Improving Undergraduate STEM Education Initiative

Reforming Pedagogy for Data-Intensive STEM Courses: Putting the Student Experience at the Center

Dr. Mine Dogucu
Dr. Kathleen Browne

@IuseProgram

AAAS IUSE Initiative

This material is based upon work supported by the National Science Foundation (NSF) under Grant No. DUE- 1937267. Any opinions, findings, interpretations, conclusions or recommendations expressed in this material are those of its authors and do not represent the views of the AAAS Board of Directors, the Council of AAAS, AAAS' membership or the National Science Foundation.

WORKSHOP

This presentation is being recorded. The recording and slides will be available in the coming week at https://aaas-iuse.org

Please note: The discussion break-out groups following the presentations will NOT be recorded.

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The AAAS-IUSE initiative supports faculty, students, and the greater undergraduate STEM education community by disseminating research and knowledge about STEM teaching, learning, equity and institutional transformation.

Check out our website to learn more and view: ***https://aaas-iuse.org***

- Blog
- Workshops
- Summer Labs On-Demand
- Resources
- Lessons Learned During COVID
- NSF IUSE Proposal Preparation Toolkit

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WORKSHOP

Teaching Accessibly and Teaching Accessibility in Data-Intensive Courses

Talk at AAAS-IUSE Workshop

Mine Dogucu
University of California Irvine

2024-04-18

mdogucu.github.io/aaas-iuse

Some statistics from tech world

- Only 4.8 % of technical roles are held by Hispanic employees, 2.4 % by Black employees and 25.8 % by women at Meta (2022)
- Of Google’s technical roles in the US, 1.2 % are held by Black women, 1.3 % by Latina women, and 0.2 % by Native American women (2023)
- Only 6.5% of Google’s global employees(technical and nontechnical) report having a disability, whereas World Health Organization estimates that 16% of the world’s population experience significant disability (2023).

Some Problems with Tech Tools

- Statistical translation tools (e.g., Google Translate) yield male pronoun defaults more frequently (Prates et al., 2019).
- Facial recognition algorithms are much less accurate in identifying women than men, and darker-skinned people than lighter-skinned people(Raji and Buolamwini, 2019).
- Autonomous vehicles fail to recognize behaviors of people with disabilities (Disability Rights UK, 2021).

We must design accessible and inclusive data-intensive courses to prepare a future data workforce that is diverse.

Teaching Accessibly

Alicia Johnson
Macalester College

ajohns24.github.io/portfolio

ajohns24

Miles Ott
Tubi

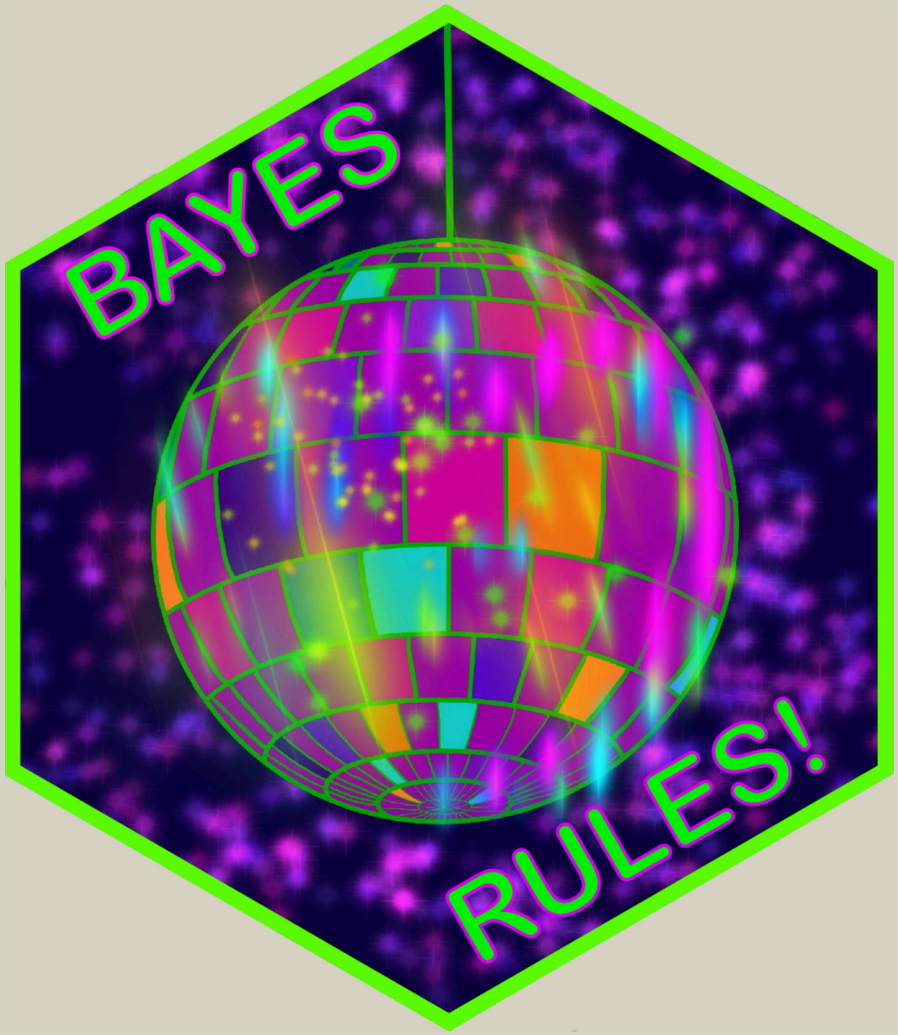
Miles_Ott

MilesOtt

mastodon.social/
@Miles_Ott@aus.social

Goal:

Write a Book on Bayesian Statistics that is **Accessible and Inclusive**



Bayes Rules! An Introduction to Applied Bayesian Modeling

{bayesrules}

mdogucu.github.io/aaas-iuse

Dogucu, M., Johnson, A. A., & Ott, M. (2023). *Framework for Accessible and Inclusive Teaching Materials for Statistics and Data Science Courses*. Journal of Statistics and Data Science Education. 31(2), 144-150.

Open-Access

- Cost of books and supplies for a student at a four-year university in 2021 was estimated to be $1240 per year (Hanson, 2021).
- About 11% of the students indicated that they skipped meals in order to afford books and course materials (Hanson, 2021).
- The bayesrulesbook.com page has been accessed from more than 150 countries.

Assistive Technology

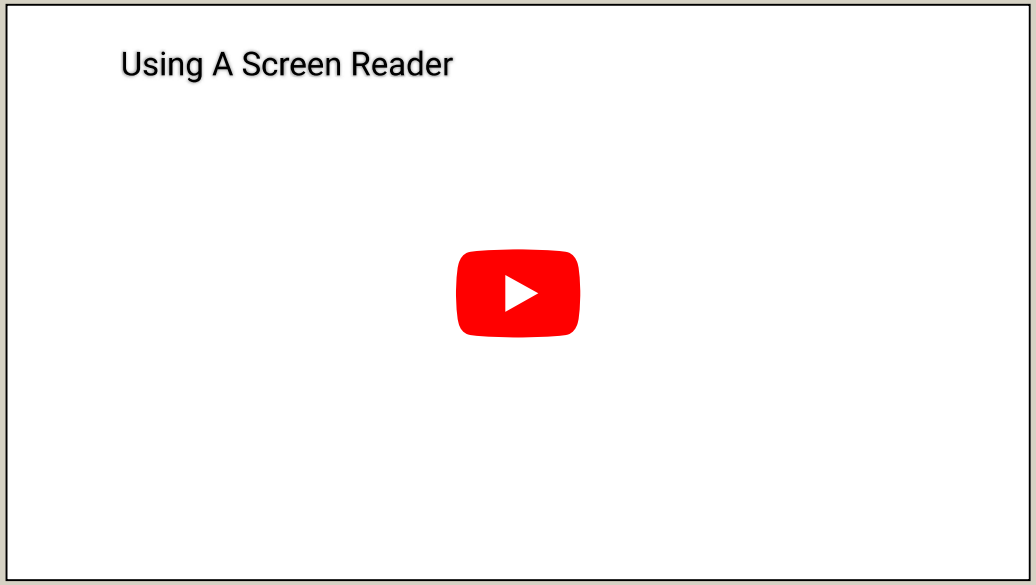
Assistive Technology is any form of technology (software, device) that helps people with disabilities perform certain activities.

Examples:

- walking sticks
- wheel chairs
- screen readers

Screen reader

A screen reader is an assistive technology that supports blind or visually impaired people in using their computer.



The video shows use of a screen reader briefly.

Alternate Text

- “Alt text” describes contents of an image.
- It is used in HTML pages.
- Screen-readers cannot read images but can read alt text.
- Alt text has to be provided.


rstudio / rmarkdown
Public
Code
Issues 179
Pull requests 15
Actions
Projects 2
Wiki
Security
Insights
Feature request: fig.alt as a chunk option #1867
Closed
3 tasks done
mdogucu opened this issue on Jul 19, 2020 · 14 comments
mdogucu commented on Jul 19, 2020
In addition to using ![alt text][id] to write alt text it would be very useful to have fig.alt option for code chunks that could write the alt text for a figure. Unfortunately, with the current state of things, the figure caption and alt text is the same when used in code chunk. Thus, when using a screen reader only figure caption is read by the screen reader. However, for visually impaired readers, often further description of an image is needed. An example of what I have on my mind is provided below with modifications to the code provided in the R Markdown book:
```{r mtcars, fig.cap = "Another amazing plot", fig.alt = "The scatter plot has hp on the x axis and mpg on th
plot(mpg ~ hp, mtcars)
```

Making math accessible

- Should calculus be a prerequisite?
- Checking intuition with active learning quizzes.
- Supporting mathematical concepts with computing.

Making learning fun

> How can we live if we don’t change? —Beyoncé. Lyric from “Satellites.”

vs.

> What is probability?

Embracing mistakes as part of learning

> As you read the book and put Bayesian methodology into practice, you will make mistakes. Many mistakes. Making and learning from mistakes is simply part of learning. We hope that you persist through the struggle of learning so that you can contribute your unique insights, perspectives, and experiences to the Bayesian community.

