Take a Guess: How Much Do Our Backpacks Weigh? A Data Collection Activity

Do you know how heavy your backpack is? Do you think your backpack is *too* heavy? Some researchers think so. In fact, scientists have studied whether carrying heavy backpacks is unhealthy for students like yourself. You and your classmates will conduct your own study about the backpacks you bring to school.

Part I : Before we begin

1. Do you think that all of the members of your class will have the same backpack weight? Give a reason for your answer.

2. Take a guess: What will be the heaviest backpack weight? What will be the lightest backpack weight?

3. Compared to the other members of the class, do you think your backpack will be lighter than average, about average, or heavier than average? Give a reason for your answer.

Part II: Activity - Collecting the Data

1. Bring your backpack to class. If you did not bring it to class, get it now (with your teacher's permission).
2.
3. On the data table provided by your teacher, record your name and your gender (male or female).

4. Now, make a guess at the weight of your backpack. Write down your guess, in pounds, on the data table provided by the teacher.

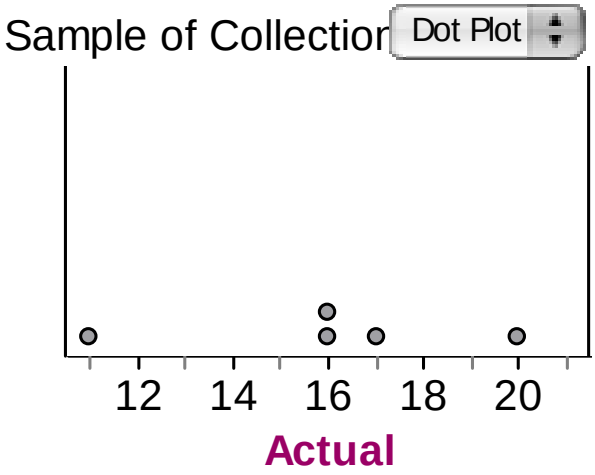
5. Now, weigh your backpack, using the bathroom scale. Record your result in pounds in the data table, also, place your name and backpack weight on the post-it note provided by your teacher.

Part 3: Constructing a dot plot

Using your data table, you will construct a dot plot of backpack weights. A dot plot for a small sample of five students is demonstrated below.

Sample of Collection 1

	Name	Gender	Actual	Guess
1	Kyle	m	20	22.00
2	TJ	m	11	12.00
3	Lydia	f	16	15.00
4	Darla	f	16	12.00
5	Kiko	m	17	18.00



1. Where is Kyle on the dot plot?

2. Find the other students on the dot plot. Which dot goes with which person?

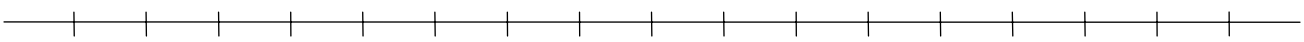
3. How would you add Phylicia to the dot plot if her backpack weighs 11 pounds?

4. How would you add Tracy to the dot plot, if her backpack weighs 24 pounds?

5. Now, your class will make a dot plot of the actual weights for all members of your class. Each student's weight will be placed on the board with a post-it note. Your teacher will provide you with a copy of the data table.

Name	***Gender***	***Guess (lbs.)***	***Actual (lbs.)***

Dot plot:



Part IV: Learning from our data

1. Who has the lowest backpack weight? How heavy is his/her backpack?

2. Who has the highest backpack weight? How heavy is his/her backpack?

3. If you had to group the students into groups based on their backpack weights, how would you make groupings? What would you name the groups?

4. Using the results of your dot plot, what weight would you consider an average backpack weight? How did you make that decision?

5. How far from the "average" weight is *your* backpack? Compared the rest of the class, are you far from the average or close to the average?

