Addressing the Standards…What Does It Look Like in Practice?

MD Partnership for Children in Nature

January 30, 2014

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 21st 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

STEM Standards of Practice

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Capacities of Literate Individuals

INDEPENDENCE

STRONG CONTENT KNOWLEDGE

COMPREHEND AND CRITIQUE

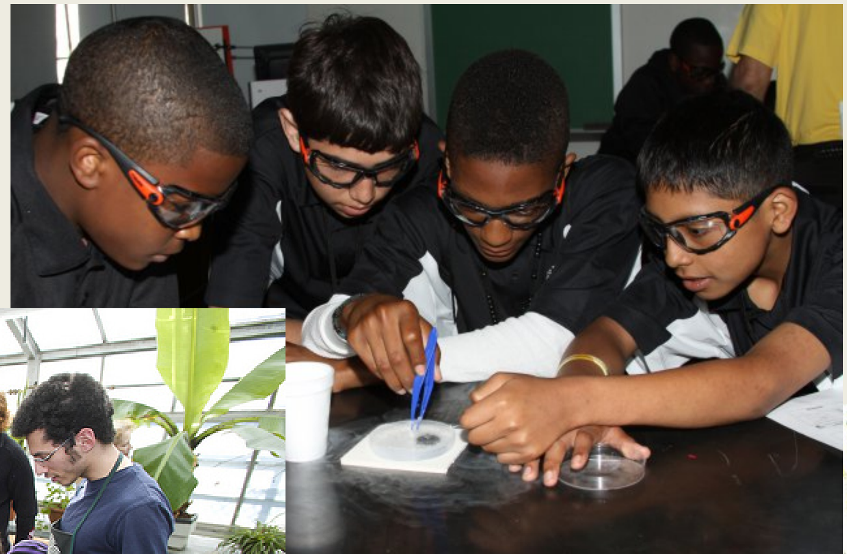
UNDERSTAND PERSPECTIVES AND CULTURES

USE TECHNOLOGY

RESPOND TO VARIOUS DEMANDS

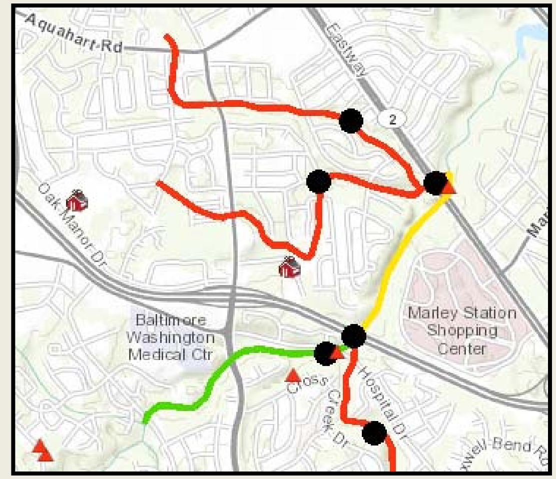
VALUE EVIDENCE

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

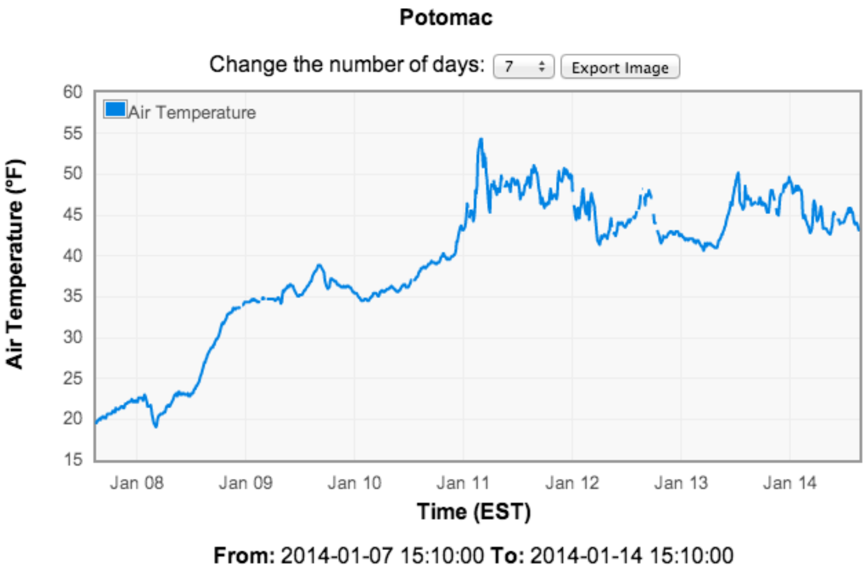
How can we reduce the impact of human activities on the water quality of streams in Maryland?

