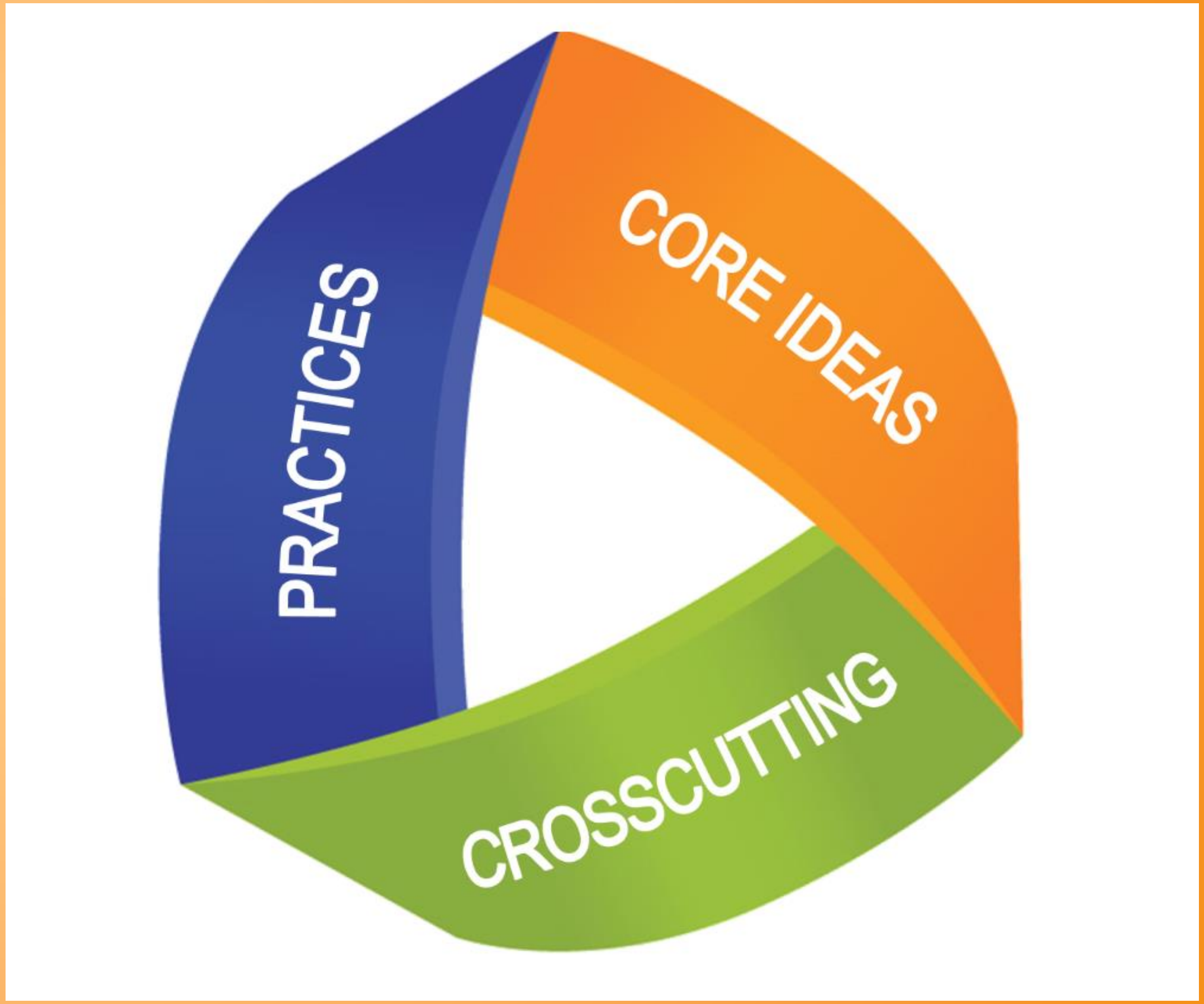
Welcome to "Citizen Science: Integrating all FIVE Dimensions of the NGSS"

Holly Hereau

Lee M. Thurston High School
Redford, MI
Twitter: @hhereau
https://hollyhereau.weebly.com

A culture of "Figuring Out"

- Students uncover important science concepts and idea through the use of science practices
- We use a problem or a phenomenon to create a culture of figuring out for all students



Disciplinary Core Ideas:

- Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline;
- Provide a key tool for understanding or investigating more complex ideas and solving problems;
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge;
- Be teachable and learnable over multiple grades at increasing levels of depth and sophistication.

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Don’t have students climb ladders … but do

- If we want create a classroom culture where ALL students are part of the knowledge building - **we need to give students access to experiences.**

- Thinking about student interest and identity as the “other 2 dimensions” helps keep that at the forefront whenever I’m planning lessons

Citizen Science = meaningful access to experiences

To ensure the experiences are meaningful they need to be

- motivated by the students
- directly connected to what they are trying to figure out

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So…
How do I as a teacher make sure this happens if the students are doing the figuring out?

Great Lakes Watershed field course

- National Oceanic and Atmospheric Administration (NOAA) B-WET grant

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Workshop June 2017 and July 2018 (another workshop will be offered again this summer! Applications have been extended to April 15th - Click HERE to apply)

Next Generation Science Storylines

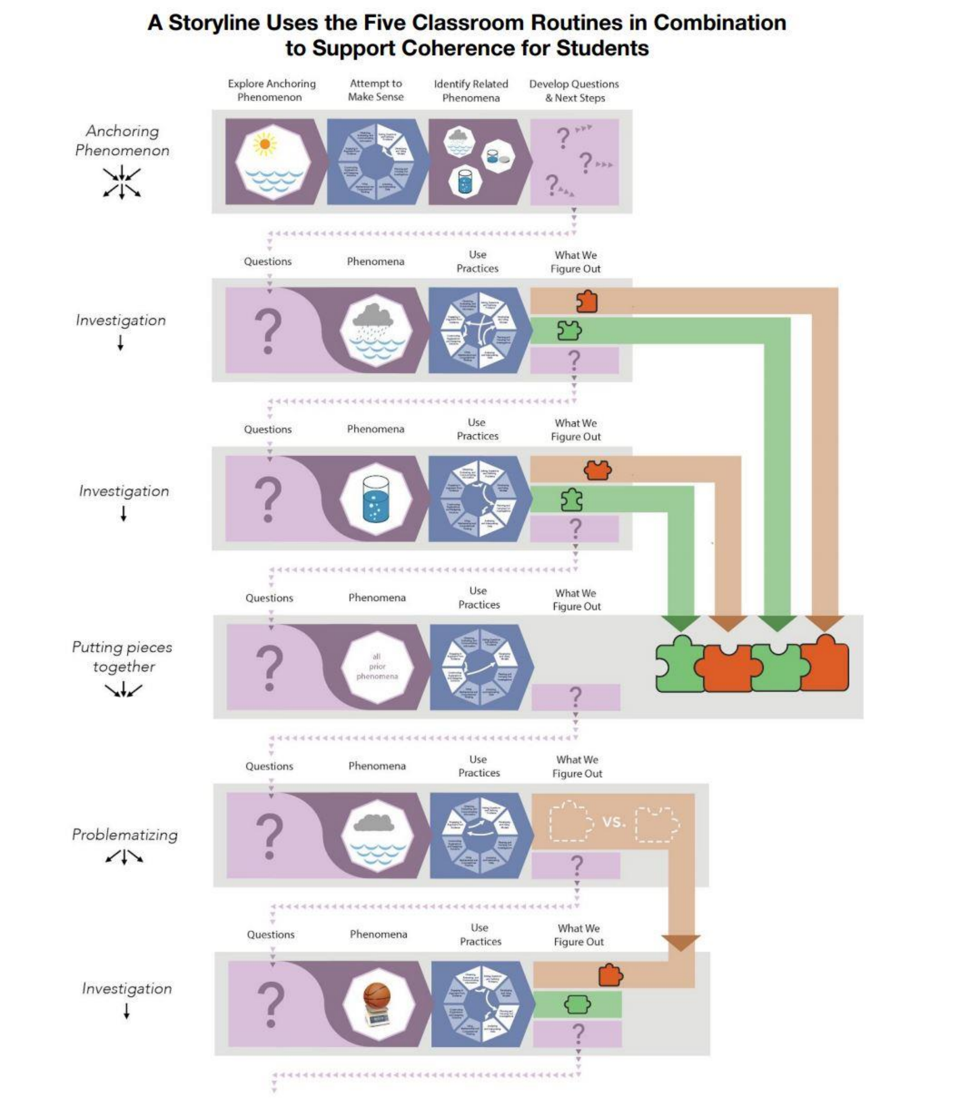
- Learn While Teaching Workshop - August 2017
- Better understanding of the Framework
- How can I make my classes more equitable?
- How do I create lessons where ALL students are part of the knowledge building?

Storylines

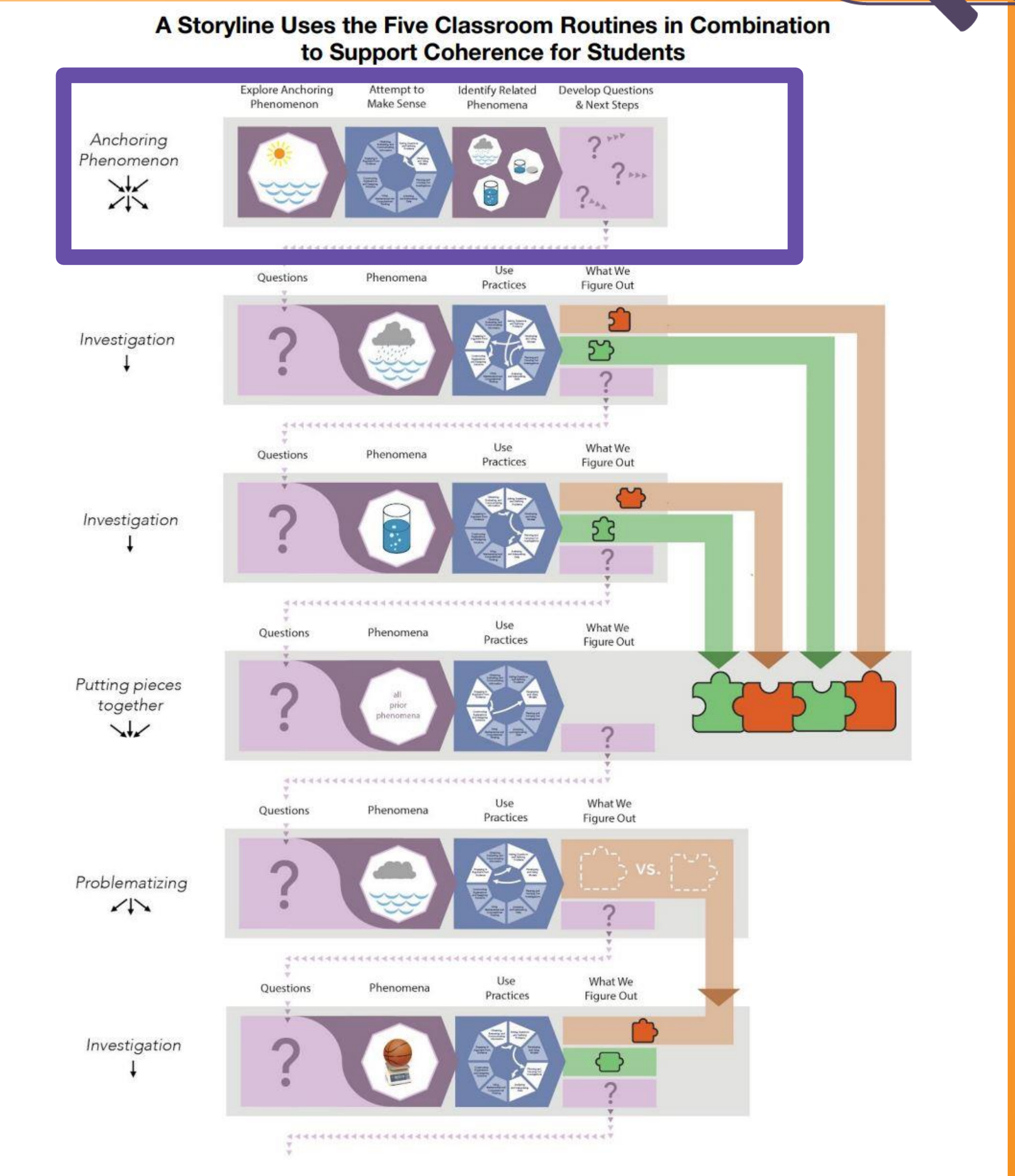
- We figure out the science ideas
- We figure out where we are going at each step
- We figure out how to put the ideas together over time

