# Use an open-ended sampling challenge to map student misunderstandings of population and sample size.

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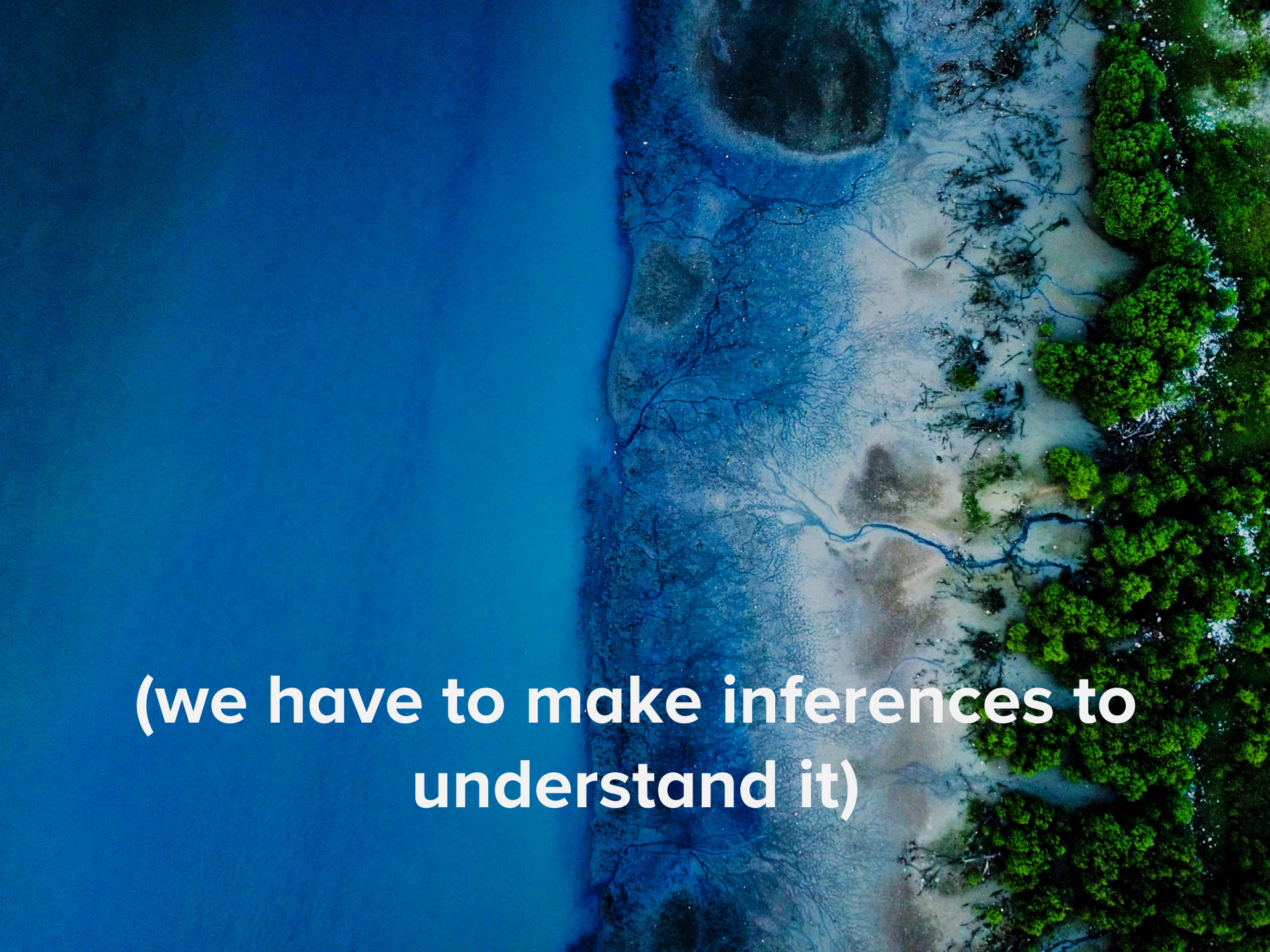
Without leaving the room, or getting out of your chair

**What “whole” or population could you sample, right here, right now?**

**What inferences could you make from your sample?**


THE WORLD IS BIG AND COMPLEX


(we have to make inferences to
understand it)

