

DATA *Nuggets*

Ways to use data analysis and classroom discourse
with authentic research to unearth students'
quantitative and inquiry skills

Cheryl Hach and Melissa Kjelvik

Goals for this session

- Discuss the challenges faced by science teachers to increase quantitative reasoning skills in their students
- Introduce Data Nuggets as a potential solution
- Review CER and how to use it in the classroom

What is Quantitative Reasoning?



What is Quantitative Reasoning?

Discuss in small groups:

- ▣ What is your definition of quantitative reasoning?
- ▣ What are students expected to do?
- ▣ How do you teach QR in your classroom?

What is Quantitative Reasoning?

- A way of viewing the world through “mathematical eyes” and approaching every day problems with confidence and logical reasoning (Piatek-Jimenez et al. 2012, Vacher 2014)
- Mathematics and statistics applied in real-life, authentic situations that impact an individual’s life as a constructive, concerned, and reflective citizen (Mayes et al. 2014)

The Problem

The Problem:

- ▣ Students in the United States consistently lag behind in science education outcomes (National Center for Education Statistics 2005)
- ▣ Students are graduating unable to apply quantitative knowledge to situations (Wilkins 2010)
- ▣ Little to no improvement between 1970-2012 (Mullis & Martin 2014)

The Implications:

- ▣ Students with low QR are more likely to drop out of school, experience unemployment, earn less (McMillan & Marks 2003, Marks et al. 2005, Rumberger & Lamb 2003)
- ▣ Left unprepared to address pressing social and scientific issues (Steen 1999)
 - ▣ These issues becoming more important as we increasingly rely on large, complicated datasets (NAP 2014)

Reform in Education

Fundamental shifts in science education

- Away from rote learning of facts
- Towards application of critical thinking and deep understanding

NGSS, ACT, AP Biology Framework emphasize:

- Ability to **analyze and interpret** data
- The use of **mathematical** thinking
- Communication of **arguments** based on **evidence**

What are Data Nuggets?



What are DATA *Nuggets* ?

- Activities that bring real data into the classroom, along with all its messiness and complexity
- Based on authentic cutting edge research
- Guide students through the entire process of science, including data analysis & interpretation
- Take 30-60 minutes and follow familiar template

How Data Nuggets got their start



- **Co-created with teachers at KBS as part of GK-12**
- Graduate students gain teaching experience
- Teachers are exposed to contemporary science
- Students practice scientific inquiry

How Data Nuggets got their start

- Teachers concerned about performing inquiry in the classroom
- Complexity of research results and messiness of data
- Students need practice working with data – graphing and interpreting



Big Themes in Data Nuggets



Learning Objectives

Through the repeated use of Data Nuggets in the classroom, students will:

1. Understand that science is an active process and how we learn about the natural world.
2. Identify and differentiate between scientific questions, hypotheses, and predictions.
3. Build their quantitative skills by working with data, graphing, and interpreting quantitative information.
4. See science as an approachable and attainable career.

Predicted student gains when using Data Nuggets

▣ Teacher survey results:

- “Students were more interested and engaged in science because they knew they were working with real data.”
- “Students were better able to think critically about data and communicate their findings to their peers and through writing.”
- “Because of their new comfort with data, students were more excited to conduct their own inquiry projects and graph.”
- Ability to analyze and interpret data, identify data ranges and trends, and appropriately question the reliability of data and outliers, all improved.

Data Nuggets in the Classroom





Featured Data Nugget: Do salmon have the genes necessary to survive warming waters from climate change?

[MAKE YOUR OWN DATA NUGGET!](#)[STANDARDS ALIGNMENT](#)[DATA NUGGET EXTENSIONS](#)[DIFFERENTIATED INSTRUCTION](#)[PUBLICATIONS AND RESEARCH](#)

DATA NUGGETS WERE FOUNDED IN 2011 BY MSU SCIENTISTS AND TEACHERS IN THE GK-12 PARTNERSHIP. THEY ARE CURRENTLY FUNDED BY A DRK-12 GRANT FROM THE NATIONAL SCIENCE FOUNDATION.

RECENT NEWS & EVENTS



Data Nuggets at the
National Academies
Special Topics
Summer Institute on
Quantitative Biology

CONTACT US




Please feel free to email Liz (eschultheis@gmail.com) or Melissa (kjelvikm@gmail.com) with any questions you might have. If you would like to create your own Data Nugget, include Data Nuggets as a broader impact in an upcoming grant, or are using Data Nuggets in your classroom for the first time, let us

DATA NUGGETS BY THEME

[adaptation](#) [agriculture](#) [algae](#)[animals](#) [behavior](#)[biodiversity](#) [biofuels](#) [birds](#) [climate](#)[change](#) [competition](#) [coral reef](#)

Search Current Data Nuggets

Below, you will find a **table** of all the current Data Nuggets available. Click on the Title to open a page displaying the Data Nugget and associated activities. The table can be **sorted** using the arrows located next to each column header. It can also be **searched** using the search command at the top of the table.

	↕ Title	↕ Keywords	↕ Summary	↕ Content Level	↕ Study Location
	A tail of two scorpions	animal behavior, animals, predation	Species rely on a variety of methods to defend against predators, including camouflage, speedy escape, or retreating to the safety of a shelter. Other animals, such as scorpions, have painful venomous stings. Scientists wanted to know whether the pain of a scorpion sting was enough to deter predators, like the grasshopper mouse.	2	Santa Rita Mountains, Arizona & Michigan State University
	CSI: Crime Solving Insects	animals, insects, parasitism	You might think maggots (blow fly larvae) are gross, but without their help in decomposition we would all trip over dead bodies every time we went outside! Forensic entomologists also use these amazing insects to help solve crimes. Blow flies oviposit on dead bodies, and the age of the maggots that hatch helps scientists determine how long ago a body died. Scientists noticed parasitic wasps were also present at some bodies. Might these wasps delay blow fly oviposition and interfere with scientists' estimates of time of death?	3	Pierce Cedar Creek Institute, Michigan & Valparaiso University, Indiana
	Shooting the poop	adaptation, animal behavior, animals, insects, predation	Caterpillars are a great source of food for many species. The silver-spotted skipper caterpillar has a variety of defense strategies against predators, including building leaf shelters for protection. This caterpillar was also discovered to "shoot its poop", sometimes launching it over 1.5m! Might this very strange behavior serve as	2	Georgetown University, Washington DC