Earth Force Framework

Next Generation Science Storylines

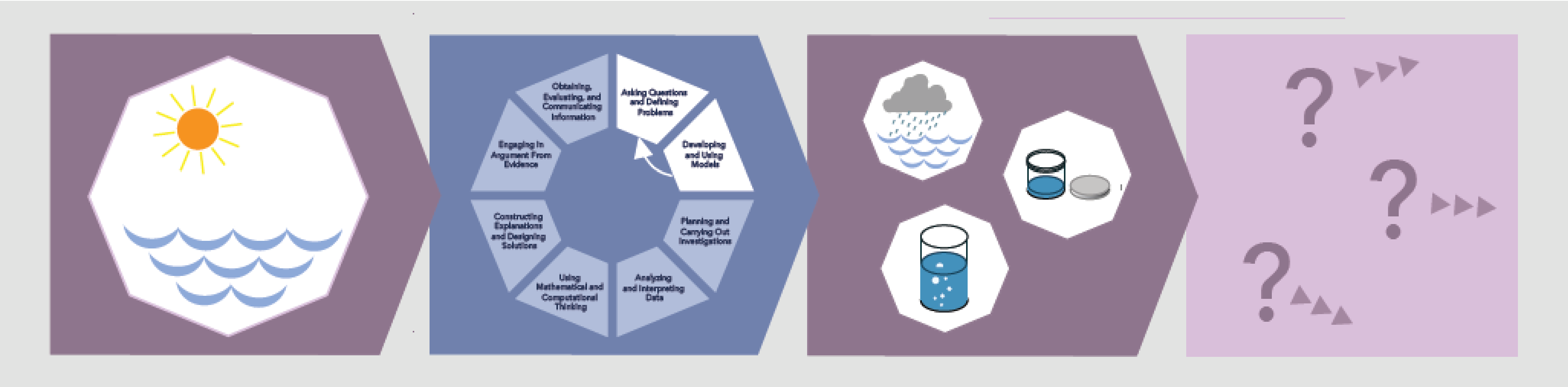


Earth Force / NextGenStoryline “Parallels”



NextGenStoryline Anchoring Phenomenon Routine

Explore Anchoring Phenomenon	Attempt to Make Sense	Identify Related Phenomena	Develop Questions & Next Steps



Community Environmental Inventory

- Energy Audit
- Recycling Audit
- Environmental/Carbon footprint
- Food Waste Audit
- Guided Walking Tour
  - Pervious/Impervious Materials
  - Storm Water
  - Water Drainage
- Interviews
- Online Databases

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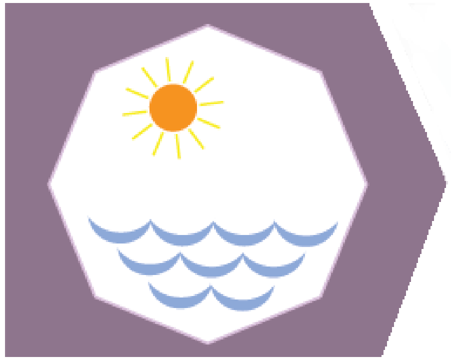
STEP 1: DISCOVER
COMMUNITY ENVIRONMENTAL INVENTORY



Explore Anchoring Phenomenon

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Through this work students began to IDENTIFY with these issues because it is part of their direct world they live and interact in.

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This builds student INTEREST in all of these pieces - because now they see how their lives intersect with the issues in their community

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"I've learned more in the first two weeks of this class than I have ever learned in any class for the whole year"

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Community Environmental Inventory data discussion

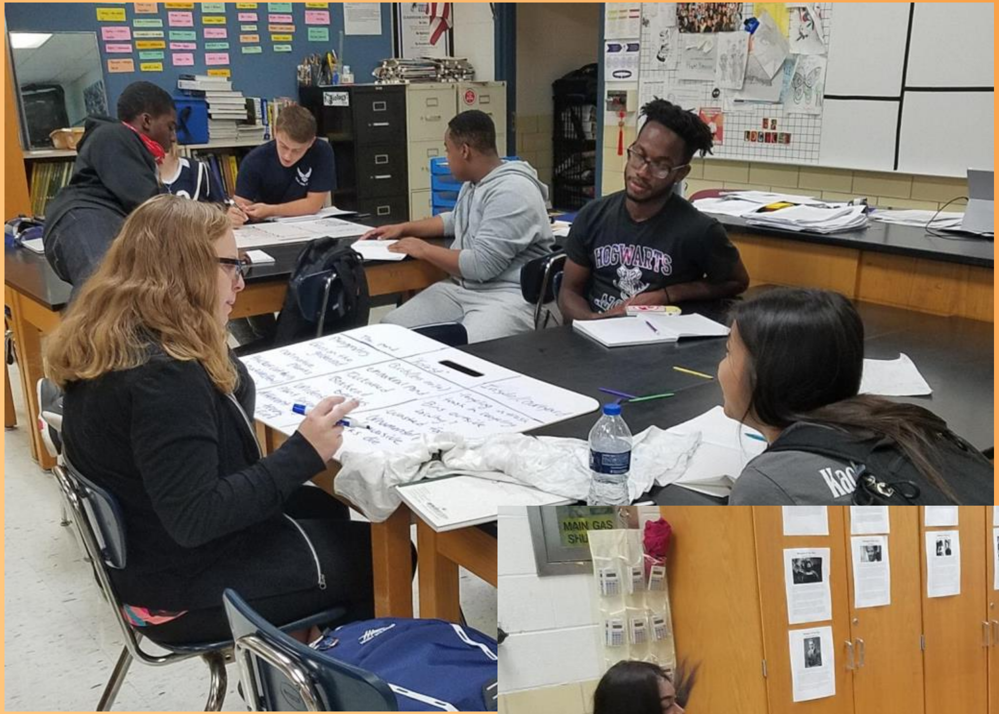
Determined Community Strengths and Potential Issues (listed below) after completing the audits:

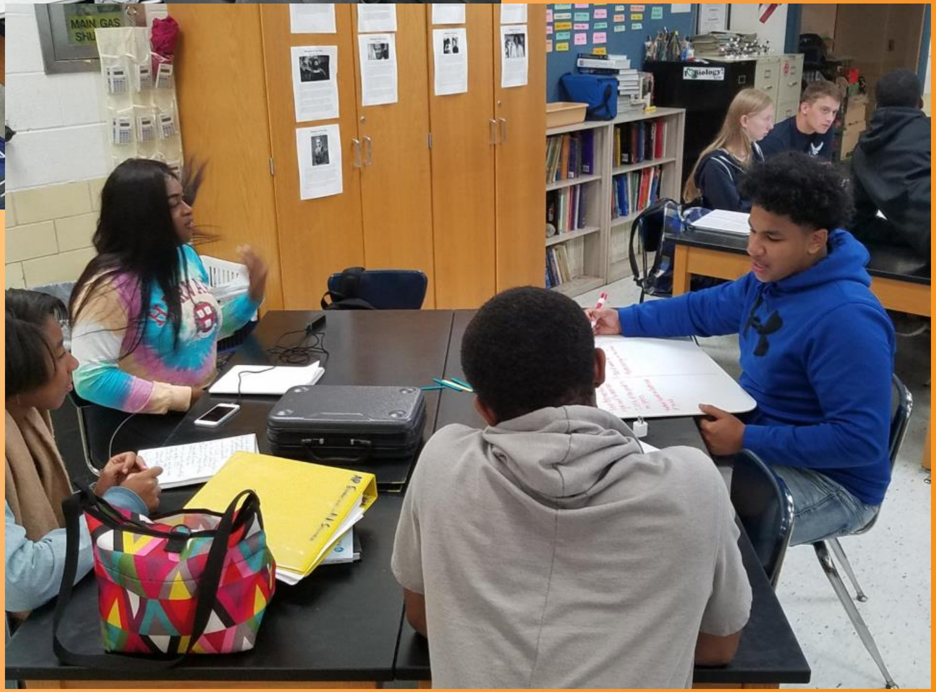
- Food waste in our cafeteria
- electricity/energy waste throughout the building
- lack of convenient recycling opportunities for both plastic and paper
- several areas on campus where water pooled
- lots of impervious surfaces that ran directly into the sewer
- a human-made “pond” that was in disrepair and covered in duckweed and algae
- a retention pond/drainage ditch that had been overrun by invasive species

Attempt to Make Sense

Issue Selection - Asking and Answering Initial Questions

- Determined list of initial questions that had to be addressed
  - Exploring cause and effect
  - Exploring assets and constraints involved
  - Does it meet the goal of improving watershed health?
- Groups presented potential projects to class





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Goal and Project Selection

- The class decided on criteria that will help decide which project to choose. They addressed each of these criteria when presenting their group proposals:
  - **REALISTIC** will students be able to complete the project given the available resources?
  - **PRECEDENT** have others tried doing this before, and how well did it work?
  - **RELEVANCE** how much will the project actually address the problem we identified?
  - **SIMPLICITY** how easy or difficult will the project be to carry out?
  - **IMPACT** how likely is it that the project will have a lasting impact?
  - **OPPOSITION** how much opposition will you likely get from other people or organizations?

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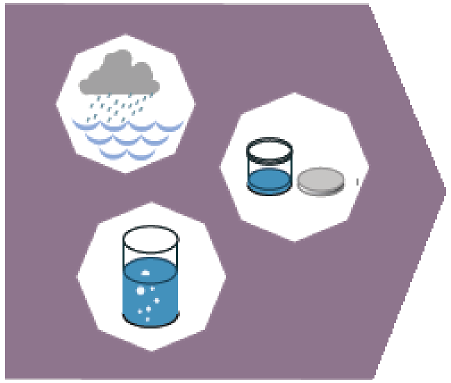
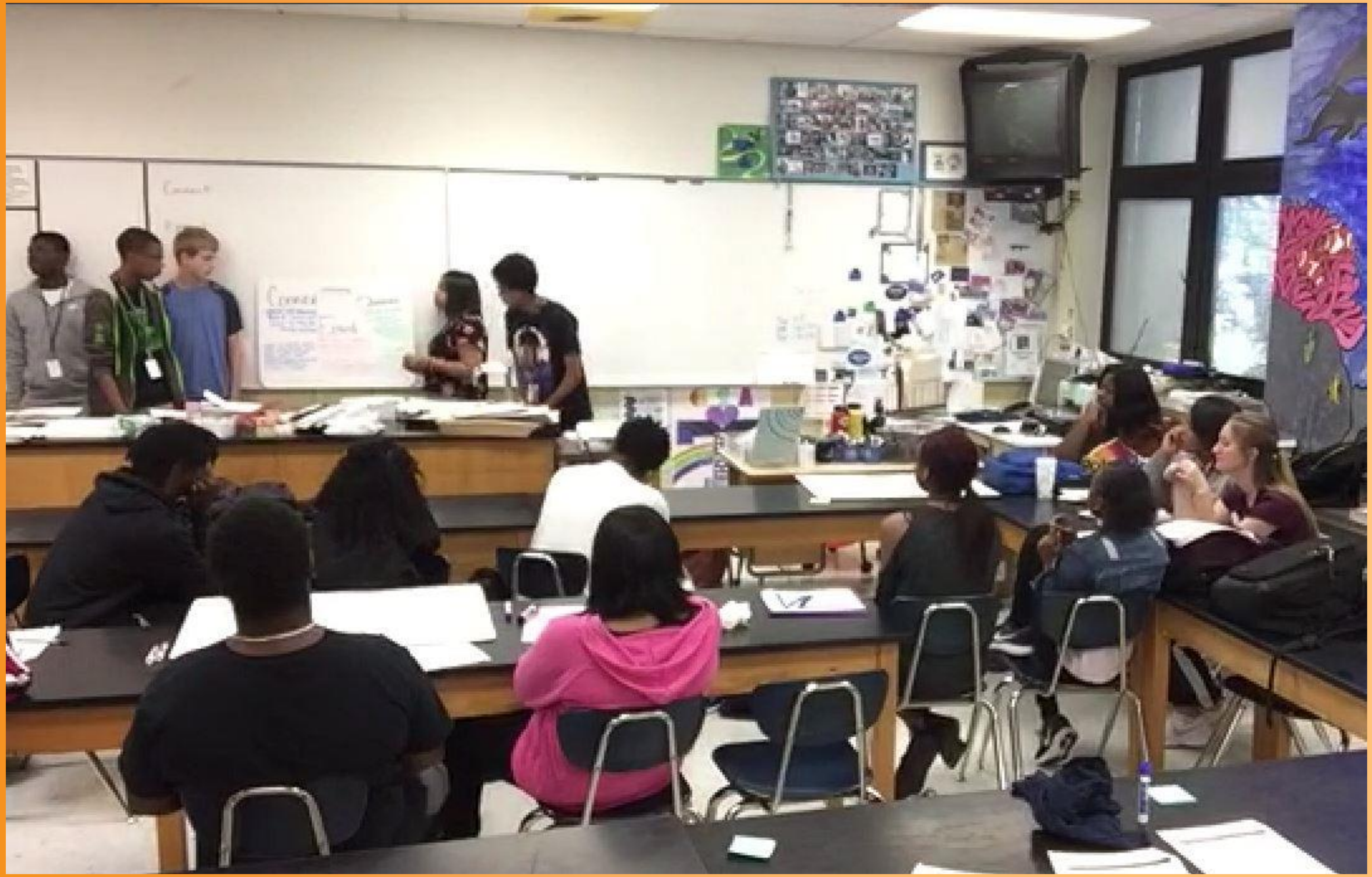
STEP 3: DISCOVER
POLICY AND COMMUNITY
PRACTICE RESEARCH



