DATA Nuggets

Unearthing quantitative and inquiry skills

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If you are scientifically literate the world looks very different to you. Its not just a lot of mysterious things happening. There is a lot we understand out there. And that understanding empowers you to, first, not be taken advantage of by others who do understand it. And second there are issues that confront society that have science as their foundation. **If you are scientifically illiterate, in a way, you are disenfranchising yourself from the democratic process, and you don't even know it.**

— Neil Degrasse Tyson

Who are we?

<u>Melissa Kjelvik</u>
PhD Student
Zoology

Studies ecological effects of animal personality (fish)

<u>Liz Schultheis</u>
PhD Student
Plant Biology

Studies mechanisms of biological invasions

Who are we?

Melissa Kjelvik

Liz Schultheis

GK12 Bioenergy Sustainability Project

BEACON

An NSF Center for the Study of Evolution in Action

What is the KBS K-12 Partnership?

15 rural school districts

Over 80 teachers involved

~10 graduate student teaching fellows

Teacher-Fellow Partnerships

- Graduate students gain teaching experience
- Teachers are exposed to contemporary science
- Students practice scientific inquiry

How were Data Nuggets created?

- High school teacher was concerned with students' evidence-based claims skills
  - Wanted lessons with real, raw data, and ACT prep
- Feedback on Data Nugget structure solicited at KBS teacher workshops
- Tested in classrooms

http://kbsgk12project.kbs.msu.edu/data-nuggets/

What is a Data Nugget?

Background information

Fish Fights

Data provided by and written by GK-12 Fellow Alycia Reynolds-Lackey

Background Information:

In many animals, males fight for territories that they use to attract females for mating. Male stickleback fish fight each other to gain territories along the bottom of the shallow areas of a lake. In these territories, males build a nest out of sand, aquatic plants, and glue they produce from their kidneys. Males then attract females to their territories with courtship dances. If a female likes a male, she will deposit her eggs in his nest. Then the male will care for those eggs and the offspring that hatch.

Figure 1 A male in his territory (front) and an intruding male (back)

Figure 2 A male (right) defending his territory from another fish (left).

Dataset

Fish #	Average Male Net Aggression (aggression performed minus aggression received per minute)	Average Territory Size (0: none, 1: small, 2: large)	Days with nest (number of days with nest)
1	-1.28	0.14	0
2	0.20	0.07	0
3	-0.11	0.29	0
4	-0.47	0.50	0
5	-1.02	0.54	0
6	-1.32	0.00	0
7	0.94	1.14	0
8	-1.18	0.00	0
9	-2.18	0.00	0
10	-0.12	0.36	0
11	1.58	1.00	0
12	-0.24	1.00	0
13	-0.46	0.00	0
14	0.49	1.64	1
15	0.66	2.00	3
16	0.45	1.07	2
17	0.49	1.71	3
18	0.38	1.71	1
19	-0.77	0.44	1
20	1.18	1.93	4
21	-0.11	0.29	1
22	0.85	2.00	3
23	1.35	1.93	3

Scientific question to analyze

***Scientific Question*:**

Is male net aggression related to territory size? If yes, how?

Evidence: The scatter plot graph below uses the data from the table on the previous page to show the relationship between **Average Male Net Aggression** and **Average Territory Size**. You will use the data to answer the scientific question by making a *claim*. The data is the *evidence* that you will base your claim on, just like a lawyer would in a court case.

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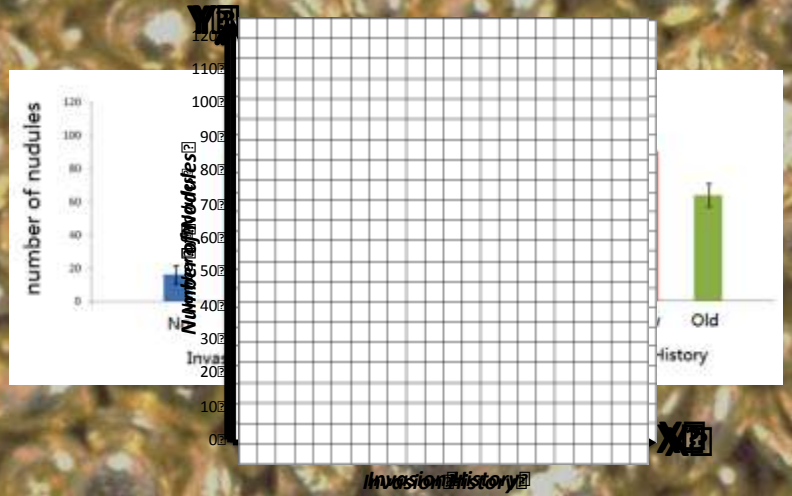
What is a Data Nugget?

Graph Types

Type A	• Graph Provided
Type B	• Explicit instructions (including what kind of graph to draw) explaining how to summarize and/or graph data • No unneeded data provided • Axes labeled with titles, units, and scale
Type C	• Brief instructions (including what kind of graph to draw) explaining how to summarize and/or graph data • No unneeded data provided • Axes labeled with titles and units only (student generates scale)
Type D	• Brief instructions explaining how to summarize and/or graph data (kind of graph to draw not indicated) • Unneeded data may be included • Axes and scale not labeled
Type E	• No instructions (other than the scientific question) indicating how to graph data • Unneeded data may be included • Axes and scale not labeled



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What is a Data Nugget?

