2014

Scientific and Engineering Practices (SEPs) in the Next Generation Science Standards: Rubrics for Grades 3-5

Tayla M Fulcher, University of Wyoming
Ana K Houseal, University of Wyoming

Available at: https://works.bepress.com/ana_houseal/44/
Scientific and Engineering Practices (SEP) in the Next Generation Science Standards

Rubrics for grades 3-5
Table of Contents!

How to Use the NGSS Science and Engineering Practices Rubrics!..................................................3&
Science and Engineering Practices (SEP) Quick Reference Guide!..................................................5&
Rubrics!.....................................................................................................................................................7&
SEP #1: Asking Questions and Defining Problems!.............................................................................9&
SEP #2: Developing and Using Models!................................................................................................11&
SEP #3: Planning and Carrying Out Investigations!............................................................................14&
SEP #4: Analyzing and Interpreting Data!............................................................................................17&
SEP #5: Using Mathematical and Computational Thinking!..............................................................19&
SEP #6: Constructing Explanations and Designing Solutions!.........................................................21&
SEP #7: Engaging in Argument From Evidence!..................................................................................23&
SEP #8: Obtaining, Evaluating, and Communicating Information!......................................................25&
Crosscutting Concepts!....................................................................................................................27&
Disciplinary Core Ideas for Grades 3-5!..............................................................................................28&
References!..............................................................................................................................................30&
How to Use the NGSS Science and Engineering Practices Rubrics

1) A lesson may contain none, one, or several SEPs. If you already know the practice(s) that may be in the lesson find the correct rubric and skip to step 3.

<table>
<thead>
<tr>
<th>Rubric/SEP #</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asking Questions and Defining Problems</td>
</tr>
<tr>
<td>2</td>
<td>Developing and Using Models</td>
</tr>
<tr>
<td>3</td>
<td>Planning and Carrying Out Investigations</td>
</tr>
<tr>
<td>4</td>
<td>Analyzing and Interpreting Data</td>
</tr>
<tr>
<td>5</td>
<td>Using Mathematics and Computational Thinking</td>
</tr>
<tr>
<td>6</td>
<td>Constructing Explanations and Designing Solutions</td>
</tr>
<tr>
<td>7</td>
<td>Engaging in Argument from Evidence</td>
</tr>
<tr>
<td>8</td>
<td>Obtaining, Evaluating, and Communicating Information</td>
</tr>
</tbody>
</table>

2) If you do not know the practice(s) that may be in the lesson go to the SEP Quick Reference Guide. The SEP Quick Reference Guide lists the attributes of all eight practices broken into categories. Some categories contain attributes from more than one practice and some attributes are found in more than one category.
   a. Find the category or categories that best represent what students are doing in the lesson.
   b. Within the category, find the attribute(s) that best represent what students are doing in the lesson.
   c. The right column “Use SEP Rubric” tells you which rubric(s) will be needed.
   d. The left column corresponds to a “fully aligned” box in the rubric. This number/letter combination allows you quickly find the part of the rubric that corresponds to what is being done in the lesson.

3) Begin with page 1, the coversheet for the rubric. Answer the 3 questions in order.
   a. If any of the questions are answered with “no” that SEP is not explicit in the lesson.
   b. If the 3 questions can all be answered with “yes” then proceed to page 2.

4) Page 2 begins the actual rubric. The left column lists the big ideas present in the SEP. Some big ideas have clarifying statements underneath them to help the user better understand the SEP. The next 3 columns describe these big ideas in terms of a lesson that is not aligned, partially aligned, and fully aligned.

5) The SEPs tend to favor student directed learning over teacher directed learning. When aligning lessons be sure to recognize who is doing each activity, the student or the teacher.

Unless otherwise noted all rubric materials are adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013).
6) Begin with the **fully aligned** column. The number/letter combination in parenthesis corresponds to the attributes listed in the SEP Quick Reference Guide.
   a. Read through what it means for a lesson to be fully aligned.
   b. If the lesson exhibits what is in the fully aligned box it is considered aligned to that SEP.

7) If the lesson does not fit into the fully aligned box, move to the partially aligned box.
   a. If a lesson falls into the partially aligned box it is not aligned to that SEP.
   b. Each partially aligned box contains recommendations for increasing alignment.
      These recommendations are usually small shifts that can be made in the lesson.

8) If the lesson does not fit into the partially aligned box move to the **not aligned** box.
   a. If the lesson falls into the not aligned box then it is not aligned to this SEP.
   b. No recommendations are included. A lesson can be moved to fully aligned, but considerable changes will need to be made.

9) Repeat steps 5-7 for each row of the rubric.

10) Repeat steps 3-7 for each additional rubric.

At least one part of the lesson must fall into a fully aligned box in order to be considered aligned to the SEP.

Unless otherwise noted all rubric material is adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards [NRC, 2013].
**Science and Engineering Practices (SEP) Quick Reference Guide**

This page is intended to be a quick reference sheet used when analyzing a lesson to help eliminate constant flipping between eight different rubrics. It is still necessary to read and answer the questions on the front page of each rubric to determine if the lesson is aligned. *Remember: A lesson must also be connected to at least one DCI and/or one CCC to be considered fully aligned to the NGSS.*

The attributes are arranged by topic. Some attributes appear in more than one category.

If the lesson contains attributes not contained on this sheet, the lesson may not be aligned or it may be aligned to a different grade band. Please see Appendix F of NGSS for information on different grade bands.

Each fully aligned square of the rubrics has a number and letter designation, for example 3c. These designations are found in the “rubric square” column and are bolded in the rubrics before the text in the “fully aligned” column.

### Does the lesson involve...?

#### SEP #1: Asking Questions?

<table>
<thead>
<tr>
<th>Rubric Square</th>
<th>Attribute</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Distinguishing between scientific (testable) and non-scientific (non-testable) questions</td>
<td>#1: Asking Questions and Defining Problems</td>
</tr>
<tr>
<td>1b</td>
<td>Asking questions that can be investigated (tested)</td>
<td>#1: Asking Questions and Defining Problems</td>
</tr>
<tr>
<td>1c</td>
<td>Asking questions about variables</td>
<td>#1: Asking Questions and Defining Problems</td>
</tr>
</tbody>
</table>

#### SEP #2: Developing and Using Models?

<table>
<thead>
<tr>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>Identifying limitations of models</td>
<td>#2: Developing and Using Models</td>
</tr>
<tr>
<td>2b /2c</td>
<td>Developing models, diagrams, or physical prototypes</td>
<td>#2: Developing and Using Models</td>
</tr>
<tr>
<td>2d</td>
<td>Using models to predict phenomena</td>
<td>#2: Developing and Using Models</td>
</tr>
<tr>
<td>2e</td>
<td>Using a model to test relationships or interactions within a system</td>
<td>#2: Developing and Using Models</td>
</tr>
</tbody>
</table>

#### SEP #3: Planning or Conducting Investigations?

<table>
<thead>
<tr>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Asking questions that can be investigated (tested)</td>
<td>#1: Asking questions and defining problems</td>
</tr>
<tr>
<td>2c</td>
<td>Using a model to test relationships or interactions within a system</td>
<td>#2: Developing and Using Models</td>
</tr>
<tr>
<td>3a</td>
<td>Planning and conducting investigations</td>
<td>#3: Planning and Carrying Out Investigations</td>
</tr>
<tr>
<td>3b/3c</td>
<td>Producing and/or collecting data</td>
<td>#3: Planning and Carrying Out Investigations</td>
</tr>
<tr>
<td>3c</td>
<td>Making observations</td>
<td>#3: Planning and Carrying Out Investigations</td>
</tr>
<tr>
<td>3d</td>
<td>Making predictions</td>
<td>#3: Planning and Carrying Out Investigations</td>
</tr>
<tr>
<td>3e</td>
<td>Testing different models of the same object, tool, or process</td>
<td>#3: Planning and Carrying Out Investigations</td>
</tr>
</tbody>
</table>

