



# Addressing the Standards...What Does It Look Like in Practice?

MD Partnership for Children in Nature  
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# Is This What It Feels Like???



# MSDE's Definition of STEM Education

STEM education is an **approach** to teaching and learning that **integrates the content and skills** of science, technology, engineering, mathematics, and other subjects, as appropriate

The goal of STEM education is to **prepare students for post-secondary study and the 21<sup>st</sup> century workforce.**

**STEM Standards of Practice** guide STEM instruction by defining the combination of **behaviors**, integrated with STEM content, which is expected of a proficient STEM student.

These behaviors include

- engagement in inquiry,
- logical reasoning,
- collaboration, and
- investigation.

# STEM Standards of Practice

1. **Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content**
2. **Integrate Science, Technology, Engineering, and Mathematics Content**
3. **Interpret and Communicate STEM Information**
4. **Engage in Inquiry**
5. **Engage in Logical Reasoning**
6. **Collaborate as a STEM Team**
7. **Apply Technology Appropriately**



# NGSS and STEM

## NGSS 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 (sci) and designing solutions (engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

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# Capacities of Literate Individuals

**INDEPENDENCE**

**STRONG CONTENT  
KNOWLEDGE**

**COMPREHEND  
AND CRITIQUE**

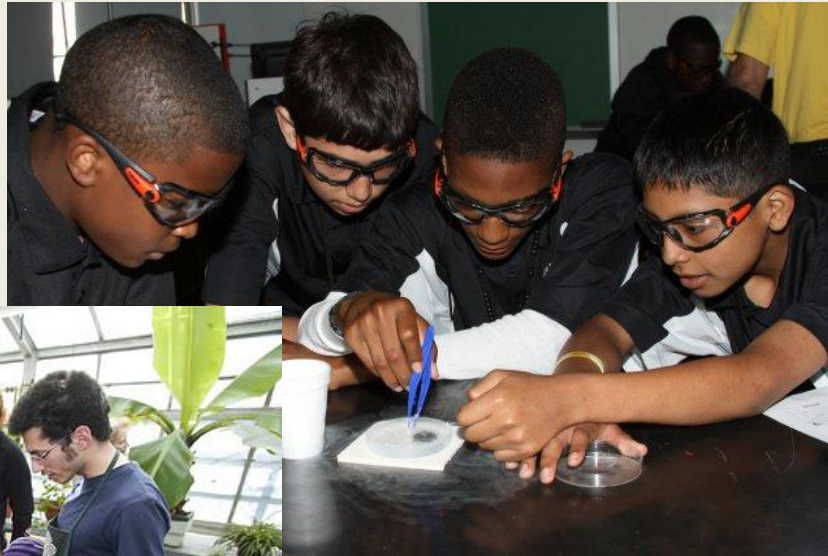
**UNDERSTAND  
PERSPECTIVES  
AND CULTURES**

**USE  
TECHNOLOGY**

**RESPOND TO VARIOUS  
DEMANDS**

**VALUE  
EVIDENCE**

# Structure of a “Lesson”

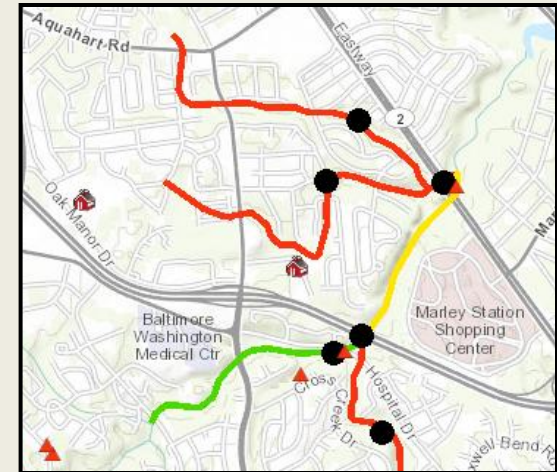






# Engage Students in the Context

# Engage students with the issue of importance of healthy streams



## NEWS Fly ash dump draws Md. fine

By Justin Fenton and Justin Fenton, SUN REPORTER | August 8, 2007

The state's environmental agency has ordered the operator of a coal ash dump site to pay a "significant" fine and clean contaminated water recently detected in Anne Arundel County. The Maryland Department of the Environment gave BBSS Inc. 60 days to comply or face legal action, agency spokesman Robert Ballinger said yesterday. He did not elaborate on the amount of the fine or specific actions. "Taking this corrective action is how we deem it necessary to take care" of the contamination, Ballinger said.





