Transitioning to New Arkansas Science Standards:

Putting Practices Into Place
Grades 5-12

Add presenter name(s) and site here

Welcome and Norms

- Welcome / Housekeeping / Norms
- Please take survey if you haven't already
- http://tinyurl.com/2015Practices

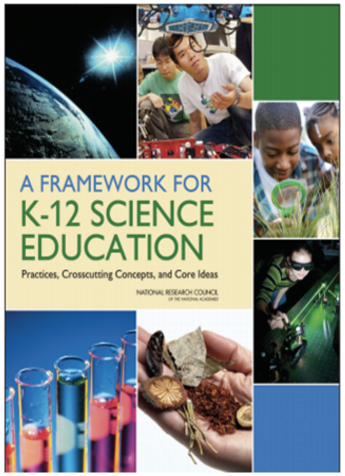
Goals

Participants will...

- **recognize the role of science and engineering practices in allowing students to build understanding of science concepts**
- **apply science and engineering practices to explain science phenomena**

A Vision for K-12 Science Education

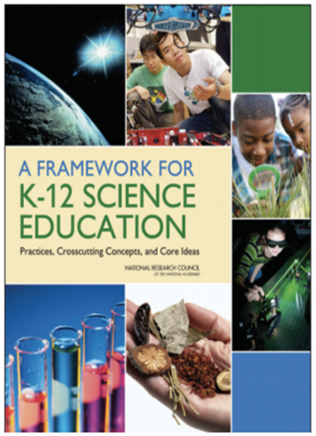
Students, over multiple years of school, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields.



Goals for K-12 Science Education

The main goal of the Framework is to ensure that by the end of high school all students have some appreciation of science, the ability to discuss and think critically about science-related issues, and the skills to pursue careers in science or engineering.

~Brian Reiser (2011)



Teaching Channel Video

- View the Teaching Channel video: NGSS A Vision for K-12 Science Education and discuss 3 questions in table groups
- How do the NGSS represent a shift in science instruction?
- What do the teachers in this video learn from engaging with the NGSS?
- How do the three dimensions work together?

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

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

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe phenomena. (MS-LS2-3)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems
- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

LS4.D: Biodiversity and Humans
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. *(secondary to MS-LS2-5)*

ETS1.B: Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary to MS-LS2-5)*

Crosscutting Concepts

Patterns
- Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

Energy and Matter
- The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Stability and Change
- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

Science Addresses Questions About the Natural and Material World
- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

Connections to other DCIs in this grade-band: **MS.PS1.B** (MS-LS2-3); **MS.LS1.B** (MS-LS2-2); **MS.LS4.C** (MS-LS2-4); **MS.LS4.D** (MS-LS2-4); **MS.ESS2.A** (MS-LS2-3),(MS-LS2-4); **MS.ESS3.A** (MS-LS2-1),(MS-LS2-4); **MS.ESS3.C** (MS-LS2-1),(MS-LS2-4),(MS-LS2-5)

Articulation across grade-bands: **1.LS1.B** (MS-LS2-2); **3.LS2.C** (MS-LS2-1),(MS-LS2-4); **3.LS4.D** (MS-LS2-1),(MS-LS2-4); **5.LS2.A** (MS-LS2-1),(MS-LS2-3); **5.LS2.B** (MS-LS2-3); **HS.PS3.B** (MS-LS2-3); **HS.LS1.C** (MS-LS2-3); **HS.LS2.A** (MS-LS2-1),(MS-LS2-2),(MS-LS2-5); **HS.LS2.B** (MS-LS2-2),(MS-LS2-3); **HS.LS2.C** (MS-LS2-4),(MS-LS2-5); **HS.LS2.D** (MS-LS2-2); **HS.LS4.C** (MS-LS2-1),(MS-LS2-4); **HS.LS4.D** (MS-LS2-1),(MS-LS2-4),(MS-LS2-5); **HS.ESS2.A** (MS-LS2-3); **HS.ESS2.E** (MS-LS2-4); **HS.ESS3.A** (MS-LS2-1),(MS-LS2-5);

Looking at a sample:

How many of the questions about NGSS can you and your table group answer?

ww.arkansased.gov

ARKANSAS K-12 SCIENCE STANDARDS

Home Page / ADE Divisions / Learning Services / Curriculum and Instruction / Arkansas K-12 Science Standards

ARKANSAS
K-12 SCIENCE STANDARDS
EDUCATION FOR A NEW GENERATION

In 2011, Arkansas became one of 26 states to lead the development of the **Next Generation Science Standards** (NGSS). Arkansas's lead state process included a consideration of conceptual shifts in science education.

