The Nature of Science for students in grades 3-5 involves:

- using grade level content and scientific practices to independently generate testable questions,
- design, plan and conduct scientific investigations,
- analyze and interpret data from the investigations,
- construct scientific explanations, and
- effectively communicate the results of scientific investigations.

<table>
<thead>
<tr>
<th>Conceptual Understanding</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level 1 students show limited understanding of major elementary school content concepts in science.</td>
<td>Level 2 students show emerging understanding of major elementary school content concepts in science.</td>
<td>Level 3 students show solid understanding of major elementary school content concepts in science.</td>
<td>Level 4 students show substantial understanding of major elementary school content concepts in science.</td>
</tr>
</tbody>
</table>

<p>| Research Questions | Level 1 students generate questions that are unrelated to the investigation or untestable even with limited educator support. | Level 2 students demonstrate limited ability to generate basic testable questions in broader teacher-directed settings or topics. Level 2 students are able to identify at least one variable related to the question. Level 2 students are able to broadly describe problems that can be solved. | Level 3 students generate testable questions or define problems in broader teacher-directed settings or topics. Students at this level ask questions about variables that can be changed (independent and dependent) and predict reasonable outcomes. Level 3 students describe problems that can be solved. | Level 4 students independently, generate testable questions or define problems. Students at this level ask questions about variables that can be changed and they are able to predict reasonable outcomes based on patterns. Level 4 students use prior knowledge and/or research to describe or define problems that can be solved. |
| Methods of Inquiry | Level 1 students are able to follow the steps, with limited teacher or peer support, in a procedure to conduct investigations. | Level 2 students are able to plan, and conduct investigations. These students rely on teacher support to develop and use models to describe observable phenomena and/or identify predictable patterns. Level 2 students require teacher support to set up experimental situations in which variables are controlled to carry out an investigation. | Level 3 students are able to independently research, plan, and conduct simple (2 variable) investigations. Level 3 students work with limited teacher support to determine what information is needed before writing the plan. With limited teacher support, Level 3 students are able to develop and use models to describe observable phenomena and/or identify predictable patterns. Level 3 students rely on limited teacher support to set up experimental situations in which variables are controlled to carry out an investigation. | Level 4 students are able to independently research, plan, and conduct simple investigations. Level 4 students independently determine what information or research is needed before writing the investigation plan. Level 4 students are able to develop and use models to describe observable phenomena and/or identify predictable patterns. Level 4 students are able to set up experimental situations in which variables are controlled to carry out an investigation. |
| Analyses and Data Transformation | Level 1 students require limited teacher support to conduct very basic qualitative and quantitative analyses of data generated through research procedures such as counting and producing frequency. | With limited teacher support, Level 2 students are able to conduct very basic qualitative and quantitative analyses of data generated through research procedures such as counting and producing frequency. | Level 3 students are able to conduct basic qualitative and quantitative analyses of data generated through research procedures such as counting and producing frequency distributions. | Level 4 students are able to conduct basic qualitative and quantitative analyses of data generated through research procedures such as computing basic descriptive statistics (e.g., means, medians). Level 4 students are able to |</p>
<table>
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<tr>
<th>Conclusions and Reasoning with Evidence</th>
<th>Level 1 students require extensive teacher support to construct explanations related to the evidence from their research or design studies. Level 1 students rely on teacher support to communicate scientific information orally and/or in written formats including various forms of media.</th>
<th>Level 2 students require limited teacher support to construct explanations somewhat related to the evidence from their research or design studies. Level 2 students are able to describe how scientific ideas are supported by evidence. Level 2 students communicate scientific information orally and/or in written formats including various forms of media.</th>
<th>Level 3 students construct explanations based on evidence from their research or design studies. Level 3 students are able to connect the results of their studies to grade appropriate content and describe how scientific ideas are supported by evidence. Level 3 students communicate scientific information orally and/or in written formats including various forms of media.</th>
<th>Level 4 students construct explanations based on evidence from their research or design studies. Level 4 students are able to connect the results of their studies to grade appropriate theories and describe how scientific ideas are supported by evidence. Level 4 students effectively communicate the results of their research using scientific arguments including an evaluation of those arguments based on their evaluation of their results. Level 4 students effectively communicate scientific information orally and/or in written formats including various forms of media.</th>
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<tbody>
<tr>
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<td>distributions. Level 1 students need teacher support to interpret data in terms of their experiment or design studies.</td>
<td>counting and producing frequency distributions. Level 2 students require limited teacher support to interpret data in terms of their experiment or design studies.</td>
<td>Level 3 students are able to interpret their data in terms of their research study to explain phenomena, identify patterns, explore relationships, and/or refine problem statements.</td>
<td>interpret their data in terms of their research study to explain phenomena, identify patterns, explore relationships, and/or refine problem statements.</td>
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</table>
Middle School Science Nature of Science Range Achievement Level Descriptors

The Nature of Science for students in grades 6-8 involves:
- using grade level content and scientific practices to independently generate testable questions,
- design, plan and conduct scientific investigations,
- analyze and interpret data from the investigations,
- construct scientific explanations, and
- effectively communicate the results of scientific investigations.