Identify Related Phenomena

Issue Selection - Consensus



The *Phragmites* infested retention pond

- has low biodiversity
- is not attracting pollinators
- is providing habitat for undesirable mammals (namely rats)
- dense reeds are trapping a lot of trash which was an eyesore and could cause other problems too
- Water is “dirty”

Project Goals

Student Goals

1. Improve watershed health
2. Increase biodiversity
3. Create opportunities for elementary and middle school students to have a local field trip where they learn about factors affecting the health of their local environment
4. Create opportunities for students (my AP students) to teach these concepts to the other students to raise awareness
5. Create outdoor space where students have place-based educational opportunities

Teacher Goals - Student Goals *PLUS*:

6. Prepare my students for the AP Environmental Exam by increasing their understanding of key content knowledge and science practices
7. Increase the analytical and critical thinking skills of students.
8. Increase the likelihood that students will think about the environment and become good environmental stewards and/or activists.
9. Increasing student knowledge of how to approach community leaders and think about stakeholders when leading stewardship action projects
10. Increase the likelihood that students will choose to go outside for recreation

Students Identified Questions they still need to answer

What do we need to figure out to be able to do this?

- What plants do we want?
- Why do we need a pond there? What does it do? Where would the water go otherwise? What are all these big things that look like drains?
- Retention pond/rain garden design - How big will it have to be? Where is the water coming from and how much water enters after rain events?

How will they find the information?

Who will find the information?

Do we need permission to do this?

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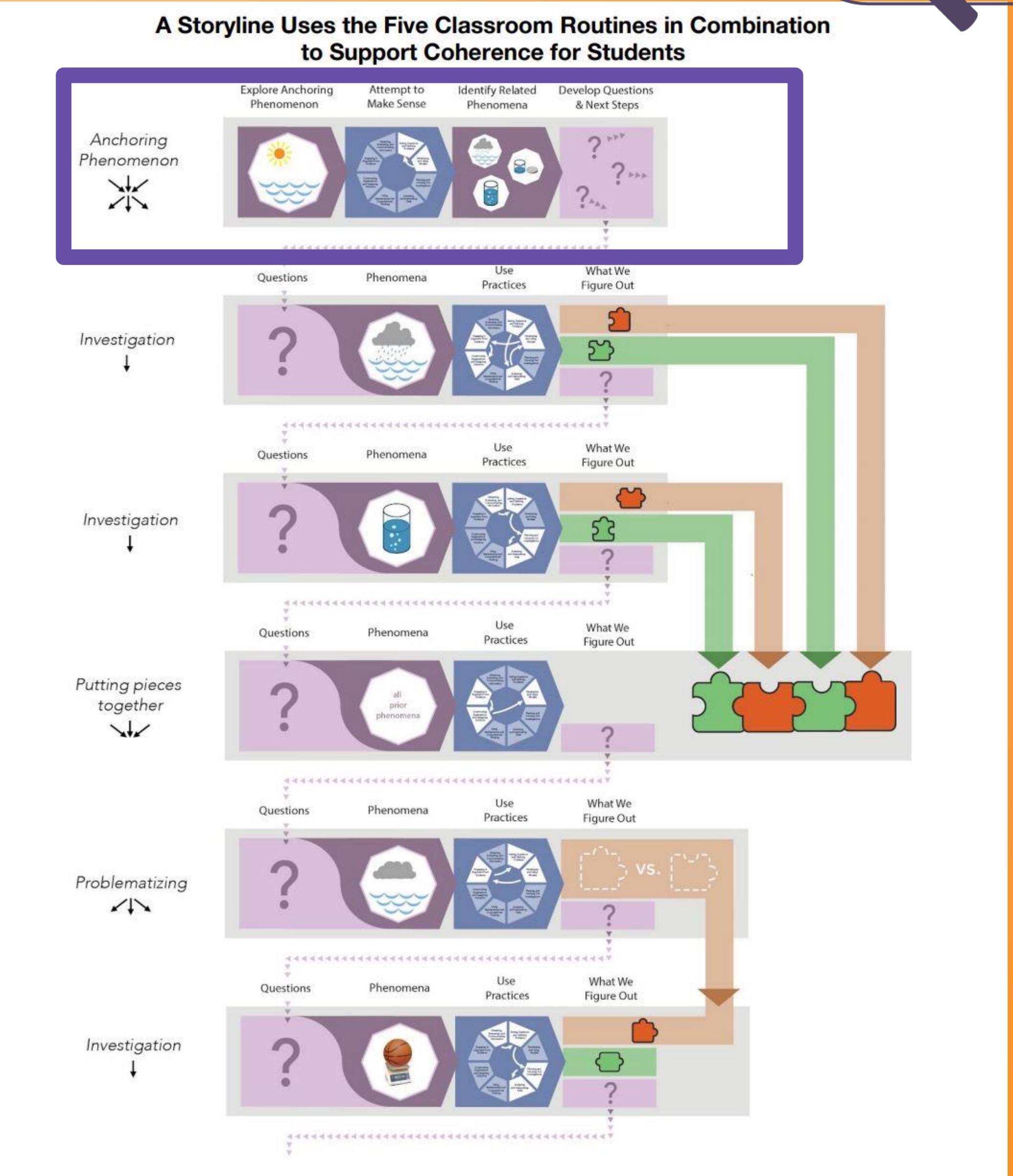
STEP 4: DECIDE
GOAL AND STRATEGY SELECTION

Develop Questions & Next Steps

Earth Force / NextGenStoryline "Parallels"



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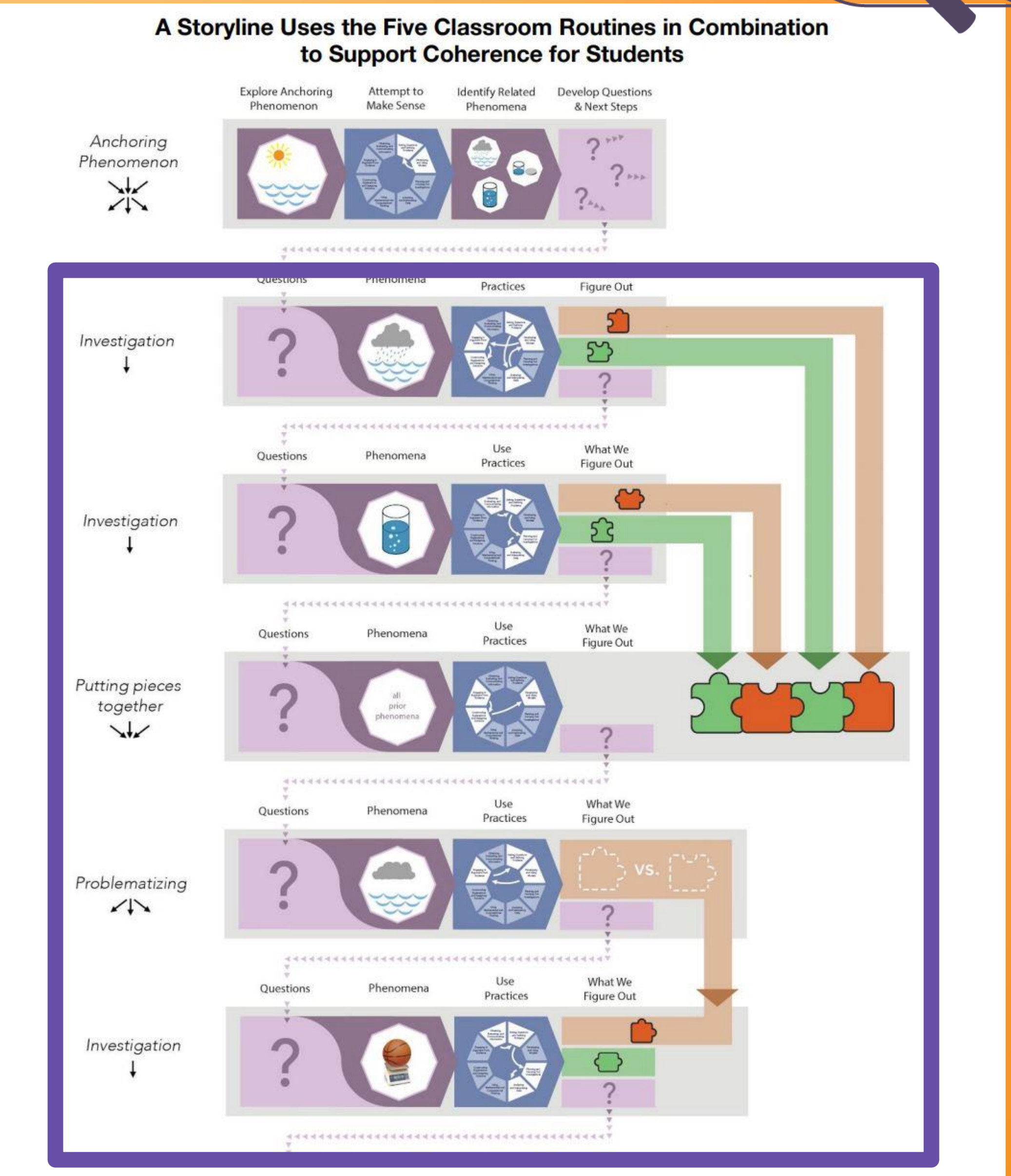

Planning and Taking Civic Action

Students formed task committees

- Soil type
- Native plant selection
- Equipment budget – determine best vendors
- Permitting for herbicide (do we need it?)
- Herbicide choice
- Methods removal and disposal
- Meeting with Superintendent for project approval

Developed a project timeline

- Herbicide treatment - no permit necessary (fall 2017)
- Start seeds in greenhouse (late winter/early spring 2018)
- Mechanical removal and/or controlled burn - sadly we did not get permission for burn (Spring 2018)
- Due to a late spring, removal began later than anticipated and we already had nesting red-wing blackbirds. 80% of the biomass was removed (Spring 2018)
- students agreed project would need an extended timeline
- Identification of new growth (Fall 2018)
- THTV updates
- Spot treatment for returning Phragmites (Fall 2018)
- Final Biomass Removal (Spring 2019)
- Partial planting and pilot field trip event (Spring 2019)

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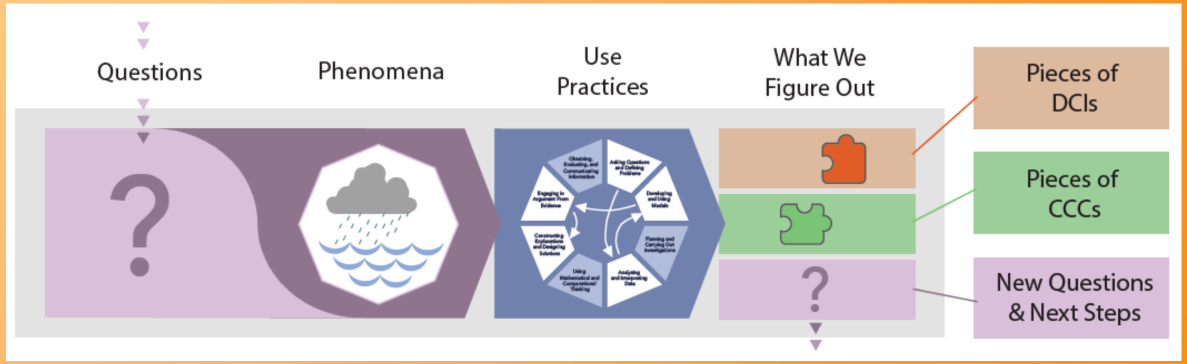