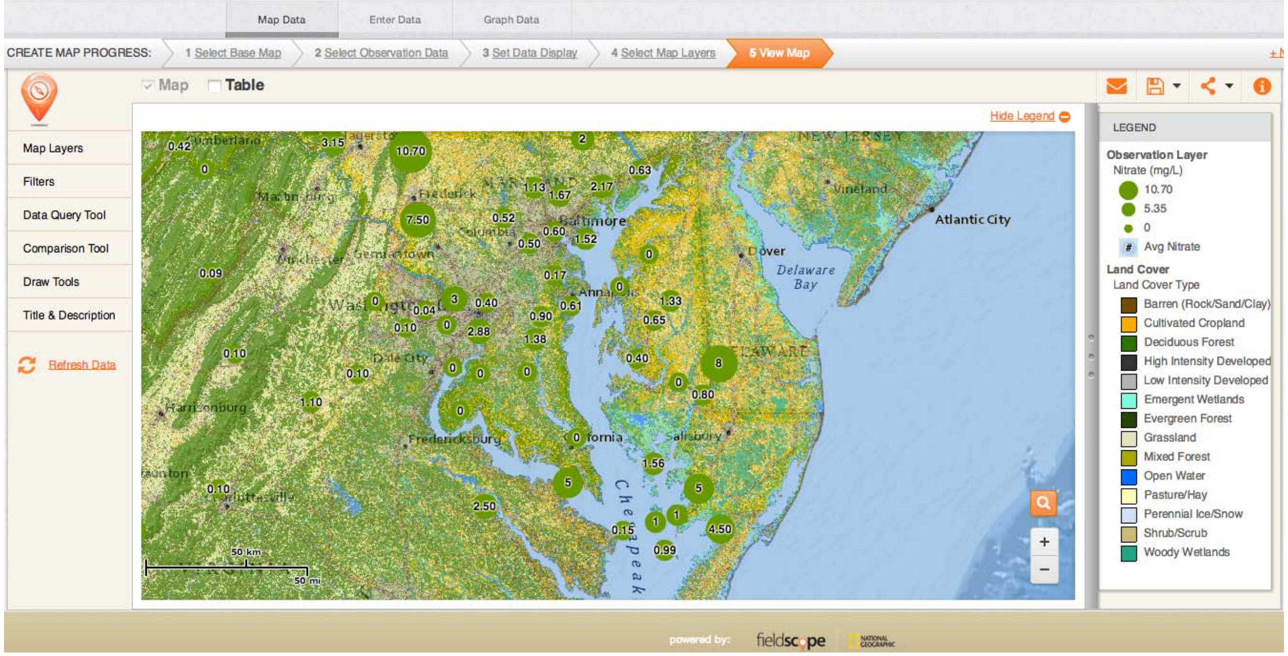
The Essential Question

- 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





What students do in the classroom before the field experience

- Participate in guided inquiry activities to build background knowledge
- Identify resources appropriate to the essential question
  - Protocols
  - Equipment
  - Methods to collect data
  - Dichotomous keys
  - Field guides

Student Preparation

- Review literature for relevant background information

JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION
JUNE AMERICAN WATER RESOURCES ASSOCIATION 2005

STREAM HEALTH RANKINGS PREDICTED BY SATELLITE DERIVED LAND COVER METRICS[1]

Marcia N. Snyder, Scott J. Goetz, and Robb K. Wright[2]

