Urban Advantage

Formal-Informal Collaborations to Improve Science Learning and Teaching

American Museum of Natural History

Denver Museum of Nature & Science


23

How do you work with partners outside the school system?

- Who are your partners?
- How long have you worked with them?
- What do they provide?
- How are they funded to work with you?

How do partnerships help improve

TEACHERS’ PRACTICE
STUDENTS’ LEARNING

urban advantage

middle school science initiative

The goal of the **Urban Advantage** program is:

To improve students' understanding of scientific knowledge and inquiry through collaborations between public school systems and informal science education institutions.

metro Denver urban advantage

middle school science initiative

Students, teachers, and families do, think, and explore like scientists —both in and out of the classroom

Metro Denver Urban Advantage is funded by the National Science Foundation's Discovery K-12 research program through grant #1020386

urban advantage

middle school science initiative

Partner Institutions

New York City Council

American Museum of Natural History

Wildlife Conservation Society Bronx Zoo

Brooklyn Botanic Garden

Wildlife Conservation Society New York Aquarium

NYC Department of Education

NYBG

nysci New York Hall of Science

Queens Botanical Garden Where people, plants, and cultures meet

Zoo Staten Island Zoo

urbanadvantagenyc.org

metro Denver urban advantage

middle school science initiative

ADAMS 14 Inspire. Educate. Empower.

DENVER BOTANIC GARDENS

DENVER PUBLIC SCHOOLS • DENVER COLORADO •

Aurora Public Schools

DENVER ZOO

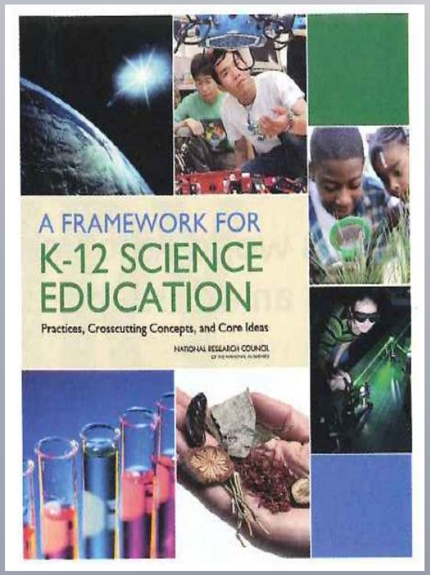
DENVER MUSEUM OF NATURE & SCIENCE

Metro Denver Urban Advantage is funded by the National Science Foundation's Discovery K-12 research program through grant #1020386

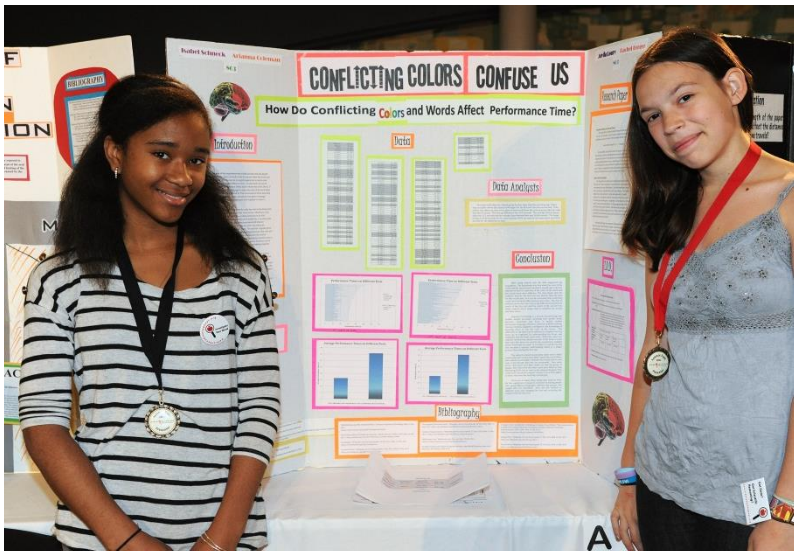
Urban Advantage is about students **doing science**

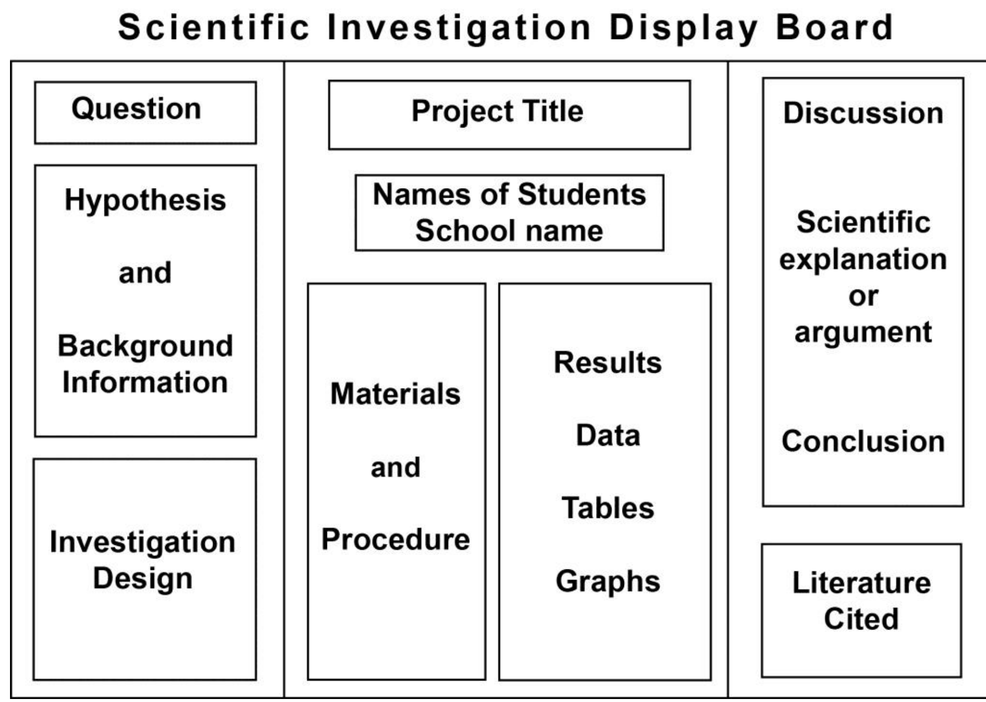
Scientific and Engineering Practices from the *new* **Framework for K-12 Science Education**

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics, information and computer technology, and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information