#### SEP #4: Analyzing and Interpreting Data and SEP #5: Mathematics or Computational Thinking?

<table>
<thead>
<tr>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>3b/3c</td>
<td>Producing and/or collecting data</td>
<td>#3: Planning and Carrying Out Investigations</td>
</tr>
<tr>
<td>4a</td>
<td>Representing data in tables and/or graphs</td>
<td>#4: Analyzing and Interpreting Data</td>
</tr>
<tr>
<td>4b</td>
<td>Using data to make sense of phenomena</td>
<td>#4: Analyzing and Interpreting Data</td>
</tr>
<tr>
<td>4c</td>
<td>Comparing and contrasting different sets of data</td>
<td>#4: Analyzing and Interpreting Data</td>
</tr>
<tr>
<td>4d</td>
<td>Analyzing data to refine design problems and/or solutions</td>
<td>#4: Analyzing and Interpreting Data</td>
</tr>
<tr>
<td>5a</td>
<td>Deciding on the best type of data to collect when evaluating a design solution</td>
<td>#5: Using Mathematics and Computational Thinking</td>
</tr>
<tr>
<td>5b</td>
<td>Organizing data sets to reveal patterns and relationships</td>
<td>#5: Using Mathematics and Computational Thinking</td>
</tr>
</tbody>
</table>

Unless otherwise noted, all rubrics are adapted from Appendix F: Science and Engineering Practices in the Next Generation Science Standards (NRC, 2013).
<table>
<thead>
<tr>
<th>SEP #6: Constructing Explanations?</th>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>5c</td>
<td>Describing, measuring, estimating, and/or graphing quantities</td>
<td>#5: Using Mathematics and Computational Thinking</td>
<td></td>
</tr>
<tr>
<td>5d</td>
<td>Creating and/or using graphs generated from simple algorithms (a simple set of instructions for completing a task)</td>
<td>#5: Using Mathematics and Computational Thinking</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEP #7: Engaging in Argumentation?</th>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>7a/7c</td>
<td>Constructing, comparing, or refining arguments</td>
<td>#7: Engaging in Argument from Evidence</td>
<td></td>
</tr>
<tr>
<td>7b</td>
<td>Distinguishing between facts, reasoned judgment, and speculation</td>
<td>#7: Engaging in Argument from Evidence</td>
<td></td>
</tr>
<tr>
<td>7c/7d/7e</td>
<td>Making or evaluating claims</td>
<td>#7: Engaging in Argument from Evidence</td>
<td></td>
</tr>
<tr>
<td>7f</td>
<td>Providing and receiving critiques</td>
<td>#7: Engaging in Argument from Evidence</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEP #8: Obtaining and Communicating Information?</th>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>8a</td>
<td>Reading grade appropriate complex texts and other media</td>
<td>#8: Obtaining, Evaluating, and Communicating Information</td>
<td></td>
</tr>
<tr>
<td>8b</td>
<td>Obtaining and combining information from books and/or other media to explain phenomena or solutions to design problems</td>
<td>#8: Obtaining, Evaluating, and Communicating Information</td>
<td></td>
</tr>
<tr>
<td>8c</td>
<td>Communicating scientific and/or technical information orally and/or in written formats</td>
<td>#8: Obtaining, Evaluating, and Communicating Information</td>
<td></td>
</tr>
<tr>
<td>8d/8e</td>
<td>Combining and/or comparing information in written texts and other media to support engagement in other SEPs</td>
<td>#8: Obtaining, Evaluating, and Communicating Information</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Engineering? (Present in all SEPs)</th>
<th>Rubric Square</th>
<th>Attributes</th>
<th>Use SEP Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1d/1e</td>
<td>Describing or defining solvable problems</td>
<td>#1: Asking questions and defining problems</td>
<td></td>
</tr>
<tr>
<td>2b/2c</td>
<td>Developing models, diagrams, or physical prototypes</td>
<td>#2: Developing and Using Models</td>
<td></td>
</tr>
<tr>
<td>3c</td>
<td>Testing different models of the same object, tool, or process</td>
<td>#3: Planning and Carrying Out Investigations</td>
<td></td>
</tr>
<tr>
<td>4d</td>
<td>Analyzing data to refine design problems and/or solutions</td>
<td>#4: Analyzing and Interpreting Data</td>
<td></td>
</tr>
<tr>
<td>5a</td>
<td>Deciding on the best type of data to collect when evaluating a design solution</td>
<td>#5: Using Mathematics &amp; Computational Thinking</td>
<td></td>
</tr>
<tr>
<td>6d</td>
<td>Applying scientific ideas to solve design problems</td>
<td>#6: Constructing Explanations and Designing Solutions</td>
<td></td>
</tr>
<tr>
<td>6e</td>
<td>Generating multiple solutions to a problem</td>
<td>#6: Constructing Explanations and Designing Solutions</td>
<td></td>
</tr>
<tr>
<td>8b</td>
<td>Obtaining and combining information from books and/or other media to explain phenomena or solutions to design problems</td>
<td>#8: Obtaining, Evaluating, and Communicating Information</td>
<td></td>
</tr>
</tbody>
</table>

Unless otherwise noted, all rubric material is adapted from Appendix F: Science and Engineering Practices in the Next Generation Science Standards (NRC, 2013) & found in the Next Generation Science Standards (NRC, 2013) &
Rubrics
SEP #1: Asking Questions and Defining Problems  
Lesson Evaluation Rubric for 3rd-5th Grade

1) Are student-generated questions a part of this lesson?  
   OR
   Are students defining problems as a part of this lesson?  
   
   If yes, continue to question 2.  
   If no, the SEP “asking questions and defining problems” is not present in this lesson.

2) Does the lesson state that students are doing at least one of the following?  
   a. Distinguishing between scientific (testable) and non-scientific (non-testable) questions  
   b. Asking questions that can be investigated (tested)  
   c. Asking questions about variables  
   d. Describing or defining solvable problems  
   
   If yes, continue to question 3.  
   If no, the SEP “asking questions and defining problems” is not present in this lesson or it is present at a different grade band. Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?  
   For a list of DCIs and CCCs please reference the NGSS available online at www.nextgenscience.org  
   If yes, continue to the rubric.  
   If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment.

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
SEP #1: Asking Questions and Defining Problems
Lesson Evaluation Rubric for 3rd-5th Grade