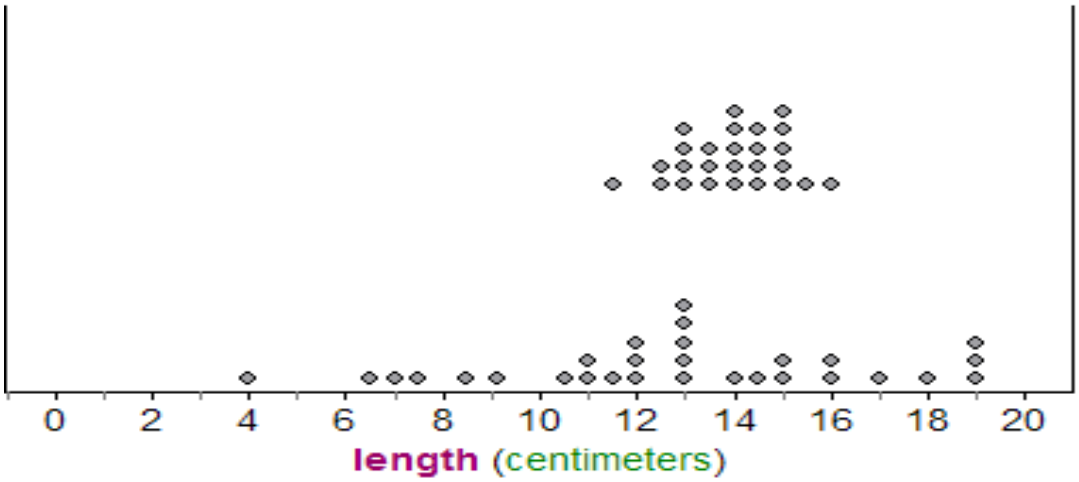
6. Summarizing your work:
   a. Write a short article for your school newspaper that summarizes the results of your study. Use evidence from your dot plot to support your conclusions. You many want to use your work form above to help you summarize your results.

   b. What important headline could you use for your story? Why did you choose that headline?

Part V: Comparing Two Groups

Mr. Stefanio's seventh grade class wanted to see how the lengths of wooden pencils and mechanical pencils were different. Each student measured the length of the pencils in their backpack. They also classified their pencils as "wooden" or "mechanical."

The class made two separate dot plots: One for the mechanical pencils and one for the wooden pencils. Both dot plots were put on the same scale. Here are the results:



1. The class did not label which dot plot went with the mechanical pencils and which one went with the wooden pencils! Figure out which one is which. Explain how you made your choice.

2. Suppose your friend Tracy finds another pencil (not one used for the study) that is 11.5 centimeters long. Do you think it's mechanical or wooden? Explain how you made your choice.

3. According to the data, which group of pencils appears to be longer, on average, for Mr. Stefanio's class? Justify your answer with the data.

4. Write a short article for your school newspaper which compares the lengths of mechanical and wooden pencils in Mr. Stefanio's class. In your paragraph, compare *average sizes* and *amount of variation* between the two groups.

Part VI: Thinking Beyond the Data

1. Suppose that your class performs the backpack data again tomorrow. Generate a possible dot plot that might come from that study. Describe how that dot plot would different from the dot plot we generated today.

2. The principal of your school wants to know if the backpacks are *too* heavy for the students in your class. Does our data collection process answer this question? If so, explain how. If not, how could you answer this question? Come up with a plan to help your principal generate a good answer.

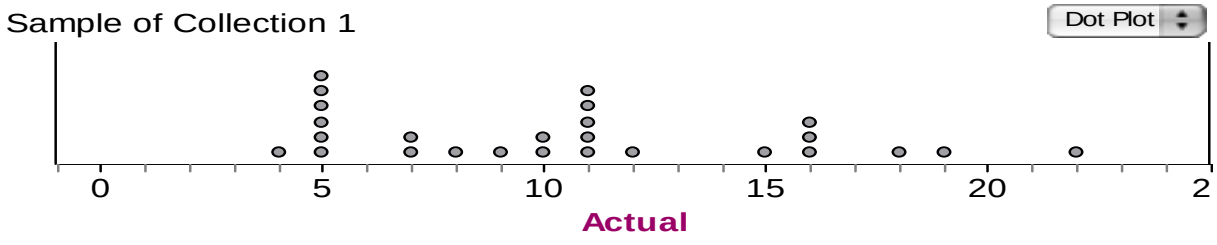
3. **Extension:** During the data collection process, each student was asked to guess at the weight of their backpack. Each student was also asked to record their gender. However, we did not use this information to analyze about backpack weights. ***Create a question*** that this additional data could help you answer. Can you create a dot plot to help you answer your question? How?

Part VII: Homework Assignment

Here's a data table and a dot plot of actual backpack weights from a group of math teachers.