Urban Advantage - NYC
Science Investigations





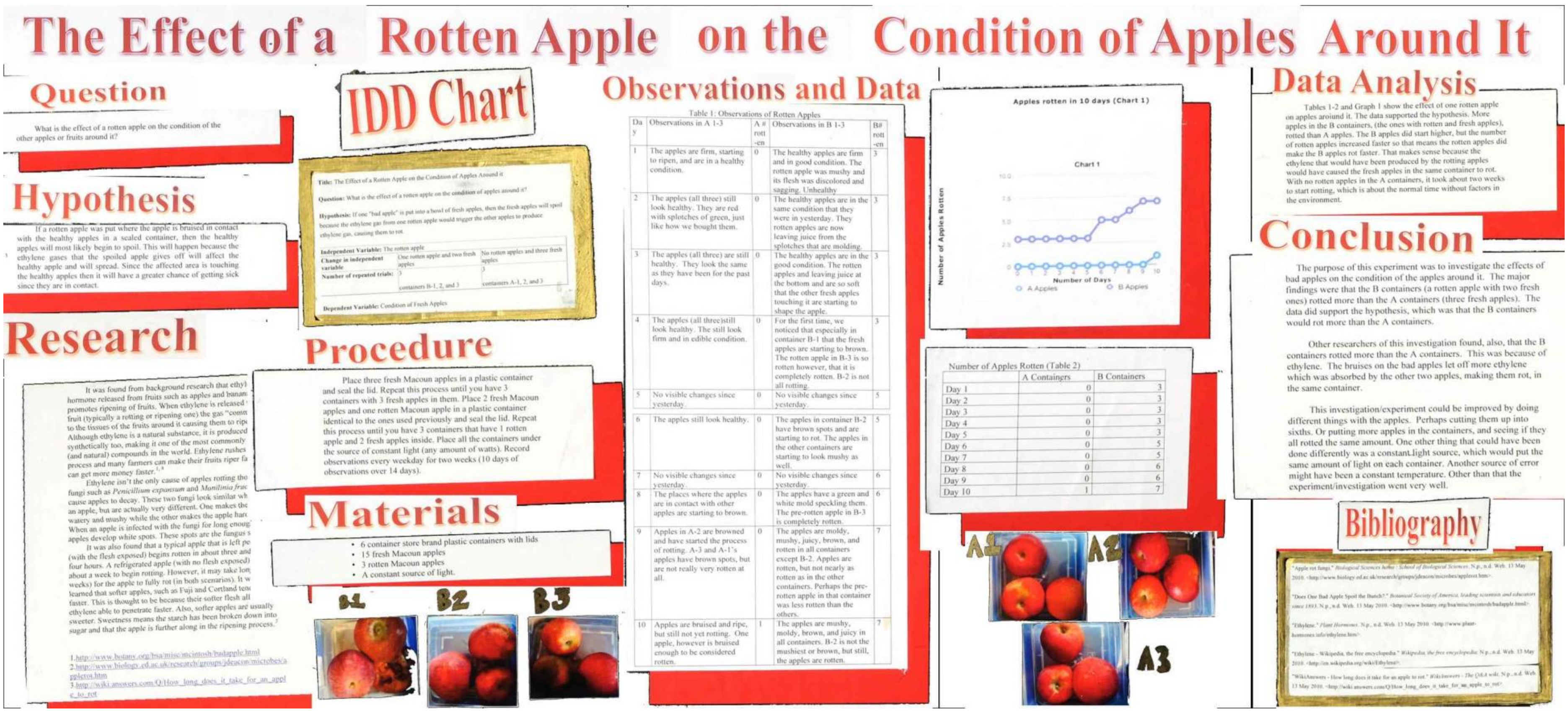
Controlled Experiments

Secondary Research Projects

Field Studies

Design Projects

Question: What is the effect of a rotten apple on the condition of the apples around it?



UA Framework: Six Components

Professional Development

- Workshops for science teachers and school administrators

Classroom Materials and Equipment

- Science materials/equipment for schools, teachers, & students

Access to Institutions

- Vouchers for class field trips, family field trips and visits

Outreach to Families

- Public exhibitions of student work, family science events at institutions, support for school-based family science nights

Capacity-Building and Sustainability

- Lead Teachers, Leadership Institute, Demonstration Schools

Assessment

- Program goals, student learning, and systems of delivery

COMPONENT 1
Professional Development for Teachers and Administrators

Teachers

- Immersion in inquiry workshops for new teachers
- Continuing teacher workshops

Administrators

- Science Leadership Breakfasts

COMPONENT 2
Classroom Materials and Equipment

- Lighted plant growing environment
- Digital cameras
- Dissecting microscope
- Stopwatches
- Magnifying glasses
- Rock collections
- Field guides
- Thermometers
- Psychrometers
- Aquarium kit
- Designing rockets kit
- Water and soil field-test kits

COMPONENT 3
Access to UA Partner Institutions

- Class field trip vouchers
- Family field trip vouchers
- Student and Family vouchers
- Teacher vouchers

COMPONENT 4
Outreach to Families

- Family Science Sundays at Partner Institutions
- Parent Coordinator Workshops
- Family Science Nights at Schools
- Annual UA Science EXPO

COMPONENT 5
Capacity-Building and Sustainability

- UA Lead Science Teachers
- Leadership Institute
- Demonstration Schools

COMPONENT 6
Program Assessment and Student Learning

- Program assessment
  - Longitudinal program evaluation
  - Classroom observations
  - Teacher surveys and interviews
  - School visits
- Student learning
  - Science exit projects
  - New York State 8th grade Intermediate-Level Science Test

Outcomes of our work as partners

- Teacher professional development
- Instructional resources
- Redefining field trips
- Impact on teachers and students

Immersive Professional development

Workshops, field work, teams, place-based

Science Leadership Teams

Teams of teachers, administrators, parent coordinators, and UA partners

IDD

Investigation Design Diagram

Title:
Sample format: The effect of (independent variable) on (dependent variable)

Research Question:
Sample format: How will (independent variable) affect (dependent variable)?)

Hypothesis:
Sample format: I think (independent variable) will affect (dependent variable) because (explain why you expect/predict this relationship between the variables)

Independent Variable: (or the "you change it" or "you choose it" variable)					
Change in independent variable:					
Number of repeated trials:					

Dependent Variable: (or the "you measure it" variable)

Constant variables:

Adapted from *Students and Research: Practical Strategies for Science Classrooms and Competitions*, 3rd Edition, by Cothron, Giese, & Rezba. (2000). Kendall/Hunt Publishing.

Instructional Resources

Making science accessible

Leveraging resources of institutions

Linking science & literacy

RIVER ECOLOGY

Investigating the effect of zebra mussels on the Hudson River

New York State's Hudson River has seen many changes, but perhaps none more dramatic than the arrival of the zebra mussel in 1991, and its rapid spread. Understanding environmental changes like this one means looking at the whole ecosystem: the web of interactions among organisms and their physical environment. Biologists at the Cary Institute of Ecosystem Studies have been studying the Hudson's freshwater tidal ecosystem since 1987. They look for patterns and connections in order to understand how the river is changing, and might change in the future.

This website gives you access to the actual data these scientists have collected about the river: factors like the cloudiness of the water, its temperature, and how many and what types of organisms live in it. Use the graphing tool to look for patterns that connect the dynamic parts of this ecosystem. Can you help the scientists investigate the effects of the zebra mussel invasion?

This project is a collaboration between the American Museum of Natural History and The Cary Institute of Ecosystem Studies.

American Museum of Natural History

Cary Institute of Ecosystem Studies

Funding for this web site provided by the National Science Foundation

Explore the River

Learn about the history of the Hudson River and how scientists monitor the river's tidal freshwater ecosystem.

Learn more...

Meet the Scientists

Using video and text passages, you can learn about the work of scientists at the Cary Institute who are studying the invasion of zebra mussels in the

Get Started...

Graph the Data

Pick which factors you want to study and use this interactive tool to view them in relation to one another.

Get started...

Analyze the Data

Can you tell which factors are related? Observe any patterns? Figure out how different parts of the Hudson River ecosystem are connected?

Get started...

River Ecology Teaching Case

amnh.org/education/hudsonriver

AMERICAN MUSEUM & NATURAL HISTORY

RIVER ECOLOGY

Investigating the effect of zebra mussels on the Hudson River

TEACHER VERSION

AMERICAN MUSEUM & NATURAL HISTORY

RIVER ECOLOGY

Investigating the effect of zebra mussels on the Hudson River

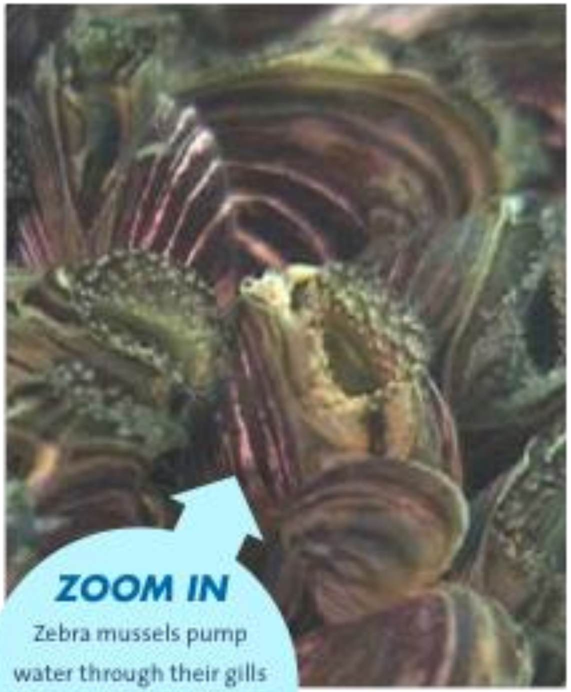
STUDENT VERSION

PASSAGE ONE

An Unwelcome Newcomer

Invasion of the Zebra Mussels

The zebra mussel is a small aquatic animal with two shells like a clam, named for its striped shell. This tiny creature may look harmless, but it can cause big problems. The zebra mussel is an invasive species, a species that's brought from its native area to a new place where it thrives and causes changes in the local habitats and communities.



