

UNIT 15: LESSON 1

Describing the Statistical Reasoning Process and Formulating Questions

OVERVIEW	
Unit Title: The Statistical Process – Posing the Right Question with Snack Trucks	Length of Lesson in # of Hours: 3 # of Classes: 1
How does this lesson connect to previous or future work as exemplified by the Standards in your scope and sequence? This lesson builds on informal introductions to data in earlier units and begins to connect these ideas to the Statistical Cycle.	
LESSON OBJECTIVES	
<i>At the end of this lesson, students will be able to:</i>	
<ul style="list-style-type: none"> • examine the Statistical Cycle • describe statistical reasoning • pose statistical questions that are designed to provide information 	
STANDARDS	
<i>Citation</i>	<i>[*This portion of the standard will not be explicitly covered in this lesson.]</i>
6.SP.1	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answer.
7.SP.1	Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
1 - 3 MATHEMATICAL PRACTICE(S) ADDRESSED IN THIS LESSON	ELEMENTS OF RIGOR
MP 3: Construct viable arguments and critique the reasoning of others. MP 4: Model with mathematics.	<i>Which aspect(s) of Rigor do the targeted Standard(s) require?</i> <input checked="" type="checkbox"/> Conceptual understanding of key concepts <input type="checkbox"/> Procedural skill and fluency <input type="checkbox"/> Rigorous application of mathematics in real-world contexts

ESSENTIAL QUESTIONS

Why is data collection and analysis important? How does it affect me?

How do I go about creating my own statistical information?

EVIDENCE OF LEARNING

Ways I and my students will know the extent to which the objectives have been met.

Students will be able to develop appropriate questions based on desired information.

LEARNING PLAN - Vocabulary

statistics
statistical process
data
frequency graph
mode
category
bar graph
circle graph
vertical or y-axis
horizontal or x-axis

LEARNING PLAN - Introduction

1. Show just one or two graphs from a site such as <https://www.statcrunch.com/5.0/viewreport.php?reportid=62506>. Ask students (in pairs) to think about what questions were asked and how the data were collected for each of the graphs. [The statcrunch.com site provides some information about who was asked and what the exact questions were. These could be shared with students after they reason for themselves.]

MATERIALS

A couple of graphs with title and data only, no accompanying explanation about the data

TIME

2. Once students share their thinking, ask:
 - Do you think these data are accurate? Why or why not?
 - What do you think would be the best way to collect data to answer such a question?

Note to teacher: *There is not a right or wrong answer to any of these questions. You want students to begin to realize that they should be asking their own questions about data, which is what this unit is about.*

Segue: *Ask students, Have you ever wondered where statistics such as “23% of Americans read a print newspaper daily” come from? Is it just made up? In this unit, you’re going to become a much more savvy consumer of data and statistics.*

LEARNING PLAN – Body of the Lesson	MATERIALS	TIME
Statistical process		
<ol style="list-style-type: none"> 1. Begin by asking students where they think real statistics come from. Ask, <i>What would be the process for figuring out who likes what?</i> 		
<ol style="list-style-type: none"> 2. Then introduce the statistical process (pose the question, collect data, analyze the distribution, and interpret the results) and compare it to their ideas. 		
<ol style="list-style-type: none"> 3. Ask students to consider decisions they have made in their lives, and what helped them make those decisions. Have them share some of their decisions and capture on chart paper. 	Chart paper Markers	
<ol style="list-style-type: none"> 4. Then focus on the ones where data (such as cost comparisons) influenced their decisions. Ask them to think about how they collected their data in order to make their own personal decisions. Add that information to the group chart. Connect their questions and data collection to the statistical process shown on the <i>Statistical Cycle</i> handout, reinforcing the idea that questions are posed for a purpose, and data are collected and analyzed to address that purpose. 	<i>Statistical Cycle</i> handout (one per student)	
<ol style="list-style-type: none"> 5. Ask student to consider where the statistical cycle begins and ends. [The arrows and cyclical design remind us that the process has no one place to begin or end; therefore, there are multiple points of entry into the statistical conversation.] Ask students to consider what the 		