## Engaging in the context

- activates student thinking and assesses prior knowledge
- encourages students to ask questions
- uncovers student misconceptions



# Establish the Essential Question



***How can we reduce the impact of human activities on the water quality of streams in Maryland?***

# The Essential Question

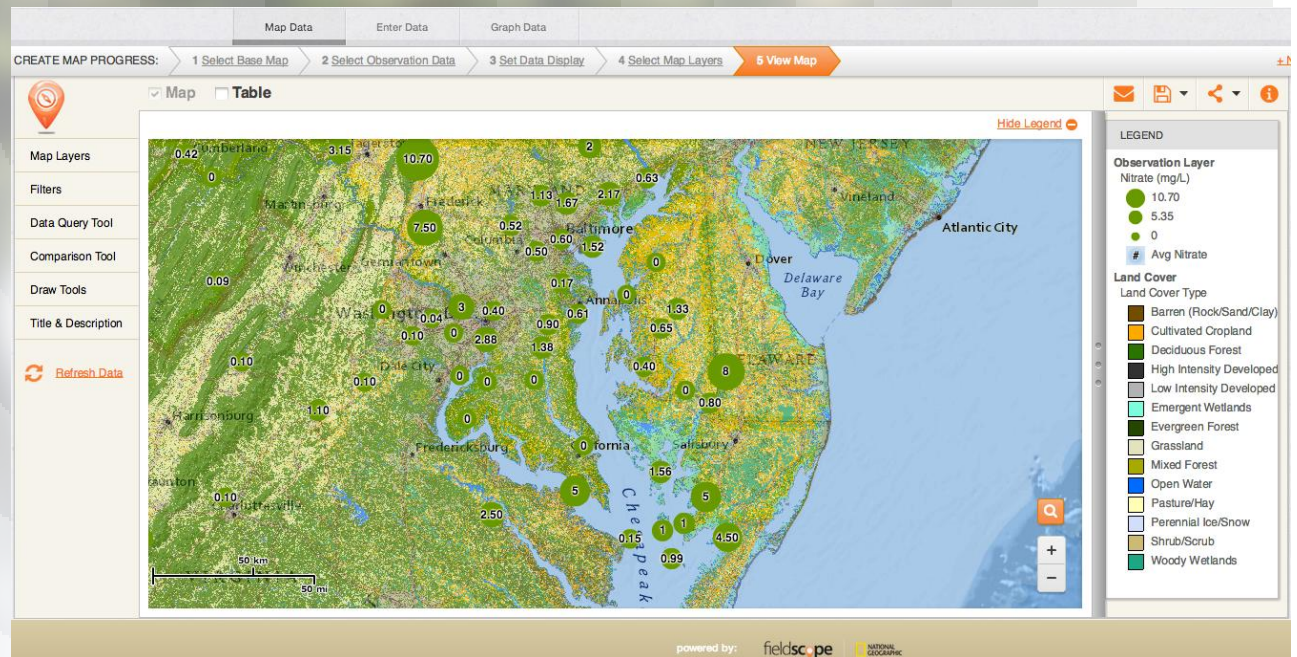
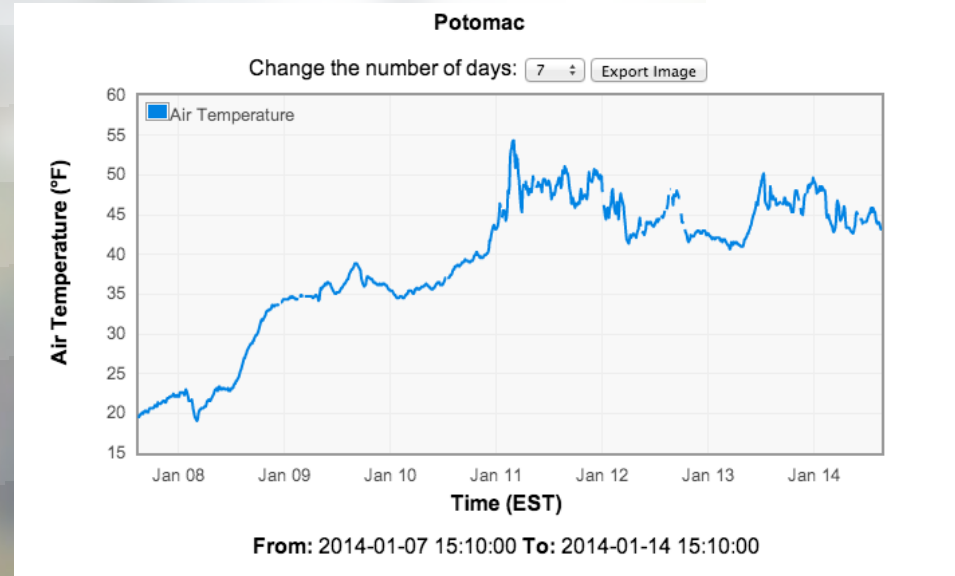
- How can we reduce the impact of human activities on the water quality of streams in Maryland?
  - Establishes the purpose for learning
  - Guides the inquiry
  - Is aligned with appropriate standards
  - Provides opportunities for student investigation
  - Makes connections between past and present learning experiences