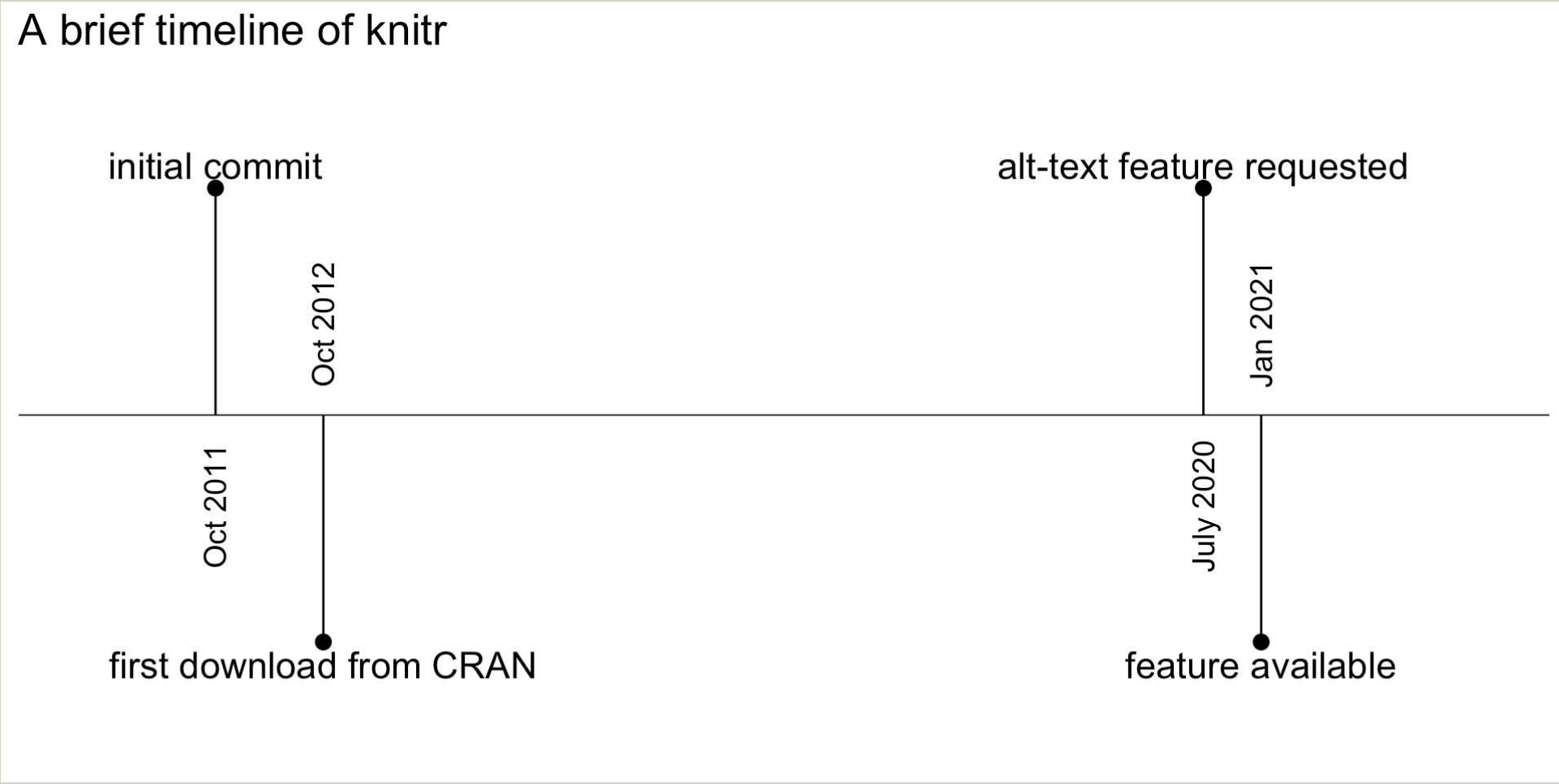
v.s.

> The proof is obvious.

Making learning relevant with diverse set of applications

- Weather
- LGBTQ+ anti-discrimination laws
- Spotify data
- Hotel bookings
- Penguins

Teaching Accessibility



Between first CRAN download and alt-text feature request, there were 22,622,426 CRAN downloads of knitr.

Developers Create Tools with no Accessibility Support

Data Scientists Create Inacessible Products

Curriculum Does Not Teach Accessibility

Developers Create Tools with no Accessibility Support

Data Scientists Create Inacessible Products

Supported by the Teach Access network.

Supported by NSF HDR DSC award #2123366

JooYoung Seo
University of Illinois Urbana-Champaign

jooyoungseo.github.io/
jooyoungseo
seo_jooyoung

Introduction to Data Science Course Website

mdogucu.github.io/aaas-iuse

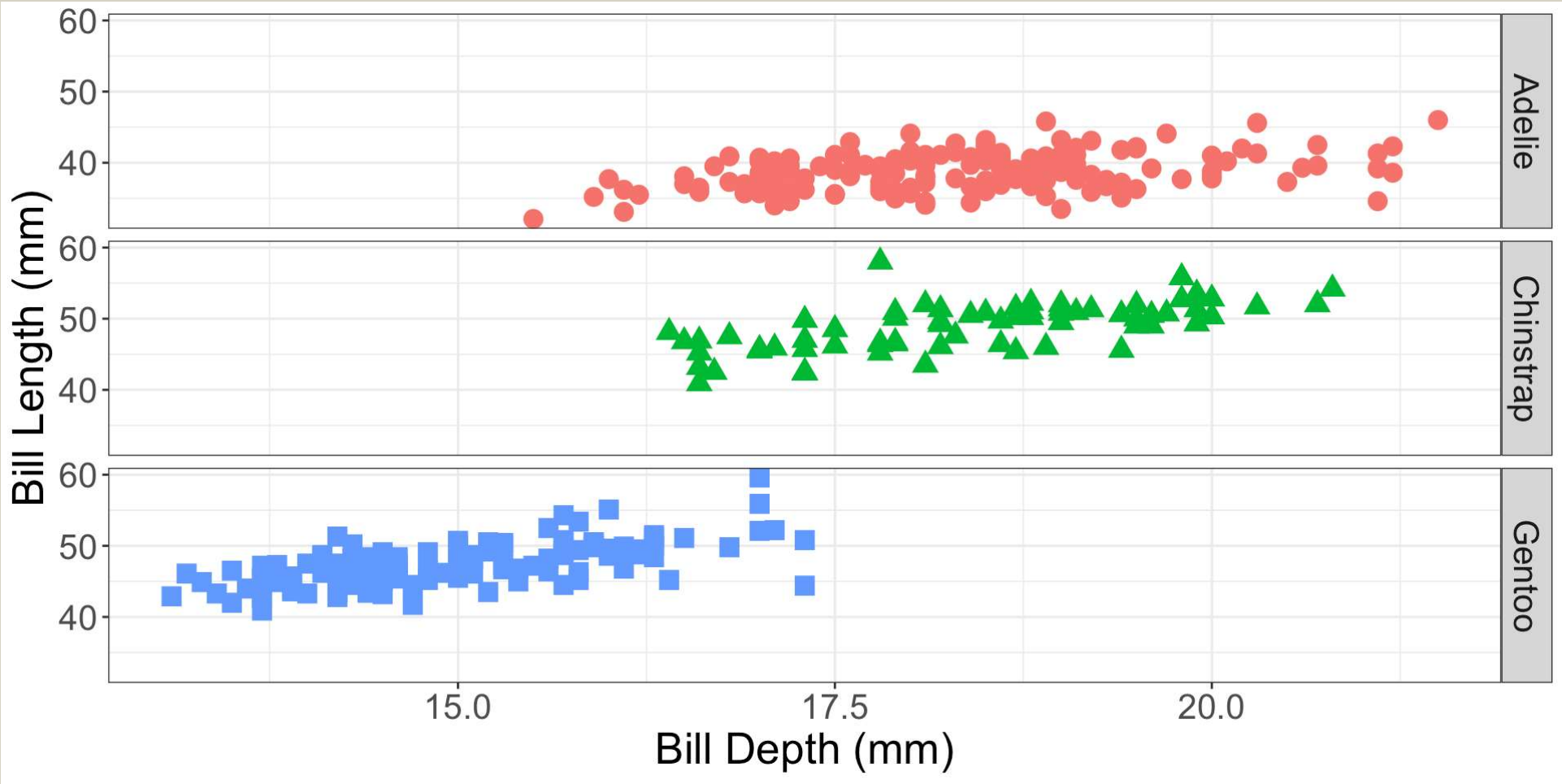
Curriculum Goal

As educators, we have to ensure that the current and the next generation of data scientists, provide public-facing outputs (websites, analysis reports, etc.) that are accessible.

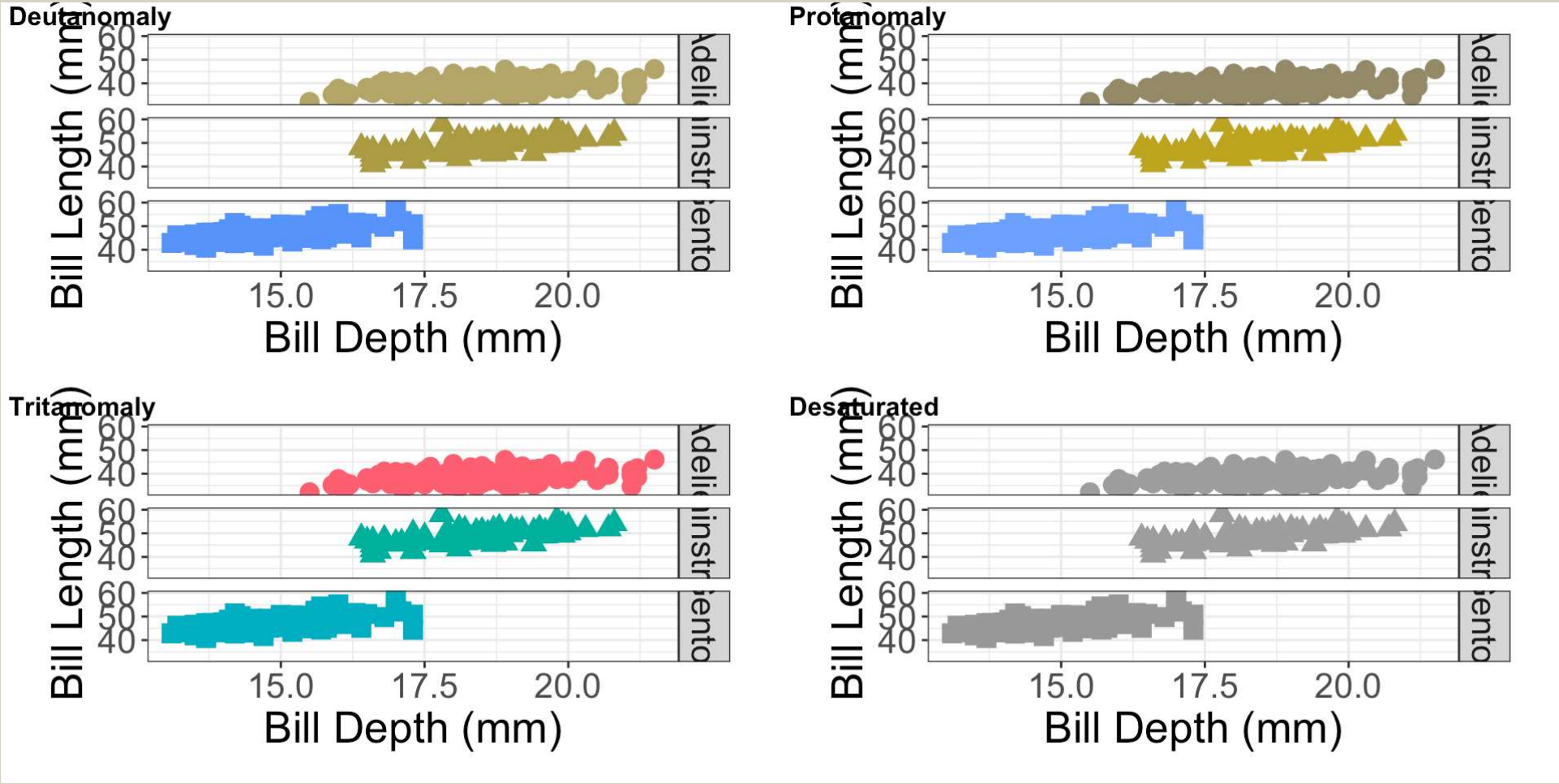
Learning Objectives

- Students should get familiar with Americans with Disabilities Act and/or United Nations Convention on the Rights of Persons with Disabilities.
- Students should use at least one assistive technology (i.e. screen reader).
- Students should consider different representations of data.