ABSTRACT: Land cover and land use change have long been known to influence the chemical, physical, and biological characteristics of streams. This study makes use of land cover maps derived from fine resolution satellite imagery and an extensive stream quality dataset to determine the relationship between small watershed health rankings and land cover composition and configuration. Landscape metrics were derived from digital impervious surface area (ISA), tree cover (percent), and agricultural crop maps within Montgomery County, Maryland. Watershed rankings were developed by state and county collaborators (MD-DNR and MCDEP) using extensive biological and chemical measurements. In stepwise logistic regression models the factors accounting for the most variation in stream health ranking were the percent ISA, followed by the percent of tree cover. Riparian buffer zone tree cover was also a significant predictor. Of the metrics that considered the spatial configuration of the landscape, a contagion index and the percent of ISA in the flow path from the ISA to the stream were also found to be significant predictors of stream health. Despite limited ability to characterize landscape configuration or narrow riparian buffer zone vegetation with coarser resolution imagery (from Landsat), model results were not significantly different from those based on the use of fine-resolution ISA information, suggesting that broader area applications of the approach are possible. The results indicate that management practices designed to improve stream water quality should focus on the amount of ISA and tree cover in both the watershed and within the buffer zone.

(KEY TERMS: land use planning; remote sensing; restoration; riparian buffers; stream health; urbanization; water quality; watershed management.)

Snyder, Marcia N., Scott J. Goetz, and Robb K. Wright, 2005. Stream Health Rankings Predicted by Satellite Derived Land Cover Metrics. Journal of the American Water Resources Association (JAWRA) 41(3):659-677.