ZOOM IN

Zebra mussels pump water through their gills to filter out particles of food (primarily

Zebra mussels once lived only in freshwater lakes and rivers of Europe and Asia. But in the 1980s, they appeared in the Great

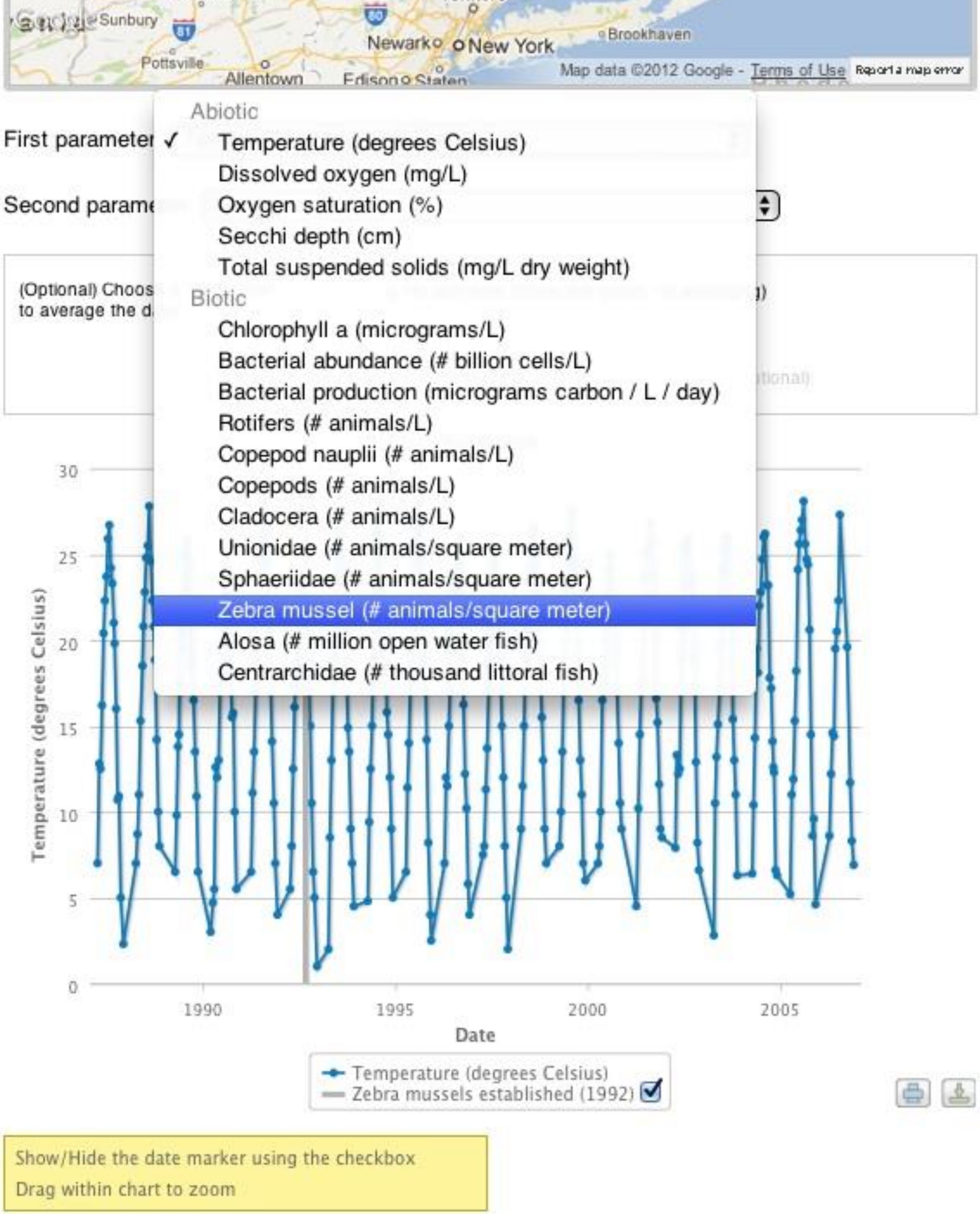
RIVER ECOLOGY

Investigating the effect of zebra mussels on the Hudson River

Graph the Data:

Over Time

1. Select a sampling station from the map below.
2. Click "Chart this location" to view data for that location.



Sunbury
Pottsville
Allentown
Newark
New York
Brookhaven
Edison
Staten
Map data ©2012 Google - Terms of Use
Report a map error
First parameter
Second parame
(Optional) Choos
to average the d
Abiotic
✓ Temperature (degrees Celsius)
Dissolved oxygen (mg/L)
Oxygen saturation (%)
Secchi depth (cm)
Total suspended solids (mg/L dry weight)
Biotic
Chlorophyll a (micrograms/L)
Bacterial abundance (# billion cells/L)
Bacterial production (micrograms carbon / L / day)
Rotifers (# animals/L)
Copepod nauplii (# animals/L)
Copepods (# animals/L)
Cladocera (# animals/L)
Unionidae (# animals/square meter)
Sphaeriidae (# animals/square meter)
Zebra mussel (# animals/square meter)
Alosa (# million open water fish)
Centrarchidae (# thousand littoral fish)
Temperature (degrees Celsius)
30
25
20
15
10
5
0
1990
1995
2000
2005
Date
Temperature (degrees Celsius)
Zebra mussels established (1992)
Show/Hide the date marker using the checkbox
Drag within chart to zoom

First parameter: Zebra mussel (# animals/square meter)

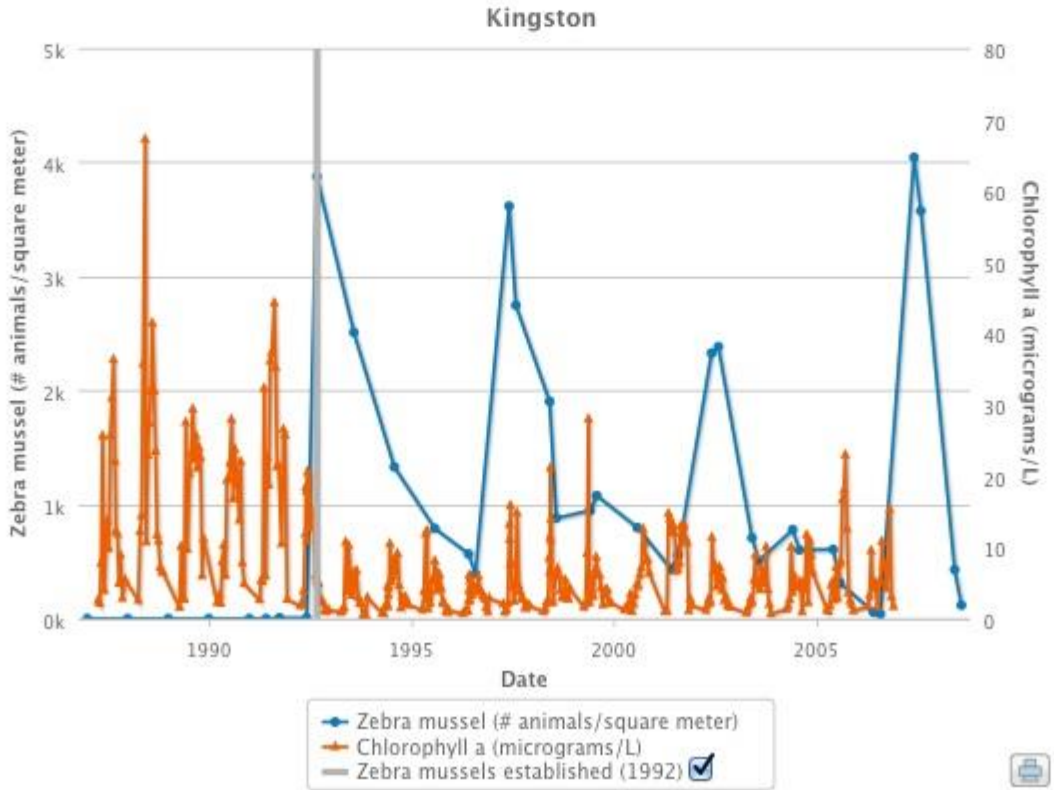
Second parameter: Chlorophyll a (micrograms/L)