CHICAGO
verizon







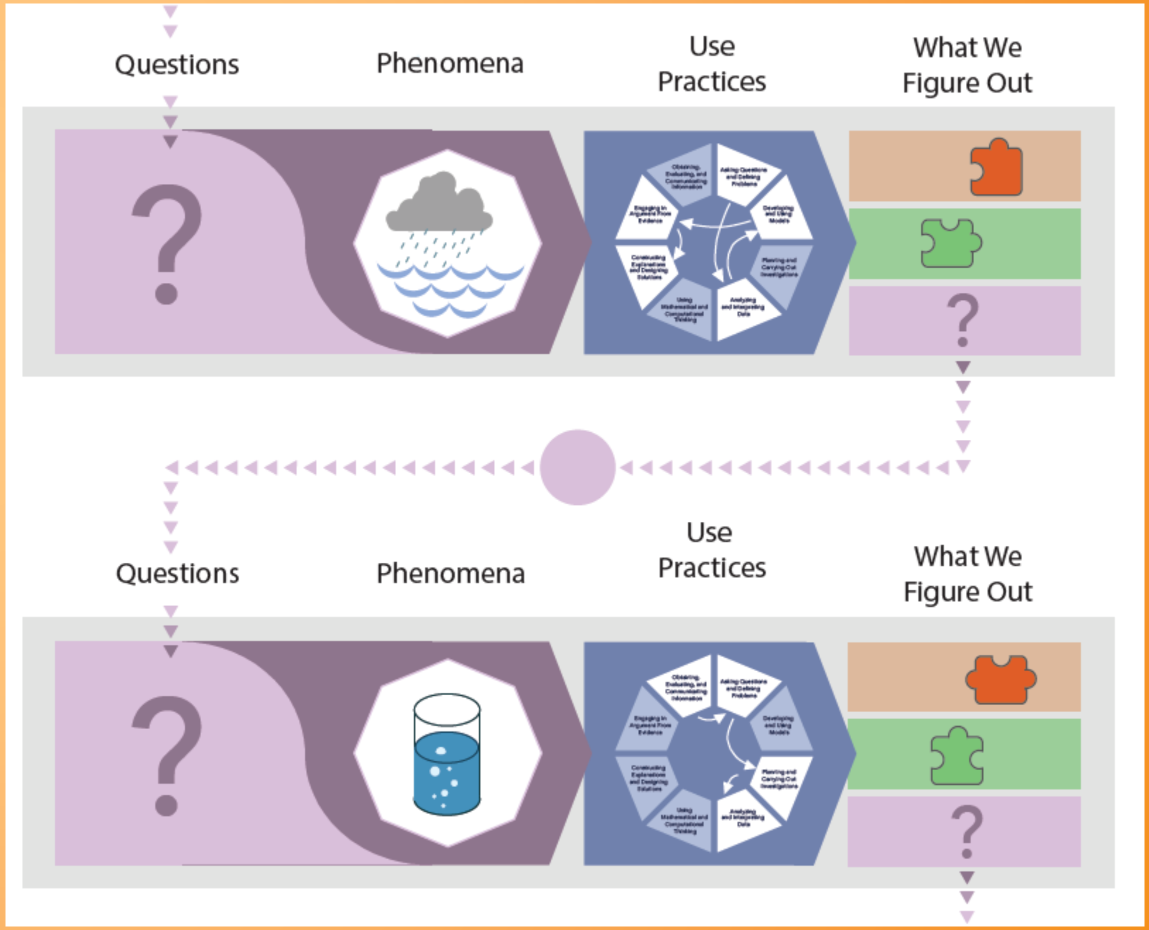



https://www.youtube.com/watch?time_continue=4&v=ddlw9gmq6V4

Tying this in to the "Big Picture"

- By starting here and looking at the potential impact we could have by helping restore this small wetland, students wondered about other wetlands and their impact on the watershed.
- They also figured out what data to collect and analyze to have an idea about the biodiversity levels in our system and to judge the water quality

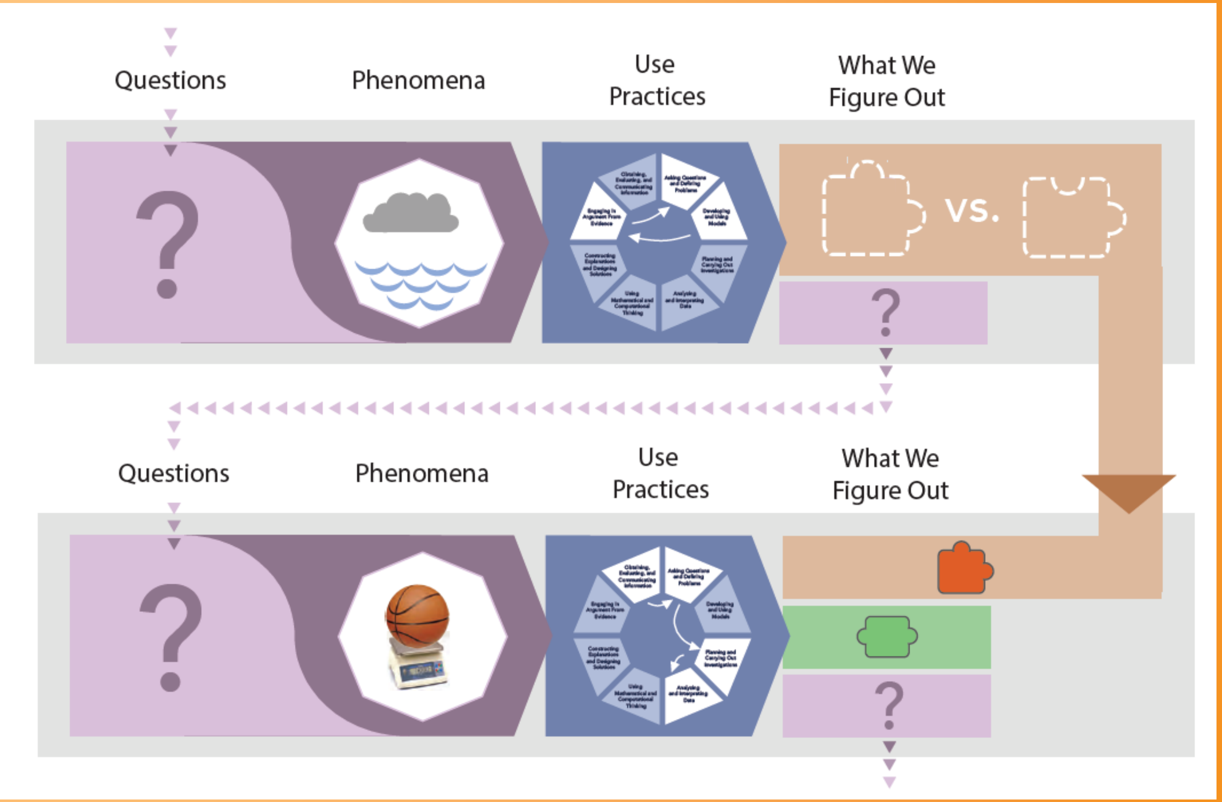
Connected Investigations



Tying this in to the "Big Picture"

- The wetlands and bodies of water they expanded their study to were vastly different in size and other important characteristics
- Students figured out that similar phenomena have similar causes in these systems - and these systems are connected
- they also figured out the kinds of allowances we need to make to account for scale, proportion and quantity

Problematizing Routine



Citizen Science/Community Science programs

Students expressed the need to learn more about biodiversity, wetlands and our watershed and wanted to be a part of more projects that could help.

Michigan Natural Features Inventory - Vernal Pool Patrol

Friends of the Rouge - Rouge Education Project

GLOBE - Aren Project, Lilac Phenology, Arctic Bird Migration, Biometry, Land Cover

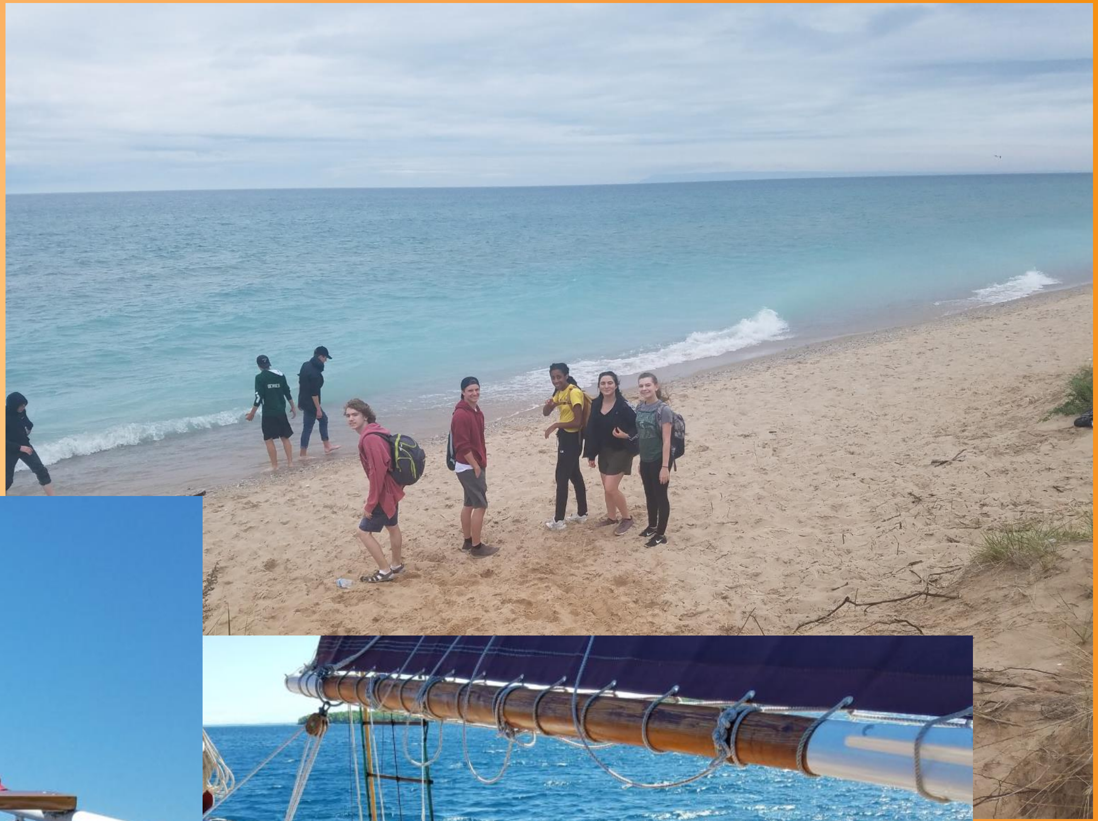
Cornell Lab of Ornithology - eBird, Project Feederwatch, Nestwatch

iNaturalist

MISIN - Midwest Invasive Species Information Network







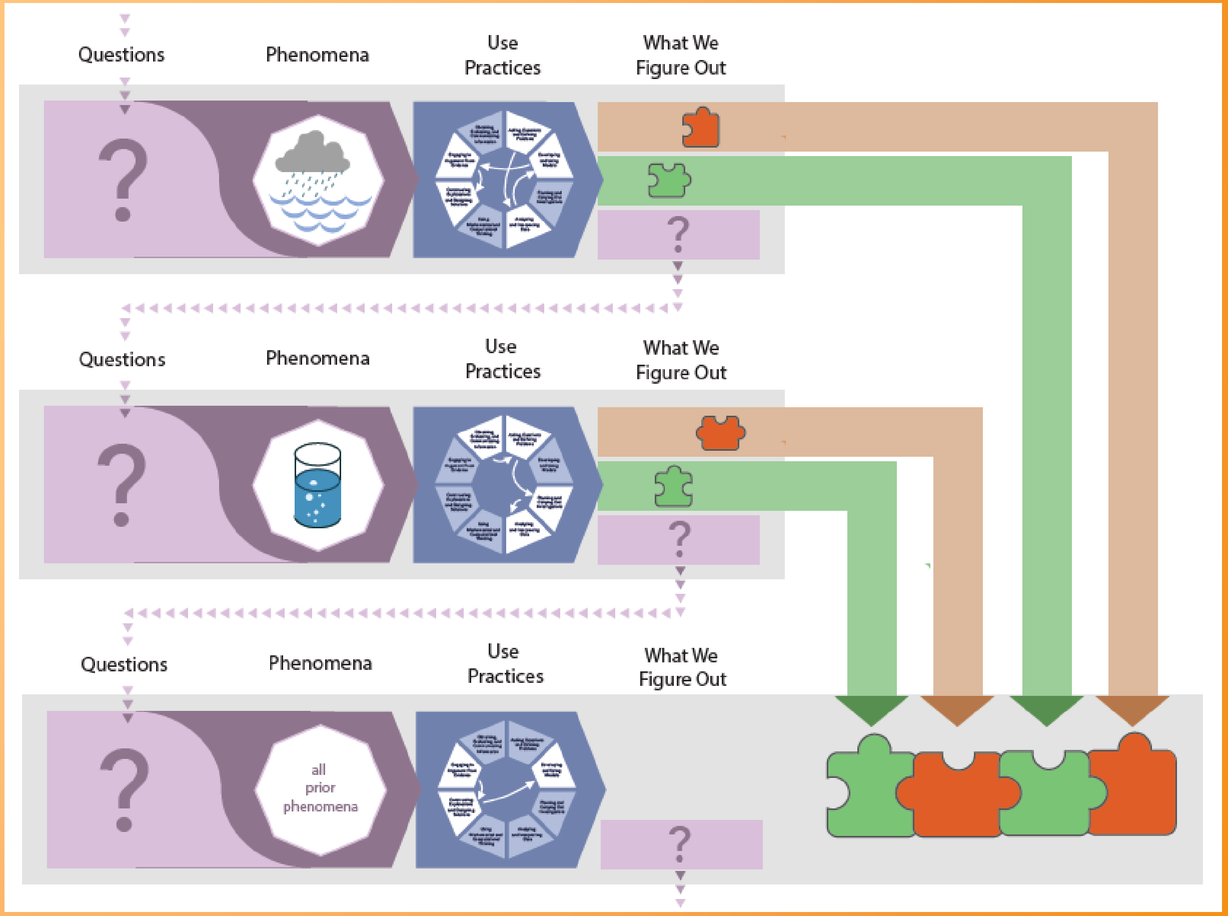


INLAND
SEAS

Tying this in to the “Big Picture”

- During this time students also looked at their own Eco-footprint (and that of their family)
- They identified their own contributions and realized that they needed to help educate others
- Plans to use our finished space as a outdoor education lab and will host field trips for elementary classrooms
- First visit scheduled for this spring!