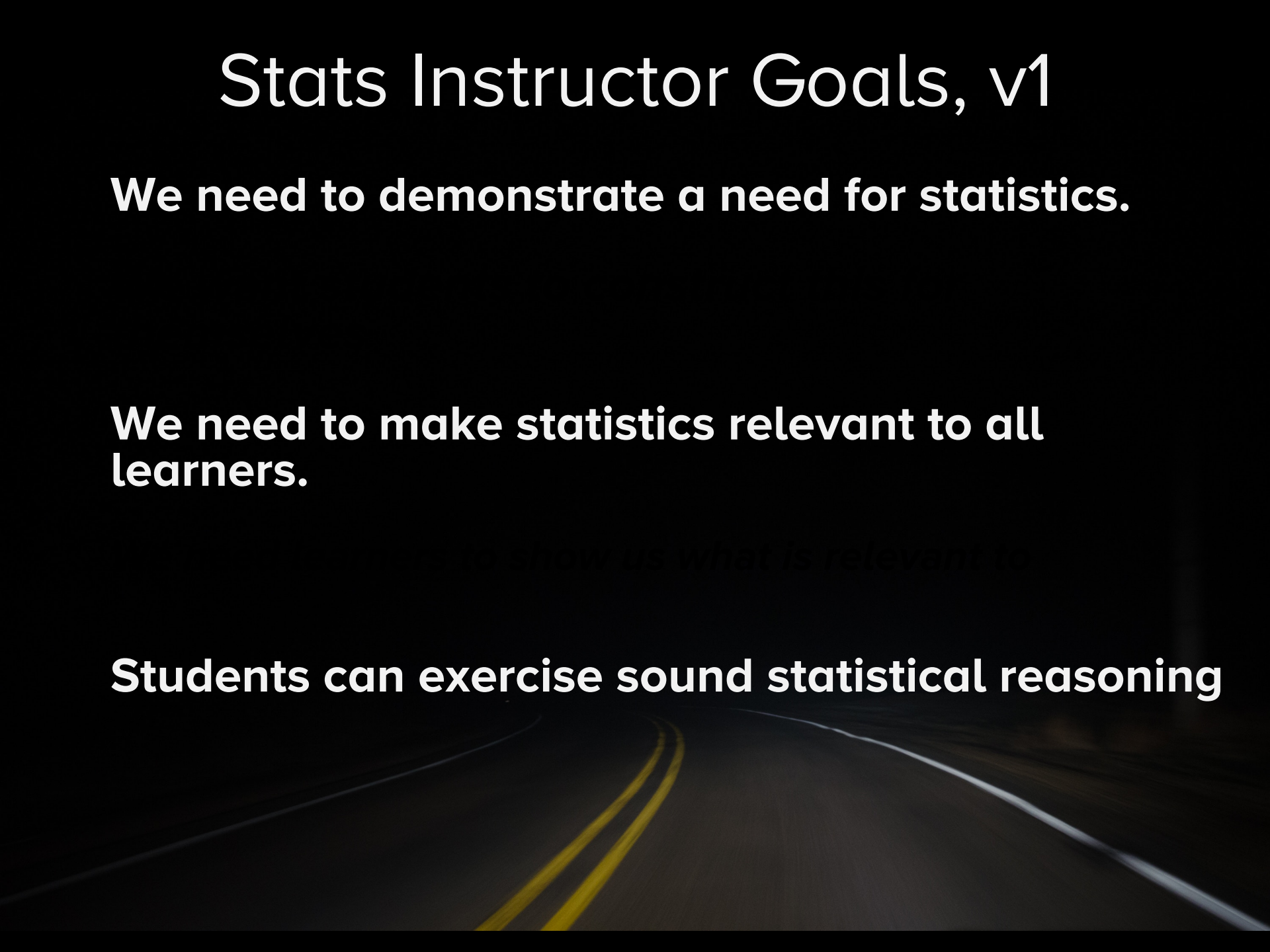
# Stats Instructor Goals, v1

**We need to demonstrate a need for statistics.**

**We need to make statistics relevant to all learners.**

***Let them show us what is relevant to***

**Students can exercise sound statistical reasoning**



# Stats Facilitator Goals, v2.0

We need to demonstrate a need for statistics.

