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Building Essential Test Readiness Skills in Science for the TASC

Central/Southern Tier RAEN, April 8, 2014, 9 A.M.–12 noon

Tom Trocco, Director of Program Support for OACE, ttrocco@schools.nyc.gov

Agenda

Learning Objectives: You will be able to:

- Understand the Framework of the Next Generation Science Standards
- Use strategies and resources to engage students in science content
- Better understand the TASC Science assessment, and the content and process skills students need to master

Introductions
Objectives
Kingdom Characteristics
- Activity
- Group Share (Charting)
- Discussion

Science Vocabulary and Strategies
- Jigsaw read *Passwords* Chapter 2
- Table Share (what new facts/vocabulary did you learn?
- Group Share (Update Charts)
- Discussion

Intro to structure of the TASC
- TASC Detailed Test Design
- TASC Science Overview
- Compare and Contrast
- Depth of Knowledge

Next Generation Science Standards
- Organization of the NGSS
- Major Shifts in the NGSS
- Discussion: What do the Major Shifts Require of us?

Evaluation

Contents

Online Resources

- Next Generation Science Standards: http://www.nextgenscience.org/
- The OACE TASC webpage: http://www.oacenyc.org/home/t-a-s-c
- CTB McGraw-Hill's TASC webpage: http://www.tasctest.com/

Cooperative Learning Brainstorm Directions

1. Work in groups of four.
2. Spend 45 seconds writing down everything you know about your assigned Kingdom.
3. When time is called, pass your paper to the right.
4. Read what your partner has written, then spend 45 seconds adding information to the Kingdom on the second sheet.
5. When time is called, pass your paper to the right.
6. Read what your partners have written, then spend 45 seconds adding information to the Kingdom on the third sheet.
7. When time is called, pass your paper to the right.
8. Read what your partners have written, then spend 45 seconds adding information to the last Kingdom on the fourth sheet.