# Student Exploration



# STUDENT EXPLORATION



# Student Preparation

- Review literature for relevant background information

## The Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams

### Background

The Wadeable Streams Assessment (WSA) is a valid survey of the biological condition of streams U.S. Wadeable streams—streams and rivers that to sample without boats—were chosen for study a critical natural resource, because we have a well of methods for monitoring them, and because the under-sampled in traditional monitoring programs a collaborative effort involving states, EPA and other tribes, universities and other organizations.

### Purpose

- Report on the condition of wadeable streams of the US.
- Help build State

The WSA was designed using modern survey techniques; 1,392 randomly sampled to represent the condition of all streams in regions that share characteristics. Participants used the same standardized methods at a results that are comparable across the nation. A rigorous quality control training all field crews, auditing field crews and labs, and re-sampling sampling began with pilot work in the West in 2000 and was completed

The WSA used *benthic macroinvertebrates* to determine the biological condition. Benthic macroinvertebrates are small creatures that live in streams at woody debris, or burrowed into the stream bottom. They include aquatic larval stages of insects such as flies and dragonflies; crustaceans such as crayfish; and worms and snails.

## Measuring Physical Habitat in Streams

### Why Measure Physical Habitat?

- The physical structure of streams is key to understanding the stream biota.
- Alteration of stream physical habitat is among the leading human alterations to streams.
- Setting goals for maintenance and restoring physical habitat in streams is a key to improving stream quality.

### Goals

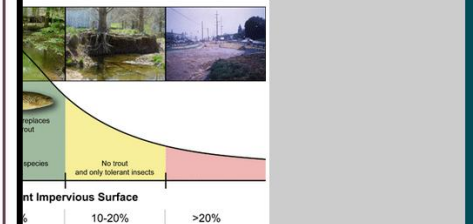
- Produce a report on the condition of wadeable streams of the U.S. by December 2005
- Promote collaboration across jurisdictional boundaries in the examination and assessment of water quality
- Build State capacity through use of survey design and comparability of methods or indicators

### What Dimensions of Physical Habitat will be Evaluated?

### How Many Measurements Do We Need?

- Residual pools are a critical habitat feature of streams
- Measurements must be taken frequently enough to be accurate
- Reducing protocol from 100 depth measures to 40 measures reduces accuracy from 99% to 70%
- WSA protocol is sufficient to provide values that are a minimum of 90% of the true value.