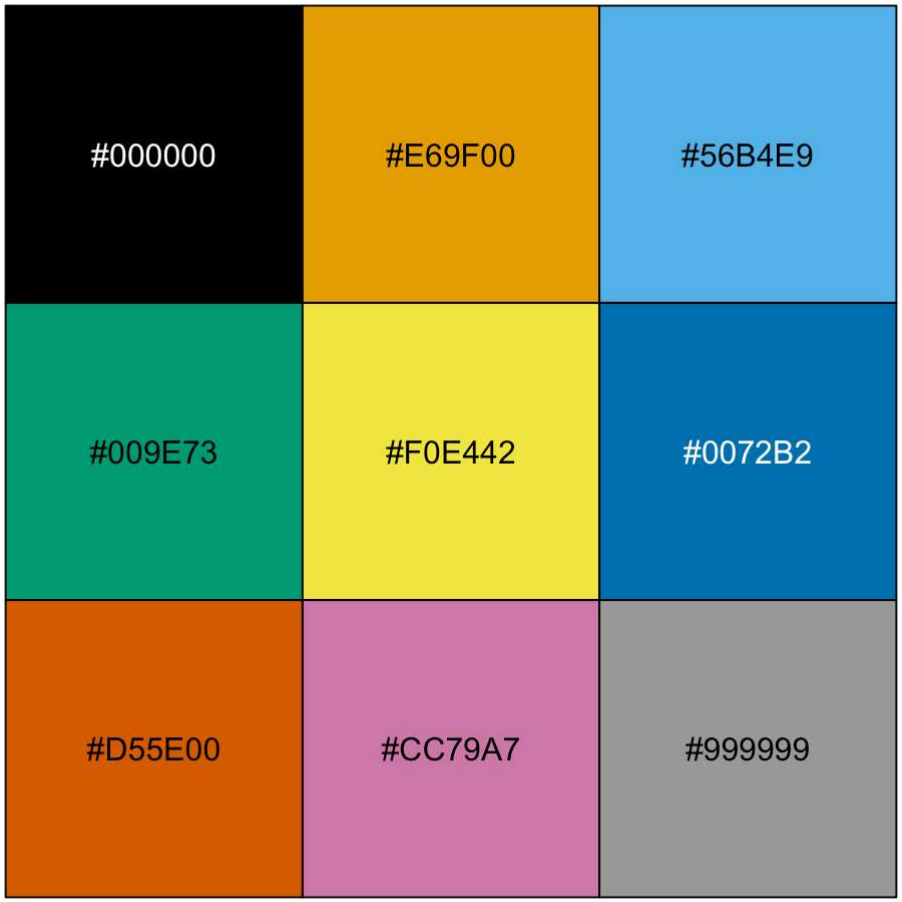
Data Visualization - Colors

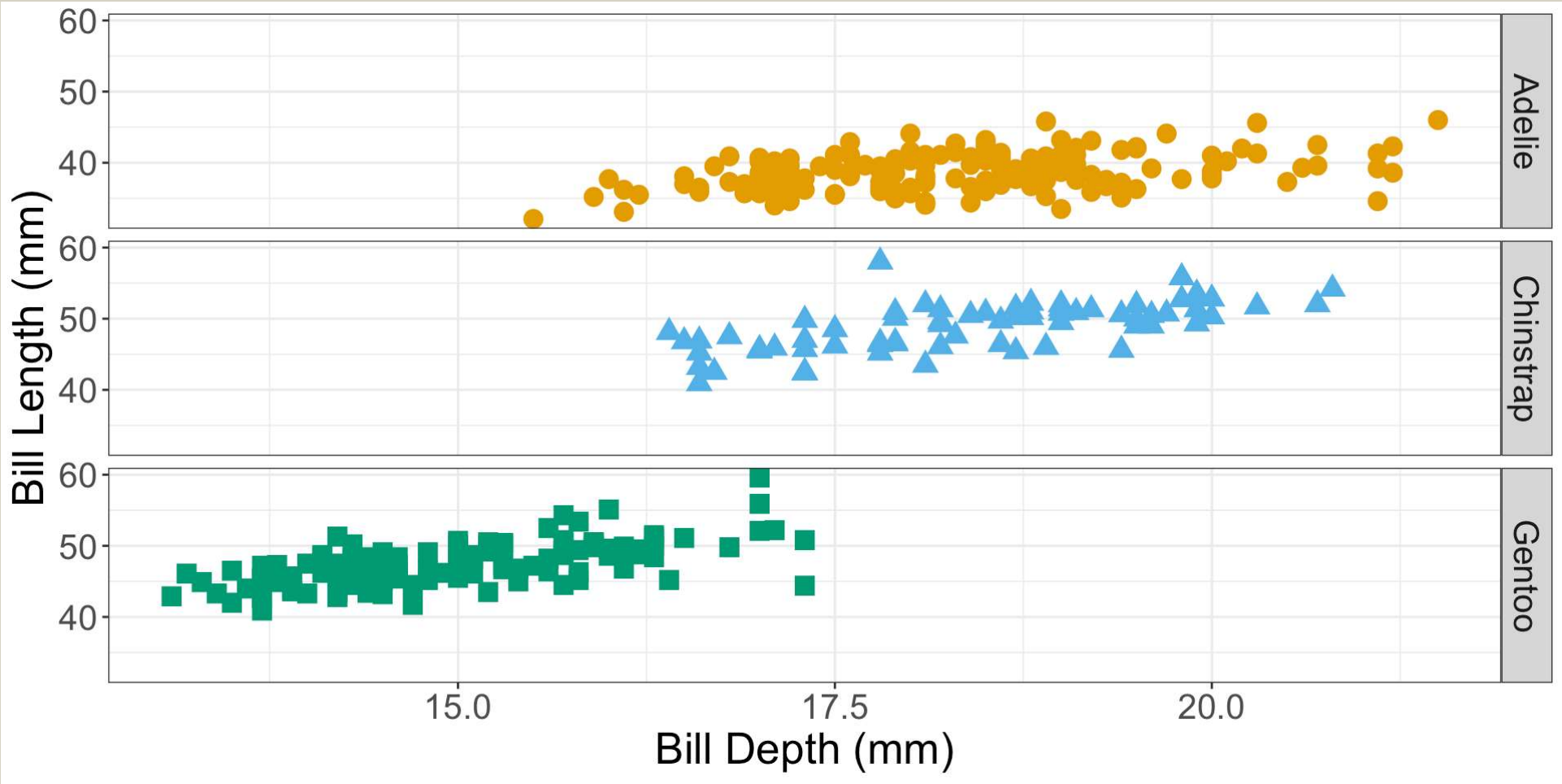


Color Blindness Simulator



Okabe-Ito Color Palette




Bill Length (mm)
60
50
40
Adelie
Chinstrap
Gentoo
15.0
17.5
20.0
Bill Depth (mm)

Resources

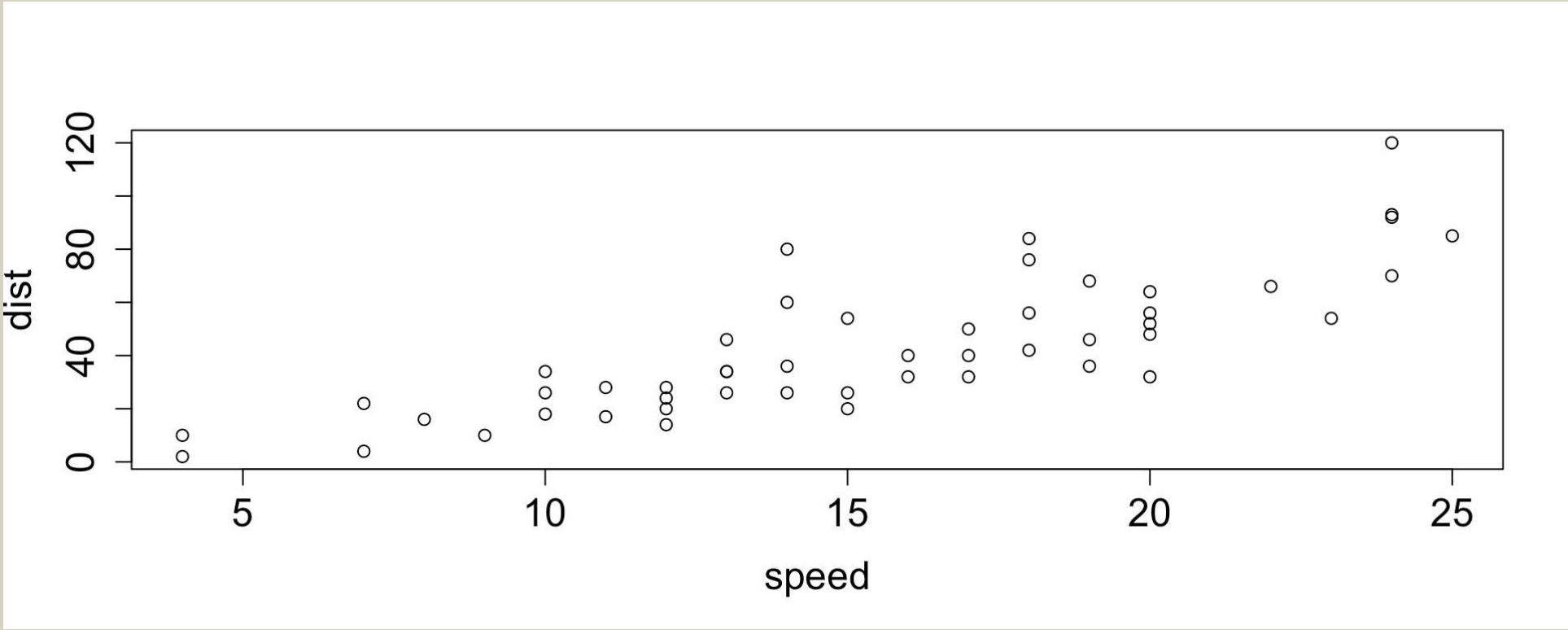
Color Blindness Simulator You can upload any image and in return get an image with colors that would be visible to color-blind people with specific color vision deficiency.

Okabe-Ito 2008 Color Universal Design. Color palette that is color-blind friendly.

Okabe-Ito color-palette Color codes for Okabe-Ito palette.

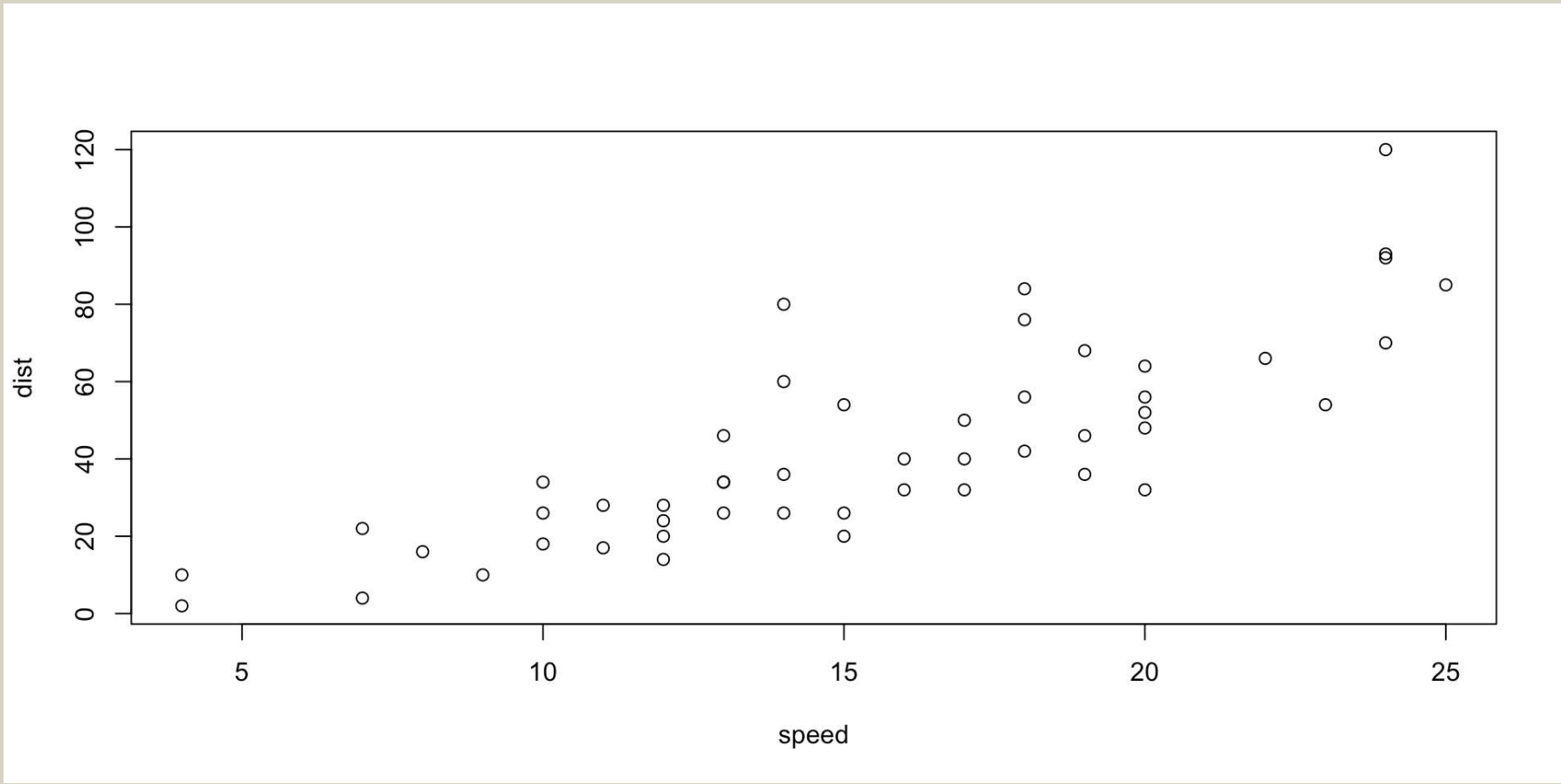
Data Verbalization

We can verbalize data via alternate text.