(Optional) Choose a "Split Date" to average the data:

No split date (Show line graph, no averaging)

Split Date #1

Split Date #2 (optional)



Show/Hide the date marker using the checkbox

Drag within chart to zoom

First parameter: Zebra mussel (# animals/square meter)

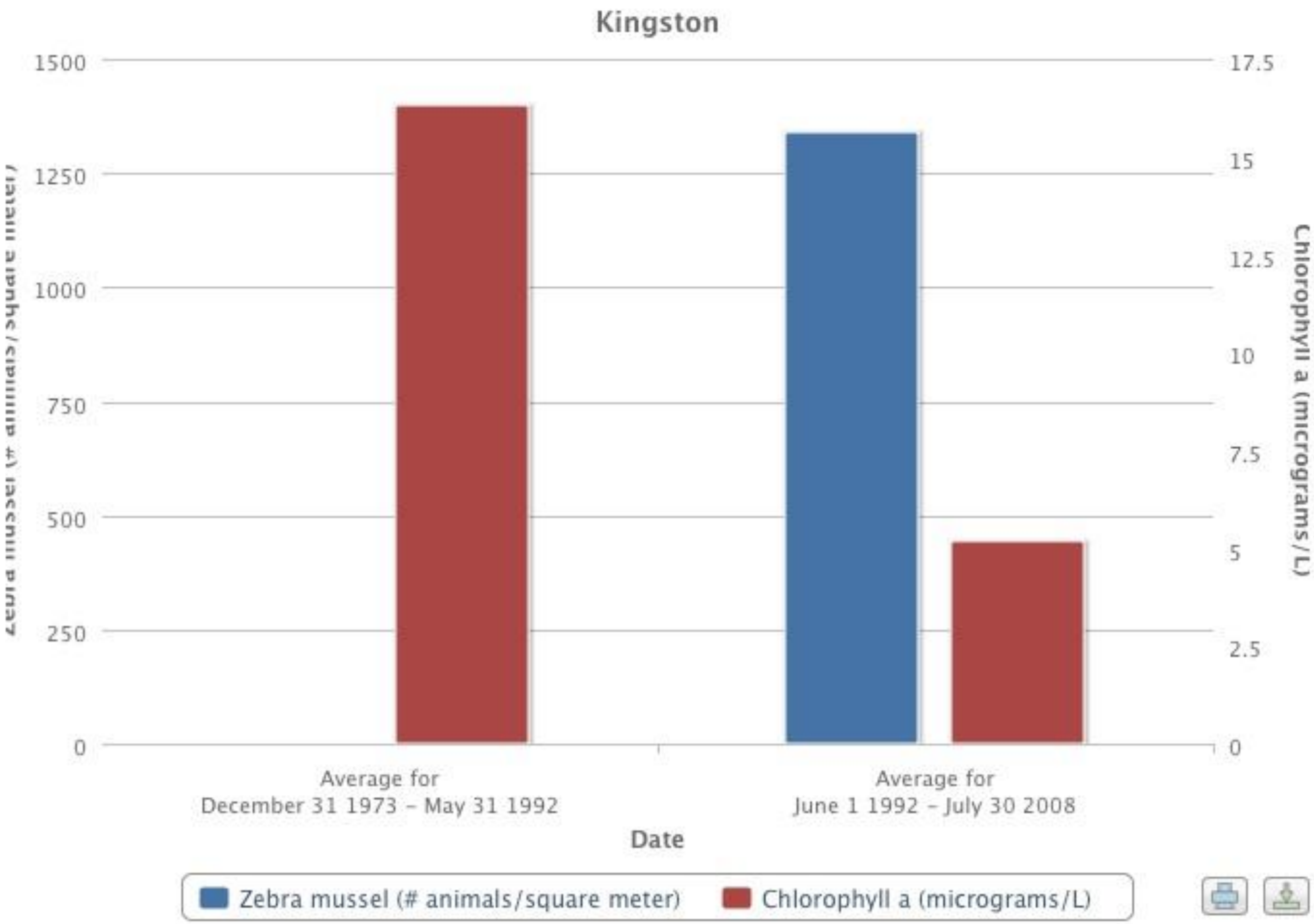
Second parameter: Chlorophyll a (micrograms/L)

(Optional) Choose a "Split Date" to average the data:

No split date (Show line graph, no averaging)

Split Date #1 1992.06.01

Split Date #2 (optional)



First parameter: Zebra mussel (# animals/square meter)

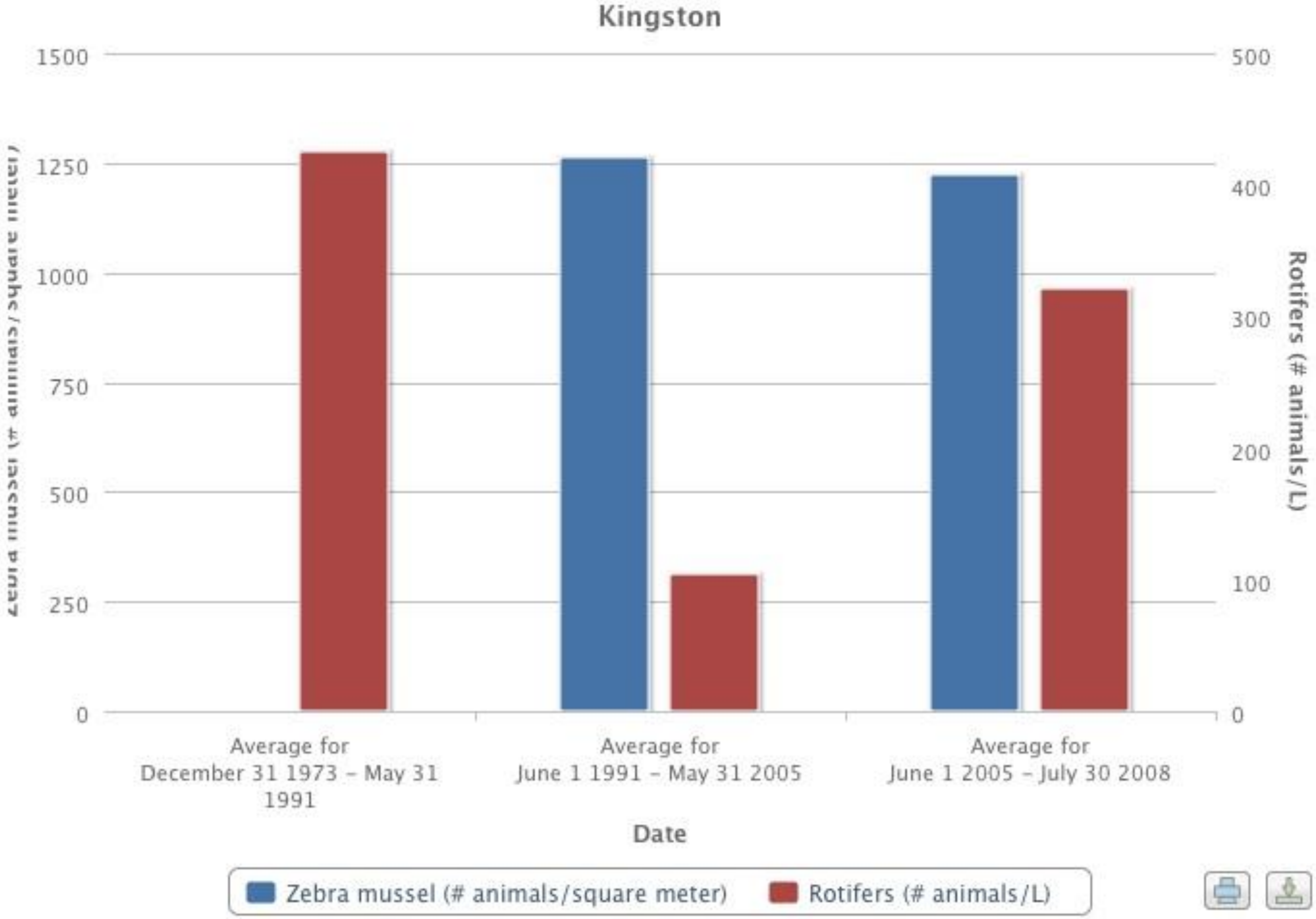
Second parameter: Rotifers (# animals/L)

(Optional) Choose a "Split Date" to average the data:

No split date (Show line graph, no averaging)

Split Date #1 1991.06.01

Split Date #2 2005.06.01 (optional)



Theory of Teacher Learning and Change

MICHIGAN STATE UNIVERSITY | College of Education

COMMON CORE STATE STANDARDS FOR

English Language Arts
&
Literacy in History/Social Studies, Science, and Technical Subjects

COMMON CORE
STATE STANDARDS INITIATIVE
PREPARING AMERICA'S STUDENTS FOR COLLEGE & CAREER

CCSS Reading Standards 1 & 2

1) Cite specific textual evidence to support analysis of science and technical texts.

