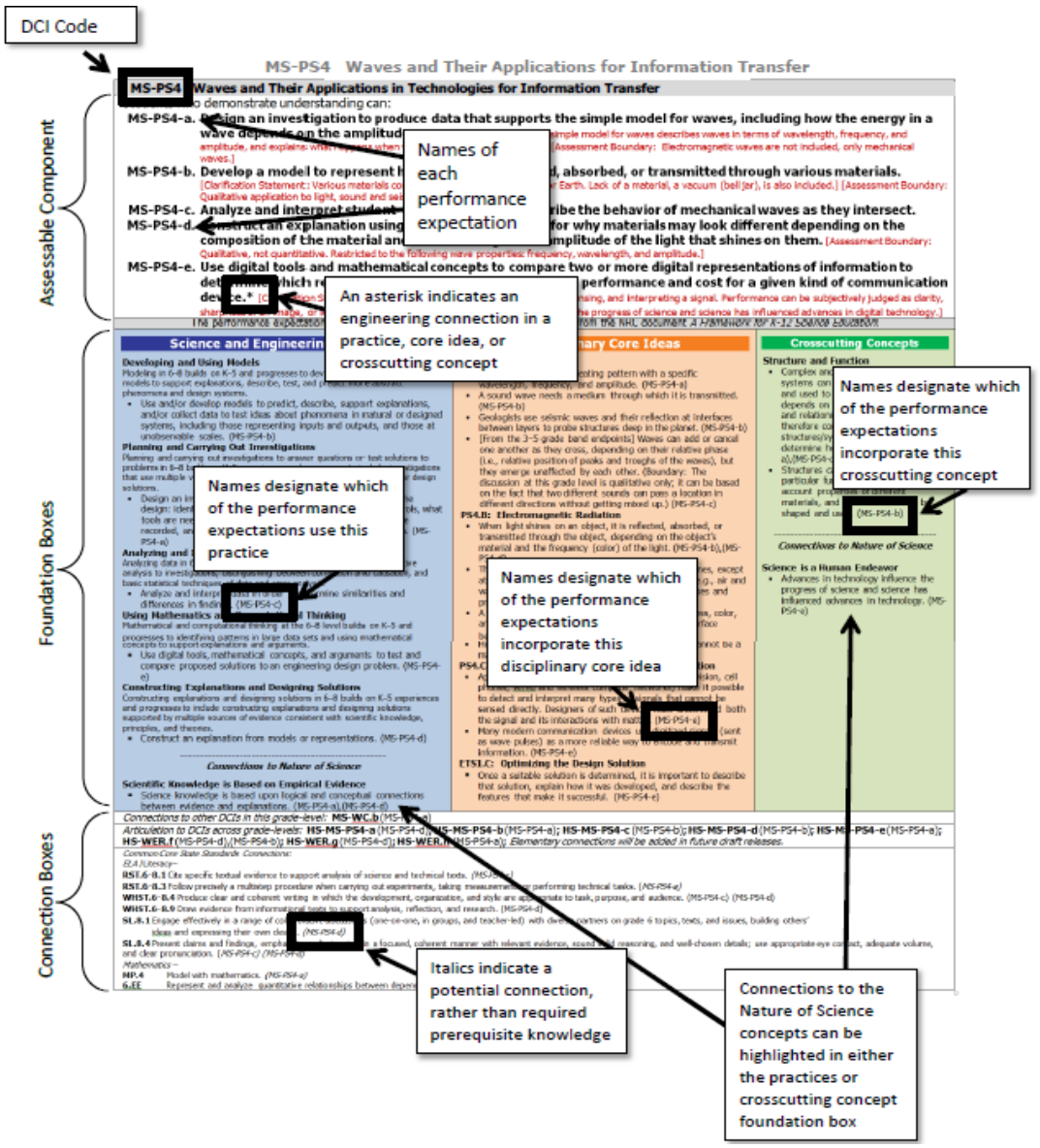
How to Read the *Next Generation Science Standards (NGSS)*

The Next Generation Science Standards (NGSS) are distinct from prior science standards in that they integrate three dimensions within each standard and have intentional connections across standards. To provide guidance and clarification to all users of the standards, the writers have created a System Architecture that highlights the NGSS as well as each of the three integral dimensions and connections to other grade bands and subjects. The standards are organized in a table with three main sections: 1) Performance expectation(s); 2) foundation boxes, and 3) connection boxes.