<table>
<thead>
<tr>
<th>Scientific Questions</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statement:</strong> Scientific questions are questions about phenomena that can be tested, by doing an experiment, to help us develop explanations for the phenomena. Testable questions are not opinion based (e.g., Which flower is the prettiest? Is not a scientific testable question). <strong>Example:</strong> Testable: What is the density of an apple? Non-testable: Which apple tastes the best?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(1a)</strong> The lesson explicitly states that students will identify scientific (testable) and non-scientific (non-testable) questions.</td>
<td>In the lesson the teacher is identifying scientific (testable) and non-scientific (non-testable) questions for students. This could include students asking questions and the teacher classifying them. <strong>Recommendation:</strong> Alter the lesson so that students are classifying questions as scientific or non-scientific. <strong>OR</strong> The lesson does not explicitly state that students will identify scientific (testable) and non-scientific (non-testable) questions, but doing so is imperative to completing the lesson. <strong>Recommendation:</strong> Make this concept explicit by writing it into the lesson.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(1b)</strong> The lesson explicitly states that students will be asking questions that can be investigated (tested). Students will also predict reasonable outcomes for those questions based on patterns. (i.e., Cause and effect relationships, What happens to a plant when it kept in the dark? Prediction: I think the plant will die.)</td>
<td>In the lesson students are not given the opportunity to ask questions that can be investigated (tested), but are asked to predict reasonable outcomes (based on patterns) from a teacher-generated question. <strong>Recommendation:</strong> When the question is teacher generated students are not doing this aspect of the SEP, allow time in the lesson for students to come up with their own questions and predictions about phenomena. <strong>OR</strong> In the lesson students are asking questions that can be investigated (tested), but they are not predicting reasonable outcomes for their questions. <strong>Recommendation:</strong> Expand the lesson so that students are predicting reasonable outcomes based on patterns for their questions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Changing Variables</strong></td>
<td>In the lesson students are not given the opportunity to ask questions about what would happen if a variable is changed. <strong>Recommendations:</strong> When the teacher asks about changing variables students are not doing this aspect of the practice. Build time into the lesson for students to “wonder” or ask questions about the investigation. Guide students toward asking about changing variables, but do not be the only one asking questions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(1c)</strong> The lesson explicitly states that students have the opportunity to and will ask questions about what would happen if a variable is changed.</td>
<td>In the lesson students are not given the opportunity to ask questions about changing variables. The teacher may ask students about outcomes from changing variables. <strong>Recommendations:</strong> When the teacher asks about changing variables students are not doing this aspect of the practice. Build time into the lesson for students to “wonder” or ask questions about the investigation. Guide students toward asking about changing variables, but do not be the only one asking questions.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The lesson does not include students identifying scientific (testable) and non-scientific (non-testable) questions.

The lesson does not give students the opportunity to ask questions that can be investigated (tested) or to predict reasonable outcomes for those questions.
SEP #1: Asking Questions and Defining Problems Rubric (continued)

<table>
<thead>
<tr>
<th></th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solvable Problems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarification Statement:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defining and describing solvable problems means students will clearly state the problem in terms of criteria for success and any constraints or limitations they may have.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Example: Mr. Smith’s class notices that after recess the classroom floor is often very wet and several students slip and fall. In order to solve this problem they determine that the ground must stay dry even after wet shoes have walked on it. They know that they are limited by time (they only have 30 minutes in class to find a solution) and materials/cost (Mr. Smith gave them a budget of $10 and let them use anything they could find in the room).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Criteria for success</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is required for the solution to be successful.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Constraints</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Things that limit a solution such as time, materials, or cost.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Not Aligned</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the lesson students are not required to use prior knowledge to describe problems that can be solved.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the lesson the **teacher** is describing problems that can be solved in terms of criteria for success and constraints. **Recommendations:** Have students describe the problem, not the teacher.

**OR**
The lesson does not explicitly state that **students** will be using prior knowledge to describe problems, but doing so is imperative to the completion of the lesson and/or implied in the instructions.

**Recommendations:** Make this concept explicit by writing it into the lesson being sure to include what constitutes a full description of the problem.

**Not Aligned**
In the lesson students are not asked to use prior knowledge to describe problems that can be solved.

(1d) The lesson explicitly states that **students** will use prior knowledge to clearly describe problems that can be solved in terms of criteria for success and any constraints or limitations they may have.

(1e) The lesson explicitly states that **students** will define a simple design problem that can be solved through the development of an object, tool, process, or system. The problem must include several criteria for success and constraints on materials, time, or cost.

In the lesson the **teacher** is defining a simple design problem and students are solving it through the development of an object, tool, process, or system. **Recommendation:** Alter the lesson so students are defining the design problem.

**OR**
The lesson explicitly states that **students** will define a simple design problem, but it cannot be solved through the development of an object, tool, process, or system **and/or** it does not include any criteria for success **and/or** it does not include any constraints on materials, time, or cost.

**Recommendations:** Take the current design problem deeper by adding in the piece(s) that are missing, make it solvable, include criteria for success, and contain constraints on materials, time, or cost.

In the lesson students are not required to define a simple design problem that can be solved.
SEP #2: Developing and Using Models  
Lesson Evaluation Rubric for 3rd-5th Grade

Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations.

1) Is creating or using models a part of this lesson?

    If yes, continue to question 2.
    If no, the SEP “Developing and Using Models” is not part of this lesson.

2) Does the lesson state that students will be doing at least one of the following?
   a. Identifying limitations of models
   b. Developing models, diagrams, or physical prototypes
   c. Using models to predict phenomena
   d. Using a model to test relationships or interactions within a system

    If at least one of the above is stated, continue to question 3.
    If no, the SEP “Developing and Using Models” is not present in this lesson or it is present at a different grade band. Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?
   For a list of DCIs and CCCs please reference the NGSS available online at www.nextgenscience.org
   If yes, continue to the rubric.
   If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment.

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
SEP #2: Developing and Using Models
Lesson Evaluation Rubric for 3rd-5th Grade

<table>
<thead>
<tr>
<th>Limitations</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statement:</strong> Models do not correspond exactly to the real world. All models contain approximations and assumptions that limit the range of validity and predictive power so it is important for students to recognize their limitations (NGSS Appendix F).</td>
<td>In the lesson the <strong>teacher</strong> is identifying limitations of models for students. <strong>Recommendation:</strong> Alter the lesson so that students are identifying the limitations of models, not teachers. <strong>OR</strong> The lesson does not explicitly state that students will identify limitations of models, but doing so is imperative to completing the lesson. <strong>Recommendation:</strong> Make this concept explicit by writing it into the lesson.</td>
<td>The lesson does not include students identifying limitations of models.</td>
<td>In the lesson students are not given the opportunity to work collaboratively to develop and/or revise a model. <strong>Recommendation:</strong> In this case students may be developing models, but not with the specifications of this SEP. Change the topic of students’ models to something that involves showing relationships between variables.</td>
</tr>
<tr>
<td><strong>(2a)</strong> The lesson explicitly states that <strong>students</strong> will identify limitations of models.</td>
<td>In the lesson the <strong>teacher</strong> is developing and/or revising a model that shows relationships among variables for frequent and regular occurring events, the students are using the teacher-developed model. <strong>Recommendations:</strong> Allow students to collaboratively develop and/or revise a model. <strong>OR</strong> In the lesson students are not given the opportunity to work collaboratively when developing and/or revising a model. <strong>Recommendation:</strong> Adjust the lesson to involve students working together when developing and/or revising models. <strong>OR</strong> In the lesson students are working collaboratively to develop and/or revise models that do not show relationships among variables for frequent and regular occurring events. <strong>Recommendation:</strong> In this case students may be developing models, but not with the specifications of this SEP. Change the topic of students’ models to something that involves showing relationships between variables.</td>
<td>In the lesson students are not asked to develop a diagram (drawing) or simple physical prototype to express their ideas for a proposed object, tool, or process. <strong>Recommendation:</strong> In the lesson students are not asked to develop a diagram (drawing) or simple physical prototype to express their ideas for a proposed object, tool, or process. <strong>OR</strong> In the lesson students may be asked to develop a diagram (drawing) or simple physical prototype following a</td>
<td><strong>Clarification Statement:</strong> Students are developing models, not teachers. This is an important distinction for this SEP. Models provided by the teacher are valuable learning tools, but they do not exemplify this practice.</td>
</tr>
<tr>
<td><strong>(2b)</strong> The lesson explicitly states that <strong>students</strong> will work collaboratively to develop and/or revise a model based on evidence (i.e., prior knowledge/experiences, research, investigations) that shows the relationships among variables for frequent and regular occurring events (i.e. the water cycle, moon phases).</td>
<td>In the lesson the <strong>teacher</strong> develops a diagram (drawing) or simple physical prototype for a proposed object, tool, or process and the students use it for the duration of the lesson, never creating their own models. <strong>Recommendation:</strong> Allow students to develop the diagram (drawing) or simple physical prototype of their own ideas. <strong>OR</strong> In the lesson students may be asked to develop a diagram (drawing) or simple physical prototype, but not of their own ideas. This could include copying a diagram from a book or other source, or creating a physical prototype following a</td>
<td>In the lesson students are not asked to develop a diagram (drawing) or simple physical prototype to express their ideas for a proposed object, tool, or process. <strong>Recommendation:</strong> In the lesson students are not asked to develop a diagram (drawing) or simple physical prototype to express their ideas for a proposed object, tool, or process. <strong>OR</strong> In the lesson students may be asked to develop a diagram (drawing) or simple physical prototype, but not of their own ideas. This could include copying a diagram from a book or other source, or creating a physical prototype following a</td>
<td><strong>(2c)</strong> The lesson explicitly states that <strong>students</strong> will develop a diagram (drawing) or simple physical prototype to express their ideas for a proposed object, tool, or process.</td>
</tr>
</tbody>
</table>
### SEP #2: Developing and Using Models Rubric (continued)

