

# 2011-12 Official Scientific Inquiry/Engineering Design Scoring Guides

## High School

|              | <p style="text-align: center;"><b>SI- Forming a Question or Hypothesis</b></p> <p style="text-align: center;"><i>Based on observations and science principles, formulate a question or hypothesis that can be investigated through the collection and analysis of relevant information.</i></p>   | <p style="text-align: center;"><b>ED- Identifying and Defining a Problem to be Solved</b></p> <p style="text-align: center;"><i>Based on observations and scientific principles, formulate the statement of a practical problem that can be addressed through the process of engineering design.</i></p>  |              |
|--------------|---|---|--------------|
| <b>5/6**</b> | <ul style="list-style-type: none"> <li>• Forms a question or hypothesis that can be investigated through collection and analysis of relevant empirical data and generally points toward a broader understanding of existing scientific relationships (e.g. interaction, dependency, correlation, causation) and/or has the potential to lead to new scientific knowledge.</li> <li>• Provides comprehensive (well documented) background science knowledge and observations to establish a detailed context for this investigation.</li> <li>• The question or hypothesis clearly guides the design of an effective or innovative investigation.</li> </ul> | <ul style="list-style-type: none"> <li>• Describes in detail a problem to be solved through the process of engineering design.</li> <li>• Thoroughly explains relevant science principles that relate to the problem.</li> <li>• Specifies appropriate criteria within constraints or limits for a solution based on science principles with supporting rationale.</li> </ul> | <b>5/6**</b> |
| <b>4</b>     | <ul style="list-style-type: none"> <li>• Forms a question or hypothesis that can be investigated through collection and analysis of relevant evidence.</li> <li>• Provides sufficient background science knowledge and/or preliminary observations to establish an appropriate context for this investigation.</li> <li>• The question or hypothesis is specific enough to guide the design of an effective investigation.</li> </ul>   | <ul style="list-style-type: none"> <li>• Describes a problem to be solved through the process of engineering design.</li> <li>• Describes the relevant science principles that relate to the problem.</li> <li>• Identifies appropriate criteria and constraints for a solution.</li> </ul>   | <b>4</b>     |
| <b>3</b>     | <ul style="list-style-type: none"> <li>• Forms a question or hypothesis that cannot be adequately investigated through collection and analysis of evidence.</li> <li>• Provides relevant but insufficient background information and/or preliminary observations.</li> <li>• The question or hypothesis is not specific enough to guide the design of an effective investigation.</li> </ul>  | <ul style="list-style-type: none"> <li>• Partially describes a problem to be solved through the process of engineering design.</li> <li>• Describes some relevant science principles that partially relate to the problem.</li> <li>• Identifies limited criteria and constraints for a solution.</li> </ul>  | <b>3</b>     |
| <b>1/2*</b>  | <ul style="list-style-type: none"> <li>• Forms a question or hypothesis that cannot be investigated using data and available resources.</li> <li>• Provides background science knowledge or preliminary observations that are not relevant to the investigation.</li> <li>• The question or hypothesis cannot guide the design of an effective investigation.</li> </ul>  | <ul style="list-style-type: none"> <li>• Describes a problem that is unable to be solved through the process of engineering design.</li> <li>• Describes science principles that do not relate to the problem.</li> <li>• Identifies unrelated criteria and constraints for a solution.</li> </ul>  | <b>1/2*</b>  |

\*\*5 for preponderance (most) completed, 6 for all completed.

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A hypothesis may be stated as a claim. An engineering design problem addresses a need with a solution that uses relevant science principles.