### Residual Pools - Effort Return





# Student Preparation

- Identify resources appropriate to the essential question
  - Protocols
  - Equipment
  - Methods to collect data

## Freshwater Macroinvertebrates Protocol

**Purpose**  
To sample, identify and count macroinvertebrates at your Hydrology Site

**Overview**  
Students will collect, sort, identify, and count macroinvertebrates from habitats at their site.

**Student Outcomes**  
Students will learn to,

- identify taxa of macroinvertebrates at their site;
- understand the importance of representative sampling;
- use biodiversity and other metrics in macroinvertebrate research (advanced);
- examine reasons for changes in the macroinvertebrate community at their Hydrology Site (advanced);
- communicate project results with other GLOBE schools;
- collaborate with other GLOBE schools (within your country or other countries); and
- share observations by submitting data to the GLOBE archive.

**Science Concepts**

*Earth and Space Sciences*  
Soils have properties of color, texture and composition; they support the growth of many kinds of plants.  
Soils consist of weathered rocks and decomposed organic matter.

*Life Sciences*  
Organisms have basic needs. Organisms can only survive in environments where their needs are met.  
Earth has many different kinds of environments that support different combinations of organisms.

Organisms functions relate to their environment.  
Organisms change the environment in which they live.  
Humans can change natural environments.  
Ecosystems demonstrate the complementary nature of structure and function.  
All organisms must be able to obtain and use resources while living in a constantly changing environment.  
All populations living together and the physical factors with which they interact constitute an ecosystem.  
Populations of organisms can be categorized by the function they serve in the ecosystem.

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### Stream Observation Data Sheet

<b>School</b>	<b>Date</b>
<b>Stream Study Site</b>	
<b>Teacher</b>	<b>Group Members:</b>
<b>Latitude</b> _____ degrees NORTH	<b>Longitude</b> _____ degrees WEST
Weather	
<b>Yesterday</b>	<b>Today</b>
<b>Air Temperature</b> _____ ° C or ° F	<b>Air Temperature</b> _____ ° C or ° F
<b>Cloud Cover</b> clear _____ partly cloudy _____ cloudy _____	<b>Cloud Cover</b> clear _____ partly cloudy _____ cloudy _____
<b>Precipitation</b> _____	<b>Precipitation</b> _____
How could yesterday's weather affect today's field study?	

### Macroinvertebrate Survey

<b>Collection method used: Kick-Seine or D-Net (circle).</b>	<b>Benthic Habitat Sampled</b>														
If using a kick-seine, collect samples 3 times.	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Habitat</th> <th># scoops</th> </tr> <tr> <td>Riffle</td> <td></td> </tr> <tr> <td>Rootwads/woody debris/leaf pack</td> <td></td> </tr> <tr> <td>Submerged Vegetation</td> <td></td> </tr> <tr> <td>Undercut Banks</td> <td></td> </tr> <tr> <td>Other (specify):</td> <td></td> </tr> <tr> <td style="text-align: right;"><b>TOTAL</b></td> <td style="text-align: center;"><b>20</b></td> </tr> </table>	Habitat	# scoops	Riffle		Rootwads/woody debris/leaf pack		Submerged Vegetation		Undercut Banks		Other (specify):		<b>TOTAL</b>	<b>20</b>
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<b>TOTAL</b>	<b>20</b>														
If using a D-net, collect 20 scoops and record the number of scoops taken from each of the habitat areas in the table →															
<b>Check all of the macroinvertebrates that you find in your stream and calculate the stream's water quality rating (you may also record the number of each captured, but to calculate the rating at the bottom, only count each kind of animal once, regardless of the quantity found).</b>															
SENSITIVE to pollution	LESS SENSITIVE	TOLERANT of pollution													
✓	✓	✓													
Caddisflies (except net spinners)	Caddisflies, common net spinning	Crayfish													
Mayflies	Dobsonflies	Scuds													
Stoneflies	Fishflies	Aquatic sowbugs													
Watersnipe flies	Crane flies	Clams													
Riffle beetles	Damselflies	Mussels													
Water pennies	Dragonflies	Lunged snails													
Gill net	Dragonflies														

# What students do during the field experience



- Design and/or participate in investigations to collect data in the field and/or classroom
- Review data and compare to expected results
- Repeat protocol or modify as needed

# What students do after the field experience



- Discuss to evaluate validity of investigative results.
  - Compare data collected by classmates
  - Compare data collected by community groups
- Collect additional data as needed
- Analyze data to identify trends

