

An Overview of 2018 Mississippi College- and Career-Readiness Standards for Science

Summer Sessions 2017

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State Board of Education
Vision and Mission

Vision _____

To create a world-class educational system that gives students the knowledge and skills to be successful in college and the workforce, and to flourish as parents and citizens

Mission _____

To provide leadership through the development of policy and accountability systems so that all students are prepared to compete in the global community

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The new science standards were created and developed to correlate with the vision and mission mandated by the State Board of Education.



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State Board of Education Goals 5-Year Strategic Plan for 2016-2021

1. All Students Proficient and Showing Growth in All Assessed Areas
2. Every Student Graduates High School and is Ready for College and Career
3. Every Child Has Access to a High-Quality Early Childhood Program
4. Every School Has Effective Teachers and Leaders
5. Every Community Effectively Using a World-Class Data System to Improve Student Outcomes
6. Every School and District is Rated “C” or Higher

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The *Mississippi College- and Career-Readiness Standards for Science* also correlates with numbers 1, 2, 3, 4, and 6 of the State Board of Education’s goals.



Session Objectives:

The objectives of this session are to:

- learn answers to frequently asked questions (FAQs);
- examine the new science standards introduction;
- compare the old standards to the new standards;
- explore the major dimensions of the science standards;
- investigate a grade-band sample activity to use as a model to plan other lessons;
- use crosswalks to compare previously used teaching strategies to the new standards.



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MS CCRS for Science – Research Review

Developed by a team of MS educators (K-College)

Used Resources from the following:

- State models: South Carolina (2014), Alabama (2015), Massachusetts (2016), and Virginia (2010)
- National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012) (informed Next Generation Science Standards-NGSS)
- National Assessment of Educational Progress (NAEP)
- The Trends in International Mathematics and Science Study (TIMSS)
- ACT College- and Career-Readiness (CCR) Benchmarks




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The major document used was the National Research Council's (NRC) Framework for K-12 Science Education. This document was the major reference for the Next Generation Science Standards (NGSS) but the task force used this document to write specific MS standards. Some overlap with NGSS but the MS standards are unique for Mississippi. The writing task force also used state standards that used the NRC document and are rated high in the Fordham's State Standard rating. The Writing Task Force used the NAEP Framework for Science and the NAEP Framework for Technology and Engineering as a resource. **MS Standards are aligned with NAEP standards.**

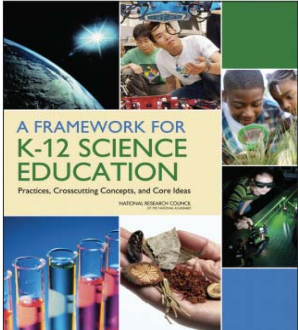
The Trends in International Mathematics and Science Study (TIMSS) is an international comparative study of student achievement. These were used as a reference.

The ACT CCR Benchmarks were used for science and reading skills needed per grade level and high school courses. This document's objectives and skills were the basis of the new 0.5 credit course, Foundations of Science Literacy, that is new for high school students.

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MS CCRS for Science – Research Review

A Framework for K-12 Science Education Practices, Crosscutting Concepts, and Core Ideas



A New Vision for Teaching and Learning

- Science for ALL Students
- Coherent Learning

Three Dimensions

- Scientific and Engineering Practices (SEPs)
- Crosscutting Concepts (CCCs)
- Core Ideas (DCIs)

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The National Research Council’s research has been used to formulate most of the MS Science Frameworks from 1996 forward.


Using their research is not new to Mississippi but the 2012 book introduces methods for teaching science that are very different from all of our other science frameworks.



Important Facts:

- The *MS CCRS for Science* are goals that reflect what a student should know and be able to do.
- This document does not dictate a manner or methods of teaching.
- The standards in this document are not sequenced for instruction and do not prescribe classroom activities, materials, or instruction strategies.
- The standards will be piloted during school year 2017-2018 with full implementation during school year 2018-2019.

This is from the introduction on page 11.



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MS CCRS for Science – FAQs

How will new standards impact Grades 5, 8, Biology tests?

- The test questions for 2017-2018 will be based on the *2010 MS Science Framework*.
- The tests in 2017-2018 will have field-test items from the *2018 MS CCRS for Science*.
- The new assessments should be in place beginning in SY 2018-2019. This test will be based on the *2018 MS CCRS for Science*. There will be a new blueprint and new items developed.
- The Office of Student Assessment will provide more details as they become available.

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Additional info – For the 2019 new tests, Grade 5 will be based on Grade 5 standards and performance objectives. This will be the same for Grade 8 and Biology. There will not be a grade band (3-5, 6-8) assessment.



MS CCRS for Science – FAQs

What about new science textbooks?

- Year of adoption for science is 2017-2018
- Meetings will begin on the state level in the early fall.
- Local Textbook Coordinators for each district will work with a local selection committee to look at the science textbooks that passes the state committee evaluation. Work with your district textbook coordinator for more information.



Organization of 9-12 Courses

2010 MS Science Framework	2018 MS CCRS for Science
21 Science Courses	13 Science Courses

Courses Retired:
Organic Chemistry, Introduction to Biology, Biology II, Microbiology*, Biomedical Research*, Geology, Astronomy*, Aerospace Studies, Spatial Information Science*, Field Experiences

* Course with asterisk can be offer after 2017-2018 through application process

New Courses:
Foundations of Biology (replaces Introduction to Biology)
Foundations of Science Literacy (inquiry course containing objectives from *ACT College and Career Readiness Standards*)

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For High School: We have reduced the number of course offerings from 21 to 13. Some of the courses are totally retired but many have been reformatted or are being offered through another venue such as, Dual Enrollment Courses, Dual Credit Courses, AP Courses, the Project Lead the Way Initiative, and Career and Technical Education (CTE) courses.

(CTE Curriculum Courses (Polymer Science, Horticulture, Engineering, Forestry, Health Sciences, various Agriscience courses); We are working on a process to allow districts to submit a yearly application requesting permission to offer Advanced Topics in Science for the courses of Microbiology, Biomedical Research, Astronomy, Spatial Information Science. More information to follow.

New Courses: Foundations of Biology replaces Introduction to Biology and has increased rigor with research and reading woven into biological topics

Foundations of Science Literacy will require the students to research, plan, and conduct experiments while improving scientific literacy and thinking skills by using sample ACT science passages to analyze and interpret data, graphics, and experimental designs.



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Resources for Teachers


The resources below will be available for teachers in the following location:

MDE Science Homepage: <http://www.mdek12.org/ESE/science>

- Crosswalks for grade bands (almost ready to post)
- Materials from the summer 2017 workshops
- Resource Guides – will need YOUR help to compile great resources per grade!
- Parent Guides (being discussed)
- Webinars (being discussed for monthly after school sessions – organized by grade band groups)

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We are working to change the MDE webpage in the fall.



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Science Home Page

<http://www.mdek12.org/ESE/science>

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Content Areas

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- [World Languages](#)

Other Links:

- [Assessed Course Manual](#)
- [K-12 Edgenuity](#)
- [MS Virtual Public Schools](#)
- [RTI/MTSS](#)



Science

The Department of Science, as part of the Office of Elementary, Education and Reading, and the Office of Secondary Education, is responsible for providing support to teachers and schools throughout the state in the implementation of the 2010 Science Framework and the transition to the 2018 Mississippi College- and Career-Readiness Standards (MSCCRS) for Science. The staff in the Department of Science develops resources for teachers, delivers statewide and school-based professional development, and supports schools in the alignment of curriculum, instruction, and assessment.

For more information concerning the 2010 Science Framework, the new 2018 MSCCRS for Science or any other services provided by the Department of Science, please contact Dr. Jackie Sampson, K-12 Science Specialist, at jsampson@mdek12.org or (801) 359-3461.

Professional Development Services

District and school administrators may request on-site professional development by accessing our Regional Service Delivery Model using the link below:

http://www.northmiss.com/index.php?option=com_content&view=article&id=147:regional-service-delivery-model-information

Professional Development Staff

Tanjanka McKinney, Science Professional Development Coordinator, tanjanka.mckinney@mdek12.org

Math and Science Partnerships (MSP)

For more information about the MSP, please contact Bonita Harris, State MSP Director, bonitaharris@mdek12.org or (801) 359-3461.

[Math and Science Partnerships Program Overview](#)

2010 Mississippi Science Framework

2010 Mississippi Science Framework

Mississippi College- and Career-Readiness Standards for Science (2018)

MS CCRS for Science – Final Approved

Mississippi Science Assessment Programs (MSAP and SATP2 Biology) Resources

Grade 5 and 8 Assessments

Biology SATP

Resources

- [MS Science Educators Listserv](#)

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The MDE science homepage will be updated frequently with new resources for the new standards. To keep up-to-date on science, join the [MS Science Educators Listserv](#) (under Resources).

Information can be found for the K-12 Science Specialist, the Professional Development Coordinator, as well as the new standards, professional organization, Math and Science Partnerships, Instructional Resources including a link to Safety policies and documents.

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Mississippi Department of Education Blogs

Dr. Carey M. Wright
State Superintendent of Education

For information and updates from Dr. Carey Wright, State Superintendent, click here.