***1. We want students to construct the need for statistics themselves***

We need to make statistics relevant to all learners.

***2. We need learners to show us what is relevant to them***

Students can exercise sound statistical reasoning

***3. Students are empowered to use sound statistical reasoning all the darn time.***

# By the end of this session, you will

- Leave with a tool for formative (and summative) assessment of statistical knowledge
- See a host of examples of statistical (and not so statistical) inference by learners
- Practice launching instructional opportunities through **questioning** and **discussing** student inferences

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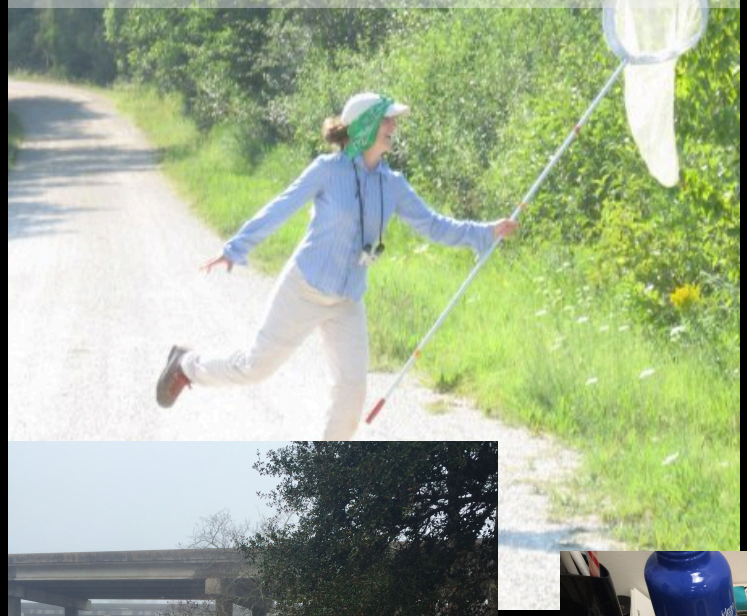

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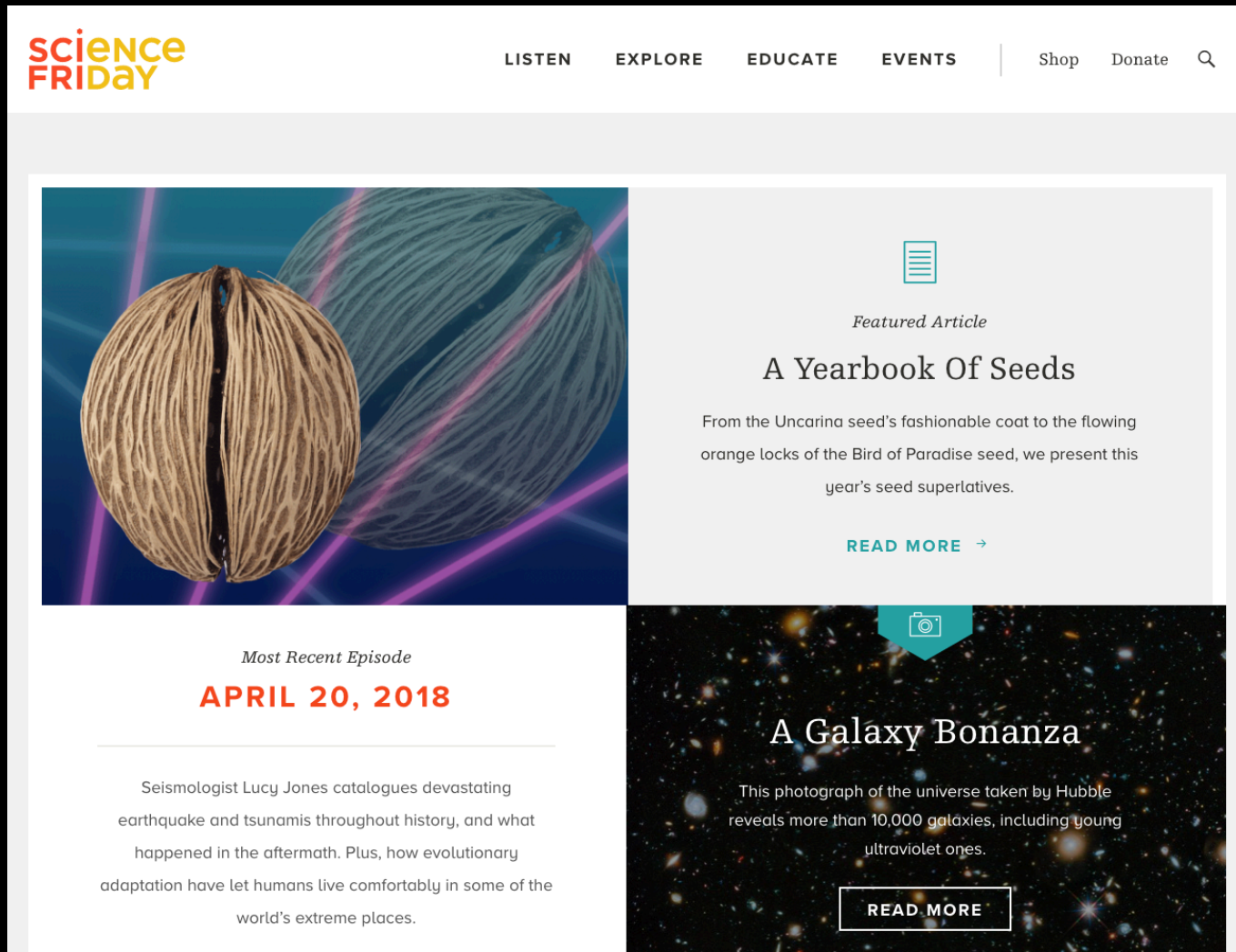
# science FRIDAY

