selected form is inappropriate for the purpose and type of data.	<b>Organizes</b> information into a <b>simple and appropriate</b> structure (e.g., table, bar graph, pictograph, and/or pie chart).	Organizes information into a <b>simple and appropriate</b> structure (e.g., table, bar graph, pictograph, and/or pie chart). Formatting, labeling, and data representation are generally accurate.	Organizes information into <b>structures appropriate for the grade level</b> (e.g., table, chart, graph, formula). Data representations are <b>accurate</b> , with <b>mostly accurate</b> formatting or labeling.	Organizes information into structures <b>appropriate for the data and the data</b> (e.g., <b>arrays, data</b> , charts, graphs, formulas). Data representations are accurate, with <b>mostly accurate</b> formatting or labeling.	Organizes information into structures <b>appropriate for the data, purpose, and grade level</b> (e.g., data arrays, tables, charts, graphs, formulas). Data representations are accurate, with <b>mostly accurate</b> formatting or labeling.	Organizes information into structures <b>appropriate for the data, purpose, and grade level</b> (e.g., data arrays, tables, charts, graphs, formulas). Data representations are accurate, <b>complete</b> , and are <b>accurately</b> formatted and labeled.	Organizes and <b>synthesizes various sources</b> of information into structures <b>appropriate for the data, purpose, and grade level</b> (e.g., data arrays, tables, charts, graphs, formulas). Data representations are accurate, complete, and are accurately formatted and labeled.

**High-Level Description: Analyzing information to identify patterns and/or relationships relevant to understanding a phenomenon or to solve a design problem.**

0	1	2	3	4	5	6	7	8
No evidence of analyzing information to identify patterns and/or relationships.	Identifies simple connections or patterns from information or observations that are relevant to understanding a phenomenon or solving a design problem.	Identifies <b>patterns in the data</b> or <b>makes qualitative observations using logical reasoning.</b> Patterns are relevant to understanding a phenomenon or solving a design problem.	Identifies <b>and explains</b> patterns in the data or makes qualitative observations using logical reasoning. Patterns are relevant to understanding a phenomenon or solving a design problem. FOR NGSS: Applies mathematics, and/or computation. When relevant, compares similarities and differences in data collected by different groups in the class.	<b>Analyzes</b> patterns and relationships among variables/data with minor errors or omissions, applying logical reasoning. <b>FOR NGSS:</b> Applies a <b>basic statistics/probability concept</b> (e.g., mean, median, mode, and variability) or a mathematical concept (e.g., ratio, rate, percent, basic operations, and simple algebra). When relevant, compares similarities and differences in findings across different trials and/or groups.	Analyzes patterns and relationships among variables/data with <b>general</b> accuracy, applying logical reasoning <b>and relevant quantitative reasoning</b> when appropriate. <b>FOR NGSS:</b> Applies relevant statistics/probability concepts or mathematical, computational, and/or algorithmic representations. When relevant, uses data from across different types and/or sources to <b>triangulate analyses of data</b> and to <b>identify (in) consistency of measurement or findings.</b>	Analyzes and <b>explains observed</b> patterns and relationships among variables/data with <b>general</b> accuracy, applying logical reasoning <b>and relevant quantitative reasoning</b> when appropriate. <b>FOR NGSS:</b> Applies relevant statistics/probability concepts or mathematical, computational, and/or algorithmic representations. When relevant, uses data from across different types and/or sources to <b>triangulate analyses of data</b> and to <b>identify (in) consistency of measurement or findings.</b>	<b>Accurately</b> analyzes and explains patterns and relationships among variables/data, applying logical reasoning and relevant quantitative reasoning when appropriate. <b>FOR NGSS:</b> Applies relevant statistics/probability concepts or mathematical, computational, and/or algorithmic representations. When relevant, uses data from across different types and/or sources to <b>triangulate analyses of data</b> and to <b>identify (in) consistency of measurement or findings.</b>	Accurately and <b>thoroughly</b> analyzes and explains patterns and relationships among variables/data, applying logical reasoning and relevant quantitative reasoning when appropriate. <b>FOR NGSS:</b> Applies relevant statistics/probability concepts or mathematical, computational, and/or algorithmic representations. When relevant, uses data from across different types and/or sources to <b>triangulate analysis of data</b> and to <b>evaluate and explain (in) consistency of measurement or findings.</b>

**High-Level Description: Developing, using, and revising models (i.e., diagrams, physical replicas, mathematical representations, analogies, and computer simulations) to describe and predict phenomena or represent and test design solutions.**