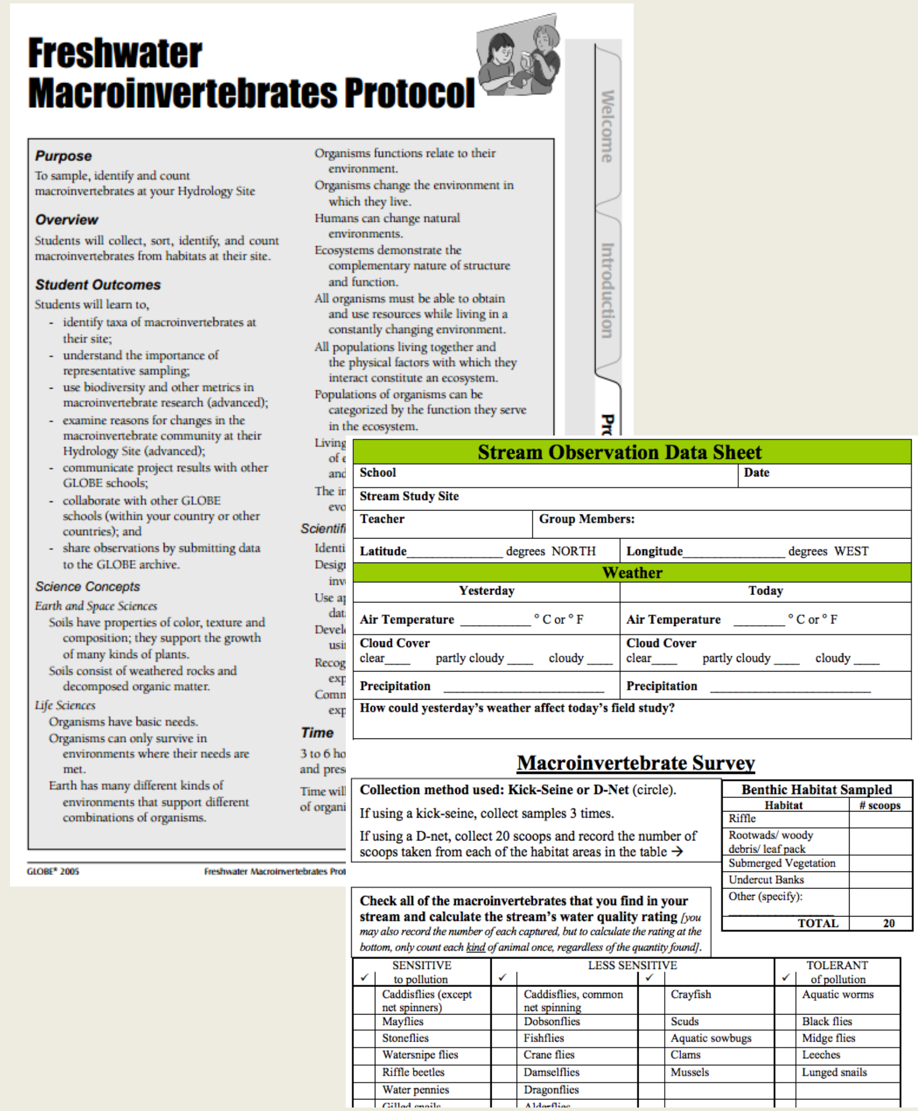
INTRODUCTION

The National Academy of Sciences has identified land cover and land use change as one of the primary drivers affecting ecological systems (NRC, 2001; U.S. Global Change Research Program, 2003). Freshwater systems are especially vulnerable to land use change, particularly the increased urbanization occurring across much of the nation, which has contributed to changes in aquatic community structure and degradation of stream biota (e.g., Wang *et al.*, 2001; Nilsson *et al.*, 2003). Currently more than 70 percent of freshwater mussels, 55 percent of crayfish, 42 percent of amphibians, and 40 percent of freshwater fishes are either vulnerable, imperiled, or critically imperiled in the United States (USEPA, 2002). In the Chesapeake Bay watershed, numerous studies have demonstrated the association between land use changes and the degradation of the biological, chemical, and physical quality of streams (Liu *et al.*, 2000; Jones *et al.*, 2001; Palmer *et al.*, 2002; Paul *et al.*, 2002). In the State of Maryland 46 percent of all streams are in poor condition, based on a combined macroinvertebrate and fish Index of Biological Integrity (IBI), and the proportion of urban land cover is expected to increase to between 16 and 21 percent of total land area within the next 25 years (Boward *et al.