- LISTEN – podcast, public radio, interviews
- WATCH – videos
- READ – articles, transcripts, book excerpts
- EDUCATE – lessons, activities, challenges

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Why am I here?


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Why am I here?


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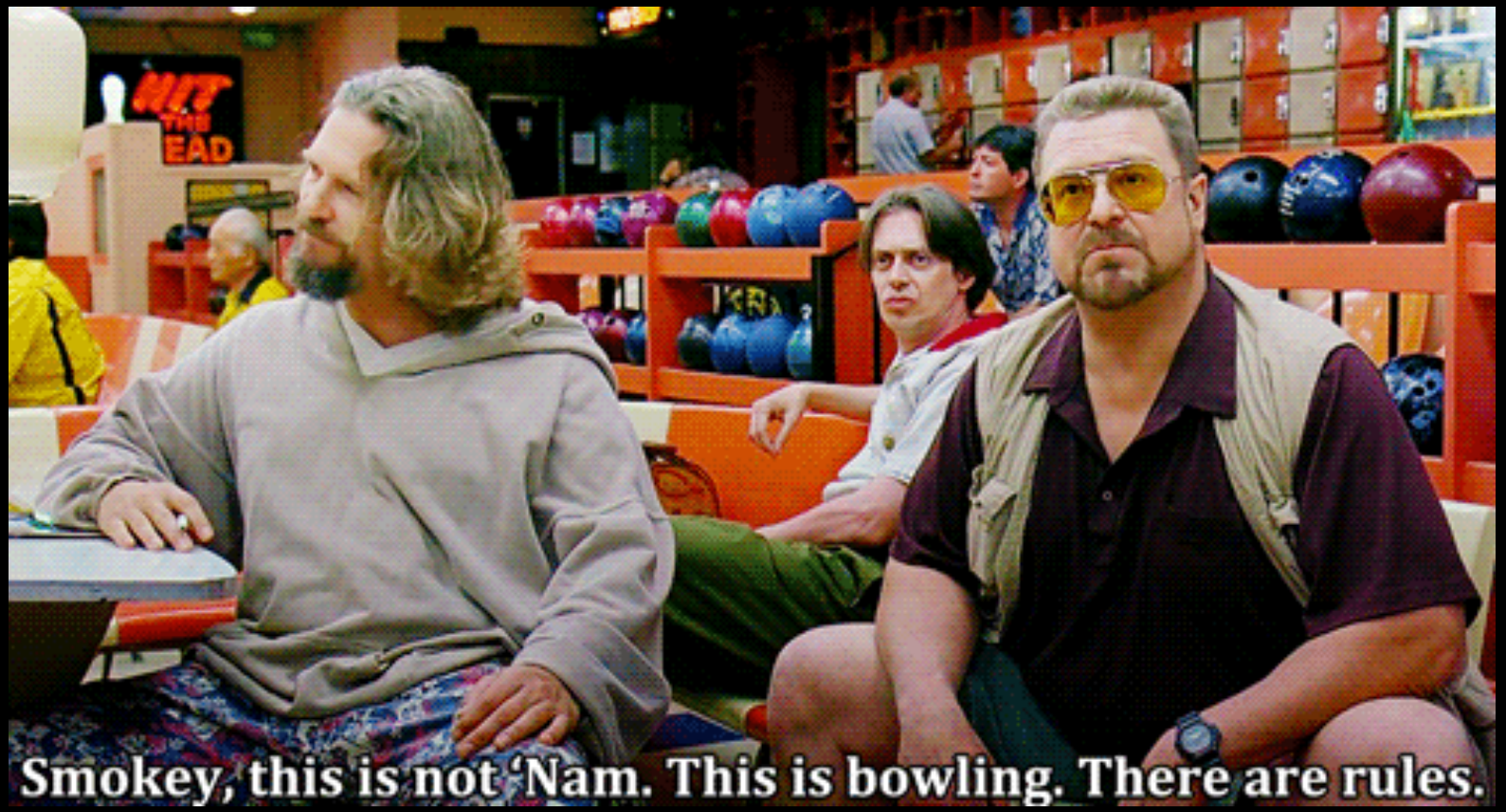
# What was **not** provided?