Name: ____

Animals	Plants
Fungus	Protists

Name: ______________________________________

Animals	**Plants**
Fungus	Protists

Name: ____

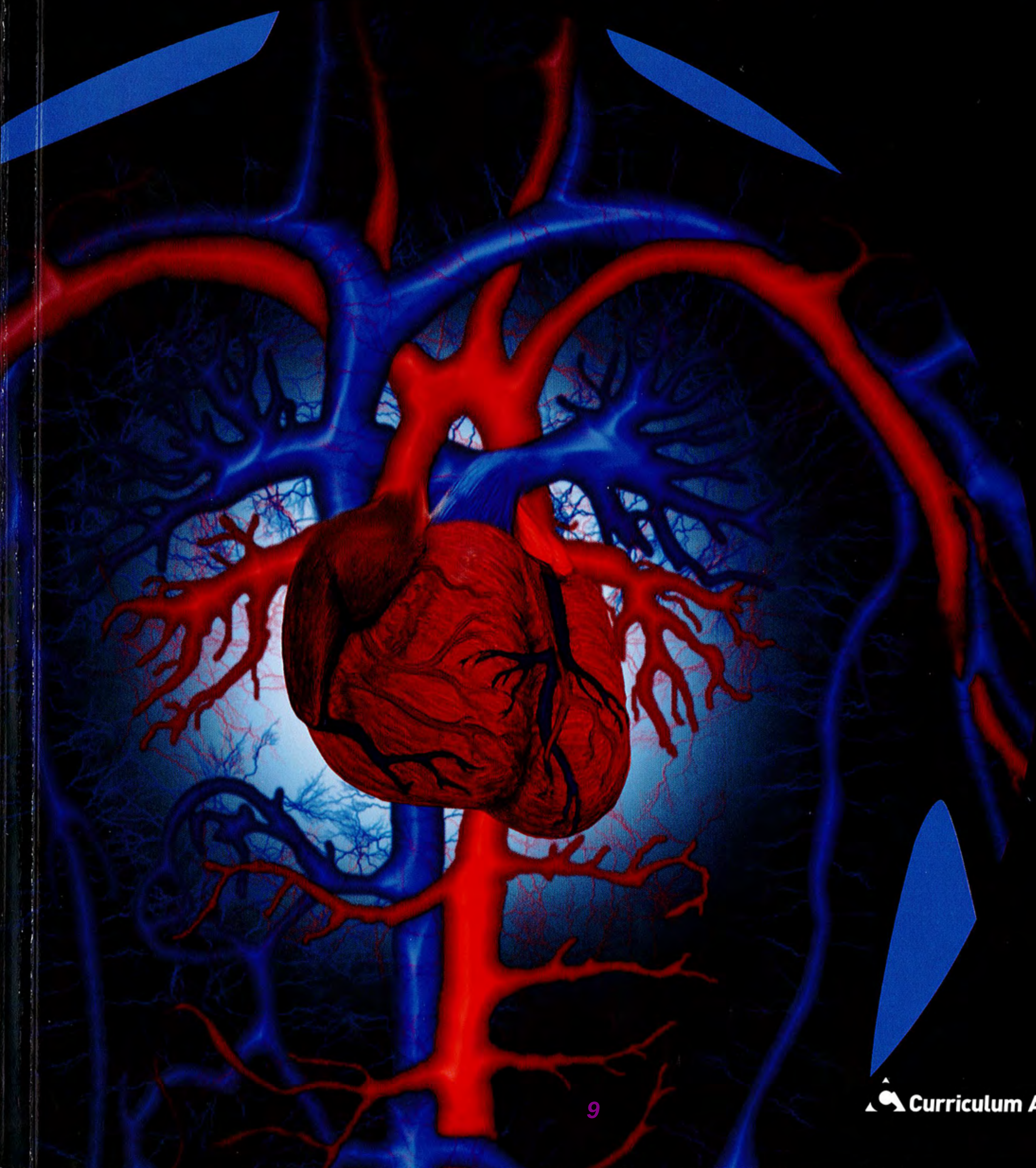
Animals	Plants
Fungus	Protists

Name: ______________________________________

Animals	Plants
Fungus	**Protists**

Passwords
Science Vocabulary

Life Science



Curriculum Associates

LESSON 2

kingdoms · vertebrate · invertebrate · vascular plant · nonvascular plant · fungi · microorganism · protist · moneran · bacteria

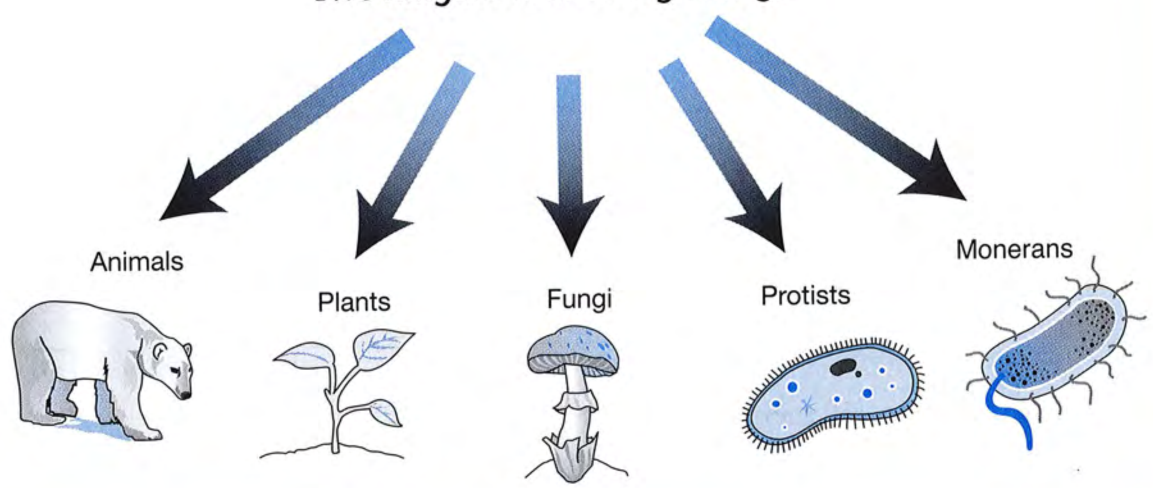
The world has so many different kinds of living things, how can they possibly be grouped? Read this selection to find out one way scientists organize living things.

Organizing Living Things

Five Kingdoms

Scientists organize living things into five major groups, or **kingdoms**. These kingdoms are animals, plants, fungi, protists, and monerans. The organisms in each group share certain features.

Five Kingdoms of Living Things



The Animal Kingdom

Animals are organisms that cannot make their own food. They get their food from other living things. Animals move from place to place to find food and shelter and to escape harm.