0	1	2	3	4	5	6	7	8
No evidence of developing, using, or revising models to describe a phenomenon or design solution.	Develops/ uses a simple, partial model to describe a phenomenon or design solution. Model includes significant errors.	Develops/ uses a simple, partial model <b>based on observations or prior knowledge</b> to describe a phenomenon or design solution. Model includes <b>minor errors</b> .	Develops/ uses a <b>mostly complete</b> model based on evidence to describe a phenomenon. <b>Also identifies limitation(s) of the model.</b> OR <b>Develops a partially complete diagram or simple physical prototype of proposed object, tool, or process.</b>	Develops/ uses a <b>complete</b> model based on evidence to <b>predict and/ or describe</b> phenomenon. Also identifies limitation(s) of the model. OR <b>Develops a complete diagram or simple physical prototype of proposed object, tool, or process that is specific enough to show and potentially test cause-and-effect relationships.</b>	Develops/uses a complete model based on evidence to predict and/ or describe phenomenon/ <b>unobservable mechanisms, including specific relationships between variables.</b> Also identifies <b>limitation(s) of the model.</b> OR <b>Develops a complete diagram or simple physical prototype of proposed object, tool, or process that is specific enough to generate all data to predict and explain phenomena or design solutions. Also evaluates merits and limitation(s) of the model.</b>	Develops/uses a complete model based on evidence to predict and/ or describe phenomenon, including specific relationships <b>within and between systems.</b> Also <b>evaluates merits and limitation(s) of the model in order to evaluate validity of the model.</b> OR <b>Develops a complete model (including computational representations) of a proposed object, tool, or process that is specific enough to generate all data needed to predict and explain phenomena or design solutions. Also evaluates merits and limitation(s) of the model.</b>	Develops/uses a complete model based on evidence to predict and/ or describe phenomenon, including specific relationships <b>within and between systems.</b> Also <b>evaluates merits and limitation(s) of the model in order to evaluate validity of the model.</b> OR <b>Develops a complete model (including computational representations) of a proposed object, tool, or process that is specific enough to generate all data needed to predict and explain phenomena or design solutions. Also evaluates merits and limitation(s) of the model.</b>	Develops/uses a complete model based on evidence to predict and/ or describe phenomenon, including specific relationships within and between systems. Also evaluates merits and limitation(s) of the model <b>and compares to other models in order to select best model.</b> OR <b>Develops a complete model (including computational representations) of a proposed object, tool, or process that is specific enough to generate all data needed to predict and explain phenomena or design solutions. Also evaluates merits and limitation(s) of the model and compares to other models in order to select best model.</b>

**High-Level Description: Interpreting data/information from sources and making valid, credible claims about a phenomenon, model, or design solution.**

0	1	2	3	4	5	6	7	8
No evidence of interpreting data/information.	Interpretation of data/information is inaccurate or inconsistent in relation to the data or evidence about a phenomenon or design solution.	Interpretation of data/information <b>partially supports claims</b> about a phenomenon or design solution.	Interpretation of data/information <b>supports accurate</b> claims about a phenomenon or design solution.	Interpretation of data/information supports accurate claims about a phenomenon or design solution. <b>Discusses some limitations of the findings.</b>	Interpretation of data/information supports accurate claims about a phenomenon or design solution. Discusses <b>possible errors</b> and limitations of findings. <b>When possible, follows through on a plan to improve the accuracy of results (e.g., by increasing the number of trials).</b>	Interpretation of data/information supports accurate claims about a <b>model</b> , or design solution. Discusses possible <b>sources of errors</b> and limitations of findings. When possible, follows through on a plan to improve the accuracy of results (e.g., by increasing the number of trials).	Interpretation of data/information <b>provides credible and complete support</b> for accurate claims about a phenomenon, model, or design solution. Discusses possible sources of errors, limitations, and/or <b>outliers.</b> When possible, follows through on a plan to improve the accuracy of results (e.g., by increasing the number of trials).	Interpretation of data/information <b>synthesis of data/ information from varied sources</b> provides complete and credible support for <b>precise</b> claims about a phenomenon, model, or design solution. Discusses possible sources of errors, limitations, and/or outliers. Follows through on a plan to improve the accuracy of results <b>and evaluates the effectiveness of those procedures.</b>



**High-Level Description: Evaluating competing design solutions for a relevant problem, accounting for criteria and constraints, and drawing on empirical evidence, including the student's own generated evidence.**