MDE Hot Topics

- Charter Schools
- Early Learning Collaborative Act
- Every Student Succeeds Act (ESSA)
- Graduation Options
- Literacy-Based Promotion
- Mississippi College and Career ready Standards
- Mississippi State Board of Education Strategic Plan
- Reading and State Standards Educator Resources
- State Board of Education Policy Manual

MDE News

MDE Announces Lottery for Special Needs Scholarship Program Applications
Jul 07, 2017

Majority of Early Learning Collaborative Students Exit Pre-K Ready for Kindergarten
Jul 06, 2017

MDE Sets Community Meeting on the Mississippi Succeeds Student Achievement Plan
Jun 28, 2017

MDE Quick Links

- Mississippi State Board of Education Members
- Professional Development Calendar
- Request Professional Development
- EdUpdate
- Family Guides to Student Success
- Mississippi School Superintendents
- Mississippi Board of Education Agenda
- Mississippi Exemplar Units and Lessons
- Mississippi Virtual Public School
- Mississippi E-Learning for Educators
- APA Notification Listserv Signup
- GoSignMeUp Registration
- State, District, and School Report Cards
- 2017 Legislative Agenda

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Note the location of the Professional Development Calendar, the “Request Professional Development”, and EdUpdate links. Your district can request professional development on science by the Professional Development Coordinator for science.

Scavenger Hunt

Explore New Science Standards





Scavenger Hunt Activity

Part One Directions:

- Working in groups at your table, use pages 10-16 of the new science standards (Introduction) to answer the questions in a Kahoot Quiz.
- Go to Kahoot.it. Enter the Game PIN.
- Answer each question, one at a time, as a group. You have 30 – 60 seconds per question.
- Be prepared to share and discuss findings after each question.

Compare Old to New!






Scavenger Hunt Activity

Part Two Directions:

- Working with your group, use the Grade 5 *2010 Science Framework* pages and the Grade 5 *2018 MS CCRS for Science* pages.
- Take 5-7 minutes to quickly compare the two documents and make a list of organizational differences on the back or bottom of the pages.
- Be prepared to share and discuss findings.



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Out with the Old

2010 MS Science Framework

2010 MS Science Framework Layout
(GRADE FIVE)

PHYSICAL SCIENCE

2. Understand relationships of the properties of objects and materials, position and motion of objects, and transfer of energy to explain the physical world.


- a. Determine how the properties of an object affect how it acts and interacts. (DOK 2)
- b. Differentiate between elements, compounds, and mixtures and between chemical and physical changes (e.g., gas evolves, color, and/or temperature changes). (DOK 2)
- c. Investigate the motion of an object in terms of its position, direction of motion, and speed. (DOK 2)
 - The relative positions and movements of objects using points of reference (distance vs. time of moving objects)
 - Force required to move an object using appropriate devices (e.g., spring scale)
 - Variables that affect speed (e.g., ramp height/length/surface, mass of object)
 - Effects of an unbalanced force on an object's motion in terms of speed and direction
- d. Categorize examples of potential energy as gravitational (e.g., boulder on a hill, child on a slide), elastic (e.g., compressed spring, slingshot, rubber band), or chemical (e.g., unit match, food). (DOK 2)
- e. Differentiate between the properties of light as reflection, refraction, and absorption. (DOK 1)
 - Image reflected by a plane mirror and a curved-surfaced mirror
 - Light passing through air or water
 - Optical tools such as prisms, lenses, mirrors, and eyeglasses
- f. Describe physical properties of matter (e.g., mass, density, boiling point, freezing point) including mixtures and solutions. (DOK 1)
 - Filtration, sifting, magnetism, evaporation, and flotation Mass,
 - density, boiling point, and freezing point of matter
 - Effects of temperature changes on the solubility of substances
- g. Categorize materials as conductors or insulators and discuss their real-life applications (e.g., building construction, clothing, animal covering). (DOK 2)

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- No grade level/course reference, except the first page of the competencies.
- Document was hard to use & lacked flow.
- Objectives appear as a list and are often not grouped in similar content.
- Bulleted topics under objectives were confusing for teachers.

2. B and f objective reference is matter. (They are not grouped together. If a school/district does not have a pacing guide, the teaching of objectives may not flow and make sense to the students.)



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In with the New

2018 MS CCRS for Science

MS CCRS for Science Layout

Disciplinary Core Idea

GRADE FIVE: Physical Science ← Grade Level Content Strand

P.5.5 Organization of Matter and Chemical Interactions

Conceptual Understanding: Matter can be segregated into tiny particles that are too small to see, but can be detected by other methods. These tiny particles are referred to as atoms, which can be combined to form molecules. Substances of the same type exhibit specific properties that can be observed and measured.

Standard

P.5.5A Students will demonstrate an understanding of the physical properties of matter.

P.5.5A.1 Obtain and evaluate scientific information to describe basic physical properties of atoms and molecules.

P.5.5A.2 Collect, analyze, and interpret data from measurements of the physical properties of solids, liquids, and gases (e.g., volume, shape, movement, and spacing of particles).

P.5.5A.3 Analyze matter through observations and measurements to classify materials (e.g., powders, metals, minerals, or liquids) based on their properties (e.g., color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, solubility, or density).

P.5.5A.4 Make and test predictions about how the density of an object affects whether the object sinks or floats when placed in a liquid.

P.5.5A.5 Design a vessel that can safely transport a dense substance (e.g., syrup, coins, marbles) through water at various distances and under variable conditions. Use an engineering design process to define the problem, design, construct, evaluate, and improve the vessel.*

Performance Objectives

P.5.5A.1

P = Physical

5 = Grade

5 = DCI for Grade K-8 (Physical Science: Organizations of Matter and Chemical Interactions)

A = first of three standards (A, B, C) under this DCI for Grade 5

1 = Performance Objective #1

Engineering Design

- Science content is better organized.
- Conceptual understanding is featured before each standard
- Performance objectives are written in complete sentences using **SEPs** as inquiry verbs.
- Performance objectives contain clear expectations of science concepts & skills required for mastery.
- Engineering Design objectives are marked with an asterisk (*) for K-8.

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The identification numbers for the grouping, the standards, and the performance objectives seem difficult to understand at first, but these are specific and more organized than any previous science framework. Conceptual Understandings are general information about each standard and performance objective. The SEP language is highlighted in red text in this view- teachers should encourage students to use any of the eight practices needed to explore and investigate each concept. Ex: P.5.5A.2, students may need to plan and conduct an experiment prior to analysis of measurements to determine physical properties of matter.

Bullet 5: Engineering design process is a series of steps that the student engineers will follow to come up with a solution to a problem.

More Features of the New!





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MS CCRS for Science – What is different?

3-5 Grade Band Overview Example

GRADES 3-5 OVERVIEW

Upper elementary is a pivotal time to enhance students' scientific literacy and active engagement in science and engineering practices. Students use their experiences from structured investigations in kindergarten through grade two to begin planning their own investigations to answer scientific questions. Because science foundations created at this level are key in developing students for college and career readiness, the cultivation of opportunities for inquiry-based activities and experiences that emphasize problem solving and the engineering design process is critical.

The standards for Grades 3-5 have been developed around the following crosscutting concepts or themes:

- Grade 3 – Interactions Within an Environment
- Grade 4 – Energy and Change
- Grade 5 – Interdependence of Systems

Themes for Grades 3-5

In grade three, students are expected to engage in the engineering design process and conduct research and communicate their understanding of each standard in a variety of ways. In grade four, students will observe, research, and conduct investigations to discover patterns related to energy and change in the world around them. In grade five, students will model, provide evidence to support arguments, and obtain and display data about relationships among a variety of systems. As a result of this yearlong study, students will gain content knowledge and tools to provide evidence and support arguments about the ways systems across content areas are interconnected and interdependent.

The seven crosscutting concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are strengthened in the appropriate context of the core science content through hands-on instruction in the classroom.

SEPs are in life science, physical science, and Earth and space science. The SEPs are designed so that students may develop skills and apply knowledge to solve real-life problems. While presented as distinct skill sets, the eight practices intentionally overlap and interconnect as students explore the science concepts. Some examples of specific skills students should develop in grades 3-5 are listed below.

1. Ask questions to predict how natural or man-made changes in a habitat cause plants and animals to respond in different ways, including hibernating, migrating, responding to light, death, or extinction (e.g., sea turtles, the dodo bird, or nocturnal species).
2. Develop and use models to explain the unique and diverse life cycles of organisms other than

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Example of 3-5 Grade Band Overview

We have grade band overviews for K-2, 3-5, 6-8, and 9-12.

The grade band overviews contains specific, grade-appropriate explanations for content, crosscutting concepts, science and engineering practices, and engineering design.

Note that each grade content for K-8 is developed around a theme.

Grade Five's Theme is "Interdependence of Systems"



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MS CCRS for Science – What is different?

9-12 Grade Band Overview Example

GRADES 9-12 OVERVIEW

The high school curriculum provides essential preparation for all students in Grades 9-12. This experience should promote the development of adequate scientific knowledge to allow students to make informed, critical choices and to succeed in both the workplace and in postsecondary courses.

Content standards are integrated with scientific and engineering practices (SEPs), cross-cutting concepts, and the use of technology to connect information gathered through scientific investigations with real-world applications and engineering solutions to human problems. The nature of science and historical perspectives are critical to understanding the foundation and processes of science, regardless of the scientific discipline.

The eight SEPs should not be considered a stand-alone set of practices, as previously presented, but rather incorporated throughout the set of content objectives. The SEPs are designed so that students may develop skills and apply knowledge to solve real-life problems. While presented as distinct skill sets, the eight practices intentionally overlap and interconnect as students explore the science concepts.

The core science content utilizes hands-on classroom instruction to reinforce the seven crosscutting concepts (i.e., patterns; cause and effect; scale, portion, and quantity; systems and system models; energy and matter; structure and function; and stability and change).


The National Academies' (2012) research-based findings state that "the actual doing of science or engineering can pique students' curiosity, capture their interest and motivate their continued study..." (p. 42). Science curricula should actively engage students in learning through scientific investigations. At least 30% of the course should be dedicated to laboratory experiences, including, but not limited to:

- field studies and field trips
- manipulatives and model
- guided experimentation

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Here is an example of 9-12 Grade Band Overview.