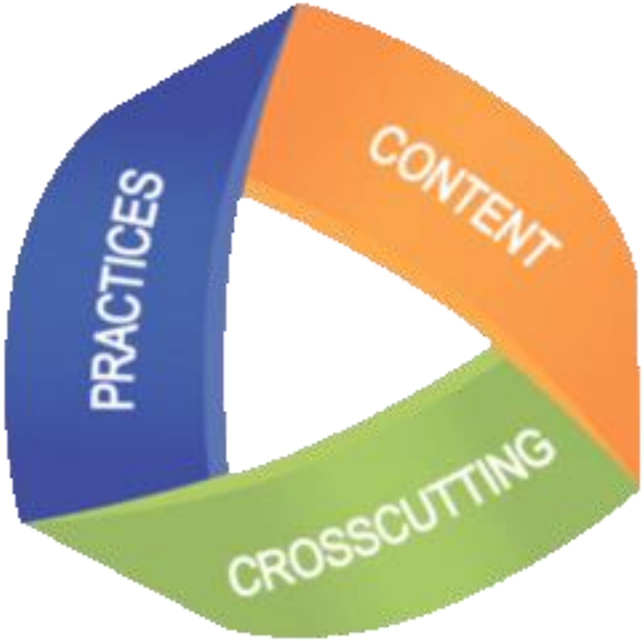
2) Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS Writing Standard 1

Write arguments to support claims with clear reasons and relevant evidence.

- Introduce claim(s) and organize the reasons and evidence clearly.
- ***Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.***
- Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons.
- Establish and maintain a formal style.
- Provide a concluding statement or section that follows from the argument presented.

NEXT GENERATION
SCIENCE
STANDARDS



- Scientific and Engineering **Practices**

- **Crosscutting Concepts** that unify the study of science and engineering through their common application across fields

- **Disciplinary Core ideas** in four content areas:

  - Physical sciences
  - Life sciences
  - Earth and Space science
  - Engineering, technology and applications of science

NEXT GENERATION
SCIENCE
STANDARDS

RIVER ECOLOGY

Investigating the effect of zebra mussels on the Hudson River

Middle School Life Science

Use a model to support explanations of the effect of resource availability on organisms and populations of organisms in an ecosystem.

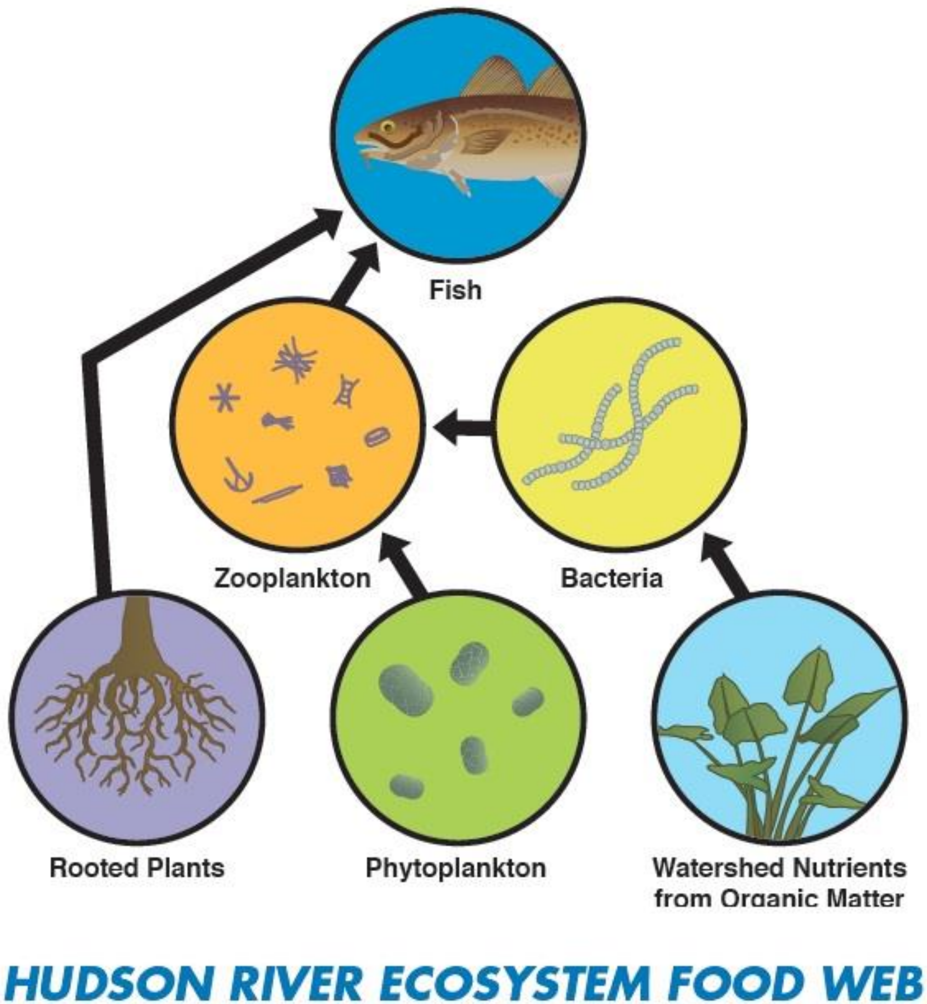
Science Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Developing and Using Models	• Interdependent Relationships in Ecosystems	• Cause and Effect

NEXT GENERATION
SCIENCE
STANDARDS

MS-LS2-a.
Use a model to support explanations of the effect of resource availability on organisms and populations of organisms in an ecosystem.

Emphasis is on cause and effect relationships between resources and populations in ecosystems in terms of changes in the numbers of individuals in the population during periods of abundant resources and scarce resources. **Models may include representations of ecosystems and /or graphs and charts showing the flow of matter in food webs or food chains for which students explain the cause and effect of various events and/or conditions.**

Using a Model



Developing a Scientific Explanation Tool (DSET)

What is the question?

What effect do zebra mussels have on phytoplankton in the Hudson River ecosystem?

Components of a scientific explanation

Claim	Evidence	Scientific Reasoning
What is the answer to your question?	***What is the raw data that supports a particular claim?***	***What are the scientific principle(s) that form a logical argument about the relationship between the claim and evidence?***
Zebra mussels cause the concentration of phytoplankton in the Hudson River to decrease significantly…	Concentrations of phytoplankton in the Hudson River (measured in micrograms chlorophyll-a per liter) prior to the arrival of the zebra mussels in 1992 was between 15 and 17 micrograms per liter. After the zebra mussel became established in 1992, with a long-term average of approx. 1,300 zebra mussels per square meter, concentrations of phytoplankton were less than 5 micrograms chlorophyll a per liter…	Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with non-living factors. Growth or organisms and population increases are limited by access to resources. Zebra mussels are filter feeders that feed on suspended organic particles in the water, including phytoplankton. Based on the fact that zebra mussels depend on plankton for food, and that the graph shows that when the number of zebra mussels increased, the amount of phytoplankton (as indicated by chlorophyll) decreased, this supports our claim that the zebra mussels caused this decrease to occur.