Pedagogical Themes in Data Nuggets

- **Science Stories** – Readers find stories more engaging, easier to comprehend, and more memorable. Stories are “sticky” because they appeal to our desire for causality and goals, and the reasoning behind an idea increases reader interest
- **Active Learning** – Instead of memorizing facts and listening to a lecture, students are involved in the learning process. Data Nuggets engage students in activities, such as reading, writing, discussion, and problem solving. Teachers can use a variety of techniques while moving through activity.
- **Place-Based Learning** – Connecting science to learners’ everyday place-based context makes the content more accessible, particularly for culturally and linguistically diverse students

Do insects prefer local
or foreign foods? ✕



MEET THE SCIENTISTS!

Want to know more about the scientists behind each Data Nugget? Click on their name for a link to their professional websites, or on their Data Nugget to learn more about their research!



**Lauren
Kinsman-
Costello**

Kent State
University &
Michigan
State
University

I am an ecosystem ecologist interested in the effects of hydrology on aquatic nutrient biogeochemistry and ecosystem function. My research aims to inform larger questions about the resilience of ecosystems faced with environmental change and the ability of humans to manage, restore, and create ecosystems. A recurring theme in my research is the role that sediments play in freshwater ecosystem function (mud matters!).

[Marvelous mud](#)



**Melissa
Kjelvik**

Michigan
State
University &
Data
Nuggets

I am a postdoctoral researcher and co-founder of Data Nuggets. I completed my PhD in Zoology and EEBB at the Kellogg Biological Station as a member of Gary Mittelbach's Lab. For my research I work with juvenile bluegill sunfish. I am interested in how fitness tradeoffs may lead to the maintenance of individual-level biodiversity, particularly in the behaviors of fish.

[Dangerously bold](#)



**Alycia
Lackey**

Michigan
State
University &
Murray State
University

My research lies at the intersection of evolution, ecology, and behavior. I am interested to examine how populations evolve in response to the environment, especially in cases of environmental change. I study what generates, maintains, and erodes diversity within and between populations. In my Ph.D. research, I explored the evolution of reproductive isolation between limnetic and benthic threespine stickleback fish species pairs. I examined both how divergent sexual and natural selection maintained distinct species and how environmental change facilitated hybridization between one species pair. I am enthusiastic about teaching, mentoring, and outreach.

[Which guy should
she choose? &
Fish fights](#)

Research Background

Background information

Do insects prefer local or foreign foods?

Featured scientist: Elizabeth Schultheis from Michigan State University

Research Background:

Insects that feed on plants, called **herbivores**, can have big effects on how plants grow. **Herbivory** can change the size and shape of plants, the number of flowers and seeds, and even what plant species can survive in a habitat. For this reason, scientists study how insects and plants interact, and how much damage insects do to plants. A plant with more herbivore damage will most likely perform worse than a plant with less.

Native plants are those that naturally occur in an area without human interference. When a plant is moved from one area to another it is called an **exotic** plant. A small proportion of exotic plants become **invasive**, meaning they grow aggressively, take over habitats, push out native species, and harming human interests. What determines if an exotic species will become invasive? Scientists are very interested in this question because it could help control invasions underway and help stop new ones in the future.

Question and Hypothesis

What is the hypothesis? Find the hypothesis in the background and underline it. A hypothesis is proposed explanation for an observation, which can then be tested with experimentation.

Scientific Question: Do invasive species receive less damage from herbivores compared to native and exotic species?



Research Background

- Scientists are still overwhelmingly white and male (Pollack 2015).
- Ethnic minority students are more likely to see themselves as scientists if they are exposed to role models that they can identify with (Price 2010).
- Overcome scientist stereotypes.



Content Levels

Level 1	<ul style="list-style-type: none">• Elementary and above
Level 2	<ul style="list-style-type: none">• Middle School and above
Level 3	<ul style="list-style-type: none">• High School and above
Level 4	<ul style="list-style-type: none">• Advanced High School students• College undergraduates

- ▣ These correspond with Flesch-Kincaid readability statistics
- ▣ Aligned with NGSS Standards