There are no themes here because each course is built around the content. The Disciplinary Core Ideas, (DEIs) are different from K-8 and based around course content. SEPs and crosscutting concepts should be used in 9-12 courses.



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MS CCRS for Science – What is different?

9-12 Statement about SEPs for Inquiry and Laboratory Extensions

Overarching (start to finish) SEPs for Inquiry Extension of Labs

Ask questions to generate hypotheses for scientific investigations based on empirical evidence and observations and/or ask questions to **clarify or refine** models, explanations, or **designs**.

Plan and conduct controlled scientific investigations to produce data to answer questions, test hypotheses and predictions, and develop explanations or **evaluate design solutions**, which require the following:

- Identify dependent and independent variables and appropriate controls.
- Select and use appropriate tools or instruments to collect data, and represent data in an appropriate form.
- Analyze and interpret various types of data sets, using appropriate mathematics, in order to verify or refute the hypothesis or **determine an optimal design solution**.
- Construct an explanation of observed relationships between variables.
- Communicate scientific and/or **technical information** in various formats.

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Each course in high school has this box at the end of the standards – Overarching SEPs for Inquiry Extension of Labs

This explains how the student should use the SEPs in designing and conducting an experiment.

Teachers are encouraged to utilize SEPs in all high school courses with experiments and other types of classroom activities.

The Three Dimensions – Very Important Info!



Major Dimensions of the *MS CCRS for Science*

Science and Engineering Practices
(These represent a more complete, holistic and accurate view of scientific activity.)

- Ask questions and define problems
- Develop and use models
- Plan and conduct investigations
- Analyze, interpret, graph, and present data
- Using mathematical and computational thinking
- Construct explanations and design solutions
- Engage in scientific argument from evidence
- Obtain, evaluate, and communicate information

Disciplinary Core Ideas
(This is the organization of the three content strands for Grades K-8.)

Life Sciences

1. Hierarchical Organization
2. Reproduction and Heredity
3. Ecology and Interdependence
4. Adaptations and Diversity

Physical Sciences

5. Organization of Matter and Chemical Interactions
6. Motions, Forces, and Energy

Earth and Space Science

7. Earth's Structure and History
8. Earth and the Universe
9. Earth Systems and Cycles
10. Earth's Resources

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Crosscutting Concepts
(These are the unifying concepts across all science content strands.)

- Patterns
- Cause and effect: Mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: Flows, cycles, and conservation
- Structure and function
- Stability and change

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This slide is a review of the 3 Major Dimensions of the new standards.

Middle Green Section: Disciplinary core ideas This is the basic content for K-8 that is subdivided into the 3 content strands. Under each Disciplinary Core Idea, the document contains specific content standards with corresponding performance objectives. Grouping content in this way allows for vertical alignment of competencies and objectives to better organize content distribution. All content strands (life, physical and earth/space) will be found in each grade level, but all disciplinary core ideas will not be found in every grade level in K-8 due to the spiral arrangement of content.

Content strands are not included in the Grades 9-12 course organization, which allows for a more logical, sequential placement and flow of content.

Left Pink Section: Science and Engineering Practices (SEPs) The SEPs replaces the Inquiry Strand included in the *2010 Mississippi Science Framework*. The 8 practices describe the behaviors that scientists and engineers engage in as they investigate and explore the natural world. These practices work together (overlap and interconnect) and are not separated in the study and investigation of science concepts. Many will be used by students as they work through each performance objective for each grade and course in K-12.

Right Blue Section: Crosscutting Concepts These are seven concepts that were adopted directly from the National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012). Crosscutting concepts are designed to help students see the unity of the sciences. For example, in Grade 5 the theme is "Interdependence of Systems" – Crosscutting concept #4 is Systems and System Models – you can see that life science focuses on ecosystems, physical science focuses on matter and its changes, and focuses on the universe systems and how the earth is impacted. The teacher will learn to look at these concepts and show/explain the connections to the students within each discipline and between each discipline.



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Example of SEP from a Performance Objective

Grade 5: Physical Science
DCI: P.5.5 Organization of Matter and Chemical Interactions

P.5.5A.4 Make and test predictions about how the density of an object affects whether the object sinks or floats when placed in a liquid.

Science and Engineering Practices
(These represent a more complete, holistic and accurate view of scientific activity.)

- Ask questions and define problems
- Develop and use models
- Plan and conduct investigations
- Analyze, interpret, graph, and present data
- Using mathematical and computational thinking
- Construct explanations and design solutions
- Engage in scientific argument from evidence
- Obtain, evaluate, and communicate information


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The performance objective above states for the students to *Make and test predictions* – Which SEP would this relate to? Yes, they will probably have to form a plan to conduct an investigation to test the predictions.

To completely study how density impacts the sinking or floating, the students may also have to use other SEPs.

For example: In the course of the investigation, the students may have to *collect, analyze and interpret data* which is another SEP; after collecting data, they may have to *using mathematical and computational thinking* to compare the density of the objects that floats or sinks. They may take the results and construct a chart, visual or a graph which would be *develop and use models*, and at the end they may *evaluate and communicate information*. This gives an illustration that even though the performance objective contain only one SEP, teachers should encourage students to use all SEPs as needed to learn and experience science through each performance objective.



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MS CCRS for Science – Crosscutting Concepts

Density of Objects – Sink or Float

- Addresses the “fragmented” approach to science lessons especially in K-8 (i.e., unit on ecosystems, then motion, then weather – What are the connections?)
- Helps the students see connections between ideas within a discipline and between different disciplines
- For the previous objective of whether objects would sink or float, students should see **Patterns** (below), and also **Cause and Effect** crosscutting concepts (there may be others).

K-2	3-5	6-8	9-12
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.			
<ul style="list-style-type: none"> • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. 	<ul style="list-style-type: none"> • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation. 	<ul style="list-style-type: none"> • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. • Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. 	<ul style="list-style-type: none"> • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. • Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced, thus requiring improved investigations and experiments. • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. • Mathematical representations are needed to identify some patterns. • Empirical evidence is needed to identify patterns.

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Crosscutting Concepts for previous slide. Think back to the previous standard and objective. To expand on crosscutting concepts, students often see science as individual units with no connections. They lose the nature of science and view as a collection of facts that can be memorized. The crosscutting concepts help the students see connections between concepts and how to study the concepts within a discipline and between different disciplines. Students will begin to see the whole picture when learning science.

This example shows **Patterns**. Patterns can be found in all three sciences. They are often related and have similar trends. In this example, the students

Types of Patterns • **Classification** • Distributions • Relationships among variables • Changes and rates of change;

Students can classify organisms (life science); matter/density of objects – sink or float (physical sciences), types of rocks or seasonal weather (earth science).



Challenge: Rework your lessons using SEPs

To begin piloting the new standards – we have to do several things.

- (1) Take inventory of what lessons you currently have. Investigate how to rewrite or tweak to fit the new standards and objectives.
- (2) Embed science and engineering practices (SEPs) into your lessons as a means of building an understanding of key concepts.
- (3) Build inquiry skills into lessons – especially safety rules! Safety is first – Always!
- (4) Don't forget experimental design processes! (hypothesis, controls, independent and dependent variables). Allow students to design and conduct investigations.



Challenge: Rework your lessons using CCCs

As you look critically at your current lessons, don't forget the crosscutting concepts!

- Support students in making connections to the Cross Cutting Concepts.
- Put descriptions of Crosscutting Concepts on bulletin boards in grade friendly language.
- Encourage students to reflect at the end of class in notebooks.
- Exit Slip – “My connection today”
Ask students to provide evidence of a Crosscutting Concept that they used in the day's lesson (does not have to be every day but you get the idea...)

Science and Engineering Practices Quiz






Science and Engineering Practices An Activity

Directions:

- Each person has a handout with the eight (8) science and engineering practices (SEPs).
- You will be shown a picture and given a brief description (if needed).
- Select one practice that immediately comes to mind.
- Remember: More than one SEP may go with a picture.







Sample	Initial Mass (g)	Final Mass (g)	% Change
1.0	1.00	1.00	0%
1.1	1.00	1.00	0%
1.2	1.00	1.00	0%
1.3	1.00	1.00	0%
1.4	1.00	1.00	0%
1.5	1.00	1.00	0%
1.6	1.00	1.00	0%
1.7	1.00	1.00	0%
1.8	1.00	1.00	0%
1.9	1.00	1.00	0%
1.10	1.00	1.00	0%
1.11	1.00	1.00	0%
1.12	1.00	1.00	0%
1.13	1.00	1.00	0%
1.14	1.00	1.00	0%
1.15	1.00	1.00	0%
1.16	1.00	1.00	0%
1.17	1.00	1.00	0%
1.18	1.00	1.00	0%
1.19	1.00	1.00	0%
1.20	1.00	1.00	0%

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Left: **Developing and Using Models** – they also could be:

Asking Questions

Obtaining, Evaluating and Communicating Information

Right: **Analyzing and Interpreting Data,**

Using Mathematics and Computational Thinking,


Obtaining, Evaluating, and Communicating Information




Left: **Obtaining, Evaluating, and Communicating Information** (presentation to explain experiment) is the best here but other SEPs apply – what about Engaging in Scientific Argument? He could be expressing his point of view from his experiment.

Right: **Engaging in Scientific Argument** – this only means expressing your point of view – not a true argument.

These students could also be using others, such as, **Constructing Explanations and Designing Solutions** or **Planning an Experiment** to conduct.