Putting the Pieces Together



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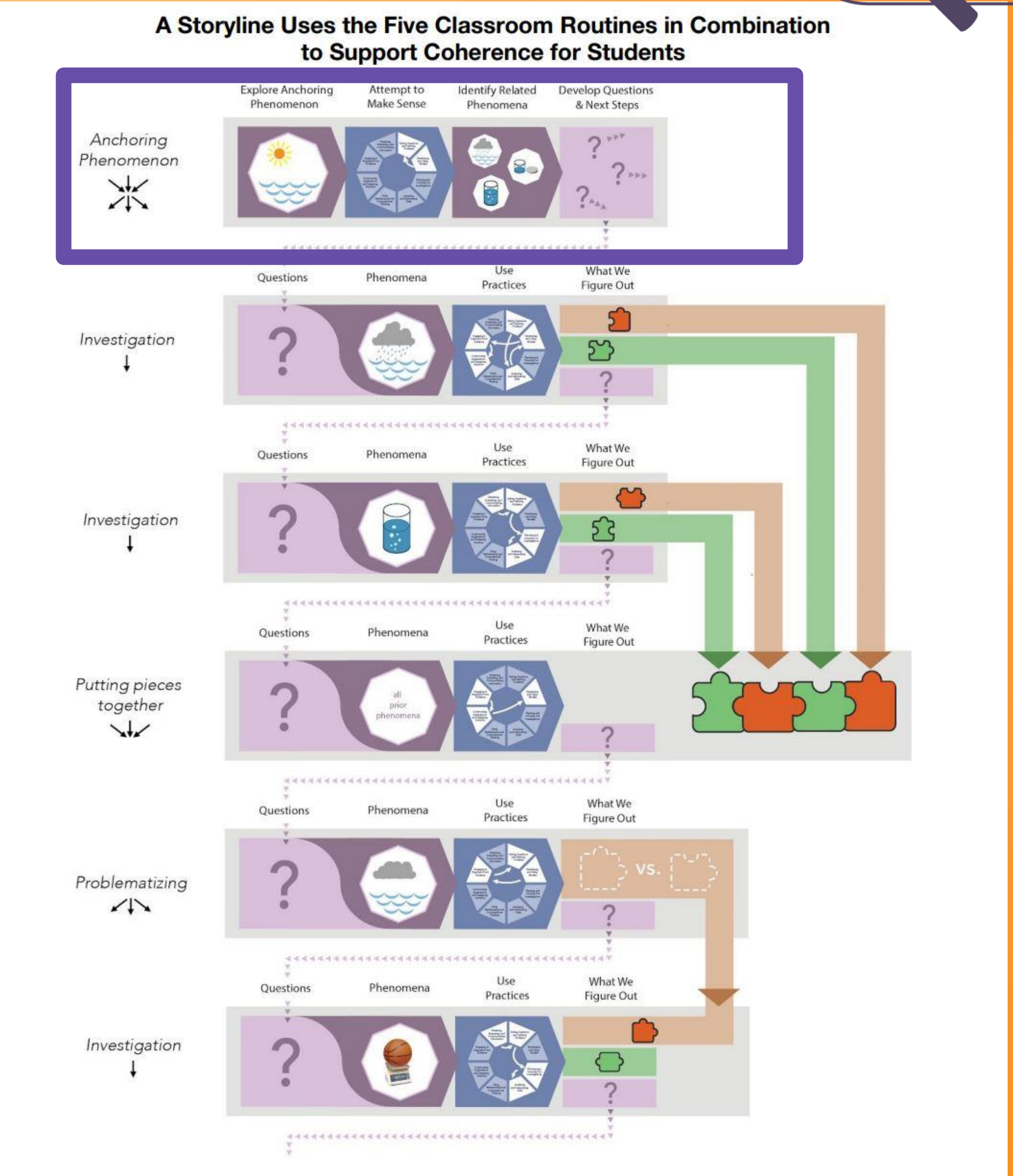

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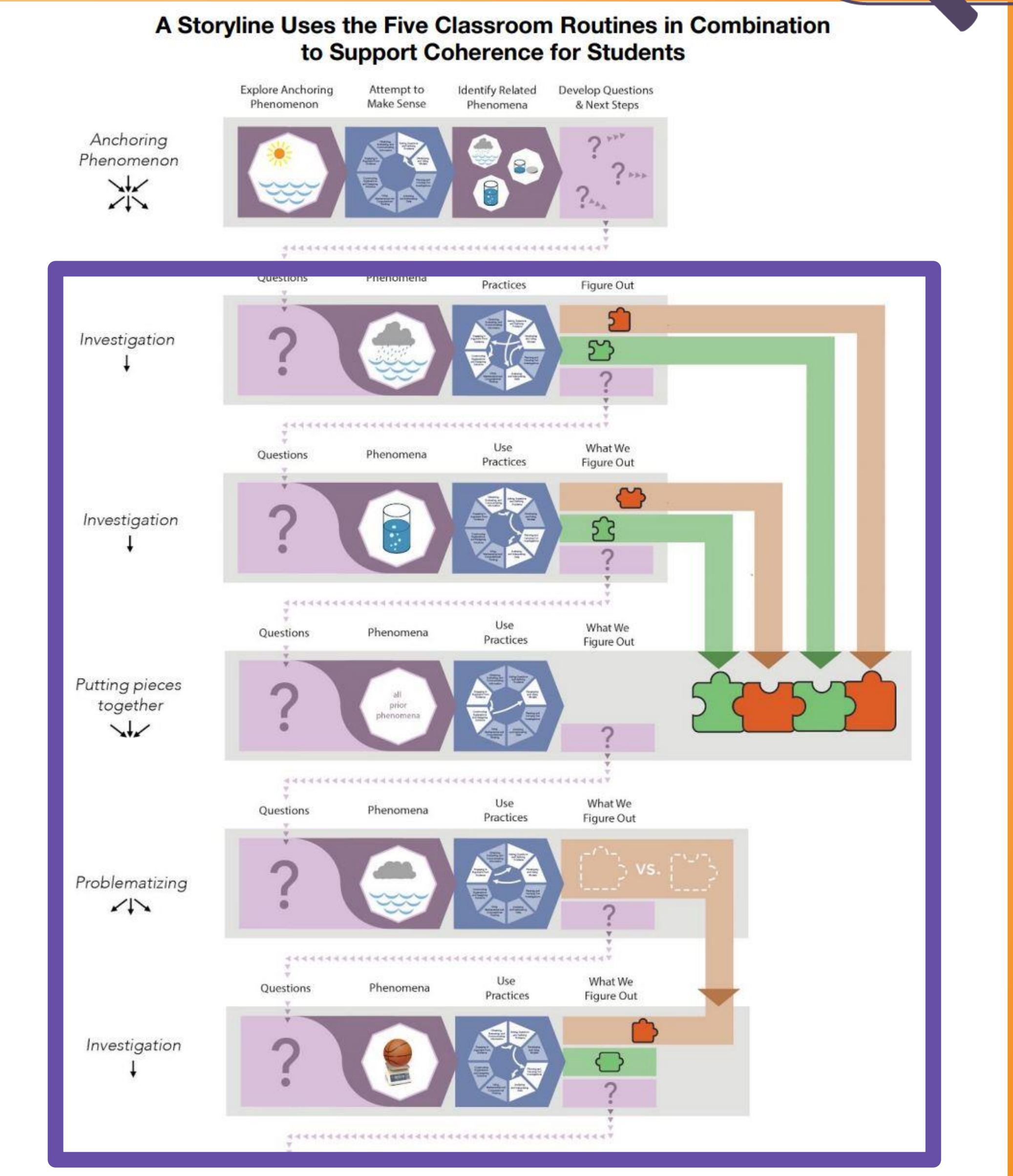

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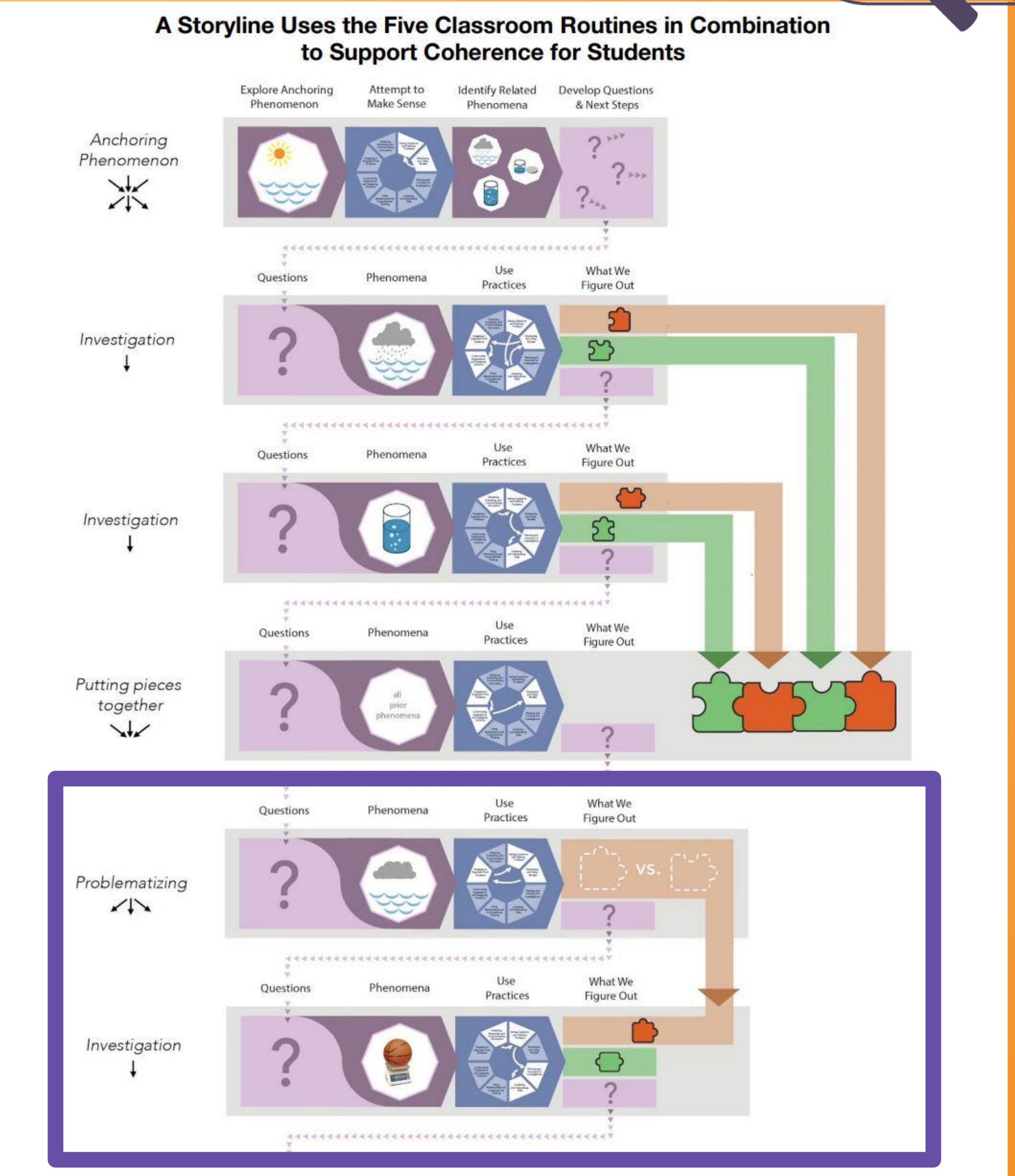

HS-ESS3-3. **Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.** [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [*Assessment Boundary: Assessment for computational simulations is limited to usi*

HS-ESS3-4. **Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*** [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal ... ock, or surface ... reducing, reusing, ... ltering global

HS-ESS3-1. **Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe ... climate ... patterns

HS-LS1-2. **Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.** [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [*Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.*]

HS-LS2-2. **Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.** [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [*Assessment Boundary: Assessment is limited to provided data.*]

HS-LS2-6. **Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.** [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

HS-LS2-7. **Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*** [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Science and Engineering Practices

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis; a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms; and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system.