The speed of cars (mph) and the distances (ft) taken to stop

```r
```{r}
#| fig-cap: "The speed of cars (mph) and the distances (ft) taken to stop"
#| fig-alt: "The scatterplot shows speed ranging from about 0 to 25 mph on the x-axis
plot(cars)
```
```



The speed of cars (mph) and the distances (ft) taken to stop

Manual Alternate Text

- Chart type
- Type of data
- Reason for including the chart
- Link to data or source (not in alt text but in main text)

Cesal, 2020

- Description conveys meaning in the data
- Variables included on the axes
- Scale described within the description
- Type of plot is described

Canelón & Hare, 2021

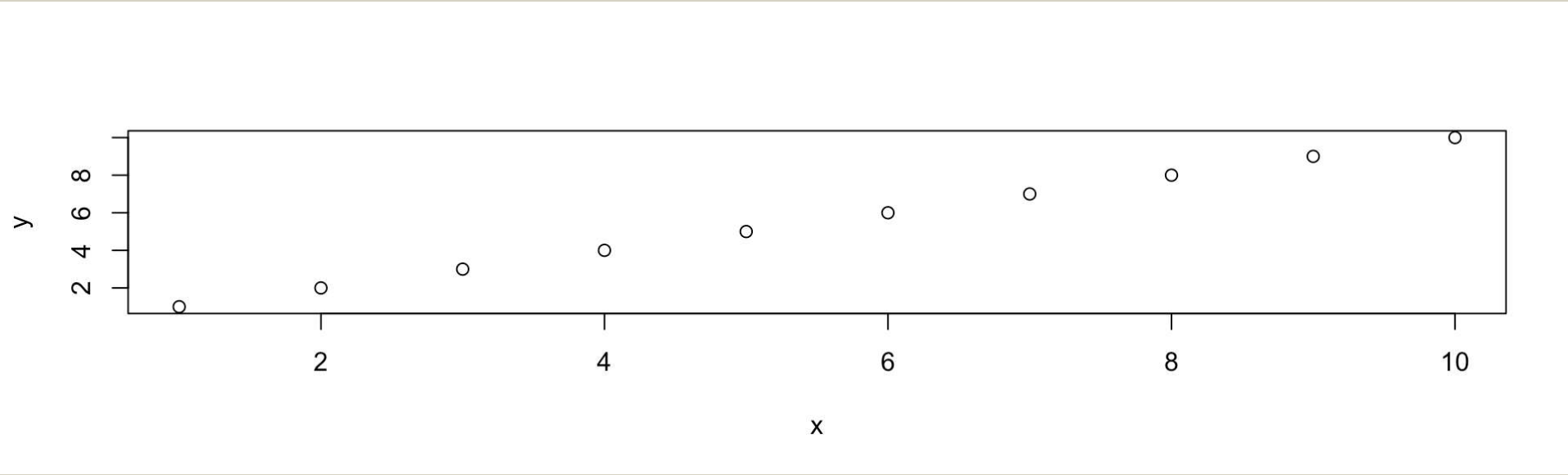
Alternate Texts are Under Utilized in the Data Science Community

"Over the 3 years of TidyTuesday, there were 7,136 data viz tweets and only 215 (3%) of them had alt-text"

Canelón & Hare, 2021

Data Sonification

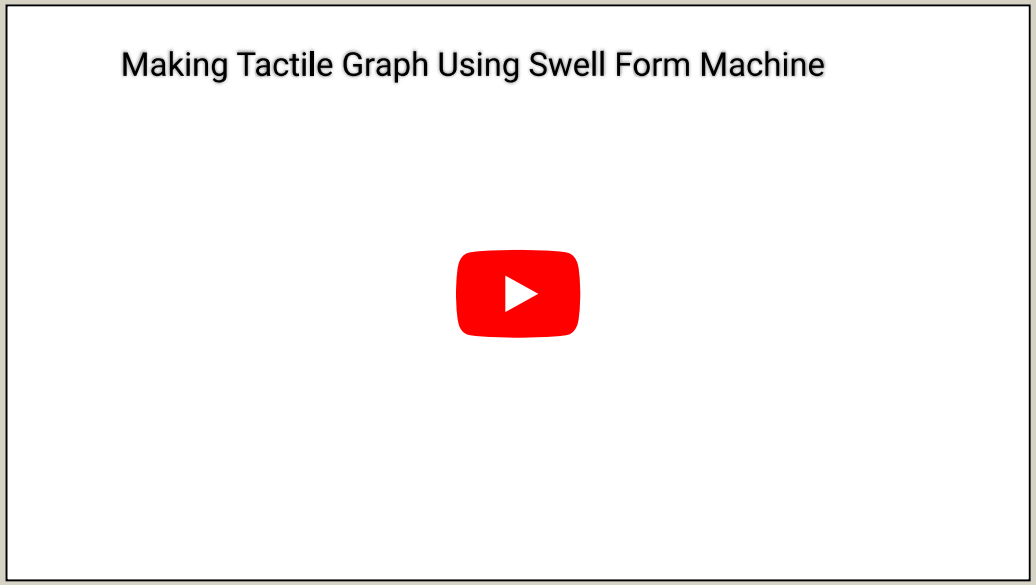
Data sonification is the presentation of data as sound.



0:00 / 0:06

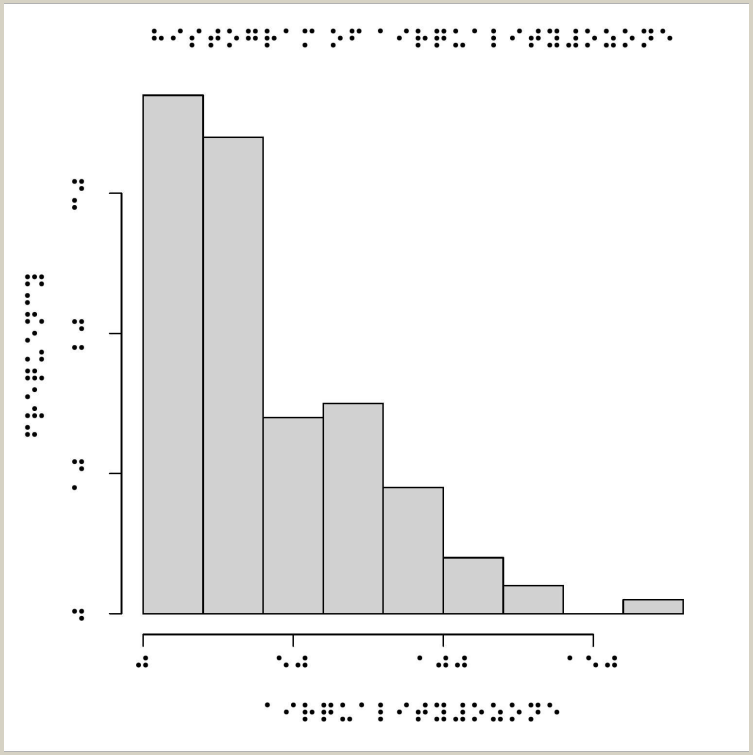
Data Tactualization

Data tactulization refers to making data visualization in a form so that it can be touchable. The video shows printing of a tactile boxplot.



Data Tactualization

```
1 library(tactileR)
2 brl_begin(file = 'tactile.pdf',
3           pt = 11,
4           paper = 'special', font='BRL'
5 hist(airquality$Ozone)
6 brl_end()
```



Different representations of data is one way of introducing accessibility to students but it is not meant to be a complete introduction to accessibility.

Seo, J. & Dogucu, M. (2023) Teaching Visual Accessibility in Introductory Data Science Classes with Multi-Modal Data Representations Journal of Data Science. 21(2), 428-441.

Accessibility is for everyone.

QUESTIONS?

minedogucu.com
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MineDogucu
mastodon.social/@MineDogucu
minedogucu

References

Prates, M. O., Avelar, P. H., and Lamb, L. C. (2019), “Assessing Gender Biasin Machine Translation: A Case Study with Google Translate,” NeuralComputing and Applications, 32, 6363–6381.

Raji, I. D., and Buolamwini, J. (2019), “Actionable Auditing: Investigatingthe Impact of Publicly Naming Biased Performance Results of Commer-cial AI Products,” in Proceedings of the 2019 AAAI/ACM Conference onAI, Ethics, and Society, pp. 429–435.

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Google Diversity Annual Report (2023) Available at https://static.googleusercontent.com/media/about.google/en//belonging/diversity-annual-report/2023/static/pdfs/google_2023_diversity_annual_report.pdf?cachebust=2943cac.

World Health Organization (2023). “Disability” Available at https://www.who.int/news-room/fact-sheets/detail/disability-and-health.

QUESTIONS?