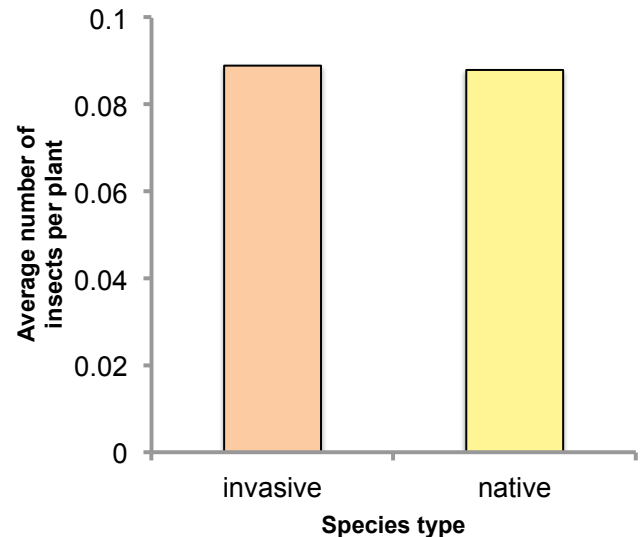
Data and Data Visualization

Dataset

Scientific Name	Species Status	Average number of insects per plant	Percent leaves with damage from insect herbivores
<i>Trifolium repens</i>	invasive	0.09	67.5
<i>Silene latifolia</i>	invasive	0.08	33.9
<i>Daucus carota</i>	invasive	0	13.3
<i>Robinia pseudoacacia</i>	invasive	0.57	86.3
<i>Dianthus armeria</i>	invasive	0.03	34.7
<i>Hieracium caespitosum</i>	invasive	0.06	27.2
<i>Stellaria graminea</i>	invasive	0	8.3
<i>Rumex acetosella</i>	invasive	0	47.5
<i>Chenopodium album</i>	invasive	0	0
<i>Phleum pratense</i>	invasive	0.06	29.1
<i>Danthonia spicata</i>	native	0	10.4
<i>Apocynum cannabinum</i>	native	0	21.6
<i>Hieracium gronovii</i>	native	0	20
<i>Lespedeza capitata</i>	native	0.08	66.7
<i>Ambrosia artemisiifolia</i>	native	0	40.5
<i>Vitis riparia</i>	native	0	100
<i>Monarda fistulosa</i>	native	0	30.5
<i>Antennaria parlinii</i>	native	0	17.7
<i>Euphorbia corollata</i>	native	0	8.3
<i>Asclepias tuberosa</i>	native	0.8	11.6

Average for Invasive		
Average for Native		

Data Visualization



Graphing Levels

Type A graph provided	<ul style="list-style-type: none">• Data: displayed on graph• Axis labels and scale provided
Type B	<ul style="list-style-type: none">• Data: student graphs data• Axis labels and scale provided
Type C student creates graph	<ul style="list-style-type: none">• Data: student graphs data• Axis labels and scale not provided

- ▣ Each Data Nugget is provided in each type on our website
- ▣ Scientist provides us with Type A and excel file, we make the rest

Constructing Explanations

Claim-Evidence-Reasoning

Make a claim that answers the scientific question. Describe the relationship between the dependent and independent variables and what that means.

Support your claim using data as evidence. Reference specific parts of the table or graph.

Explain your reasoning and how the data supports your claim. Connect the data back to what you learned about _____.

What do the data from this study tell us about the scientist's hypothesis? Use evidence to explain why or why not. If you feel the data was inconclusive, explain why.

Scientist Next Steps

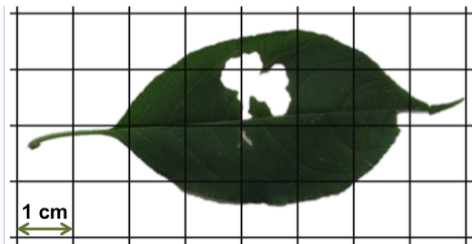
Your next step as a scientist: Science is an ongoing process. After this experiment, Elizabeth was left wondering, if herbivory does not explain invasiveness, what does? What other things could be different about invasive species?

Teacher Note: If a difference in damage from herbivores does not explain invasive species success, than what does? Perhaps damage from another type of enemy could drive this pattern, such as mammals that browse on plants, or disease. Elizabeth's future experiments do not support these alternative hypotheses – invasive species are more damaged by mammals and diseases as well! Overall, Elizabeth's research does not find support for the Enemy Release Hypothesis, which states that invasive species are more successful than native and non-invasive exotic species because enemies in their new ranges do not damage them.

Alternatively, Elizabeth is currently researching whether invasive species are those that are more tolerant to herbivory. Even though invasive species had the highest levels of damage, this damage may have less of an effect on them compared to its effects on native and exotic species. Invasive species tend to grow quick and they may be able to compensate for herbivory and still grow large when damaged. To test for tolerance, Elizabeth is conducting an experiment with plants where insect herbivores are either present or

Student Engagement Activities

Let's look at one leaf to see how Elizabeth collected herbivory data. Here is an example of a leaf from an invasive plant:



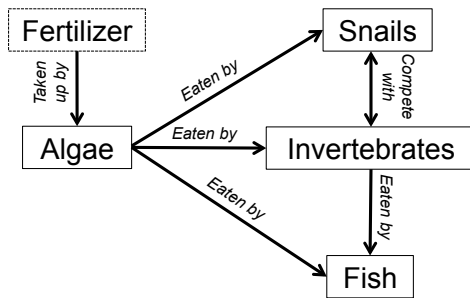
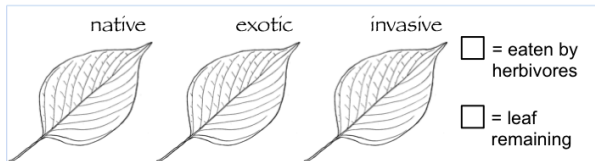
Observe the shape of the leaf. Does it appear that some of the leaf area is missing and has been eaten by herbivores? Estimate how many grid cells the leaf covers and how many grid cells are missing from the leaf. Each grid cell represents 1 square cm.

Area of leaf eaten by herbivores = _____

Total area of leaf = _____

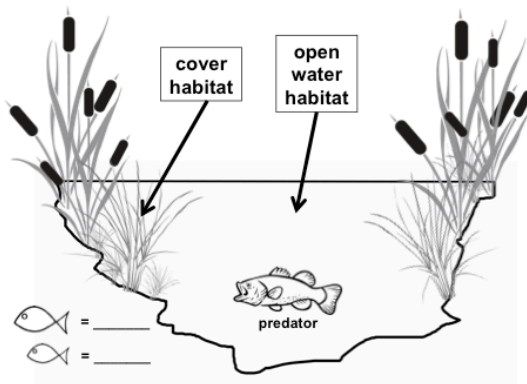
Proportion leaf area eaten by herbivores = Area of leaf eaten / total area of leaf = _____

Draw Your Predictions: On the three leaves below, draw your predictions for the amount of herbivory on the three plant types. Use one color to fill in areas that the herbivores have eaten. Use another color to fill in the rest of the leaf. Remember to fill in the legend to show which colors you used.



Draw your predictions: Below is a diagram of a pond where you can draw your predictions. Think about how bold and shy fish might respond to a predator.