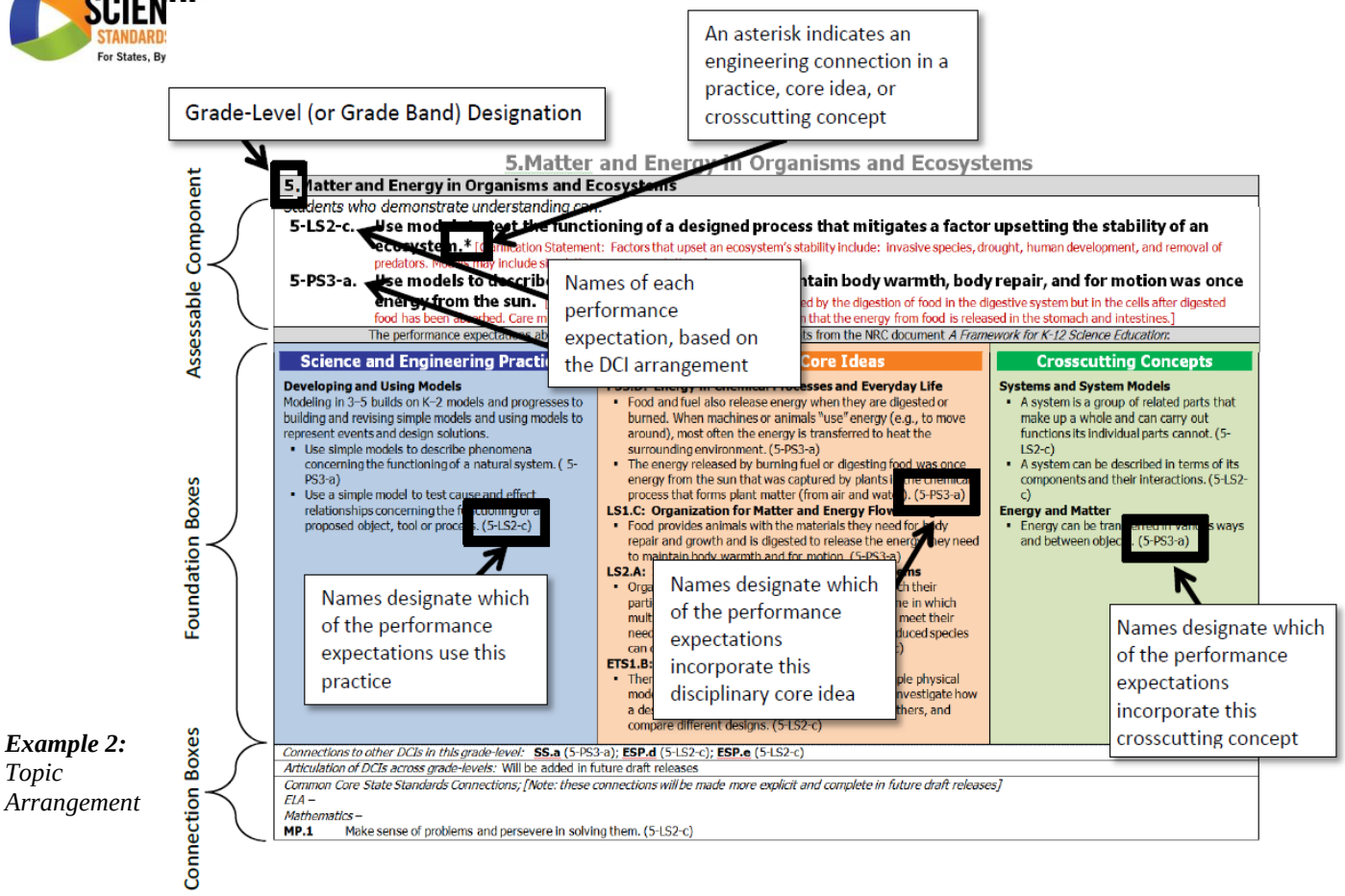
The NGSS represent a major shift in science education. As such, the lead states and writing teams wanted to ensure that the document represented that shift. To meet that goal, the document does not represent the traditional list of standards statements to be interpreted and "unpacked." The architecture is a departure from the norm for the purpose of giving all users as much information as possible to ensure common understanding of the standards. Given the different nature, this document was put together to guide new readers on the architecture and the relationships between the different components.

<u>Reading the Elements of the System Architecture</u>

In the figure below (Example 1), from top to bottom are seen the title, the topic label row, the performance expectation(s) (the assessable component), the foundation boxes (containing Practices, Disciplinary Core Ideas and Crosscutting Concepts), and the connection boxes. The coding is based on grade-level-DCI-PE. So, MS-PS4-a is translated to middle school, Waves and Their Applications for Information Transfer, first performance expectation.



Example 1: *DCI Coding and Arrangement*



Example 2: *Topic Arrangement*

A detailed explanation of the elements of the System Architecture follows:

Purpose of the Performance Expectations

The Next Generation Science Standards (NGSS) are written as student performance expectations, as recommended by *A Framework for K-12 Science Education,* blending Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. This is a key difference in the NGSS compared to most current state standards. The performance expectations are the assessable components of the NGSS architecture.

Successful student performance in the standards will require a deep understanding of each disciplinary core idea and all of the associated grade-band endpoints from the NRC *Framework*. The NGSS writers initially attempted to explicitly include all of these discreet, small-grain size components of the *Framework* in the performance expectations, but found that the resulting statements were bulky and reduced readers' comprehension of the standards. Instead, the performance expectations were written at a level necessary to communicate the "big idea" associated with each set of grade-band end points, showing the conceptual knowledge and skills students are to demonstrate.