Re-Defining Field Trips

Access to Science Institutions

Four Types of Vouchers

- School Group Vouchers
- Student & Family Vouchers
- Family Field Trip Vouchers
- Teacher Vouchers

AND

- Free Bus Transportation for Family Field Trips

RE-DEFINING FIELD TRIPS

METRO DENVER URBAN ADVANTAGE
MIDDLE SCHOOL SCIENCE

metro Denver urban advantage

middle school science initiative

From an ill-defined free-for-all..

..to a way to spark inquiry and investigation.

metro Denver urban advantage

middle school science initiative

Local science-rich institutions

not just destinations–

places for *learning science*

metro Denver urban advantage

middle school science initiative

How can the museum, zoo, and gardens provide the *scaffolding* teachers need to connect back to the classroom?

Metro Denver Urban Advantage is funded by the National Science Foundation's Discovery K-12 Research Program through grant # DRL 1020386.

metro Denver urban advantage
middle school science initiative

Orientation Video

Demystifying

Clarifying

Fun

Metro Denver Urban Advantage is funded by the National Science Foundation's Discovery K-12 Research Program through grant # DRL 1020386.

metro Denver urban advantage

middle school science initiative

Field Trip Template

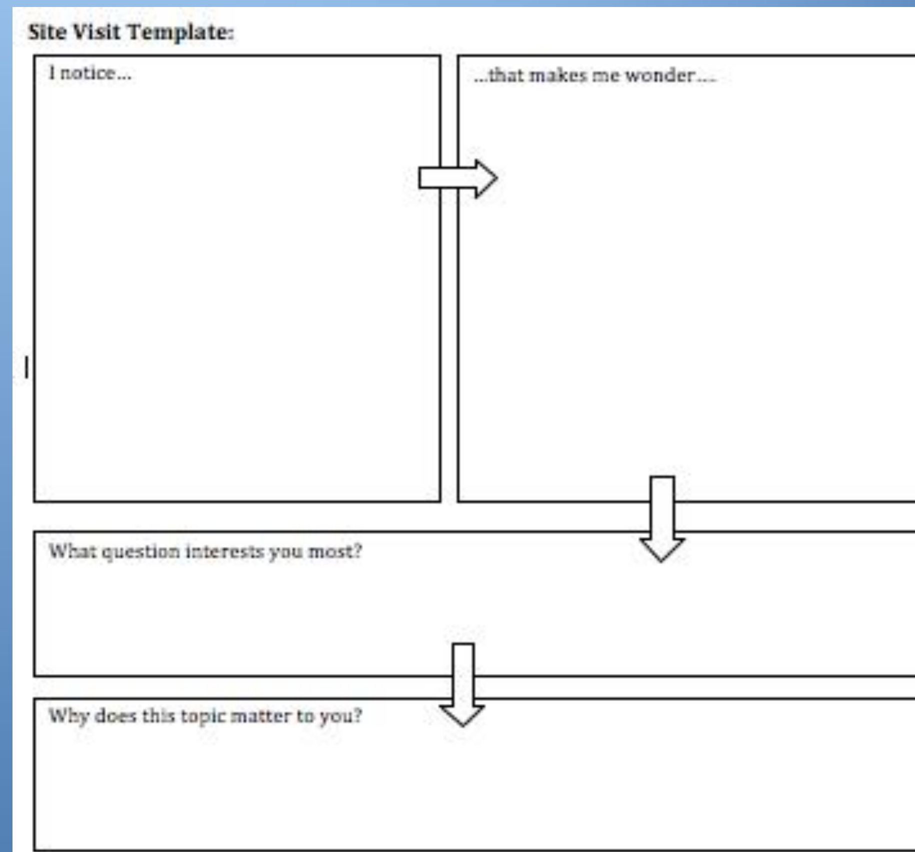
Scaffolding the experience–

yet still

open-ended

and free

choice.


Site Visit Template:

I notice...

...that makes me wonder...

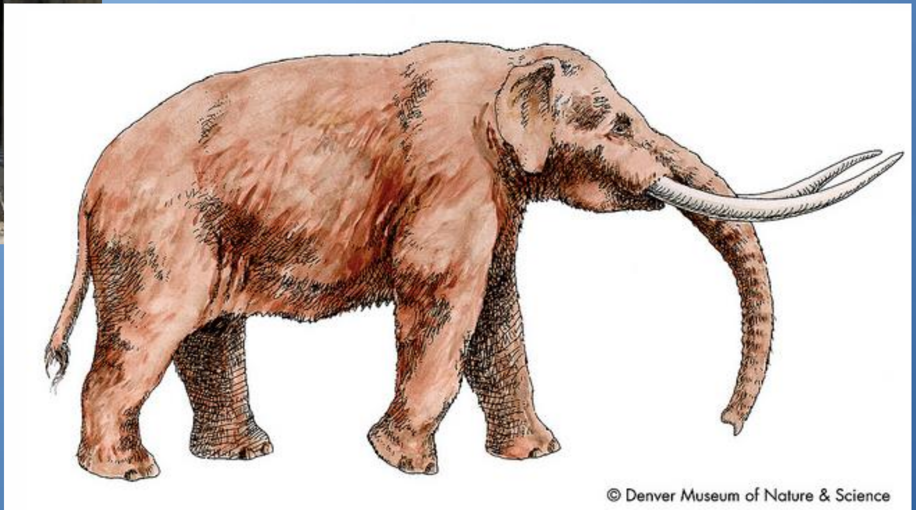
What question interests you most?

Why does this topic matter to you?

Metro Denver Urban Advantage is funded by the National Science Foundation's Discovery K-12 Research Program through grant # DRL 1020386.

metro Denver urban advantage

middle school science initiative



Artist rendering of an American Mastodon

THE SNOWMASTODON PROJECT™

DENVER MUSEUM OF NATURE & SCIENCE

MAMMOTHS AND MASTODONS

TITANS OF THE ICE AGE

February 15–May 27, 2013

EXHIBITION FEATURES

Top 10 Things to See and Do

The Snowmastodon Project®

The Snowmastodon Project®

^ Back to Top

Impact on Teachers & Students

Denver Efficacy Study

NYU Impact Evaluation

RESEARCH QUESTIONS

1. Impact of Urban Advantage on

   students

2. Impact of Urban Advantage on

   teachers

3. Impact of Urban Advantage on

   families

RANDOM ASSIGNMENT OF SCHOOLS

Urban Advantage






Comparison





Data Collection Efforts

Standardized Student Science Assessment

Pre-Post Student Science Assessment

Pre-Post Student Surveys

Pre-Post Teacher Surveys

Post-only Parent Surveys

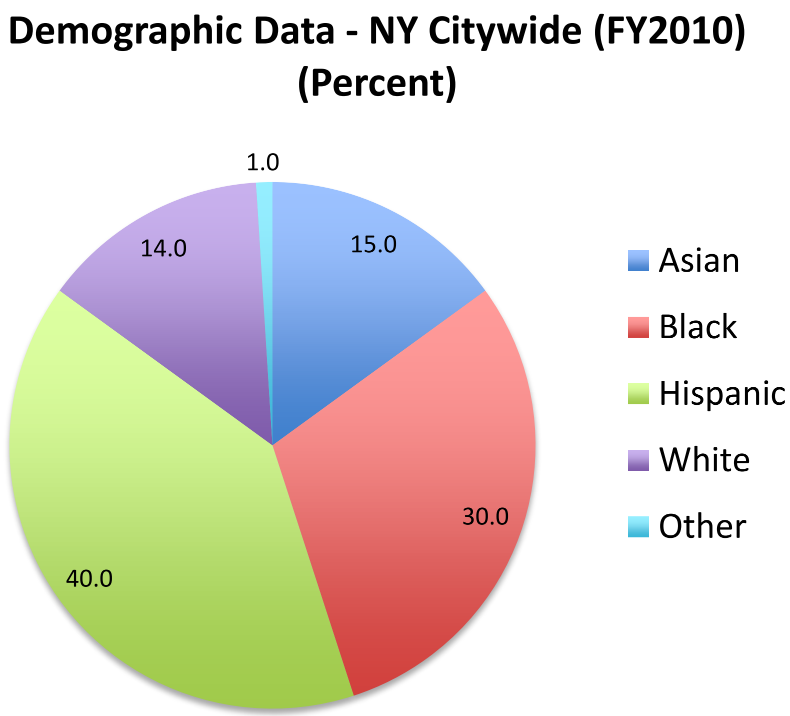
urban advantage
middle school science initiative