<p>arrows mean. [They move in one direction, i.e., the process flows in a sequence even though it can begin and end anywhere along the cycle.]</p> <p>6. Ask students to think back to the decisions they just discussed from their lives and what helped them make those decisions. Have them consider at what point they began the Statistical Cycle when making those decisions. For example, if someone mentioned about deciding to get a used car, what made them want the used car in the first place? Did they observe that they were unhappy with their old car and realized a newer car could offer them something better? What observations led them to that conclusion [repair costs, unreliable, cost too much in gas]? What part of the Statistical Cycle would those observations fall within? [It could have been a question that got it started or even data collection.]</p> <p>Segue: Let's take a look at how the Statistical Cycle might look if we start by formulating questions about the countries in our closet.</p>		
<p>Formulating questions and collecting data</p>		
<p>7. <i>Say, Today, we will be investigating where our clothing and accessories are produced. Most of the clothing and accessories we buy tell us what country they were produced in. What type of question could we ask about this information? What might we want to know?</i> [Record student questions and comments on the board.]</p> <p>Note to teacher: <i>Students should come up with something along the lines of “where does our clothing/accessories come from?” although it may be more specific, such as “which continent produces the largest portion of our clothing?” If, for example, students generate questions like, “Was our clothing made in sweatshops?”, point out that this is a great question that could be investigated using statistics, but we won’t have the information to investigate that question available to us today.</i></p> <p>8. If not mentioned, ask, <i>In what country do you think most of our clothes and accessories are made?</i> Have students record their response on <i>EMPower Many Points Make a Point: Data and Graphs</i>, Lesson 1 [Countries in Our Closet], Student Book, p. 7.</p> <p>9. Ask each participant to provide three pieces of data. (If you have a large group, you can ask for two. You will want to have at least 12-15 pieces of data for this activity.) Students can check clothing tags, shoes, pocketbooks, hats, belts, etc. Have students write each country on a separate index card or sticky note with a marker so they are easy to read. Post all of the data points on the board so participants can see them.</p>	<p><i>EMPower Many Points Make a Point: Data and Graphs</i> (SB, p. 7)</p> <p>Index cards and tape or sticky notes Markers</p>	

- Follow directions for EMPower *Many Points Make a Point: Data and Graphs*, Lesson 1 (Teacher Book, pp. 16-20)[Countries in Our Closet] activities:
- Opening Discussion starting below the “Heads Up!” box where it begins with “You have looked at your closets, checked the tags...” (TB, p. 16)
 - At the conclusion of the Opening Discussion, be sure to ask students to consider what part(s) of the Statistical Cycle they just completed. [formulating a question and collecting data]
- Activity 1 (TB, pp. 17-18) [Organizing the Data]
 - You can skip the distribution of the sticky notes since students will already have recorded their data on an index card or sticky note. Be sure to draw the horizontal line for students to begin organizing their data by country.
 - As you work through the questions below the “Heads Up!” box on TB, p. 17, have students record their answers on SB, p. 8. You also can refer them to the frequency graph on SB, p. 9 as you complete the discussion from Activity 1.
 - Be sure to read through the *Looking Closely* sections on TB, pp. 21-22.
 - At the conclusion of Activity 1, be sure to ask students to consider what part of the Statistical Cycle they just completed. [analyzing data]
- Activity 2 (TB, pp. 18-19) [Statements about Data]
 - At the conclusion of Activity 2, be sure to ask students to consider what part of the Statistical Cycle they just completed. [analyzing data]
- Activity 3 (TB, pp. 19-20) [Changing the Categories]
 - Students can use the grid paper printed on SB, p. 11 for this activity, or they may wish to use a whole sheet of graph paper provided in the classroom. The frequency graph will be reused later in the class, so be sure to have students hold onto their copy.
 - Use the WorldAtlas.com list of [countries by continent](https://www.worldatlas.com/countries-by-continent.htm) as additional reference material in the activity. You may want to cut and paste the list into a Word file if internet and computers are not readily available for students to do their own research.
 - Be sure to read through the *Lesson in Action* on TB, p. 26 to get a sense for the kinds of observations students might make when the data is reorganized by continent.
 - At the conclusion of Activity 3, be sure to ask students to consider what part of the Statistical Cycle they just completed. [analyzing data and interpreting results]

EMPower *Many Points Make a Point: Data and Graphs* (SB, pp. 8-11)
 Graph paper
 Colored pencils
 WorldAtlas.com for list of countries by continent
<https://www.worldatlas.com/countries-by-continent.htm>