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</thead>
<tbody>
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<td></td>
<td>Level 1 students show limited understanding of major middle school content concepts in science.</td>
<td>Level 2 students show emerging understanding of major middle school content concepts in science.</td>
<td>Level 3 students show solid understanding of major middle school content concepts in science.</td>
<td>Level 4 students show substantial understanding of major middle school content concepts in science.</td>
</tr>
<tr>
<td>Research Questions</td>
<td>Level 1 students generate questions that are generally unrelated to the investigation or not scientifically testable.</td>
<td>Level 2 students demonstrate the ability to generate a basic testable question. Students at this level can identify one relevant variable related to the research question.</td>
<td>Level 3 students demonstrate the ability to generate testable questions or define engineering problems. Students at Level 3 can specify the parameters and state the expected relationship between two variables.</td>
<td>Level 4 students demonstrate the ability to generate testable questions or define problems that extend beyond classroom discussions. Students at Level 4 can specify the parameters and state the expected relationship between two or more variables. They relate their questions and/or problems to real-world situations and/or make connections to scientific theories.</td>
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<tr>
<td>Methods of Inquiry</td>
<td>Level 1 students can generate a rudimentary plan for carrying out an investigation but the plan does not correctly identify the relevant variables. Level 1 students are able to conduct observations however, they are incomplete and/or do not directly relate to the investigation. Level 1 students collect minimal data, is incomplete, or not connected to the question.</td>
<td>Level 2 students can generate a research plan with enough detail that someone else should be able to conduct the investigation. The research or engineering plan tests variables other than those identified in his/her question. Level 2 students are able to make observations related to the investigation, but the observations have errors and do not match the research/engineering plan.</td>
<td>Level 3 students can generate a research or engineering procedure enabling them to and conduct investigations using a variety of research methods in a specific setting. Level 3 students can make accurate qualitative and/or quantitative observations that match their stepwise plan.</td>
<td>Level 4 students can generate a research or engineering procedure enabling them to conduct investigations using a variety of research methods in a various settings. Level 4 students’ plan calls for ongoing evaluations and revisions throughout the investigation as necessary to improve process and outcomes. The final procedure is well-documented replicable. Level 4 students make detailed qualitative and/or quantitative observations directly related to the investigation.</td>
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<tr>
<td>Analyses and Data Transformation</td>
<td>Level 1 students can conduct very basic qualitative and quantitative analyses of data generated through research procedures such as counting, producing frequency distributions, and some basic tables and graphs.</td>
<td>Level 2 students are able to conduct basic qualitative and quantitative analyses of data generated through research procedures appropriately using basic descriptive statistics. Level 2 students</td>
<td>Level 3 students are able to conduct basic qualitative and quantitative analyses of data generated through research procedures using basic descriptive statistics and using appropriate tables, figures, drawings, or graphs. Level 3 students</td>
<td>Level 4 students are able to conduct sophisticated qualitative and quantitative analyses of data generated through research procedures such as computing basic descriptive statistics (e.g., means, medians). They present and interpret their data using organized and presented tables, graphs, and figures.</td>
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</table>
graphs. Level 1 students need teacher support to interpret data in terms of their experiment or design studies.

require teacher support to interpret data in terms of their experiment or design studies.

to interpret their data in terms of their research study to explain phenomena, identify patterns, and clearly connect the analyses to the research questions.

detailed tables, figures, scientific drawings, and graphs as appropriate.

Level 4 students are able to interpret their data in terms of their research study to explain phenomena, identify patterns, explore relationships, and/or refine problem statements. Level 4 students are able to use their analyses to connect the data explicitly to the question.

Conclusions and Reasoning with Evidence

Level 1 students do not identify trends or sources of error. Level 1 students create explanations that are unrelated to their claim or are not based on data or research. The Level 1 students do not state their conclusion(s).

Level 2 students are able to minimally connect data to their questions. They can recognize trends, but cannot explain the significance of the trend. Level 2 students can only identify some of the possible sources of error. Level 2 students can create explanations that are related to their claims and they offer minimal evidence supported by data.

Level 3 students are able to construct explanations using evidence to support their claims. Level 3 students present evidence grounded in their data as interpreted through their analyses. Level 3 students can select an appropriate format to communicate their conclusions and they clearly state what they learned in the investigation. The student is able to communicate and defend the merit and

Level 4 students are able to develop an explanation grounded explicitly in evidence from the investigation and how this relates to other sources including scientific knowledge and other research. Level 4 students’ reasoning is complete and logically consistent with their claim, research, and data. Level 4 students are able to communicate a clear and concise argument, synthesizing knowledge gained from research and
| and/or research. Level 2 students communicate their conclusions, but not specific or relevant to the research question. | validity of their conclusions. | investigation. Level 4 students evaluate the quality of investigation and suggest remedies to all identified problems, weaknesses, or sources of error. |
High School Science Nature of Science Range ALD

The Nature of Science for students in grades 9-12 involves:
- using grade level and course-specific content and scientific practices to independently generate testable questions,
- design, plan and conduct scientific investigations,
- analyze and interpret data from the investigations,
- construct scientific explanations, and
- effectively communicate the results of scientific investigations.