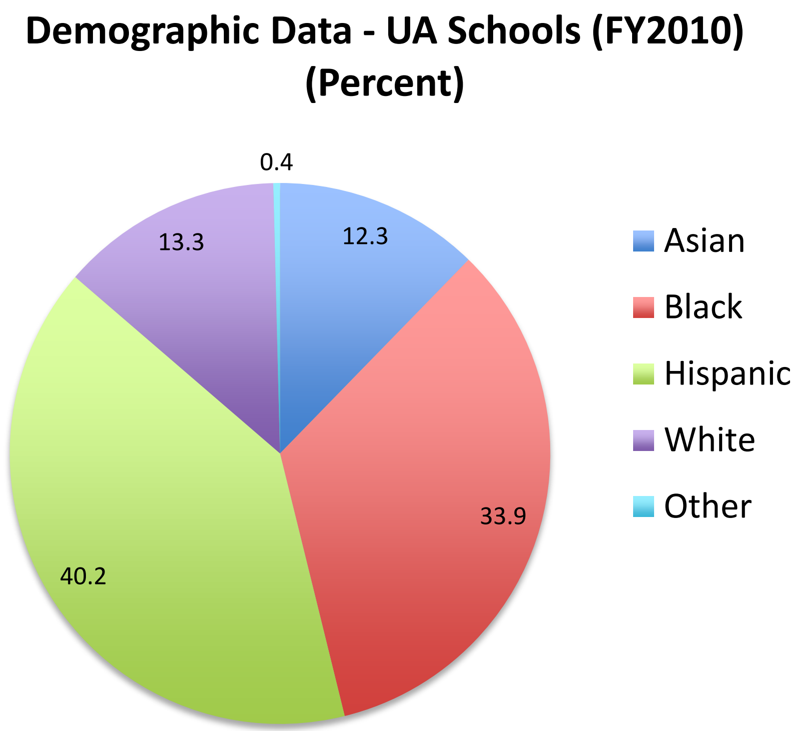
New York City

School Year	*2004-2005*	*2005-2006*	*2006-2007*	*2007-2008*	*2008-2009*	*2009-2010*	*2010-2011*	*2011-2012*	*2012-2013*
Schools	***31***	***111***	***129***	**156**	**147**	**174**	**156**	**137**	**123**
New Teachers	62	133	116	127	61	182	86	63	111
Continuing Teachers		62	94	129	196	204	285	280	253
Total Teachers	***62***	***195***	***210***	**256**	**257**	**386**	**371**	**343**	**364**
UA Students	***5,500***	***18,722***	***21,016***	***27,541***	**24,793**	**37,582**	**37,822**	**35,824**	**33,295**

In FY13, 22% of all NYC middle schools participate in UA

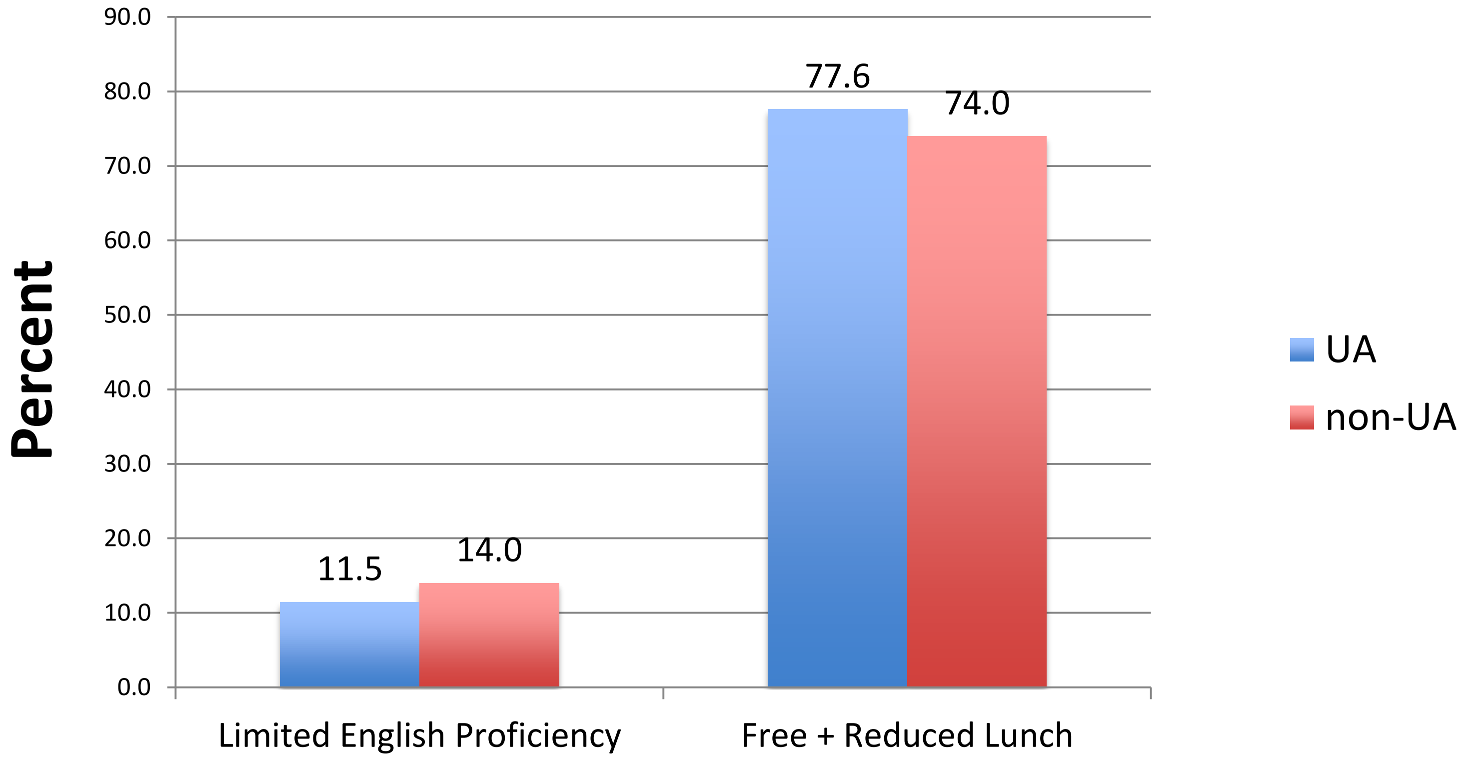
Demographic Data:
UA Schools vs. non-UA Schools