<table>
<thead>
<tr>
<th>Recommendation: Do not provide students with something to copy. Allow them to use their creativity and their own ideas when developing the diagram or physical prototype.</th>
</tr>
</thead>
</table>

(2d) The lesson explicitly states that students will develop a model using an analogy, example, or abstract representation to describe and/or predict phenomena. (i.e. A drawing of evaporation or a representation of how humans smell odors)

In the lesson students are not given the opportunity to develop a model. The **teacher provides the model** and students use it to describe and/or predict phenomena.

**Recommendation:** Build time into the lesson for students to develop their own models. A teacher provided model is a first step in scaffolding students towards developing their own models, but does not align with this SEP.

In the lesson students will have no opportunity to develop a model using an analogy, example, or abstract representation to describe and/or predict phenomena.
SEP #3: Planning and Carrying Out Investigations
Lesson Evaluation Rubric for 3rd-5th Grade

1) Does the lesson involve planning and/or carrying out investigations?
   If yes, continue to question 2.
   If no, the SEP “Planning and Carrying Out Investigations” is not part of this lesson

2) Does the lesson state that students will be doing at least one of the following?
   a. Planning and conducting investigations
   b. Producing and/or collecting data
   c. Making predictions
   d. Testing different models of the same object, tool, or process

   If at least one of the above is stated, continue to question 3.
   If no, the SEP “Planning and Carrying Out Investigations” is not present in this lesson or it is present at a different grade band. Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?
   For a list of DCIs and CCCs please reference the NGSS available online at www.nextgenscience.org
   If yes, continue to the rubric.
   If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
SEP #3: Planning and Carrying Out Investigations
Lesson Evaluation Rubric for 3rd-5th Grade

<table>
<thead>
<tr>
<th>Planning and Conducting Investigations</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3a) The lesson explicitly states that students will collaboratively plan and conduct an investigation. The criteria for the investigation must also be listed in the lesson. This includes all of the following. Students will be asked to: 1) Produce data (qualitative or quantitative) and, 2) Use fair tests (controlling for variables so that only one variable is being tested at a time) and, 3) Consider the number of trials performed</td>
<td>The lesson may explicitly state that students are carrying out an investigation, but not one that they have planned. This includes teacher-designed investigations done by students. <strong>Recommendation:</strong> Present students with the same basis for the investigation but allow them to work together to come up with their own plan for an investigation. OR The lesson does not give the students an opportunity to plan the investigation collaboratively. <strong>Recommendation:</strong> Allow students to work as a class or in small groups to plan the investigation. OR The lesson does explicitly state that students will plan and conduct an investigation, but it does not contain all of the criteria students must include in their investigation. The teacher may urge students to include these items when doing the lesson but they are not written into the lesson. This includes all of the following. Students will be asked to: 1) Produce data (qualitative or quantitative) 2) Use fair tests (controlling for variables so that only one variable is being tested at a time) 3) Consider the number of trials performed <strong>Recommendation:</strong> Make this part of the lesson explicit by writing in any missing criteria for planning the investigation.</td>
<td>The lesson does not give students the opportunity to plan and carry out an investigation.</td>
<td></td>
</tr>
</tbody>
</table>
| **Data**

**Clarification Statement:** Data can be collected in the qualitative (notes or observations) or quantitative (measurements) form. Students must decide what measurements should be taken, how accurate the measurements need to be, and what tools will take the best measurements. At this level students will use data as evidence to explain a phenomena or evaluate a design solution.

(3b) The lesson explicitly states that when planning an investigation students will be given the opportunity to consider different methods and tools needed for collecting data (i.e. when measuring how far a ball rolls after traveling down a ramp students must decide how to measure the distance, inches, cm, ft, or m, and what tool will give the most accuracy, a tape measure, 12 in ruler, or meter stick) | The lesson explicitly states that when planning an investigation students will be collecting data, but they will not plan what data to collect or what tools will be used to collect it. The teacher decides what data will be collected and how to collect it. **Recommendation:** Build time into the lesson for students to decide what data they need to collect and how they will collect it. | In the lesson, when planning an investigation students do not have the opportunity to consider different methods and/or tools for collecting data. |

Unless otherwise noted all rubric materials are adapted from Appendix F: Science and Engineering Practices in the NGSS Found in the Next Generation Science Standards (NRC, 2013). &
SEP #3: Planning and Carrying Out Investigations Rubric (continued)

<table>
<thead>
<tr>
<th>Data (continued)</th>
<th>In the lesson <strong>students</strong> are collecting data by making observations (qualitative data) and/or measurements (quantitative data) but that data is not used as evidence for explaining a phenomena or when testing a possible design solution. <strong>Recommendation:</strong> Do not stop at data collection, have students use their data when explaining what happened in the investigation or when testing design solutions. Data does not become evidence until it is used when supporting a claim. Unless students use the data they collect to support a claim it cannot be considered evidence. OR In the lesson the <strong>teacher collects data</strong> for the students and shares it with them to be used as evidence for explaining a phenomena or when testing a possible design solution. <strong>Recommendation:</strong> Alter the lesson so that students have the opportunity to collect the data they are using for evidence.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3c) The lesson explicitly states that <strong>students</strong> will collect data by making observations (qualitative data) and/or measurements (quantitative data). The data collected will then serve as the basis for evidence in an explanation of a phenomena or when testing a possible design solution.</td>
<td>In the lesson <strong>students</strong> are collecting data by making observations (qualitative data) and/or measurements (quantitative data) but that data is not used as evidence for explaining a phenomena or when testing a possible design solution. <strong>Recommendation:</strong> Do not stop at data collection, have students use their data when explaining what happened in the investigation or when testing design solutions. Data does not become evidence until it is used when supporting a claim. Unless students use the data they collect to support a claim it cannot be considered evidence. OR In the lesson the <strong>teacher collects data</strong> for the students and shares it with them to be used as evidence for explaining a phenomena or when testing a possible design solution. <strong>Recommendation:</strong> Alter the lesson so that students have the opportunity to collect the data they are using for evidence.</td>
</tr>
<tr>
<td>Predictions <strong>Clarification Statement:</strong> A prediction is not the same as a hypothesis. A prediction is a proposed explanation for phenomena, not necessarily tested. A true hypothesis requires actually testing the proposed explanation. In this SEP students are only required to predict, they do not necessarily have to test their predictions.</td>
<td>In the lesson <strong>students</strong> are not collecting data by making observations (qualitative data) or by taking measurements (quantitative data).</td>
</tr>
<tr>
<td>(3d) The lesson explicitly states that <strong>students</strong> will make predictions about what would happen if a variable changes. Students can, but do not need to test these predictions.</td>
<td>In the lesson <strong>students</strong> are not collecting data by making observations (qualitative data) or by taking measurements (quantitative data).</td>
</tr>
<tr>
<td><strong>Developing Solutions</strong> <strong>Clarification Statement:</strong> In this phase of engineering design students research and explore multiple solutions to a problem in order to determine which design best meets their criteria for success (what it means for the product to be successful).</td>
<td>In the lesson <strong>students</strong> are not collecting data by making observations (qualitative data) or by taking measurements (quantitative data).</td>
</tr>
<tr>
<td>(3e) The lesson explicitly states that <strong>students</strong> will test two different models of the same object, tool, or process to determine which best meets the criteria for success.</td>
<td>In the lesson <strong>students</strong> are not collecting data by making observations (qualitative data) or by taking measurements (quantitative data).</td>
</tr>
</tbody>
</table>

Unless otherwise noted, all rubric material is adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013).
SEP #4: Analyzing and Interpreting Data  
Lesson Evaluation Rubric for 3rd-5th Grade

1) Does the lesson involve analyzing or interpreting data?
   If yes, continue to question 2.
   If no, the SEP “Analyzing and Interpreting Data” is not part of this lesson.