0	1	2	3	4	5	6	7	8
No evidence of evaluating a design solution.	Makes a claim about the merit of a solution to a problem by discussing generally how it meets the criteria or constraints of the problem with minimal reference to evidence.	Makes a claim about the merit of a solution to a problem by discussing how it <b>meets specific</b> criteria and constraints of the problem with <b>some</b> reference to evidence.	Makes a claim about the merit of a solution to a problem by discussing how it meets specific criteria and constraints of the problem with <b>clear citation of empirical evidence.</b>	Makes a claim that <b>compares and evaluates competing design solutions to a real-world problem based on empirical evidence and scientific reasoning or analysis.</b> <b>For the selected design solution, explains whether empirical evidence satisfies design criteria and constraints.</b>	Makes a claim that compares and evaluates competing design solutions to a real-world problem based on empirical evidence and <b>scientific principles or disciplinary ideas.</b> <b>For the selected design solution, explains how well empirical evidence demonstrates that design criteria and constraints are satisfied.</b>	Makes a claim that compares and evaluates competing design solutions to a real-world problem based on empirical evidence, scientific or disciplinary ideas and principles, <b>and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).</b> <b>For each design solution, explains how well empirical evidence demonstrates that design criteria and constraints are satisfied.</b>	Makes a claim that compares and evaluates competing design solutions to a real-world problem based on empirical evidence, scientific or disciplinary ideas and principles, <b>and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).</b> <b>For each design solution, explains how well empirical evidence demonstrates that design criteria and constraints are satisfied.</b>	Makes a claim that compares and evaluates competing design solutions to a real-world problem based on empirical evidence, scientific or disciplinary ideas and principles, and <b>logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).</b> <b>For each design solution, explains how well empirical evidence demonstrates that design criteria and constraints are satisfied.</b> <b>Explains limitations of the empirical evidence or trade-offs of different solutions, and determines what additional information is required to make a more informed choice.</b>

**High-Level Description: Evaluating arguments or explanations. For NGSS: When possible, students should be asked to evaluate competing or alternate arguments/explanations and apply the same analytic lens to evaluate multiple arguments/explanations.**

0	1	2	3	4	5	6	7	8
No evidence of evaluating an argument.	Restates an argument/explanation. OR States an opinion on the argument/explanation with minimal reference to evidence.	<b>Summarizes</b> an argument/explanation. States an opinion on the argument/explanation and rationale <b>based on the relevance of the evidence.</b> FOR NGSS: Considers whether the evidence is empirical.	<b>Accurately</b> summarizes an argument/explanation <b>or specific claims.</b> <b>Evaluates the logic</b> of the reasoning and the relevance/ <b>nature</b> of the evidence. FOR NGSS: Considers whether empirical evidence <b>is based on research and distinguishes among facts and opinions.</b>	Accurately summarizes an argument/explanation <b>and specific claims.</b> Evaluates the argument based on the logic of the reasoning, and relevance, and credibility of the evidence, and <b>credibility</b> of the evidence. FOR NGSS: Considers whether interpretation of empirical evidence <b>is scientifically reasonable.</b>	<b>Explains</b> an argument/explanation and specific claims. Evaluates the argument based on the logic of the reasoning, and relevance, and credibility of the evidence. <b>When relevant, identifies false statements and fallacious reasoning (i.e., logical fallacies).</b> FOR NGSS: Considers whether interpretation of empirical evidence is scientifically reasonable <b>and whether it supports or refutes a scientific explanation or model.</b>	<b>Clearly</b> explains an argument/explanation and specific claims. Evaluates the argument by <b>thoroughly assessing</b> the logic of the reasoning and the relevance, credibility, and <b>sufficiency</b> of the evidence. When relevant, identifies false statements and fallacious reasoning (i.e., logical fallacies). FOR NGSS: Considers the <b>sufficiency and consistency</b> of the empirical evidence, including the student's own generated evidence, and limitations of the empirical evidence.	Clearly explains an argument/explanation and specific claims. Evaluates the argument by thoroughly assessing the logic of the reasoning and the relevance, credibility, <b>and consistency</b> of evidence. When relevant, identifies false statements and fallacious reasoning (i.e., logical fallacies) <b>and explains alternate claims or evidence to improve the logic of the argument/explanation.</b> <b>Determines what additional information is required to resolve contradictions.</b> FOR NGSS: Considers <b>currently accepted explanations or models</b> , the sufficiency and consistency of empirical evidence, including the student's own generated evidence, and limitations of empirical evidence.	Clearly explains an argument/explanation and specific claims. Evaluates the argument by thoroughly assessing the logic of the reasoning and the relevance, credibility, and consistency of evidence. Identifies false statements and fallacious reasoning (i.e., logical fallacies) and explains alternate claims or evidence to improve the logic of the argument/explanation. <b>Determines what additional information is required to resolve contradictions.</b> FOR NGSS: Considers currently accepted explanations <b>and models, new evidence</b> , the sufficiency and consistency of empirical evidence, including the student's own generated evidence, and limitations of empirical evidence.