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Obtaining, Evaluating and Communicating Information

Developing and Using Models – if drawing a sketch of a slide

Asking Questions and Defining Problems

Others could be used here -



Write a statement summarizing the relationship between temperature and germination of pumpkin seeds. Predict the rate of germination of pumpkin seeds at 50 degrees Celsius.

Effect of Soil Temperature on the Germination Rate of Pumpkin Seeds


Soil Temperature (°C)	Germination Rate (%)			Average Germination Rate (%)
	X	X	X	
20	60	64	70	65
24	75	78	82	78
28	86	84	83	84
32	69	65	63	66

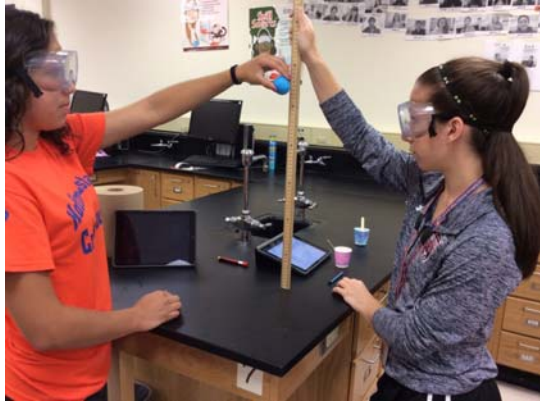
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**Using Mathematics and Computational Thinking,
Analyzing and Interpreting Data,
Obtaining, Evaluating, and Communicating Information**

Others could be used here -

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Planning and Conducting an Investigation – maybe not showing the plan but they had to plan before doing

Obtaining, Evaluating and Communicating Information


Asking questions

Others could be used here -

Engineering Design Process

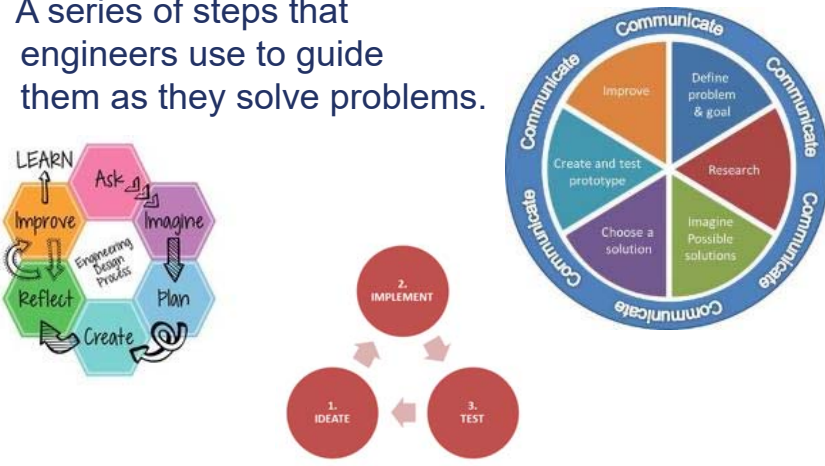
The asterisk performance objectives*



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Engineering Design Process


- A series of steps that engineers use to guide them as they solve problems.



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Our last NEW component is the Engineering Design Process. Engineering design standards are represented in some performance objectives with grade-banded, specific wording that prompts educators to approach learning and exploration using the engineering process. These performance objectives are marked with an *. For high school courses, these objectives are also marked as “Enrichment.”

Engineering design process (EDP) is the method of devising a system, component, or process to meet desired needs. It is important to note that the EDP is flexible and can be approached in a variety of ways. This slide shows a variety of methods that can be used by students for an Engineering Design process.

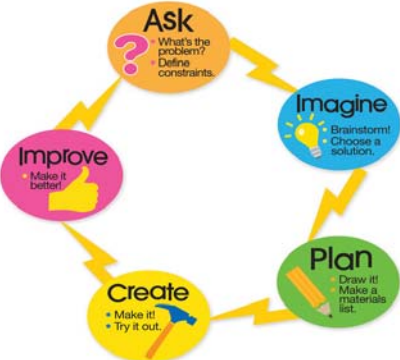


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Engineering Design Process

Engineering Design Process


- A series of steps that engineers use to guide them as they solve problems.




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Writing Process

- A series of steps that authors use to guide them as they create pieces of writing.




The engineering design process is a series of steps with a similar process to writing an essay. Writing involves a great deal of planning, prewriting, reviewing/revision, and editing before the final product is finished. The engineering design process is very similar. Students can stop and rework each step and can back up and rework.



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Example of Engineering Design

Example:
E.K.8B.3 *Develop a device (i.e., umbrella, shade structure, or hat) which would reduce heat from the sun (temperature) using an engineering design process to define the problem, design, construct, evaluate, and improve the device.**



Planning

→



Building Model

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E.K.8B.3: *“Develop a device (i.e., umbrella, shade structure, or hat) which would reduce heat from the sun (temperature) using an engineering design process to define the problem, design, construct, evaluate, and improve the device.*”*

For this lesson, students will be asking questions, designing and using models, planning and carryout an investigation, analyzing and interpreting data, and constructing explanations. This lesson could start by asking students what it means to be shaded when it is hot outside. What types of objects provide shade? (trees, hats with brims, buildings, canopies, buildings).

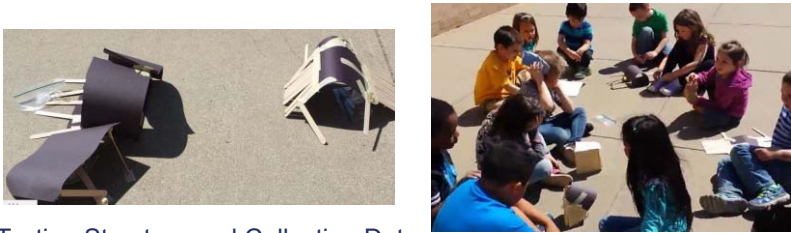
Next the teacher at this level may have to provide an actual design task instead of leaving it open for the student to interpret.

In this example the teacher gave students a focus task: To protect ice cubes placed in the sun from melting


The pictures show the planning stage and the construction stage.

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Example of Engineering Design



Testing Structure and Collecting Data



Communicating Results

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The pictures show the testing of the various structures, students collecting data, and lastly communicating results.

After the results are shared with all of the students the teacher will lead the students to compare all results and identify the characteristics of the more effective structures.


Teacher questions could include:

What things helped the structures protect the ice cube?

What things were probably missing from the structures that did not protect the ice cube as well?

Did the color of the paper make a difference? Why do you think that is?

Students could then plan improvements for the structure for future testing.



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Example of Engineering Design

Video clip:

https://betterlesson.com/lesson/resource/3292580/a-place-in-the-shade-3-mp4?from=resource_title

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This video clip shows the Obtaining, Evaluating, and Communication Information SEP in this engineering design activity.

Physical Science Activities

K-2, 3-5, 6-8, Biology





Physical Science Activity

Our focus today will be physical sciences.

- You will play the role of the students and will conduct simple investigations that matches at least one objective in the grade-band.
- (Sorry we don't have an activity for every grade/course! You can get ideas (we hope) by working with your group. Think about how you can adapt the teaching strategies for your own lessons/topics.)

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Reasons for the choice of physical science topics:

Physical science was an area that many teachers have said they need additional help.

Materials were easy to transport and use in this one room K-12 mobile workshop.



Physical Science Activity

For the K-2 Group:

P.K.5A Students will demonstrate an understanding of the solid and liquid states of matter.

***P.K.5A.2** Describe and compare the properties of different materials (e.g., wood, plastic, metal, cloth, paper) and classify these materials by their observable characteristics (visual, aural, or natural textural) and by their physical properties (weight, volume, solid or liquid, and sink or float).*

Standard and Objectives for K.



Physical Science Activity K-2 Group

For the K-2 Group:

P.2.5 Students will demonstrate an understanding of the properties of matter.

***P.2.5.1** Conduct a structured investigation to collect, represent, and analyze categorical data to classify matter as solid, liquid, or gas. Report findings and describe a variety of materials according to observable physical properties (e.g., size, color, texture, opacity, solubility).*

***P.2.5.2** Compare and measure the length of solid objects using technology and mathematical representations. Analyze and communicate findings.*

***P.2.5.3** Compare the weight of solid objects and the volume of liquid objects. Analyze and communicate findings.*

Additional Standard and Objectives for Grade 2.



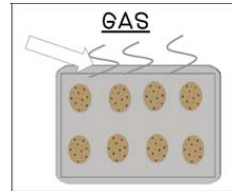
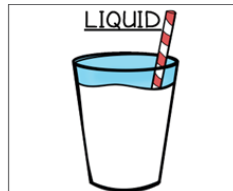
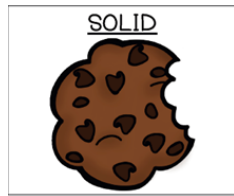
Physical Science Activity K – 2 Group

K-2 could start the lesson with something like:

Look around the room and write down 5 items that take up space and have mass.

What is matter?

What are our three states of matter?



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Discussion of how to introduce lessons



Physical Science Activity 3-5 Group

For the 3-5 Group:

P.3.5 Students will demonstrate an understanding of the physical properties of matter to explain why matter can change states between a solid, liquid, or gas dependent upon the addition or removal of heat.

P.3.5.2 Develop and use models to communicate the concept that matter is made of particles too small to be seen that move freely around in space (e.g., inflation and shape of a balloon, wind blowing leaves, or dust suspended in the air).

Standard and Objectives for Grade 3.



Physical Science Activity 3-5 Group

P.5.5A Students will demonstrate an understanding of the physical properties of matter.

P.5.5A.2 Collect, analyze, and interpret data from measurements of the physical properties of solids, liquids, and gases (e.g., volume, shape, movement, and spacing of particles).