*, 1999). In the greater Baltimore-Washington, D.C., region, urban and residential lands surrounding the Chesapeake Bay have increased by 63 percent in the 15 years from1986 through 2000, and a predictive model calibrated with these results estimates an additional 80 percent

[1]Paper No. 03153 of the *Journal of the American Water Resources Association* (JAWRA) (Copyright © 2005). **Discussions are open until December 1, 2005.**
[2]Respectively, Organization for Tropical Studies, La Selva Biological Station, San Pedro, Costa Rica; The Woods Hole Research Center, P.O. Box 296, Woods Hole, Massachusetts 02543-0296; and NOAA Special Projects Office, 1305 East-West Highway, Silver Spring, Maryland 20910 (E-Mail/Goetz: sgoetz@whrc.org).

Student Preparation

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



What students do during the field experience

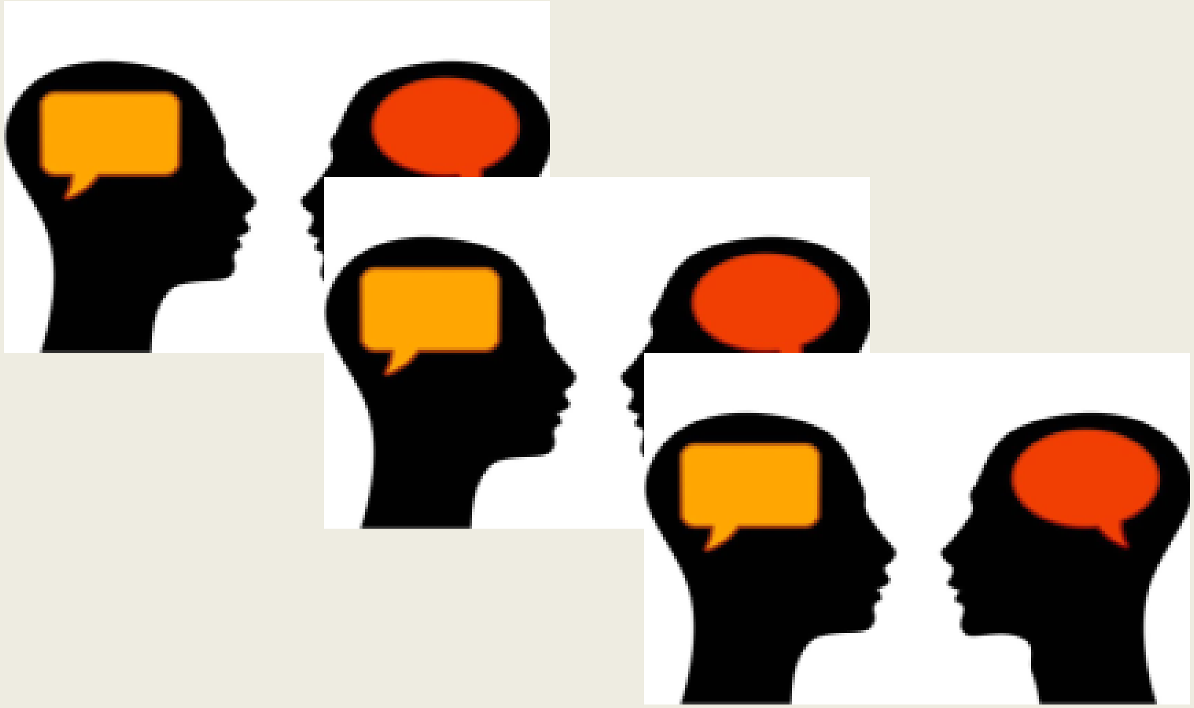
- Design and/or participate in investigations to collect data in the field and/or classroom
- Review data and compare to expected results
- Repeat protocol or modify as needed