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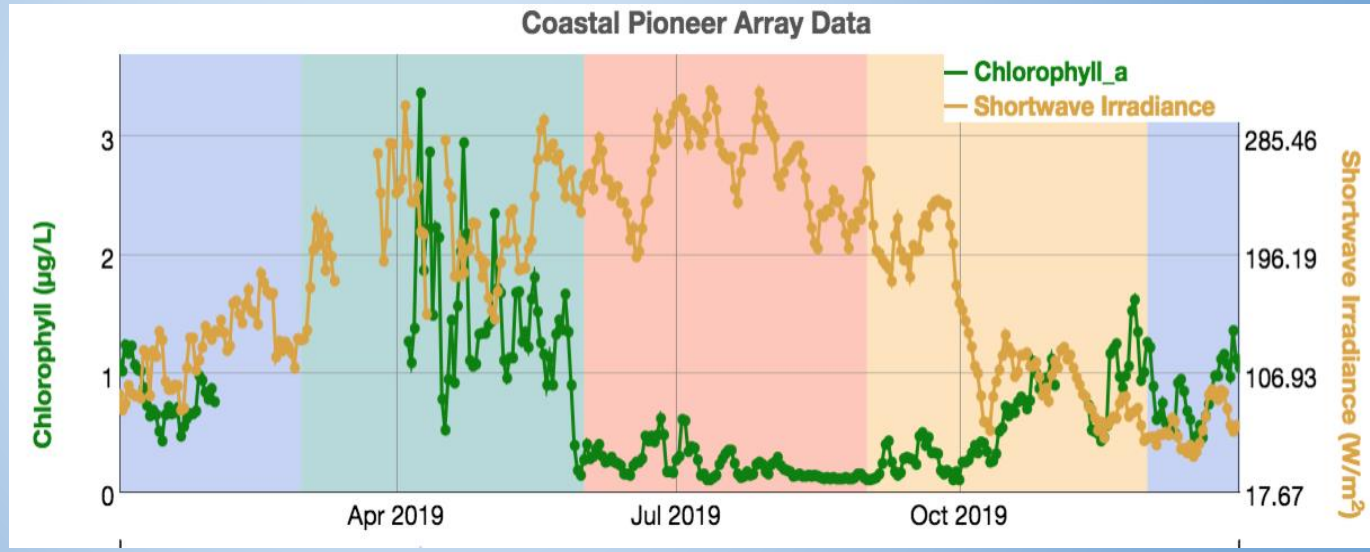
Improving Undergraduate Scientific Explanations: Exploring the Role of Data Literacy Skills in Scientific Reasoning

Kathleen Browne, Andrea Drewes, Gabriela Smalley, Rider University; Sage Lichtenwalner, Rutgers University



NSF IUSE Grant
[ID 2021347] 2020-2023
Level 1, Engaged Student Learning Track

RIDER UNIVERSITY

RUTGERS

Plan

- Background for our NSF project
- Some preliminary results
- Share resources developed

Acknowledgements: Programs that influenced our project

- Oceanographic Observations Initiative (OOI) Data Explorations & Lab Manual Projects
- Environmental Data Driven Inquiry & Exploration Exercises (EDDIE) project
- NSF IUSE program
- Next Generation Science Standards for K-12
- Ours students!

Background

- Struggled to help students develop their scientific reasoning revealed in exam essays
- Influenced by Next Generation Science Standards (NGSS Lead States, 2013) specifics re: explanations using evidence
- Experimented with adapted resources with limited improvements
- Informally added data literacy skills development with positive early results
- Formalized and tested instructional plans for the NSF IUSE grant project

Evolution of my efforts to develop students' scientific reasoning

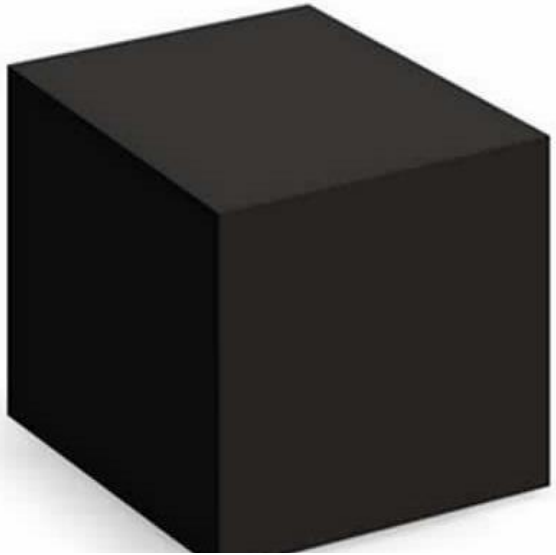
Why…?

Explain why….

Why…? Explain

Why…? Expla
clear or under
give the reasc

Why…? Ex
clear or unc
to give the reasons for] ***To explain, you will need numerous sentences.***



If students could articulate their struggles….
What is **in an "explanation"?**

K-12 Next Generation Science Standards (NGSS)

Claim-Evidence-Reasoning [C-E-R] Rubric

9–12 Science Practices: Constructing Explanations

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 ideas, principles, and theories.

- Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.
- Construct and revise 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.
- Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
- Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
- Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

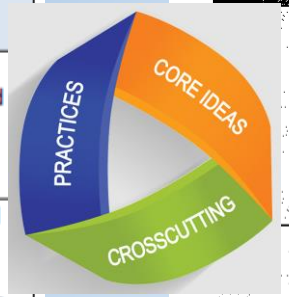


TABLE 5.5 Base Rubric for Scientific Explanation

LEVEL (Varies from 1 to 5)	Claim	Evidence	Reasoning
	A statement or conclusion that answers the original question/ problem.	*Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.*	*A justification that connects the evidence to the claim. It shows why the data counts as evidence by using appropriate and sufficient scientific principles.*
0	Does not make a claim, or makes an inaccurate claim.	Does not provide evidence, or only provides inappropriate evidence (evidence that does not support claim).	Does not provide reasoning, or only provides inappropriate reasoning.
	Makes an accurate but incomplete claim.	Provides appropriate, but insufficient, evidence to support claim. May include some inappropriate evidence.	Provides reasoning that connects the evidence to the claim. May include some scientific principles or justification for why the evidence supports the claim, but not sufficiently.
	Makes an accurate and complete claim.	Provides appropriate and sufficient evidence to support claim.	Provides reasoning that connects the evidence to the claim. Includes appropriate and sufficient scientific principles to explain why the evidence supports the claim.

MacNeill et al., 2006

www.nextgenscience.org/

Given a map of EQ's and volcanoes provided for the area near the west coast of South America, explain what kind of plate motion is occurring using both drawings and words to **explain**. Be sure **to use the evidence provided in your explanation**.

OR

Using the data sets provided regarding plate margin activity, describe each set thoroughly and then, using the **claim-evidence-reasoning approach**, respond to the following: How are the 2 different plate boundaries depicted similar and how are they the same?

Note: Essays are worth quite a few points. A short essay if succinct and well composed with lots of info could earn all points. But typically, a 1-2 sentence response does not earn many pts.

Please note the use of the term "explain" in my question. Students sometimes ignore it…I recommend you keep in mind the meaning of the work "explain":

EXPLAIN: **to <u>give the reason</u> for or cause of; to <u>show</u> the logical development or relationships of**

This is really important!

Still wasn't satisfied…..how to use "evidence"????

2014

D-C-E-R Framework

Modified from McNeill & Krajcik, 2012

- describe data (trends, patterns, ranges, outliers, similarities, differences, etc.) **[Data Descriptions-D]**
- draw conclusions about the data and relevant phenomena, **[Claim-C]**
- and support those conclusions with scientific reasoning that includes proper evidence tied to the students' understanding of relevant science concepts [**Evidence-E** and **Reasoning-R**]

Improving Undergraduate Scientific Explanations: Exploring the Role of Data Literacy Skills in Scientific Reasoning

NSF IUSE Grant, [ID 2021347] 2020-2023, Level 1, Engaged Student Learning Track

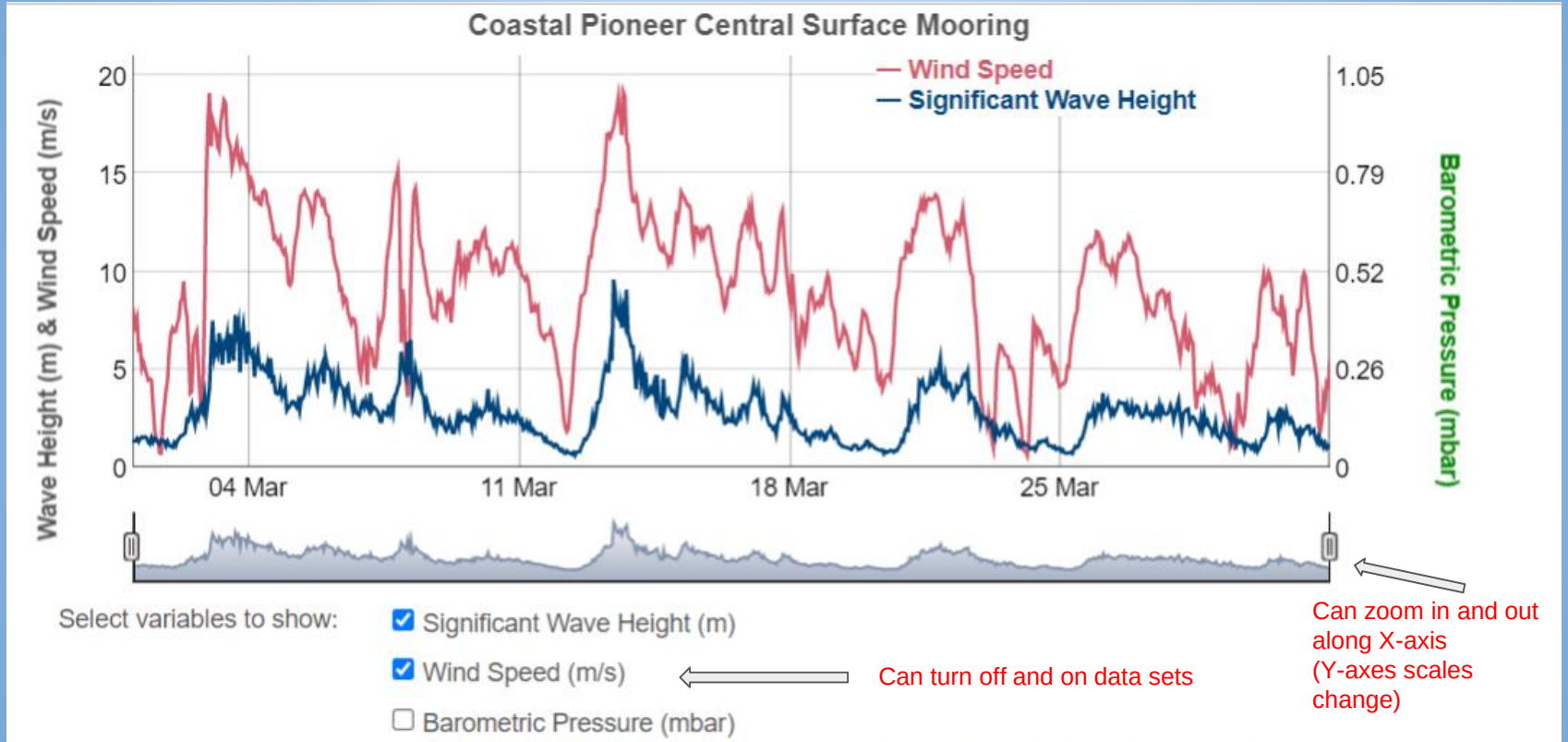
Course Information

- Introductory Oceanography course, Rider University, NJ
- Class size: ~30 students
- First-year to seniors
- Science and non-science majors
- Sections using **intervention** strategies (with data exploration activities) and sections for **comparison** (lecture only)

Data collected (Spring 21 - Fall 23)**:**

- Data Exploration Activities (4 per semester)
  - Intervention group only
  - Group & Individual work
- Exam Essay Questions related to data interpretation (3, one per exam)
- Pre/Post semester surveys ($^{+}$modified):
  - OCK: Ocean Concepts Knowledge Survey
  - VLAT^{+}: Visualization Literacy Assessment Test
  - LCTSR^{+}: Lawson's Classroom Test of Scientific Reasoning
- Student Interviews