Reading Levels

Level 1	• Upper Elementary and above
Level 2	• Middle School and above
Level 3	• High School
Level 4	• Advanced High School students (e.g., Honors and AP Biology) • College undergraduates

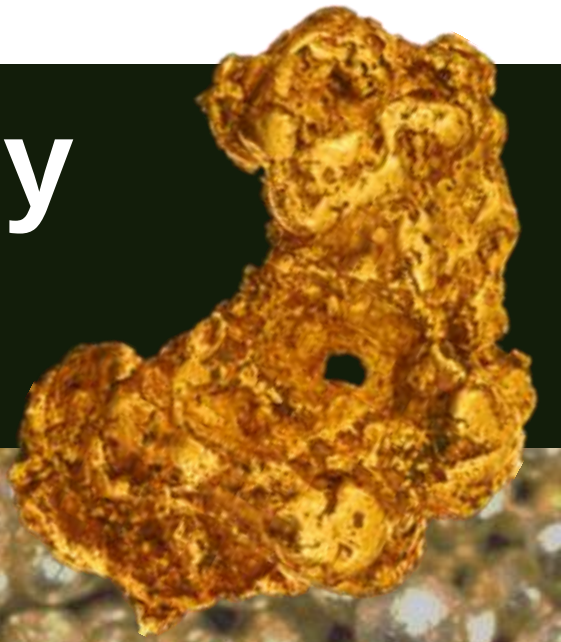
Data Nuggets Cover a variety of subjects:

- Animal Behavior
- Evolution
- Invasion Ecology
- Mutualisms
- Competition
- Ecosystem Ecology
- Photosynthesis

Skills addressed by using Nuggets

- Introduction to the process of science
- Seeing scientists as approachable
- Seeing science as interesting and attainable
  - Current research may engage students more than classic textbook examples
  - Could increase students' desire to pursue a career in science

Skills addressed by using Nuggets



- Working with real (messy) data
- Quantitative reasoning skills
  - Graph creation and interpretation
  - Descriptive statistics (mean, variation…)
- Making claims based on evidence from data

Addressing science standards
ACT College Readiness

- Interpretation of data
- Scientific investigation
- Evaluation of models, inferences, and experimental results

College Readiness Standards

		Interpretation of Data	*Scientific Investigation*	*Evaluation of Models, Inferences, and Experimental Results*
*28–32**	**Standards**	Compare or combine data from a simple data presentation with data from a complex data presentation ■ Identify and/or use a complex (e.g., nonlinear) mathematical relationship between data ■ Extrapolate from data points in a table or graph	Determine the hypothesis for an experiment ■ Identify an alternate method for testing a hypothesis	Select a complex hypothesis, prediction, or conclusion that is supported by a data presentation or model ■ Determine whether new information supports or weakens a model, and why Use new information to make a prediction based on a model
33–36†	**Standards**	Compare or combine data from two or more complex data presentations Analyze given information when presented with new, complex information	■ Understand precision and accuracy issues ■ Predict how modifying the design or methods of an experiment will affect results ■ Identify an additional trial or experiment that could be performed to enhance or evaluate experimental results	■ Select a complex hypothesis, prediction, or conclusion that is supported by two or more data presentations or models Determine whether given information supports or contradicts a complex hypothesis or conclusion, and why

Addressing science standards

Next Generation SS

- Focus on science understanding and application, instead of fact memorization
- Coherent progression of scientific understanding through K-12 education
- Engage in inquiry and experimental design

Future of Data Nuggets

- Create more Nuggets!
  - Cover more content area
  - Engage scientists in science education
- Design an easily accessible website
- Classroom assessment

Thank you!

MSU BEACON & GK-12 Projects:

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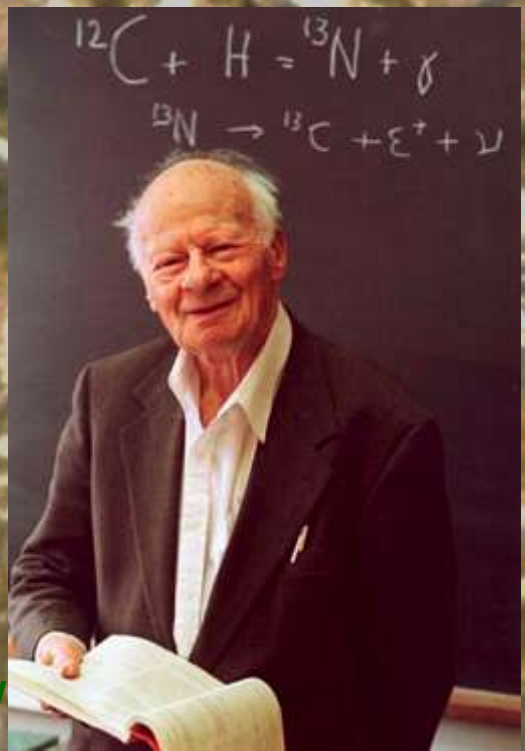
BEACON

We need science education to produce scientists, but we need it equally to create literacy in the public. Man has a fundamental urge to comprehend the world about him, and science gives today the only world picture which we can consider as valid. It gives an understanding of the inside of the atom and of the whole universe, or the peculiar properties of the chemical substances and of the manner in which genes duplicate in biology. An educated layman can, of course, not contribute to science, but can enjoy and participate in many scientific discoveries which as constantly made. Such participation was quite common in the 19th century, but has unhappily declined. **Literacy in science will enrich a person's life.**

— Hans Albrecht Bethe
Nobel laureate in physics



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