<table>
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<tbody>
<tr>
<td>Conceptual Understanding</td>
<td>Level 1 students show limited understanding of major high school content concepts in science.</td>
<td>Level 2 students show emerging understanding of major high school content concepts in science.</td>
<td>Level 3 students show solid understanding of major high school content concepts in science.</td>
<td>Level 4 students show substantial understanding of major high school content concepts in science.</td>
</tr>
<tr>
<td>Research Questions</td>
<td>Level 1 students generate questions that are generally unrelated to the investigation or not scientifically testable.</td>
<td>Level 2 students demonstrate the ability to generate a basic testable question. Students at this level can identify at least one relevant variable related to the research question or engineering problem.</td>
<td>Level 3 students demonstrate the ability to generate testable questions or define engineering problems. Students at Level 3 can specify the parameters of the question and state the expected relationship among at least two variables. Level 3 students will be able to explain how their question relates to important aspects of the investigation.</td>
<td>Level 4 students demonstrate the ability to generate testable questions or define problems that extend beyond classroom discussions that reflect a deep understanding of the investigation. Level 4 students can specify the parameters and state the expected relationship between two or more variables. They relate their questions and/or problems to real-world situations and/or make connections to</td>
</tr>
<tr>
<td>Methods of Inquiry</td>
<td>Level 1 students can generate a rough plan for carrying out an investigation but the plan does not correctly identify the relevant variables or is otherwise missing major components. Level 1 students are able to conduct observations however, they are incomplete and/or do not directly relate to the investigation. Level 1 students collect minimal data, is incomplete, or not connected to the question.</td>
<td>Level 2 students can generate a research plan with enough detail that someone else should be able to conduct the investigation. The research or engineering plan tests variables other than those identified in his/her question. Level 2 students are able to make observations related to the investigation with some errors.</td>
<td>Level 3 students create clear, replicable research or engineering procedures enabling them to and conduct investigations using a variety of research methods in a specific setting. Level 3 students are able to collect accurate, organized, and precise qualitative and/or quantitative data according to the design plan.</td>
<td>Level 4 students can generate a research or engineering procedure enabling them to conduct investigations using a variety of research methods in a various settings. Level 4 students anticipate the need for revisions throughout the investigation as necessary to improve process and outcomes. The final procedure is well-documented replicable. Level 4 students collect detailed, accurate, organized, and precise qualitative and/or quantitative data directly related to the investigation and make appropriate adjustments as necessary.</td>
</tr>
<tr>
<td>Analyses and Data Transformation</td>
<td>Level 1 students can conduct very basic qualitative and quantitative analyses of data generated through research procedures.</td>
<td>Level 2 students are able to conduct basic qualitative and quantitative analyses of data generated through research procedures using research procedures.</td>
<td>Level 3 students are able to conduct basic qualitative and quantitative analyses of data generated through research procedures using research procedures.</td>
<td>Level 4 students are able to conduct sophisticated qualitative and quantitative analyses of data generated through research procedures. Students apply a wide range</td>
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<tr>
<td>Conclusions and Reasoning with Evidence</td>
<td>research procedures such as counting, producing frequency distributions, and some basic tables and graphs. Level 1 students need teacher support to interpret data in terms of their experiment or design studies.</td>
<td>appropriately using basic descriptive statistics. Level 2 students require teacher support to interpret data in terms of their experiment or design studies. Students are able to construct supporting visuals with some errors</td>
<td>basic descriptive statistics and using appropriate tables, figures, drawings, or graphs. Level 3 students are able to interpret their data in terms of their research study to explain phenomena, identify patterns, and clearly connect the analyses to the research questions. Students are able to construct supporting visuals and mathematics to make meaning of the data.</td>
<td>of mathematical processes to strengthen their evaluation of their data. They present and interpret their data using organized and detailed tables, figures, scientific drawings, and graphs as appropriate. Level 4 students are able to interpret their data in terms of their research study to explain phenomena, identify patterns, explore relationships, and/or refine problem statements. Level 4 students are able to use their analyses to connect the data explicitly to the question.</td>
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<td>Possible sources of error. Level 2 students can create explanations that are related to their claims and they offer minimal evidence supported by data and/or research. Level 2 students communicate their conclusions, but weakly related to the research question.</td>
<td>To articulate impacts of experimental error and the limitations of the experiment. Level 3 students can select an appropriate format to communicate their conclusions and they clearly state what they learned in the investigation. The student is able to communicate and defend the merit and validity of their conclusions.</td>
<td>Research, and data. Level 4 students are able to communicate a clear and concise argument, synthesizing knowledge gained from research and investigation. Level 4 students evaluate the quality of investigation and suggest remedies to all identified problems, weaknesses, or sources of error. Students are able to articulate and quantify the impact of experimental error and the limitations of the experiment as well as suggesting remedies for potential shortcomings.</td>
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