Sample of Collection 1

	Name	Gender	Guess	Actual
1	Tom	m	4.00	7
2	Kiko	m	18.00	16
3	Diego	m	13.00	12
4	Elmer	m	18.00	18
5	Vivienne	f	20.00	16
6	Leila	f	4.00	4
7	Chandra	f	18.00	22
8	Saghal	f	12.00	5
9	Richard	m	10.00	10
10	Ethan	m	5.00	10
11	Zach	m	9.00	5
12	James	m	8.00	11
13	Heidi	f	15.00	16
14	Sam	m	18.00	11
15	Dylan	m	5.00	5
16	Kenny	m	10.00	5
17	Brenda	f	10.00	9
18	Ishmael	m	1.54	5
19	Zelda	f	7.00	5
20	Pablo	m	25.00	19
21	Tina	f	8.00	7
22	Bianca	m	11.00	11
23	Arco	m	10.00	8
24	Hertz	m	5.00	15
25	Giselle	f	4.00	11
26	Hugo	m	10.00	11



Questions are on the next page.

Questions:

1. How many teachers are in this study? Explain how to find this information by using the table *and* by using the dot plot.

2. What do the four dots above the number "11" tell us about the group of teachers?

3. Why aren't there any dots above the number 14? Write a sentence to explain why.

4. You are in charge of classifying the teachers into groups by their backpack weight. Divide them into groups. Name your groups. Justify your decision.

5. One researcher says it's unhealthy for teachers to carry more than 15 pounds in their backpack. Do you think this group of teachers needs to change their backpack carrying habits? Why?

6. Compare the weights for the group of teachers to the backpack weights in your class. Does one group tend to have heavier backpacks? Does one group show more variation? Justify your answer.

Teacher Notes, Take a Guess: How much do our Backpacks Weigh?

Objectives:

- To collect data to answer a statistical question
- To Construct a dot plot, reasoning / interpret the dot plot
- To help students develop an intuitive notion of the center and spread of a distribution
- To make and evaluate judgments about statistical questions by using information from a data distribution
- To verbally summarize group characteristics.

Activity Time: one or two class periods.

Setting: Part 1 should be a whole class discussion. Part 2 is a whole-class activity. Parts 3-6 can be performed by students in groups of 3 or 4, with either teacher facilitation or by leaving time to share conclusions in whole class discussion. Part 7 is a homework assignment.

Statistics Prerequisites: none:

Explanation/ Rationale for the lesson

***Part I*:** These pre-data collection questions are designed for students to formulate ideas about natural variation in a topic they understand well – the weight of their backpack. The key issue here is for students to recognize that the same measurement will vary from student to student. The questions also ask students to construct a rough estimate of the degree of variation (lightest, heaviest weight) and place their own backpack weight in context of the larger group by considering what would be "average" in the group.

Part II: Teachers should plan to make the entire data table accessible to everybody in the class. This can be done by displaying a large table in the classroom, making photocopies for students, or projecting results on a computer screen. Although this activity does not make use of gender or the guesses, future activities will make use of these variables. By collecting these additional variables, students may want to speculate about the relationship between variables: "Do boys backpacks weigh more than girls?" "Are we good guessers of our backpack weights?" Such question formulation emerges as a natural process of investigating the question at hand.

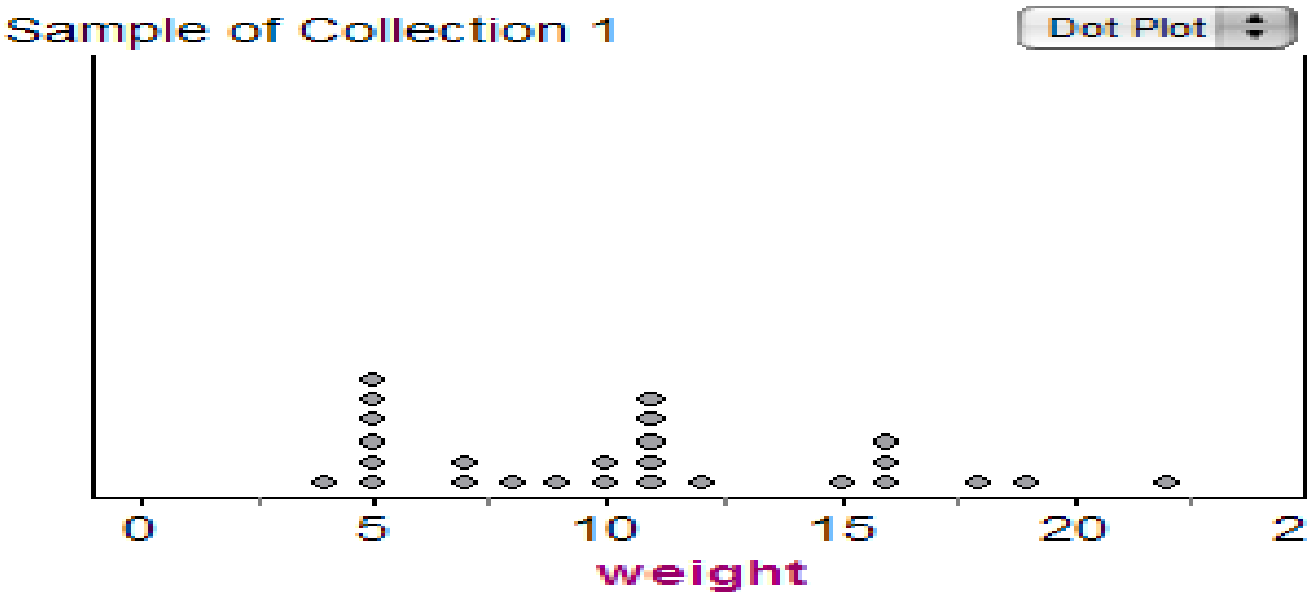
***Part III*:** Students should be able to understand the principles of appropriate visual design by thoughtfully reading the partial dot plot and by answering the questions in part 3. In particular:

a. All dots must go on a consistent scale with equal spacing.

b. Individuals with the same measurement have dots that are placed on top of each other. The height of the dot towers will correspond to how frequency of students with that particular weight.

c. The scale must be extended so that all individuals can be placed. There is no need for plots to start as "0"

Part IV: Questions 1 and 2 are statistical literacy questions to confirm that the students can read the dot plot in context of the data. By highlighting the highest and lowest values, students also get a sense of the total width of the data (the range: a rudimentary measure of variation). Question 3 is a formative assessment question on statistical reasoning to determine whether students can view the data not only as a collection of individual values but as a group (or a few subgroups). This jump from individual to group can be a challenge for younger students. Suppose a dot plot for the class looks like this:



Students could observe three groups of backpacks in the dot plot above. They might designate backpacks 5 lbs and below as light, those between 6 and 11 as medium, and those over 15 lbs. as "heavy." Others may only see two or four groups. Invite a variety of answers to this process. Press students to justify their choices, and listen for students' decisions to be guided by the distribution. Unequal groups and unequal scale lengths are fine here. Forcing equal numbers in each group or equal widths for each group such "rules" are unwarranted and take focus away from looking at the distribution of weights.

Part V: This series of questions asks students to compare two groups of data. The question introduces students to the ides of a relationship between two variables: type of pencil and length of pencil. Question 1 Asks students to think about how mechanical pencils and wood pencils would differ. Since mechanical pencils don't reduce their size due to sharpening, the lengths of mechanical pencils will not shrink due to sharpening. Wooden pencils will show more variation due to sharpening. This question may be considered a statistical reasoning question, because it requires students to make a decision based on an intuitive idea of variability.

Question 2 asks students to make a judgment about a pencil of size 11.5 inches – for which group is such a pencil more likely or plausible? This question allows the teacher to determine whether students can relate the idea of "more likely" to the presence of clumps in the distribution. Observe that 11.5 would be a very low mechanical pencil length, but not unusual for a wooden pencil. Question 3 Asks students to compare centers of both distributions. This can be a challenge for students since the wooden pencils have a great deal of variation – how do they find the center? This is also a good time to press students to use the same criterion with coming up with a "center" for both distributions. Question 4 requires students to use their understanding of center sand spread to compare wooden and mechanical pencils in proper context.

Part VI: Looking beyond the data.

These questions help students look beyond the existing classroom study of backpack weights, and think about ways to use the existing data to form new questions.

Question 1 is designed to help students acknowledge the possibility of day-to-day variation in the class's backpack weights, and conjecture real-world circumstances that would plausibly produce different results than the ones seen in the data they collected. This question will challenge students to move beyond individual backpack variation on a single day to day-to-day variation for the entire group of backpack weights.

Question 2 asks students to distinguish between the idea of "heavier than average," which was worked out in previous parts, and "too heavy," which cannot be defined by the existing data. Students may propose a specific value as too heavy ("more than 15 pounds," for example). The teacher should press students to justify these suggestions. Other students may research what doctors have found in other studies. One study suggests that students' backpacks should not total more that ten per cent of their body weight (Moore et al, 2007).

Question 3 asks students to generate statistical questions that can be answered with the variables not analyzed earlier in the lesson. This extension brings students into a level B of question formulation.

Part VII

The homework assignment reviews ideas found in the lesson.