1. Start by looking at the legend. Do you predict bold or shy fish will grow larger? Label which fish is bold and which is shy and choose a color for each.
2. Now move to the pond diagram. Draw bold and shy fish in the habitats where you predict they will spend most of their time.
3. Draw your survival predictions. Do you predict there will be more bold or shy fish left at the end of the experiment? Add more fish to your diagram if necessary.



Using the Teacher Guide

Teacher Notes: Provide additional background information for teachers, as well as suggestions for discussion topics.

Checks for Understanding: Provide stopping points for teachers to assess student understanding.

Meta Moments: Provide stopping points for teachers to have a conversation with their students about the process of science itself. Stepping back from the research, students can discuss the decisions they are making as they work through the Data Nugget.

Using the Teacher Guide

YouTube

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The sweet smell of (reproductive) success



Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/anbehav



Bird odour predicts reproductive success

Danielle J. Whittaker^{a,b,*}, Nicole M. Gerlach^b, Helena A. Soini^c, Milos V. Novotny^c,
Ellen D. Ketterson^b

^a BEACON Center for the Study of Evolution in Action, Michigan State University, East Lansing, MI, U.S.A.

^b Department of Biology, Indiana University, Bloomington, IN, U.S.A.

^c Institute for Phormone Research and Department of Chemistry, Indiana University, Bloomington, IN, U.S.A.

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Junco hyemalis

mate assessment

Although the importance of chemical communication in birds has long been overlooked or doubted, volatile compounds in avian preen secretions have been shown to covary with traits including species, sex and breeding condition, and thus may be useful mate recognition cues. Here we demonstrate for the first time that these compounds may reliably predict reproductive success in a North American songbird, the dark-eyed junco, *Junco hyemalis*. Several compounds associated with sex differences in this species varied with reproductive success, such that females with a more 'female-like' volatile profile and males with a more 'male-like' profile produced more genetic offspring. A male's green oil volatile compounds also predicted his success in rearing offspring in his home nest: males with a higher abundance of 'male-like' compounds had more surviving nestlings, including offspring sired by extrapair males. Finally, males with a higher abundance of 'female-like' compounds had more extrapair offspring in their home nests. Our results suggest that odours correlate with reproductive success and thus have qualities that could allow them to serve as reliable mate assessment cues in birds.

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er has published a new study demonstrating that
potential mates. [From the MSU press release:](#)

er of choice for
, however, have
lites that don't

Michigan State
birds do indeed
y predicts their
current issue of
ounds in avian



ne-grasshopper-mouse/

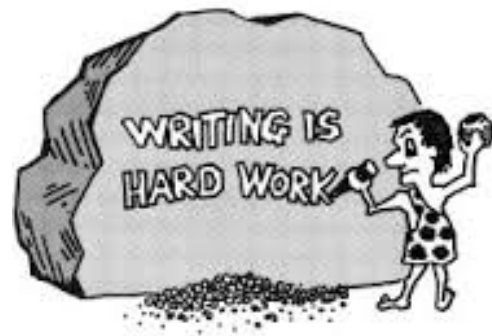
Constructing Explanations



Claim-Evidence-Reasoning (CER)

- Structure for constructing explanations
- Basis of scientific conclusions
- Consists of three parts:
 1. Restate the scientific questions with the answer that is suggested by examining the data.
 2. What evidence (data) supports your claim
 3. Reasoning links evidence to the claim using scientific principles

“We know it when we see it, but really how do we teach it?”



Why is CER Important?

- Helps students evaluate how the evidence helps answer the scientific question presented in an experiment or reading material
- CER framework trains student thinking about looking at data and assists them in making their understanding clear in written responses
- Foundation for discourse that all students can engage in
- Prepares them to be discerning, thoughtful citizens in the future (we hope!)

Teaching CER needs to be intentional

- ▣ Explicit directions to students with modeling. They need to understand exactly what the learning objectives are and practice them!
- ▣ Begin with a simple sets of data and teach expectations of claim and evidence. That's the easy part.
- ▣ Reasoning is the most difficult of the practices – for teachers and students alike!
 1. Why does the evidence support the claim?
 2. Links the logic that supports the claim, describes the connection, supports real-world application

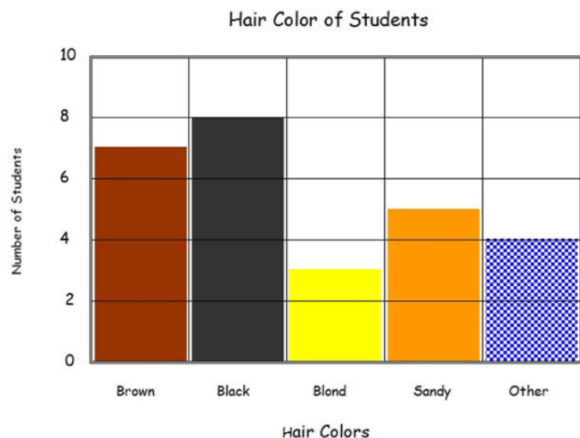
"Practice isn't the thing you do once you're good. It's the thing you do that makes you good." - Malcolm Gladwell

Identifying a Claim

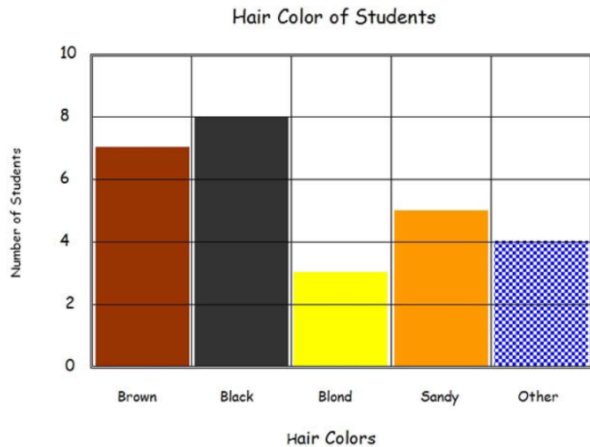
Restate the scientific question including the answer that is suggested by examining the data.