Animals can be vertebrates or invertebrates. A **vertebrate** is an animal with a backbone, such as a fish, toad, or bird. A backbone gives a vertebrate inner support.

A toad is a vertebrate.

An **invertebrate** is an animal with no backbone, such as a starfish, crab, or spider. Many invertebrates have an outer shell for support and protection.

A crab is an invertebrate.

The Plant Kingdom

Plants are organisms that use sunlight to make their own food. Plants are divided into two main groups. A **vascular plant** has tubes that carry food and water. Rose bushes and palm trees are examples of vascular plants. A **nonvascular plant**, such as moss, has no tubes for carrying food and water.

The Fungi Kingdom

Yeast, mold, and mushrooms are three types of fungi. **Fungi** are like plants because they do not move around, but they are not green and do not make their own food. Fungi take in nutrients from other living things. For example, mushrooms grow on rotting tree trunks.

Mushrooms are fungi.

The Protist and Moneran Kingdoms

A tiny organism made up of a few cells or a single cell is called a **microorganism**. A **protist** is a microorganism that usually has a single cell. Some protists are more like animals, but others are more like plants.

A **moneran** is a microorganism that has only one cell. The cell has no nucleus in the center. Instead, the nucleus is spread throughout the cell. **Bacteria** are one kind of moneran.

My Science Vocabulary

Go to page 94 to list other words you have learned about organizing living things.

kingdoms	**invertebrate**	**nonvascular plant**	**microorganism**	**moneran**
vertebrate	**vascular plant**	**fungi**	**protist**	**bacteria**

A. ***Match each word with its meaning. Write the letter of the correct meaning on the line in front of each word.***

1. ____ nonvascular plant
2. ____ fungi
3. ____ bacteria
4. ____ moneran
5. ____ vertebrate
6. ____ kingdoms
7. ____ vascular plant
8. ____ microorganism
9. ____ invertebrate
10. ____ protist

a. a plant with tubes that carry food and water

b. a microorganism that usually has a single cell and may be like a plant or an animal

c. an animal with a backbone

d. one kind of moneran

e. a microorganism that has only one cell, with the nucleus spread throughout the cell

f. organisms that take in nutrients from other living things

g. a plant that has no tubes for carrying food and water

h. the major groups of living things

i. a tiny organism with only a few cells or a single cell

j. an animal that has no backbone

TASC Science Section Design Compared to the GED

	TASC	GED
Content Area		
• Physical Sciences	33%	35%
• Earth and Space Sciences	33%	20%
• Life Sciences	34%	45%
• Scientific and Engineering Practices	Integrated	
• Cross-Cutting Concepts	Integrated	
Testing Time	85 min (90 min Spanish)	80 min
Number of Questions	47 MC (8 stimuli)	50 MC

What are the implications of these changes for curriculum, instruction, and assessment?

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The TASC Test Science

The Test Assessing Secondary Completion™ — the TASC test is designed to assess the high school performance expectations in the Next Generation Science Standards (NGSS). A PDF of the NGSS arranged by Disciplinary Core Idea is available online at: http://www.nextgenscience.org/next-generation-science-standards

The NGSS performance expectations state what all learners should be able to do in order to demonstrate their understanding of science. Each NGSS performance expectation integrates a Science and Engineering Practice, one or more Disciplinary Core Ideas, and a Crosscutting Concept. Each NGSS performance expectation also includes a Clarification Statement and an Assessment Boundary to provide further information for the purposes of curriculum, instruction, and assessment.

The TASC test Science assessment will include items for the disciplines of Physical Sciences, Life Sciences, and Earth and Space Sciences. Each discipline is subdivided into several Core Ideas, which each contain multiple performance expectations. Each test item assesses one performance expectation. Items may require recalling knowledge, applying knowledge and skills, or reasoning.

The number of test items per Core Idea is proportional to the number of performance expectations within the Core Idea. As a result, each Core Idea will have about 2-5 items on a given test. A given test will not necessarily include items for every performance expectation present in the NGSS, though any performance expectation is potentially assessable.