Conceptual Shifts

Science standards should:

- *reflect science as it is practiced and experienced in the real world.*
- *build coherently from Kindergarten through Grade 12.*
- *focus on deeper understanding as well as application of content.*
- *integrate core ideas, practices, and crosscutting concepts.*
- *make explicit connections to literacy and math.*

Arkansas K-12 Science Standards

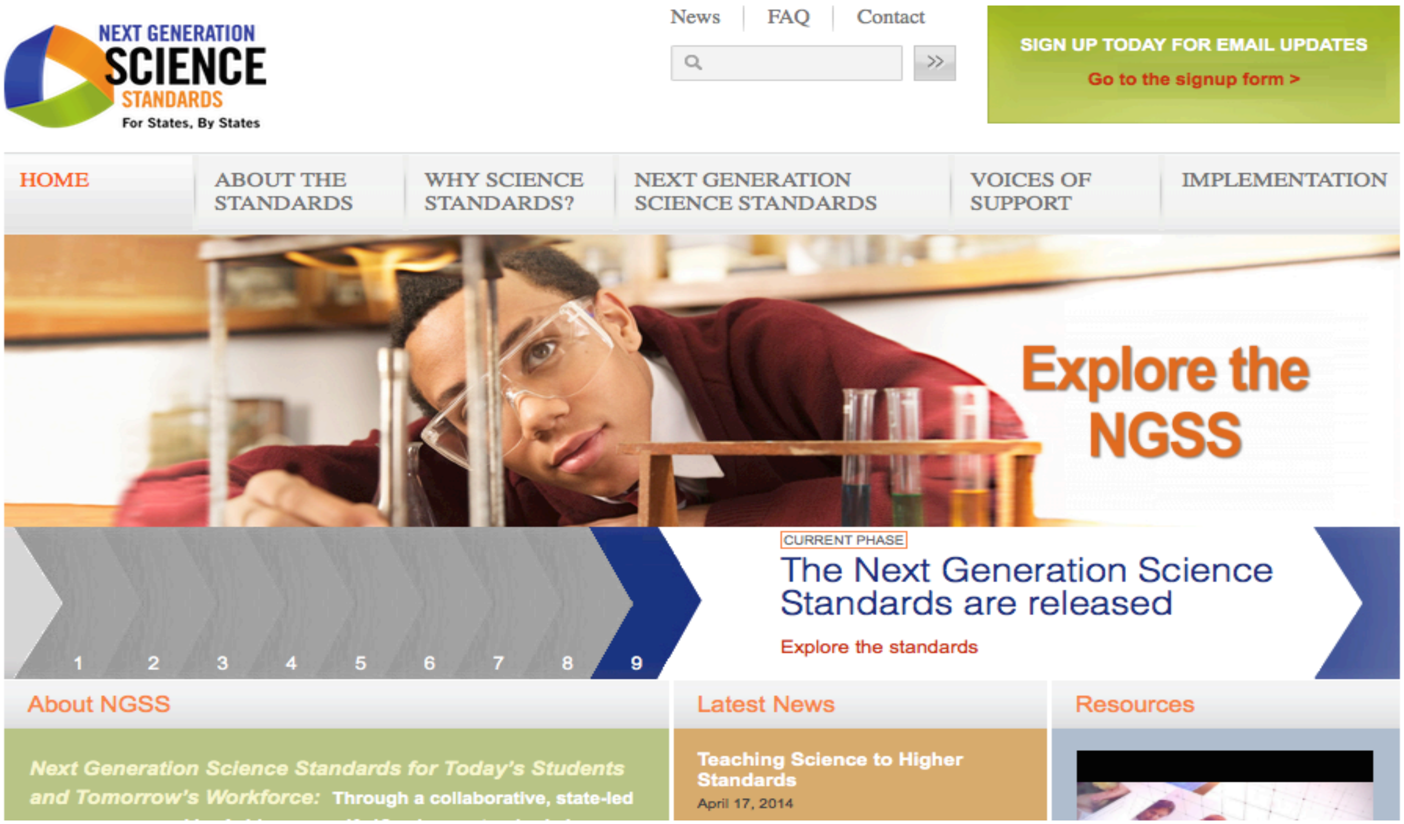
- Foundational Research Documents ▸
- NGSS Documents ▸
- Working Documents ▸
- Communication Tools ▸
- Science PD Opportunities ▸
- Arkansas Science Assessments ▸