It is important to note, however, that the performance expectations are not a set of instructional or assessment tasks. The writers intended the NGSS to be a set of student performances ***after*** instruction. Care has been taken to keep the level of each performance expectation at a conceptual level, leaving instructional procedures to states, districts, and teachers.

Some Key Points about the Performance Expectations

- The coding scheme is based on the disciplinary core idea arrangement as defined in *A Framework for K-12 Science Education*. Therefore, if the performance expectations are viewed in a different arrangement, by topic for instance, the coding is still representative of the disciplinary core ideas. The web application allows performance expectations to be searched by disciplinary core idea and topics.
- The performance expectations may also be viewed by topical groupings. Topical groupings of performance expectations do not imply a preferred ordering for instruction—nor should all performance expectations under one disciplinary core idea or topic necessarily be taught in one course. A list of all topics is included in the glossary.
- An asterisk (*) indicates engineering design performance expectations.
- There are two additional statements associated with the performance expectations that are meant to render additional support and clarity:
    - *Assessment Boundary Statements* are included with individual performance expectations where appropriate, to provide further guidance or to specify the scope of the expectation at a particular grade level.
    - *Clarification Statements* are designed to supply examples or additional clarification to the performance expectations.

Purpose of the Foundation Boxes

While the performance expectations can stand alone, a more coherent and complete view of what students should be able to do comes when the performance expectations are viewed in tandem with the foundation boxes. In many past science standards documents, conceptual level understanding requirements led to the exercise of "unpacking the standards." Conversely for the NGSS development process, the NRC *Framework* provided the "unpacked" information, which the NGSS writers used to develop the performance expectations. The writers then listed this source material from the *Framework* in the foundation boxes, thereby expanding and explaining the performance expectations in relation to the three dimensions: Science and Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts. The goal of the foundation boxes is to provide enough information in order to not require the standards to be further "unpacked." While states will adopt the performance expectations as standards, the NGSS writing team sees the foundation boxes as essential to communicate the full, coherent picture to teachers and assessment/curriculum developers.

Each statement in any one of the three foundation boxes is coded to the performance expectation(s) that embody it in parentheses.

Origin of the Foundation Boxes

- *Science and Engineering Practice Statements*: These statements are derived from and grouped by the eight categories detailed in the *Framework* to further explain the science and engineering practices important to emphasize in each grade band. Most topical groupings of performance expectations emphasize only a few of the practice categories; however, all practices are emphasized within a grade band. Teachers should be encouraged to utilize several practices in any instruction. The purpose is to demonstrate the specific practice for which students will be held accountable.
- *Disciplinary Core Ideas (DCIs)*: These statements are taken verbatim from the *Framework*, and detail the sub supporting ideas necessary for student mastery of the core idea.
- *Crosscutting Concept Statements*: These statements were derived from the *Framework* to further explain the crosscutting concepts important to emphasize in each grade band. The

crosscutting concepts are grouped by the categories detailed in the *Framework*. Most topical groupings of performance expectations emphasize only a few of the crosscutting concept categories, however all are emphasized within a grade band. Again, the list is not exhaustive nor is it intended to limit instruction. Aspects of the Nature of Science are listed here. They are not additional content, but meant to show how the Nature of Science applies to specific performance expectations.

Purpose of the Connection Boxes

The Connection Boxes are designed to support a coherent vision of the standards. Due to the considerations of the next revision, the connections to DCI boxes will be finalized in the final release of the standards. The intent of each component is described below.

- *Connections to other DCIs in this grade level*: This box will contain the names of science topics in other disciplines that have corresponding disciplinary core ideas at the same grade level. For example, both Physical Science and Life Science standards contain core ideas related to Photosynthesis, and could be taught in relation to one another. As the standards move toward completion, this box will provide links to specific performance expectations.
- *Articulation of DCIs across grade levels*: This box will contain the names of other science topics that either 1) provide a foundation for student understanding of the core ideas in this standard (usually standards at prior grade levels) or 2) build on the foundation provided by the core ideas in this standard (usually standards at subsequent grade levels). As the standards move toward completion, this box will provide links to specific performance expectations.
- *Connections to the Common Core State Standards*: This box will contain the coding and names of pre-requisite or co-requisite Common Core State Standards in English Language Arts & and Literacy and Mathematics that align to the performance expectations. For example, performance expectations that require student use of exponential notation will align to the corresponding CCSS mathematics standards. An effort has been made to ensure, in particular with mathematics, that the skill needed by science was taught in a previous year where possible.

<u>Color Coding</u>

Online versions of the standards display color coding of the words within each standard statement. The colors represent the three dimensions: blue for Science and Engineering Practices, orange for Disciplinary Core Ideas, and green for Crosscutting Concepts. Clarification Statements and Assessment Boundaries are red. Because crosscutting concept connections usually incorporate some of the disciplinary core idea language in each performance expectation, it was not possible to color-code them both simultaneously.

Printed and PDF versions of the standards do not have color coding of the three dimensions; in these cases the coding for the three dimensions will be accomplished through the lowercase letters found after each foundation box statement.