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

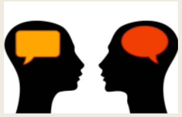
Explaining Results

- 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

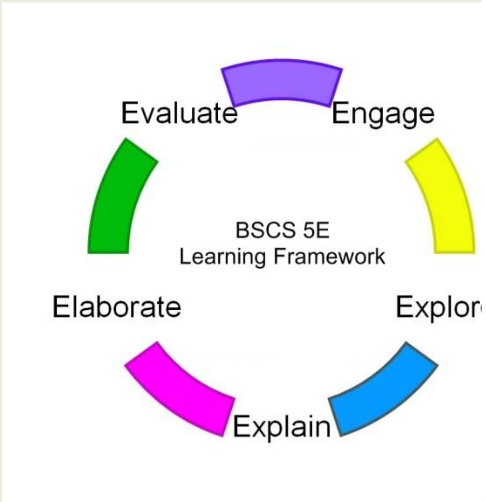
- Make inferences on the health of the stream
- Conduct additional research as needed
- Construct an argument about the best way to reduce the impact on the stream (“claim – evidence – reasoning”)

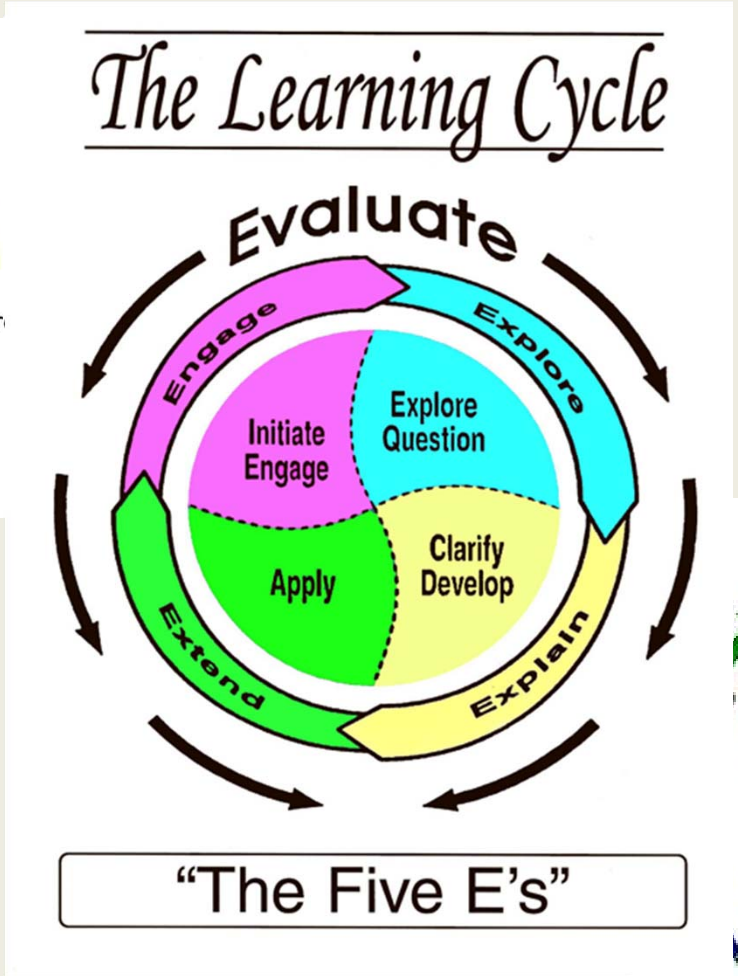
Extending Learning to Civic Action

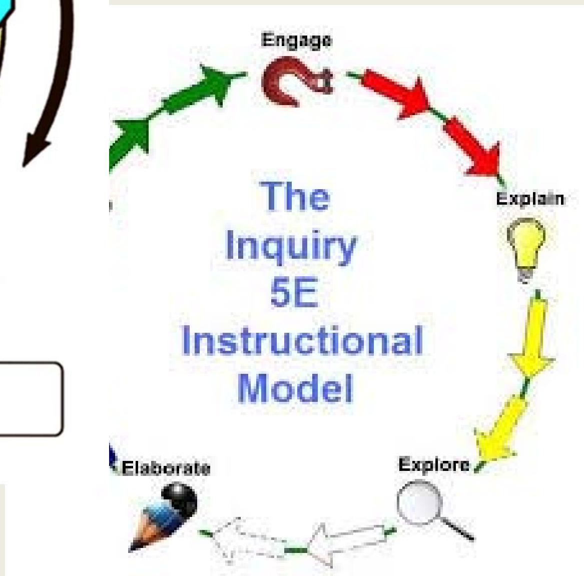
Engaging in Civic Action

- 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?