Provide Experiences with Data

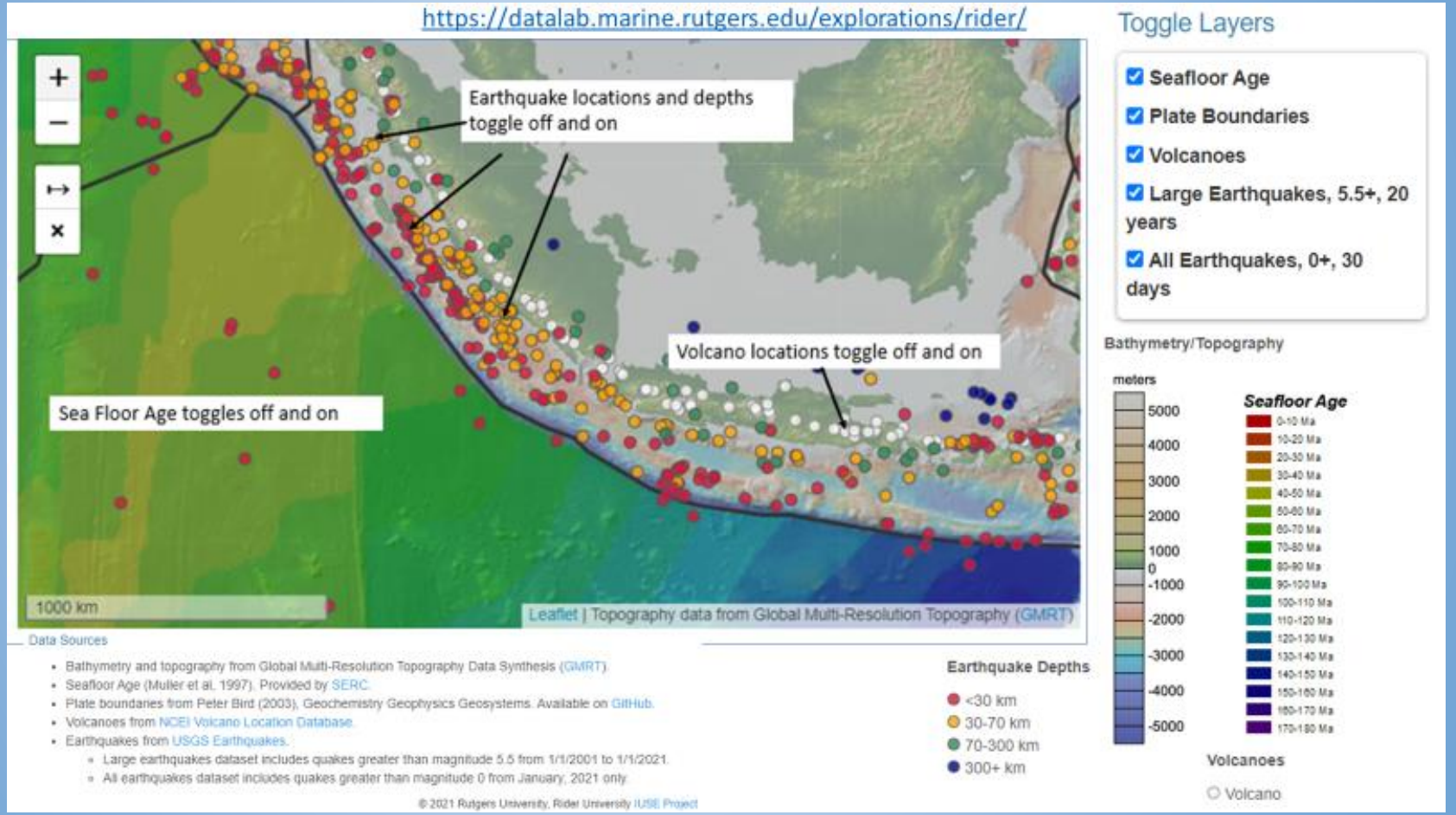


https://oceanobservatories.org/data/

https://datalab.marine.rutgers.edu/explorations/rider/waves.htm

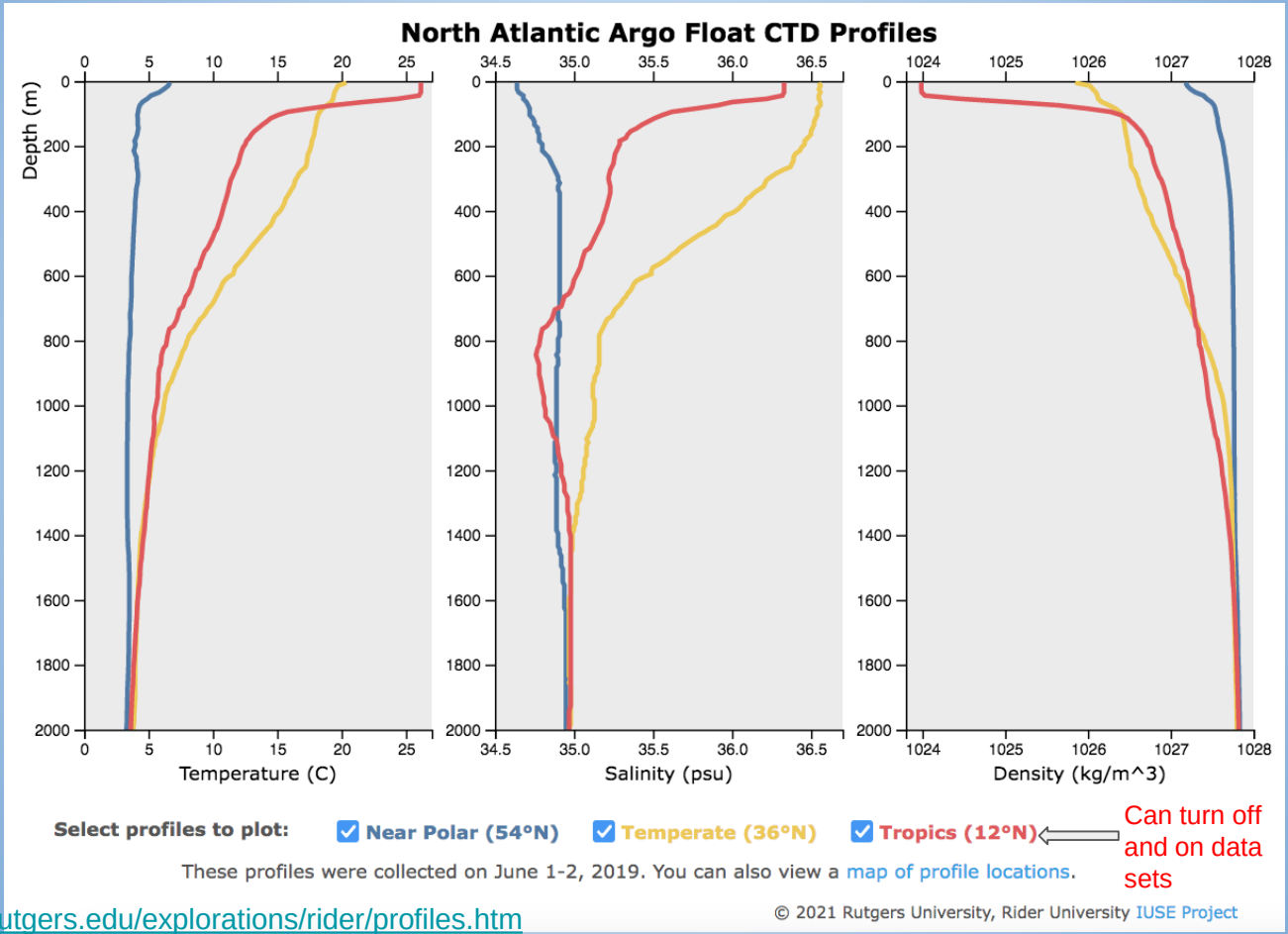
Provide More Experiences with Data

https://www.gmrt.org/
https://serc.carleton.edu/sp/library/google_earth/examples/49004.html
https://github.com/fraxen/tectonicplates/
https://www.ngdc.noaa.gov/hazel/view/hazards/volcano/loc-search/
https://www.usgs.gov/programs/earthquake-hazards/earthquakes



Provide More Experiences with Data

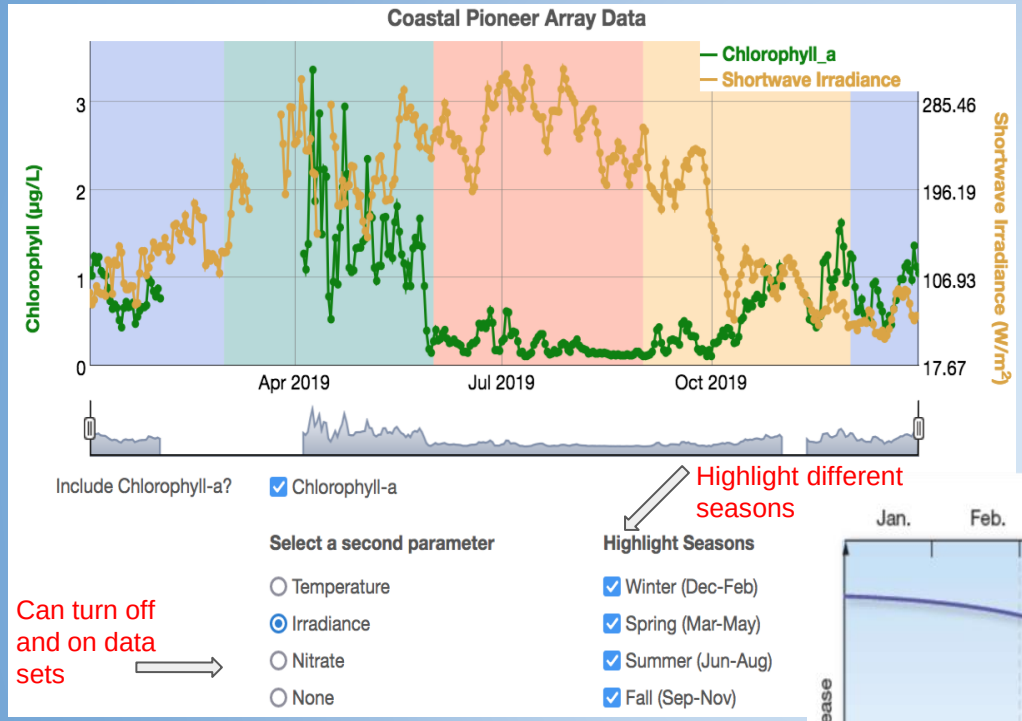
https://fleetmonitoring.euro-argo.eu/

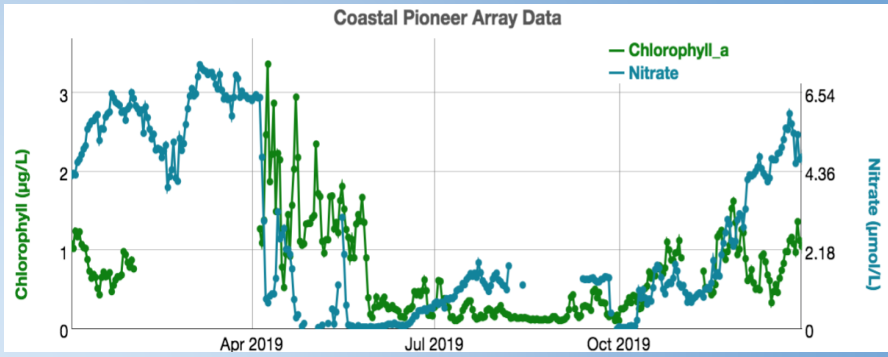


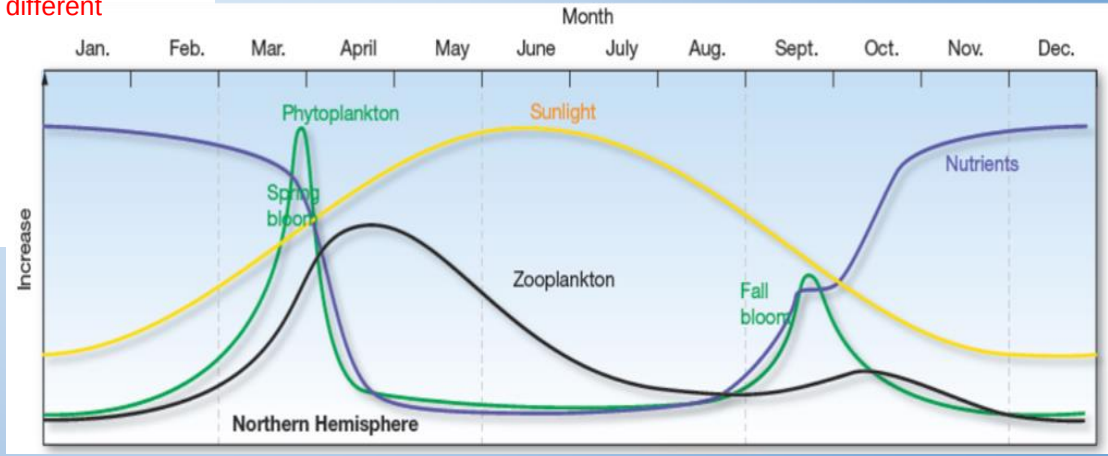
Can turn off and on data sets

https://datalab.marine.rutgers.edu/explorations/rider/profiles.htm

Experience with messy “Real World” Data (compared to some textbook figures)







https://oceanobservatories.org/data/

https://datalab.marine.rutgers.edu/explorations/rider/production.htm

Essentials of Oceanography by Trujillo & Thurman

DCER Instructional Framework

(See lesson plans shared)

Instruction to guide learning about ocean concepts.