High Emphasis:

Life Sciences

- Core Idea: HS-LS1 From Molecules to Organisms: Structures and Processes
- Core Idea: HS-LS2 Ecosystems: Interactions, Energy, and Dynamics
- Core Idea: HS-LS3 Heredity: Inheritance and Variation of Traits
- Core Idea: HS-LS4 Biological Evolution: Unity and Diversity

Earth and Space Sciences

- Core Idea: HS-ESS1 Earth's Place in the Universe
- Core Idea: HS-ESS1 Earth's Systems
- Core Idea: HS-ESS1 Earth and Human Activity

Medium Emphasis:

Physical Sciences

- Core Idea: HS-PS1 Matter and Its Interactions
- Core Idea: HS-PS2 Motion and Stability: Forces and Interactions
- Core Idea: HS-PS3 Energy
- Core Idea: HS-PS4 Waves and Their Applications in Technologies for Information Transfer

Note: The TASC test will not include test items to directly assess the performance expectations in the Core Idea of HS-ETS1 Engineering Design. However, some performance expectations in Physical Sciences, Life Sciences, and Earth and Space Sciences integrate engineering through a Practice or Disciplinary Core Idea. Items aligned to those performance expectations may require examinees to demonstrate their understanding of science through the application of the engineering design process such as defining and delimiting a problem, designing solutions to a problem, and evaluating and optimizing design solutions.

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TEST ASSESSING SECONDARY COMPLETION™

Compare and Contrast

GED Sample Question

	W	**w**
W	**WW**	**Ww**
w	**Ww**	**ww**

*A certain plant species varies in the shape of its leaf edges. The wavy-edged (***W***) is dominant to the straight-edged (***w***). According to the Punnett Square, what is the probability of an offspring having wavy-edged leaves?*

1. 25%
2. 0%
3. 50%
4. 75%
5. 100%

TASC Sample Question

A certain plant species varies in the shape of its leaf edges. Some of the plants have wavy-edged leaves, and some of the plants have straight-edged leaves. In this plant species, the trait for leaf-edge shape is controlled by a single gene. The dominant allele is represented by W, and the recessive allele is represented by w.

Two plants with wavy-edged leaves are crossed with each other, producing 421 offspring plants. Of these, 298 offspring plants have wavy-edged leaves, and 123 offspring plants have straight-edged leaves.

What are the genotypes of the parent plants in this cross?

A. Ww and ww
B. Ww and Ww
C. WW and ww
D. WW and Ww

How are the two questions similar? How are they different?

Applying Webb's Depth-of-Knowledge (DOK) Levels in Science

Karin K. Hess

According to Norman L. Webb ("Depth-of-Knowledge Levels for Four Content Areas," March 28, 2002), interpreting and assigning depth-of-knowledge levels to both objectives within standards and assessment items is an essential requirement of alignment analysis. Four levels of Depth of Knowledge are used for this analysis.

A general definition for each of the four (Webb) Depth-of-Knowledge levels is followed by Table 1, which provides further specification and examples for each of the DOK levels in science. Generally speaking, large-scale, on-demand assessments should only assess Depth-of-Knowledge Levels 1, 2, and 3. Depth-of-Knowledge at Level 4 should be reserved for local assessment and is included here primarily for illustrative purposes.

Descriptors of DOK Levels for Science (based on Webb, March 2002 and TIMSS Science Assessment framework, 2003)

Level 1 Recall and Reproduction requires recall of information, such as a fact, definition, term, or a simple procedure, as well as performing a **simple** science process or procedure. Level 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. A "simple" procedure is well-defined and typically involves only **one-step**. Verbs such as "identify," "recall," "recognize," "use," "calculate," and "measure" generally represent cognitive work at the recall and reproduction level. Simple word problems that can be directly translated into and solved by a formula are considered Level 1. Verbs such as "describe" and "explain" could be classified at different DOK levels, depending on the complexity of what is to be described and explained.

A student answering a Level 1 item either knows the answer or does not: that is, the answer does not need to be "figured out" or "solved." In other words, if the knowledge necessary to answer an item automatically provides the answer to the item, then the item is at Level 1. If the knowledge necessary to answer the item does not automatically provide the answer, the item is at least at Level 2.

Level 2 Skills and Concepts includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is **more complex** than in level 1. Items require students to make some decisions as to how to approach the question or problem. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply **more than one step**. For example, to compare data requires first identifying characteristics of the objects or phenomenon and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

Some action verbs, such as "explain," "describe," or "interpret," could be classified at different DOK levels, depending on the complexity of the action. For example, interpreting information from a simple graph, requiring reading information from the graph, is a Level 2. An item that requires interpretation from a complex graph, such as making decisions regarding features of the graph that need to be considered and how information from the graph can be aggregated, is at Level 3.

