Or this one?

A. I’ve read it thoroughly.
B. I’ve skimmed it for general information.
C. It’s on my bookshelf.
D. It’s the first time I’ve seen it.

http://www.nap.edu/catalog.php?record_id=18409

Why, What, Who, When & Where

- Explain the reasons for building new science standards.
- Describe the process and timeline for constructing the Framework and the NGSS.
- Describe the structure of a standard within NGSS.
- Discuss the implications of the "shifts" in NGSS for teaching and learning.
- Examine instructional strategies that reflect the intent of NGSS.

Why were the NGSS developed?

Goal
For all students to:
- Have appreciation for the beauty and wonder of science
- Have sufficient knowledge of science and engineering to engage in public discussions
- Be careful consumers of scientific information relevant to their daily lives
- Continue to learn about science outside school
- Have the skills to enter careers of their choice, including (but not limited to) science, engineering and technology.
The National Assessment of Educational Progress (NAEP)

- NAEP is the largest nationally representative and continuing assessment of what America’s students know and can do in various subject areas.

2009 NAEP Science Results

Grade 4
34% of students perform at or above Proficient

Grade 8
30% of students perform at or above Proficient

Grade 12
21% of students perform at or above Proficient
PISA is an international assessment that measures 15-year-old students’ reading, mathematics, and science literacy. PISA also includes measures of general or cross-curricular competencies, such as problem solving. PISA emphasizes functional skills that students have acquired as they near the end of compulsory schooling.

2009 PISA Science Results Grade 10

29% of students scored at or above level 4—the level at which students can complete higher order tasks.

Trends in International Mathematics and Science Study

TIMSS provides reliable and timely data on the mathematics and science achievement of U.S. students compared to that of students in other countries.
TIMSS Performance

United States v Singapore Benchmark Achievement

<table>
<thead>
<tr>
<th>Grade</th>
<th>% Advanced</th>
<th>% High</th>
<th>% Intermediate</th>
<th>% Low</th>
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<tr>
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<td>US**</td>
<td>Singapore*</td>
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<td>1995</td>
<td>19</td>
<td>14</td>
<td>50</td>
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</tr>
<tr>
<td>Grade 8</td>
<td>% Advanced</td>
<td>% High</td>
<td>% Intermediate</td>
<td>% Low</td>
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<td></td>
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<td>1995</td>
<td>11</td>
<td>29</td>
<td>38</td>
<td>64</td>
</tr>
</tbody>
</table>

* Rank = 1; ** Rank = 5; ***Rank = 9

Where do you start when developing new standards?
Building on the Past; Preparing for the Future

Phase I

Phase II

A New Vision of Science Learning that Leads to a New Vision of Teaching

Vision for Science Education

“The framework is designed to help realize a vision for education in the sciences and engineering in which (all) students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.”

A Framework for K-12 Science Education pp. 8-9
The framework is built on the notion of learning as a developmental progression. It is designed to help children continually build on and revise their knowledge and abilities, starting from their curiosity about what they see around them and their initial conceptions about how the world works.

Framework, p.11

Who developed the NGSS?

NEXT GENERATION SCIENCE STANDARDS
For States, By States
What does a standard look like in the NGSS?

YIKES!!
What's Inside the Standards Box?

Exploring the Standards Box

• Read the explanation for each heading
• Write a heading in the box that best explains each section of the Standards Box.

Title and Performance Expectations

4-PS3 Energy

What Is Assessed
A set of performance expectations describing what students should know and be able to do to master this standard.

Title and Code
The titles of standard pages are not necessarily unique and may be reused at several different grade levels. The code, however, is a unique identifier for each set based on the grade level, content area, and topic it addresses.

A Closer Look at a Performance Expectation

K-LS1 From Molecules to Organisms: Structures and Processes

K-LS1. Use observations to describe patterns of what plants and animals (including humans) need to survive.

Note: Performance expectations combine practices, core ideas, and crosscutting concepts into a single statement of what is to be assessed. They are not instructional strategies or objectives for a lesson.
Foundation Box

The practices, core disciplinary ideas, and crosscutting concepts from the Framework for K-12 Science Education that were used to form the performance expectations.

Scientific & Engineering Practices
Activities that scientists and engineers engage in to either understand the world or solve a problem.

Disciplinary Core Ideas
Concepts in science and engineering that have broad importance within and across disciplines as well as relevance in people’s lives.

Crosscutting Concepts
Ideas, such as Patterns and Cause and Effect, which are not specific to any one discipline but are important in all.

The Connection Box

Connection Box
Other standards in the Next Generation Science Standards or in the Common Core State Standards that are related to this standard.

Inside the NGSS Box

What is Assessed
A collection of several performance expectations describing what students should be able to do to master this standard.

Foundation Box
The practices, core disciplinary ideas, and crosscutting concepts from the Framework for K-12 Science Education that were used to form the performance expectations.

Connection Box
Other standards in the Next Generation Science Standards or in the Common Core State Standards that are related to this standard.
How is content articulated in the NGSS?

Next Generation Science Standards
For States, By States

Review and discuss the progression of energy standards with a partner or your team.