Related Files

- Arkansas K-12 Science Standards Strategic Plan ▸
- Arkansas K-12 Science Standards Frequently Asked Questions ▸
- Arkansas K-12 Science Standards Timeline ▸

Arkansas Department of Education
Leadership Support Service

www.nextgenscience.org



Arkansas Department of Education
Leadership Support Service

Please clear your tables before leaving for a 10 min break.

Putting Practices in Place

ENGAGE

Describe what you know about the movement of molecules in your notebook.

- Pair and discuss your ideas.
- Collaborate to create a common description with your partner.
- Report to whole group.

EXPLORE

Topsy Turvy investigation: Handout 4

- Read Handout 4 completely
- Predict what you think is going to happen on page 5 of your science notebook.
- Follow the instructions for set-up to begin investigation.
- Make drawings of your observations as you conduct the investigation on page 6

EXPLAIN

- Compare your data with others at your tables or with groups across the room.
- Share your observations and discuss possible explanations.
- I know molecules move because…

EXPLORE

How do other materials move across other "membranes"?

EXPLAIN

- Discuss at your table how the two new phenomena add to your understanding of molecular movement.

EXPLAIN

- **Read** the article "Diffusion and Osmosis"
- **Annotate:** key evidence regarding molecular motion.

✓ - supports my explanation

! - adds to or contradicts my explanation

? - I have questions about this idea

EXPLAIN

- Add ideas questions to your notebook.
- Discuss the evidence you've discovered and revise your model, if needed.

...Before, I thought… now, I know…

Science & Engineering Practices

Science and Engineering Practices

1. Asking questions (science) and defining problems (engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (science) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Handout 6 or Appendix F @ Nextgenscience.org or NGSS @ NSTA

Science & Engineering Practices

3 Practices in Focus

Developing and using models

Constructing explanations and designing solutions

Engaging in argument from evidence

- Describe your current understanding of these three practices, in your notebooks.
- How have you engaged in these practices so far today?

Arkansas Department of Education Leadership Support Service

3 Practices in Focus

- **Jigsaw in groups of 3:**
  - Each participant reads ONE description of a science practice. (not progression)
  - Describe the key details to your partners.

Progression in Practices

Refer to the Progression Tables- Practice 2, 6, and 7
Locate your grade band in the table.
Respond on sticky notes.

- How are students expected to be engaged in this practice at your grade band level?
- What changes will need to take place in curriculum and instruction for students to fully engage in this practice?