Level 3 Strategic Thinking requires deep knowledge using reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are **complex and abstract**. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multi-step task requires **more demanding reasoning**. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Experimental designs in Level 3 typically involve more than one dependent variable. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve non-routine problems.

Level 4 Extended Thinking requires **high cognitive demand** and is **very complex**. Students are required to make several connections—relate ideas *within* the content area or *among* content areas—and have to select or devise one approach among many alternatives on how the situation can be solved. Many on-demand assessment instruments will not include any assessment activities that could be classified as Level 4. However, standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. "Develop generalizations of the results obtained and the strategies used and apply them to new problem situations," is an example of a Grade 8 objective that is a Level 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be Level 4.

Level 4 requires complex reasoning, experimental design and planning, and **probably will require an extended period of time** either for the science investigation required by an objective, or for carrying out the multiple steps of an assessment item. However, the extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2 activity. However, if the student conducts a river study that requires taking into consideration a number of variables, this would be a Level 4.

Table 1: Examples for each of the DOK Levels in Science, based on Webb (Karin Hess, 2005)

Level 1 **Recall & Reproduction**	**Level 2** **Skills & Concepts**	**Level 3** **Strategic Thinking**	**Level 4** **Extended Thinking**
a. Recall or recognize a fact, term, definition, simple procedure (such as one step), or property b. Demonstrate a rote response c. Use a well-known formula d. Represent in words or diagrams a scientific concept or relationship e. Provide or recognize a standard scientific representation for simple phenomenon f. Perform a routine procedure, such as measuring length g. Perform a simple science process or a set procedure (like a recipe) h. Perform a clearly defined set of steps i. Identify, calculate, or measure **NOTE: If the knowledge necessary to answer an item automatically provides the answer, it is a Level 1.**	a. Specify and explain the relationship between facts, terms, properties, or variables b. Describe and explain examples and non-examples of science concepts c. Select a procedure according to specified criteria and perform it d. Formulate a routine problem given data and conditions e. Organize, represent, and compare data f. Make a decision as to how to approach the problem g. Classify, organize, or estimate h. Compare data i. Make observations j. Interpret information from a simple graph k. Collect and display data **NOTE: If the knowledge necessary to answer an item <u>does not</u> automatically provide the answer, then the item is at least a Level 2. Most actions imply more than one step.**	a. Interpret information from a complex graph (such as determining features of the graph or aggregating data in the graph) b. Use reasoning, planning, and evidence c. Explain thinking (beyond a simple explanation or using only a word or two to respond) d. Justify a response e. Identify research questions and design investigations for a scientific problem f. Use concepts to solve non-routine problems/more than one possible answer g. Develop a scientific model for a complex situation h. Form conclusions from experimental or observational data i. Complete a multi-step problem that involves planning and reasoning j. Provide an explanation of a principle k. Justify a response when more than one answer is possible l. Cite evidence and develop a logical argument for concepts m. Conduct a designed investigation n. Research and explain a scientific concept o. Explain phenomena in terms of concepts	a. Select or devise approach among many alternatives to solve problem b. Based on provided data from a complex experiment that is novel to the student, deduct the fundamental relationship between several controlled variables. c. Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions d. Relate ideas *within* the content area or *among* content areas e. Develop generalizations of the results obtained and the strategies used and apply them to new problem situations **NOTE: Level 4 activities often require an extended period of time for carrying out multiple steps; however, time alone is not a distinguishing factor if skills and concepts are simply repetitive over time.**

 updated 2007

MS-LS3 Heredity: Inheritance and Variation of Traits

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms
- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*

LS3.A: Inheritance of Traits
- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

LS3.B: Variation of Traits
- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

Structure and Function
- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Connections to other DCIs in this grade-band: **MS.LS1.A** (MS-LS3-1); **MS.LS4.A** (MS-LS3-1)

Articulation across grade-bands: **3.LS3.A** (MS-LS3-1),(MS-LS3-2); **3.LS3.B** (MS-LS3-1),(MS-LS3-2); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1),(MS-LS3-2); **HS.LS3.A** (MS-LS3-1),(MS-LS3-2); **HS.LS3-B** (MS-LS3-1),(MS-LS3-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS3-1),(MS-LS3-2)*

Mathematics –

MP.4	Model with mathematics. *(MS-LS3-2)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-LS3-2)*

