Teacher Guide for Writing Survey Question: BIO Fencepost Activity
Version: 01.09.2023

Writing Survey Questions: Overall Tips

- Every student should be able to answer for every question. One survey question should not be dependent on a prior answer.

  - **Q1: Have you ever experienced a hurricane? Q2: What impacts have you experienced from a hurricane?**

    - If a student answered "No" to Q1, they can't answer Q2. You could offer a "NA" option, but those tend to be unsatisfying and less engaging.

- Be careful with phrasing and word choices to be in a students' language and perceptions of the world. Reflect on where you are assuming their prior experience or how they will interpret words – even if it's stuff they "should" know from class. Define terms in the question. Avoid words that are open to interpretation. If you want to know about "impacts," what does that include? If you want to know which option students think is "the best," give clarity about best for what or for whom?

  - **Q: Have you ever experienced the effects of wildfires?**

    - "Effects" or "Impacts" – you may be thinking broadly (e.g., property damage, precautionary evacuation, smoke, change in sky color, air quality); but students are often more literal and narrow in interpretations (e.g., did my house burn down?). In this case, offer examples of what *you* mean by "effects" to get them thinking along the same lines as you.

    - "Effects" – you may be assuming students *know* all of the possible effects of that natural disaster that you are thinking of. (Or that they even know what that natural disaster is or is called.) Again, give specifics if this is your question.

- If a question is "Pick One" of a list of choices, the question should be able to answerable with just one of the options. If a student could answer with two of the items, give clarity about how they should narrow.

  - **Q: What did you see the last time you went to [name of park by school]? People. Trash/Litter. Animals.**

    - A student very likely saw multiple of those things at the park. If you wanted to get at the perception of debris that can run off into the ocean, you could ask: Think back to the last time you were at the __ Park, how many of these types of trash/litter do you remember seeing on the ground? Plastic. Glass. Paper. Cigarette Butts. Metal/cans. Food waste. I didn't see any of these.
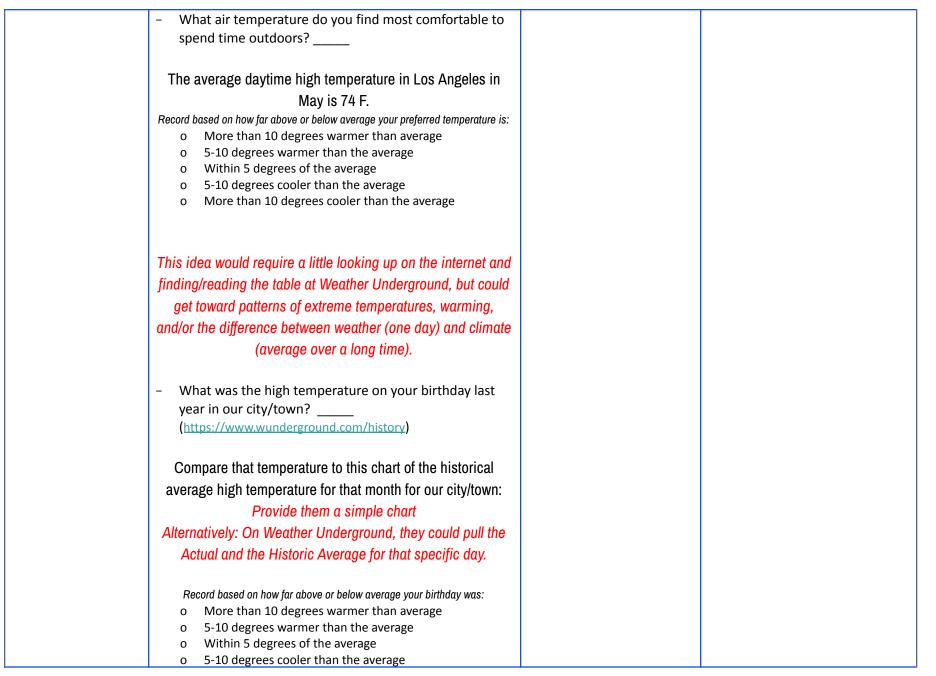
- Don't quiz students. Avoid questions with a single, correct answer – or ones that *feel* like there's a right answer. Kids will feel tested and it's often not as engaging. Focus on questions about personal experience, opinions, perspectives, attitudes, etc.

  o **Which type of animal has the most different species? Mammals. Birds. Reptiles. Insects.**

    ▪ Even if kids don't know the answer, there will be a clear sense that there *is* a right answer. It's a great assessment question for you to know what they know! But for this activity, it might be a little disengaging for them to explore that data (which is more about how right or wrong they were).

- Ask questions that have stakes for students. Think about questions where they will be curious or interested to see what peers said; questions that don't have obvious or common answers; questions that are likely to elicit diverging opinions. This will help them be engaged in the data.

- Ask a variety of question types (see next section). Don't ask all Y/N or multiple choice. Ask questions that lend themselves to different types of data and, thus, visualization strategies.