2) Does the lesson state that students will be doing at least one of the following?
   a. Representing data in tables and/or graphs
   b. Using data to make sense of phenomena
   c. Comparing and contrasting different sets of data
   d. Analyzing data to refine design problems and/or solutions

   If at least one of the above is stated, continue to question 3.
   If no, the SEP “Analyzing and Interpreting Data” is not present in this lesson or it is present at a different grade band. Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?
   For a list of DCIs and CCCs please reference the NGSS available online at www.nextgenscience.org
   If yes, continue to the rubric.
   If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment.

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.

& & &

Unless otherwise noted all rubric material is adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013) &
### SEP #4: Analyzing and Interpreting Data
**Lesson Evaluation Rubric for 3<sup>rd</sup>-5<sup>th</sup> Grade**

<table>
<thead>
<tr>
<th>Representing Data</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statement:</strong> Data can be… qualitative (observations) or quantitative (measurements).</td>
<td>(4a) The lesson explicitly states that <strong>students</strong> will represent data in tables and/or graphs (bar graphs, pictographs, and/or pie charts). Students will be asked to use the charts and/or graphs to find patterns that indicate relationships. <strong>Data can be collected by students or provided by the teacher for students to analyze.</strong></td>
<td>In the lesson students are representing data in tables and/or graphs (bar graphs, pictographs, and/or pie charts) but are not asked to interpret them by finding patterns that indicate relationships. This includes the teacher finding patterns and indicating relationships for students. <strong>Data can be collected by students or provided by the teacher for students to analyze.</strong> <strong>Recommendation:</strong> Add to the lesson the opportunity for students to interpret the graphs they have created. <strong>OR</strong> In the lesson the <strong>teacher</strong> will represent data in tables and/or graphs (bar graphs, pictographs, and/or pie charts). Students will be asked to use the charts and/or graphs to find patterns that indicate relationships. <strong>Data can be collected by students or provided by the teacher for students to analyze.</strong> <strong>Recommendation:</strong> Add to the lesson the opportunity for students to represent data in tables and/or graphs.</td>
<td>The lesson does not give students the opportunity to represent data in tables and/or graphical displays.</td>
</tr>
</tbody>
</table>

| Understanding Phenomena | (4b) The lesson explicitly states that **students** will examine and interpret data using logical reasoning, mathematics, and/or computational thinking to help them understand phenomena. **Data can be collected by students or provided by the teacher for students to analyze.** | The lesson states that **students** will examine and/or interpret data but does not indicate that students will use their analysis when trying to understand a phenomenon. **Data can be collected by students or provided by the teacher for students to analyze.** **Recommendation:** Explicitly state in the lesson that students will use data to help them understand a phenomena. | In the lesson students are not given the opportunity to examine or interpret data. |

| Similarities and Differences in Data | (4c) The lesson explicitly states that **students** will examine data collected by at least 2 different groups. **Students** will compare and contrast the data sets then discuss the similarities and differences in their findings. **Data can be collected by students or provided by the teacher for students to analyze.** | The lesson states that **students** will examine data collected by at least 2 different groups. However, students are not comparing and contrasting the data sets and/or participating in a discussion surrounding their similarities and differences. **Data can be collected by students or provided by the teacher for students to analyze.** **Recommendation:** Specify that in their data analysis students will be comparing and contrasting data from different groups then discussing the similarities and differences. | In the lesson students are not examining data collected by at least 2 different groups. |
SEP #4: Analyzing and Interpreting Data Rubric (continued)

<table>
<thead>
<tr>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Using Data in Engineering</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4d) The lesson explicitly states that <strong>students</strong> will use data to improve a problem statement or the design of a proposed object, tool, or process. <em>Data can be collected by students or provided by the teacher for students to analyze.</em></td>
<td>The lesson states that <strong>students</strong> will have the opportunity to improve a problem statement (this includes the problem, the criteria for successful solving of the problem, and any constraints or limitations) or the design of a proposed object, tool, or process, but the improvement is not based on data. <strong>Recommendation:</strong> Make it explicit within the lesson that the improvements made to problem statement or design solution will be based off of data. <em>Data can be collected by students or provided by the teacher for students to analyze.</em></td>
<td>In the lesson students do not use data to improve a problem statement or the design of a proposed object, tool, or process.</td>
</tr>
<tr>
<td>(4e) The lesson explicitly states that <strong>students</strong> will use data to evaluate and improve design solutions. <em>Data can be collected by students or provided by the teacher for students to analyze.</em></td>
<td>The lesson states that <strong>students</strong> will evaluate and improve design solutions, but the improvements are not data-based. <strong>Recommendation:</strong> Include in the lesson that the improvements in the design solution will be based off of data. <em>Data can be collected by students or provided by the teacher for students to analyze.</em></td>
<td>In the lesson students do not use data to evaluate and/or improve design solutions.</td>
</tr>
</tbody>
</table>
**SEP #5: Using Mathematical and Computational Thinking**

**Lesson Evaluation Rubric for 3rd-5th Grade**

1) Does the lesson involve students using mathematics or computational thinking?

   - If yes, continue to question 2.
   - If no, the SEP “Using Mathematical and Computational Thinking” is not part of this lesson.

2) Does the lesson state that students will be doing at least one of the following?

   - a. Deciding on the best type of data to collect when evaluating a design solution
   - b. Organizing data sets to reveal patterns and relationships
   - c. Describing, measuring, estimating, and/or graphing quantities
   - d. Creating and/or using graphs generated from simple algorithms (a simple set of instructions for completing a task)

   - If at least one of the above is stated, continue to rubric.
   - If no, the SEP “Using Mathematical and Computational Thinking” is not present in this lesson or it is present at a different grade band.

   Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?

   - For a list of DCIs and CCCs please reference the NGSS available online at [www.nextgenscience.org](http://www.nextgenscience.org)

   - If yes, continue to the rubric.
   - If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment.