Next Generation Science Standards Organization

Title and Code: ***MS*** identifies this as Middle School, ***LS*** as Life Science

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

Performance Expectations: what students should be able to do to show mastery

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	**LS1.B: Growth and Development of Organisms** • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)* **LS3.A: Inheritance of Traits** • Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) • In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Foundation Box: the Science and Engineering Practices, Disciplinary Core Ideas, and Cross-Cutting Concepts from the Framework for K-12 Science Education used to define the Performance Expectations above

Connections to other DCIs in this grade-band: **MS.LS1.A** (MS-LS3-1); **MS.LS4.A** (MS-LS3-1)

Articulation across grade-bands: **3.LS3.A** (MS-LS3-1),(MS-LS3-2); **3.LS3.B** (MS-LS3-1),(MS-LS3-2); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1),(MS-LS3-2); **HS.LS3.A** (MS-LS3-1),(MS-LS3-2); **HS.LS3-B** (MS-LS3-1),(MS-LS3-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS3-1),(MS-LS3-2)*

Mathematics –

MP.4	Model with mathematics. *(MS-LS3-2)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-LS3-2)*

Connections Box: Connections to other science standards within this grade band, articulations across grade bands, and connections to Common Core Standards in Mathematics and English Language Arts/Literacy

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [*Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.*]

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

Structure and Function

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Note the Clarification Statements above, which supply examples or additional clarification to the performance expectations.

Also note the Assessment Boundary statements, which specify the limits to large scale assessment.

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*

LS3.A: Inheritance of Traits

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

LS3.B: Variation of Traits

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

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The Next Generation Science Standards, http://www.nextgenscience.org/

Practices, Cross-Cutting Concepts, and Core Ideas	A Shift from Previous Standards
Science and Engineering Practices (from Appendix F) 1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations (for science) and designing solutions (for engineering) 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Cross-Cutting Concepts (from Appendix G) 1. Patterns 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 44 Disciplinary Core Ideas, with 11 emphasized: **High Emphasis**: *Life Sciences* • LS1 From Molecules to Organisms: Structures and Processes • LS2 Ecosystems: Interactions, Energy, and Dynamics • LS3 Heredity: Inheritance and Variation of Traits • LS4 Biological Evolution: Unity and Diversity *Earth and Space Sciences* • ESS1 Earth's Place in the Universe • ESS1 Earth's Systems • ESS1 Earth and Human Activity **Medium Emphasis:** *Physical Sciences* • PS1 Matter and Its Interactions • PS2 Motion and Stability: Forces and Interactions • PS3 Energy • PS4 Waves and Their Applications in Technologies for Information Transfer	1. The NGSS reflect how science is practiced and experienced in the real world by intertwining three dimensions: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. 2. The NGSS are student performance expectations – NOT curriculum—and clarify what students should know and be able to do be the end of a grade or grade band. 3. The science concepts in the NGSS Build coherently from grade K through 12, which is a movement away from learning disjointed and isolated facts and towards move complex ideas as students progress through grade levels and bands. 4. The NGSS focus on deeper understanding of content as well as application of content. The NGSS focus on a smaller set of disciplinary core ideas that students should know by the time they graduate from high school, rather than the myriad of facts associated with each core idea. The facts and details are important evidence, but should not be the sole focus of curriculum, instruction, and assessment. 5. The NGSS integrate applications of science, technology, and engineering from grade K through grade 12 along with the core ideas of life, physical, and earth and space sciences. This requires the development of curriculum, instruction, and assessment, along with teacher professional development, to integrate engineering and technology into the structure of science education. 6. The NGSS are designed to prepare students for college, career, and citizenship. All students, no matter what their future education and career path is, must have a solid K–12 science education in order to be prepared for college, careers, and citizenship. 7. The NGSS correlate to the Common Core State Standards in ELA and math. The three sets of standards overlap in meaningful and substantive ways and offer an opportunity to give all students equitable access to learning standards

What do the Major Shifts Require?

Directions: Read shifts 1, 3, and 4 and reflect on what we will need “more of” and what we will need “less of” in our HSE classrooms.

Shift #1: Interconnected Nature of Science	
“More of”	**“Less of”**

Shift #3: Focus and Coherence	
“More of”	**“Less of”**

Shift #4: Deeper Understanding and Content Application	
“More of”	**“Less of”**