Here's what happened:

**sciencefriday.com/takeasample**

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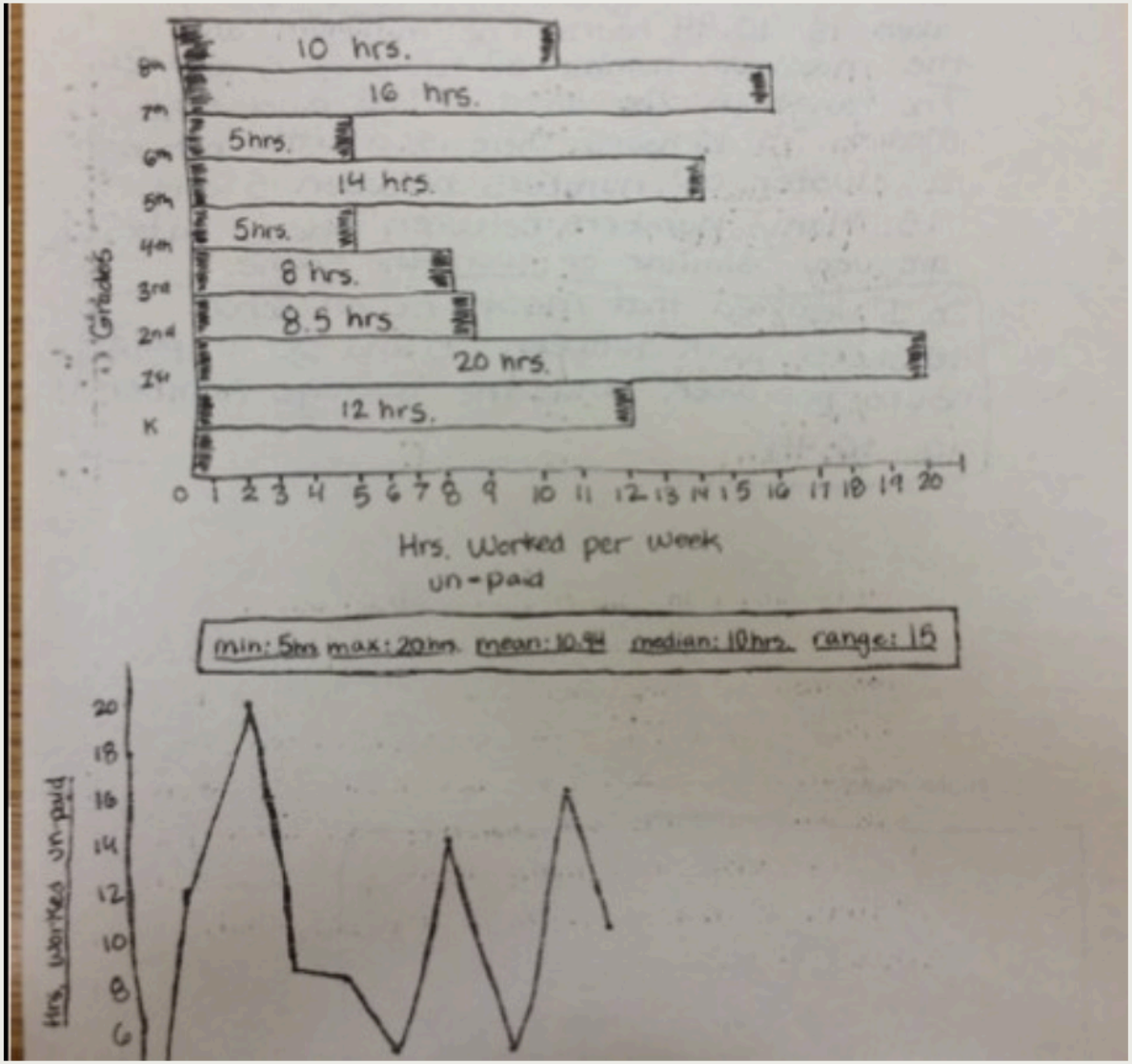
## Grains of Sand