What might be the scientific question that fits this data?

Make a claim about the data.



Identifying the Evidence

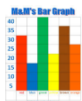


What evidence supports your claim?

Applying Reasoning to CER



Claim - it allows us to look more closely at what the data is telling us.

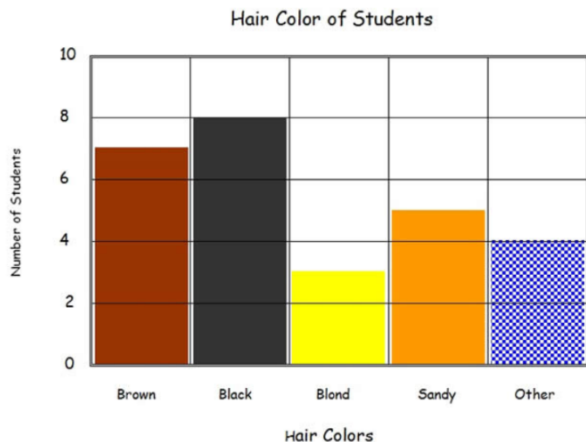


Evidence - the data that has been gathered in response to an experiment, aims to provide an answer to the question.






Reasoning - the connections between the evidence and the claim and the underlying scientific principles that relate to the claim.

Let's practice



What *scientific reasoning* links the data to the claim?

Scientific Question:

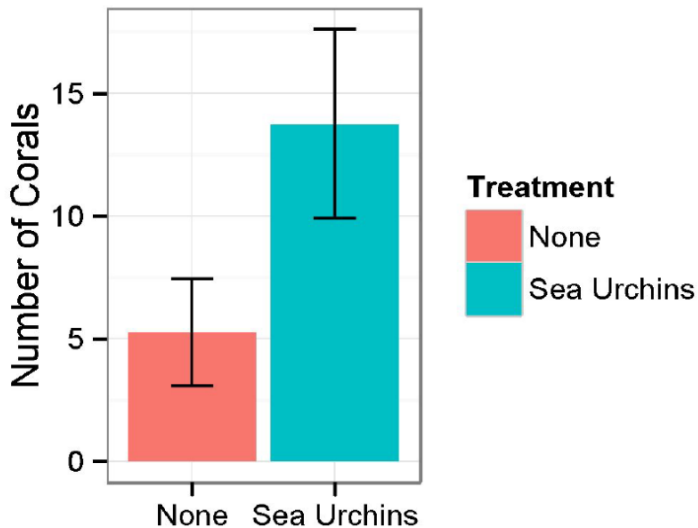
 Claim			
 Reasoning	Why does the evidence support the claim?	Why does the evidence support the claim?	Why does the evidence support the claim?
	What is the underlying science concept?	What is the underlying science concept?	What is the underlying science concept?
 Evidence	Evidence:	Evidence:	Evidence:

DATA *Nugget*




Won't you be my urchin?




Featured scientist: Sarah W. Davies from University of Texas at Austin

Scientific Question: How does the presence of urchins affect corals?



Step 1

 Claim	<p>The number of corals growing in bins with sea urchins is higher than those bins without sea urchins.</p>		
 Reasoning	<p>Why does the evidence support the claim?</p>	<p>Why does the evidence support the claim?</p>	<p>Why does the evidence support the claim?</p>
	<p>What is the underlying science concept?</p>	<p>What is the underlying science concept?</p>	<p>What is the underlying science concept?</p>
 Evidence	<p>Evidence:</p>	<p>Evidence:</p>	<p>Evidence:</p>

 Claim	The number of corals growing in bins with sea urchins is higher than those bins without sea urchins.		
Reasoning 	Why does the evidence support the claim?	Why does the evidence support the claim?	Why does the evidence support the claim?
	What is the underlying science concept?	What is the underlying science concept?	What is the underlying science concept?
 Evidence	Evidence: The average number of corals on tiles with sea urchins was 13.75.	Evidence: The average number of corals on tiles without sea urchins was 5.25.	Evidence:

Step 2



Claim

The number of corals growing in bins with sea urchins is higher than those bins without sea urchins.

Reasoning

Why does the evidence support the claim?

The evidence supports the claim because in four trials, the average number of corals with sea urchins was higher.

What is the underlying science concept?

The sea urchin eat the algae that can be competitive with corals, allowing corals to be more successful.

Why does the evidence support the claim?

The evidence supports the claim because in four trials, the average number of corals without sea urchins was lower.

What is the underlying science concept?

Without sea urchins, algae competes with the coral and limits the coral growth.

Why does the evidence support the claim?

What is the underlying science concept?



Evidence

Evidence:

The average number of corals on tiles with sea urchins was 13.75.

Evidence:

The average number of corals on tiles without sea urchins was 5.25.

Evidence:

Step 3

Criteria	Student 1	Score	Student 2	Score	Student 3	Score	Student 4	Score
Claim: Statement that answers the scientific question.	Just look at the graph.		The difference is more corals are growing on tiles with sea urchins than tiles without sea urchins.		The corals grew with and without sea urchins.		The tiles with sea urchins are affected more than the tiles without the sea urchins (less corals).	
Evidence: Scientific data that supports the claim.	Theres more corals with sea urchins.		My evidence is tiles with sea urchins have 2 ½ more corals growing on them than without sea urchins.		More corals grew with sea urchins 13 and 5 without sea urchins.		The corals with sea urchins had 13.75 and the tiles without sea urchins had 5.25.	
Reasoning: a. why evidence supports the claim and b. what the underlying science concept(s) does it link to.	Algae changes color.		The data supports it by having the tiles with sea urchins have more corals than the tiles without sea urchins. They are used to it.		Corals are helped by sea urchins.		It supports our claim because it shows sea urchins help corals grow.	