# Explaining Results

- Making connections between stream health and human activities



# Explaining Results

- Analyze data to make inferences related to the essential question
  - Student data (own and others)
  - Agency data
- Share the data
  - Student-student discourse/Student-teacher discourse
  - Upload to FieldScope
  - Write an essay to explain the results



# Making Connections

- Make inferences on the health of the stream
- Conduct additional research as needed
- Construct an argument about the best way to reduce the impact on the stream ( “claim – evidence – reasoning” )

# Extending Learning to Civic Action

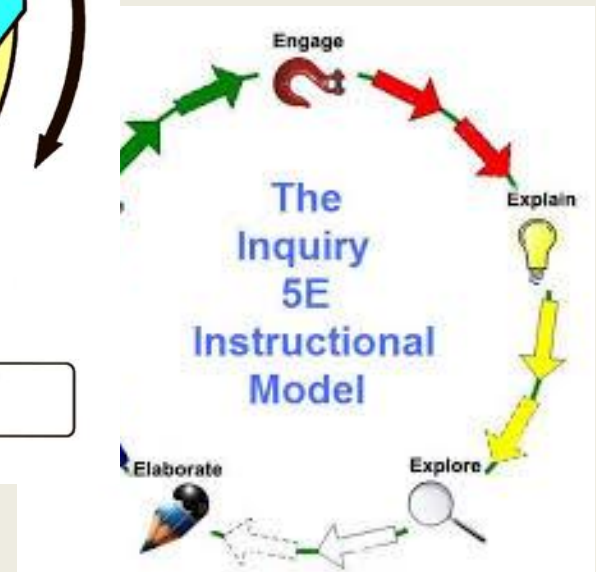
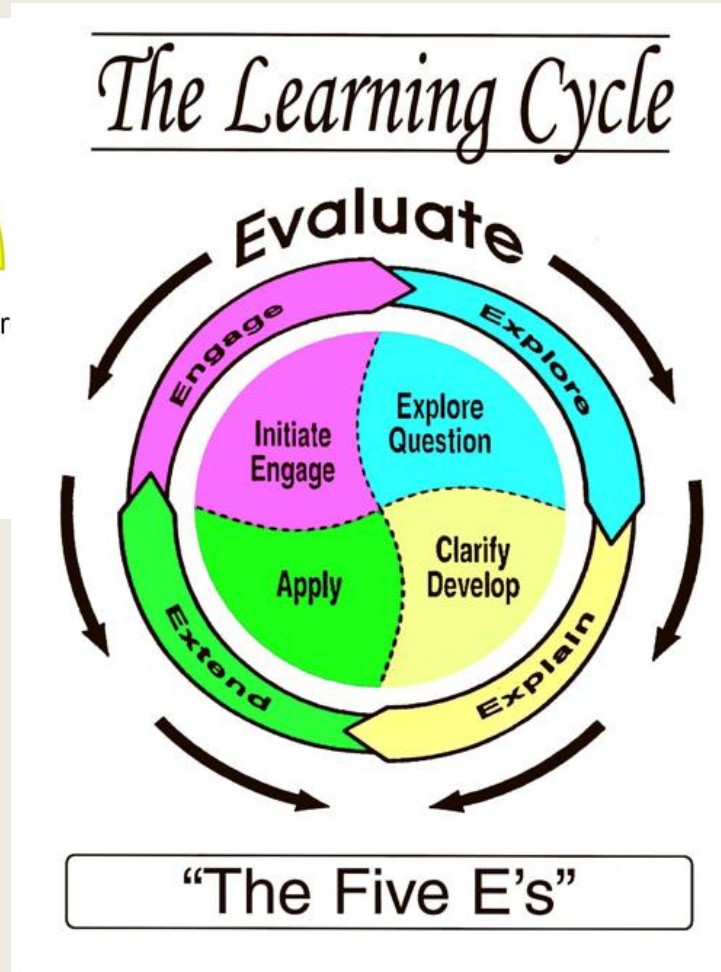
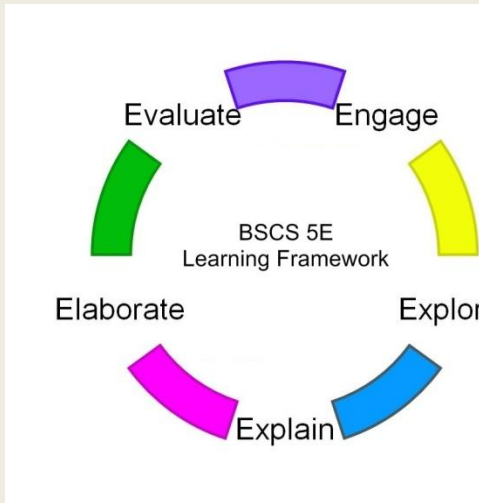


