## Innovation 3: Building K–12 Progressions

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| **Summary** | Students’ three-dimensional learning experiences are designed and coordinated over time to ensure students build understanding of *all three dimensions* of the standards, Nature of Science (NOS) concepts, and Engineering Design concepts and practices as expected by the standards. |

From the *Framework*:

[Instructional materials] based on the framework and resulting standards should integrate the three dimensions—scientific and engineering practices, crosscutting concepts, and disciplinary core ideas—and follow the progressions articulated in this report… In addition, curriculum materials need to be developed as a multiyear sequence that helps students develop increasingly sophisticated ideas across grades K–12.

To ensure that students can build their understanding over time in this way, lessons and units need to be thoughtfully designed and coordinated over time. Though a given curriculum or instructional materials program being evaluated with PEEC may focus on a single grade level or grade band, the NGSS place all of these progressions in a K*–*12 context. Both within years and across years, instructional materials should be thoughtfully, deliberately, and clearly progressing as elaborated below**.**

### **Three Dimensions K*–*12 Progression**

The three-dimensional learning experiences described in *Innovation 2: Three-Dimensional Learning* need to be coherently coordinated over time to increase student proficiency in all three dimensions. In other words, the way that students use any given science and engineering practice on day one of a curriculum should be significantly different from how they are using that practice on day 180, and students should have many experiences across the year learning new elements of the practice and applying elements of the practice that have already been learned to new situations. The same can be said of the DCIs and the CCCs. Progressions of all three dimensions should be coordinated over time, and clear support should be provided to the teacher to see how these progressions build over time. Guidance should also be provided for teachers to support adjusting instruction of all three dimensions to meet the needs of their students. In programs that extend beyond a single year, these progressions should be coordinated over the full breadth of the instructional materials program.

Teachers at each grade level may feel that there is a lot of content to “cover” in their grade level. However, by ensuring that instructional materials build coherent progressions, teachers and students do not need to start from scratch with each learning sequence or unit. Teachers need to understand where students’ understanding and abilities are in each dimension, and they need to know how much students are expected to progress during their grade level. Instructional materials designed for the NGSS provide sustained learning opportunities from kindergarten through high school for all students to engage in and develop a progressively deeper understanding of each of the three dimensions. Students require coherent, explicit learning progressions both within a grade level and across grade levels so they can continually build on and revise their knowledge and expand their understanding of each of the three dimensions by grade 12. High quality NGSS-designed instructional materials must clearly show how they include coherent progressions of learning experiences that support students in reaching proficiency on **all** parts (e.g., all elements of the SEPs, DCIs, and CCCs) of the NGSS by the end of each grade level and across grades.

See NGSS [Appendix E](http://nextgenscience.org/sites/default/files/Appendix%20E%20-%20Progressions%20within%20NGSS%20-%20052213.pdf), [Appendix F](http://nextgenscience.org/sites/default/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf), and [Appendix G](http://nextgenscience.org/sites/default/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf) for more information about the learning progressions for each dimension and how they build over time. For some more concrete examples of what *Innovation 3: Building K-12 Progressions* looks like in instructional materials programs, see Table 3.

Table 3: NGSS Innovation 3: Three Dimensions K–12 Progression

High quality instructional materials programs designed for the NGSS include:

| **Less** | **More** |
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| Building on students’ prior learning only for the DCIs. | Building on students’ prior learning in all three dimensions. |
| Little to no support for teachers to reveal students’ prior learning. | Explicit support to teachers for identifying students’ prior learning and accommodating different entry points, and describes how the learning sequence will build on the prior learning. |
| Assuming that students are starting from scratch in their understanding. | Explicit connections between students’ foundational knowledge and practice from prior grade levels. |
| Students engaging in the SEPs only in service of learning the DCIs | Students engaging in the SEPs in ways that not only integrate the other two dimensions, but also explicitly build student understanding and proficiency in the SEPs over time. |
| CCCs marginalized to callout boxes, comments in the margins, or are implicit and conflated with the other dimensions. | Students learn the CCCs in ways that not only integrate the other two dimensions, but also explicitly build student understanding and proficiency in the CCCs over time. |
| Including teacher support that focuses only on the large grain size of each dimension rather than digging down to the element level (e.g. the SEP “Analyzing and Interpreting data” rather than the grade 3*–*5 element of the same practice “Analyze data to refine a problem statement or the design of a proposed object, tool, or process.” | Including teacher support clearly explains out how the elements of the practices are coherently mapped out over the course of the instructional materials program. |