In addition to answering yes to the first three questions, a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
### SEP #5: Using Mathematical and Computational Thinking

#### Lesson Evaluation Rubric for 3rd-5th Grade

<table>
<thead>
<tr>
<th>Choosing Data Types</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statements:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Qualitative data will consist of notes or observations.</td>
<td>(5a) The lesson explicitly states that students will decide if qualitative or quantitative data are best when determining whether a proposed object or tool meets the criteria for success.</td>
<td>The lesson states that students will use data to determine whether a proposed object or tool meets the criteria for success, but does not give students the opportunity to decide what type of data they will use. Data type has been decided by the teacher. <strong>Recommendation:</strong> Add time into the lesson for students to decide on the best type of data to use to determine the success of a proposed object or tool.</td>
<td>The lesson does not give students the opportunity to decide which type of data is best when determining whether a proposed object or tool meets the criteria for success.</td>
</tr>
<tr>
<td>• Quantitative data will consist of measurements, such as height, speed, weight, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The criteria for success are the requirements a solution must have to be considered successful.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Organizing Data

| (5b) The lesson explicitly states that students will organize simple data sets to reveal patterns that suggest relationships. To see patterns data could be organized into tables and/or graphs (bar graphs, pictographs, and/or pie charts). Data can be collected by students or provided by the teacher for students to analyze. | In the lesson students are organizing simple data sets in tables and/or graphs (bar graphs, pictographs, and/or pie graphs) but are not asked to interpret them by finding patterns that indicate relationships. This includes the teacher finding and showing patterns to students. Data can be collected by students or provided by the teacher for students to analyze. **Recommendation:** Alter the lesson to give students the opportunity to interpret the graphs they have created. | In the lesson students are not required to organize simple data sets. |

#### Using Quantities to Address Questions and Problems

| (5c) The lesson explicitly states that students will describe, measure, estimate, and/or graph quantities (e.g., area, volume, time, weight) to help answer scientific questions and solve engineering problems. | The lesson states that students will answer scientific questions and/or solve engineering problems, but does not specify how they will do so. When doing the lesson students may inherently describe, measure, estimate, and/or graph, but it is not written into the lesson. **Recommendation:** Make this aspect explicit in the lesson by specifying the actions students may participate in answering questions or solving problems. | In the lesson students will not describe, measure, estimate, and/or graph quantities. |

*Unless otherwise noted, all rubric material is adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013).*
SEP #5: Using Mathematical and Computational Thinking Rubric (continued)
**Graphs and Charts from Simple Algorithms**

Clarification Statements:
An algorithm is a process or set of rules to be followed in calculations or other problem solving operations.

In this SEP, creating a chart or graph from a simple algorithm means that all students will use a defined process or set of steps to make a chart or graph based on data from a tested solution to a problem. Since all graphs and/or charts are made by the same process it allows students to compare different solutions more easily.

<table>
<thead>
<tr>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5d) The lesson explicitly states that students will compare alternative solutions to an engineering problem by using and/or creating graphs and/or charts produced from simple algorithms.</td>
<td>The lesson states that students will compare alternative solutions to an engineering problem by using and/or creating graphs and/or charts, but does not specify how they will do so. A simple algorithm may be used but is not explicitly named in the lesson. <strong>Recommendation:</strong> Specify how students will compare solutions, be sure the comparison is based on the use or creation of charts and/or graphs produced from a simple algorithm. <strong>OR</strong> The teacher compares alternative solutions to an engineering problem by using and/or creating graphs and/or charts for students. A simple algorithm may be used but is not explicitly named in the lesson. <strong>Recommendation:</strong> Allow students to compare solutions by using a simple algorithm to create charts and/or graphs.</td>
<td>In the lesson students will not compare alternative solutions to an engineering problem.</td>
</tr>
</tbody>
</table>
SEP #6: Constructing Explanations and Designing Solutions
Lesson Evaluation Rubric for 3rd-5th Grade

1) Does the lesson involve students constructing explanations or designing solutions?
   If yes, continue to question 2.
   If no, the SEP “Constructing Explanations and Designing Solutions” is not part of this lesson

2) Does the lesson state that students will be doing at least one of the following?
   a. Constructing explanations
   b. Using evidence to construct or support an explanation or design solution
   c. Identifying evidence that supports a particular point in an explanation
   d. Applying scientific ideas to solve design problems
   e. Generating multiple solutions to a problem

   If at least one of the above is stated, continue to rubric.
   If no, the SEP “Constructing Explanations and Designing Solutions” is not present in this lesson or it is present at a different grade band.
   Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?
   For a list of DCIs and CCCs please reference the NGSS available online at www.nextgenscience.org
   If yes, continue to the rubric.
   If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
**SEP #6: Constructing Explanations and Designing Solutions**

**Lesson Evaluation Rubric for 3rd-5th Grade**

<table>
<thead>
<tr>
<th>Constructing Explanations</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statement:</strong> In this SEP an explanation links a scientific theory with scientific observations or phenomena, it is a causal explanation that identifies the underlying chain of cause and effect (NRC, 2012; Reiser, Berland, &amp; Kenyon, 2012).</td>
<td>The teacher provides an explanation of phenomena for students based on observed relationships. <strong>Recommendation:</strong> Allow students to come up with their own explanations. OR The lesson states that students will construct an explanation but it is not based on observations or the basis for the explanation is not explicitly written in the lesson. <strong>Recommendation:</strong> Make it explicit by adding to the lesson the basis for the explanation (observed relationships).</td>
<td>The lesson does not give students the opportunity to construct an explanation.</td>
<td></td>
</tr>
</tbody>
</table>

| (6a) The lesson explicitly states that students will construct an explanation of a phenomena based on observed relationships. (i.e. constructing an explanation for the distribution of plants in a backyard) | | | |

<table>
<thead>
<tr>
<th>Using Evidence</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(6b) The lesson explicitly states that students will construct or support an explanation or design a solution to a problem by using evidence (i.e., measurements, observations, patterns).</td>
<td>In the lesson students are constructing or supporting explanations or designing a solution to a problem but not using evidence (e.g., measurements, observations, patterns) or the use of evidence is implied, not explicitly stated. <strong>Recommendation:</strong> Make this explicit by specifying the use of evidence when constructing or supporting explanations or when designing a solution.</td>
<td>In the lesson students are not constructing or supporting an explanation OR they are not designing a solution to a problem.</td>
<td></td>
</tr>
</tbody>
</table>

| (6c) The lesson explicitly states that students will be presented with an explanation and asked to identify the evidence that supports specific points within it. | In the lesson the teacher identifies evidence that supports specific points of an explanation for students. **Recommendation:** Allow students to identify the evidence. OR In the lesson students are presented with an explanation but are not explicitly asked to identify the evidence that supports specific points. This may be implied and/or imperative to the completion of the lesson, but not stated. **Recommendation:** Make this explicit by adding to the lesson that students are identifying supporting evidence for specific points in the explanation. | In the lesson students are presented with an explanation but they are not asked to identify the evidence that supports it. |

<table>
<thead>
<tr>
<th>Solving Design Problems</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statements:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criteria-what is required for the solution to be successful. Constraints-things that limit a solution such as time, materials, or cost.</td>
<td>In the lesson students are using their knowledge of science to solve design problems, but it is not explicitly stated in the lesson. <strong>Recommendation:</strong> Make the use of scientific knowledge explicit in the lesson.</td>
<td>In the lesson students are not solving design problems.</td>
<td></td>
</tr>
<tr>
<td>(6d) The lesson explicitly states that students will apply their knowledge of science to solve design problems.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| (6e) The lesson explicitly states that students will come up with multiple solutions to a problem. They will also compare these solutions based on how well they meet the established criteria and constraints of the problem. | In the lesson students will come up with multiple solutions to a problem, but will not compare solutions based on how well they meet the criteria and constraints of the design problem. **Recommendation:** Make comparing solutions based on how well they meet the established criteria and constraints of the design problem a part of the lesson. OR In the lesson students evaluate a single solution on how well it meets criteria and constraints. **Recommendation:** Have students generate more than one solution. Instead of evaluating a single solution, evaluate multiple. | In the lesson students will come up with only one solution to a problem. |

---

Unless otherwise noted, all rubric material is adapted from Appendix F: Science and Engineering Practices in the NGSS Sound and the Next Generation Science Standards (NRC, 2013).
### SEP #7: Engaging in Argument From Evidence
#### Lesson Evaluation Rubric for 3rd-5th Grade

1) **Does the lesson involve students participating in argumentation?**

   - If yes, continue to question 2.
   - If no, the SEP “Engaging in Argument From Evidence” is not part of this lesson.