# Engaging in Civic Action

- Student(s) identify appropriate strategy for action
- Work collaboratively to address the issue
  - Identify resources
  - Establish partnerships
  - Anticipate obstacles
- Implement strategy
- Reflect on the effectiveness of the strategy

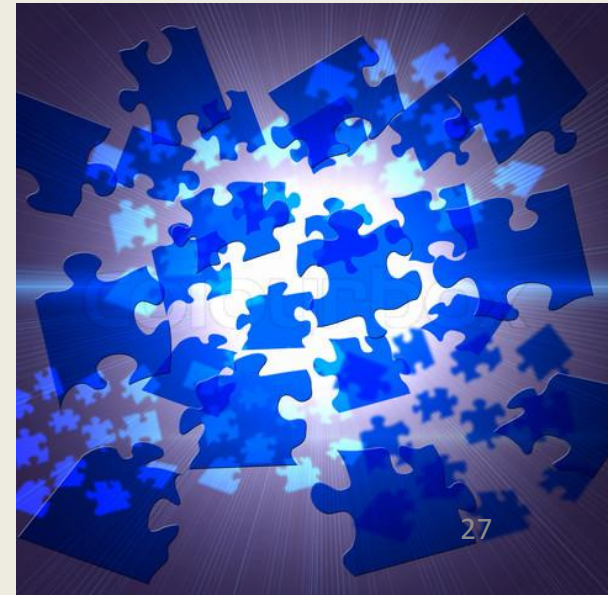


# What Instructional Format was Used?



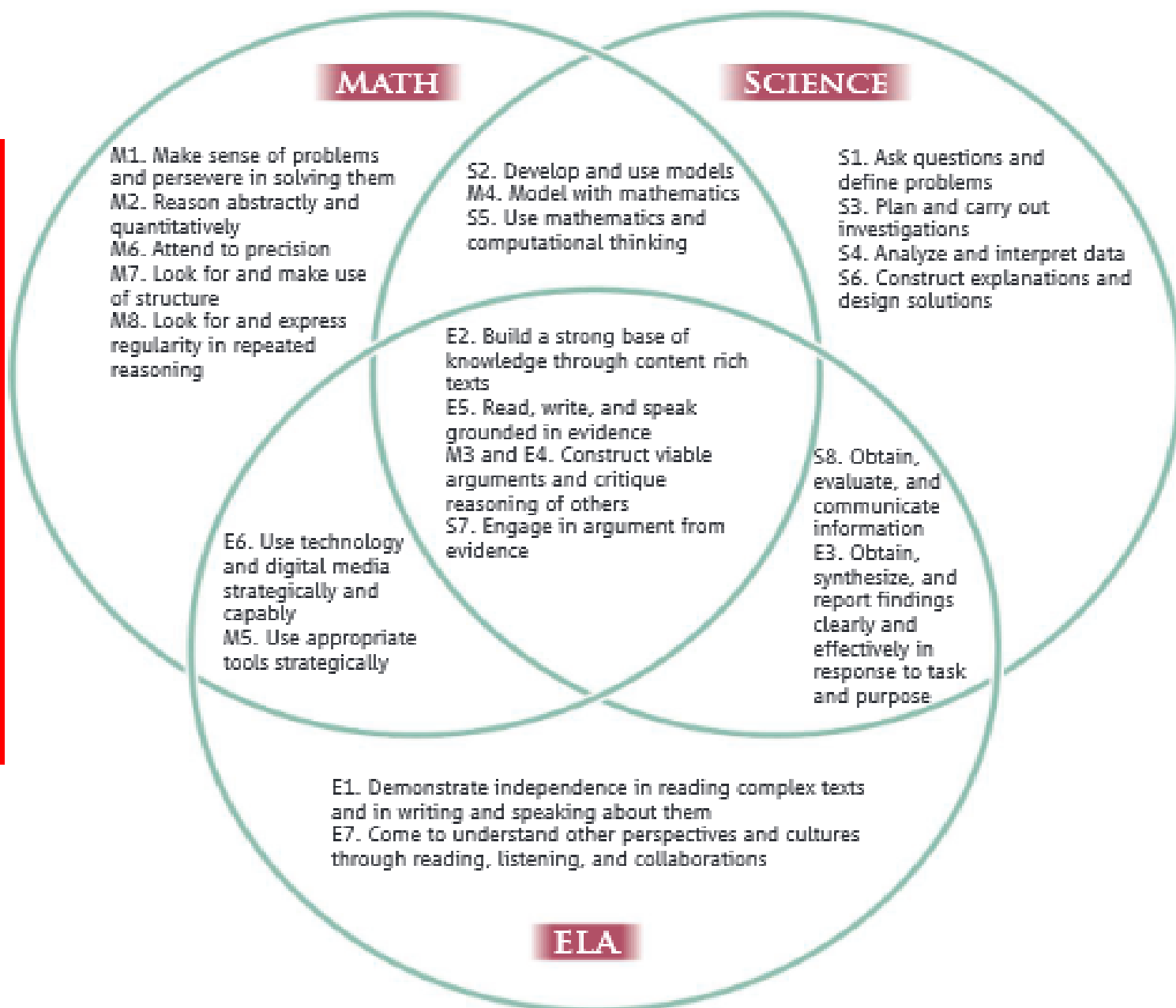
# Jigsaw

- Share your individual observations
- Discuss as a group
- Summarize the Ahas
- Identify the Take Aways
- Discuss the implications for your and/or for instruction
- Report to all