Overview of Questions Types, Examples, and Visualization Options

Question	Example(s)	What to Show	Strong Visualization Strategies
Binary Data: Yes / No	– Have you ever been to an ocean before? – Have you ever used a telescope? – Do you have a vegetable garden at home?	Presence / Absence	<u>Show Contrast</u> Color Shape/Symbol Pattern
Binary Data: Either / Or	– Which natural disaster would you least want to experience, a hurricane or a wildfire?	Two distinct groups	<u>Show Contrast</u> Shape/Symbol Color

Categorical Data: Multiple Choice – select one	– Which of these natural disasters do you feel most concerned about?
	  o Wildfires
	  o Hurricanes
	  o Tornados
	  o Floods
	  o Droughts
		Many distinct groups	<u>Highlight Many Distinct Categories</u>
			Shape/Symbol
			Pattern

Ordinal Data: Multiple Choice – Sequenced options or select all	– How many of these natural disasters do you feel our community needs to prepare for? Choose as many as apply, or zero if none are concerns.
	  o Wildfires
	  o Hurricanes
	  o Tornados
	  o Floods
	  o Droughts
	
	– When do you think we should start teaching students about wildfire preparedness?
	  o Elementary school
	  o Middle school
	  o High school
		Frequency of applicable categories
		
		Groups that inherently hold a known order or sequence
			<u>Highlight Inherent Sequence of the Categories</u>
			Density (fewer – many)
			Value (light – dark)
			Size/Scale (less – more)

	o College		

Ordinal Data: Rating Scale (single-direction; 0 – 5)	– How concerned do you feel about climate change affecting our world?
	  o Extremely concerned
	  o Very concerned
	  o Somewhat concerned
	  o A little concerned
	  o Not at all concerned
	
	– How big of a priority do you think preventing wildfires should be for our state's government?
	  o Top priority
	  o High priority, but not top
	  o Medium priority
	  o Low priority
		Intensity of feeling, response, or opinion	<u>Highlight Strength / Intensity</u>
			Value (light – dark)
			Intensity (weak – strong)
			Size/Scale (small – large)
			Density (fewer – many)

Ordinal Data: More/Less Scale (bi-directional; -2 to +2)	– Do you think there are more, less, or about the same number of animal species that live on land compared to the number of animal species that live in water (oceans, lakes, rivers)?
	  o A lot less live on land
	  o A little less live on land
	  o About the same in land and water
	  o A little more live on land
	  o A lot more live on land
	
	– Do you think you're more or less concerned about the impacts of climate change than the average student in our school?
	  o A lot less concerned
	  o A little less concerned
	  o About the same
	  o A little more concerned
			<u>Highlight Bi-Directional Variation</u>
			Direction/Flow (higher – lower)
			Color (warm – cool)
			
			Note: categorical symbols and scales that mainly show growth (size, value, density) don't capture the nuance that the answers <u>diverge</u> from a neutral point – rather than just being on a range from low to high. While you could visualize them in another way, you'd lose that important characteristic of the underlying data.

	○ A lot more concerned		
Interval Data: Asking for a Number or Measurement → Group Data	– On a typical Tuesday, how many hours per day do you typically spend looking at screens (phones, tablets, TV, computers, video games) for fun (not schoolwork)? _____ *Record based on which group your answer fell into:* o 0-2 hours o 3-4 hours o 5-6 hours o 6-7 hours o More than 7 hours ● – What air temperature do you find most comfortable to spend time outdoors? _____ *Record based on which group your answer fell into:* o *Below 60 F* o *60-70 F* o *70-80 F* o *80-90 F* ○ *Above 90 F*	Reduce raw number answers into groups	<u>Highlight the Distribution of the Range</u> Value (light – dark) Intensity (weak – strong) Size/Scale (small – large) Density (fewer – many) Color Range (cool – warm)
Interval Data: Asking for a Number or Measurement → Compare to Average	– On a typical Tuesday, how many hours per day do you typically spend looking at screens (phones, tablets, TV, computers, video games) for fun (not schoolwork)? _____ Research from 2021 showed that the average amount of screen time for kids your age was 5.5 hours. *Record based on how far above or below average your estimate is:* o More than 2 hours above average (over 8 hours) o Above average by 1 to 2.5 hours (6.5-8 hours) o Around the average (5-6 hours) o Below average by .5 – 2.5 hours (3-4.5 hours) o More than 2 hours below average (less than 3 hours)	Individual variation relative to an average or baseline	<u>Highlight Bi-Directional Variation</u> Direction/Flow (higher – lower) Color & Value (values of red – values of blue)

– What air temperature do you find most comfortable to spend time outdoors? _____

The average daytime high temperature in Los Angeles in May is 74 F.

Record based on how far above or below average your preferred temperature is:

o   More than 10 degrees warmer than average
o   5-10 degrees warmer than the average
o   Within 5 degrees of the average
o   5-10 degrees cooler than the average
o   More than 10 degrees cooler than the average

This idea would require a little looking up on the internet and finding/reading the table at Weather Underground, but could get toward patterns of extreme temperatures, warming, and/or the difference between weather (one day) and climate (average over a long time).