- Use mathematical representations of phenomena or design solutions to support

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Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions.

Disciplinary Core Ideas

ESS3.C: Human Impacts on Earth Systems

- The sustainability of societies and the b supports them requ

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- Scientists and engineers can contributions by echnologies that pollution and at preclude egradation.

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

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Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

eveloping Possible

evaluating solutions, it is ant to take into account a of constraints, including afety, reliability, and tics, and to consider cultural, and nmental impacts. (secondary)

ections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern on major

Crosscutting Concepts

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Crosscutting Concepts

Scale, Proportion, and Quantity

- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Crosscutting Concepts

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable.

Crossc

Cause and Effect

- Empirical eviden between cause and correlation and make claims about specific causes and effects.

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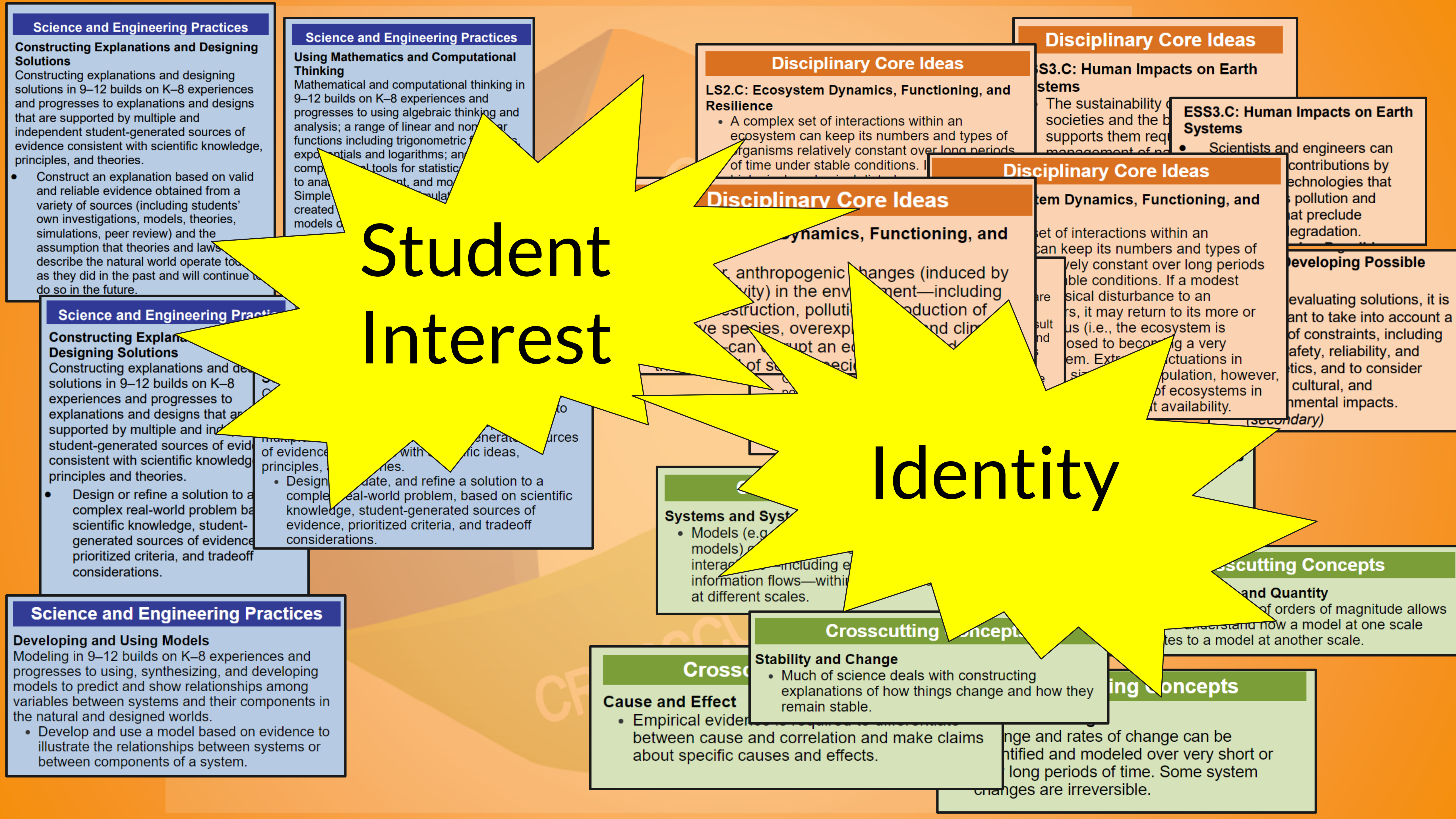
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Work on this project was possible thanks to:

Financial support provided by:

- MWEA/MSTA Dan Wolz Clean Water Education Grant - $1000
- Cornell Lab of Ornithology Garden Grant - $1000
- Meemic Classroom Improvement Grant - $300
- MAEOE Grant - $500
- NOAA B-WET Grant (through Watershed Field Course) - $300 plus extras
- Knight Center for Environmental Journalism Grant - $1000 for Env Sci/$1000 for video productions
- 2018 Michigan Lottery Excellence in Education Award - $500
- NOAA Planet Stewards Education Project Grant – $2500
- MDSTA Mini Grant - $500
- Meemic Traditional Grant - $500
- KidsGardening.org Budding Botanist Grant - $3000
- Michigan Natural Features Inventory Healthy Watersheds grant - $500

Work on this project was possible thanks to:

Professional Learning opportunities provided by and in collaboration with:

- Northwestern University Science Storylines Team/NGSX Learn While Teaching Alpha Pathway
  - *Brian Reiser, Michael Novak, Tara McGill, Kelsey Edwards, Aliza Zivek, Trey Smith, Sarah Michaels (Clark University), Renee Affolter (Lead Instructor NGSX and Vermont Science Initiative), Deanna Bailey (NGSX) Trish Shelton (NSTA)*
- University of Colorado Boulder, Denver Public Schools and the iHub Team
  - *Bill Penuel, Katie VanHorn, Douglas Watkins*
- Inland Seas - Watershed Field Course
  - *Jeanie Williams and Chelsea Nestor*
- NOAA Planet Stewards Community
  - *Claire Lannoye-Hall, Bruce Moravchik, Molly Harrison*
- Michigan Natural Features Inventory
  - *Daria Hyde, Yu Man Lee, and Phyllis Higman*
- Rouge Education Project
  - *Erin Cassady*
- Earth Force
  - *Michelle Blodgett and Grace Scarsella*
- Cornell Lab of Ornithology
  - *Lyndsay Glasner and Kelly Schaeffer*
- Achieve Inc.
  - *Vanessa Wolbrink, Aneesha Badrinarayan, and Matt Krehbiel*
- Michigan Math and Science Leadership Network
  - *Mary Starr, Wendi Vogel*
- Wayne County Math and Science Center
  - *Rich Bacolor, Dave Bydlowski, Greg Johnson*
- Twitter PLNs
  - *#NGSSchat, #NGSS_tweeps, #NGSNavigators, #MiSciPLN*

Work on this project was possible thanks to:

Professional Learning opportunities provided by and in collaboration with:

South Redford School District administrators, teachers (especially Wayne Wright, Lynda O'Donnell and Jessica Mahl), and our students!

And those Project Goals?

Student Goals

1. Improve watershed health
2. Increase biodiversity
3. Create opportunities for elementary and middle school students to have a local field trip where they learn about factors affecting the health of their local environment
4. Create opportunities for students (my AP students) to teach these concepts to the other students to raise awareness
5. Create outdoor space where students have place-based educational opportunities

Teacher Goals - Student Goals *PLUS*:

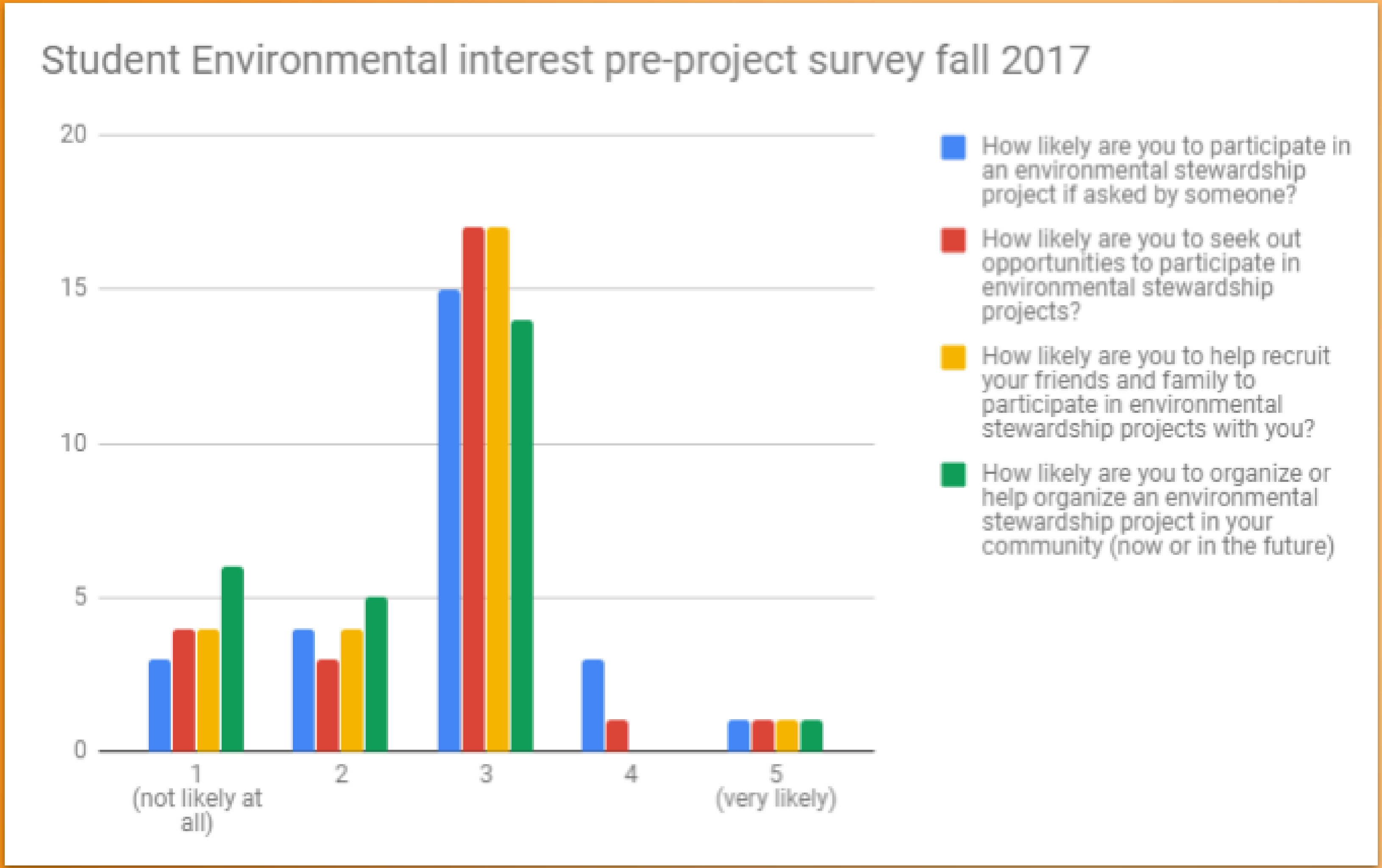
6. Prepare my students for the AP Environmental Exam by increasing their understanding of key content knowledge and science practices
7. Increase the analytical and critical thinking skills of students.
8. Increase the likelihood that students will think about the environment and become good environmental stewards and/or activists.
9. Increasing student knowledge of how to approach community leaders and think about stakeholders when leading stewardship action projects
10. Increase the likelihood that students will choose to go outside for recreation