Evaluate Student Responses

Rank the set of student responses from best (1) to worst (10) for:

- ▣ Claims
- ▣ Evidence
- ▣ Reasoning

Scaffolding CER

- ▣ Before using Data Nuggets, students will need instruction in basic science principles
- ▣ Data Nuggets then provide practice in dealing with data and interpreting it
- ▣ Start off by heavily scaffolding students, and take away over time

You can't do Data Nuggets without teachers!

Talk Moves

Teachers can use to elicit better reasoning:

- “Do these data support the science concepts?”
- “Can you say/write more about that?”
- “Let me repeat back what I hear you saying....”
- “Why do you think that?”
- “Sally, can you repeat what Katie is saying in your own words?”
 - “Is that what you were saying?”
- “Does it always work that way?” or “Are there exceptions to this?”
- “Can you add some science details to that?”
- “How does the science relate to those results?”
- “What convinces you that this science concept explains the data?”

Suggested Sentence Starters

1. My evidence supports my claim because _____, therefore _____.
2. My evidence supports the claim because _____ and it is important because _____.
3. The trend is showing us _____ that proves our claim is correct/incorrect and it is important to science because _____.



You might consider making bookmarks for your students. A C-E-R poster for your classroom might support better student writing.

Using the CER Tool

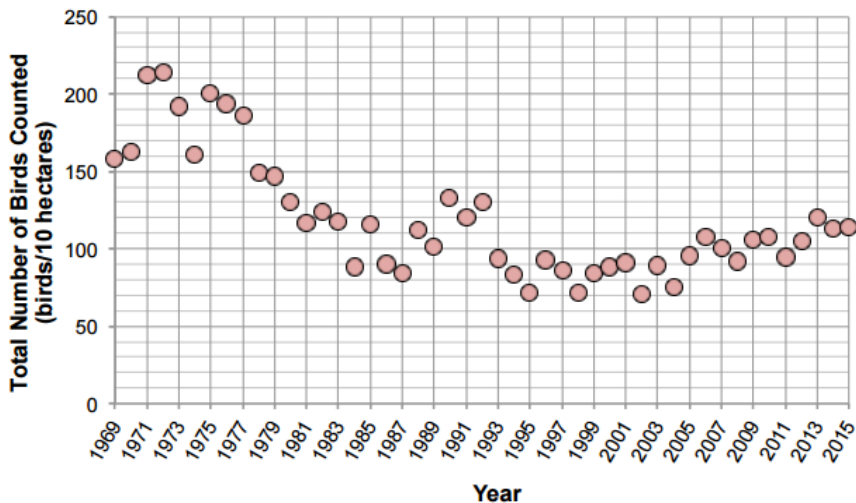
- As a pre-writing scaffold and turned in as a formative or summative assessment.
- A vehicle to discuss a table/graph orally with their classmates before completing the Data Nugget individually.
- As a structured exemplar before assigning CER as a written paragraph.


DATA *Nugget*

Bye Bye Birdie? Part I

Featured scientist: Richard Holmes from the Hubbard Brook Experimental Forest

Scientific Question: How has the total number of birds at the Hubbard Brook Experimental Forest changed over time?





Claim

The total number of birds at the Hubbard Brook Experimental Forest has gone down over time.

Reasoning

Why does the evidence support the claim?

The evidence shows a higher number of birds in 1969

Why does the evidence support the claim?

The evidence shows a downward trend over time, from 1969 - 2015

Why does the evidence support the claim?


What is the underlying science concept?

Therefore, conditions in the forest were better for birds in 1969 than they were in 2015

What is the underlying science concept?

Therefore, we can reason that there was some type of environmental change that caused the bird numbers to drop

What is the underlying science concept?



Evidence

Evidence:

In 1969, there were a total number of 158 birds counted during the forest sampling

Evidence:

In 2015, there were 114 birds counted in the forest sampling

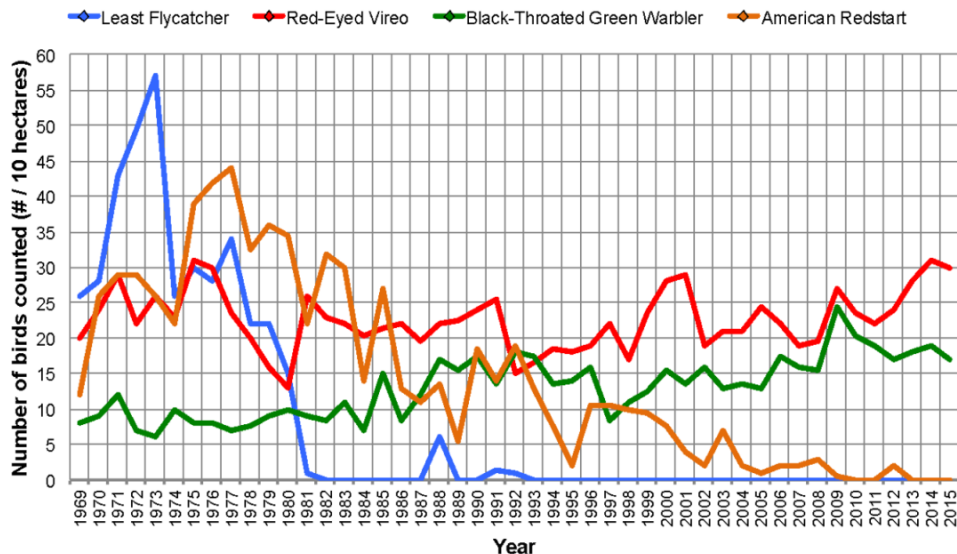
Evidence:

DATA *Nugget*

Bye Bye Birdie? Part II

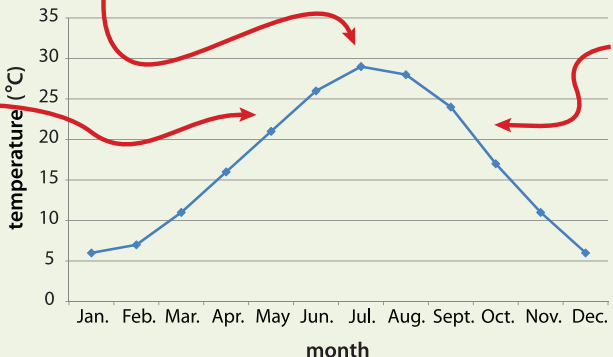
Featured scientist: Richard Holmes from the Hubbard Brook Experimental Forest

Scientific Question: What is the population trend of each bird species over the years 1969-2015?