Wahid and Alex both used sampling to estimate the grains of sand on beaches near Busan Foreign School in South Korea by figuring out the number of grains in a small volume and estimating the volume of the beach. Wahid's estimate wsa 102,355,000,000,000 grains of sand, and Alex's estimate was 2,111,603,752,600,000. *Photo by Wahid*

## 6,011 Square Meters of School Yard

Ms. Nolan's 4th graders used GoogleEarth to estimate the size of their schoolyard, then counted sticks, caterpillars and trash in five random square meters. Based on their samples, they estimate there are over 46,000 sticks, 2400 caterpillars, and 6000 pieces of trash in the whole schoolyard! *Photo by Tarmo Lampinen*

***2. We need learners to show us what is relevant to them***




## Extra Hours Worked by Teachers

Alexandra from Beach School sampled the number of extra unpaid hours that teachers work at her school each week by conducting a survey. “I learned that most Beach School teachers work between 5 and 20 unpaid hours per week and the average number is 10.94”

***2. We need learners to show us what is relevant to them***


## Mountain Trees

"In Busan, Korea, there is a mountain called Jangsan. I always wondered how many trees are on a mountain. I took three samples of 7.5m x 7.5m or 56.25m^2, Of the three samples I took, there were 5 trees, 5 trees, and 4 trees. Therefore there were 4.7 trees per 56.25m^2.

16 180 807.2m^2 / 56.25m^2 = 287 658.794

287 658.794 * 4.7 trees = 1 352 123.232 trees in all of Jangsan." – Ryan K

***2. We need learners to show us what is relevant to them***

| Day | Time | Amount of Cars |
|---|---|---|
| Saturday | 4:00 – 5:00 | 16 |
| Saturday | 6:00 – 7:00 | 8 |
| Monday | 4:00 – 5:00 | 23 |
| Monday | 6:00 – 7:00 | 11 |

## Car Traffic

Vincent sampled traffic: “In my research I was looking to see how many cars passed by my house from 4:00 to 5:00 and 6:00 to 7:00 on the weekdays and on the weekends. I found that during the week from 4:00 to 5:00 it is the busiest time for cars to pass by my house. On the contrary, during the weekends, there are very few cars that pass by my house. I have concluded that I should be weary of cars on my street when I am visiting a friend.”

***1. We want students to construct the need for statistics themselves***

***2. We need learners to show us what is relevant to them***

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## Book Colors

Bess sampled book colors: "3.8% of books are white, 7.6% of books are brown, 19% of books are blue, 13% of books are red, 5% of books are yellow, 13% of books are green, 11% of books are purple, 13% of books are black, 7.6% of books are grey, and finally, 3.8% of books are orange. This is based off of the top shelf of a bookshelf." *Photo by* ***ParentingPatch***

***2. We need learners to show us what is relevant to them***

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Thursday 4/14 - 12 poops
Friday 4/15 - 5 poops
Tuesday 4/19 - 19 poops
Wednesday 4/20 - 16 poops
Friday 4/22 - 13 poops
Saturday 4/23 - 8 poops
Monday 4/25 - 15 poops

**That's 12.57 poops per day.**

There are 7 dog parks in our town. So that's 88 un-scooped poops per day. That's 32,120 poops per year.... OMG!!!