2017-2018 Survey Results:

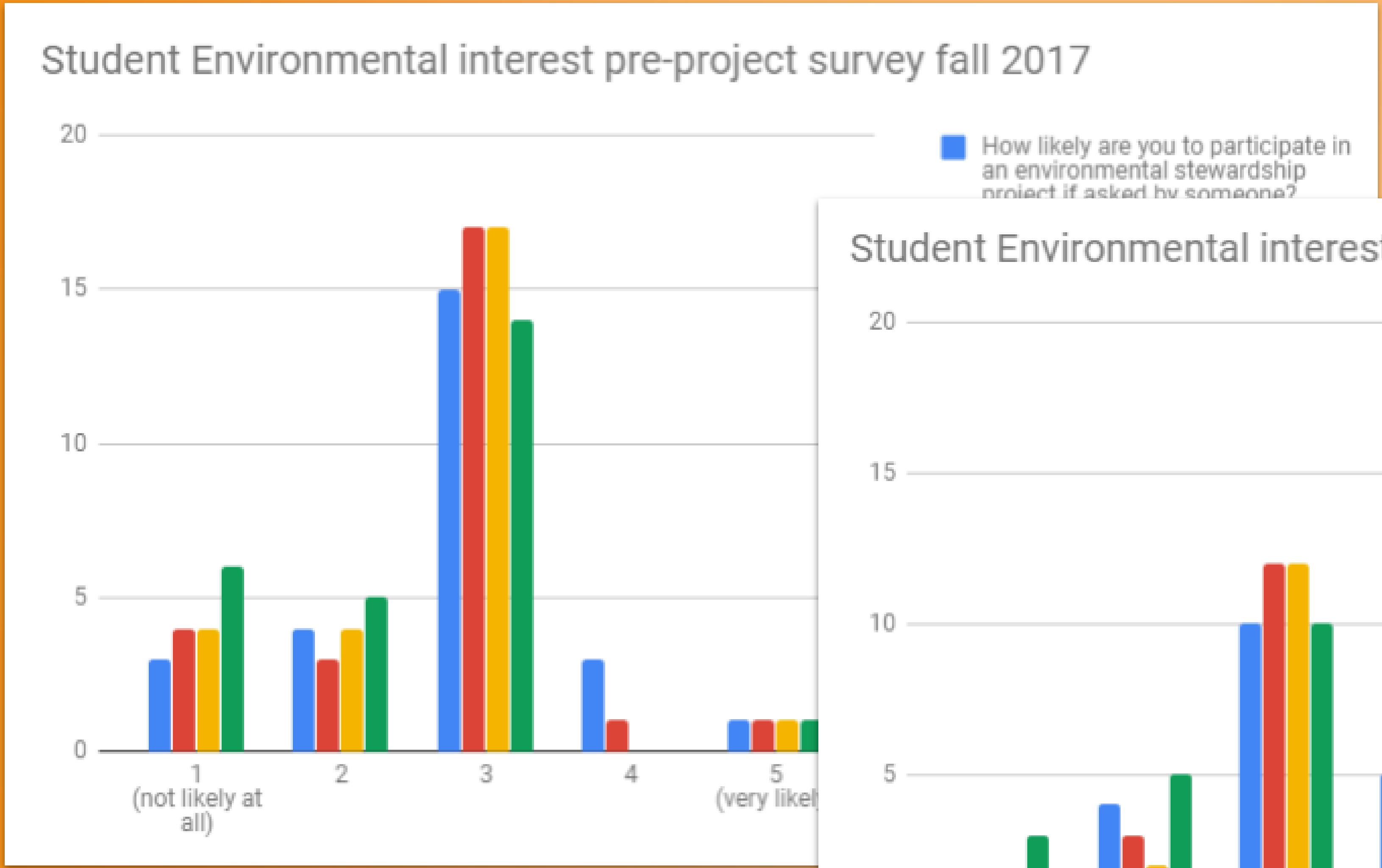
Students were asked the following four questions in September 2017 (prior to starting the project) and again a few weeks before the end of the school year in May of 2018.

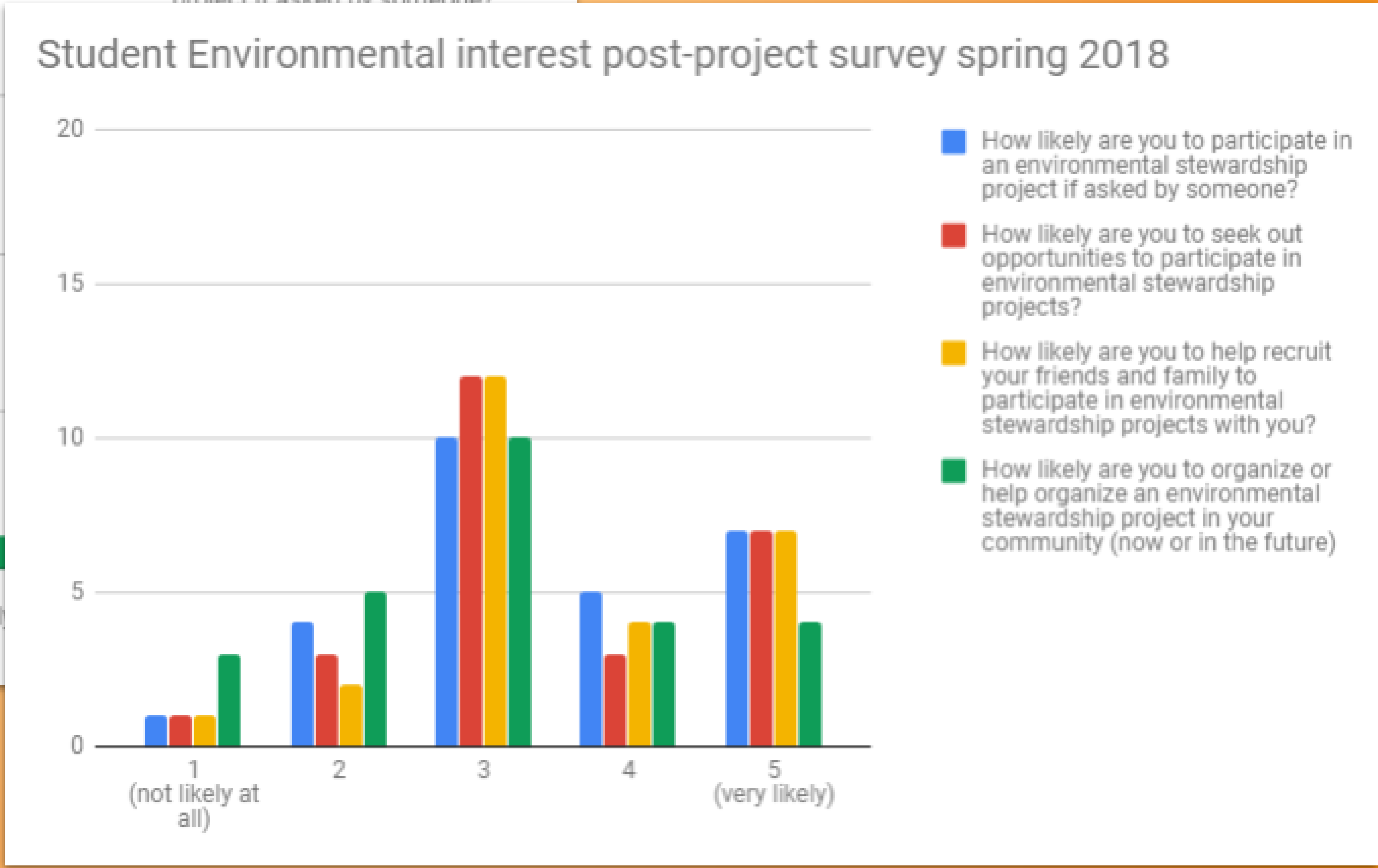
- How likely are you to participate in an environmental stewardship project if asked by someone?
- How likely are you to seek out opportunities to participate in environmental stewardship projects?
- How likely are you to help recruit your friends and family to participate in environmental stewardship projects with you?
- How likely are you to organize or help organize an environmental stewardship project in your community (now or in the future)

2017-2018 Survey Results:

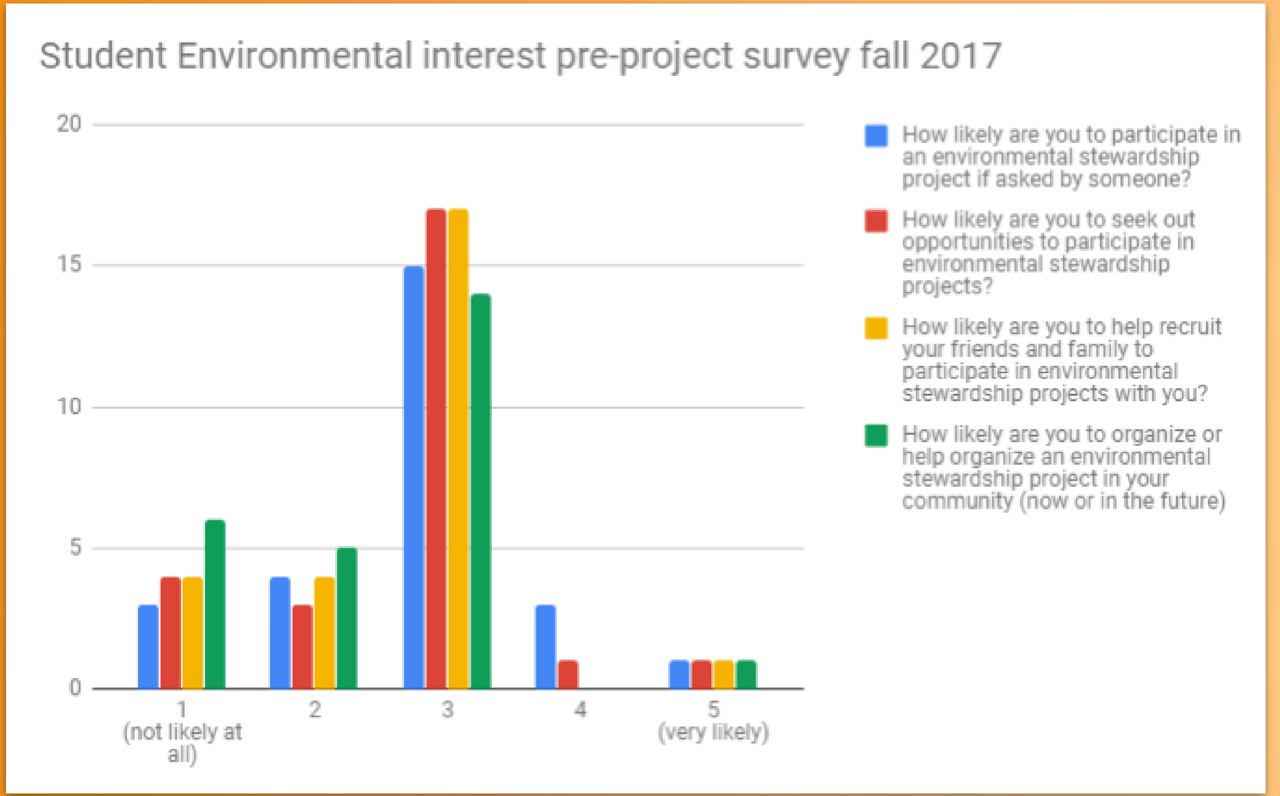


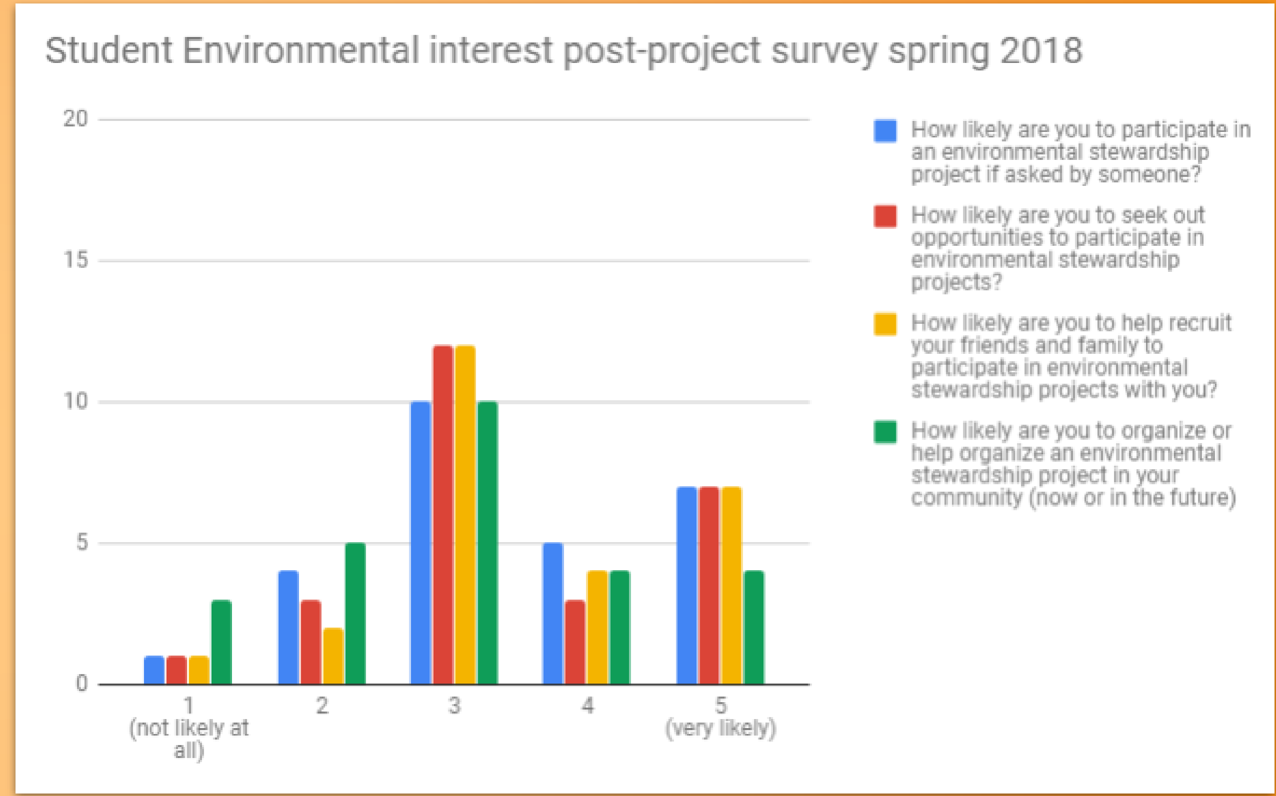
2017-2018 Survey Results:





2017-2018 Pre- and Post-Survey Results:

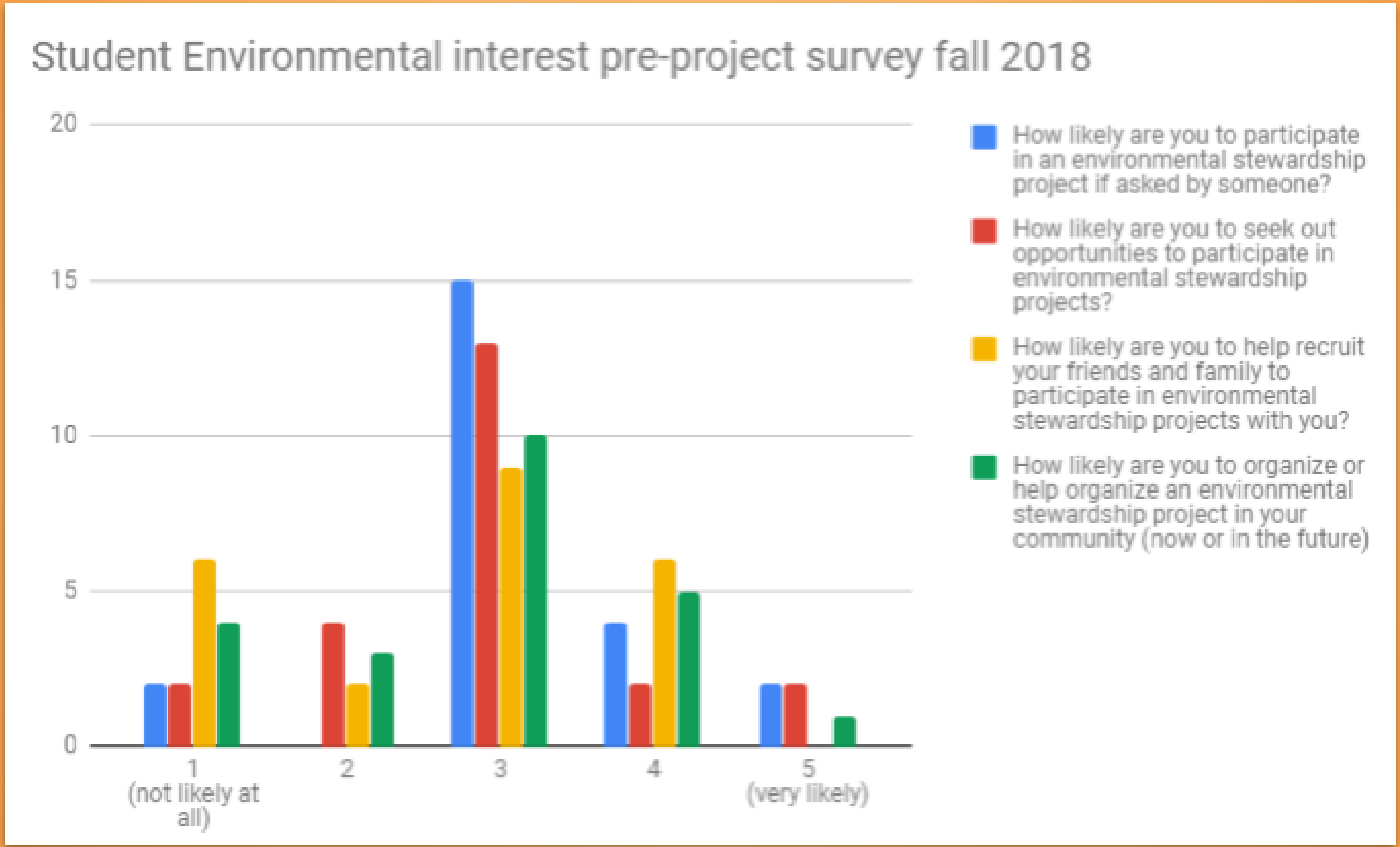




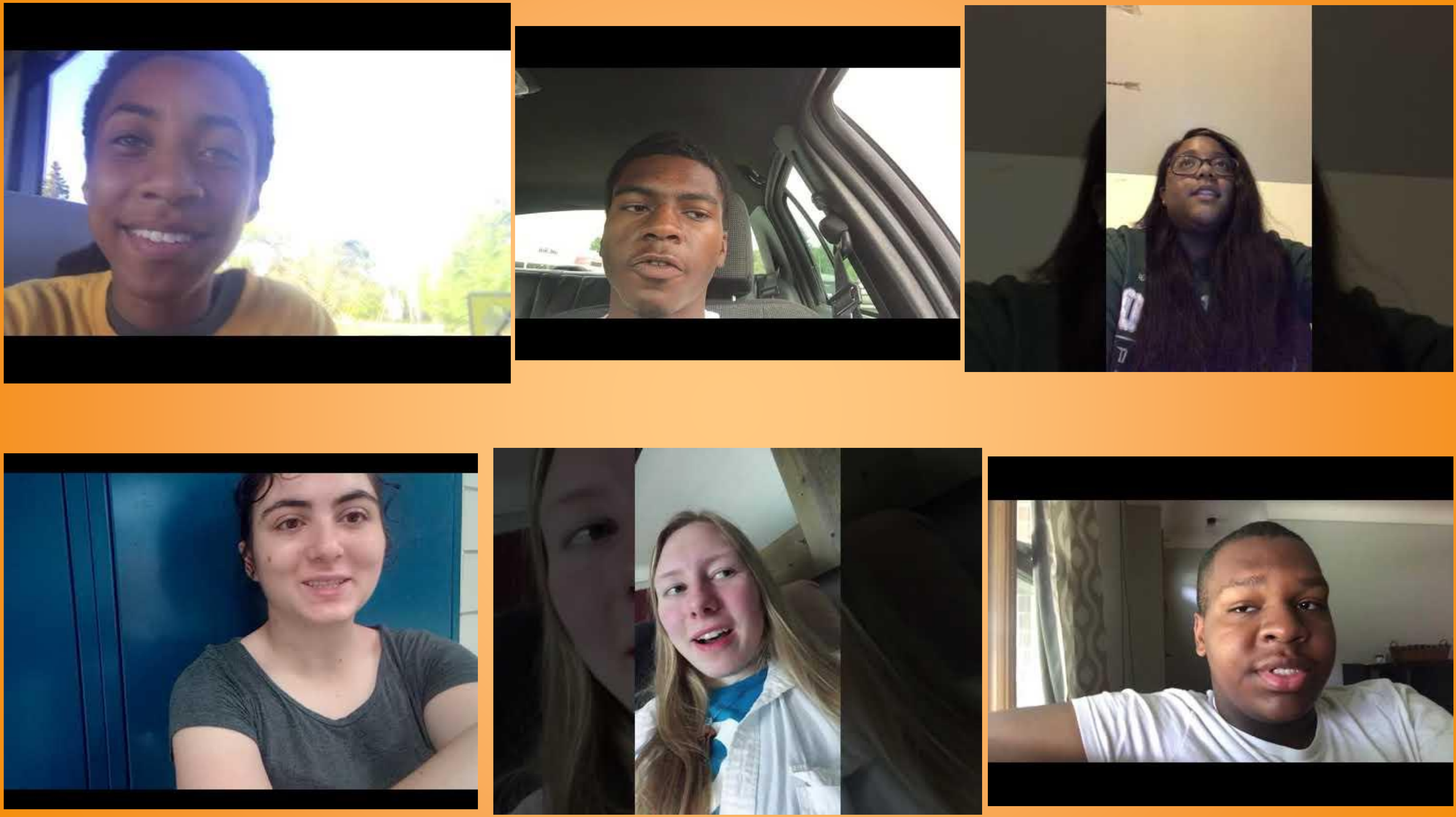
At the beginning of the class only 8% of student answers reflected a positive attitude about Participation in Environmental Stewardship

At the end of the class 39% of student answers reflected a positive attitude about Participation in Environmental Stewardship

2018-2010 Pre-Project Survey Results:



24% of student answers reflected a positive attitude about Participation in Environmental Stewardship at the start of this year.




Find more good stuff at https://hollyhereau.weebly.com/ Feel free to explore for ideas but I would especially love to hear from you if you are interested in collaborating!
holly.hereau@southredford.org

Explore the links below for examples, tools, resources and ideas

Nextgenstorylines.org

STEM Teaching Tools

MNIF

NOAA

iHUB

The Cornell Lab of Ornithology

Earth Force

The Center for Great Lakes Literacy

Links to where you can find applications for funding to support this work

- MWEA/MSTA Dan Wolz Clean Water Education Grant
- Cornell Lab of Ornithology Garden Grant
- Meemic Classroom Improvement Grant
- Michigan Alliance for Environmental and Outdoor Education (MAEOE) Grant
- MACUL grant
- Watershed Field Course (NOAA B-Wet Grant funded)
- Knight Center for Environmental Journalism Grant
- Michigan Lottery Excellence in Education Award
- NOAA Planet Stewards Education Project Grant
- MDSTA Mini Grant
- Meemic Traditional Grant
- KidsGardening.org Budding Botanist Grant
- KidsGardening.org link to open grants
- Michigan Natural Features Inventory Healthy Watersheds (NOAA B-Wet Grant funded)
- Project Learning Tree Greenworks Grants
- Lowe's Small Toolbox for Education Grant
- Wild Ones Lorrie Otto Seeds for Education (SFE) Fund
- Annie's Grants for Gardens
- Whole Kids Foundation Garden Grants
- Whole Kids Foundation and the Bee Cause Project Bee Grants
- Fiskars Project Orange Thumb Grants
- USDA Farm to School Grant Program
- Big Green Learning Gardens
- Jeffers Foundation School Garden Grants
- Green Education Foundation Green Thumb Challenge
- Captain Planet Foundation EcoSolution Grants
- The Pollination Project Grants
- Toshiba Grants for grades K-12
- Walmart Foundation Community Grant Program
- Target Field Trip Grants
- NEA Student Achievement Grant
- MonarchWatch.org and Kansas Biological Survey Free Milkweek Plugs
- Cornell Douglas Foundation Grants
- The Awesome Foundation Grants
- Costco Grants
- Quadratec Cares "Energize the Environment" Grant Program
- Cliff Bar Family Foundation Grant
- Patagonia Environmental Grants