– What was the high temperature on your birthday last year in our city/town? _____
(https://www.wunderground.com/history)

Compare that temperature to this chart of the historical average high temperature for that month for our city/town:

Provide them a simple chart
Alternatively: On Weather Underground, they could pull the Actual and the Historic Average for that specific day.

Record based on how far above or below average your birthday was:

o   More than 10 degrees warmer than average
o   5-10 degrees warmer than the average
o   Within 5 degrees of the average
o   5-10 degrees cooler than the average

	o More than 10 degrees cooler than the average		

More Detail on Survey Question Types

Binary

Binary questions ask students to choose one of two possible answers. The most common type of binary question is yes/no, but this question can also ask for students to choose an either/or response.
- This question type can be a good "warm up" question. It will also make a big visual impact on fenceposts, due to only having two possible answer options, so it is easier to glean patterns at a glance.
- The most common representation for a Y/N question is likely something for Yes (a color, shape, pattern, etc.) alongside nothing, blank, or a zero symbol for No, or using dual/opposite colors or symbols (happy face, sad face).
- Either/Or questions will need two representations, but they shouldn't indicate the same type of positive/negative quality as a Yes/No question.

Categorical Data: Multiple Choice

Multiple choice questions ask students to choose an answer from a list of pre-populated answers. As a categories, they are all distinct groups with no inherent order, sequence, or values. The typical way to ask this question is to ask students to "Pick one."
- This question lends itself to shapes/symbols to represent different multiple-choice answers because there is no inherent direction, value, or order to the options. Colors could be used, if the items have an inherent color association (e.g., favorite ice cream flavor – chocolate, vanilla, strawberry).
- Other types of symbols bring in other meaning that the data don't hold.
- Because of the limitation in ways to represent these data, you may want to minimize the number of these questions in the Fenceposts survey.

If your answer options have a natural sequence (e.g., grade levels, age groups, etc.), you are dealing with ordinal data, which opens to door to design tools that show growth or gradation.

Ordinal Data: Multiple Choice (Select All)

Another way to tackle multiple choice questions is to allow students to "Select All that Apply". This opens the door to different representations. It could also open the door to a discussion of how representations can reduce data and you "lose" information.
- Instead of *which* answers they picked, the representation could focus on *how many* answers each student selected. This would open the door to design tools that inherently show sequence or gradation (e.g., density, value, intensity, size/scale).
- You could still use symbols for which answers were picked, with strategies for how to represent multiple in one box. Are there particular combinations of concern? Show everything you picked? What do you want to see in the answers?
- You could play with showing how many answers were chosen *alongside* which answers were chosen. **This opens the door to directly exploring how the exact same pieces of data can be analyzed and represented graphically in multiple ways.**
    - In this strategy, you use a single survey question, but represent the exact same data (their answers) in two different ways on two different squares of the fencepost. How do the different representations of the same data tell you different things?

Ordinal Data: Rating Scale

Rating scale questions are most often asked to get at personal opinions or perspectives. There are two ways to set up a rating scale – one-direction and bi-direction. Each one introduces different affordances for visualization.
Single Direction Scale: Not at all to Very Much
   o This type of question will lend itself to design tools that show a single direction growth/movement – including value, intensity, size/scale, or density.
   o They could also support use of symbols, but you'd want to choose symbols that convey a directionality (neutral face emoji to cry-laughing emoji).

Bi-Directional Scales: More/Less or Agree/Disagree
   o This type of question gives options that diverge from a neutral point. (You don't have to include a neutral point as an option; but the point is that the answers have both negative and positive elements to them.)
   o This is great for design choices to show bi-directionality – such as direction/flow and color scales (hot/cold).
   o While you could use other options, it's an opportunity to talk about how other representations "lose" the quality of the data that shows divergence.

Interval Data

Interval data are simply numbers; measurable, continuous numbers (temperature, height, weight, volume, time, age, etc.). This type of data always needs to be reduced through analysis before visualizing; a table of raw numbers doesn't show *anything*. This will be tricky for Fenceposts, but we give some examples a questions where a student could give their personal numeric answer, and then offer options for ways to offer the visualization categories that would analyze the raw number differently.
   o Single Direction Groups: You create groups that clump even ranges of numeric answers. The groups must be at even intervals (e.g., 1-3, 4-6, 7-9, etc.). Groups that are at uneven intervals (e.g., 1-3, 4-12, 13-15, 16-20) will misrepresent the data.
      o Visualization strengths are like the single direction scales above

   o Variation from the Average (Bi-Directional): Interval data will lend itself to exploring the idea of individual variation. In this strategy, the students represent their answer based on how much and in which direction it varies from an average.
      o To avoid having to "do the math" on the class's data (this isn't math or statistics class), our question examples highlight ways you could bring in outside data about an average, that they can compare themselves to.
      o Visualization strengths are like Bi-Directional Scales above; but the approach of variation from average may be even better for emphasizing directionality and strength of directionality.

Advanced Options: Ranking Questions

If you're ready to push the envelope with your students, consider a question where they rank the answer options in order of importance / preference / value. Ranking questions contain so much information in the data, they are notoriously difficult to visualize. If you want students to wrestle with these questions, they could consider what to visualize from ranked data.