## Dog Waste

Claudia and Theresa sampled (cleaned up) dog poop in a local park. “We would pick up unclaimed poop during each visit and find out how many poops were being left behind...How many poops are left a day in our town?”

*1. We want students to construct the need for statistics themselves*

# What needs to happen?

## (YOU MAY BE FREAKING OUT)


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# Questioning and discussion, the path forward

- ***What is a statistical question?***
- ***A dataset has a distribution***

CCSS.MATH.CONTENT.6.SP.A.1

CCSS.MATH.CONTENT.6.SP.A.2

CCSS.MATH.CONTENT.HSS.ID.A.3

- ***Data is influenced by how it was collected***

CCSS.MATH.CONTENT.6.SP.B.5.B CCSS.MATH.CONTENT.7.SP.A.2 CCSS.MATH.CONTENT.HSS.IC.B.3

- ***Data may be used to form inferences about a population***

CCSS.MATH.CONTENT.HSS.IC.A.1

- ***Data can be used to infer relationships***

CCSS.MATH.CONTENT.8.SP.A.3

CCSS.MATH.CONTENT.8.SP.A.1

**549: Standard(s) Statistics: Exploring Common Core Statistics Content Marriot Ballroom Salon 14 @ 4:30pm**

# What scenarios could you give this student to encourage them to think about this data **statistically**?

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Model with mathematics.
Attend to precision.

# Peer-to-Peer “what if” practice

- *How do you know _____ isn’t going on?*
- *What if your next sample you got _____?*
- *What if every time you sampled, you were inadvertently _____ing?*
- *What if these results are only typical for/when _____?*
- *How much does your answer change with each new sample?*
- *Does other data support your inferences?*
- How do you know that _____ is typical?

Construct viable arguments and critique the reasoning of others.

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# What could you ask this learner to encourage them **to consider randomization** in their sampling?

## Grains of Sand

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Make sense of problems and persevere in solving them.

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How could you encourage this learner to describe an appropriate **scope of inference** for this observation?


Make sense of problems and persevere in solving them.