Instruction to guide students to study data and compose descriptions of patterns and variability in authentic data sets.
Data sets include authentic data from the Ocean Observatory Initiative (OOI)

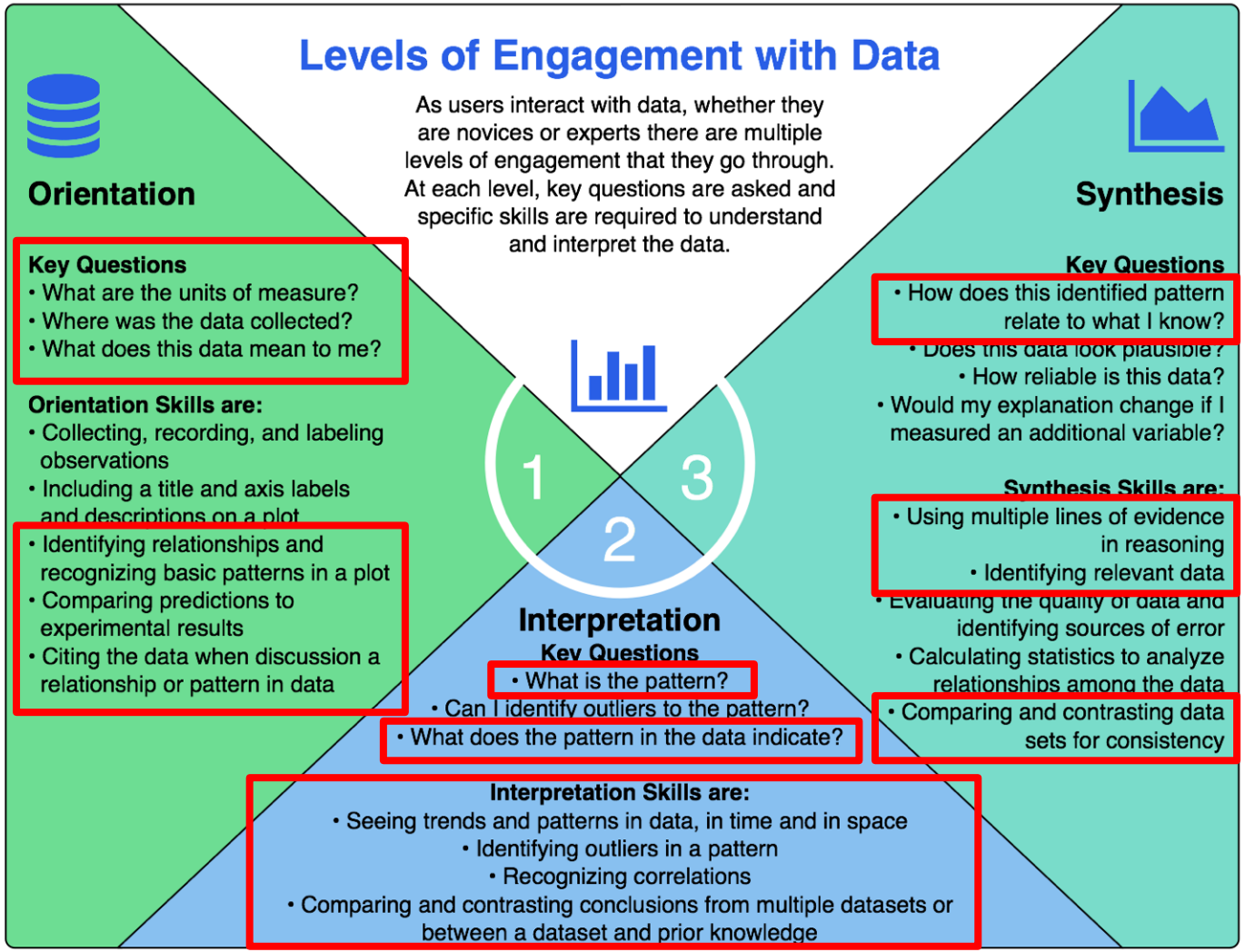
Study: Student results in "intervention" vs "comparison" lecture classes

Students draw conclusions from the data, discuss their ideas and reasonings to tie specific quantitative evidence to their understanding of relevant science concepts with guidance as.

Finally, students compose individual explanations in class "data studies" & exams.

Guidance to incorporate Data Literacy guidance

Hotaling et al. (2019) Framework
[See annotated Waves Data Study lesson plan]



Expanded/Modified Rubric For Instruction & Assessing Explanations

Description ***C***onclusion ***E***vidence ***R***easoning

Proficiency level	*D*escriptions *First, thoroughly describes all trends, patterns, similarities, and/or differences etc. ("T/P/D/S etc.") in the data .*	D w/out R? Y/N	*C*onclusion *A statement that answers the original question/problem. If no question is provided, students make their own conclusion from the data studied.*	*E*vidence *Scientific data that support the conclusion. The data need to be appropriate and sufficient to support the conclusion.*	*R*easoning *A justification that connects the evidence to the conclusion. It shows why the data count as evidence by using appropriate and sufficient scientific principles (addressed in this class); also includes reasoning for any data that are not relevant to the conclusion.*
0	None provided; completely irrelevant		None provided; completely irrelevant	None provided; completely irrelevant	None provided; completely irrelevant
1 (weak)	Provides few "T/P/D/S etc." descriptions or mostly inappropriate descriptions and/or level of detail of descriptions.		Provides an inappropriate conclusion given the data used; or restates a data description.	Provides very little (when more is present) and/or inappropriate evidence (evidence that does not support the conclusion). 1a very little evid; 1b inaccurate evid	Provides very little or inappropriate reasoning. 1a - only incl. evidence; 1b - only incl. sci principles; 1c - both evid and principles but are connected inaccurately
2 (passing)	Provides some appropriate "T/P/D/S etc." descriptions; but not all; or level of detail is inappropriate for some described.		Provides an appropriate, but insufficient conclusion. If only one conclusion is needed, this score could be used where students reference the proper feature etc. but does not name it specifcially (etc.).	Provides appropriate, but insufficient evidence (given all data present). Or provides sufficient, but some inappropriate evidence. 2a appro but insuff; 2b suff but inappro	Provides reasoning that connects the evidence to the conclusion. Some, but insufficient scientific principles or justification for why the evidence supports the conclusion.
3 (strong)	Completely describes all "T/P/D/S etc." at an appropriate level of detail. With quantitative details included when available. If interps or explanations included, they are ignored.		Provides an appropriate and sufficient conclusion.	Provides appropriate and sufficient evidence that includes some relevant specific quanititative information and pattern descriptions.	Provides reasoning that connects the multiple pieces (when available) of evidence to the conclusion. Includes appropriate and sufficient scientific principles to explain why the evidence supports the conclusion.

When you complete your answer, highlight text with the following color coding:

Conclusion/Claim

Yellow- data summaries relevant for your claim ("evidence")

Blue - science background concepts relevant to explain your claim

Green- - text that connects evidence to science concepts

Modified from McNeil et al., 2006

Exam Questions

1. Determine plate boundary type with data sets provided
2. Determine and explain the relationship between wind speed and wave height with data sets provided
3. Explain what controls primary production in the winter season with data sets provided*

Different concepts and data sets; *#3 is likely a more complex phenomenon

Student S1B03 Results

(Color-coding done by PIs)

Exam 1. Between the 4 data sets I realized that there is a lack of pattern. There are many shallow earthquakes within the area but not very many volcanoes at all. The sediment is mostly thin with some thicker areas and the sea floor is about half extremely old and half younger. These data sets tell me that the **plates in this boundary** have definitely shifted a good bit in order to form the many shallow earthquakes that have occurred within the area circled in the top left map. After considering all of this information and taking a close look at each data set, I believe that the plate boundary that occurs in the Indian Ocean is a transform boundary. Transform boundaries include many shallow earthquakes and very little volcanoes. Since the sea floor in this area is very old, there have been many shifts between the plates over the million years that it has been there and that is why there are shallow earthquakes across this area. The lines that the earthquakes form in the top left map are the areas that the plates slid past each other under the ocean. All of this evidence between earthquakes, volcanoes, sediment thickness, and seafloor age, lead me to believe that in the maps above of the Indian Ocean there is a transform boundary.

	D	C	E	R
Total 4.5	1.5	1	1	1

Exam 3. A) The annual trends of temperate **primary production** are that in the cold-warm months of spring and warm-cold months of fall primary productivity is higher. These trends change annually because the temperate area is not always hot or cold, it changes. The annual trends of tropical primary productivity are that the trend stays the same annually. This is because the tropical region stays warm-hot temperatures.

B) These regions' annual trends are different because of their different temperatures and the amount of sunlight as well as nutrients that are able to work together at the surface in order to allow primary producers to photosynthesize.

C) My conclusion stated in B relates to A because the primary producers in the temperate and tropic regions are not able to thrive in the same ways. For example, the trends in the temperate area show that chlorophyll is at its highest during the cold-warm spring because that is when there is no thermocline layer in the ocean, since the surface water is still colder during those months. Between March and April in the temperate region, chlorophyll is highest because nutrients are able to move to the surface and there is enough sun to allow for photosynthesis. The tropic region is different because the temperature is warmer there annually, which is why there is no change in primary productivity. The warmer temperatures in this region keep the surface water of the ocean warm, which creates the thermocline layer and blocks nutrients from moving to the surface. Although there is lots of sun in this region year-around, the primary producers cannot photosynthesize unless they have both sunlight and nutrients.