Kindergarten  Grade 4  Middle School  High School

Partner/Group Review and Discussion

Discuss and Record your observations:
• How do the standards build coherently K-HS?
• How do core ideas progress K-12?
• How does the cognitive rigor progress K-HS?
• What are the opportunities for integration with ELA, Math, and STEM?
What are the three dimensions of learning in the NGSS?

- The NGSS are written as Performance Expectations
- NGSS will require contextual application of the three dimensions by students.

http://www.nextgenscience.org/hsess3-earth-human-activity

Dimension 1
Science and Engineering Practices

- Behaviors that scientists engage in as they investigate, build models, analyze data and communicate information
- “Practices” rather than “skills” since knowledge and skills are required that are specific to each practice.
- Engineering involves solving a problem through design.
- Engineering practices make STEM relevant to students.

Framework, pp. 41-82
Asking Questions...

Why are there seasons?
Why did the structure collapse?
How is electric power generated?
What do plants need to survive?

... Defining Problems

Developing and Using Models
Constructing Explanations (Science) and . . .

. . . Designing Solutions (Engineering)

Engaging in Argument from Evidence
Dimension 2
Crosscutting Concepts

- Have application across all domains of science
- Provide an organizational schema for interrelating knowledge from various science fields

- Include:
  1. Patterns, similarity, and diversity;
  2. Cause and effect;
  3. Scale, proportion and quantity;
  4. Systems and system models;
  5. Energy and matter;
  6. Structure and function;
  7. Stability and change
Dimension 3
Disciplinary Core Ideas

- Focus K–12 science curriculum, instruction and assessments on the most important aspects of science
- Broad importance or key organizing principle
- Key tool for understanding complex ideas
- Connected to personal or societal concerns
- Teachable and learnable at multiple grades

Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>Physical Science</th>
<th>Life Science</th>
<th>Earth &amp; Space Science</th>
<th>Engineering Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS1: Matter &amp; Interactions</td>
<td>LS1: From Molecules to Organisms</td>
<td>ESS1: Earth's Place in the Universe</td>
<td>ETS1: Engineering Design</td>
</tr>
<tr>
<td>PS3: Energy</td>
<td>LS3: Heredity: Inheritance and Variation of Traits</td>
<td>ESS3: Earth &amp; Human Activity</td>
<td></td>
</tr>
<tr>
<td>PS4: Waves and Their Applications in Technologies for Information Transfer</td>
<td>LS4: Biological Evolution: Unity &amp; Diversity</td>
<td></td>
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</tr>
</tbody>
</table>

Current State Science Standard Sample

Inquiry Standards

Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities utilizing safe laboratory procedures.

Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

Content Standards

Distinguish between atoms and molecules.

Recognize that there are more than 100 elements and some have similar properties as shown on the Periodic Table of Elements.

Identify and demonstrate the Law of Conservation of Matter.
Three Dimensions Intertwined

- The NGSS are written as Performance Expectations
- NGSS will require contextual application of the three dimensions by students.

The 5E Instructional Model

- Appropriate for lessons or units
- Activates prior knowledge
- Student-centered
- Multiple opportunities to explore
- Connects to real world scenarios
- Assessment opportunities in each E

High School

- **Engage:** view images of the “arms” of organisms, and attempt to identify their habitat; discuss adaptations.
- **Explore:** review slides of the Galapagos Islands and examine data on beak depth and tarsal length in finches. How could variation in beak depth help or harm finches?
- **Explain:** read and discuss Darwin’s description of natural selection.
- **Elaborate:** examine morphological features of apes and humans. Students build models to compare DNA codes for proteins to determine relatedness of organisms.
- **Explain:** describe findings and predict relationships to ancestor
- **Evaluate:** use graphical evidence for natural selection to construct an explanation for adaptation of populations
Performance Expectation?

<table>
<thead>
<tr>
<th>3E</th>
<th>Practices</th>
<th>DCIs</th>
<th>Crosscutting</th>
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</table>

HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

What shifts are necessary for teaching and learning in the NGSS?
Conceptual Shifts in the NGSS

1. K-12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world.
2. The Next Generation Science Standards are student performance expectations, NOT curriculum.
3. The science concepts build coherently from K-12.
4. The NGSS focus on deeper understanding of content as well as application of content.
5. Science and Engineering are integrated in the NGSS from K–12.
6. NGSS content is focused on preparing students for the next generation workforce.
7. The NGSS and Common Core State Standards (English Language Arts and Mathematics) are Aligned.

Maryland and the NGSS: Where are We Going?
Outcomes

- Explained the reasons for building new science standards.
- Described the process and timeline for constructing the Framework and the NGSS.
- Described the structure of a standard within NGSS.
- Discussed the implications of the "shifts" in NGSS for teaching and learning.
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Exit Slip

- Write a message that describe the implications of the NGSS for teaching and learning in YOUR classroom.
  - Tweet
  - Message
  - Facebook

Resources

http://www.nap.edu/catalog.php?record_id=13165#

Developing Assessments for the Next Generation Science Standards
http://www.nap.edu/download.php?record_id=18409

NSTA
http://ngss.nsta.org/access-standards/
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Next Generation Science Standards
www.nextgenscience.org

National Academy of Sciences
http://sites.nationalacademies.org/dbasse/base/framework_kss_sciences/index.htm