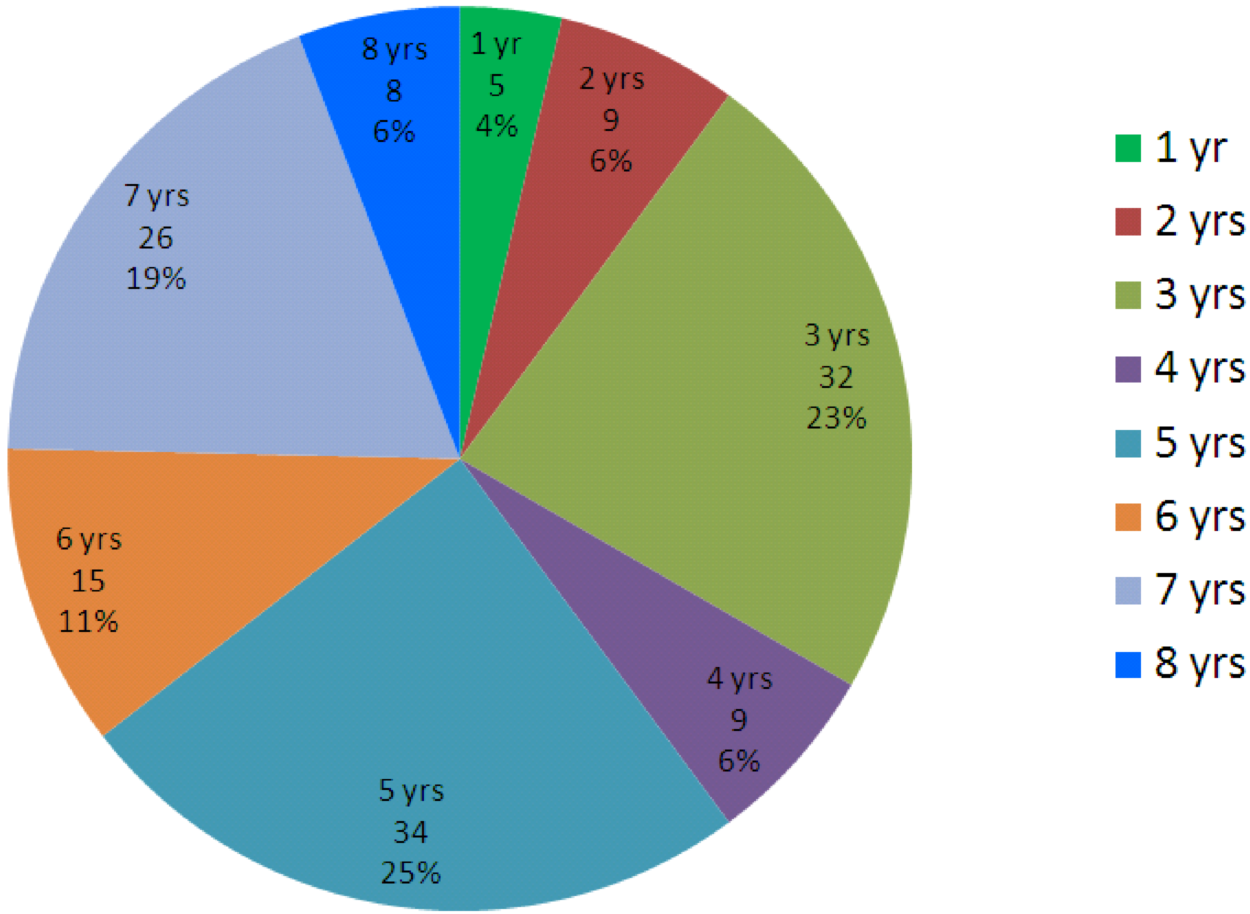
UA New York City

Language and Free/Reduced Lunch: UA Schools vs. non-UA Schools



UA New York City

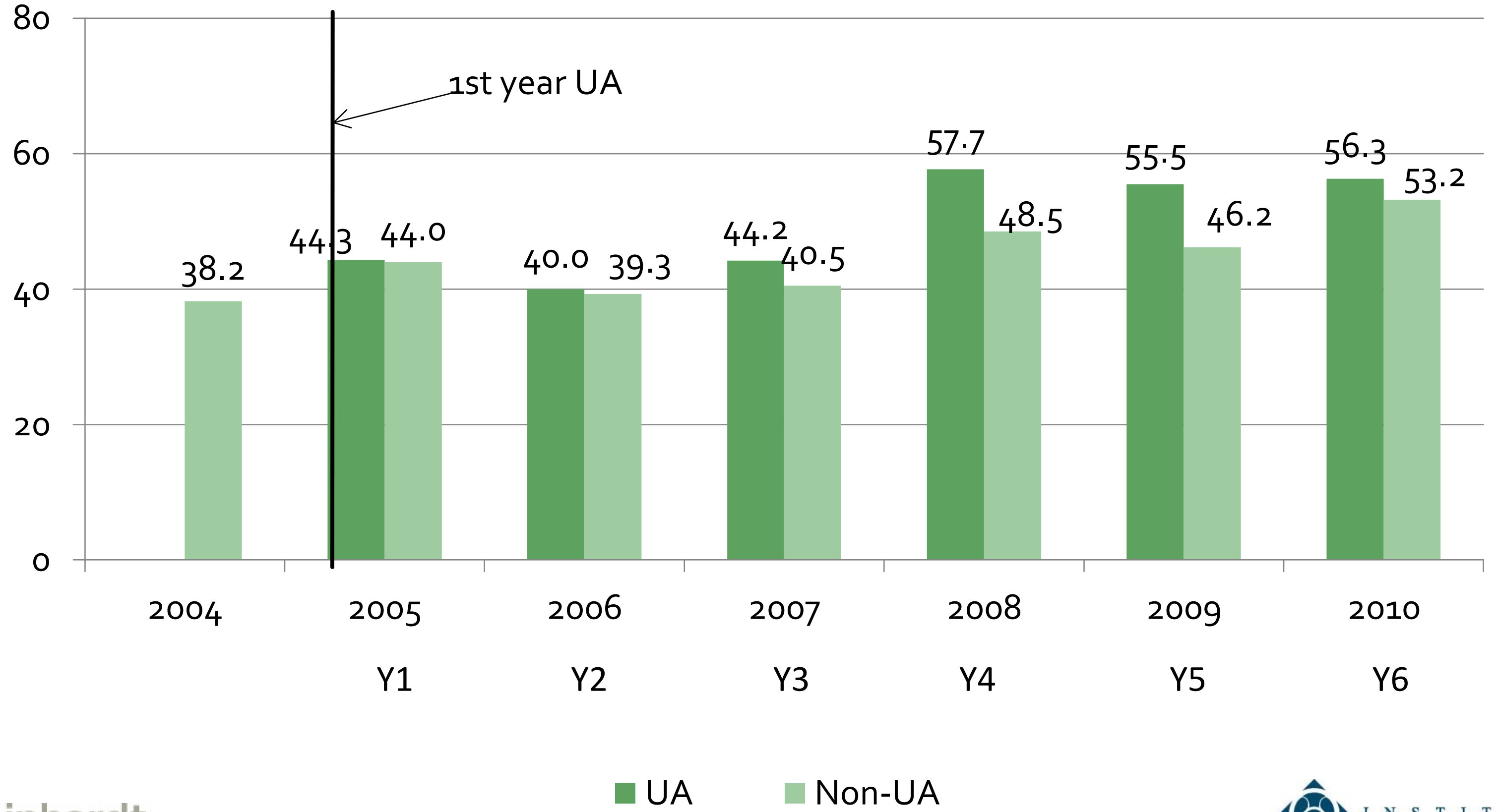
2012 Schools by Years of Participation



UA New York City

Raw performance data suggests UA is effective

Student Weighted Mean Achievement, 8th Grade Intermediate Level Science (ILS) Test – Percent Proficient



UA New York City

NYUSteinhardt
Steinhardt School of Culture, Education, and Human Development

Institute for Education and Social Policy

Linear Probability Coefficients, High School Outcomes

	Model 1	Model 2
	β/s.e	β/s.e
Attending a STEM School	0.014*** (0.003)	0.008* (0.004)
Attending a Partial STEM School	NS	NS
Taking Living Environment Regents in 8th or 9th Grade	0.255*** (0.012)	0.246*** (0.012)
Passing Living Environment Regents	NS	NS
Passing Living Environment Regents with 65 or higher	0.040*** (0.006)	0.032*** (0.006)
Passing Living Environment Regents with 85 or higher	0.062*** (0.005)	0.054*** (0.005)
Taking Earth Science Regents in 8th or 9th Grade	0.039*** (0.007)	0.033*** (0.007)
Passing Earth Science Regents	0.029*** (0.0006)	0.012* (0.0006)
Passing Earth Science Regents with 65 or higher	0.059*** (0.007)	0.037*** (0.008)
Passing Earth Science Regents with 85 or higher	0.062*** (0.005)	0.054*** (0.005)
School Fixed Effects	YES	YES

* p<0.05, ** p<0.01, *** p<0.001
Robust clustered standard errors in parentheses
Control variables not shown are: Black, Hispanic, Asian, Female, Poor, Special Education, LEP, and for Model 1 lagged_zmath.

INSTITUTE FOR Education and Social Policy

Post 8th Grade Outcomes

- Students at UA schools were found to be 25.5% more likely to take the Living Environment Regents exam in 8th or 9th grade and showed significantly higher levels of proficiency than students in non-UA schools.

- There is an increased probability of UA students attending STEM high schools.

Table Discussions

1. Choosing the “right” STEM partners to collaborate
2. Determining the curricular focus of a STEM partnership
3. Building and sustaining a STEM partnership program
4. Funding a STEM partnership program
5. Designing a STEM partnership program for scale
6. Assessing the impact of a STEM program on student learning and teacher practice

urban advantage
middle school science initiative

metro Denver urban advantage
middle school science initiative