### **Engineering Design and the Nature of Science**

The NGSS include engineering design and the nature of science as significant concepts. Similar to the three dimensions of the standards, engineering design and the nature of science have been included in past science standards, but the degree to which and the way they are incorporated into the NGSS is a distinct part of this innovation of the NGSS. They are both blended into the three dimensions of the standards and called out in specific places. While all the SEPs have elements that are explicitly focused on engineering, there are specific Engineering Design DCIs throughout the standards, and crosscutting ideas related to the interplay of Engineering, Technology, Science, and Society are integrated into standards in each grade band. (See [Chapter 3 in the *Framework*](http://www.nap.edu/openbook.php?record_id=13165&page=41) for a detailed description of how the practices are used for both science and engineering. Box 3-2 briefly contrasts the role of each practice’s manifestation in science with its counterpart in engineering.) These engineering concepts and practices are included in standards throughout the NGSS that are marked with an asterisk. There are also grade-banded engineering design-specific standards in the NGSS to ensure that student learning about engineering design concepts is coherent and builds over time. NGSS [Appendix I](http://www.nextgenscience.org/sites/ngss/files/Appendix%20I%20-%20Engineering%20Design%20in%20NGSS%20-%20FINAL_V2.pdf) and [Appendix J](http://www.nextgenscience.org/sites/ngss/files/APPENDIX%20J_0.pdf) describe these progressions in more detail. Instructional materials designed for the NGSS should make sure that engineering is not an extension or engagement tool, but is incorporated meaningfully with science throughout student learning, and included as explicit and integrated learning targets.

As students engage in the science and engineering practices and use the crosscutting concepts and deepen understanding of the DCIs to make sense of phenomena and problems, they might accomplish some of what was referred to in separate areas of previous science standards documents as “Understanding the nature of science”. However, several aspects of the nature of science (e.g., the concepts that scientific investigations use a variety of methods, scientific knowledge is based on empirical evidence, science is a way of knowing, science is a human endeavor) are also explicitly included in the NGSS and integrated into the performance expectations. This is explained in more detail in NGSS [Appendix H](http://www.nextgenscience.org/sites/ngss/files/Appendix%20H%20-%20The%20Nature%20of%20Science%20in%20the%20Next%20Generation%20Science%20Standards%204.15.13.pdf). Instructional materials designed for the NGSS should ensure that these nature of science concepts are likewise explicitly embedded throughout student learning experiences and teacher supports, building learning progressions across grade bands.

For more examples of what NGSS Innovation 3: Building K-12 Progressions looks like in instructional materials programs as they relate to engineering design and the nature of science, see Table 4.

Table : NGSS Innovation 3B: Engineering Design and the Nature of Science

High quality instructional materials programs designed for the NGSS include:

| **Less** | **More** |
| --- | --- |
| Presenting engineering design and the nature of science disconnected from other science learning (e.g., design projects that do not require science knowledge to complete successfully, or an intro unit on the nature of science). | Engaging all students in learning experiences that connect engineering design and the nature of science with the three dimensions of the NGSS; not separated from science DCIs. |
| Presenting engineering design and/or nature of science in a hit or miss fashion, i.e. they are made apparent to students, but there is no coherent effort to coordinate or improve student understanding or proficiency over time. | Both engineering design and nature of science are thoughtfully woven into the three dimensional learning progressions so that students receive support to develop their understanding and proficiency. |
| Introducing students to ideas about engineering design or the nature of science, but not expecting students to retain or apply this information. | Measuring student learning in relation to engineering design and the nature of science across a system of assessments. |
| Teacher support only explains the importance of the nature of science and engineering design without a plan for scaffolding student understanding and application. | Teacher support explains how engineering design and the nature of science are coherently mapped out over the course of the instructional materials program. |