- Summary Discussion (TB, p. 20) Activity 3 (TB, pp. 19-20) [Changing the Categories]
 - Students can use the grid paper printed on SB, p. 11 for this activity, or they may wish to use a whole sheet of graph paper provided in the classroom. The frequency graph will be reused later in the class, so be sure to have students hold onto their copy.
 - Use the WorldAtlas.com list of [countries by continent](#) as additional reference material in the activity. You may want to cut and paste the list into a Word file if internet and computers are not readily available for students to do their own research.
 - Be sure to read through the *Lesson in Action* on TB, p. 26 to get a sense for the kinds of observations students might make when the data is reorganized by continent.
 - At the conclusion of Activity 3, be sure to ask students to consider what part of the Statistical Cycle they just completed. [analyzing data and interpreting results]
- Summary Discussion (TB, p. 20) Activity 3 (TB, pp. 19-20) [Changing the Categories]
 - Students can use the grid paper printed on SB, p. 11 for this activity, or they may wish to use a whole sheet of graph paper provided in the classroom. The frequency graph will be reused later in the class, so be sure to have students hold onto their copy.
 - Use the WorldAtlas.com list of [countries by continent](#) as additional reference material in the activity. You may want to cut and paste the list into a Word file if internet and computers are not readily available for students to do their own research.
 - Be sure to read through the *Lesson in Action* on TB, p. 26 to get a sense for the kinds of observations students might make when the data is reorganized by continent.
 - At the conclusion of Activity 3, be sure to ask students to consider what part of the Statistical Cycle they just completed. [analyzing data and interpreting results]
 - Summary Discussion (TB, p. 20)

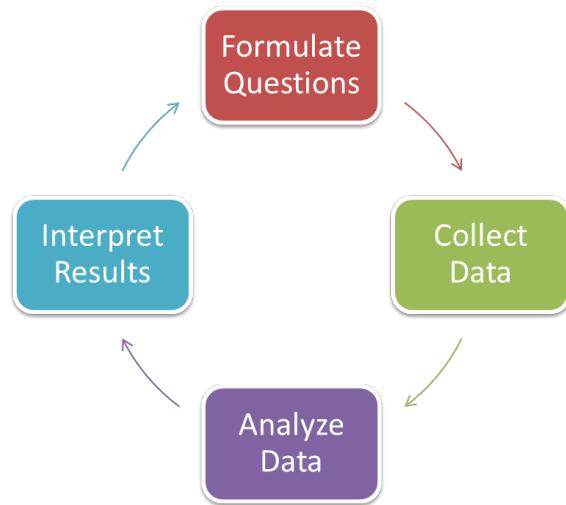
Analyzing data in a new way

Note to teacher: Return to the frequency graph completed earlier from the countries in the closet for the activities below. Be sure to read the *Looking Closely* sections, the *Facilitation* sections, and the *Lesson in Action* on TB, pp. 43-47 before starting this part of the lesson plan.

EMPower Many Points Make a Point: Data and Graphs, Lesson 3 (SB, pp. 35-37)

<p>10. Follow directions for EMPower <i>Many Points Make a Point: Data and Graphs</i>, Lesson 3 [Displaying Data in a New Way] activities:</p> <ul style="list-style-type: none"> • Activity 1 (TB, pp. 40-41) [Constructing a Bar Graph] • Activity 2 (TB, p. 41) [Constructing a Circle Graph] • Summary Discussion (TB, pp. 41-42) 	<p>Markers of various colors Scissors Scotch tape Blank paper Rulers</p>	
<p>LEARNING PLAN – Closure / Conclusion</p>	<p>MATERIALS</p>	<p>TIME</p>
<p>On a sticky note or index card, write one statistical question you would like to investigate based on the data collected today.</p>	<p>Index cards or sticky notes</p>	
<p>ADDITIONAL PRACTICE</p>	<p>MATERIALS</p>	
<p>For further practice on data collection and organization</p>	<p>EMPower <i>Many Points Make a Point: Data and Graphs</i></p> <ul style="list-style-type: none"> • Lesson 1 (SB, pp. 12-18) • Lesson 3 (SB, pp. 38-46) 	

The Statistical Cycle



Formulate Questions:

Statistical questions anticipate **variability** in their answers. For example, if we ask “How tall is Martha?” (not a statistical question) we anticipate only one answer, but if we ask, “How tall are the people in this room?” (a statistical question) we anticipate a variety of heights. Statistical reasoning must be used to gather and analyze data so that the statistical question can be answered in a meaningful way.

Collect Data:

Since statistical questions ask about **real world contexts** and expect variability in the responses, data must be collected to attempt to answer the question. During data collection, it is important to decide what will be **measured** (will this measurement help answer the question?) and how the measurements will be taken (in order to minimize measurement variability).

Analyze Data:

Analyzing data requires sorting, organizing, and usually visualizing the data using charts and graphs. With quantitative (numerical) data, numerical summaries such as mean, median, mode, and range can be used to gain insight. When analyzing data, we are interested in how the data is distributed, which includes the shape, center, and spread of the data.

Interpret Results:

Unlike formal mathematics, statistics uses **inferential reasoning** rather than deductive proof: that is, we use statistics to build a case in support of a certain answer to our question, but we must always acknowledge (and sometimes quantify) the **uncertainty** present in our results.

-Source: *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report*, available at www.amstat.org/asa/education/Guidelines-for-Assessment-and-Instruction-in-Statistics-Education-Reports.aspx