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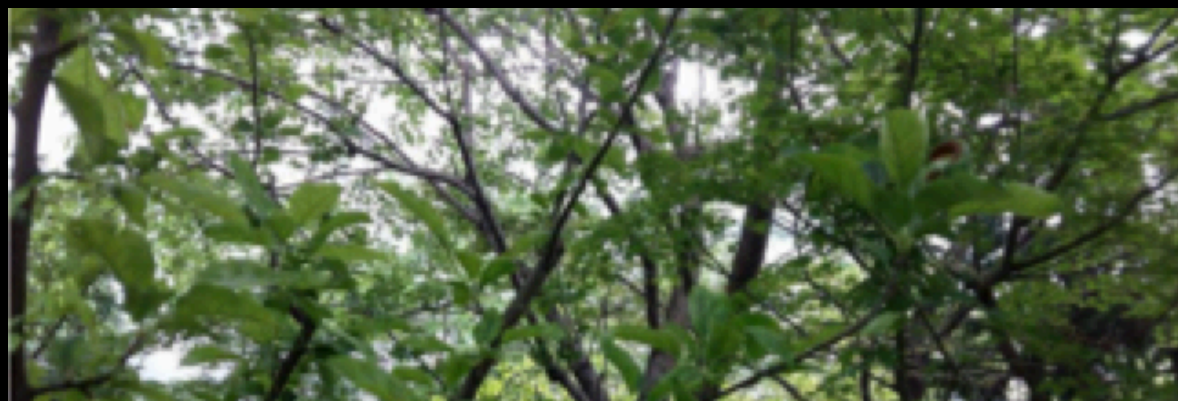
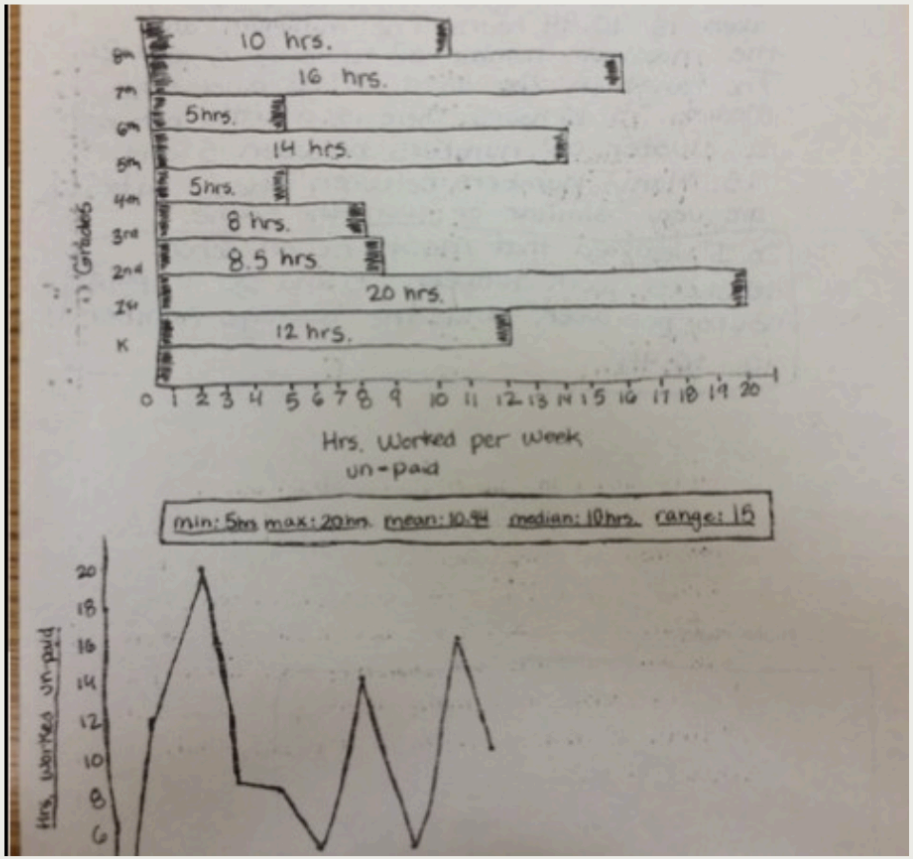
Put the following populations on an **inference continuum** based on this dataset

1. We know NOTHING!
2. 
3. 
4. 
5. INFER ALL THE THINGS

A. All trees
B. Trees of the same age and species
C. Trees in this park
D. This particular tree
E. A branch on this tree



# How could you inspire this student to expand their study to show a **relationship** between hours worked by teachers and some other variable?




### Extra Hours Worked by Teachers

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Reason abstractly and quantitatively.

Model with mathematics.

Use appropriate tools strategically.

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# Connect Challenges to “Tools”

- “I need to collect more samples, but how many!?!”
  sample size, variance, simulation
- “I want to be able to estimate/predict…”
  frequency, probability, expectation
- “I can’t know what’s really happening”
  distribution, limits, confidence intervals
- “I want to see if there’s an effect or relationship between”
  tests, boxplots, inference, significance

# #TakeASample assessment recipe

1. An open-ended challenge (#TakeASample)
2. An arena where they can view and respond to one another's data (Twitter, Juicer.io)
3. "No wrong inferences" environment (culture, see also "constructivism")
4. Time to sample (but not too much)
5. Time to reflect and improve (but not too little)

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# Pushbacks to pushbacks

- This invites and reinforces misconceptions
  *This "damage" has already been done, and is reinforced on a daily basis by your student's brains, media, peers, and parents)*

- This sets up your students for a "gotcha" attack on their approach
  *If learning is student-directed, they will be critiquing and improving their own protocols and pruning their own inferences*

- But you didn't teach them [mean, distribution, range, center, spread, shape, other essential and jargonic word here] before they made inferences!
  *These concepts should be offered as TOOLS in response to student-generated challenges*

- It's not in the standards for earlier grades, it's not tested, it's not relevant, I don't have the time.
  *For case studies in relevancy, I'd point you to just about anything on fivethirtyeight.com, Woman's World magazine, or the NYTimes data visualization blog …*

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