Arkansas Department of Education
Leadership Support Service

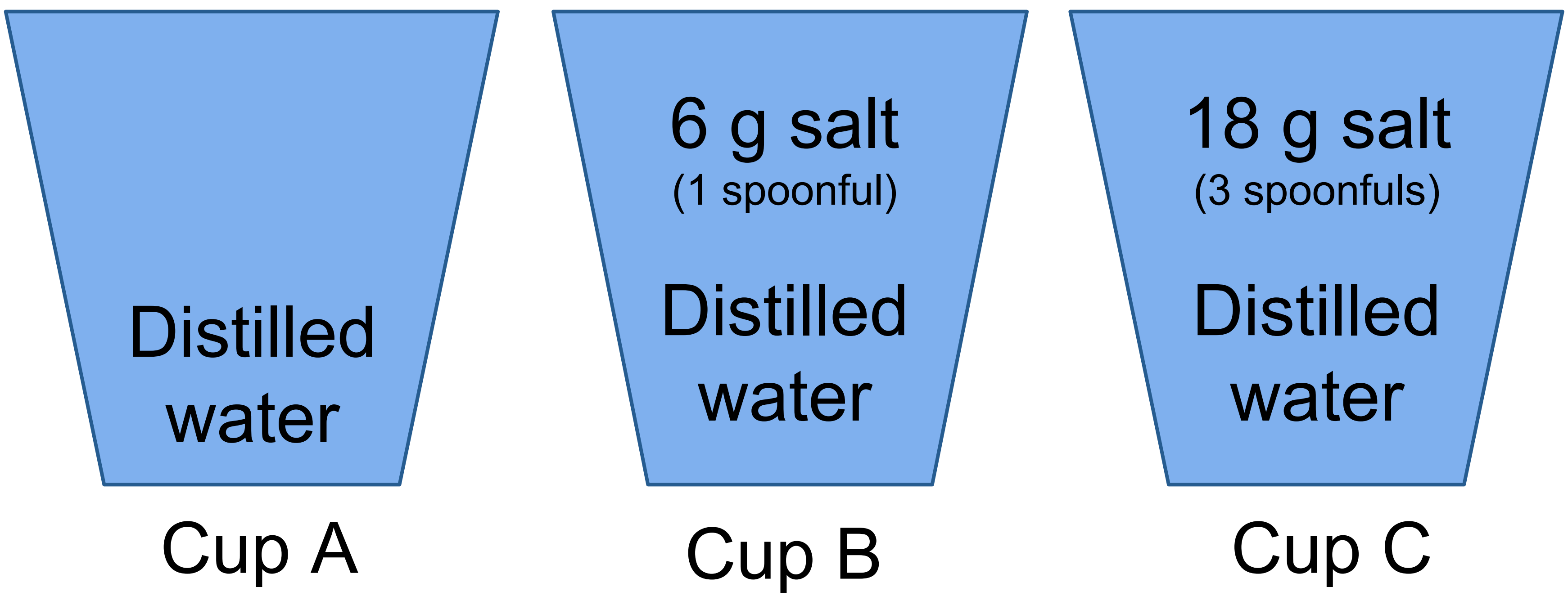
Progression in Practices

Place your sticky notes in the appropriate practice charts around the room.

SEP:	3-5	6-8	9-12
How students are engaged in this practice.			
What needs to happen in curriculum and instruction?			

Investigation

Mix the following solutions in three cups:



- Place one gummy bear in each cup.
- In your notebook, predict, draw, and explain the ***molecular movement*** that will occur in each container overnight.

Place Holder slide between day 1 and day 2

Transitioning to New Arkansas Science Standards:

Putting Practices Into Place
Grades 5-12 Day 2

Add presenter name(s) and site here

What Happened?

- Remove the gummy bears and inspect them.
- Refer to the predictions in your notebook on page 9.
- *How do the results compare to the predictions? What surprised you?*
- Revise your models if necessary.
- With your group, determine how this ***phenomenon*** is similar and different to “Topsy-Turvy” and record your thoughts in your notebook .

ARKANSAS DEPARTMENT OF EDUCATION
LEADERSHIP SUPPORT SERVICE

Arkansas Department of Education
Leadership Support Service

Models and Modeling: An Introduction

- Read the article and mark sections that stand out to you about Models.
- On a strip of Post-It paper, write <u>one word</u> that "speaks" to you about modeling.
- On a second strip of Post-It paper, write <u>one phrase</u> that "speaks" to you about modeling.

Modeling In Your Classroom

Read over the key words and phrases that were written about modeling.
Refer to page 11 in science notebook.

- How does this change your view of modeling?
- Identify ways that you have participated in modeling throughout this training
- Where can your students use the practice of ‘developing a model’ in your lessons?

ARKANSAS DEPARTMENT OF EDUCATION LEADERSHIP SUPPORT SERVICE

A new lens of modeling

- Read over the sample lessons in HO#8.
- As a group, use the Grades 6-8 & Grades 9-12 columns on pg 6 of Appendix F to identify why some of those lessons are better suited for meeting the NGSS Practice of “Developing & Using Models”.