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|              | <p style="text-align: center;"><b>SI- Designing an Investigation</b></p> <p style="text-align: center;"><i>Design a controlled experiment, field study, or other systematic investigation that provides sufficient data to answer a question or test a hypothesis about the natural world.</i></p>  | <p style="text-align: center;"><b>ED- Generating Possible Solutions</b></p> <p style="text-align: center;"><i>Evaluate and select an engineering solution from a range of possible options, and defend that solution for testing using trade-offs, criteria and constraints.</i></p>   |              |
|--------------|---|--|--------------|
| <b>5/6**</b> | <ul style="list-style-type: none"> <li>• Proposes scientifically logical, safe, and ethical procedure in a precise and efficient design.</li> <li>• Thoroughly identifies, controls, and monitors relevant variables and describes a systematic investigative process that is clear and adaptable if necessary.</li> <li>• Presents a design that will provide data of exceptional quality and quantity to address the question or hypothesis and to investigate possible relationships.</li> </ul> | <ul style="list-style-type: none"> <li>• Describes multiple viable solutions based on scientific or engineering principles.</li> <li>• Uses and clearly articulates the concept of trade-offs to compare and evaluate possible solutions in terms of criteria and constraints.</li> <li>• Selects and defends a solution for testing based on a comprehensive review of the criteria and constraints. Uses initial testing, data and/or research to support decision.</li> </ul> | <b>5/6**</b> |
| <b>4</b>     | <ul style="list-style-type: none"> <li>• Proposes a scientifically logical, safe, and ethical procedure that can be easily followed.</li> <li>• Identifies relevant variables and defines a systematic, investigative process that has clearly defined procedures.</li> <li>• Presents a design that will provide data of sufficient quality and quantity to address the question or hypothesis.</li> </ul>   | <ul style="list-style-type: none"> <li>• Describes several possible solutions based on scientific or engineering principles.</li> <li>• Uses the concept of trade-offs to evaluate possible solutions in terms of criteria and constraints.</li> <li>• Selects and defends a solution for testing based on the criteria and constraints.</li> </ul>  | <b>4</b>     |
| <b>3</b>     | <ul style="list-style-type: none"> <li>• Proposes a scientifically logical, safe, and ethical procedure that can be easily followed but includes scientific or logical errors or omissions.</li> <li>• Identifies relevant variables but does not clearly define a systematic investigative procedure.</li> <li>• Presents a design that will provide data of insufficient quality or insufficient quantity to fully address the question or hypothesis.</li> </ul>                                 | <ul style="list-style-type: none"> <li>• Describes solutions which are similar in nature and are partially based on scientific or engineering principles.</li> <li>• Makes limited use of the concept of trade-offs to evaluate possible engineering solutions in terms of criteria and constraints.</li> <li>• Selects and defends a solution for testing partially based on the criteria and constraints.</li> </ul>   | <b>3</b>     |
| <b>1/2*</b>  | <ul style="list-style-type: none"> <li>• Proposes a limited scientifically logical, safe, or ethical procedure that cannot be easily followed.</li> <li>• Partially identifies variables or presents an investigative procedure that lacks enough detail to be followed.</li> <li>• Presents a design that will provide data of neither sufficient quality nor quantity to fully address the question or hypothesis.</li> </ul>   | <ul style="list-style-type: none"> <li>• Describes only one possible solution.</li> <li>• Incorrectly uses of the concept of trade-offs to evaluate possible solutions in terms of criteria and constraints.</li> <li>• Defends solution for testing with unrelated criteria.</li> </ul>   | <b>1/2*</b>  |

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|              | <b>SI- Collecting and Presenting Data</b><br><i>Collect, organize, and display sufficient and appropriate data to facilitate scientific analysis and interpretation.</i>  | <b>ED- Testing Solution(s) and Collecting Data</b><br><i>Create and test or otherwise analyze solution(s) by collecting, organizing, and displaying data to facilitate the analysis and interpretation of results.</i>   |              |
|--------------|---|--|--------------|
| <b>5/6**</b> | <ul style="list-style-type: none"> <li>Collects comprehensive, complete and detailed data that are consistent with the planned investigative design.</li> <li>Records accurate raw data using appropriate units with quantity and quality consistent with the designed procedure and reports anomalous data.</li> <li>Displays appropriate data in a manner that utilizes formats that clarify and highlight relationships to be analyzed and explained.</li> </ul> | <ul style="list-style-type: none"> <li>Creates and modifies a prototype, model, or process description that completely addresses and explains criteria and constraints and supports testing or analysis.</li> <li>Collects and processes multiple types of data relevant to criteria and constraints and uses the data to support modifications in the solution.</li> <li>Displays relevant data that is appropriately formatted for analysis and clearly supports the degree of effectiveness of the solution and any modifications of the original solution that have occurred.</li> </ul> | <b>5/6**</b> |
| <b>4</b>     | <ul style="list-style-type: none"> <li>Collects data that are consistent with the planned investigation design.</li> <li>Records accurate raw data using appropriate units and labels.</li> <li>Displays appropriate data in a manner that communicates results in an organized format to facilitate scientific analysis and interpretation.</li> </ul>   | <ul style="list-style-type: none"> <li>Creates and may modify prototype, model, or process description that adequately addresses criteria and constraints and supports testing or analysis.</li> <li>Collects and processes sufficient data relevant to criteria and constraints.</li> <li>Displays relevant data that is appropriately formatted for analysis.</li> </ul>   | <b>4</b>     |
| <b>3</b>     | <ul style="list-style-type: none"> <li>Collects data that are consistent with the planned investigation design, but may be incomplete.</li> <li>Records accurate raw data with incorrect or some missing units or labels.</li> <li>Displays appropriate data in a manner that communicates results understandably, but may be somewhat incomplete or disorganized.</li> </ul>   | <ul style="list-style-type: none"> <li>Creates a prototype, model, or process description that partially addresses criteria and constraints and can be tested or analyzed.</li> <li>Collects and processes insufficient data relevant to criteria and constraints.</li> <li>Displays data that is not effectively formatted for analysis.</li> </ul>   | <b>3</b>     |
| <b>1/2*</b>  | <ul style="list-style-type: none"> <li>Records data that are inconsistent with the planned investigation design.</li> <li>Records inaccurate data and is missing units and labels.</li> <li>Displays inaccurate, incomplete or disorganized data.</li> </ul>  | <ul style="list-style-type: none"> <li>Creates a prototype, model, or process description that incorrectly addresses criteria and constraints or cannot be tested or analyzed.</li> <li>Collects and processes data irrelevant to criteria and constraints.</li> <li>Displays incomplete or irrelevant data that is not effectively formatted for analysis.</li> </ul>   | <b>1/2*</b>  |