**Dimension: Designing a solution (e.g., an object, tool, process or system) that is supported by scientific ideas and meets criteria and constraints; evaluating and refining the solution through analysis of empirical evidence.**

0	1	2	3	4	5	6	7	8
No evidence of an appropriate design solution.	Designs a solution to address a problem with little or no connection to criteria or constraints.	Designs a solution that meets <b>one or more criteria and constraints</b> of the problem. Evaluation of the solution and the refined solution <b>reflect minimal attention to empirical evidence.</b>	Designs a solution that refers to <b>a scientific idea and meets core criteria and constraints.</b> Evaluation of the solution and the refined solution <b>refer to empirical evidence.</b>	Designs a solution that refers to and <b>applies a relevant scientific idea</b> and meets <b>core and additional specific criteria</b> and constraints. Evaluation of the solution and the refined solution refer to and <b>are consistent with empirical evidence.</b>	Designs a solution that refers to and <b>accurately applies</b> relevant scientific idea(s) and <b>makes trade-offs to satisfy criteria and meet constraints.</b> Evaluation of the solution and the refined solution <b>reflect analysis of empirical evidence.</b>	Designs a solution to a complex real-world problem; solution is <b>explicitly and accurately supported</b> with relevant scientific ideas and makes trade-offs to satisfy prioritized criteria and <b>meets most constraints.</b> Evaluation of the solution and the refined solution <b>reflect accurate analysis of empirical evidence.</b>	Designs a solution to a complex real-world problem; solution is explicitly and accurately supported with relevant scientific ideas <b>and/or models and optimizes trade-offs</b> to satisfy prioritized criteria and <b>fully meet</b> constraints. <b>Solution takes into account possible unanticipated effects.</b> Evaluation of the solution and the refined solution <b>clearly reflect accurate analysis of empirical evidence collected by the student and, when available, credible secondary sources.</b>	Designs a <b>sophisticated</b> solution to a complex real-world problem; solution is explicitly and accurately supported with relevant scientific ideas and/or models and optimizes trade-offs to satisfy prioritized criteria and fully meet constraints. Solution takes into account possible unanticipated effects. Evaluation of the solution and the refined solution clearly reflect accurate analysis of empirical evidence collected by the student and, when available, <b>credible</b> secondary sources.

High-Level Description: Explaining a phenomenon using empirical evidence, disciplinary ideas, and logical reasoning.

0	1	2	3	4	5	6	7	8
No evidence of an appropriate explanation.	Explanation is not consistent with empirical evidence or disciplinary ideas.	<b>Constructs an explanation to describe a phenomenon with minimal reference to empirical evidence.</b>	Constructs an explanation <b>about observed relationships</b> to describe a phenomenon <b>based on empirical evidence</b> . FOR NGSS: Explanations are based on empirical data (e.g., measurements, observations, patterns) and are used to make predictions.	Constructs an explanation about a <b>phenomenon based on empirical evidence and makes a connection to a disciplinary idea.</b> FOR NGSS: <b>Explains the relationship among variables based on empirical data and a scientific principle, or model.</b>	Constructs an explanation about a phenomenon <b>supported by logical reasoning</b> , empirical evidence, and making connection to a disciplinary idea. When relevant, identifies limitations of the evidence. FOR NGSS: Explains the relationship among variables; explanations are supported by a <b>brief discussion</b> of empirical data and scientific principles, theories, or models.	Constructs an explanation about a phenomenon, <b>supported by logical reasoning</b> , empirical evidence, and/or <b>explanations of disciplinary concepts.</b> When relevant, describes limitations of the evidence. FOR NGSS: <b>Accurately and completely</b> explains the relationship among variables; explanations are supported by a <b>discussion</b> of empirical data and scientific principles, theories, or models.	Constructs a <b>complete and credible</b> explanation about a phenomenon, supported by a <b>synthesis of logical reasoning</b> , empirical evidence, and/or explanations of disciplinary concepts. When relevant, <b>explains limitations of the evidence and/or alternate explanations/approaches.</b> FOR NGSS: Accurately and completely explains the relationship among variables; explanations are supported by a <b>synthesis of empirical data from a variety of data sources, including students' own investigations</b> , scientific theories, models, simulations, and/or <b>peer review.</b>	