P.5.5C Students will demonstrate an understanding of the difference between physical and chemical changes.

- *P.5.5C.1 Analyze and communicate the results of chemical changes that result in the formation of new materials (e.g., decaying, burning, rusting, or cooking).*
- *P.5.5C.2 Analyze and communicate the results of physical changes to a substance that results in a reversible change (e.g., changes in states of matter with the addition or removal of energy, changes in size or shape, or combining/separating mixtures or solutions).*

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Standard and Objectives for Grade 5



Physical Science Activity 3-5 Group; 6-8 Group


After students learn physical properties of matter, they began to explore chemical properties of matter.

The following video was made by a student.
Maybe engage students with something like...

Video link:

<https://www.youtube.com/watch?v=WGYJWhj7ePU>

Video to introduce topic of chemical and physical changes















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Physical Science Activity

3-5 Group; 6-8 Group

Is it Physical or Chemical?

 breaking a window	 baking a cake	 slicing bread	 crushing a soda can
 frying an egg	 melting ice	 using batteries	 exploding fireworks
 burning fire	 crashing cars	 rusting chains	 chopping wood

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Break a window – physical

Baking a cake – chemical

Slicing bread – physical

Crushing a soda can – physical

Frying an egg – chemical

Ice melting – physical

Using batteries – chemical

Fireworks – chemical

Fire – chemical

Car crash – physical

Rusting Chains - chemical

Chop wood - physical

What is Making popcorn – physical (water inside corn kernel expands the starch inside)



Physical Science Activity 6-8 Group

For the 6-8 Group:

P.7.5A Students will demonstrate an understanding of the physical and chemical properties of matter.

P.7.5A.3 Compare and contrast chemical and physical properties (e.g., combustion, oxidation, pH, solubility, reaction with water).

Standard and Objectives for Grade 7



Physical Science Activity 6-8 Group

For the 6-8 Group:

P.7.5D Students will demonstrate an understanding of chemical formulas and common chemical substances to predict the types of reactions and possible outcomes of the reactions.

- **P.7.5D.1** Analyze evidence from scientific investigations to predict likely outcomes of chemical reactions.
- **P.7.5D.2** Design and conduct scientific investigations to support evidence that chemical reactions (e.g., cooking, combustion, rusting, decomposition, photosynthesis, and cellular respiration) have occurred.
- **P.7.5D.3** Collect, organize, and interpret data using various tools (e.g., litmus paper, pH paper, cabbage juice) regarding neutralization of acids and bases using common substances.

Standard and Objectives for Grade 7



Physical Science Activity 3-5 Group; 6-8 Group

Student will begin to study chemical reactions by Grade 7.

Maybe introduce these lessons with something like this...

Video link:

<https://www.youtube.com/watch?v=aKPoQYevoLs>

The five indicators that a chemical change has occurred: gas production (bubbles), color change, temperature change, precipitate formation, or light production.



Physical Science Activity Biology

For the Biology Group:

BIO.1B Students will analyze the structure and function of the macromolecules that make up cells.

- **BIO.1B.1** *Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms.*
- **BIO.1B.2** *Design and conduct an experiment to determine how enzymes react given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms.*

Standard and Objectives for Biology – these tie into chemical reactions and changes within the living organisms



Physical Science Activity Biology

Biomolecules from Amoeba Sisters

<https://www.youtube.com/watch?v=YO244P1e9QM>

A short video made by a student about enzyme activity.


Video link:

<https://www.youtube.com/watch?v=9mr1g7xhLLc>

Suggestions for engaging students prior to lesson

Physical Science Activities





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Physical Science Activity

K-2 Group – Physical Properties

Bag of Matter, Cup of Water, Bag of Tools to Investigate the matter on the table by using the bag of tools; Record observations on your sheet.

- How could you change this activity to better teach your grade lessons?

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The K-2 group was given a bag of matter and a bag of tools. A cup of water was placed on the table in a clear cup.

The bag of matter contains buttons, dry noodles, marbles, wood craft stick, metal washers (screws), hair pins, rubber bands, small portion of sandpaper, soft fabric (fake fur), wooden block, cotton ball, small ball of playdough (in plastic clear bag as not to dry out), small bottle of bubbles (like at wedding section at dollar store); balloons. [Many other objects can be used if these are not available.] The tool bag contained graduated cylinder, ruler, and small clear containers.

The teachers were asked to explore the bag of matter and the water using the tool bag and to discuss how they could teach the objectives for their grade using these materials. All teachers, including the grade one teachers, were asked to explore other objectives to discuss strategies for using these techniques to teach students science concepts.


[Hint: the small clear containers were added to the tool bag so teachers could explore the concept that water takes the shape of the container. An appropriate ruler and graduated cylinder for K-2 is needed.]

References:

<https://www.lernerbooks.com/SiteCollectionDocuments/TeachingGuides/9780822553489.pdf>

http://rpsec.usca.edu/Workshops/SISSI/LessonPlans/PropertiesSolids_LessonPlan.pdf

<http://www.mccracken.kyschools.us/Downloads/2%20NGSS%20UNIT%20Matter.pdf>



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Physical Science Activity

3-5 Group – 3 activities:

- (1) Matter and Tool bags – Investigate physical properties; 3 states of matter; find volume of a solid and irregular solid
- (2) Investigate physical properties of unknown substances
- (3) Investigate chemical properties - gas production
[Unknowns: 1 = cane sugar; 2 = baking powder; 3 = sand; 4 = sea salt]

- How could you change this activity to better teach your grade lessons?

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Activity 1: The 3-5 group was given a bag of matter and a bag of tools. A cup of water was placed on the table in a clear cup.

The bag of matter contains a wooden block, cotton ball, rock, balloon, small bottle of bubbles (like at wedding section at dollar store); The tool bag contained graduated cylinder, ruler, small clear containers. The teachers were asked to explore the bag of matter and the water using the tool bag and to discuss how they could teach the objectives for their grade using these materials. All teachers, including the grade four teachers, were asked to explore other objectives to discuss strategies for using these techniques to teach students science concepts.

Activity 2: The 2nd bag contained four containers marked 1, 2, 3, 4, four tiny 1 oz. containers, toothpicks, and a 2nd bag with a white tablet and a small cup. **Part 1:** Teachers were asked to observe the solids inside the container using a magnifying glass or the photo app on their cell phone to see the structure of the solids. Teachers were asked to place a small amount of each substance inside the tiny cups, add water, and stir with toothpicks. Record observations. **Part 2:** Teachers were asked to take a ziplock[®] bag and place a small amount of water using your paper cup in the bag. Add the solid tablet and quickly remove air and seal the bag. Observe what happens and write a description. How is this different from Part 1? [Hint: part one shows dissolving -physical change- for 1, 2, and 4; part two is a chemical change]

References:


<https://www.lernerbooks.com/SiteCollectionDocuments/TeachingGuides/9780822553489.pdf>

http://rpsec.usca.edu/Workshops/SISSI/LessonPlans/PropertiesSolids_LessonPlan.pdf

www.inquiryinaction.org/pdf/InquiryinAction.pdf

http://www.chem4kids.com/files/matter_changes.html

<https://www.alkaseltzer.com/science-experiments/>

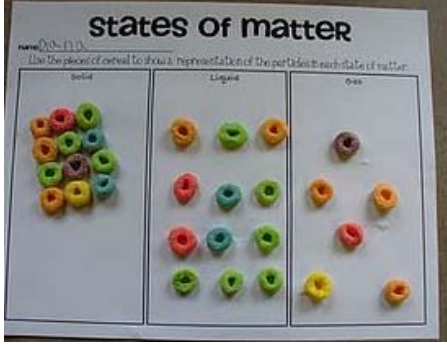


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Physical Science Activity

K-5

What SEP would this represent?



Name: Chedman
Make a representation of the atoms in each state of matter.

Solid	Liquid	Gas
		

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A final activity would be to have the students make a model of the arrangement of particles in a solid, liquid, gas. Materials would be a glue stick and fruit loop cereal.



Physical Science Activity K-5

Gases take up space and have mass!



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Even if you don't have a balance for this experiment, you can allow students to explore air and mass (weight).

Simply blow up a small balloon and tie to the end of a clothes hanger. Tie an identical balloon to the other end. Hold up the hanger and the end holding the inflated balloon will hang lower.



Physical Science Activity K-5

Can you find three phases of matter?




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Ice – solid

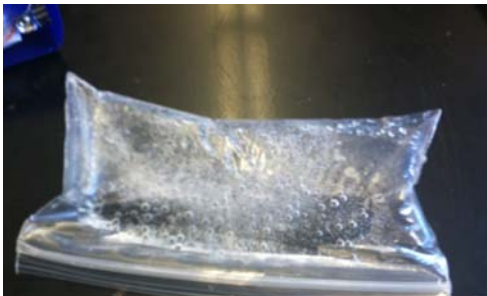
Soft drink – liquid

Bubbles – filled with gas

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Physical Science Activity 3-5

Is this physical or chemical?



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Chemical – unlike the dissolving for the unknown solutions in cups 1, 2, 3, 4 (except 3), this is a chemical change – note the gas release in the bag where you placed the small amount of water and the antacid tablet.



Physical Science Activity Grades 6-8

6-8, HS Physical Science Group: 2 Activities

(1) Chemical and physical changes - Physical – dissolving only; Chemical – color change, bubbles

(2) Neutralization– Red cabbage indicator was the control – add cream of tartar to one plate and detergent to another

- How are acid, base, and pH concepts used in this activity?
- How could you change this activity to better teach your grade lessons?