2) **Does the lesson state that students will be doing at least one of the following?**
   - a. Constructing, comparing, or refining arguments
   - b. Distinguishing between facts, reasoned judgment, and speculation
   - c. Providing and receiving critiques
   - d. Making or evaluating claims

   - If at least one of the above is stated, continue to rubric.
   - If no, the SEP “Engaging in Argument From Evidence” is not present in this lesson or it is present at a different grade band. Please see Appendix F of the NGSS for more information on grade band expectations.

3) **Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)?**

   - For a list of DCIs and CCCs please reference the NGSS available online at [www.nextgenscience.org](http://www.nextgenscience.org)

   - If yes, continue to the rubric.

   - If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
**SEP #7: Engaging in Argument From Evidence**  
**Lesson Evaluation Rubric for 3rd-5th Grade**

<table>
<thead>
<tr>
<th>Constructing Arguments</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarification Statements:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argument- a claim based on evidence</td>
<td>(7a) The lesson explicitly states that students will construct and/or support an argument with evidence, data, and/or a model.</td>
<td>The lesson states that students will construct and/or support an argument, but the use of evidence, data, and/or a model is not specified. <strong>Recommendation:</strong> Make the lesson explicit by specifying that students will construct and/or support an argument by using evidence, data, and/or a model.</td>
<td>The lesson does not give students the opportunity to construct and/or support an argument.</td>
</tr>
<tr>
<td>Evidence- not opinion based, something that gives a sign or proof of the existence or truth of something, or that helps somebody to come to a particular conclusion, this could include observations, measurements, or patterns.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data- could include qualitative (notes or observations) or quantitative (measurements) data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model- representations of phenomena that allow us to better understand them; can include drawings, diagrams, mathematical models, graphs, charts, physical representations, and simulations. (NRC, 2012)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analyzing Explanations**

<table>
<thead>
<tr>
<th>Clarification Statements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facts-Something that truly exists or happens</td>
</tr>
<tr>
<td>Speculation-Reasoning based on incomplete facts or information</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analyzing Explanations</th>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>(7b) The lesson explicitly states that when presented with an explanation students will determine which parts of it are facts, reasoned judgments based on research findings, and speculation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recommendation:</strong> Make this explicit by stating in the lesson that students will be distinguishing between the three. OR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the lesson the teacher is determining which parts of an explanation are facts, reasoned judgment based on research findings, and speculation then presenting that information to students. <strong>Recommendation:</strong> Shift this part of the lesson to the students; ask them to distinguish between the three.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the lesson students are not asked to distinguish among facts, reasoned judgment based on research findings, and speculation.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Using Evidence**

| (7e) The lesson explicitly states that students will compare and improve arguments based on an evaluation of the evidence presented. | | | |
| **Recommendation:** Add to the lesson that students will compare AND improve their arguments. OR | | | |
| The lesson states that students will compare and/or improve arguments, but not based on an evaluation of evidence. **Recommendation:** Include in the lesson that students must base their comparisons and improvements of arguments on evidence. | | | |

The lesson does not explicitly state that students will be determining which parts of an explanation are facts, reasoned judgments based on research findings, and speculation, but doing so is imperative to the lesson.

In the lesson the teacher is determining which parts of an explanation are facts, reasoned judgment based on research findings, and speculation then presenting that information to students.

In the lesson students are not asked to compare and/or improve arguments.

 Unless otherwise noted all rubric materials are adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013).
### SEP #7: Engaging in Argument from Evidence Rubric (continued)

| Using Evidence (continued) |  
|---------------------------|--|---|
| **(7d)** The lesson explicitly states that students will use data to evaluate claims made about cause and effect.  
In the lesson the teacher uses data to evaluate students’ claims about cause and effect.  
**Recommendation:** Allow students to evaluate claims on their own.  
**OR**  
The lesson states that students will evaluate claims, but not explicitly claims made about cause and effect.  
**Recommendation:** Make this explicit by adding to the lesson that the evaluation will be of claims specific to cause and effect.  
**OR**  
The lesson states that students will evaluate claims made about cause and effect, but does not specify they will use data to do so.  
**Recommendation:** Make this explicit by adding to the lesson that the evaluation of claims will be done based on data.  
In the lesson students are not asked to use data to evaluate claims.  

---

| Making Claims |  
|----------------|---|
| **(7e)** The lesson explicitly states that students will make a claim about the ability of a solution to solve a problem. When doing so they are required to cite relevant evidence about how it meets the criteria and constraints of the problem.  
The lesson states that students will make a claim about the ability of a solution to solve a problem, but does not specify that evidence is required to show how it meets the criteria and constraints of the problem. Using evidence may be implicit and/or necessary for the completion of the lesson.  
**Recommendation:** Make it explicit within the lesson that students must use evidence to back up their claim.  
**OR**  
The lesson states that teachers make a claim about the ability of a solution to solve a problem and students cite the evidence that supports it.  
**Recommendation:** Have students make a claim about the ability of a solution to solve a problem and cite relevant evidence.  
In the lesson students are not asked to make claims about the ability of a solution to solve a problem.  

---

| Critiquing |  
|----------------|---|
| **(7f)** The lesson explicitly states that students will have the opportunity to share their proposed procedure, explanation, or model. Students will provide and receive feedback from their peers in a respectful manner. All feedback is based on relevant evidence or is in the form of a specific question about the proposed procedure, explanation, or model.  
The lesson states that students will have the opportunity to share their proposed procedure, explanation, or model, but do not provide or receive feedback from their peers. This could include receiving feedback from the teacher, not peers.  
**Recommendation:** Make it explicit within the lesson that after students share they will receive feedback from peers based on evidence or by being asked a question. The teacher will not be the sole source of feedback.  
**OR**  
The lesson states that students will give and receive feedback, but does not specify that the feedback is based on relevant evidence or that it is in the form of a specific question about the proposed procedure, explanation, or model.  
**Recommendation:** Include in the lesson the specifics required for feedback.  
In the lesson students do not have the opportunity to provide and/or receive critiques from peers.  

---

Unless otherwise noted, all rubric materials and adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013).
### SEP #8: Obtaining, Evaluating, and Communicating Information
#### Lesson Evaluation Rubric for 3rd-5th Grade

1) Does the lesson involve **students** obtaining or communicating information?

   - If yes, continue to question 2.
   - If no, the SEP “Obtaining, Evaluating, and Communicating Information” is not part of this lesson.

2) Does the lesson state that **students** will be doing at least one of the following?
   - Reading grade appropriate complex texts and other media
   - Obtaining and combining information from books and/or other media to explain phenomena or solutions to design problems
   - Communicating scientific and/or technical information orally and/or in written formats
   - Combining and/or comparing information in written texts and other media to support engagement in other SEPs

   - If at least one of the above is stated, continue to question 3.
   - If no, the SEP “Obtaining, Evaluating, and Communicating Information” is not present in this lesson or it is present at a different grade band.
   - Please see Appendix F of the NGSS for more information on grade band expectations.

3) Does the lesson connect to at least one 3rd-5th grade Disciplinary Core Idea (DCI) and/or one CCC (Crosscutting Concept)? For a list of DCIs and CCs please reference the NGSS available online at [www.nextgenscience.org](http://www.nextgenscience.org)

   - If yes, continue to the rubric.
   - If no, this lesson is not fully aligned to this SEP. A fully aligned lesson combines content and practice. Connect this lesson to a DCI and/or CCC for full alignment

In addition to answering yes to the first three questions a lesson must fall under “Fully Aligned” in at least one area of the rubric to be considered aligned to the NGSS.

If the lesson does not contain any aspects in the “Fully Aligned” column it is not considered aligned to the NGSS.