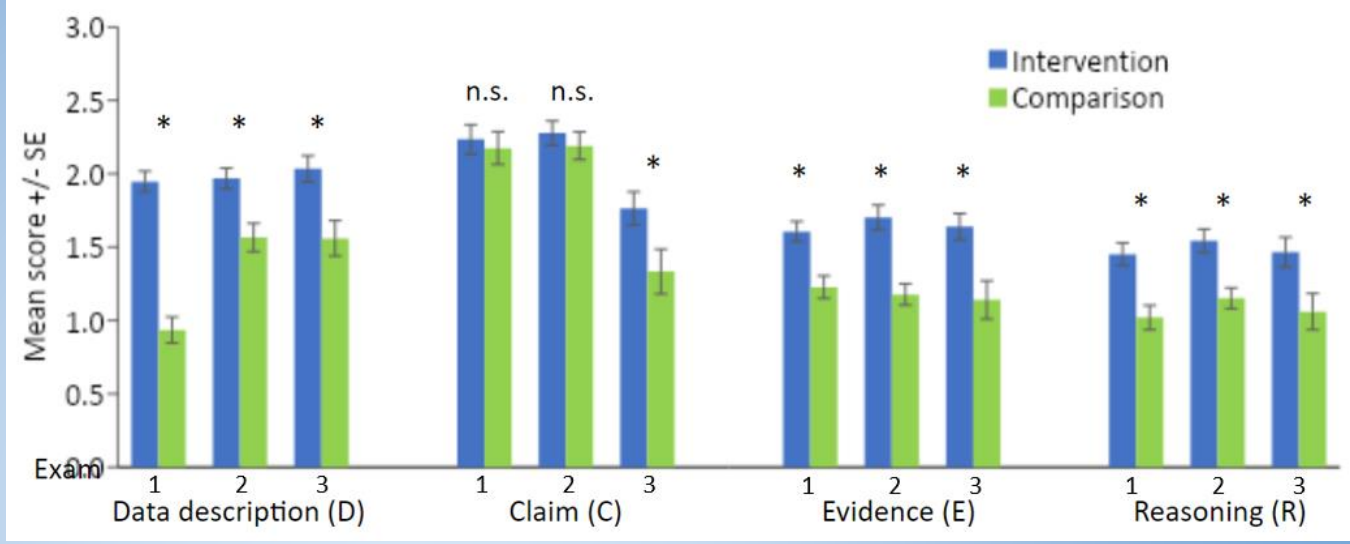
Conclusion/Claim
Yellow- data summaries relevant for your claim ("evidence")
Blue - science background concepts relevant to explain your claim
Green- - text that connects evidence to science concepts

	D	C	E	R
Total 8.5	1.5	3	2	2

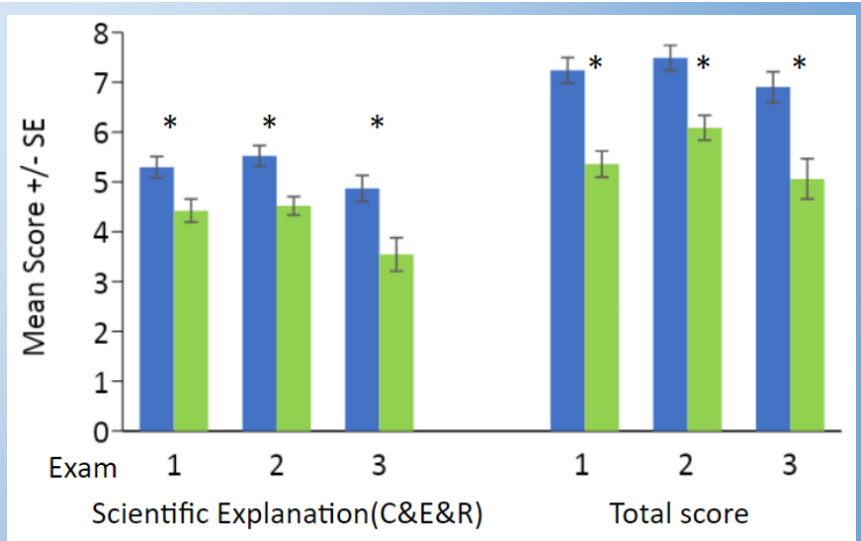
Results: Exam Essay Scores

Independent Samples t-Test:
Intervention vs. comparison

* Significantly different at p<.001



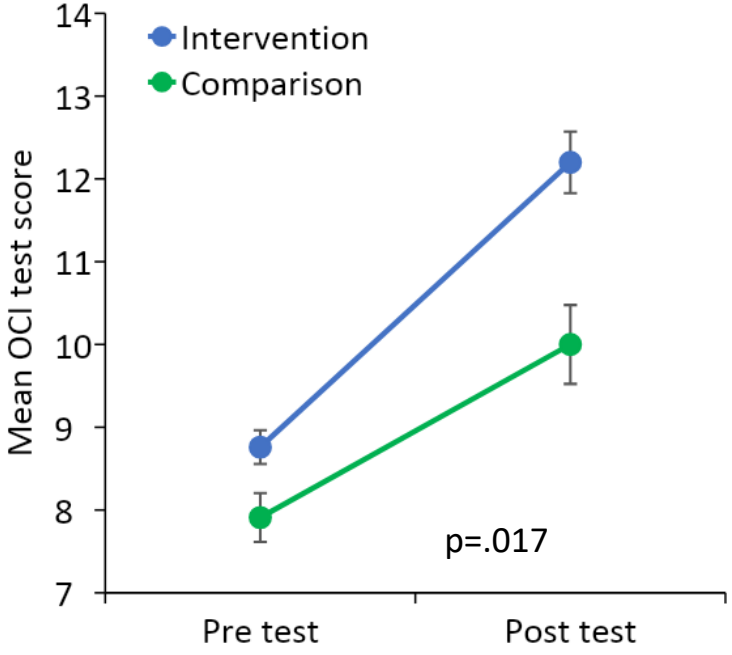
- Intervention group: significantly higher scores than comparison group across most components (D, E, R; but not C)
- Both groups can make a correct claim, but intervention students are able to create evidence-backed explanations with scientific reasoning while the comparison group struggles to do so



Results: Pre/Post Surveys

Two-way Mixed ANOVA, Group*Time interaction

OCK (Ocean Concepts Knowledge Survey)

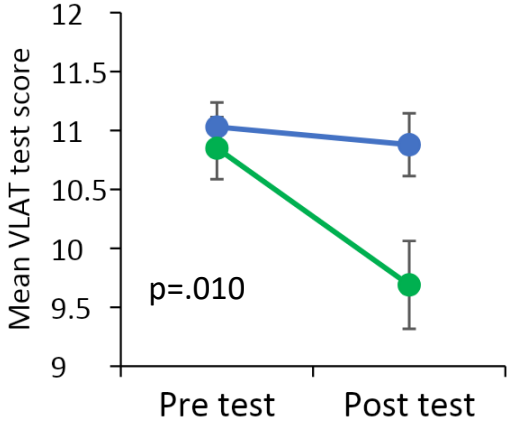


Intervention group had significantly larger improvement on OCK

VLAT+ (Lee et al. 2017)

Visualization Literacy Assessment Test

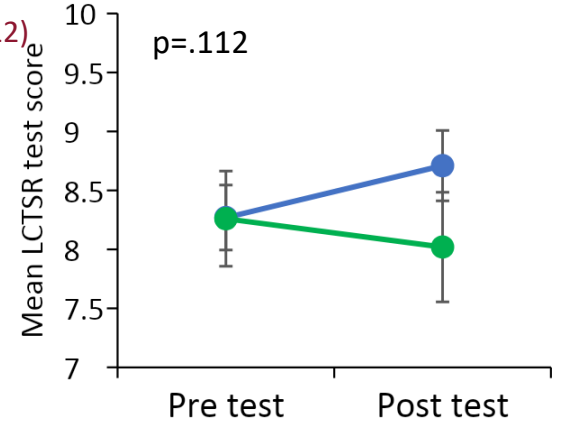
Intervention group score remained the same while comparison group score decreased…



LCTSR+ (Moore & Rubbo 2012)

Lawson's Classroom Test of Scientific Reasoning

Scores did not change significantly for either group



+ Modified for our project

Summary, Conclusions

- Incorporation of data exploration activities resulted in significant improvements in data descriptions and the ability to create evidence-backed explanations with scientific reasoning
- Activities also resulted in significant improvements of ocean content knowledge (OCI) by the end of the semester
- Data visualization (VLAT) & Scientific reasoning (LCTSR) results from in-class assignments:
  - End of semester fatigue…?
  - Are tests really measuring the skills targeted in our study?
  - One semester may not be enough time to show improvements?
  - Students in comparison sections mre confused by end of semester?
- If a course goal is to strengthen scientific reasoning, this method seem to work!

Thank you!

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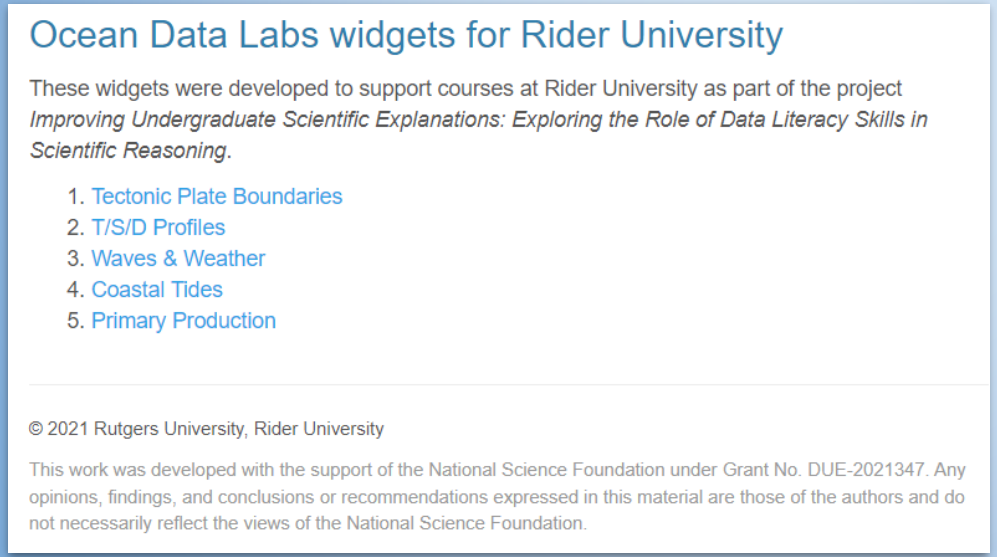
NSF IUSE Grant

[ID 2021347] 2020-2023

Level 1, Engaged Student Learning Track



Ocean Data Labs widgets for Rider University

These widgets were developed to support courses at Rider University as part of the project *Improving Undergraduate Scientific Explanations: Exploring the Role of Data Literacy Skills in Scientific Reasoning*.

1. Tectonic Plate Boundaries
2. T/S/D Profiles
3. Waves & Weather
4. Coastal Tides
5. Primary Production

This work was developed with the support of the National Science Foundation under Grant No. DUE-2021347. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

https://datalab.marine.rutgers.edu/explorations/rider/

Ocean Data Labs

https://datalab.marine.rutgers.edu/

PROJECT SUPPORTED BY: NSF

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THE OOI OCEAN DATA LABS PROJECT

The National Science Foundation's Ocean Observatories Initi

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  - EDDIE Earth and Ecosystems
  - EDDIE Macrosystems
  - EDDIE Environmental

Project EDDIE: Environmental Data-Driven Inquiry & Exploration

Jump to Project Goals / About Large Data Sets / Data Sources / References / Project Support

Scientists are increasingly using sensor-collected, high-frequency and long-term datasets to study geological and environmental processes. Our interdisciplinary team of faculty and research scientists has developed flexible classroom modules that aim to expose undergraduate students to such real-world experiences. These modules utilize large, long-term, high-frequency and sensor-based datasets that can be used in a variety of introductory, mid-level, and advanced courses that meet a series of

Presentations at the Earth Educators' Rendezvous, Philadelphia, 7/15

Guiding Students to Use Evidence to Support their Scientific Reasoning, workshop 1:30-4

Guiding students to use evidence to support their scientific reasoning: Research Results, poster 4:30-5:45

References cited

Hotaling, L., McDonnell, J. M., Ferraro, C., Florio, K., & Lichtenwalner, S. (2019). Educating with data, in Fauville, G., Payne, D. L., Marrero, M. E., Lantz-Andersson, A. & Crouch, F. (Eds.), Exemplary Practices in Marine Science Education: A Resource for Practitioners and Researchers. Springer, pp. 17-224.

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Improving Undergraduate STEM Education Initiative

Reforming Pedagogy for Data-Intensive STEM Courses: Putting the Student Experience at the Center

Dr. Mine Dogucu
Dr. Kathleen Browne

@IuseProgram

AAAS IUSE Initiative

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WORKSHOP

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Slides and recording will be available in the coming days.

We value your feedback, please take a few minutes to complete the survey.

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Improving Undergraduate STEM Education Initiative

Using Artificial Intelligence (AI) to Enhance Learning for All Students

May 22, 2024 | 2:00pm-3:30pm ET

Dr. Narges Norouzi
Dr. Ibukun Osunbunmi

@IuseProgram

AAAS IUSE Initiative

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