ARKANSAS DEPARTMENT OF EDUCATION
LEADERSHIP SUPPORT SERVICE

Constructing Explanations

The goal of science is to construct explanations for the causes of phenomena. Students are expected to construct their own explanations, as well as apply standard explanations they learn about from their teachers or reading.

~NGSS Appendix F

Learning Progressions

Refer to the Grade K-12 Progressions for **Practice:** *Constructing Explanations and Designing Solutions*

Prompt: What connections can you make between your notebook entries and the progressions?

Engaging in Argument from Evidence

Prompt: What is the definition of a scientific argument?

Science Notebook: page 12

Scientific Argument:

A process based on evidence and reasoning to evaluate claims, that leads to explanations acceptable to the scientific community.

~NGSS Appendix F

Arkansas Department of Education
Leadership Support Service

Scientific Argument:

A **process** based on **evidence** and **reasoning** to evaluate **claims**, that leads to **explanations** acceptable to the scientific community.

~NGSS Appendix F

Distinguish between these terms:

In your notebooks, *describe* each.

- **Claim**
- **Evidence**
- **Reasoning**

Claim, Evidence, and Reasoning

Examine your Science Notebook:

Highlight:

- Claims ‘C’
- Evidence ‘E’
- Reasoning ‘R’

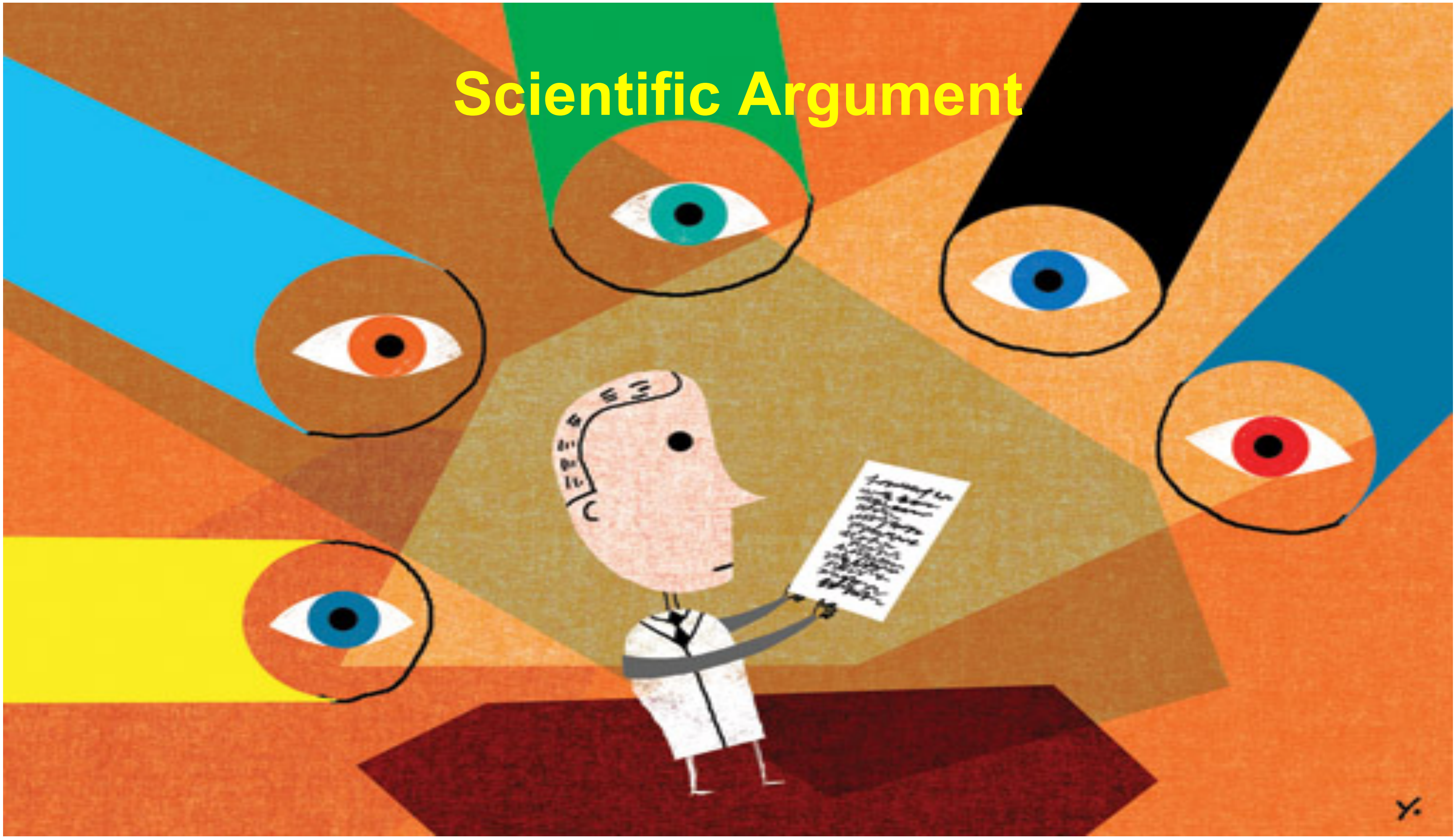
Arkansas Department of Education
Leadership Support Service