Follow the recommendations in the “Partially Aligned” column to help align the lesson. These are often small shifts within the lesson.
**SEP #8: Obtaining, Evaluating, and Communicating Information**  
**Lesson Evaluation Rubric for 3rd-5th Grade**

<table>
<thead>
<tr>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Obtaining Information</strong></td>
<td><strong>Clarification Statement:</strong> Reliable media can include informational websites, newspapers, magazines, papers, symposia, or lectures.</td>
<td></td>
</tr>
</tbody>
</table>
| (8a) The lesson explicitly states that **students** will read and comprehend grade-appropriate complex texts and/or other reliable media. From the reading **students** will summarize and obtain scientific and technical ideas and describe how they are supported by evidence. | **Recommendation:** Make these three expectations explicit in the lesson and add in any missing expectations.  
**OR**  
In the lesson the **teacher** is reading complex texts and/or other reliable media. The **teacher** may also be summarizing and/or obtaining scientific and technical ideas and/or describing how scientific and technical ideas are supported by evidence for their students.  
**Recommendation:** Change the lesson so that students are doing the reading, summarizing, obtaining ideas and describing how they are supported by evidence. | In the lesson students are not reading grade-appropriate complex text and/or other reliable media. |
| (8b) The lesson explicitly states that **students** will find and combine information from books and/or other reliable media to help them understand and explain a phenomena or to help them design solutions to problems. | In the lesson the **teacher** is finding and/or combining information from books and/or other reliable media to help their students understand and explain a phenomena or to help them design solutions to problems.  
**Recommendation:** Alter the lesson so that students are in charge of finding and combining information then using it to help themselves understand and explain a phenomena or design a solution to a problem.  
**OR**  
The lesson does not state that **students** will find and/or combine information from books and/or other reliable media to help them understand and explain a phenomena or to help them design solutions to problems but doing so is implied and/or necessary to complete the lesson.  
**Recommendation:** Make it explicit. State in the lesson that students will be finding information on their own from books and/or other reliable media and using it to understand a phenomena or design a solution. | In the lesson students are not finding and/or combining information from books and/or other reliable media. |
SEP Rubric #8: Obtaining, Evaluating, and Communicating Information Rubric (continued)

<table>
<thead>
<tr>
<th>Fully Aligned</th>
<th>Partially Aligned</th>
<th>Not Aligned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communicating Information</strong>&lt;br&gt;(8c) The lesson explicitly states that students will share scientific and/or technical information orally and/or in written formats. This could include various written and oral formats, media, tables, diagrams, and charts.</td>
<td>The lesson states that students will share scientific and/or technical information but does not specify the format in which they will do so. <strong>Recommendation:</strong> Add to the lesson how students will share information. Be sure to include whether it is written and/or spoken.</td>
<td>The lesson does not give students the opportunity to share scientific and/or technical information orally or in a written format.</td>
</tr>
<tr>
<td><strong>Supporting other SEPs</strong>&lt;br&gt;<strong>Clarification Statement:</strong> Finding and evaluating information in text is a skill that can easily be combined with other SEPs.&lt;br&gt;For example, students may compare several texts and use them as evidence when constructing an argument or combine scientific ideas from text to help solve design problems.&lt;br&gt;(8d) The lesson explicitly states that students will be comparing and/or combining complex text and/or other reliable media when engaging in other SEPs.</td>
<td>In the lesson the teacher is comparing and/or combining complex texts and/or other reliable media to help students engage in other SEPs. <strong>Recommendation:</strong> Alter the lesson so that students will be the ones comparing and/or combining complex text and/or other reliable media. <strong>OR</strong>&lt;br&gt;The lesson states that students will be using complex text and/or other reliable media, but only in the obtaining, evaluating, and communicating information SEP. <strong>Recommendation:</strong> Include these skills as a part of another SEP. Specify in the lesson how using complex texts helps engagement in the other SEP.</td>
<td>In the lesson students are not engaging in any other SEPs.</td>
</tr>
<tr>
<td>(8e) The lesson explicitly states that students will combine information found in written text and the corresponding tables, diagrams, and/or charts when engaging in other SEPs.</td>
<td>In the lesson the teacher is combining information found in written text and the corresponding tables, diagrams, and/or charts to support engagement in other SEPs. <strong>Recommendation:</strong> Alter the lesson so that students will be the ones to combine information found in written text and the corresponding tables, diagrams, and/or charts when engaging in other SEPs. <strong>OR</strong>&lt;br&gt;The lesson states that students will combine information found in written text and the corresponding tables, diagrams, and/or charts, but only in the obtaining, evaluating, and communicating information SEP. <strong>Recommendation:</strong> Include these skills as a part of another SEP. Specify in the lesson how doing so helps engagement in the other SEP.</td>
<td></td>
</tr>
</tbody>
</table>
Crosscutting Concepts


1. **Patterns.** Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. **Cause and effect: Mechanism and explanation.** Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. **Scale, proportion, and quantity.** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system’s structure or performance.

4. **Systems and system models.** Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. **Energy and matter: Flows, cycles, and conservation.** Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems’ possibilities and limitations.

6. **Structure and function.** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. **Stability and change.** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.
Disciplinary Core Ideas for Grades 3-5

More information and a complete description of DCIs can be found at http://www.nextgenscience.org/search-standards-dci

3rd Grade
Physical Science
PS2.A: Forces and Motion
PS2.B: Types of Interactions
Life Science
LS1.B: Growth and Development of Organisms
LS2.C: Ecosystem Dynamics, Functioning, and Resilience
LS2.D: Social Interactions and Group Behavior
LS3.A: Inheritance of Traits
LS3.B: Variation of Traits
LS4.A: Evidence of Common Ancestry and Diversity
LS4.B: Natural Selection
LS4.C: Adaptation
LS4.D: Biodiversity and Humans
Earth Systems Science
ESS2.C: The Role of Water in Earth’s Surface Processes
Engineering Design
ETS1.A: Defining and Delimiting Engineering Problems
ETS1.B: Developing Possible Solutions
ETS1.C: Optimizing the Design Solution

4th Grade
Physical Science
PS3.A: Definitions of Energy
PS3.B: Conservation of Energy and Energy Transfer
PS3.C: Relationship Between Energy and Forces
PS3.D: Energy in Chemical Processes and Everyday Life
PS4.A: Wave Properties
PS4.B: Electromagnetic Spectrum
PS4.C: Information Technologies and Instrumentation
Life Science
LS1.A: Structure and Function
LS1.D: Information Processing
Earth Systems Science
ESS1.C: The History of Planet Earth
ESS2.A: Earth Materials and Systems
ESS2.B: Plate Tectonics and Large-Scale System Interactions
ESS2.E: Biogeology
ESS3.A: Natural Resources
ESS3.B: Natural Hazards

Unless otherwise noted, all rubric materials are adapted from Appendix F: Science and Engineering Practices in the NGSS found in the Next Generation Science Standards (NRC, 2013).
Engineering Design
ETS1.A: Defining and Delimiting Engineering Problems
ETS1.B: Developing Possible Solutions
ETS1.C: Optimizing the Design Solution

5th Grade
Physical Science
PS1.B: Chemical Reactions
PS2.B: Types of Interactions
PS3.D: Energy in Chemical Processes and Everyday Life
Life Science
LS2.A: Interdependent Relationships in Ecosystems
LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
Earth System Science
ESS1.A: The Universe and its Stars
ESS1.B: Earth and the Solar System
ESS2.A: Earth Materials and Systems
ESS2.C: The Roles of Water in Earth’s Surface Processes
ESS3.C: Human Impacts on Earth Systems
Engineering Design
ETS1.A: Defining and Delimiting Engineering Problems
ETS1.B: Developing Possible Solutions
ETS1.C: Optimizing the Design Solution
References