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Activity 1: Take a cardstock grid showing solids across the top (baking powder, baking soda, detergent, cream of tartar, cornstarch) and along the side are the solutions (water, vinegar, iodine, indicator – red cabbage juice). Teachers will place a small amount of each powder on the grid and use pipets to put the solutions into the powders and stir with toothpick. Record results. Determine if physical or chemical change has occurred. An unknown will be placed on the last column of the grid and the teachers will use the solutions to determine the identity of the unknown powder.

Activity 2: Teachers have three shallow cups and will place two-three pipets of red cabbage juice. To one cup, add a tiny amount of detergent and stir with toothpick. Repeat until the solution changes color. To a 2nd cup, add a tiny amount of cream of tartar and stir with toothpick. Repeat until the solution changes color. Challenge: Make the detergent solution and the cream of tartar solution go back to the original color. Use the third small plate of only red cabbage juice as the control.

References:

<http://www.inquiryinaction.org/classroomactivities/activity.php?id=22>

http://funsci.com/fun3_en/acids/acids.htm#1



Physical Science Activity Group Reports

6-8 and High School Chemistry, Physics Group

Indicators: Making a Universal Indicator

Procedure: Follow the instructions carefully. **MS-ESS-1-1**

Step 1: Put 10 drops of each indicator in the test tubes and label them. Record the indicator color. **MS-ESS-1-1**

Step 2: Add 10 drops of the indicator to the test tubes and label them. Record the indicator color. **MS-ESS-1-1**

Step 3: Add 10 drops of the indicator to the test tubes and label them. Record the indicator color. **MS-ESS-1-1**

Step 4: Add 10 drops of the indicator to the test tubes and label them. Record the indicator color. **MS-ESS-1-1**

Step 5: Add 10 drops of the indicator to the test tubes and label them. Record the indicator color. **MS-ESS-1-1**

Indicator	pH 1 (Strong Acid)		pH 7 (Neutral)		pH 13 (Strong Base)	
	Color	Color	Color	Color	Color	Color
Phenolphthalein (Phen)	Colorless	Colorless	Colorless	Colorless	Colorless	Colorless
Methyl Orange (MO)	Red	Orange	Yellow	Yellow	Yellow	Yellow
Bromothymol Blue (BTB)	Red	Yellow	Green	Green	Blue	Blue
Universal Indicator (UI)	Red	Orange	Yellow	Green	Blue	Purple
Thymol Blue (Thy)	Red	Yellow	Green	Green	Blue	Blue
Aluminum Indicator (Al)	Red	Orange	Yellow	Green	Blue	Blue
Phenolphthalein (Phen)	Colorless	Colorless	Colorless	Colorless	Colorless	Colorless



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What skills will students need? Tools would be for use of pipets; Students will also need to know characteristics of chemical changes.

How to conduct experiment?

What about safety?

Discuss each of these points by collecting responses and discussing with follow up questions as needed.



Physical Science Activity Biology

Biology – 2 Activities:

(1) Organic molecules – Construct simple models and answer questions about 4 types (proteins, carbohydrates, nucleic acids, lipids)

(2) Enzyme activity - Pineapple (raw, canned) with Jello; Liver (cooked, raw) with hydrogen peroxide (H_2O_2) plus water – Purpose of raw + water? Purpose of repeating cups 1 and 4?

What is the enzyme and substrate in each?

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Activity 1: The teachers were given a large plastic bag containing 4 cardstock sheets with proteins, carbohydrates, lipids, nucleic acids printed. A smaller plastic bag contained cutouts of various organic molecule “pieces” (ribose sugar, amino acid, glucose, nitrogen base, fatty acid, phosphate group, glycerol). Teachers were asked to assemble a model of each organic molecule.

Activity 2: The teachers were given three 2 oz. cups of gelatin (red). They were given a tiny cup containing a canned pineapple piece and another cup containing a raw pineapple piece. Teachers placed the pineapple on the gelatin. The third cup was a control. For the second part, teachers placed three pipets of hydrogen peroxide into three small cups. A fourth cup had the same amount of water added. The temperature was taken for each cup and recorded. A tiny piece of raw liver was added to three cups (2 with hydrogen peroxide and one with water) and the temperature was taken. Observations were recorded. The cooked liver was placed in the final cup of hydrogen peroxide and the temperature taken. Observations were recorded.

Pineapple reference:

http://mdk12.msde.maryland.gov/instruction/curriculum/hsa/biology/enzyme_activity/teachers_guide_engagement2.html

<http://practicalbio.blogspot.com/2012/01/in-two-beakers-of-gelatin-above-fresh.html>

Enzyme reference:

https://www.biologycorner.com/worksheets/enzyme_lab.html

[www.biologyjunction.com/Catalase Enzyme Lab revised.doc](http://www.biologyjunction.com/Catalase%20Enzyme%20Lab%20revised.doc)

<http://spooksinmay.weebly.com/chicken-liver-enzyme-lab.html>



Physical Science Activity Group Reports

High School Biology Group



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What skills will students need? Tools would be for use of pipets; Students will also need to know characteristics of chemical changes.

How to conduct experiment?

What about safety?

Discuss each of these points by collecting responses and discussing with follow up questions as needed. Diagrams show results of liver reactions and pineapple reactions.




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Physical Science Activity

K-12

Reflection for ALL Groups:

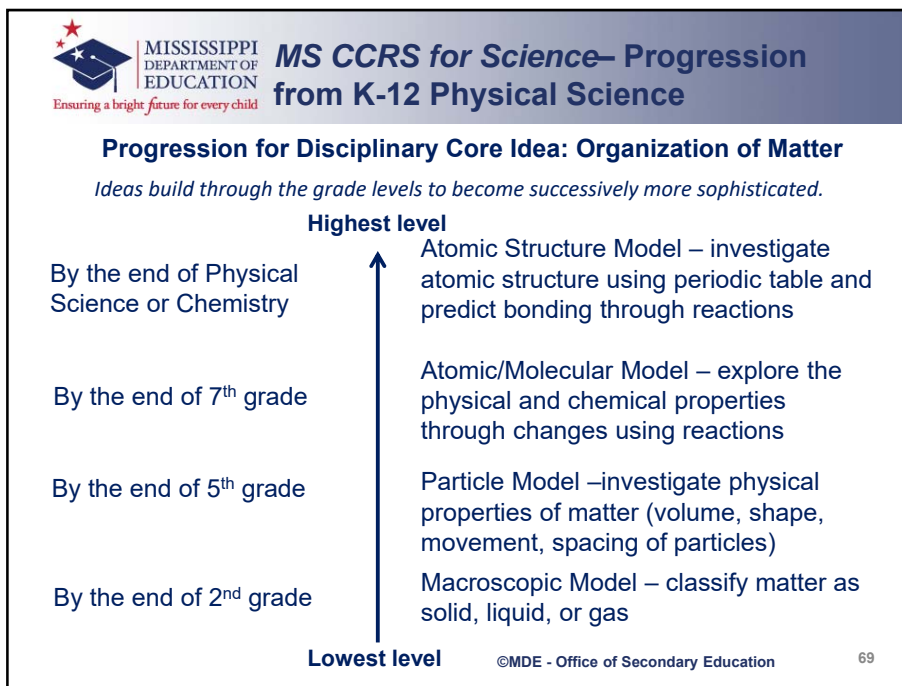
- Did the activity match the objective?
- What **SEP(s)** did you use while performing the activities? 
- What would students need to know prior to the activity (tools, content, safety)?
- Brainstorm! What other ideas did you come up with?

Science and Engineering Practices
(These represent a more complete, holistic and accurate view of scientific activity.)

- Ask questions and define problems
- Develop and use models
- Plan and conduct investigations
- Analyze, interpret, graph, and present data
- Using mathematical and computational thinking
- Construct explanations and design solutions
- Engage in scientific argument from evidence
- Obtain, evaluate, and communicate information

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Each group will use these reflection questions to evaluate the activity.
Group discussions will be conducted.



The new science standards are built around a spiral progression. We do not repeat the same exact content in every grade from K-8 but the content is enhanced in the appropriate grade band. This example shows the spiraled progression for a physical science disciplinary core idea: Organization of Matter.

2nd grade students will be able to classify matter;


5th grade students will investigate unique properties of matter;

7th grade students will explore the physical and chemical properties through changes using reactions

Physical Science or Chemistry students will investigate the atomic structure using the periodic table and predict bonding through reactions

Biology teachers – what did the student have to know prior to your organic molecule lessons and enzyme activity? Answer: covalent bonding, pH, chemical reactions from grade 7;

You can see that this concept is not taught in every grade level but is taught at least once in each grade band. Did you see this TODAY in your experiments?



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MS CCRS for Science– What is different?

Progression for Life Science – Grades 6, 7, 8

Topics in Grade 6 Life Science
Cell Structure and Function
Interactions of Organisms with Environment
Classification tools/Characteristics of major kingdoms

Topics in Grade 7 Life Science
Cycling of matter through living systems
Photosynthesis and aerobic and anaerobic respiration

Topics in Grade 8 Life Science
Mitosis and Meiosis
Genetics and principles of heredity
DNA and Chromosomes

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As mention in the previous slide, the new standards are arranged differently from the 2010 Science Framework. The 2010 document taught very similar concepts in Life, Earth and Physical sciences at each grade level in a straight progression. The 2018 MS CCRS for Science are spiraled in content design. Each grade does not teach a repeat of the same content with a “little extra added in.”

Look at this slide for life science progression in grades 6-8

As you can see all of these topics are unique per grade – no content is repeated. The content in each grade provides necessary introductory material for the successful completion of biology at the high school level. If only Grade 8 life science standards were taught in grades 6, 7, and 8, would the students be fully prepared for Biology?