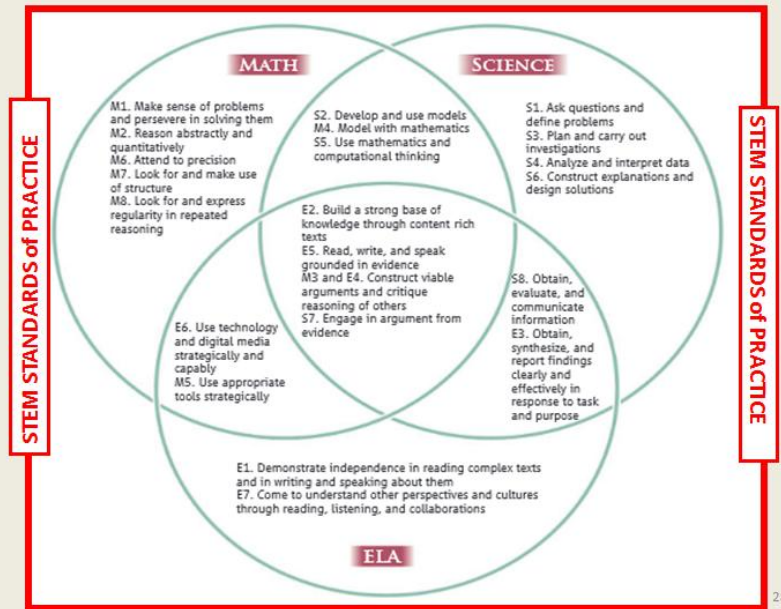
**STEM STANDARDS of PRACTICE**

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**end**

[additional info]



For the above Venn diagram (previous slide) showing the relationship of ELA, Math, NGSS, and STEM, here are the links that were mentioned:

<http://nstahosted.org/pdfs/ngss/PracticesVennDiagramColor.pdf> (COLOR)

<http://nstahosted.org/pdfs/ngss/PracticesVennDiagramBW.pdf> (BLACK & WHITE)

These links do not include STEM—the rectangle around the outside edge was added to indicate that STEM really touches everything.