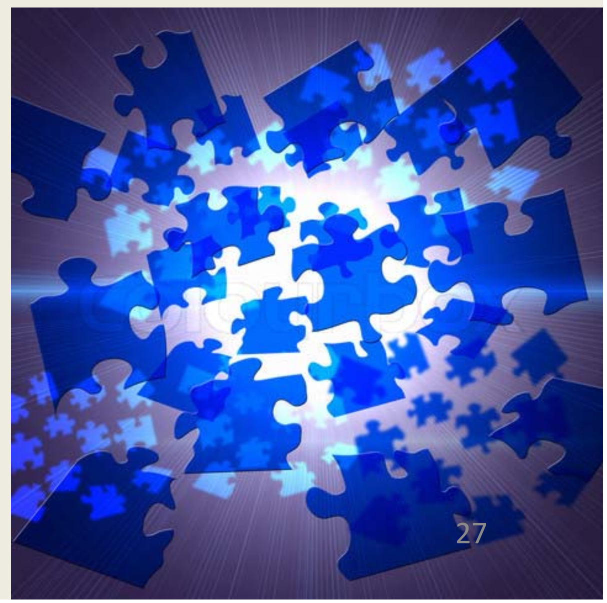


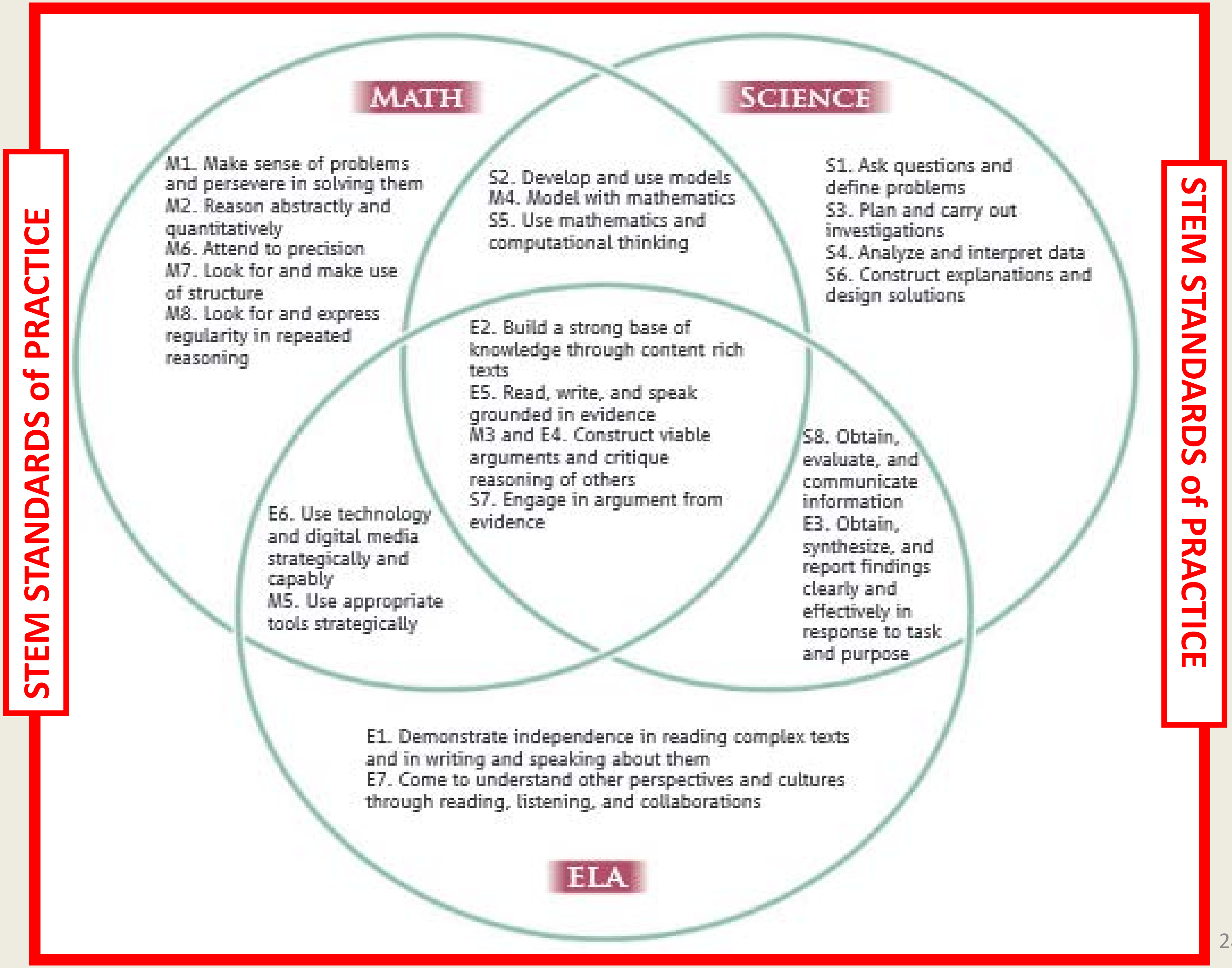




Jigsaw

- Share your individual observations
- Discuss as a group
- Summarize the ahas
- Discuss the implications for your program and/or for instruction
- Report to all




STEM STANDARDS of PRACTICE
MATH
SCIENCE
M1. Make sense of problems and persevere in solving them
M2. Reason abstractly and quantitatively
M6. Attend to precision
M7. Look for and make use of structure
M8. Look for and express regularity in repeated reasoning
S2. Develop and use models
M4. Model with mathematics
S5. Use mathematics and computational thinking
S1. Ask questions and define problems
S3. Plan and carry out investigations
S4. Analyze and interpret data
S6. Construct explanations and design solutions
E2. Build a strong base of knowledge through content rich texts
E5. Read, write, and speak grounded in evidence
M3 and E4. Construct viable arguments and critique reasoning of others
S7. Engage in argument from evidence
E6. Use technology and digital media strategically and capably
M5. Use appropriate tools strategically
S8. Obtain, evaluate, and communicate information
E3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose
E1. Demonstrate independence in reading complex texts and in writing and speaking about them
E7. Come to understand other perspectives and cultures through reading, listening, and collaborations
ELA
STEM STANDARDS of PRACTICE