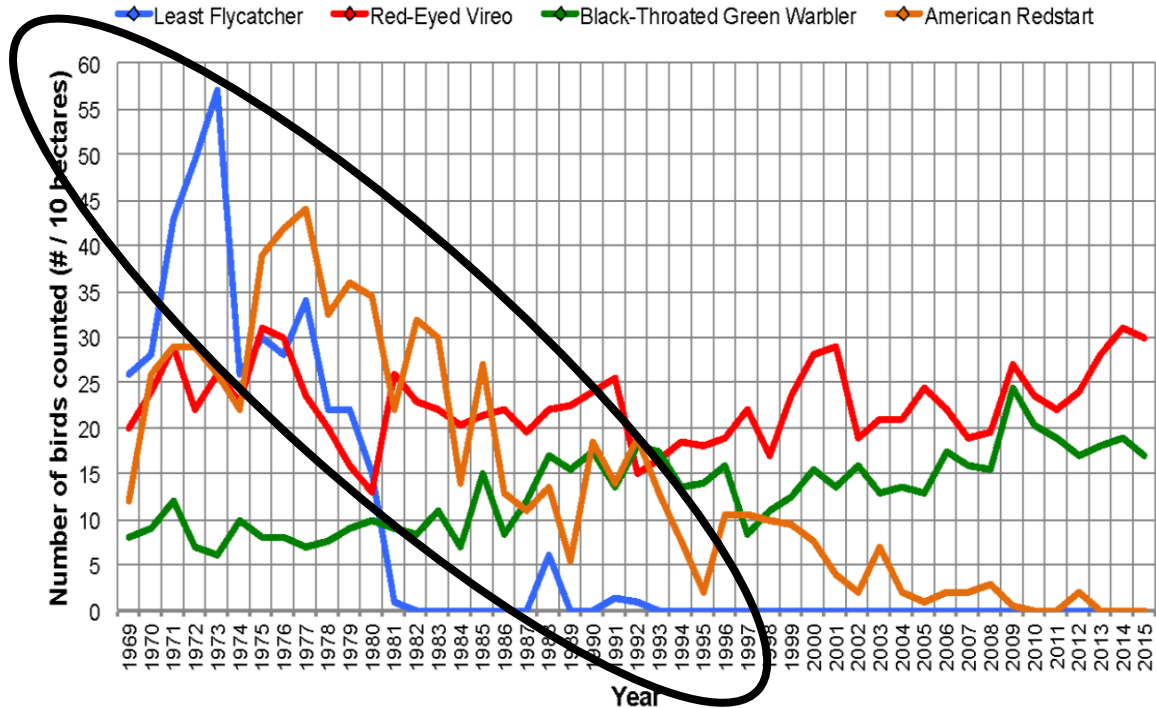


Scaffolding CER

Taking a step further back – I² tool

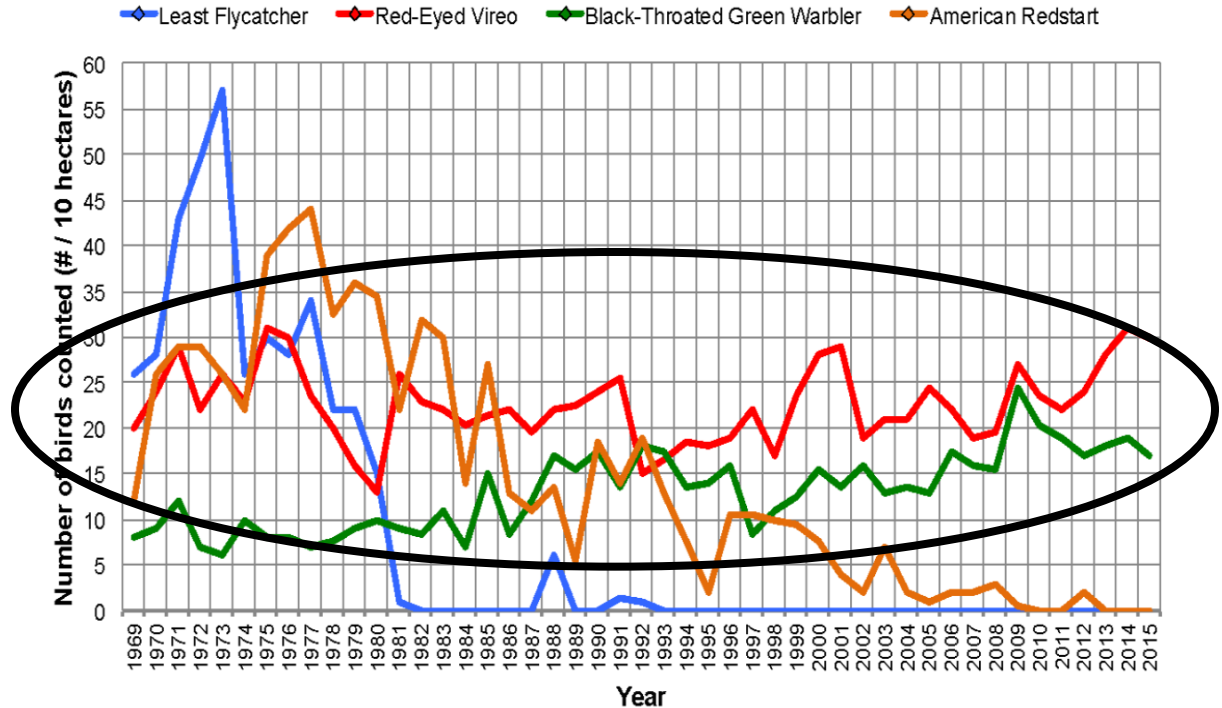
I ² step	Example
<p>Step 1: Identify ("What I see" comments)</p> <ul style="list-style-type: none">■ Identify any changes, trends, or differences you see in the graph or figure.■ Draw arrows and write a "What I see" comment for each arrow.■ Be concise in your comments. These should be just what you can observe.■ Do not try to explain the meaning at this point.	<p data-bbox="664 412 792 464">What I see: a peak in July</p> <p data-bbox="711 480 1156 507">Average Monthly Temperatures in One U.S. City</p>  <p data-bbox="425 524 592 616">What I see: an upward slope between February and July</p> <p data-bbox="1210 524 1378 616">What I see: a downward slope between July and December</p> <p data-bbox="425 889 1378 993">For this example, there are arrows drawn that point to the two trends and the change. Notice that the arrows point to the general upward and downward trends, not to each data point. A "What I see" comment describes what each arrow points to on the graph.</p>