Ideas for Lesson Planning K-12





Ideas for Lesson Planning

Content:

Which is more effective – provide information (notes) prior to activity or after?

Does it make a difference?

Student take and make notes during activity – report out and clarify misunderstandings

Think about what you are doing today? What if you were copying notes and completing a worksheet?



Ideas for Lesson Planning

What is a 5E Lesson Plan?

- Supports inquiry/SEP-based instruction
- Allows students to make discoveries and to process new skills in an engaging way
- Students are learning and more knowledgeable about their own metacognition because they are coached along and not just listening to teachers lecturing.
- Teacher's role is to facilitate and support students as they build new knowledge.

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A video series for K-5 teachers using 5E from Primary Connections:


<https://www.youtube.com/watch?v=OSo5R3sDXAc>

<https://www.youtube.com/watch?v=j-wkE7V-Vxw>

<https://www.youtube.com/watch?v=aFM4GsyR-EE>

<https://www.youtube.com/watch?v=foNqMIFU5Ts>

<https://www.youtube.com/watch?v=qsLi1hs65OY>



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Ideas for Lesson Planning


Let's watch a clip explaining using 5E lesson planning techniques.

<https://www.youtube.com/watch?v=IQzQumJmJv8>

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This video is designed for teachers of 6-12 students.



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How to plan innovative lessons

Let's watch a clip with younger students showing the teacher checking for understanding, a 5E concept – Explain.

<https://betterlesson.com/lesson/resource/3256830/conferencing-with-students-mov>

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This is a more structured way of using 5E Explore and Evaluation for K-5 students.

Monitoring Student Understanding

Once students begin discussing and recording observations, conference with every group. Support students by asking guiding questions (listed below). Encourage students to engage in Science & Engineering Practice: Engaging in Argument from Evidence.

1. What have you noticed?
2. Why do you suppose ____?
3. What have you found so far?
4. Has your thinking changed?
5. What evidence do you have?
6. How did you decide _____?
7. What conclusion can you draw about ____?



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Ideas for Lesson Planning

The Five E's are:

- **Engage**
- **Explore**
- **Explain**
- **Elaborate**
- **Evaluate**

Challenge: Research science lessons that utilize 5Es.
Try to begin incorporating these proven techniques when you plan for next year.

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See video links referenced for teachers in a previous slide.

Engage: To engage means to excite and to draw the student's curiosity


Explore: Students will explore by using manipulatives, watch a short video, conduct a short practice or work in groups to discuss a concept

Explain: Teachers use questions to explain concepts

Elaborate: Teachers can use what students have learned by extending or expanding the concept or allow students to explore more to test out a different idea; if students did not learn what was intended – this could be a reteach opportunity

Evaluate: reflection, writing activity, presentation, video, model (mini book with drawing); rubric can be used to grade – it could be the dreaded test ----

Many veteran teachers find the 5E lesson plan just more to do. I think that it makes teaching the lesson easier in that the students are more willing to learn, the activities are set up, the lesson sequence is well thought out and the objective is thoroughly explored.



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MS CCRS for Science – Crosscutting Concepts

Physical Properties

- Addresses the “fragmented” approach to science lessons especially in K-8 (i.e., unit on ecosystems, then matter, then types of rocks – What are the connections?)
- Helps the students see connections between ideas within a discipline and between different disciplines

K-2	3-5	6-8	9-12
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.			
<ul style="list-style-type: none"> • Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. 	<ul style="list-style-type: none"> • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products. • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation. 	<ul style="list-style-type: none"> • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. • Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. • Patterns can be used to identify cause and effect relationships. • Graphs, charts, and images can be used to identify patterns in data. 	<ul style="list-style-type: none"> • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. • Classifications or explanations used at one scale may fail or need revision when information from smaller or larger scales is introduced, thus requiring improved investigations and experiments. • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. • Mathematical representations are needed to identify some patterns. • Empirical evidence is needed to identify patterns.


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Classifying matter using physical properties ties into the crosscutting concept of **Patterns**.

Patterns can be found in all three sciences. They are often related and have similar trends.

Types of Patterns • **Classification** • Distributions • Relationships among variables • Changes and rates of change;

Students can classify organisms (life science); matter (physical sciences), types of rocks or seasonal weather (earth science).



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MS CCRS for Science – Crosscutting Concepts

Physical and Chemical Changes

- Cause and Effect relationships may be used to predict phenomena in natural or designed systems.
- A change to the molecular or compound structure has a cause that could effect the substance by forming a new substance.


K-2	3-5	6-8	9-12
Cause and Effect: Mechanism and Prediction: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.			
<ul style="list-style-type: none"> • Events have causes that generate observable patterns. • Simple tests can be designed to gather evidence to support or refute student ideas about causes. 	<ul style="list-style-type: none"> • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship. 	<ul style="list-style-type: none"> • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. 	<ul style="list-style-type: none"> • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.

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Studying physical and chemical changes shows **Cause and Effect**. A change to the molecular or compound structure has a cause that could effect the substance by forming a new substance.

Changes to the structure may result in a new substance with matter being conserved.

Cause and effect relationships may be used to predict phenomena in natural or designed systems.



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MS CCRS for Science – Crosscutting Concepts

Organic Molecules and Enzymes

• Structure and Function and Stability and Change

K-2	3-5	6-8	9-12
Structure and Function: The way an object is shaped or structured determines many of its properties and functions.			
<ul style="list-style-type: none"> • The shape and stability of structures of natural and designed objects are related to their function(s). 	<ul style="list-style-type: none"> • Different materials have different substructures, which can sometimes be observed. • Substructures have shapes and parts that serve functions. 	<ul style="list-style-type: none"> • 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 and designed structures/systems can be analyzed to determine how they function. • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. 	<ul style="list-style-type: none"> • Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.
Stability and Change: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.			
<ul style="list-style-type: none"> • Some things stay the same while other things change. • Things may change slowly or rapidly. 	<ul style="list-style-type: none"> • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change. 	<ul style="list-style-type: none"> • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including the atomic scale. • Small changes in one part of a system might cause large changes in another part. • Stability might be disturbed either by sudden events or gradual changes that accumulate over time. • Systems in dynamic equilibrium are stable due to a balance of feedback mechanisms. 	<ul style="list-style-type: none"> • Much of science deals with constructing explanations of how things change and how they remain stable. • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. • Feedback (negative or positive) can stabilize or destabilize a system. • Systems can be designed for greater or lesser stability.

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For the Biology Activities showing Organic Molecules including Enzymes: What are the crosscutting concepts?


This example shows **Structure and Function**.

The functions and properties of natural and designed objects and systems can be inferred from the chemical structure, the way their components are shaped and used, and the molecular substructures of its various materials

Organic Molecules and Enzymes both have structures that determine the function of the molecules.

Another crosscutting concept is **Stability and Change**: For a natural system like enzyme activity, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

Small changes can have a huge impact. If enzymes cannot digest food, then larger problems can occur to the organism.



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Physical Science Activity


Name: _____

Why Does Matter Matter?
by Kely Hathway

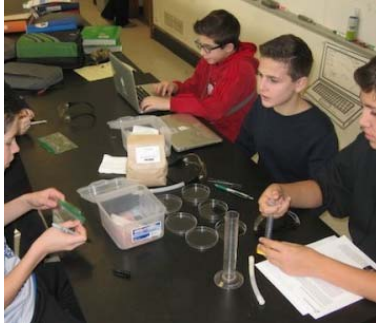
solids	volume	container	matter	ice	juice
gases	mass	atoms	chair	oxygen	melting
liquids	shape	space	milk	helium	

Choose a word from the box to complete each sentence.

1. The three basic properties of matter are _____ and _____.
2. All matter is made up of tiny particles called _____.
3. Volume is the amount of _____ that matter takes up.
4. Mass is the amount of _____ an object has.
5. Liquids take the shape of their _____.
6. _____ do not have a definite shape or volume.
7. _____ do not have a definite shape, but they do have a definite volume.
8. _____ have a definite shape and volume.
9. A _____ and _____ are examples of solids.
10. _____ and _____ are examples of liquids.
11. _____ and _____ are examples of gas.
12. Solid ice is _____ when it is changing into a liquid.




OR



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What is the best way to learn about matter?
Method on left or method on right?



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Physical Science Activity

PHYSICAL AND CHEMICAL PROPERTIES AND CHANGES
Name _____ Key _____

PHYSICAL PROPERTY 1. observed with senses 2. does not involve destroying matter	CHEMICAL PROPERTY 1. indicates how a substance reacts with something else 2. cannot ever be changed into a new substance when the reaction
--	---

Identify the following as a chemical (C) or physical property (P):

1. blue color 2. density 3. flammability (burns) 4. solubility (dissolves) 5. reacts with acid 6. supports combustion 7. sour taste	8. melting point 9. reacts with water 10. lustrous 11. boiling point 12. luster 13. odor 14. reacts with air
---	--

PHYSICAL CHANGE 1. a change in size, shape, or state 2. no new substance is formed	CHEMICAL CHANGE 1. a change in the physical and chemical properties 2. a new substance is formed
---	---

Identify the following as physical (P) or chemical (C) changes:



1. NaCl (table salt) dissolves in water. 2. Ag (silver) tarnishes. 3. An apple rots. 4. Heat changes H ₂ O to steam. 5. Baking soda reacts to vinegar. 6. Fe (iron) rusts. 7. Alcohol evaporates. 8. Ice melts.	9. Milk sours. 10. Sugar dissolves in water. 11. Wood rots. 12. Pancakes cook. 13. Grass grows. 14. A tire is inflated. 15. Food is digested. 16. Paper towel absorbs water.
---	---

Physical and Chemical Changes

Part A
Can you recognize the chemical and physical changes that happen all around us? If you change the way something looks, but haven't made a new substance, a physical change (P) has occurred. If the substance has been changed into another substance, a chemical change (C) has occurred.