Brandons Scientific Explanation

- Fat and soap are both stuff, but they are different substances. Fat is used for cooking and soap is used for washing. They are both things we use everyday. The data table is my evidence that they are different substances. Stuff can be different substances if you have the right data to show it.

- Fat and soap are different substances. Fat is of white and soap is milky white. Fat is soft squishy and soap is hard. Fat is soluble in oil, but soap is not soluble in oil. Soap is soluble in water, but fat is not. Fat has a melting point of 47°C and soap has a melting point above 100° C. Fat has a density of 092 g/cm3 and soap has a density of 0.84 g/cm3. These are all properties. Because fat and soap make different properties, I know they are different.

Scientific Argument



Constructing an Explanations Using Argument:

Prompt: -INDEPENDENTLY-

- *Develop a claim related to how molecules move.*
- *Support your* claim with evidence from the text and investigations you conducted.

Paired Discussion: Engaging in Argument

Negotiate ideas to make the claim stronger.

What do you know? How do you know?

Claim + Evidence and Reasoning = Explanation

How does the evidence support the claim?

Arkansas Department of Education
Leadership Support Service

Groups of 4: Develop an Explanation

Negotiate in groups to determine the final explanation.

Poster: Create an explanation supported by the strongest argument. Display on the wall.

Poster Carousel: Numbered Heads

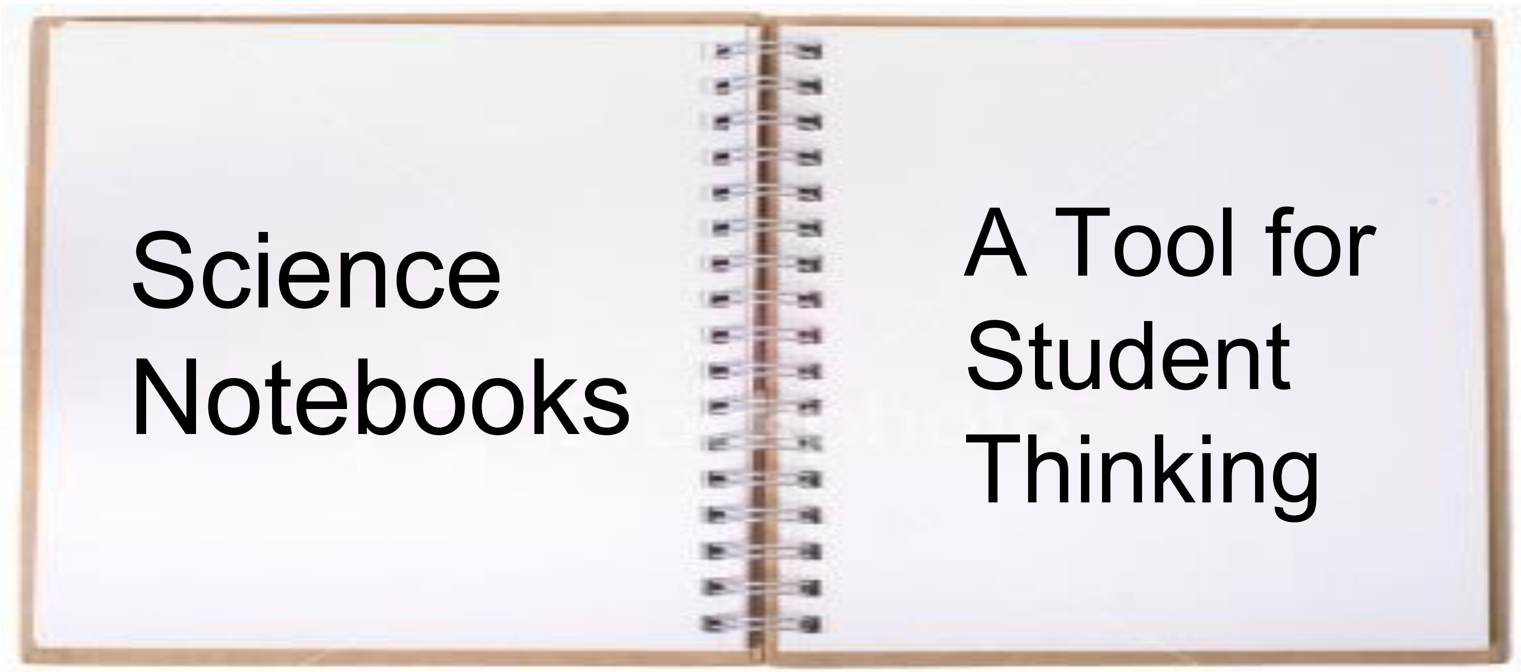
REFLECTION

Constructing Explanations and Designing Solutions.

The goal of science is to construct explanations for the causes of phenomena. Students are expected to construct their own explanations, as well as apply standard explanations they learn about from their teachers or reading

ARKANSAS DEPARTMENT OF EDUCATION
LEADERSHIP SUPPORT SERVICE


TIME FOR A BREAK



K-12 Alliance/WestEd ‘14

Review Student Notebook Entries

- With yellow post-it notes….Flag areas where you see signs of student thinking
- Share what you discovered at your table
- Be prepared to share with whole group

Essences of Thinking

- Prior Knowledge
- Collecting/Organizing Data
- Making Sense of Data
- Metacognition

Essence Sample Notebooks

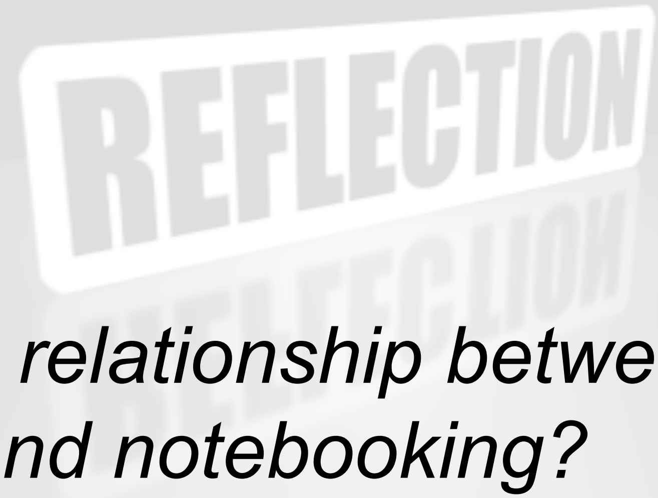
Use codes below to indicate examples of student thinking in notebooks:

- (PK) Prior Knowledge
- (COD) Collecting/Organizing Data
- (MSD) Making Sense of Data
- (M) Metacognition

Flag Evidence of Thinking In Your Notebooks:

- (PK) Prior Knowledge
- (COD) Collecting/Organizing Data
- (MSD) Making Sense of Data
- (M) Metacognition

Science Notebooking



1. What is the relationship between the science practices and notebooking?
2. How do they support student learning of Disciplinary Core Ideas?

Post Survey

http://tinyurl.com/2015PracticesPost