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Data means evidence or record which may or may not require transformation to communicate results.

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|              | <b>SI- Analyzing and Interpreting Results</b>  | <b>ED- Analyzing and Interpreting Results</b>  |              |
|--------------|--|--|--------------|
|              | <i>Summarize and analyze data, and identify uncertainties. Draw a valid conclusion, explain how it is supported by the evidence and communicate the findings of the scientific investigation.</i>  | <i>Summarize and analyze data, evaluate the proposed solution, identify uncertainties, and suggest design improvements.</i>  |              |
| <b>5/6**</b> | <ul style="list-style-type: none"> <li>• Draws a valid and comprehensive conclusion that addresses the question or hypothesis, identifies relationships in the data, and explicitly explains how the conclusion is supported by the data.</li> <li>• Uses the results to analyze and critique the design and procedures providing significant sources of uncertainties and discuss how these might affect the results, and suggest insightful improvements, revisions or extensions.</li> <li>• Communicates the findings using relevant terminology to report results, explain possible patterns within the data, and if needed justifies alternate reasonable explanations.</li> </ul> | <ul style="list-style-type: none"> <li>• Based on the results, draws relevant conclusions about the viability of the tested/analyzed solution, makes a recommendation based on criteria and constraints and describes the process by which design modifications were made. Defends modifications and conclusions in terms of scientific and engineering principles and demonstrates how they fulfill criteria and constraints.</li> <li>• Uses data analysis to describe and explain strengths, weaknesses and uncertainties of the solution.</li> <li>• Describes design modifications or further engineering based on analysis of data and supported by science and engineering principles.</li> </ul> | <b>5/6**</b> |
| <b>4</b>     | <ul style="list-style-type: none"> <li>• Draws a valid conclusion that addresses the question or hypothesis and supports the conclusion explicitly using the data.</li> <li>• Provides evidence that the design, procedures, and data have been reviewed to identify sources of uncertainties and discuss how these might affect the results.</li> <li>• Communicates the findings using relevant terminology to report results, identify possible patterns within the data, and propose reasonable explanations.</li> </ul>   | <ul style="list-style-type: none"> <li>• Based on the results, draws relevant conclusions about the viability of the tested/analyzed solution and makes a recommendation.</li> <li>• Analyzes data and identifies strengths, weaknesses and uncertainties of the solution.</li> <li>• Describes design modifications or further engineering based on the information gathered.</li> </ul>  | <b>4</b>     |
| <b>3</b>     | <ul style="list-style-type: none"> <li>• Draws a conclusion that addresses the question or hypothesis but is only partially supported by the evidence.</li> <li>• Provides minimal evidence that the design, procedures, and data have been reviewed to identify sources of uncertainties.</li> <li>• Communicates the findings using overly general terminology to report results and propose reasonable but incomplete explanations.</li> </ul>  | <ul style="list-style-type: none"> <li>• Based on the results, draws incomplete conclusions about the viability of the tested/analyzed solution and makes a recommendation.</li> <li>• Analyzes data and partially identifies strengths, weaknesses and uncertainties of the solution.</li> <li>• Suggests insufficient design modifications or further engineering based on the information gathered.</li> </ul>  | <b>3</b>     |
| <b>1/2*</b>  | <ul style="list-style-type: none"> <li>• Draws a conclusion that is not clearly related to the question or hypothesis and is minimally supported by the evidence.</li> <li>• Provides incorrect evidence that the design, procedures, data have been reviewed to identify uncertainties.</li> <li>• Communicates the findings with inaccurate terminology to report results or proposes inaccurate explanations.</li> </ul>  | <ul style="list-style-type: none"> <li>• Based on the results, draws incorrect conclusions about the viability of the tested/analyzed solution and/or makes a disconnected recommendation.</li> <li>• Superficially analyzes data and incorrectly identifies strengths, weaknesses and/or uncertainties of the solution.</li> <li>• Suggests unrelated design modifications or further engineering not based on the information gathered.</li> </ul>   | <b>1/2*</b>  |

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