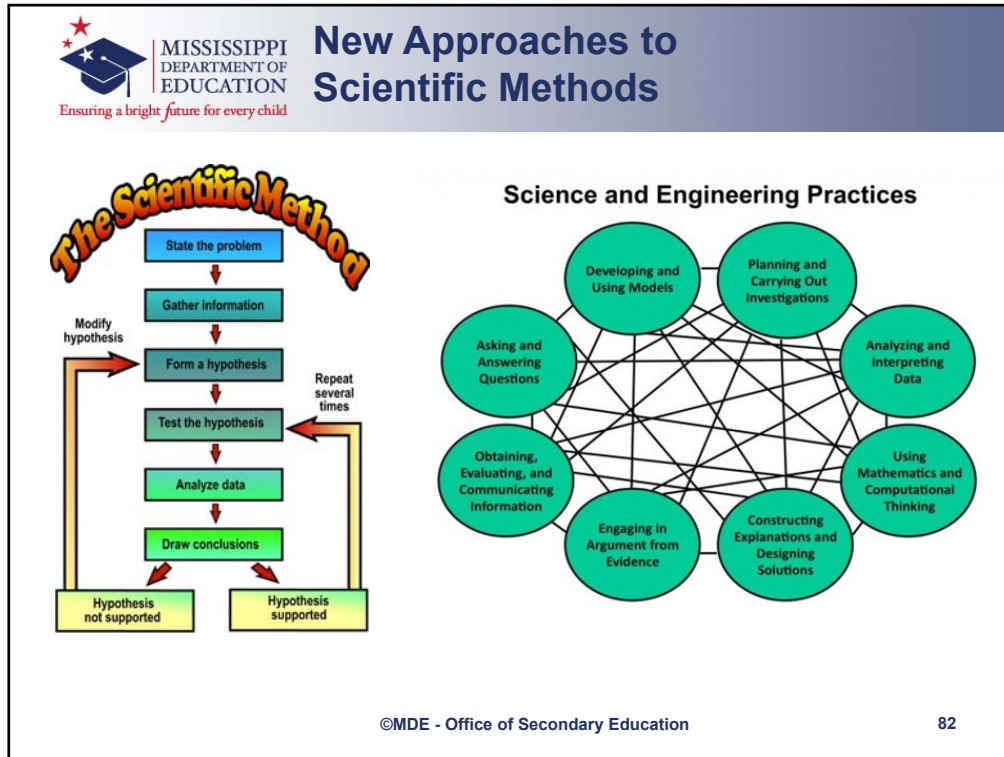
1. An ice cube is placed in the sun. Later there is a puddle of water. Later still the puddle is gone.	
2. Two chemicals are mixed together and a gas is produced.	
3. A bicycle changes color as it rusts.	
4. A solid is crushed to a powder.	
5. Two substances are mixed and light is produced.	
6. A piece of ice melts and reacts with sodium.	
7. Mixing salt and pepper.	
8. Chocolate syrup is dissolved in milk.	
9. A marshmallow is heated over a campfire.	
10. A marshmallow is cut in half.	

OR

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What is the best way to learn about physical and chemical properties?
 Method on left or method on right?



Many teachers introduced science by showing students the scientific method, the step-by-step method to “doing science”.

It’s time to change how we teach students to be scientists.

It turns out, that the scientific method as we have known it, no longer exists. Actually, it really never existed! Real scientists and engineers do not follow a linear approach. They use multiple methods. Should we feel bad that we used the linear scientific method with students? No. However, we are now armed with new knowledge and we understand that there is a new and better way of doing things – SEPs.



Let's tie the 3 Major Dimensions of our new standards by using a simple analogy. Let's think about making a cake.

Can you make a cake with just ingredients? Can you make a cake without ingredients?

Cake ingredients are our science content knowledge.

SEPs are the tools and techniques to use to study science just as mixing, measuring and baking tools are needed to put the cake ingredients together for baking;


Crosscutting concepts are needed to make the final connection to the unity of the sciences. Icing helps unite the layers of the cake together and makes the cake taste better!

Remember, we can memorize a recipe without actually making it just like we can memorize science facts without using anything other than a textbook. If we take the science content ingredients and go through the SEP practices of making the cake, we will gain and enhance skills and techniques that we can apply in many situations. The crosscutting concept icing makes the cake even better and adds to our student's knowledge of how science works in the world.

Work in Grade Bands

Planning by Using the Crosswalks



 MISSISSIPPI DEPARTMENT OF EDUCATION <i>Ensuring a bright future for every child</i>		<h1>Crosswalk Inquiry Strand</h1>	
Crosswalk 2010 MS Science - 2018 MS CCRS for Science Inquiry Strand Grade 5			
2010 MS Framework G5 - Inquiry	2018 MS CCRS for Science - all grades and courses		
Competency 1.1. Develop and demonstrate an understanding of scientific inquiry using process skills.	All Inquiry skills will be taught in the appropriate performance objectives in the new standards. Students will use various Science and Engineering Practices (SEPs) to learn the content. All science skills should be included as needed.		
1a. Form a hypothesis, predict outcomes, and conduct a fair investigation that includes manipulating variables and using experimental controls.			
1b. Distinguish between observations and inferences.			
1c. Use precise measurement in conjunction with simple tools and technology to perform tests and collect data. • Tools (English rulers [to the nearest one-sixteenth of an inch], metric rulers [to the nearest millimeter], thermometers, scales, hand lenses, microscopes, balances, clocks, calculators, anemometers, rain gauges, barometers, hygrometers) • Types of data (height, mass, volume, temperature, length, time, distance, volume, perimeter, area)			
1d. Organize and interpret data in tables and graphs to construct explanations and draw conclusions.			
1e. Use drawings, tables, graphs, and written and oral language to describe objects and explain ideas and actions.			
1f. Make and compare different proposals when designing a solution or product.			
1g. Evaluate results of different data (whether trivial or significant).			
1h. Infer and describe alternate explanations and predictions.			

Grade 5 Science Crosswalk


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A challenge will be to put the necessary inquiry skills including safety into the new standards. How would this be done?

Did the students really remember the proper use of equipment and the techniques when this was taught at the beginning of school? How effective was teaching the Inquiry strand as stand-alone material and often not incorporating the concepts into the actual teaching of the Life, Earth, and Physical strands?



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Crosswalks – K-8, Biology

Crosswalk 2010 MS Science - 2018 MS CCRS for Science
Physical Science Grade 5

2010 MS Framework GS – Physical Science	2018 MS CCRS for Science GS – Physical Science Topics
Competency 2. Understand relationships of the properties of objects and materials, position and motion of objects, and transfer of energy to explain the physical world.	Standard statements are in bold font below.
2a. Determine how the properties of an object affect how it acts and interacts.	See P.5.5A below
2b. Differentiate between elements, compounds, and mixtures and between chemical and physical changes (e.g., gas evolves, color, and/or temperature changes).	P.5.5C Students will demonstrate an understanding of the difference between physical and chemical changes. P.5.5C.1 Analyze and communicate the results of chemical changes that result in the formation of new materials (e.g., decaying, burning, rusting, or cooking). P.5.5C.2 Analyze and communicate the results of physical changes to a substance that results in a reversible change (e.g., changes in states of matter with the addition or removal of energy, changes in size or shape, or combining/separating mixtures or solutions). P.5.5C.3 Analyze and interpret data to support claims that when two substances are mixed, the total weight of matter is conserved.
2c. Investigate the motion of an object in terms of its position, direction of motion, and speed. • The relative positions and movements of objects using points of reference (distance vs. time of moving objects) • Force required to move an object using appropriate devices (e.g., spring scale) • Variables that affect speed (e.g., ramp height/length/surface, mass of object) • Effects of an unbalanced force on an object's motion in terms of speed and direction	P.5.6 Students will demonstrate an understanding of the factors that affect the motion of an object through a study of Newton's Laws of Motion. P.5.6.1 Obtain and communicate information describing gravity's effect on an object. P.5.6.2 Predict the future motion of various objects based on past observation and measurement of position, direction, and speed. P.5.6.3 Develop and use models to explain how the amount or type of force, both contact and non-contact, affects the motion of an object. P.5.6.4 Plan and conduct scientific investigations to test the effects of balanced and unbalanced forces on the speed and/or direction of objects in motion. P.5.6.5 Predict how a change of force, mass, and/or friction affects the motion of an object to convert potential energy into kinetic energy. P.5.6.6 Design a system to increase the effects of friction on the motion of an object (e.g., non-slip surfaces or vehicle braking systems or flaps on aircraft wings). Use an engineering design process to define the problem, design, construct, evaluate, and improve the system.*

Grade 5 Science Crosswalk
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Crosswalks are now available for K-8, Biology. Physical Science, Chemistry, and Physics will be developed this fall.

All resources will be linked to the new standards on the MDE science homepage.



Crosswalk for Inquiry Strand

Challenge 1:

- Students' science skills are very important [e.g., use of tools, experimental design (variables of experiments), collecting and organizing data, graphing, reading data and graphs]
- How do we incorporate the concepts into the K-12 lessons for the new standards?

Let participants discuss these at table.



Crosswalk Challenge K-12

Challenge 2:

- Spend time with fellow grade band teachers and discuss the crosswalks
- Write down major changes for your grade/courses
- Brainstorm with others ideas on how to teach at least one standard (or at least a couple of performance objectives).
- Share Ideas with entire group

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Let participants discuss these at table. Each group will use chart paper and place on a gallery walk. Presentations will be the exit ticket for the workshop.



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