Identify trends in the graph



Least Flycatchers went from the most abundant to the least abundant in less than 15 years

Identify trends in the graph



There are almost always more red-eyed vireos counted than black-throated green warblers

Bird population trends are different for each of the four species shown. Some have increased, some have decreased, and some have stayed the same.

Claim

Reasoning

Evidence

Why does the evidence support the claim?

The evidence from sampling shows that the Least Flycatcher population has dropped

What is the underlying science concept?

Therefore, since the flycatcher prefers semi-open spaces in the forest, as forest succession progressed and less open space was available, their populations decreased as they migrated elsewhere.

Evidence:

Least Flycatcher population went from 26 in 1969 to 0 by 1993 and have been absent from the forest since then.

Why does the evidence support the claim?

The evidence from sampling shows that the Red-eyed Vireo population has remained constant

What is the underlying science concept?

Need some explanation – the vireo should not be successful in early disturbed ecosystem

Evidence

Red-eyed Vireo population shows minimal change. There were 20 birds in 1969 and in 2015 there were 30

Why does the evidence support the claim?

The evidence from sampling shows that the Black-Throated Warbler population has increased

What is the underlying science concept?

Black-Throated Green Warbler is versatile in its habitat, able to be successful under many circumstances, although it is more successful as forests are less disturbed.

Evidence

Black-Throated Green Warbler population has increased from 8 birds in 1969 to 17 birds in 2015

Why does the evidence support the claim?

The evidence from sampling shows that the American Redstart population has dropped.

What is the underlying science concept?

American redstart prefers conditions similar to the Least Flycatcher, preferring mid-successional forests with open spaces, avoiding forests with abundant cover.

Evidence

American Redstart population was 12 in 1969 and diminished to 2 or less after 2008

Assessing Student Understanding



Classroom Assessments

- ▣ Data Nuggets have also been used as formative and summative assessments
- ▣ Rubric developed to facilitate the use of DNs as assessments
 - ▣ Currently being revised after working with summer expert teachers (please provide any feedback!)

Data Nuggets Rubric

Criteria	0	1	2	3	#
Hypothesis	No attempt made to underline text.	Incorrect sentence underlined AND none of the hypothesis.	Part/all of hypothesis AND other text.	Only and all of hypothesis (not prediction).	
Variables	No attempt to list variables.	Neither variable listed is correct.	Only one variable is correct OR only one of the multiple correct variables listed OR extra, unnecessary variables are listed.	Both variables correctly and clearly identified AND multiple variables listed, if appropriate.	
Graph	No attempt to graph OR graph is missing five graph components from list under score 3.	Chose incorrect type of graph OR chose correct type AND missing three or four graph components from list under score 3.	Chose correct type of graph AND missing two components from list under score 3.	Chose correct type of graph AND missing no more than one component: <input type="checkbox"/> Labeled one or both axes correctly. <input type="checkbox"/> Include units on one or both axes, if applicable. <input type="checkbox"/> Data points are graphed correctly. <input type="checkbox"/> Can differentiate variables or categories on graph (i.e. key) <input type="checkbox"/> Trendline or error bars are included, where applicable, and are drawn correctly.	
Data Interpretation					
Claim	No claim written OR claim is missing more than three of the criteria listed under score 3.	Claim is missing three of the criteria listed under score 3.	Claim is missing two of the criteria listed under score 3.	Claim is missing no more than one of the following criteria: <input type="checkbox"/> Correct (based on graph) <input type="checkbox"/> Clearly stated <input type="checkbox"/> Answers the question <input type="checkbox"/> Complete and includes all relevant variables <input type="checkbox"/> Minimal extra information (such as evidence)	
Evidence	No evidence OR evidence is missing more than three of the criteria under score 3.	Evidence is missing three of the criteria listed under score 3.	Evidence is missing two of the criteria listed under score 3.	Evidence is missing no more than one of the following: <input type="checkbox"/> Correct (based on claim) <input type="checkbox"/> Clearly stated using complete sentences <input type="checkbox"/> Provides all necessary evidence related to claim (comparison, trend, etc.) <input type="checkbox"/> Quantitative, not just qualitative <input type="checkbox"/> References table or graph, preferably a specific part	

Assessing Student Understanding

This rubric can help you answer:

- ▣ What do your students understand at the beginning of the school year? Where are their skill levels?
- ▣ What areas are your students getting stuck?
- ▣ What aspects of the scientific process do you need to address misconceptions?
- ▣ Did your students understand the scientific content?
- ▣ Have your students improved over the course?
- ▣ Are your students ready to analyze and interpret data on standardized tests?

Future Data Nugget Opportunities

Efficacy Study

- ▣ We will be looking for teachers to participate in a one-year research study (\$\$)
- ▣ Integrating Data Nuggets into your classroom

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